Completing and Using Schedule P

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Abstract

Schedule P is a complex section of the Annual Statement, demanding much expertise to complete and to understand. The cross checks performed by the NAIC compare the Schedule P figures within its various parts, with other pages of the Annual Statement, and with Schedule P data from the preceding year. The NAIC uses Schedule P Summary data for three of the Insurance Regulatory Information System ("IRIS") tests, and it uses the detailed line of business data to determine the reserving risk and the written premium risk charges in the risk-based capital formula. Investment analysts and rating agencies use the schedule to measure the adequacy of a company's held reserves and thereby estimate its financial strength and expected market value. The IRS uses the schedule to determine loss reserve discounts, anticipated salvage and subrogation, and the discounts for anticipated salvage and subrogation. Actuaries and accountants need a thorough understanding of this Schedule, both to complete it for their own company or client and to evaluate the performance of peer companies.

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Preface

by Richard J. Roth, Jr.[1]

Few people probably remember what Schedules O and P were like in the 1980s when they contained little more than loss and loss adjustment expense development. The insurance department regulators needed more detailed information by line in order to monitor the solvency of the insurance companies. The information in the Annual Statement is the only information that the regulators have between the on-site financial examinations. Furthermore, the investment community, the rating agencies, agents, and the insurance industry observers wanted more financial disclosure. In the 1980s, the personal computer was coming into common use as a powerful analytical tool.

In the middle 1980's, I decided to make a proposal to combine Schedules O and P into a completely redesigned Schedule P. The intent was to include all of the basic actuarial statistics necessary to make a wide variety of actuarial analyses using the personal computer. There would be no analyses or projections in Schedule P, only the data to make the analyses and projections in a form that could be readily used in a personal computer.

Today, it is difficult to imagine how much opposition I faced, which came mainly from the larger insurance companies. The larger insurance companies did not want any more disclosure in the Annual Statement. They argued that their businesses were so complicated that the additional Schedule P information would be "meaningless." We regulators had to keep reminding the larger companies that the insurance world is really made up of hundreds of small and medium size companies, which require constant monitoring.

Only after the third major effort before the NAIC Blanks Committee was I able to get Schedule P substantially changed, even though I had widespread support among actuaries. Additional features in Schedule P were added in subsequent years, such as Parts 5, 6 and 7.

Even today, any changes to Schedule P in terms of additional reporting usually meet with fierce opposition from the larger insurers and reinsurers.

Schedule P is the actuarial portion of the Annual Statement and is critical to monitoring the solvency of insurers. The Casualty Actuarial (technical) Task Force of the NAIC is charged with maintaining and preserving Schedule P. Only small changes are likely to be made in the future, to reflect changes in the industry or risk based capital. The main concern in the future will be to prevent the NAIC Blanks Committee from weakening Schedule P by eliminating

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[1] Richard J. Roth, Jr., former Chief Casualty Actuary of the California Insurance Department and Chair of the NAIC Casualty Actuarial Task Force, was the architect of the new Schedule P in 1989.

information. Certain large insurers and reinsurers would argue that the NAIC financial reporting should be "modernized" or "simplified" or "deregulated" and that "unnecessary and wasteful reporting should be eliminated." These are code words for attempts to eliminate information on reinsurance transactions and claim counts.

As this text by Sholom Feldblum so clearly shows, there is a wealth of information in Schedule P, but most of the information could be easily lost if the NAIC and the actuarial profession are not constantly vigilant to attacks to reduce what has been fought so hard to obtain. This is the constant challenge.

Each year, the information in Schedule P is in wide demand. The NAIC, rating agencies and private companies distribute Schedule P data by CD's shortly after the Annual Statements are filed. This information is used by a wide range of users, including rating agencies, stock analysts in New York, competing companies, and, of course, regulators. Consulting actuaries have developed software programs for sale that will produce analyses of the Schedule P data.

I wish to thank my friend and fellow actuary, Sholom Feldblum, for the extraordinary job that he has done over the years in writing this text and in teaching how to use Schedule P. His efforts are now greatly helping the property/casualty insurance industry in the United States stand apart from the rest of the industries in terms of financial reporting.

– Richard J. Roth, Jr., June 2002

COMPLETING AND USING SCHEDULE P

Introduction

MAJOR PURPOSES OF THE SCHEDULE

Property-casualty insurance is a highly regulated industry. Insurers exchange promises for premiums; they promise to indemnify losses that may not be settled until years after the policy premiums are collected.

If a manufacturing firm becomes insolvent, its owners and creditors lose. If an insurance company becomes insolvent, its customers – the policyholders – bear the brunt of the loss.

The public relies upon insurers to fulfill their promises, and state regulators are entrusted with safeguarding insurance solvency. Other industries, such as public utilities, may be regulated because they are not sufficiently competitive. Insurers are regulated (in part) because they are extremely competitive – and the rough and tumble of the marketplace may leave their promises unfulfilled.

For some industries, solvency regulation is an accounting task. Regulators audit the company's books to ensure that assets and liabilities are properly accounted for. For property-casualty insurance, solvency regulation is a highly specialized actuarial skill. Solvency risks may be unanticipated by the company, and they may be discerned only by trained analysis of the company's financial statements and historical loss experience. Schedule P is perhaps the most useful tool that regulators have to monitor company solvency and safeguard the public trust in the property-casualty insurance industry.

Schedule P is designed to measure loss and loss adjustment expense reserve adequacy, both retrospectively and prospectively. Schedule P displays historical triangles of losses, claims, and premiums, showing the observed development over the past ten years and facilitating the estimates of future development.

Part 1 of Schedule P provides a comprehensive view of the company's current loss reserve structure, including gross and ceded reserves by line of business and type of reserve (loss vs expense and case versus bulk) on an accident year basis.[2] Part 2 provides a retrospective test, by accident year and line of business, of reserves held in prior years. The totals from the

[2] The term "loss" in this paper often signifies both loss and allocated loss adjustment expenses (identified as defense and cost containment expenses in Schedule P).

one year and two year adverse development exhibits, shown in the Part 2 Summary exhibit, are used for IRIS tests 9, 10, and 11, the NAIC retrospective and prospective early warning tests of reserve adequacy.

The historical exhibits in Parts 2 through 6 provide data for several prospective tests of loss reserve adequacy. Part 3 displays paid loss development triangles, and the difference between Parts 2 and 4 provides case incurred (or reported) loss development triangles. Average severities, both incurred and paid, may be derived from the claim count figures in Part 5 combined with the loss figures in Parts 2, 3, and 4.

Other Purposes

Schedule P has numerous other functions:

- It shows payments and reserves for losses and loss adjustment expenses by line and by accident year, thereby isolating blocks of business with good or poor experience. In addition, the accident year figures provided in Schedule P show the effects of changes in loss reserve margins on the calendar year results reported in the Underwriting and Investment Exhibit.
- It provides the loss payment patterns for the federal income tax loss reserve discounting procedure. In addition, it provides the disclosures needed for "grossing up" losses (i) for interest discounts and (ii) for anticipated salvage and subrogation.
- It provides the data for computing the reserving risk and the written premium risk charges in the risk-based capital (RBC) formula, thereby setting the insurer's capital requirements. It also provides the loss payment patterns for the investment income offsets in the formula.
- It shows the percentage of premiums and losses associated with loss-sensitive contracts for the loss-sensitive contract offset in the risk-based capital formula, and it shows the sensitivity of premiums and of reinsurance commissions to losses on these contracts.
- It separates occurrence from claims-made experience for three lines of business, as needed for the risk-based capital claims-made offset.
- It supports the opinion of the Appointed Actuary on loss and loss adjustment expense reserve adequacy.
- It shows the development of exposure year premiums resulting from audits and retrospective adjustments, allowing a more accurate comparison of loss ratios by accident year. This development is also needed to determine the tax basis earned premium for lines with audits or retrospective adjustments.
- It shows direct plus assumed versus ceded experience, so that the effects of reinsurance transactions on accident year loss ratios can be examined.
- It shows claim count development patterns and changes in average claim severity by year, allowing better analysis of claims department performance.

Schedule P is not limited to solvency regulation and tax filings. It is used extensively by actuaries and financial analysts to estimate a company's net worth. For an experienced reserving actuary, Schedule P provides more information than the SEC's Form 10K.

Schedule P was revised extensively for the 1989 Annual Statement, with further modifications in subsequent years. This paper explains what data are required for the schedule, and how the exhibits should be completed. It describes how to use Schedule P data for prospective analyses of loss reserve adequacy, using both paid and incurred loss development procedures. It discusses the use of Schedule P information for other reporting requirements, such as the risk-based capital formula, the Statement of Actuarial Opinion, and the IRS loss reserve discounting procedure.

Historical Experience

Schedule P shows experience for all lines of business, though the grouping of lines differs from the grouping in the Underwriting and Investment Exhibit. The long-tailed lines show the 10 most recent accident years of data plus a prior years row. These lines are primarily casualty lines or lines that have a significant casualty component.

A. Homeowners/Farmowners
B. Private Passenger Auto Liability/Medical
C. Commercial Auto/Truck Liability/Medical
D. Workers' Compensation
E. Commercial Multiple Peril
f. Medical Malpractice (occurrence policies in section 1 and claims-made policies in section 2)
G. Special Liability (Ocean Marine, Aircraft [All Perils], Boiler and Machinery)
H. Other Liability (occurrence in section 1 and claims-made in section 2)[3]
M. International
R. Products Liability (occurrence in section 1 and claims-made in section 2)

The short-tailed lines show the two most recent accident years of data plus a prior years row. These are primarily first party property lines of business.

I. Special Property (Fire, Allied Lines, Inland Marine, Earthquake, Glass, Burglary & Theft)
J. Auto Physical Damage
K. Fidelity / Surety

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[3] According to the Annual Statement *Instructions*, "Business reported on the Aggregate write-ins for other lines of business of the Underwriting and Investment Exhibit and the State Page should be included in the Other Liability sections of Schedule P." This seems strange; perhaps the intention is to include the aggregate write-in lines under the "other" exhibits, not the "Other Liability" exhibits.

L. Other (Including Credit, Accident and Health)
S. Financial Guaranty / Mortgage Guaranty

The data reported in the prior years row differ among the sections of Schedule P, as explained below.

REINSURANCE EXPERIENCE

Proportional reinsurance, or pro-rata reinsurance (quota share and surplus share), is shown as assumed or ceded premiums, losses, and loss adjustment expenses in the exhibits for the primary lines of business. A 50% quota share treaty for personal automobile liability business is reflected in the assumed and ceded columns of Parts 1B, 2B, etc.

Assumed non-proportional reinsurance, or excess-of-loss reinsurance, is split into three categories and shown separately from the primary lines of business: non-proportional property, non-proportional casualty, and financial lines (exhibit categories N, O, and P).[4] These reinsurance lines use the 10-year casualty format.

Ceded non-proportional reinsurance is reported in the same exhibit as the underlying business. A primary company which cedes part of its workers' compensation business on an excess-of-loss treaty records the experience in the ceded columns of Part 1D, and the reinsurer who assumes the business includes it in Part 1O (Part "one-oh," not Part "ten"). A reinsurance company which retrocedes part of its workers' compensation business that it assumed on a non-proportional treaty shows the retrocession in Part 1O as well.

If a reinsurance treaty contains both proportional and non-proportional sections, the premiums and losses for the sections must be divided and reported on the appropriate lines: the proportional parts for both the ceding company and the assuming company in the exhibits for the underlying lines of business, the non-proportional parts for the ceding company in the exhibits for the underlying lines of business, and the non-proportional parts for the assuming company in the exhibits for the underlying lines of business. This is analogous to the treatment of reinsurance treaties that are prospective with regard to some claims and retroactive with regard to other claims: the premiums and losses for the two sets of claims must each be treated according to their appropriate statutory rules.[5]

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[4] Lines of business with both property and casualty components, such as homeowners, commercial multiple peril, and aircraft, are included in Reinsurance B (liability reinsurance). Financial reinsurance includes reinsurance on fidelity and surely contracts. The Annual Statement *Instructions* list the elements of each reinsurance line in more detail.

[5] See SFAS 113, paragraph 25: "When practicable, prospective and retroactive provisions included within a single contract shall be accounted for separately"; SSAP 62, paragraph 24: "Prospective and retroactive provisions included within a single agreement shall be accounted for separately." For summaries of GAAP and statutory accounting, see Yoheved and Sarason [2002].

Intercompany pooling agreements are reported differently; see the full discussion later in this paper.

Prospective vs Retroactive Reinsurance

Only prospective reinsurance affects the Schedule P figures. Retroactive reinsurance is not reflected in the Schedule P exhibits.

Retroactive reinsurance is defined in SSAP 62, paragraph 21, as "reinsurance in which a reinsurer agrees to reimburse a ceding entity for liabilities incurred as a result of past insurable events covered under contracts subject to the reinsurance." The NAIC *Instructions* to the Statement of Actuarial Opinion (section 11) provide a three-fold definition:

> *For the purpose of this instruction, "retroactive reinsurance" refers to any agreement which increases the transferring insurer's Surplus to Policyholders as a result of the transferee undertaking any loss obligation already incurred and for which the consideration paid by the transferring insurer is derived from present value or discounting concepts.*

Retroactive reinsurance affects the special surplus entry on the liability side of the statutory balance sheet (page 3 of the Annual Statement), but it is not reflected in the Annual Statement exhibits and schedules, such as Schedule P.[6] It affects statutory income in the same fashion as prospective reinsurance does, except that it is coded under "other income" on the statutory statement of earnings (SSAP 62, paragraph 28i). It has a full effect on policyholders' surplus, though not on the unassigned portion of surplus. It affects GAAP income, GAAP equity, and taxable income.

Reinsurance and Risk-Based Capital

Risk-based capital adjusted surplus includes special surplus funds. The adjusted surplus used to compute the risk-based capital ratio does not depend on whether the reinsurance is classified as prospective or retroactive.

The risk-based capital *ratio* is slightly reduced if the reinsurance is coded as retroactive instead of prospective. The RBC ratio equals adjusted surplus divided by the risk-based capital requirements. The RBC reserving risk charge is greater than the charge for

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[6] SSAP No. 62, "Reinsurance," paragraph 28, says with regard to retroactive reinsurance agreements:

1. The ceding entity shall record, without recognition of the retroactive reinsurance, loss and loss expense reserves on a gross basis on the balance sheet and in all schedules and exhibits.
2. The assuming entity shall exclude the retroactive reinsurance from loss and loss expense reserves and from all schedules and exhibits.

reinsurance recoverables, particularly after the covariance adjustment. Prospective reinsurance reduces risk-based capital requirements and decreases the denominator of the risk-based capital ratio. Retroactive reinsurance does not have this effect.

Illustration: Companies A and B have the same initial surplus and capital requirements. Company A prospectively reinsures a book of general liability business. Company B retroactively reinsures an identical book of business. Companies A and B have the same ending surplus, though some of company B's surplus is coded as special surplus funds. Company B has more loss reserves shown on the balance sheet, in the Underwriting and Investment Exhibit, and in Schedule P than Company A has; company A has a write-in contra-liability for reinsurance recoverables which Company B does not have. Company B has greater RBC requirements than Company A has, since the reserving risk charge is greater than the credit risk charge (over 30% versus 10%) and the margin effect of the reserving risk charge is much greater than the marginal effect of the credit risk charge; see Feldblum [1996: RBC] for the RBC risk charges and Feldblum [2002: Comm] for estimating the effects of retroactive reinsurance on RBC requirements.

Reinsurance and Surplus Relief

The statutory treatment of retroactive reinsurance is more conservative than the GAAP treatment in that it does not allow a reduction of statement reserves. It is more liberal than the GAAP treatment in that it allows full "up-front" surplus relief, whereas GAAP recognizes the profit from retroactive reinsurance ratably over the lifetime of the claims.

Illustration: On December 31, 20XX, the ABC Insurance Company has $100 million of loss reserves which it retrospectively reinsures for $80 million. Both its policyholders' surplus and its GAAP equity are $200 million on that date. By December 31, 20XX+1, $25 million of the original loss reserves have been settled. It has no other underwriting or investment operations.

ABC's statutory financial statements show $20 million of other income on December 31, 20XX, $20 million of special surplus funds, and no change in unassigned surplus. During 20XX+1, ABC shows a $25 million reduction in loss reserves and a $25 million reduction in the write-in contra-liability for recoverable from retroactive reinsurance.

ABC's GAAP financial statements show no income on December 31, 20XX, and no change in GAAP equity. During 20XX+1, ABC shows income of $25/$100 x $20 million = $5 million as well as a $5 million increase in GAAP equity.

Summary Exhibits

The Summary exhibits show 10 accident years of data plus a prior years row for all lines of business combined. Ten accident years of data, as well as a prior years line, must be kept for all lines of business, since all 10 years are used for the Summary exhibits.[7]

Illustration: For the 20X9 Annual Statement, Schedule P, Part 1J, "Auto Physical Damage," shows two individual accident years, 20X8 and 20X9, along with a prior years row. For incorporation of the auto physical damage experience into the Schedule P, Part 1 Summary exhibit, the company must keep auto physical damage data for accident years 20X0 through 20X9, along with a prior years row suitable for the 10 year exhibits. The entries in the prior years row in the Part 1J exhibit do *not* equal the data for the prior years row used for the summary exhibit plus the data for accident years 20X0 through 20X7. Separate data must be kept.

IRIS tests 9 and 10, the one-year and two-year retrospective tests of reserve adequacy; are based on the Part 2 Summary exhibit. IRIS test 11, the prospective test of reserve adequacy, uses the one and two-year adverse developments from the Part 2 Summary exhibit as inputs (along with other data).

The Schedule P Exhibits

Part 1 shows cumulative experience by accident year at the Statement date. Most of the figures in Part 1 are audited by an independent CPA, and the Statement of Actuarial Opinion should reconcile to the data in Part 1.

Parts 2 through 6 show the supporting historical triangles. Parts 2 through 5 are cumulative accident year data. Part 6 is cumulative exposure year data, which is the premium equivalent of accident year losses and expenses. The Part 7 policy year exhibits are not intended to support the Part 1 information; see the discussion below.

For the individual years shown on the exhibits, Part 1 shows calendar year premiums that are not changed for subsequent earned but unbilled premiums or accrued retrospective premiums. The losses and expenses are cumulative accident year figures.

Illustration: In the 20X9 Schedule P, the 20X5 paid loss and expense figures in columns 4 through 10 represent payments from January 1, 20X5, through December 31, 20X9, for

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[7] The Schedule P *Instructions* say: "Since the Summary of each part contains ten years of historical data, the information from the "prior" line for the Property Lines, Sections I through L, and Financial Guaranty/Mortgage Guaranty, Section S, must be supplemented for the eight accident years preceding the two most recent years."

accident year 20X5. The 20X5 unpaid loss and expense reserves in columns 13 through 23 are the reserves held on December 31, 20X9.

The treatment of losses and expenses is similar for Parts 2 through 5.

PRIOR YEARS ROWS

The "prior years" row differs among the various Schedule P parts.

- No calendar year earned premiums are shown for the prior years row in Part 1; the cells are "XXX"ed out. The exposure year earned premiums in the Part 6 prior years row reflects the current calendar year contributions to the old exposure years.

- For the Part 1 prior years row, the loss and expense payments and the salvage and subrogation reimbursements are those made or received in the most recent calendar year only. This is not a cumulative amount. This is the same procedure as that used for the exposure year earned premiums in Part 6.

- For the Part 3 prior years row, the loss and expense payments are those made since January 1 of the *second* calendar year shown along the column headings. For the 20X9 Annual Statement, these are payments made since January 1, 20X1 (not January 1, 20X0.) The top-left corner cell is "XXX"ed out in these exhibits.

- The unpaid loss and expense reserves in the prior years rows are the reserves for old accident years evaluated at the current statement date for Part 1 and at each December 31 for Parts 2 and 4 and for outstanding claims in Part 5.

- The reported claim triangles and closed claim triangles in Part 5 use the Part 3 format, not the Part 1 or Part 6 format.

DATA TYPES

Part 1 shows data separately for "direct and assumed" and for "ceded," so that the analyst may determine the effects of reinsurance recoverables on the company's experience. If the direct and assumed loss ratio is significantly higher than the net loss ratio, the business ceded may be unprofitable. The reinsurers may cancel treaties, raise reinsurance rates, or underwrite facultative business more carefully in future years.

- The *net* loss ratio is influenced by the reinsurance market at the current time: in soft reinsurance markets, the net loss ratio appears better than in hard markets.

- The direct and assumed loss ratio reflects the quality of the primary insurer's book of business, and it may be a good predictor of both the direct and net loss ratios in future years.[8]

Parts 2, 3, and 4 show historical loss triangles for *net* losses and "defense and cost containment" (DCC) expenses; there are no corresponding triangles for direct business.

Part 5 shows historical claim count triangles for direct and assumed business.

Part 6 shows historical development of direct and assumed exposure year earned premium (in section 2) and of ceded exposure year earned premium (in section 2).

Part 7 shows policy year earned premiums, losses, and reinsurance commissions for business written on loss-sensitive contracts. These policy year figures pertain to a portion of the company's business only; the data cannot be reconciled with other Annual Statement exhibits. Part 7 was designed for the loss-sensitive contract offset in the risk-based capital formula, and it need be completed only by companies seeking this offset.

The DCC expenses in Parts 1 through 4 are the current NAIC version of the old "allocated loss adjustment expenses" (ALAE). "Allocated loss adjustment expenses" is the standard insurance term for loss expenses associated with particular claims, such as legal defense costs and expert medical testimony. Before 1998, loss adjustment expenses in Schedule P were divided between allocated and unallocated. For the 1998 and subsequent Annual Statements, loss adjustment expenses were divided more rigorously between (i) defense and cost containment (DCC) and (ii) adjusting and other (AAO); see below. In general, DCC corresponds to ALAE and AAO corresponds to ULAE.

In theory, historical loss triangles for direct and assumed business can be formed by joining the Part 1 exhibits from successive years. The effort involved usually outweighs the benefits, and this analysis is not commonly performed. Changes in intercompany pooling agreements and discrepancies between the Schedule P exhibits of different years distort these analyses and further diminish their value.

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[8] Richard Roth, who designed the current Schedule P, writes [1986], page 86: "Surprisingly, very few companies – particularly small companies – have any idea how profitable or whether they are making money or whether the business being ceded is profitable or not profitable. Once they pay that reinsurance premium they don't care, it's just gone. . . . Well, what happens is if the business that is being ceded is consistently unprofitable, we know that two or three years down the line they're not going to have any reinsurance. Also, it says that the business that they're writing is probably underpriced and that they will soon have problems."

Part 1 – Current Valuation

PREMIUMS

Part 1 premiums are recorded by calendar year.[9] Once entered, they are "frozen," and they are not adjusted for subsequent earned but unbilled premiums stemming from exposure audits or accrued retrospective premiums stemming from retrospective premium adjustments.

Illustration: An insurance company issues retrospectively rated workers' compensation policies. Worse than expected adverse development on a block of business raises the loss figures and the associated premium figures at subsequent valuations.

- The additional losses are assigned to the appropriate accident years in Parts 1 – 4.
- In Part 1, the additional premiums received are assigned to the current calendar year, not to the years when the policies were issued or the premium was earned.

Part 1 of Schedule P shows overstated loss ratios for the year when the losses occurred and understated loss ratios for the year in which the additional premiums are billed.[10]

The overstatement and understatement discussed above relates to over- and under-estimation of the retrospective premium adjustments. The initial estimate of the future retrospective premium adjustment *is* included in the calendar year earned premiums.

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[9] The latest calendar year net earned premium shown in Schedule P, Part 1, column 3, row 11 (total for all accident years), for each line of business should equal the net earned premium shown on page 7, "Underwriting and Investment Exhibit," Part 2, "Premiums Earned," column 4. Premium figures from earlier years should agree with the figures in the preceding years' Annual Statements. If there is an intercompany pooling agreement that has changed over time, the comparison with earlier Annual Statements can be done only on a consolidated basis. See the discussion in the text on intercompany pooling.

[10] Salzmann [1967], pages 120-121, notes that "calendar/accident year loss ratios are theoretically less accurate than policy year loss ratios," but she adds that "the primary purpose of Schedule P is to assist in the determination of adequate reserve levels — not the precise measurement of loss ratios." This is correct for the chain ladder loss reserving techniques, which do not rely on premium figures. It is less true for other reserving techniques, such as the Stanard-Bühlmann expected loss technique or the Brosius least squares technique; see the discussions of Parts 2 and 3 below.

Upon reviewing an earlier (pre-1996) draft of this paper, Richard Roth commented: "An acknowledged weakness of Schedule P is the mismatch between losses and premiums by year, especially for reinsurance and workers' compensation. Early drafts of Schedule P addressed this problem; however, the problem is not that easy to solve. It is not enough just to add a column for policy year premiums. Whole triangles of premiums must be reported." These triangles are now shown in Part 6 of Schedule P.

More accurate "exposure/accident year" loss ratios and loss ratio development can be obtained by combining the information in Parts 2 and 6. The illustrations in the discussion below of Part 6 show the difference between the initial estimates of future retrospective adjustments and subsequent revisions of these estimates.

In Part 1 of Schedule P, the prior years row shows payments made or received in the current year, or reserves held on open cases as of the statement date. No figures are shown for premiums on the prior years row, since current calendar year adjustments do not affect previous calendar year premiums.

LOSS AND LOSS EXPENSE PAYMENTS

Columns 4 through 11 show loss and loss expense payments by accident year. For the individual accident years, these are cumulative payments. For accident year 20XX, column 4 shows loss payments on direct and assumed business from January 1, 20XX through the statement date.

For the prior years row, the payments are those made in the current calendar year only. For the 20XX Annual Statement, these are the payments made from January 1, 20XX through December 31, 20XX.

Salvage and Subrogation Received

Column 4 (direct and assumed loss payments) and column 5 (ceded loss payments) are *net* of salvage and subrogation received.

- *Salvage:* The insurer settles an automobile physical damage claim by paying the $10,000 blue book value of the car. It sells the damaged car to a repair shop for $2,000. The company shows $8,000 as the loss paid in column 4 and $2,000 as the salvage received in column 10.
- *Subrogation:* The insurer settles an automobile physical damage claim by paying the $10,000 blue book value of the car. The driver of the other vehicle is negligent and liable for the damages. The company collects the full $10,000 from the driver of the other vehicle or the driver's insurer. The company shows $0 as the loss paid in column 4 and $10,000 as the subrogation received in column 10.

Column 10, salvage and subrogation received, is for information only (termed a "memorandum" column in the Annual Statement *Instructions*); it is not used to calculate subsequent columns. Column 11, the total net paid column, equals columns 4 – 5 + 6 – 7 + 8 – 9; it does not involve column 10.

Salvage and subrogation is most material for automobile physical damage (Part 1J). Some companies show significant amounts of subrogation for automobile liability (Part 1B) and workers' compensation (Part 1D) as well.

Illustration A: The insurer makes a $40,000 personal injury protection [PIP] loss payment to its own insured injured in an auto accident in a no-fault state. The driver of the other vehicle was negligent and the damages exceed the tort threshold. The company collects $25,000 by subrogation from the negligent driver or the negligent driver's auto insurer. The net loss payment in Part 1B, personal auto liability/no-fault, is $15,000; the subrogation is $25,000.

Illustration B: The insurer makes a $40,000 workers' compensation loss payment to its own insured injured in an auto accident stemming from a work-related accident. The driver of the other vehicle was negligent and is liable for the damages. The company collects $25,000 by subrogation from the negligent driver or the negligent driver's auto insurer. The net loss payment in Part 1B, personal auto liability/no-fault, is $15,000; the subrogation is $25,000.

Calendar Year Reconciliation

Schedule P, Part 1, shows cumulative paid losses by accident year. The Underwriting and Investment Exhibit, Part 3, shows paid losses in the most recent calendar year. The Annual Statement cross-checks determine the calendar year paid losses from figures in the current Schedule P and that of the previous year, and they compare these figures with those in the Underwriting and Investment Exhibit.[11]

Illustration: The reconciliation for the 20X9 Annual Statement is as follows.

a. In the 20X9 Schedule P, Part 1, column (4) minus column (5), total row (row 12), shows cumulative net loss payments at December 31, 20X9, for accident years 20X0 through 20X9 plus the calendar year 20X9 loss payments for accident years prior to 20X0.
b. In the 20X8 Schedule P, Part 1, column (4) minus column (5), the sum of rows 3 through 11, shows cumulative net loss payments at December 31, 20X8, for accident years 20X0 through 20X8. We do not include the prior years row or the first individual accident year row (the year prior to 20X0).
c. The difference between (a) and (b) is the calendar year 20X9 loss payments.

The calendar year payments for loss plus defense and cost containment (DCC) expenses can be derived from Part 3 of the current year's Schedule P. Part 3 of the Underwriting and Investment Exhibit shows pure loss payments, without the DCC payments.

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[11] A cross-check reconciles entries in different exhibits of the Annual Statement or in Annual Statements of different years. These are computer cross-checks performed on the electronic submission; they are not done by pencil and paper.

For the accident year to which losses are assigned, see the discussion below of occurrence versus claims-made business.

Loss Adjustment Expenses

Before 1998, loss adjustment expenses were divided between allocated loss adjustment expenses (ALAE) and unallocated loss adjustment expenses (ULAE).

- ALAE were adjustment expenses related to particular claims, such as legal defense fees paid to outside counsel.
- ULAE were adjustment expenses that were not related to individual claims, such as claims department rent, utilities, and similar overhead costs.

For pricing insurance policies, most companies include ALAE with losses, using data subdivided by accident year (or policy year), subline, state, and various other dimensions. ULAE is generally included as a loading on losses plus ALAE.

The expenses included in ALAE or ULAE differed somewhat by company. For instance, a company using outside legal counsel may include the defense costs with ALAE, whereas a company using in-house legal counsel may include the defense costs with ULAE. This presented no problems for individual company ratemaking, though it created difficulties for bureau ratemaking and for accounting supervision.

The problem was particularly severe for rating bureaus. If some companies code defense costs as ALAE because they use outside legal counsel and other companies code defense costs as ULAE because they use in-house legal counsel, the aggregate industry data compiled by the rating bureau contains a mixture of definitions and might not be appropriate for any of the companies.

In the 1990's, the rating bureaus, particularly the National Council on Compensation Insurance (NCCI), began standardizing the coding of ALAE vs ULAE. Expenses would be classified by type of expense to promote similar coding among companies. For instance, legal defense costs would be coded as ALAE, whether inside or outside counsel was used. Companies that used in-house legal counsel would allocate the salaries and overhead costs of their attorneys to individual claims.

DCC and AAO: Principles

Some companies were concerned that new NCCI classification rules might not be consistent with statutory accounting requirements, which still defined ALAE as loss adjustment expenses that were related to particular claims. In 1997, the NAIC Casualty Actuarial (Technical) Task Force (CATF) proposed new definitions of ALAE and ULAE that classified by type of expense. The new definitions were adopted by the NAIC for the 1998 and subsequent Annual

Statements. To avoid any confusion between the old and new definitions, revised terms were adopted as well (in 1999): defense and cost containment (DCC) for ALAE and adjusting and other (AAO) for ULAE.

Three principles govern the 1998 definitions of loss adjustment expenses:

2. The classification is by type of expense, regardless of whether the expense relates to specific claims.[12]
3. The classification is uniform for all companies. No discretion is permitted for the classification of loss adjustment expenses.[13]
4. The new definitions divide expenses into two groups: (i) expenses that vary with the amount of loss are coded as defense and cost containment and (ii) expenses that vary with the number of claims, or which do not vary with either the amount of loss or the number of claims, are coded as adjusting and other.[14]

The first two principles are determinative if they conflict with the third principle. If an expense is classified by the NAIC as defense and cost containment, the company does not have the option of coding the expense as adjusting and other, even if the company believes that the expense varies with the number of claims and not with the amount of loss.

Schedule P Interrogatory number 2 requires the company to acknowledge that it is using the new definitions:

> *2. The definition of allocated loss adjustment expenses (ALAE) and, therefore, unallocated loss adjustment expenses (ULAE), was changed effective 1/1/98. This change in definition applies to both paid and unpaid expenses. Are these expenses (now reported as "Defense and Cost Containment" and "Adjusting and Other") reported in compliance with these definitions in the statement?*

The expenses classified as defense and cost containment include legal defense fees, the costs of expert witnesses, and fees to professionals working in defense of a claim. The

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[12] The Annual Statement *Instructions* say that "it is the character of the expenses that is most important, not whether the expenses were internal or external to the insurer."

[13] The statutory accounting principles *Statement of Concepts*, paragraph 31, says: "The regulators' need for meaningful, comparable financial information to determine an insurer's financial condition requires consistency in the development and application of statutory accounting principles." The consistency principle was a dominant stimulus for the new definitions of DCC and AAO.

[14] The Annual Statement Instructions say: *The loss adjustment expenses are separated with the intent of identifying the "Defense and Cost Containment" expenses as those which are correlated with the loss amounts, and the "Adjusting and Other" as those expenses which are correlated with claim count or are general loss adjustment expenses.*

expenses classified as adjusting and other include adjustors' fees as well as fees to other professionals working as adjustors. General claim department overhead which can not be grouped into a DCC category, such as rent, is classified as adjusting and other.[15]

Illustration: A company uses in-house attorneys to handle the legal defense of routine claims. For statutory financial statements besides Schedule P, the salaries and other employee costs of these attorneys is coded as defense and cost containment, and classified by line of business and by calendar year. For Schedule P, these costs must be subdivided by accident year (in addition to line of business and calendar year). The legal department must allocate the salaries and other employee costs, including the related portions of legal department overhead, to the relevant claims.[16]

Declaratory Judgment Actions

The environmental impairment (pollution) liabilities facing the insurance industry are potentially great. The remediation of abandoned toxic waste sites is a major component of pollution liability costs, but the responsibility for these costs is disputed by insurance companies and

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[15] The formal definitions are as follows (SSAP No. 55, "Unpaid Claims, Losses, and Loss Adjustment Expenses," paragraph 5(c): "Defense and cost containment includes

1. Surveillance expenses;
2. Fixed amounts for cost containment expenses;
3. Litigation management expenses;
4. Lost adjustment expenses for participation in voluntary and involuntary market pools if reported by accident year;
5. Fees or salaries for appraisers, private investigators, reinspectors and fraud investigators, if working in defense of a claim, and fees or salaries for rehabilitation nurses, if such cost is not included in losses;
6. Attorney fees incurred owing to a duty to defend, even when other coverage does not exist; and
7. The cost of engaging experts.

Adjusting and other includes

1. Fees of adjusters and settling agents (but not if engaged in a contentious defense);
2. Loss adjustment expenses for participation in voluntary and involuntary market pools if reported by calendar year;
3. Attorney fees incurred in the determination of coverage, including litigation between the insurer and the policyholder; and
4. Fees or salaries for appraisers, private investigators, hearing representatives, reinspectors and fraud investigators, if working in the capacity of an adjuster."

[16] Allocation of legal department overhead costs to individual claims or accident years is explicitly required by the Annual Statement *Instructions*: "The fees charged for insurer employees should include overhead, just as an outside firm's charges would include." The company may *not* classify the salaries as DCC and the related employee expense costs as AAO.

their policyholders. The primary issue is whether the pre-1986 Commercial General Liability (CGL) policy provided coverage for these liabilities.

After the passage of the CERCLA legislation in 1980 by the Congress, insurers and their policyholders turned to the courts for declaratory judgment regarding the incidence of liability. The courts were asked to judge (to "declare") which party must pay the remediation costs. Most legal defense costs for pollution cases in the 1980's and early 1990's related to attorney fees for these declaratory judgment (DJ) actions.

Before codification, there were three views regarding the allocation of these attorney fees:

1. Insurance companies were paying these legal defense costs to absolve themselves of liability. Legal defense costs for both third party and first party claims are coded as ALAE. The same coding should be used for defense costs stemming from DJ actions.
2. The DJ costs are related not to the defense of claims but to the determination of coverage for specific types of claims. They are similar to other adjusting costs and should be coded as ULAE.
3. The DJ costs are not related to claims handling but to policy interpretation. They should be coded as general expenses, not as loss adjustment expenses.

Of these three types of expenses – ALAE, ULAE, and general expenses – only ALAE affects the one-year and two-year adverse loss reserves development tests (IRIS tests 9 and 10), since only ALAE is included in the Schedule P, Part 2, Summary exhibit. The declaratory judgment actions were unanticipated costs, and (for some companies) the adverse development was large.

Under the revised NAIC definitions of loss adjustment expenses, DJ legal fees are coded as adjusting and other, not as defense and cost containment. They do not affect the adverse loss development for IRIS tests 9 and 10.[17]

Distribution of Adjusting and Other Expenses

Most defense and cost containment (DCC) expenses are related to specific claims and can be assigned to accident years. Adjusting and other expenses in columns 8 and 9 are claims department overhead and salaries; they are assigned to accident year by formula.

Schedule P contains columns both for direct and assumed and for ceded adjusting and other expenses. In practice, adjusting and similar claims department expenses are rarely ceded

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[17] The Annual Statement *Instructions* say that DCC expenses "exclude expenses incurred in the determination of coverage" (i.e., declaratory judgment action expenses). These expenses are explicitly included in AAO, which include "attorney fees incurred in the determination of coverage, including litigation between the insurer and the policyholder."

in reinsurance contracts, since they can not be easily measured and associated with individual losses, policies, policy years, or underwriting years.

The distinction between (i) direct + assumed and (ii) ceded applies only to accident years 1997 and subsequent. For accident years prior to 1997, the net adjusting and other expenses are shown in the direct + assumed column. There was only a single "net" column for unallocated loss adjustment expenses before 1997, and it would have been difficult for companies to restate the old experience between direct + assumed and ceded portions.

Until 1997, Schedule P had a mandated statutory formula for distributing ULAE to accident years. (ULAE was the precursor of the current adjusting and other expenses.) In 1997, the distribution rules were changed; there is no longer a set statutory procedure, but there is general guidance on the permitted procedures. Some companies are still using the old procedure, which remains permissible; other companies have switched to new methods. Both approaches are explained below.

Previous Statutory Procedure

The old statutory procedure, which governed the distribution of paid ULAE from calendar years before 1997, is still used by many companies. This approach was defined in the pre-1997 Schedule P Interrogatory #4 as follows:

> *The unallocated loss expense payments paid during the most recent calendar year should be distributed to the various years in which losses were incurred as follows: (1) 45 percent to the most recent year, (2) 5 percent to the next most recent year, and (3) the balance to all years, including the most recent, in proportion to the amount of loss payments paid for each year during the most recent calendar year. If the distribution in (1) or (2) produces an accumulated distribution to each year in excess of 10 percent of the premiums earned for such year, disregarding all distributions made under (3) such accumulated distribution should be limited to 10 percent of premiums earned and the balance distributed in accordance with (3).*

The assumptions underlying this procedure are

- Half of unallocated loss adjustment expenses are incurred when the claim is reported (costs of setting up files and initial investigations), and half are incurred when the claim is settled (costs of issuing checks and final negotiations).

- 90% of claims are reported during the year when the accident occurred, and 10% are reported the following year.

Unallocated expenses related to claim reporting are assigned to the two most recent accident years in a 9 to 1 proportion, and unallocated expenses related to claim settlement are allocated in proportion to loss payments.[18]

Illustration: Distribution of AAO Expenses

Suppose the company has the following 2005 experience for a line of business, all of whose claims are settled within five years:

Exhibit 1.1: Prior Method of Distributing Unallocated Loss Expenses by Accident Year ($000)

Cal/Acc Year	Earned Premium	Losses Paid in 2005	
2001	8,000	200	Calendar year 2005 unallocated
2002	8,500	500	loss adjustment expenses paid: 600
2003	9,000	800	
2004	9,000	2,000	
2005	9,500	2,500	

The calendar year 2005 unallocated loss adjustment expenses (now AAO expenses) are $600,000. 45% of $600,000, or $270,000, is allocated to 2005, and 5% of $600,000, or $30,000, is allocated to 2004. The remaining $300,000 is allocated in the same proportion as paid losses. Exhibit 1.2 shows the full distribution of unallocated loss adjustment expenses to accident year.

Exhibit 1.2: Prior Method of Distributing Unallocated Loss Expenses by Accident Year ($000)

Cal/Acc Year	Losses Paid in 1995	Paid Loss percentage	Unallocated Expense Distribution: Steps 1 & 2	Step 3	Total
2001	200	3%	0	10	10
2002	500	8	0	25	25
2003	800	13	0	40	40
2004	2,000	33	30	100	130
2005	2,500	42	270	125	395
Total:	6,000	100%	300	300	600

[18] This distribution also assumes that the dollar amount of closed claims equals the dollar amount of reported claims. See Kittel [1991] and Bill [1991] for the effects of exposure growth and inflation on the distribution of ULAE by accident year.

Many medical malpractice, products liability, professional liability, non-proportional reinsurance claims are not reported until years after the accident date, and insurers providing this coverage spend much time negotiating settlements and handling the claims. The old statutory distribution procedure assigned at least 45% of the calendar year unallocated loss adjustment expenses to the most recent accident year. This percentage is too high for lines of business with long reporting lags.

In addition, the old statutory procedure assumed that half of the ULAE was proportional to the amount of the loss settlement. Many components of ULAE, such as setting up claim files, are more closely related to the number of claims than to the size of the loss.

> *Illustration:* In the late 1990's and early 2000's, hundreds of thousands of asbestos claims have been filed. The associated AAO expenses are large. All of these claims relate to the prior years row in the products liability or other liability exhibits.

Revised Method

The old statutory procedure had long been recognized as arbitrary before the 1997 changes.[19] By the late 1980's, many companies were using more sophisticated ULAE reserving procedures, which associated claims department expenses more accurately with policy years or accident years. In 1989, W. Johnson published a reserving method that associated ULAE entirely with claim reporting and settlement patterns, not with loss payment patterns.

The third Schedule P Interrogatory now says:

> *The adjusting and other expense payments and reserves should be allocated to the years in which the losses were incurred based on the number of claims reported, closed and outstanding in those years. When allocating adjusting and other expense between companies in a group or a pool, the adjusting and other expenses should be allocated in the same percentage used for the loss amounts and the claim counts. For reinsurers, adjusting and other expense assumed should be reported according to the reinsurance contract. For adjusting and other expense incurred by reinsurers, or in those situations where suitable claim count information is not available, adjusting and other expense should be allocated by a reasonable method determined by the company and described in Interrogatory 7, below. Are they so reported in this Statement?*

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[19] Troxel and Breslin [1983], page 130, comment: ". . . the unpaid ULAE for a workers' compensation claim will probably be less than 50 percent since a large reserve is often established for related monthly payments which incur little ULAE." See also Salzmann [1967], page 125: "The present percentages used to distribute unallocated claims expense . . . in Schedule P are arbitrary. Industry studies might be undertaken to determine unallocated claims expense distributions by size of claim and by age of claim." For further explanation of the prior procedure, see Salzmann [1988], page 83.

The Interrogatory seems to mandate an allocation method. The Annual Statement Instructions clarify that the method alluded to is preferred but not mandatory:

> *The "Adjusting and Other" expenses can be assigned in any justifiable way among the accident years. The preferred way is to apportion these expenses in proportion to the number of claims reported, closed, or outstanding each year.*

The Schedule P Interrogatory cited above gives a general procedure without specifying the specifics, which may differ by line of business and by company. Part 5 of Schedule P provides histories of claim count information by accident year, facilitating the use of claim counts to distribute adjusting and other expense payments by year.

Illustration: Revised Method of AAO Distribution

Suppose the company determines that for other liability claims, the average 20XX adjusting and other expense costs per claim, based on a random sample of claims, were as follows:

- claims reported during the year (initial investigation and setting up files): $500
- claims settled during the year (final investigation and payment expenses): $300
- claims closed during the year with no payment (final investigation): $200
- claims open at year-end but not reported in the year (general expense): $100

In this sample, all the claims reported during the year remained outstanding at year-end.

This expense study is simplistic, and it may easily be refined. For example:

a. Some adjusting and other expense depends on the amount of loss. Large claims receive more attention from claims department personnel than small claims receive.
b. The adjusting and other expenses vary by characteristics of the claims. More complex claims require more investigative work and incur more AAO expenses.

The dollar amounts per claim depend on the time period of the sample, and they increase with inflation in subsequent years. We convert the dollar amounts to relativities, which are not affected by inflation.

We distribute the adjusting and other expenses to accident years in three steps.

1. We determine expense relativities by type of claim, based on the sample data.
2. We compile the number of claims reported, outstanding, and closed with and without payment by accident year from Schedule P, Part 5.
3. We distribute the calendar year adjusting and other expense payments to accident years by the claim count figures and the relativities.

RELATIVITIES

To avoid the distorting effects of inflation, we express adjusting costs in relativities. We denote the cost of maintaining an outstanding claim through the end of the year as one unit of adjusting expense. The cost of closing a claim without payment is two units of adjusting expense, and the cost of settling a claim with payment is three units of adjusting expense.

A reported claim either remains open at the end of the year or is closed (with or without payment) during the year. The costs of reported claims in the sample overlaps with the cost of claims open at year end and claims closed during the year. The average AAO cost of a reported claim should be differentiated according to its status at the end of the year. For simplicity, let us assume that all reported claims in the sample were outstanding at the end of the year. The cost of reporting itself is four units of adjusting expense, so the total cost of a claim reported during the year is five units of adjusting expenses.[20]

CLAIM HISTORY

Schedule P, Part 5, shows three types of cumulative accident year direct plus assumed claim count triangles: (i) closed with payment, (ii) outstanding, and (iii) reported. A triangle of claims closed without payment may be formed by subtraction:

> *cumulative claims reported – cumulative claims outstanding at year end – cumulative claims closed with payment = cumulative claims closed without payment.*

The historical Schedule P triangles show cumulative claim counts; incremental (calendar year) claim counts are needed for distributing adjusting and other payments. The incremental claim counts are determined as the difference between the cumulative claim counts at the current valuation date and the cumulative claim counts in the preceding column. For the prior years row, the entry in the final column is the incremental amount, not the cumulative amount, so no further calculation is needed.

Suppose we must distribute $10 million of calendar year 20X9 adjusting and other expense payments by accident year. We calculate the following incremental 20X9 claim count figures:

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[20] A more rigorous analysis would determine the distribution of reported claims by their status at the end of the year. This distribution, along with the average AAO costs, might be as follows:

• reported during the year and still outstanding at the end of the year:	50%	$450
• reported during the year and closed without payment:	25%	$500
• reported during the year and closed with payment:	25%	$600

This distribution would be used to further refine the analysis in the text.

Exhibit 1.3: Reported, Outstanding, and Closed Claims by Accident Year

Acc Year	Reported	Closed with Payment	Closed w/o Payment	Out-standing	Weighted Claims	Distri-bution
Prior	0	5	0	5	20	0.20%
20X0	0	10	0	10	40	0.40%
20X1	0	15	0	20	65	0.65%
20X2	0	25	0	30	105	1.05%
20X3	10	40	5	55	225	2.25%
20X4	15	60	10	80	340	3.40%
20X5	25	80	10	120	480	4.80%
20X6	50	100	10	180	700	7.00%
20X7	125	150	15	300	1,280	12.80%
20X8	275	215	50	400	2,245	22.45%
20X9	800	200	100	500	4,500	45.00%
Total	1,300	900	200	1,700	10,000	100.00%

The "weighted claims" entry for each accident year equals the sum of the entries in the four preceding columns times the relativities for each type of claim. For example, the weighted claims for accident year 20X9 is

$$800 \times 4 + 200 \times 3 + 100 \times 2 + 500 \times 1 = 4{,}500.$$

DISTRIBUTION

The distribution of adjusting and other payments by accident year is proportional to the distribution of weighted claims by accident year. The total calendar year 20X9 adjusting and other expense payments is $10 million, and the total incremental weighted claims for all accident years at December 31, 20XX, is 10,000. The distribution of AAO payments to accident year 20X9 is

$$\$10{,}000{,}000 \times 4{,}500 / 10{,}000 = \$4{,}500{,}000.$$

The $4,500,000 is the incremental AAO for accident year 20X9 in calendar year 20X9. Similarly, the incremental AAO for accident year 20X8 in calendar year 20X9 is $2,245,000.

Schedule P requires cumulative figures. The cumulative AAO for accident year 20X8 at statement date December 31, 20X9 equals $2,245,000 plus the cumulative AAO for accident year 20X8 at statement date December 31, 20X8. Similar computations are done for the individual accident years. The prior years row in Schedule P, Part 1 shows the current calendar year activity, so the entry is 0.20% × $10,000,000 = $20,000.

From the Schedule P interrogatory, it might seem that the old statutory distribution method is no longer permitted, since it is not "based on the number of claims reported, closed and outstanding." This is not the intention. Dick Roth, who drafted the new interrogatory, explains that the old statutory method is indeed based on the number of claims reported, closed and outstanding. However, it also makes assumptions about the way that AAO is paid: 50% when the claim is reported and 50% when the loss is paid. The current procedure no longer requires companies to make this assumption.[21]

POOLING AND REINSURANCE AAO

When allocating AAO among companies in a pool, one should use the same method used to allocate losses and claims to the participating companies, not the "number of claims reported, closed and outstanding." Suppose that Companies A and B participate in a pool. If Company A gets 40% of the losses and Company B gets 60% of the losses, then Company A gets 40% of the AAO and Company B gets 60% of the AAO. Companies A and B then allocate their respective percentages of the AAO to accident years according to a claim count method.

The amount of AAO assumed by a reinsurance company depends upon the reinsurance contract. If the contract is a 50% pro-rata treaty, the contract may specify that the reinsurer also assumes 50% of the AAO. Unallocated loss adjustment expenses are generally not included in reinsurance treaties, so this issue is rarely material.

In reinsurance arrangements, the reinsurance company may not have the claim counts of the underlying business. If so, the reinsurer may use another method to distribute AAO to accident years.

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[21] The Annual Statement *Instructions* say: "The "Adjusting and Other" expenses can be assigned in any justifiable way among the accident years. The preferred way is to apportion these expenses in proportion to the number of claims reported, closed, or outstanding each year." Any distribution method may be used, as long as it can be justified.

CLAIM COUNTS

Column 12 shows the number of claims reported on direct and assumed business. The lines of business may be grouped into three categories with respect to claim count coding:

- Reported claim counts are shown for nine lines of business: homeowners/farmowners, personal auto liability, commercial auto liability, workers' compensation, commercial multiple peril, other liability, medical malpractice, auto physical damage, and products liability. For these nine lines, claims outstanding are also shown in column 25 and claims closed with and without payment are shown in Schedule P, Part 3. Reported claim counts are not shown for lines combining different types of coverage, such as special liability, special property, international, and non-proportional reinsurance.
- The remaining *primary* lines of business show the number of claims outstanding in column 25, but they need not show the reported claims or the number of claims closed with and without payment.
- The non-proportional reinsurance lines (A, B, and C) need not show even the number of outstanding claims.

Illustration: Claim counts are difficult to assign to non-proportional reinsurance, as the following examples show.

- An explosion in a large factory may reverberate through several excess reinsurance layers and their retrocession agreements. Rules for the percentage of a claim shown by each reinsurer would be arbitrary.
- An aggregate retention in an excess-of-loss treaty would cause a reinsurance recoverable stemming from the complete book of business. There is no claim count.

Average Claim Severities

Claim count information can be used in several ways.

Cumulative losses paid to date divided by cumulative claims closed with payment provides the average paid claim cost. A comparison of a carrier's trend in average claim cost by accident year for a given line of business with either industry averages or inflation indices may help identify deteriorating or improving books of business.

Similar ratios may be formed from other claim count figures. As examples,

- Cumulative losses reported to date divided by the sum of claims closed with payment and outstanding claims shows the average incurred claim cost for non-frivolous claims.

- Outstanding case reserves divided by outstanding claims shows the average size of case reserves. A comparison of trends in this ratio with trends in average paid claim costs may identify strengthening or weakening case reserve adequacy.[22]

Claims may be counted either "per claim" (i.e., "per accident") or "per claimant." Automobile liability insurance illustrates the difference. If an insured driver causes an accident and injures three other persons, each of whom seeks bodily injury compensation, are there three claims or one claim? Carriers may use either definition, but they must be consistent for all lines. The choice is reported in Schedule P Interrogatory 6:

6. Claim count information is reported (check one): (a) per claim _____
   (b) per claimant _____

Direct and Assumed vs Ceded

Claim count information in Schedule P uses direct and assumed business, not ceded or net business. The assumed business on the primary lines of business is assumed proportional business, whereas the ceded business on the primary lines of business includes ceded non-proportional business.

Assumed claim counts on proportional reinsurance arrangements uses the same proportion as losses. With regard to intercompany pooling agreements, for instance, the Annual Statement *Instructions* say

> *Claim counts should be reported in accordance with the pooling arrangement and should reflect the company's proportionate share of the total number of claims. If the company's losses are 40% of the pool, then 40% of the claim counts should be reported.*

The same procedure is used for proportional reinsurance arrangements between unaffiliated entities.[23] For non-proportional reinsurance, there is no simple way to determine the number of claims ceded or assumed, since the percentage of a claim that is ceded depends on the

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[22] Actuarial expertise is essential in such analyses. Average claim cost ratios (paid, reported, and outstanding) depend on the maturity of the data. All three ratios increase with the development period, though they increase at different rates. See Salzmann [1984] on the importance of using data at the same maturity when comparing accident years.

[23] In past years, the NAIC *Instructions* were unclear regarding assumptions from non-affiliated ceding companies. The previous version of this paper, written in 1996, cited the Annual Statement Instructions then applicable and noted Richard Roth's recommendations for completing the exhibit. The issues have since been resolved as stated in the text, and the Annual Statement *Instructions* have been changed to accord with Mr Roth's recommendations. Companies that are still using the old claim count method for non-affiliated proportional reinsurance should switch to the procedure outlined in this paper.

size of the claim. For this reason, ceded and net claim counts are not shown for any line, and assumed claim counts are not shown for non-proportional reinsurance.

Loss and Loss Expense Reserves

Columns 13 through 25 show data by accident year on unpaid amounts: losses, loss expenses, anticipated salvage and subrogation, and claims.

Before 1989, Schedule P, Part 1F showed IBNR reserves separately from case reserves. It was unclear whether the development on reported cases should be classified as IBNR or as case reserves, and insurers chose different definitions of IBNR. To avoid inconsistency among companies, Schedule P divides reserves between case reserves and bulk + IBNR reserves. All actuarial reserves, whether for development on reported cases or emergence of unreported cases, comprise the "bulk + IBNR" reserves.[24]

Actuarial bulk reserves for reported claims are not necessarily a sign of under-reserving, as long as the company sets proper total reserves.

> *Illustration:* A workers' compensation carrier reports 1,000 claims for lower back sprains and strains. Most workers with such injuries return to work within a few weeks, though some become permanently disabled. The insurance company can not identify the claims that will develop into permanent cases. Some companies augment the individual case reserves to fund the claims that develop adversely; other companies use bulk reserves. Neither method is intrinsically better.

Many claims examiners set a single case reserve for both losses and defense and cost containment expenses. For these companies, columns 17 and 18, the case basis "direct plus assumed" and ceded reserves for defense and cost containment expenses unpaid would be zero. Zero entries in columns 17 or 18 are acceptable, as long as the appropriate bulk reserves are recorded in columns 19 and 20.

> *Illustration:* A claims adjuster sets a $1 million reserve for a general liability claim. The reserving actuary estimates that 20% of the amount will be used for defense and cost containment expenses. The appropriate entries in Schedule P would be +$1 million as the case basis losses unpaid, –$200,000 as the bulk losses unpaid, and +$200,000 as the bulk defense and cost containment expenses unpaid.[25]

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[24] See SSAP No. 55, "Unpaid Claims, Losses, and Loss Adjustment Expenses," paragraph 5(b): "Bulk provisions are reserves included with other IBNR reserves to reflect deficiencies in known case reserves."

[25] In practice, the entries for this claim would be mixed with the entries of other claims, and the negative loss reserve would not be noticeable.

Retroactive Reinsurance

Prospective reinsurance is the transfer of the risk of loss from exposures that have not yet been earned. Retroactive reinsurance is the transfer of losses that have already occurred, though they have not yet been settled and some have not even been reported yet.

Retroactive reinsurance is sometimes used to circumvent statutory requirements to hold full value (undiscounted) reserves.

> *Illustration:* A block of unpaid losses has an ultimate (full) value of $100 million and a present value of $75 million. The primary company transfers the losses to a reinsurer with a payment of $80 million. The reinsurer gains $5 million of economic income, and the primary company gains $20 million of statutory income.

GAAP recognizes both prospective and retroactive reinsurance. For GAAP financial statements, the equity gain from retroactive reinsurance is recognized ratably over the settlement lifetime of the claims.

For statutory accounting, retroactive reinsurance increases total surplus, but it does not immediately affect unassigned surplus. Retroactive reinsurance has no effect on the loss reserves shown on Annual Statement "exhibits or schedules" (i.e., the Underwriting and Investment Exhibit and Schedule P). The reinsurance is not coded as ceded business in Schedule P and it does not reduce loss reserves on line 1 of page 3. Instead, the reinsurance recoverable is coded as a write-in contra-liability on line 22 of page 3 and an offsetting entry on line 24, "aggregate write-ins for special surplus funds."

RETROACTIVE REINSURANCE ACCOUNTING ILLUSTRATION

On December 31, 20XX, $100 million of loss reserves are reinsured retrospectively for $80 million. The accounting entries are as follows:

December 31, 20XX:

		Debit	Credit
Balance sheet:	Case loss reserve:		(No change)
Income statement:	Other income:		$20,000,000
Balance sheet:	Cash paid:		$80,000,000
Balance sheet:	Contra-liability for reinsurance recoverable:		$100,000,000
Balance sheet:	Special surplus funds:		$20,000,000[26]

[26] The $20,000,000 in the special surplus line is a segregation of surplus, not an accounting entry.

Details of retroactive reinsurance transactions are shown in note 22F to the Annual Statement. Note 22F discloses the following five items, by calendar year, for all retroactive reinsurance agreements "that have already occurred and that will generate special surplus transactions":

a. Reserves transferred;
b. Consideration paid or received;
c. Paid losses reimbursed or recovered;
d. Special surplus from retroactive reinsurance; and
e. The cedants and reinsurers included in items (a) through (d)

For explanation and illustration of this note, see Yoheved and Feldblum [2002: notes].

Anticipated Salvage and Subrogation

Before 1991, statutory accounting required insurers to hold loss reserves gross of anticipated salvage and subrogation, whereas GAAP statements showed reserves net of anticipated salvage and subrogation.[27]

Illustration: The company's policyholder incurs an automobile collision claim. The car is severely damaged, and the company expect to pay the "blue book" value of $5,000. The company expects to receive salvage of $2,000 on the damaged vehicle.

For GAAP statements, the company sets up a loss reserve of $3,000, whereas for statutory statements, the company sets up a loss reserve of $5,000. The salvage was not recognized until it was received.

The Internal Revenue Service bases taxable income on Annual Statement figures. In 1991, the Treasury amended its deduction for incurred losses to permit only reserves *net* of salvage and subrogation anticipated as an offset to taxable income (see Rev. Proc. 91–48 1991–34 I.R.B. 1), just as it allows only discounted reserves as an offset to taxable income. It presumed that Schedule P reserves were gross of anticipated salvage and subrogation, and it reduced these figures to a net basis. The Treasury determines anticipated salvage and subrogation on a formula basis, just as it determines the loss reserve discount on a formula basis.

For many insurers, Schedule P reserves were net of anticipated salvage and subrogation even before 1991, despite the statutory regulation to the contrary.[28] To avoid a double reduction for anticipated salvage and subrogation, with the corresponding overstatement of

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[27] See page 22 for definitions of these terms and for the statutory accounting treatment of salvage and subrogation received.

[28] A survey of 14 major property-casualty insurance companies in 1990 found that 13 were offsetting their reserves, either partially or fully, for anticipated salvage and subrogation.

taxable income and of the federal income tax liability, the NAIC allowed insurers to report reserves net of anticipated salvage and subrogation for the 1991 and subsequent Annual Statements and to "gross up" the reserves for federal income tax purposes.[29]

The Treasury allows insurers to "gross up" their loss reserves for anticipated salvage and subrogation only if the amount of the reduction is disclosed in the Annual Statement.[30] Column 23, "salvage and subrogation anticipated," shows this disclosure. It is not used in the Schedule P calculation of the net incurred losses, since loss reserves in column 24 are already net of the anticipated salvage and subrogation amounts in column 23, just as the Schedule P paid losses are net of salvage and subrogation received.[31] A similar disclosure of anticipated salvage and subrogation is made in the Statement of Actuarial Opinion Regarding Loss and Loss Adjustment Expense Reserves, paragraph 9(a).[32]

Companies may use either of two practices to report anticipated salvage and subrogation: the case reserves in columns 13 and 14 may be shown net of anticipated salvage and subrogation, or the case reserves may be shown gross of anticipated salvage and subrogation, and the anticipated amounts (for both reported and IBNR claims) may be an offset to the bulk reserves in columns 15 and 16.

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[29] For statutory financial statements, the reporting entity may choose not to reduce loss reserves for anticipated salvage and subrogation. For GAAP financial statements and for tax purposes, the reduction for anticipated salvage and subrogation is required.

As Ruth Salzmann has pointed out to me, the major purpose of Part 2 of Schedule P is to show favorable or adverse loss development. If reserves are gross of anticipated salvage and subrogation, but payments are net of salvage and subrogation received, the Part 2 triangles show apparent favorable development, because salvage and subrogation is not recognized until it is received. Reporting reserves net of anticipated salvage and subrogation improves the accuracy of the Schedule P retrospective tests of reserve adequacy.

[30] Compare Treasury regulations 2001FED 26,153, §1.832-4, paragraph 14.D(2): "A company. . . is allowed to increase the unpaid losses shown on its annual statement only if the company . . . discloses on its annual statement, by line of business and accident year, the extent to which estimated salvage recoverable is taken into account in computing the unpaid losses shown on the annual statement filed by the company for the calendar year ending with or within the taxable year of the company." Alternatively, a separate disclosure statement may be filed with regulatory authorities.

[31] Similarly, the paid losses in column 4 are already net of the salvage and subrogation received in column 10.

[32] The disclosure wording of the Statement of Actuarial Opinion, paragraph 9A, is as follows:

Anticipated salvage and subrogation included as a reduction to loss reserves as reported in Schedule P – Analysis of Losses and Loss Expenses, Underwriting and Investment Exhibit – Part 3A and on Page 3 – Liabilities, Surplus, and Other Funds, Line 1, $_____.

For tax purposes, the anticipated salvage and subrogation is discounted just as the gross loss reserves are discounted. The Treasury procedures for estimating and discounted anticipated salvage and subrogation are discussed below in conjunction with the discounting procedures for loss reserves.

Distributing Unallocated Expense Reserves

Property-casualty insurance companies often place less emphasis on estimating reserves for adjusting and other expenses (unallocated loss adjustment expenses) for several reasons:

1. The amount of the reserve for adjusting and other expenses is relatively small, and it is not subject to large uncertainty.
2. The reserves for adjusting and other expenses are not included in the NAIC retrospective reserve adequacy tests (IRIS tests 9 and 10; see below), and there is no cross-check in the Annual Statement for the amount of these reserves.
3. Some companies do not appreciate the rationale for holding reserves for adjusting and other expenses. They reason as follows:

> *Losses are an expense of the period during which the loss occurred, so loss reserves are set up when the loss occurs, even if the loss has not yet been paid or even reported. Defense and cost containment expenses (ALAE) are associated with particular claims, so they have the same accounting treatment as those claims. But adjusting and other expenses are claims department overhead. Just as underwriting department overhead flows through income when it is incurred, so claims department overhead should flow through income when it is incurred.*

This reasoning is not correct. The underwriting department overhead is incurred for policies written during that time period, so the expense flows through the income statement for that time period. The claims department overhead is incurred (in part) for claims that occurred

during previous accounting periods. A reserve must be established when the claims occur, not when these expenses are incurred.[33] [34]

Because adjusting and other expenses are not associated with particular claims or particular accident years, and because this reserve may not be of major concern, some companies determine a general reserve that is not associated with specific accident years. Before 1997, Schedule P had no instructions for distributing unallocated loss adjustment expenses unpaid to accident year.

A common procedure for this distribution was to use the rationale for the distribution of unallocated expense payments to accident years, and to assume that the "bulk + IBNR" reserves consist of pure IBNR, not development on known cases.

The unallocated expense reserves were distributed in the same proportion as case reserves plus twice the IBNR reserve. Because of its simplicity, this procedure is still used by many companies.[35]

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[33] Both GAAP and statutory accounting allocate all loss adjustment expenses to the period when the claims occurred. SFAS 60, paragraph 20, says:

A liability for all costs expected to be incurred in connection with the settlement of unpaid claims (claim adjustment expenses) shall be accrued when the related liability for unpaid claims is accrued. Claim adjustment expenses include costs associated directly with specific claims paid or in the process of settlement, such as legal and adjusters' fees. Claim adjustment expenses also include other costs that cannot be associated with specific claims but are related to claims paid or in the process of settlement, such as internal costs of the claims function.

Statutory accounting has the same rule; see SSAP No. 55.

[34] Total loss adjustment expense reserves should reconcile with the Underwriting and Investment Exhibit. Schedule P, Part 1, line 12 (total for all accident years), columns 17 – 18 + 19 – 20 + 21 – 22 should equal the corresponding line of business entries in Part 3A of the Underwriting and Investment Exhibit, column 9, "unpaid loss adjustment expenses." The Underwriting and Investment Exhibit does not subdivide the unpaid loss adjustment expenses between defense and cost containment expenses and adjusting and other expenses.

[35] Salzmann [1988], pages 83–84, describes this procedure in more detail:

"By combining the intent and arithmetic of the footnote to the schedules, the total unallocated LAE liability is the sum of two products: (1) the liability for reported losses times the paid/paid ratio @ 50%, and (2) the IBNR liability times the paid/paid ratio @ 100%.

These two calculations can be reduced to one:

Unallocated LAE liability = .5 paid/paid ratio *x* (Total loss liability + IBNR liability)."

[Before 1989, the procedure for distributing unallocated loss adjustment expense payments to accident years was described in a footnote to Schedule P, Part 1 and not in the Annual Statement instructions. Salzmann's

These assumptions are not entirely accurate. In particular, much IBNR is development on reported cases, so the second assumption over-weights the proportion of the reserves for adjusting and other expenses associated with IBNR reserves.

Schedule P Interrogatory #3 now requires reserves for adjusting and other expense payments to be allocated to accident years based on "the number of claims reported, closed, and outstanding."[36] Reserving methods patterned on the procedure recommended by Johnson [1989] are used by some companies. The parameters of the reserving method, such as the percentage of adjusting and other expense costs to be ascribed to claim reporting or to claim payment, vary by line of business and by company. There is no standard method of estimating AAO reserves or of spreading them to accident year.

Claims Outstanding

Column 25 shows the number of claims outstanding on direct and assumed business. Column 25 must be completed for all primary lines of business, though not for the three reinsurance lines.[37] The ratio of case reserves in column 13 (or case reserves plus DCC reserves in columns 13 plus 17) to column 25 shows the average value of an outstanding claim. This ratio must be used with caution, for two reasons:

1. Lines such as workers' compensation, automobile no-fault, and accident & health provide periodic payments during the duration of a disability. The case reserves show only the remaining unpaid losses, not the entire benefits, so the ratio of case reserves to claims outstanding understates the value of an outstanding claim. This distortion increases as the claims mature.

2. Smaller, simpler cases are settled more rapidly than larger, more complex cases, particularly in the tort liability lines of business.

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paid/paid ratio is the ratio of "unallocated loss adjustment expense paid to losses paid for the most recent calendar year(s).*]*

As Ruth Salzmann has explained to me, "The method is not put forward on its own merits; rather, it is appropriate only because it is consistent with the *assumption* underlying the formula allocation of paid unallocated loss expenses by accident year. Thus, the method does no more than anticipate future *formula* allocations." Claim reporting and settlement patterns allow a better distribution of both paid and unpaid unallocated expenses by accident year; see the following footnote.

[36] As noted above, this should be interpreted as a recommendation, not as a requirement. The Annual Statement Instructions explain that "the Adjusting and Other expenses can be assigned in any justifiable way among the accident years. The preferred way is to apportion these expenses in proportion to the number of claims reported, closed, or outstanding each year."

[37] These exhibits show assumed non-proportional business. Since the reinsurer is assuming a layer of loss, not the entire loss, the number of outstanding claims is not a meaningful figure.

3. Loss development on reported cases is included in the bulk reserves shown in column 15, not in the case reserves of column 13. One can not include column 15 in calculating the average value, since this column includes IBNR reserves, and IBNR claims are not included in column 25. If there is significant loss development on reported cases, then the ratio noted above understates the value of an outstanding claim.

ILLUSTRATION: OUTSTANDING CLAIM SEVERITY

Lest readers underestimate the difficulties of using Schedule P average outstanding claim severities, we show an example of workers' compensation premiums, unpaid losses and loss adjustment expenses, outstanding claim counts, and average outstanding claim severities.

Exhibit 1.4: Outstanding Claim Severity

Year	Net Premium	Net Unpaid Loss + LAE	Direct + Assumed Outstanding Claims	Outstanding Claim Severity
Prior		$800,000	13,650	$58,608
20X0	$1,800,000	$230,000	2,600	$88,462
20X1	$2,650,000	$320,000	3,400	$94,118
20X2	$2,800,000	$330,000	4,400	$75,000
20X3	$2,800,000	$360,000	5,400	$66,667
20X4	$2,650,000	$325,000	6,600	$49,242
20X5	$2,500,000	$530,000	8,800	$60,227
20X6	$2,250,000	$650,000	10,000	$65,000
20X7	$2,000,000	$715,000	14,250	$50,175
20X8	$1,650,000	$750,000	23,000	$32,609
20X9	$1,300,000	$880,000	42,000	$20,952

The progression of average outstanding claim severities reflects the company's operations and the nature of workers' compensation claims.

- For accident years 20X2 and prior, almost all the outstanding claims are lifetime pension cases. The increasing severities reflect inflation and the partial (weekly) payments on these claims. The pension claims in the prior years row stem from old years; the severities reflect only the amount still remaining to be paid.
- For accident years 20X2 through 20X4, the pension cases are increasingly mixed with temporary cases, and the average outstanding claim severities decrease.
- The company began switching business to large dollar deductible policies in 20X4, as the decline in net earned premium indicates. The rise in average outstanding claim severities in 20X5 and 20X6 reflects the higher average costs of excess claims.

☞ The claims in accident years 20X7 through 20X9 are increasingly dominated by temporary cases, and much of the reserves are bulk reserves, not case reserves. The average outstanding claim severities decline rapidly, despite the increasing use of large dollar deductible policies.

Loss Ratios

Columns 26 through 31 are calculated figures.

- Column 26, "Total losses and loss expenses incurred, direct and assumed," equals the sum of columns 4, 6, 8, 13, 15, 17, 19, and 21.
- Column 27 (ceded) equals the sum of columns 5, 7, 9, 14, 16, 18, and 20.
- Column 28 (net) equals column 26 minus column 27, or the sum of columns 11 and 24.
- Columns 29 through 31, "Loss and loss expense percentage (Incurred / Premiums Earned)" for direct and assumed, ceded, and net business are the ratios of columns 26 through 28 to columns 1 through 3, respectively.

Industry-wide averages by line of business of column 31 for 1983-1992 were used to determine the written premium charge in the NAIC risk-based capital formula. The individual company ratios in column 31 are used for the company adjustment to the written premium risk charge in the risk-based capital submission; see Feldblum [RBC: 1996].

These ratios are gross of non-tabular discount and net of tabular discount. They are used by financial analysts to assess the underwriting performance of insurance enterprises (i) in absolute terms, (ii) in comparison with other insurers, and (iii) in comparison with past performance.

Loss Reserve Discounting

Columns 32 and 33 show the non-tabular discount for losses and loss adjustment expenses, respectively. These columns provide a reconciliation of the Schedule P figures with the entries in the Underwriting and Investment Exhibit, which are reproduced in columns 35 and 36 of Schedule P.

In general, property-casualty loss reserves are shown at undiscounted values on statutory accounting statements, with the exception of tabular discounts.[38] The statutory undiscounted values must include the effects of expected inflation from the statement date to the settlement date, but they may not include the effects of discount rates.

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[38] Undiscounted values are also termed nominal values or ultimate values. Discounted values are also termed market values or fair values.

Loss reserve valuation in other accounting systems – GAAP, tax, risk-based capital, and international accounting – are noted below.

- For property-casualty insurance, GAAP discounting rules follow the statutory accounting procedures, with minor exceptions.
- For federal income tax purposes, only discounted reserves are offsets to taxable income. The discounted reserves are determined from Schedule P entries; see page 171 below.
- The risk-based capital formula determines the reserving risk charge and the written premium risk charge based on discounted reserves. The RBC formula uses the IRS discounting procedures and loss payment patterns, though with a flat 5% discount rates instead of the 60 month moving average of the federal mid-term rates. The RBC loss reserve discount factors were established in 1993 and have not been changed since then.
- Currently evolving international insurance accounting standards use fair value (i.e., discounted value) for loss reserve valuation.

TABULAR AND NON-TABULAR DISCOUNTS

There are two types of loss reserve discounts: tabular discounts and non-tabular discounts. Tabular discounts are discounts based upon a mortality or morbidity table. Under statutory accounting, they may be applied only to the indemnity (i.e., wage replacement) portion of workers' compensation pension cases or to long-term disability claims. They may not be applied to the medical benefits or loss adjustment expenses associated with these claims.[39] This is similar to the reserve valuation for an immediate annuity, except that the beneficiary of a workers' compensation pension case is a disabled life.

Non-tabular discounts are determined from the aggregate payment patterns of the book of business or other information, generally using historical paid loss data. See the section below on the IRS loss reserve discount factors for an illustration.

> *Illustration:* A construction worker is permanently paralyzed after a fall from a scaffold. The weekly workers' compensation indemnity benefits are $1,000 for life. Based on the injured worker's age, sex, and health status, the expected future lifetime is 40 years. The undiscounted reserve is 40 years × 52 weeks × $1,000 per week = $2.08 million. The discounted reserve, which would be substantially less, is shown in Schedule P.
>
> The workers' compensation insurer also pays for daily home health care visits, rehabilitation treatment, and periodic nursing and physician care. The current cost is

[39] SSAP No. 65, "Property and Casualty Contracts," paragraph 11, says: "Tabular reserves are indemnity reserves that are calculated using discounts determined with reference to actuarial tables which incorporate interest and contingencies such as mortality, remarriage, inflation, or recovery from disability applied to a reasonably determinable payment stream. Tabular reserves shall not include medical loss reserves or loss adjustment expense reserves."

about $600 a week. These costs are expected to increase with inflation and with deterioration of the worker's condition as he or she ages. Based on actuarial analyses of future inflation rates and development patterns, the undiscounted reserve is $3.5 million and the discounted reserve is $1.1 million. This is classified as a non-tabular reserve discount, even though it is based on an individual claim.

DISCOUNTING AND RISK-BASED CAPITAL

The distinction between tabular and non-tabular reserve discounts affects the risk-based capital ratio. The RBC ratio is the company's "adjusted surplus" divided by its risk-based capital requirements. Adjusted surplus is policyholders' surplus minus non-tabular reserve discounts, along with other adjustments applicable primarily to life insurance companies. Tabular reserve discounts do not have this effect. Since the risk-based capital ratio is seen as an indicator of financial strength, companies have an incentive to reclassify non-tabular reserve discounts as tabular reserve discounts.[40]

Illustration: For the ABC Insurance Company, policyholders' surplus is $500 million, loss reserves are $800 million, the tabular discount is $100 million, the non-tabular discount is $50 million, and the risk-based capital requirements are $300 million. The RBC ratio is

($500 million – $50 million) / $300 million = 150%.

DISCOUNTING AND STATUTORY REPORTING

The treatment of discounting in the Annual Statement exhibits and schedules is as follows:

- Loss and expense reserves on the balance sheet (page 3, lines 1, 2, and 3), in the Underwriting and Investment Exhibit, Parts 3 and 3A (pages 10 and 11), and in other parts of the Annual Statement (such as the Page 15 state pages) are net of both tabular and non-tabular discounts.

- Schedule P, Part 1, is net of tabular discount and gross of non-tabular discount. In order to reconcile Part 1 of Schedule to the rest of the Annual Statement, non-tabular discounts are disclosed in columns 32 and 33.

- Schedule P, Parts 2 and 4 are gross of both tabular and non-tabular discounts. The reconciliation between Part 1 of Schedule P and Parts 2 and 4 of Schedule P is in the Note to the Financial Statements titled "Discounting of Liabilities for Unpaid Losses and Unpaid Loss Adjustment Expenses" [Note 28, section (1), in 2001]. Disclosure of loss

[40] The exclusion of discounts on medical benefits and loss adjustment expenses from classification as tabular discounts was established by Mr. Vincent Laurenzano in May 1994 in conjunction with the final draft of the property-casualty risk-based capital formula, and it was subsequently adopted into statutory accounting.

reserve discounts in or with the Annual Statement is necessary for the company to "gross up" its discounted reserves for federal income tax purposes, thereby reducing its tax liability for the year; see the section on IRS loss reserve discounting further below.

The "amortization of discount," or the "unwinding of the interest discount," in loss triangles that are net of discount shows up as apparent adverse loss development. Part 2 of Schedule P is intended to show true adverse loss development, so it is reported gross of all discounts.

For lines of business which do *not* have tabular discounts (that is, for all lines except workers' compensation and accident & health), the reconciliation between Part 1 and Part 2 of Schedule P is as follows: for each accident year,

Part 1, columns 28 – 21 + 22 – 8 + 9 equals Part 2, column 10.

Net incurred losses and loss adjustment expenses by accident year (Part 1, column 28) minus net adjusting and other expense reserves (column 21 minus column 22) minus net cumulative adjusting and other expenses paid (column 8 minus column 9) equals net incurred losses and defense and cost containment expenses at the current statement date (Part 2, column 10). This reconciliation does not work for lines of business that have tabular discounts. The Part 2, column 10 figures are higher by the amount of the tabular discount.

Dynamic Discount Rates

Life insurance and annuity policy reserves are held at discounted values on statutory financial statements. The maximum allowable discount rate that is prescribed by statutory regulation is dynamic in that it varies with the yield on investment grade corporate bonds minus a specified margin that varies with the characteristics of the insurance product; see the 1990 Standard Valuation Law for life insurance products.

Similarly, the 2001 statutory accounting codification rules limit the maximum interest rate for *non-tabular* reserve discounts when discounting is permitted. The maximum permitted interest rate is the lower of (i) the yield on five year Treasury notes and (ii) the company's investment yield minus 1.5 percentage points. The company's investment yield is

a. The company's average yield on *invested* assets if invested assets exceed the loss reserves plus the unearned premium reserves, or
b. The company's average yield on *total* assets if invested assets are less than the loss reserves plus the unearned premium reserves.[41]

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[41] See SSAP Number 65, "Property and Casualty Contracts," paragraph 12:

When establishing discounted loss reserve liabilities prescribed or permitted by the state of domicile using a non-tabular method . . . the rate used [shall not] exceed the lesser of the following two standards:

The maximum permitted discount rate is dynamic in that it varies with the current yields on Treasury securities and with the company's own investment results. Prior to the codification of statutory accounting in the late 1990's, most states that permitted discounting in specific instances used static maximum discount rates, which were absolute rates coded in the law.[42]

No maximum discount rate is specified by statutory accounting for tabular discounts. However, the discount rate used, both for tabular and non-tabular discounts, must be disclosed in the notes to the financial statements.

ILLUSTRATION: MAXIMUM DISCOUNT RATE

A property-casualty insurance company discounts certain reserves using a non-tabular method. The maximum permitted discount rate is based on the following data.

December 31, 20XX loss reserves:	$120 million
December 31, 20XX unearned premium reserves:	$50 million
December 31, 20XX statutory invested assets:	$160 million
Average investment yield on invested assets during 20XX:	9.5% per annum
December 31, 20XX total statutory assets:	$210 million
20XX investment income earned (line 8 of U&IE):	$14 million
5 year Treasury note rate on December 31, 20XX	7.5% per annum

The yield on five year Treasury notes is 7.5% per annum. On the statement date, the company holds $170 million of loss plus unearned premium reserves, and it has $160 million of invested assets. Since the invested assets are less than the reserves, we examine the yield on total assets, which is $14 million / $210 million = 7.0%. Subtracting the statutory margin of 1.5% gives 5.5%. The maximum permitted statutory discount rate is the lower of 5.5% and 7.5%, or 5.5% per annum.

This company has a large percentage of non-invested assets, such as premiums receivable, accrued retrospective premiums, deferred tax assets, and non-investment real estate. If the company's invested assets were greater than the loss plus unearned premium reserves of $170, we would use the yield on invested assets minus 1.5% percentage points, to give 8.0%

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a. If the reporting entity's statutory invested assets are at least equal to the total of all policyholder reserves, the reporting entity's net rate of return on statutory invested assets, less 1.5%, otherwise, the reporting entity's average net portfolio yield rate less 1.5% as indicated by dividing the net investment income earned by the average of the reporting entity's current and prior year total assets; or

b. The current yield to maturity on a United States Treasury debt instrument with maturities consistent with the expected payout of the liabilities.

[42] Statutory accounting retains the static perspective in the IRIS test on the company's investment yield, which uses fixed numbers as the bounds (currently 4.5% to 10.0%).

per annum. The maximum permitted loss reserve discount rate would be the lower of 8.0% and 7.5%, or 7.5% per annum.

DISCOUNTING DISCLOSURES AND RECONCILIATION

Columns 35 and 36 show the effect of the non-tabular discount on the loss and loss adjustment expense reserves. If no discount is used, column 35 equals columns 13 – 14 + 15 – 16 (net case reserves plus net bulk reserves), and column 36 equals columns 17 – 18 + 19 – 20 + 21 – 22 (net case DCC reserves plus net bulk DCC reserves plus net AAO reserves). If a non-tabular discount is used, the discount figures in columns 32 and 33 must be subtracted from these sums to obtain columns 35 and 36.

Schedule P, Part 1 loss reserves are net of tabular discounts. No adjustment for tabular discounts is needed to reconcile the figures with the Underwriting and Investment Exhibit.

Both tabular and non-tabular discounts are disclosed in Note 28 to the financial statements. For the tabular discounts, the note shows

a. The table used;
b. The discount rates;
c. The amount of the discounted reserves; and
d. The amount of the discount.

The amount of the discount is subdivided by line of business and by type of reserve: case reserves vs bulk and IBNR reserves.

Tabular discounts on known claims (case reserves) are easily determined. Given the required input data, such as the age, sex, and impairment status of the annuitant (the claimant), the weekly benefit, the discount rate, and the mortality table, the discounted reserve is determined by actuarial formula.

Tabular discounts on IBNR reserves are more complex. The reserving actuary determines the expected number of permanent disability or fatal cases to emerge on existing business, the expected subdivision by sex, and the average age, impairment status, and weekly benefit amounts. These projections, together with the discount rate, the mortality table, and the actuarial formulas, give the discounted reserves.[43]

The tabular discount shown in Note 28 should reconcile with the difference in loss reserves at the statement date between (i) Schedule P, Part 1, loss plus LAE reserves but not including AAO reserves, and (ii) Schedule P, Part 2 minus Part 3.

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[43] Workers' compensation IBNR for pension cases is not the emergence of unreported claims but the re-evaluation of temporary total claims or permanent partial claims into permanent total claims.

For non-tabular discounts, Note 28 to the financial statements shows

a. The discount rates and their basis (i.e., their rationale);
b. The amount of the discounted reserves; and
c. The amount of the discount.

The amount of the discount is subdivided by line of business and by type of reserve: case reserves vs bulk and IBNR reserves vs defense and cost containment expenses vs adjusting and other expenses. Non-tabular discounts may be applied to loss adjustment expenses; tabular discounts may not be applied to loss adjustment expenses.

The non-tabular discounts in Note 28 should reconcile with the entries shown in Schedule P, Part 1, columns 35 and 36 for losses and loss adjustment expenses, respectively.

INTERCOMPANY POOLING

Column 34 shows the intercompany pooling participation percentage, if applicable. Member companies of an insurance group often redistribute premiums, losses, and loss adjustment expenses according to participation formulas. Column 34 shows the individual company's share of the group figures.

Intercompany pooling agreements are used primarily for rating purposes.

> *Illustration:* A private passenger automobile insurer wishes to differentiate between high-risk, moderate risk, and low-risk drivers. It does not have a risk classification plan filed and approved in all jurisdictions that matches the judgment of its underwriters. The insurer sets up three affiliated legal entities, Companies X, Y, and Z, to write substandard, standard, and preferred risks at rates appropriate for each type of driver.
>
> A single management team runs all three legal entities, and they desire a single set of underwriting results for the corporate group as a whole. Each legal entity cedes all its business to the lead company, which then retrocedes a percentage of the pooled business back to each legal entity.

For Schedule F and for other parts of the Annual Statement, each legal entity's percentage of the pooled business is assumed business, not direct business. The cessions to the lead company appear as ceded reinsurance in Schedule F, Part 3, and the assumptions of a percentage of the pooled business appear as assumed business in Schedule F, Part 1.[44]

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[44] Schedule F explicitly differentiates between reinsurance transactions with affiliated companies and those with unaffiliated companies; see Feldblum [2002: SchF].

For Schedule P, each legal entity's percentage of the pooled business is direct business, not assumed business. The intercompany pooling agreement does not create cessions or assumptions for Schedule P. To complete Schedule P, one constructs first a pooled schedule, and each legal entity takes its appropriate percentage of every entry. The "appropriate" percentage is the percentage in the *current* intercompany pooling agreement, not the percentage for the year in which the losses occurred; see the discussion below.

The intercompany pooling agreement relates to underwriting revenues and expenditures: premiums, losses, loss adjustment expenses, and underwriting expenses. It does not affect assets, investment income, or surplus. Asset transactions may be handled by a single investment department, but the assets and investment income of each legal entity are kept distinct.

The coding of cessions to unaffiliated reinsurers and assumptions from unaffiliated companies depends on whether the cessions or assumptions are classified as pooled business.

Illustration: Intercompany Pooling

The coding of intercompany pooling transactions varies with the circumstances. The illustration below shows the more common transactions. The prose documentation is followed by a table listing the entries.

Illustration (Step 1): Companies X, Y, and Z are affiliated members of an insurance fleet that writes private passenger automobile insurance. Companies X, Y, and X write substandard, standard, and preferred risks, respectively. For marketing purposes, most risks are classified as preferred. In 20XX, Companies X, Y, and Z write $10 million, $20 million, and $70 million of premium.

By an intercompany pooling agreement, companies X and Z cede all their premium to company Y. Company Y is termed the "lead company." Company Y retrocedes 30% of the business to Company X and 20% of the business to Company Z. For the Schedule P entries, company X shows 30% of the pooled earned premiums and incurred losses as direct business, Company Y shows 50% of the pooled earned premiums and incurred losses as direct business, and Company Z shows 20% of the pooled earned premiums and incurred losses as direct business. To complete the individual company Schedule P's, we construct the pooled Schedule P and take percentages.

Illustration (Step 2): We add three sets of transactions.

- Before pooling, Company X reinsures its business under a 50% pro-rata treaty.
- Before pooling, Company Z assumes $30 million of private passenger automobile premium from an unaffiliated insurer.

- After pooling but before retroceding business to Companies X and Z, Company Y has an excess of loss reinsurance treaty above a $100,000 retention with a 10% reinsurance rate on subject premium.

i. The $5 million of ceded premium by Company X is ceded pooled premium, which is shared in the 30%, 50%, 20% percentages by the three companies.
ii. The $30 million of assumed premium by Company Z is assumed pooled premium, which is shared in the 30%, 50%, 20% percentages by the three companies. The total written premium by Company Z which is ceded to the pool is $70 million + $30 million = $100 million, of which Companies X, Y, and Z get 30%, 50%, and 20%.
iii. Ceded premiums under the excess of loss treaty by Company Y are ceded pooled premiums. The total pooled written premium is $5 million from Company X, $20 million from Company Y, and $100 million from Company Z, for a total of $125 million. Before pooling by the 30%, 50%, and 20% percentages, the excess of loss premiums and losses are removed.

We add one additional step to this illustration, which slightly changes the figures.

Illustration (Step 3): The intercompany pooling agreement does not include New Jersey business.

- Company X writes $2 million of New Jersey written premium, of which it ceded $1 million by its quota share treaty.
- Company Z writes directly $3 million of New York written premium, and it assumes $1 million of New Jersey written premium as part of the totals shown earlier.

For Schedule P,

i. Company X cedes only $8 million to the pool, half of which is then ceded pooled business. The remaining $2 million of New Jersey premium is direct business for company X, of which $1 million is ceded.
ii. The $3 million + $1 million = $4 million of New Jersey written premium written directly or assumed by company Z is not pooled.

Illustration (Step 4): Company Y's assets have been depleted by poor investments. After pooling, company Y cedes 20% of its resulting business for surplus relief. This transaction does not affect the Schedule P entries of companies X and Z.

The components of this illustration are shown in the chart below. Figures are in millions of dollars.

Exhibit 1.5: Intercompany Pooling Agreement (Figures in Millions of Dollars)

	Affiliated Companies			
	X	Y	Z	Pooled
Direct WP, rest of country (pooled)	$8	$20	$67	
Direct WP, New Jersey (not pooled)	$2	$0	$3	
Assumed WP, rest of country (pooled)	$0	$0	$29	
Assumed WP, New Jersey (not pooled)	$0	$0	$1	
Direct + assumed pooled WP	$8	$20	$96	$124
Ceded pooled WP	$4	$0	$0	$4
Net pooled WP, before excess of loss	$4	$20	$96	$120
Pool excess of loss cession to non-affiliates				$12
Net pooled WP, after excess of loss				$108
Pool retrocessions to affiliates	$21.6	$54.0	$32.4	
Post-pooling cessions to non-affiliates	$0	$10.8	$0	
WP affecting Schedule P	$21.6	$43.2	$32.4	

POOLING RESTATEMENTS

The Annual Statement *Instructions* say, "The pooling percentage is to reflect the company's participation in the pool as of year-end." If an insurance group modifies the pooling arrangement, there may be an apparent change in the incurred or paid loss development because of the intercompany agreement, not because of changes in claims handling or reserving procedures. Therefore, "any retroactive change in pooling participation will require appropriate restatement of Schedule P."

Illustration: A member company of an insurance group receives 40% of the pooled business in 20XX. In 20XX+1, its pooling participation percentage changes to 70%. Leaving the original 40% participation for 20XX may distort the loss development patterns: its loss payments and reserves were 40% of the group total in 20XX, but its payments and reserves were 70% of the total in 20XX+1. Its loss triangles would show jumps in both

payments and reserves between 20XX and 20XX+1. To facilitate the use of the loss development patterns, the company restates all past figures to a 70% participation percentage.

If the pooling percentage changes, the individual company historical figures in the current Schedule P will not agree with the entries of previous years. Rather, for any accident year, the Schedule P entries divided by the pooling percentage in column 34 should reconcile with the Schedule P entries in previous years divided by the pooling percentage.[45]

The need for loss triangles to forecast accurately future development argues for even more comprehensive restatements of past experience.

Illustration: An insurer incorporates a new subsidiary in 20XX and gives it 40% of its total business. Premiums and losses for this subsidiary were zero before 20XX, as the company did not yet exist. But if the parent company gets 100% of the business before 20XX, but only 60% in 20XX and subsequent years, its loss development triangles will be distorted. According to Richard Roth, the subsidiary should be given 40% of the business for all years, even when it did not exist, and the parent company should be given 60% of the business for all years.

Treaty commutations affect both the reported and the paid loss development patterns. The same logic would dictate that both the ceding and assuming carriers restate their experience after a treaty commutation. Carriers commute individual claims in addition to whole treaties, such as lifetime pension claims in workers' compensation, long term disability claims in accident and health insurance, and structured settlements in other liability. The analyst completing *Schedule P* is not always aware of these commutations, and restating past history is an onerous task.

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[45] The text follows Richard Roth's explanations. Mr. Roth designed the current Schedule P, and he was chairman of the NAIC Casualty Actuarial (Technical) Task Force, so his interpretation was determinative, at least until his retirement in 2001. The Annual Statement *Instructions* themselves are ambiguous.

- The *Instructions* say that any *retroactive* change in pooling participation will require appropriate restatement of Schedule P (emphasis added). According to Mr. Roth, *any* change in pooling participation requires restatement of Schedule P.
- Schedule P provides separate column 34 entries (intercompany pooling participation percentage) for each accident year. According to Mr. Roth, the percentage for each accident year should be the current participation percentage.
- If the pooling percentages change on a calendar year basis or a policy year basis (and include the development from past accident years), the accident year loss development patterns would be distorted. If the pooling percentages change on an accident year basis, the accident year loss development patterns would not necessarily be distorted.

In theory, when a commutation affects the loss development patterns, the effects should at least be disclosed in Question 7 of the *Schedule P* Interrogatories. In practice, a company may note that commutations have occurred, but it would rarely try to quantify the effects.

Similar problems exist for primary companies when their reinsurers become insolvent. Loss reserves are shown net of reinsurance recoverables in the Schedule P historical triangles. If a reinsurer becomes insolvent, the ceded reserve drops to $0 and the net reserve increases. Even if the primary company had been aware of the potential insolvency, the loss reserves are net of the recoverable, and the provision for reinsurance separately adjusts the company's surplus for the expected uncollectible amounts (see Feldblum [2002: SchF]. When reinsurance recoverables are written off, disclosure in Schedule P Interrogatory Number 7 is appropriate.

Occurrence and Claims-Made Business

In 1993, the old claims-made business exhibit was removed from Schedule P, three lines of business were segmented into occurrence and claims-made portions, and the disclosure of extended loss and expense reserves was put into a Schedule P interrogatory.
Occurrence policies provide coverage for accidents that occur during the policy period, regardless of when the claims are reported. Claims-made policies provide coverage for accidents that are reported during the policy period. Most claims-made policies limit coverage to accidents that occur subsequent to the "retroactive date," or the date that claims-made coverage was first issued to the policyholder. Claims-made coverage is used primarily for medical malpractice insurance, certain other professional liability insurance, and some products liability insurance.[46]

Tail Coverage

The coverage restrictions on claims-made policy forms can inhibit movement from one insurance company to another.

[46] Statutory accounting principles for claims-made policies is covered in SSAP Number 65, "Property and Casualty Contracts," paragraphs 4 through 9.

Illustration: A physician is covered during 20XX under a claims-made policy with one insurer. On January 1, 20XX+1, the physician switches to a claims-made policy with a second insurer. The new claims-made policy has a retroactive date of 1/1/XX+1.

The first insurer will not indemnify claims that are reported after the switch to the second insurer on 1/1/XX+1. The second insurer will not indemnify claims that occurred while the physician was covered by the first insurer since they occurred before the retroactive date.

To cover claims that occur during the claims-made period with the first insurer but are reported subsequent to its termination, the physician purchases tail coverage from the first insurer. The tail coverage covers claims that occur during the claims-made period but are reported after its termination.

Extended Tail Coverage

Tail coverage is also used if the physician leaves his or her practice and longer needs full insurance coverage.

> *Illustration:* A physician leaves private practice to join an HMO. The HMO has medical malpractice coverage for its staff, and the physician no longer needs an individual policy. The physician may still need a tail policy to cover accidents that occurred before the physician joined the HMO.

If a physician stops practicing because of retirement, disability, or death, he or she (or the estate) still needs tail coverage for late reported claims. Medical malpractice coverage is expensive, and its importance may not be appreciated when the physician stops working.

To avoid burdening the retired or disabled physician (or the estate) with the heavy costs of tail coverage, some insurers spread this cost over the term of the claims-made coverage and provide free tail coverage in the event of retirement, disability, or death.

> *Illustration:* The cost of annual claims-made coverage for a certain physician is $10,000. The insurer may charge $12,000, and use the extra $2,000 a year to build up a reserve for free tail coverage in the event of retirement, disability, or death. This is not a loss reserve, since the insurance company does not yet have any liability for claims. It is not shown in the Schedule P exhibits. It is akin to life insurance policy reserves, or to an active life reserve in disability insurance.[47] It is shown on the insurer's balance sheet as a write-in

[47] See SSAP #65, "Property and Casualty Contracts," paragraph 8: "Some claims made policies provide extended reporting coverage at no additional charge in the event of death, disability, or retirement of a natural person insured. In such instance, a policy reserve is required to assure that premiums are not earned prematurely. The amount of the reserve should be adequate to pay for all future claims arising from these

line on page 3, but there is no exhibit in the property-casualty Annual Statement that discloses it. Instead, the extended loss and expense reserves by accident year and by line of business (for medical malpractice, other liability, and products liability) are shown in the first Schedule P interrogatory.

RBC Underwriting Risk Charges

The separate occurrence and claims-made exhibits for medical malpractice, other liability, and products liability stem from the risk-based capital underwriting risk charges. The paragraphs below provide a brief summary; see Feldblum [1996: RBC] for further explanation.

The reserving risk and written premium risk charges in the risk-based capital formula are determined from Schedule P information. Reserving risk is the risk that unanticipated events may increase the company's obligations for past claims above the amounts expected at the statement date.

Illustration: A company has $100 million of medical malpractice loss reserves. In a "worst case" adverse scenario, as defined by the NAIC's risk-based capital formula, the reserves may develop adversely by 56.5% to $156.5 million. The present value of medical malpractice loss reserves is 80.8% of the undiscounted value in the RBC formula. The company needs $156.5 million × 80.8% = $126.5 million of assets to guard against unanticipated adverse development.

The adverse loss development may result from two causes: (a) the emergence of late reported claims, or pure IBNR loss emergence, and (b) increases in the loss estimates for reported claims, or development on known claims. Claims-made business has no pure IBNR loss emergence. Some companies argued that claims-made business should show less adverse loss development, and it needs a smaller reserving risk charge.

To quantify the difference in adverse loss development between occurrence and claims-made business, the NAIC segmented the Schedule P exhibits for three lines of business into occurrence and claims-made portions in 1993. These three lines – medical malpractice, other liability, and products liability – include almost all the claims-made business written in the property-casualty insurance industry.

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coverage features, after recognition of future premiums to be paid by current insureds for these benefits. The reserve, entitled 'extended reporting endorsement policy reserve' shall be classified as a component part of the unearned premium reserve considered to run more than one year from the date of the policy." Before this rule became effective (in 2001), the extended loss and expense reserves could be placed in either the loss reserves or the unearned premium reserves, at the option of the company.

Post Codification Tail Coverage Accounting

Tail coverage converts claims-made coverage into occurrence coverage. Like occurrence policies, it covers losses which occur during a certain period, regardless of when they are reported. Tail coverage is appended to claims-made policies, but it is included with the Schedule P occurrence exhibits, not the claims-made exhibits.

Post-codification statutory accounting for tail coverage on claims-made policies depends on the duration of the tail period.

If the tail has an indefinite term, the full premium is earned on the date the policy is issued and a bulk loss reserve is established for the estimated future losses. There is no unearned premium reserve, and all reserves are shown in Schedule P.

If the tail has a definite (limited) term, the premium is earned over the term of the tail coverage. An unearned premium reserve is established on the effective date of the policy, and it is amortized over the term of the coverage. Case loss reserves are established as the losses are reported. Bulk loss reserves are needed for adverse development on known case reserves, not for the emergence of IBNR claims. The only reserves shown in Schedule P are those for known cases.

Illustration: A physician with medical malpractice coverage under a claims-made policy switches from Insurer A to Insurer B on January 1, 20XX. To cover potential liability for claims occurring before January 1, 20XX, but reported on or after January 1, 20XX, the physician purchases tail coverage from Insurer A on December 31, 20XX–1 for a premium of $15,000.

If the tail policy has an unlimited duration (an "indefinite term"), the earned premium on December 31, 20XX–1 is $15,000. A bulk reserve is established on December 31, 20XX–1, for the expected future claims, which may be more or less than $15,000.[48] The bulk reserve is shown in Schedule P for accident year 20XX–1.

If the tail policy has a three year term (a "definite term"), the written premium on December 31, 20XX, is $15,000, the unearned premium reserve is $15,000, and the earned premium is $0. The unearned premium reserve is amortized over three years, either ratably over the policy term ($5,000 each year) or in proportion to the expected protection. If the insurer

[48] Since the average medical malpractice loss may be paid several years in the future, the present value of the losses may be 50% or less of the nominal value. If the discount factor is 50%, the $15,000 premium may cover $25,000 of undiscounted losses plus $2,500 of underwriting expenses and profit. A premium of $15,000 coupled with a loss reserve of $25,000 may indicate a long tail, not under-pricing.

expects the claims over the three years to be *reported* in a 7:5:3 proportion, the amortization schedule may be $7,000 in 20XX, $5,000 in 20XX+1, and $3,000 in 20XX+2.

As claims are reported, case loss reserves are established. There is no bulk reserve for IBNR claims that are expected to be reported during the three year period, since these claims are covered by the unearned premium reserve. If the insurer believes that the unearned premium reserve for the block of business is inadequate, a premium deficiency reserve is established; no bulk reserve is used.[49] Bulk reserves are needed only for adverse development on known claims.

Under post codification statutory accounting rules, tail coverage with an indefinite term is like occurrence coverage, and tail coverage with a definite term is like claims-made coverage. In theory, tail coverage with an indefinite term should be reported on the occurrence exhibits, and tail coverage with a definite term should be reported on the claims-made exhibits. Tail coverage with a three year term is like a three year claims-made policy.

The Schedule P rules stipulate that all tail coverage is reported on the occurrence exhibits. The Schedule P rules pre-date the post codification accounting principles for claims-made coverage: the Schedule P rules were made in 1993, whereas the post codification statutory accounting rules for claims-made policies were not effective until 2001.

Loss Date

The caption of Part 1, column 1 says "years in which premiums were earned and losses were incurred," and the captions in Parts 2 through 6 are similar. Part 7 uses policy year experience, so its caption is "Years in which policies were issued." There is no reference to "accident year" in the column captions, though we speak of Schedule P as an accident year schedule. The date when losses are incurred means the date the insurer incurs the obligation for the loss under the coverage provided by the contract. This date differs by type of policy:

- For occurrence policies, this is the date that the loss occurs.
- For claims-made policies, this is the date that the loss is reported to the insurer.[50]
- For tail coverage, this is the date that the policy is issued.

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[49] See SSAP #65, "Property and Casualty Contracts," paragraph 9: "When the anticipated losses, loss adjustment expenses, and maintenance costs anticipated to be reported during the extended reporting period exceed the recorded unearned premium reserve for a claims made policy, a premium deficiency reserve shall be recognized."

[50] See SSAP Number 55, "Unpaid Claims, Losses, and Loss Adjustment Expenses," paragraph 4: "For claims made type policies, the covered or insured event is the reporting to the entity of the incident that gives rise to a claim."

- For fidelity and surety, this is the date that the loss is discovered.[51]

Illustration: An accident covered by a medical malpractice policy occurs in 1993 and is reported in 1997.

- If the physician had an occurrence policy in 1993, this loss is recorded in Schedule P as an accident year 1993 loss.
- If the physician had claims-made coverage from 1993 through 1997, this loss is recorded in Schedule P as an accident year 1997 loss.
- If the physician had claims-made coverage from 1993 through 1995, and then purchased tail coverage on December 31, 1995, this loss is recorded in Schedule P as an accident year 1995 loss.

EXCESS STATUTORY RESERVES

Until the codification of statutory accounting in 2001, excess of statutory over statement reserves were determined in Schedule P for certain long-tailed lines of business whose reported experience in the most recent accident years seemed overly optimistic. The statutory reserves did not affect statutory income, taxable income, GAAP income, or GAAP equity.

The excess of statutory over statement reserves, known as the "Schedule P penalty," was eliminated in 2001. The formula used to calculate the excess of statutory over statement reserves was not considered to be an accurate predictor of loss reserve adequacy. Continued use of this formula contravened the recognition principle of post-codification statutory accounting, which stipulates that liabilities be recognized when they are incurred.

Instead, the adequacy of Schedule P reserves is monitored as follows.

i. The Statement of Actuarial Opinion requires a qualified actuary to opine on the reasonableness of the company's reserves. The report of the Appointed Actuary must reconcile the opinion with the entries in Schedule P, Part 1.

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[51] A fidelity policy covers a firm for losses resulting from embezzlement by its employees. Common fidelity loss scenarios involve (i) company officers with check writing privileges, such as claims adjustors and procurement officers, who might embezzle funds by writing checks to friends or relatives or (ii) members of accounting or investment departments who might divert funds to their own accounts. The embezzlement may continue for many years before the employer becomes aware of it; much embezzlement is never discovered. If the occurrence of the theft were the date of accident, it would be time-consuming and perhaps impossible to ascertain whether the accidents were covered by a given policy. If the date of report were the date of accident, firms may delay reporting the embezzlement until they had purchased or upgraded their fidelity insurance coverage. Instead, the date of accident is the date of discovery, or the date that the embezzlement is assumed to have been discovered.

ii. The reserve adequacy tests performed with the historical loss triangles in Schedule P, Parts 2, 3, 4, and 5 provide actuarial tests of reserve adequacy.
iii. Periodic financial examinations by the state insurance departments using more extensive data provide additional tests of reserve adequacy.

The actuarial tests of reserve adequacy obviated the need for rote statutory formulas.

STRUCTURED SETTLEMENTS

Retroactive reinsurance does not affect the Schedule P entries, since it may be misused to implicitly discount reserves and circumvent statutory accounting reserving philosophy. Structured settlements are similar to retroactive reinsurance. However, structured settlements are used primarily for the benefit of claimants, not to implicitly discount the statutory reserves.

Regulatory authorities and courts often encourage the use of structured settlements. Casualty insurance contracts indemnify policyholders for their liability under tort compensation systems. The policyholder may be liable for negligent operation of a motor vehicle or for negligent manufacture of a harmful product.

Most casualty insurance damages are paid in lump sums. Damages received as compensation for accidents are exempt from federal income taxation, by specific exemption in the Internal Revenue Code. The subsequent investment income on the compensation received is subject to taxation just like any other investment income.

If the lump sum award is used by the claimant to purchase a life annuity, a percentage of each life annuity payment is subject to federal income taxation. The percentage depends on the annuitant's life expectancy and the type of annuity.

> *Illustration:* A life annuity with benefits of $80,000 a year is purchased for a premium of $1,000,000. The annuitant has a life expectancy of 20 years. The expected nominal benefits are $1,600,000 in total, and the premium is 5/8 of this amount. For each benefit payment, 3/8 is subject to federal income taxation and 5/8 is exempt from taxation.

Governments and courts are concerned that lump sum awards may not always be in the best interests of accident victims, particularly if the victim is not competent to manage the funds wisely. In a structured settlement, the insurance company pays the damages as an annuity, either a life annuity or as a combination of a life annuity, an annuity certain, or lump sum payments.

If a structured settlement is properly constructed, *all* the benefits are exempt from federal income taxation. A properly constructed structured settlement has significant tax advantages over a lump sum payment.

Illustration: A young child is permanently disabled by a negligently constructed toy. To avoid potential mismanagement of a lump sum award by the victim or by the victim's guardians, the court awards damages of $5,000 a month ($60,000 a year) for the child's lifetime. The estimated total benefits are $3,000,000, given the child's age, sex, physical condition, and expected life. To fund the award, the casualty insurance company purchases a $5,000 per month life annuity from a life insurance company for $1,000,000. The casualty insurance company owns the life annuity, with the child as the measuring life.

Statutory Accounting for Structured Settlements

The statutory accounting for the structured settlement depends on the terms of the life annuity.

Scenario A: The casualty insurance company designates itself as the payee of the life annuity, and it assigns the payments to the child. The casualty insurance company retains its liability to the child if the life insurance company that issues the annuity fails to pay benefits.

A loss reserve of $3,000,000 is reported in Schedule P, and the $1,000,000 life annuity is a fixed-income financial asset shown on the balance sheet. As the benefits are paid, the Schedule P reserves are reduced by the nominal payments, and the reported value of the life annuity is amortized in accordance with its remaining value.[52]

Illustration: A structured settlement is effected on December 31, 20XX. The accounting entries for 20XX and 20XX+1 are as follows. This illustration assumes that the value of the life annuity decreases by $20,000 during the first year, since the annuitant has a shorter remaining life expectancy.

December 31, 20XX:

		Debit	Credit
Balance sheet:	Case loss reserve:		$3,000,000
Income statement:	Incurred loss:	$3,000,000	
Balance sheet:	Cash paid:		$1,000,000
Balance sheet:	Life annuity:	$1,000,000	

The case reserve on the balance sheet (a credit) balances the incurred loss on the income statement (a debit). The reduction in the cash asset on the balance sheet (a credit) balances the life annuity on the balance sheet (a debit).

[52] The value of the life annuity at each subsequent date is based on the illustrative policy values.

December 31, 20XX+1:

		Debit	Credit
Balance sheet:	Loss reserve decrease:	$60,000	
(Cash flow statement:	Paid loss:	$60,000)	
Balance sheet:	Cash paid:		$60,000
Balance sheet:	Cash received from annuity:	$60,000	
Balance sheet:	Life annuity reduction:		$20,000
Income statement:	Miscellaneous income:		$40,000

The reduction in the loss reserve on the balance sheet, a debit, balances the reduction in value of the life annuity and the miscellaneous income, which are credits. The cash received from the annuity balances the cash paid to the claimant. The paid loss is neither a debit nor a credit. It is a cash flow statement entry, not a balance sheet or income statement entry.

Scenario B: The claimant is the payee of the annuity, as well as the measuring life. The cost of the annuity is coded as a paid loss, and the original loss reserve is eliminated. The casualty insurance company has completed its obligations to the claimant by purchasing the annuity. The life insurance company that issued the annuity has the obligation to ensure timely and continued payments. The following are the accounting entries for the same structured settlement if the claimant is the payee.

December 31, 20XX:

		Debit	Credit
Incurral of loss:			
Balance sheet:	Case loss reserve:		$3,000,000
Income statement:	Incurred loss:	$3,000,000	
Structured settlement and purchase of annuity:			
Balance sheet:	Cash paid:		$1,000,000
(Cash flow statement:	Paid loss:	$1,000,000)	
Income statement:	Incurred loss:	–$2,000,000	
Balance sheet:	Case loss reserve:		–$3,000,000
Net of the two transactions:			
Balance sheet:	Case loss reserve:		$0
Income statement:	Incurred loss:	$1,000,000	
Balance sheet:	Cash paid:		$1,000,000

Subsequent payments from the life insurance company to the claimant do not affect the balance sheet or the income statement of the property-casualty insurance company.

A structured settlement with the claimant as the payee causes a sharp decline in the ultimate incurred loss and an increase in the paid loss on the date of settlement or purchase. This

affects the observed development patterns in Schedule P, Parts 2, 3, and 4. Structured settlements should be noted in Schedule P, Interrogatory 7.

COMMUTATIONS

Commutations are the reverse of retroactive reinsurance. They have the opposite effect on Schedule P observed loss development as structured settlements have.

In a commutation, the primary insurance company "buys back" a reserve that had been ceded to a reinsurance company. The reserve is generally for long term disability benefits or for workers' compensation indemnity losses. The primary company and the reinsurer may agree that the primary company can more efficiently handle the periodic loss payments to the claimant.

> *Illustration:* One of the claims ceded under a workers' compensation excess of loss reinsurance treaty is a lifetime pension claim with $1,000 weekly benefit payments. Ten years after the inception of the underwriting year, this is the only claim still outstanding.

The remaining life expectancy of the injured worker is 20 years, and the undiscounted loss reserve is $1,040,000. The primary company commutes the claim by *accepting* a payment of $400,000 from the reinsurer and relieving it of its liability. (The primary company buys the reserve by accepting cash; the reinsurer sells the reserve by paying cash. The reserve is a liability, the opposite of an asset.)

The primary company shows the following accounting entries on the date of the commutation:

		Debit	Credit
Commutation of reserve:			
Balance sheet:	Case loss reserve:		$1,040,000
Income statement:	Incurred loss:	$640,000	
Balance sheet:	Cash received:	$400,000	

There is an increase in the reported losses on the date of commutation, which distorts the Schedule P loss development pattern. Structured settlements should be disclosed in Schedule P, Interrogatory 7. In practice, a workers' compensation insurer which effects numerous commutations each year may not consider them sufficiently material for disclosure.

Auxiliary Exhibits

SCHEDULE P TRIANGLES

Schedule P provides several historical triangles for each line of business: three loss triangles, three claim count triangles, and two premium triangles.

- Part 2 shows net incurred losses and defense and cost containment (DCC) expenses.
- Part 3 shows net paid losses and DCC expenses.
- Part 4 shows net bulk and IBNR reserves for losses and DCC expenses.
- Part 5 shows direct and assumed claims closed with loss payment (section 1), claims outstanding (section 2), and claims reported (section 3).
- Part 6 shows earned premiums by exposure year in two formats: direct and assumed (section 1) and ceded (section 2).

Schedule P, Part 7 shows triangles of policy year premiums and losses and of reinsurance commissions. These triangles show transactions on loss sensitive business only. They are designed for the risk-based capital submission, not for monitoring reserve adequacy.

Derived Triangles

Other loss exhibits can be formed from these data. The incurred losses in Part 2 are the sum of paid losses, case reserves, and bulk reserves. A triangle of reported losses (also termed case incurred losses, or paid losses plus case reserves) can be formed as the Part 2 triangle minus the Part 4 triangle. A triangle of outstanding case reserves can be formed as the Part 2 triangle minus the Part 4 triangle minus the Part 3 triangle.

The other commonly used triangles for loss reserve adequacy monitoring are the following:

- Net exposure year earned premium formed as the Part 6 direct plus assumed exposure year earned premium minus the Part 6 ceded exposure year earned premium.
- Total direct plus assumed claims closed (both with payment and without payment) formed as Part 5 direct plus assumed reported claims minus Part 5 direct plus assumed outstanding claims.
- Net loss ratios formed in one of two fashions: (a) Part 2 net incurred losses divided by Part 1 net earned premium, or (b) Part 2 net incurred losses divided by net exposure year earned premium from Part 6. The net exposure year earned premium is the difference between the direct plus assumed premium and the ceded premium.

Average severity triangles are also frequently used in loss reserve adequacy testing:

Exhibit 3.3: Completing the 20X9 Part 3X "Prior" Line

	20X0	20X1	20X2	20X3	20X4	20X5	20X6	20X7	20X8
Prior	0	180	280	355	405	440	490	515	535

The 20X9 payment is the amount in Part 1X, columns 4 – 5 + 6 – 7 (= columns 11 – 8 + 9). For the prior row, this is $23,000 – $2,000 + $0, or $21,000. This figure is added to the cumulative payments through 20X8 in Part 3X to give the cumulative payments through 20X9, or $535,000 + $21,000 = $556,000.

Loss Reserve Adequacy Testing – Prospective Valuation

The primary purpose of Schedule P is to provide the data for prospective tests of loss reserve adequacy. The historical exhibits in Parts 2, 3, 4, 5, and 6 are designed to facilitate these tests. This paper describes the types of tests that may be applied, and it provides illustrations of the major ones.

Schedule P is used by state regulators, tax examiners, rating agencies, financial analysts, and other analysts. This paper provides a complete explanation of the actuarial reserving methods, their strengths, and their potential pitfalls.

Fundamental Principle of Reserve Estimation

The fundamental principle of actuarial loss reserve estimation techniques is that there are stable patterns of loss reporting or loss settlement, and that the observed historical experience is a valid predictor of future expected experience. These patterns may relate to dollar amounts of losses, number of claims, or to ratios of losses to claims, losses to other losses, or losses to premiums. For instance, a chain ladder paid loss development method assumes that the ratio of the paid losses at one evaluation date to the paid losses at the previous evaluation date is relatively stable from accident year to accident year. Observed ratios from past accident years are a valid predictor of expected ratios in future accident years.

The insurance environment is always changing, and company claims practices change as well. The actuarial reserving techniques described here are designed not only to apply the observed historical patterns to future periods but also to modify these patterns in accordance with known or anticipated changes in the insurance environment and company claims practices.

Homogeneity and Stability

Actuarial reserving methods rely on certain assumptions which are not perfectly fulfilled by the Schedule P data:

The stability of the patterns assumed in loss reserve projections varies with the homogeneity of the data. Claims of the same type (homogeneous data), such as indemnity benefits on workers' compensation lower back sprains, show more stable patterns. A mix of claims of varied types, such as all workers' compensation claims, may show less stable patterns.

Heterogeneous data are most problematic when the mix of claim types changes. The private passenger automobile liability exhibits in Schedule P include jurisdictions with both tort liability compensation systems and no-fault compensation systems. When a state changes its compensation system, or when the company changes its mix of business by state, the stability of the reserving patterns is impaired.

Similarly, the workers' compensation exhibits in Schedule P include numerous types of policies, such as first dollar coverage, retrospectively rated policies, and large dollar deductible policies, as well as numerous types of benefits and claims, ranging from physicians' fees for non-disabling injuries to lifetime indemnity payments for permanent total disabilities. When the types of policies issued or the types of benefits change, the stability of the reserving patterns is impaired.

The Schedule P exhibits are a compromise between a simple, unrefined view of the company's total reserves and a refined analysis by homogeneous loss groupings. The analyst working with Schedule P should understand the uses to which the data can be put and the limitations on the reserve indications that are produced.

Reserve estimation requires a good understanding of the external financial environment and of the company's claims handling practices. Changes in claim settlement rates, case reserve adequacy, or inflation must be incorporated into the reserve indications.

Several methods of testing for changes in the company's claims handling practices can be used to make the reserve indications more accurate. Schedule P provides the data needed for some of these tests. Actuaries and regulators should understand the types of tests commonly used and the adjustments needed to improve the reserve indications.

Schedule P, Part 3 is particularly useful for external evaluations of loss reserve adequacy, since it is not dependent upon company reserving policies. It is not affected by changes in the company's case reserve adequacy, about which regulators and outside analysts may have

little information.[54] It is most effective for lines of business where there are substantial loss payments in the first year or two and claim settlement rates are stable; examples are personal automobile liability and workers' compensation. It is less useful for lines with long lags in claims reporting and settlement, where the proportion of loss payments is small in the first year or two, and where claim settlement rates fluctuate widely; examples are products liability and non-proportional reinsurance.

Loss Reserving Techniques

Loss reserving techniques can be classified along several dimensions:

1. Estimates of dollars of loss vs separate estimates of claim frequency and claim severity;
2. Paid amounts vs reported amounts; the amount may be either dollars of loss or the number of claims;
3. Chain ladder techniques vs expected loss techniques; the techniques may be applied to both paid amounts and reported amounts and to both dollars of loss and the number of claims; and
4. Estimation along rows (development techniques) vs estimation down columns (trend techniques).

Some reserving methods use combinations of these techniques.

1. The Brosius least squares approach uses a credibility weighted combination of a chain ladder estimate and an expected loss estimate.
2. Some reserving methods estimate claim counts by development techniques and average claim severity by trend techniques.

We explain the reserving techniques that can be done with Schedule P data, so that regulators and other analysts can make optimal use of the information provided. The exposition in this paper does not assume a prior knowledge of the actuarial methods described here, though practical reserving experience is helpful for making efficient use of these techniques.

We begin with a paid loss development using dollars of loss; this is probably the most common method of evaluating the reserve adequacy of other companies when the available information is limited to Schedule P data. The intuition for this reserving technique is that the pattern of payments is stable from accident year to accident year. For instance, if the ultimate

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[54] Changes in the company's case reserve adequacy can be estimated from a combined analysis of Parts 2, 3, 4, and 5 of Schedule P, as discussed below in the text. These are estimates gleaned from reported data; they are not as valuable as discussions with claims department personnel that internal actuaries use. For a checklist of the types of information relevant to the reserving actuary, see the appendix to Berquist and Sherman, [1977].

paid losses for an accident year are 250% of the losses paid through the first 12 months in the past, we assume the ratio of 250% holds true for future accident years as well.

ACTUARIAL RESERVING PRINCIPLES

The following principles underlie actuarial reserving methods:[55]

1. *Use of all available data:* We could base the loss development factors on mature years for which we know the ultimate loss payments. This was a common technique in the first half of the twentieth century, and it is still used for short-tailed health insurance reserves (see the calculation of claim completion ratios in Bluhm [2000], chapter 30). For long-tailed lines of business, mature years are old years, and the ratio of ultimate losses to losses paid within the first 12 months may have changed in the intervening time. By using only mature years, we ignore the most recent data, which generally provides the most relevant information.

   For the chain ladder development procedures, we use link ratios, or age-to-age factors. The link ratios compare figures at adjacent development ages, such as 12 months and 24 months, or 24 months and 36 months. The 12 to 24 month paid loss link ratio is the cumulative accident year paid losses evaluated at 24 months of development divided by the cumulative paid losses at 12 months of development for the same accident year. The loss development factor from a given valuation date to ultimate is the cumulative product of the link ratios from that date to ultimate. The development factor from 12 months to ultimate is the cumulative product of the link ratios from 12 months to 24 months, from 24 months to 36 months, from 36 months to 48 months, and so forth.

2. *Stability:* A chain ladder loss development procedure can be implemented with incremental loss payments (or loss reportings) or with cumulative loss payments (or loss reportings). In later development periods, the incremental figures are small, and the ratios of incremental figures are increasingly unstable. To provide greater stability, we use cumulative figures in all the chain ladder development procedures.

3. *Extrapolation and Smoothing:* Loss reserve indications are most important for the long-tailed commercial casualty lines of business, such as workers' compensation, general liability, products liability, medical malpractice, and excess of loss reinsurance, and particularly for lines of business with high volatility in claim reporting and settlement practices. For these lines, claim settlement patterns extend well beyond ten years, which is the limit of the Schedule P loss triangles.

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[55] See Feldblum [2002: SB] for a more complete presentation of the principles underlying actuarial reserving methods.

- Average paid loss severity formed as the Part 3 net paid losses divided by the Part 5 direct plus assumed closed claims, either in total or closed with payment only.
- Average reported claim severity formed as the net reported losses (Part 2 minus Part 4 triangles) divided by the Part 5 direct plus assumed reported claims.
- Average outstanding case reserves formed as the net outstanding case reserves (Part 2 minus Part 4 minus Part 3 triangles) divided by the Part 5 direct plus assumed outstanding claims.

LOSS ADJUSTMENT EXPENSES

Each loss triangle includes defense and cost containment expenses, but not adjusting and other expense.[53] The Underwriting and Investment Exhibit does not differentiate between these two types of loss adjustment expenses. Rather, the combined unpaid loss adjustment expenses are shown by line of business in the Underwriting and Investment Exhibit, Part 3A, page 11, column 9. The division between unpaid DCC and unpaid AAO loss adjustment expenses by line of business can also be found in the Insurance Expense Exhibit, columns 15 and 17, in both Part 2 (net business) and Part 3 (gross business).

Before 1998 the NAIC differentiated between allocated loss adjustment expenses (ALAE) and unallocated loss adjustment expenses (ULAE). In general, ALAE became DCC and ULAE became AAO. For some companies, the differences can be material.

The adoption of the new expense classification in 1998 could be by calendar year or by accident year, at the company's option.

- If calendar year adoption is used, the historical triangles contain allocated loss adjustment expenses for the pre-1998 calendar year columns and defense and cost containment expenses for the 1998 and subsequent calendar year columns.
- If accident year adoption is used, the historical triangles contain allocated loss adjustment expenses for the pre-1998 accident year rows and defense and cost containment expenses for the 1998 and subsequent accident year rows.

There is no simple way to obtain completely homogeneous loss triangles.

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[53] Before 1989, the *Schedule P* historical triangles included all loss adjustment expenses. This format was criticized on the grounds that the statutory distribution of unallocated loss adjustment expenses (now adjusting and other expenses) to accident year is arbitrary and lessens the usefulness of the historical loss triangles; see Otteson [1967].

Net vs Direct Experience

The historical loss triangles show net experience. Historical triangles of direct plus assumed business can be formed by combining Annual Statements of successive years, using figures from Schedule P, Part 1.

> *Illustration:* In March 20XX+1 one can compile historical development exhibits of direct plus assumed business from the 20XX and preceding years' Schedule P's, using direct plus assumed columns from Part 1.

The claim count triangles in Part 5, as well as the claim count columns in Part 3, show direct plus assumed experience. Net claim counts are not shown in Schedule P. The Part 5 claim count triangles are shown only for eight lines of business. These are the nine lines for which claim counts are shown in Schedule P, Part 1 minus auto physical damage, which has only a two year exhibit.

The exposure year earned premium triangles in Part 6 show direct plus assumed experience and ceded experience separately. Net experience is the difference between these triangles. For the rationale of showing separate direct plus assumed triangles and ceded triangles instead of net triangles, see the discussion of the Part 6 triangles below.

Several other items are shown in the Schedule P auxiliary exhibits. Part 2 shows one and two year loss developments in columns 11 and 12. Part 3 shows the number of claims closed, with and without loss payments, for nine lines of business, in columns 11 and 12.

The paid loss triangles in Part 3 are easier to compile than the loss triangles in Part 2. They are also less affected by changes in company claims department practices (such as changes in case reserve adequacy), and they are more likely to contain accurate figures. They are commonly used by actuaries to analyze reserve adequacy of peer companies and by regulators to analyze reserve adequacy of domestic companies. We begin the discussion with Part 3.

Part 3 – Paid Losses

Part 3 shows cumulative paid losses and DCC expenses by accident year and development date. The same accident years are shown as in Part 1: ten years for the long-tailed (liability and assumed non-proportional reinsurance) lines of business, and two years for the short-tailed property lines. Ten years of data must be gathered for all lines of business, since they are all included in the ten year Part 3 Summary exhibit; see the discussion of Part 1 above.

The paid loss figures for the current year's Part 3 exhibits can be derived from the Part 3 exhibits of the prior year's Schedule P and Part 1 of the current year's Schedule P.

- Historical data for individual accident years — that is, all figures except those in the first row (prior years) and the right-most column (the current valuation) — are unchanged from those in the previous year's Part 3 exhibit.
- The figures in the right-most column of the Part 3 exhibits are the current valuation. These entries should equal columns 4 – 5 + 6 – 7 (net paid losses plus net paid DCC expenses) in Part 1. This computation is equal to columns 11 – (8 – 9), or total paid loss and loss adjustment expenses minus paid AAO expenses.

The prior years row must be handled separately, as explained below.

THE "PRIOR" YEARS ROW

The Part 3 "prior years" entries can be obtained from the previous year's Annual Statement, after a suitable modification of the figures. The cell in the upper left hand corner of Schedule P, Part 3, which is the first calendar year column for the prior years row, always contains a zero entry. Some printed versions of the Annual Statement place "XXX" in this cell.

Illustration: In the 2010 Annual Statement, the 2001 accident year row begins with loss payments in calendar year 2001. The prior years row, which includes accident years 2000 and prior, begins with loss payments in calendar year *2002*. The rationale for this format is that the prior years row shows the development on the year-end (December 31) 2001 reserve. This development begins with payments in calendar year 2002.

When computing the entries for the prior years row for the 20XX Annual Statement based on the entries in the 20XX–1 Annual Statement, one must take into account the different accident years included in the prior years row and the different starting date for the cumulative loss payments.

The 20XX Schedule P, Part 3, prior years line shows the cumulative loss and DCC payments in calendar years 20XX–8 and subsequent for accident years 20XX–10 and prior. The 20XX–1 Schedule P, Part 3, prior years line shows the cumulative loss and DCC payments in calendar years 20XX–9 and subsequent for accident years 20XX–11 and prior. In the 20XX–1 Schedule P, the 20XX–10 accident year row shows the cumulative payments for that accident year starting in 20XX–10. We explain the calculations by means of an illustration.

Illustration: Completing the Prior Years Row

To complete the prior years row in the 20X9 Schedule P, we follow the steps outlined below.

- We take the prior years row and the 20X8–10 row from the 20X8 Schedule P, subtract from each figure in these two rows the cumulative paid losses and DCC through 20X0, and add the two rows.
- We discard the cumulative paid losses and DCC through 20X0–1 (which is now negative), keep the next entry (a zero) as the first figure in the new prior line, and enter the remaining figures in the rest of the row.
- For the last figure in the row, we add the calendar year 20X9 paid losses and DCC for accident years prior to 20X0 to the last cumulative total. The calendar year 20X9 paid losses and DCC for accident years prior to 20X0 are shown in the 20X9 Schedule P, Part 1, column 11 minus column 9 plus column 8, prior row.

Illustration: The 20X8 Schedule P, Part 3X contains the entries shown in Exhibit 3.1. Figures are in thousands of dollars.

Exhibit 3.1: 20X8 Schedule P, Part 3X, First Two Rows

	X0–1	20X0	20X1	20X2	20X3	20X4	20X5	20X6	20X7	20X8
Prior	0	220	350	400	425	450	460	470	475	480
X0–1	375	600	650	700	750	775	800	840	860	875

In the 20X9 Part 1X exhibit for this line of business, the prior years row shows $23 thousand in column 11 ("Total net paid"), $2 thousand in column 8 ("Adjusting and other payments, direct and assumed"), and $0 in column 9 ("Adjusting and other payments, ceded").

To complete the 20X9 Part 3X exhibit, the cumulative payments through 20X0 are subtracted from the first two rows in the 20X8 Part 3X exhibit. In the example, $220 thousand is subtracted from the 20X8 prior row and $600 thousand is subtracted from the second row (accident year 20X0–1) giving the following entries (Exhibit 3.2):

Exhibit 3.2: Adjustments to the 20X8 Part 3X "Prior" Line

	X0–1	20X0	20X1	20X2	20X3	20X4	20X5	20X6	20X7	20X8
Prior	–220	0	130	120	205	230	240	250	255	260
X0–1	–225	0	50	100	150	175	200	240	260	275

The two rows are summed, and the (calendar year) 20X0–1 column is dropped, as shown in Exhibit 7:

Actuarial Averages

We determine averages of the most recent three and the most recent five link ratios, and we select prospective factors from the historical figures and expectations about future conditions. In this illustration, the selected link ratios lie between the three and five year averages.

The method of taking averages differs among reserving actuaries. The following methods are the most common:

1. Straight averages (equal weighted averages).
2. Straight averages after eliminating the high and low values (an "ex-high-low" average).
3. Weighted averages, where the weights are the paid losses in the earlier of the two valuations. This is equivalent to using the sum of the dollar amounts at the later valuation divided by the sum of the dollar amounts at the earlier valuation.
4. Weighted averages, where the weights increase from the older accident years to the more recent accident years.

There are two distinct rationales for using weighted averages.

Rationale 1: The rationale for using weighted averages where the weights are the paid losses in the earlier of the two valuations is that years with more exposure should be given greater credibility.

- When changes in volume stem from monetary inflation, the simple averages are proper.
- When the changes in volume stem from changes in exposure, the weighted averages are proper.

The former reason for changes in volume (that is, monetary inflation) is more common, so generally simple average should be used.

Rationale 2: When more recent experience is a better predictor of future expected link ratios, weighted averages should be used, where the weights increase from the older accident years to the more recent accident years. The optimal weights can be determined using statistical techniques; see Mahler [1990; 1997].

The elimination of high and low values has both advantages and drawbacks.

- An ex-high-low average may be useful when the data are sparse and random loss fluctuations lead to unreasonable expected link ratios. In addition, Schedule P data are not always "clean." Unusual link ratios may stem from incorrect coding of loss amounts, not from actual payment fluctuations.

- The elimination of high and low values leaves out important information about potential fluctuations in reserve development. The use of ex-high-low averages makes it seem like future development is more stable than it truly is.

A statistical bias may be introduced by using an ex-high-low average, and an existing bias may be corrected by an ex-high-low average. These biases are particularly important when the data are sparse or when the loss distribution is skewed.

The distribution of paid loss link ratios is skewed, since a large court award may result in an unusually high link ratio but the link ratios generally do not fall below unity.[59] An ex-high-low average eliminates the very high link ratios, but it has little effect on the low link ratios. This may create a bias in the projected link ratios, since the high observations are removed.

The preceding paragraph seems to imply that the removal of high and low link ratios may create a bias. The converse may also be true, since the chain ladder method is inherently biased, and the removal of high and low link ratios may partially offset that bias. See Stanard [1985] and Wu [1999] for discussion of the bias in the chain ladder reserving method.

[59] Recoveries from reinsurance, salvage, and subrogation sometimes cause link ratios below unity. If all figures are properly coded net of recoveries, whether from reinsurance, salvage, or subrogation, and if actual recoveries equal expected recoveries, the net paid loss link ratios should be equal to or greater than unity. If actual recoveries are greater than expected, or if the figures are not coded net of anticipated recoveries, the net net paid loss link ratios may be less than unity.

Exhibit 3.6: Paid Loss Development Test of Reserve Adequacy (dollars in thousands)

	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9–10
Averages									
3 year	2.415	1.352	1.171	1.102	1.060	1.044	1.033		
5 year	2.322	1.335	1.162	1.094	1.059				
Select	2.350	1.340	1.170	1.100	1.060	1.040	1.030	1.030	1.020
Cumulative	4.835	2.057	1.535	1.312	1.193	1.125	1.082	1.051	1.020
Pd to Date	$156	$406	$485	$546	$542	$534	$434	$403	$454
Developed	$754	$835	$746	$716	$647	$601	$470	$423	$463
Ultimate	$830	$919	$819	$788	$711	$661	$517	$466	$509
Reserve	$674	$513	$334	$242	$169	$127	$83	$63	$55

PAID LOSS DEVELOPMENT FACTORS

The *cumulative* link ratios, or paid loss development factors, are the cumulative products of the appropriate link ratios (age-to-age factors) in adjacent columns. For instance, the cumulative link ratio from seven to ten years, or 1.082, is the product of 1.030, 1.030, and 1.020, which are the link ratios from seven to eight, eight to nine, and nine to ten years.

The cumulative losses *paid to date* are taken from the last column of Exhibit 3.4: $156,000 is the cumulative accident year 20X9 paid losses at December 31, 20X9, $406,000 is the cumulative accident year 20X8 paid losses at December 31, 20X9, and so forth. The 20X9 paid losses are at one year of maturity; they are placed below the development factor for one to ten years. Similar placement is used for paid losses of other accident years. The next row in Exhibit 3.6, "developed," shows losses developed to ten years of maturity.

PAID LOSS DEVELOPMENT TAIL FACTORS

In the long-tailed (commercial casualty and reinsurance) lines of business, payments continue after ten years. The percent of losses still unpaid after ten years may be estimated in several ways. We can use (i) data reported in Schedule P itself , (ii) external factors, or (iii) curve-fitting techniques.

Schedule P Data

Schedule P data show paid losses at 10 years of maturity for the oldest accident year and the incurred losses at the same maturity in Part 2. If the bulk + IBNR reserves at ten years of development are fully adequate, the Part 2 cumulative incurred losses at ten years of development for the most mature accident year are a reasonable estimate of ultimate losses. The ratio of the paid losses to the incurred losses at that date may be used as the paid loss development tail factor from ten years to ultimate.

Not all companies set fully adequate bulk + IBNR reserves at late development dates, since the statutory margin in undiscounted reserves for late-paying claims may offset the apparent reserve inadequacy.[60] In addition, unanticipated loss development may occur even at late maturities. Examination of the one-year and two-year development in the prior years row should help the analyst determine the statutory reserve adequacy at ten years of development.

This estimate is sensitive to random loss fluctuations, since it uses one ratio to determine a development factor that affects all accident years. As an alternative, the analyst may decompose the paid loss tail factor into two parts: (i) the ratio of paid losses to reported losses at ten years of development and (ii) the ratio of reported losses to incurred losses at ten years of development. The first ratio can be determined from prospective chain ladder developments of paid losses and of reported losses. The second ratio may be estimated from the oldest accident year or the oldest two accident years shown in Schedule P.

The one- and two-year adverse loss developments for the prior years row from the Part 2 exhibits are helpful for selecting a reported loss tail factor. The one-year adverse loss development divided by the reported losses at ten years of maturity for the oldest accident year shown in Schedule P is sometimes used as an estimate of the reported loss tail factor from ten years to ultimate. A similar estimate is provided by one half of the two-year adverse loss development divided by the reported losses at ten years of maturity for the oldest accident year shown in Schedule P. This type of estimate was used by the NCCI for workers' compensation until the mid-1990's (see Feldblum [1992: WCR]).

CAVEATS

This estimate must be used with caution, since various circumstances may distort the expected patterns.

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[60] The "statutory margin" is the difference between statutory reserves and fair value reserves. For most lines of business, the this is the difference between undiscounted and discounted reserves. For workers' compensation and long term disability insurance, this is the difference between reserves valued using tabular discounts only and reserves valued using both tabular and non-tabular discounts.

For the long-tailed lines of business, the analyst develops an actuarial model that reflects the reporting or settlement pattern of the losses. One may construct the model with Schedule P data themselves, or one may adopt the results of other models. The model provides estimates of the expected loss development beyond ten years.

Analysts' views vary regarding the importance of tail effects on loss development. On the one hand, the choice of a tail factor affects all accident years, and it has a leveraged effect on the overall reserve indication. On the other hand, payments made many years in the future have a lower present value than payments made in the near future.

Most reserving methods use standard techniques for (i) tail development factors, (ii) changes in loss cost inflation, and (iii) selection rules for link ratios. We show the most common procedures in the discussion below.

Outline: Paid Loss Development

The format of a paid loss development analysis is as follows.[56] Link ratios, or the ratios of cumulative paid losses at one valuation to cumulative paid losses at the preceding valuation, are calculated for each accident year and valuation date. A prospective link ratio for each development interval is selected from the historical observations, using averages, weighted averages, trends, or other projection techniques.

No single procedure for determining prospective link ratios is appropriate for all lines and companies. One common approach is to use the average of the most recent three to five link ratios, adjusted for random outliers and known or suspected trends. Unusual results should be checked for data errors, and the final selected factors should be smoothed to form a consistent progression. The prospective link ratios show the expected development between adjoining valuation points.

Development factors from each valuation point to 10 years of maturity are the cumulative products of the adjoining link ratios. For example, the development factor from six years to ten years is the product of the link ratios from (a) six to seven years, (b) seven to eight years, (c) eight to nine years, and (d) nine to ten years.

At the current statement date, each accident year shows cumulative paid losses at a different development age. The product of these cumulative paid losses and the paid loss development factors from that development age to ultimate are the estimated ultimate losses by accident year.

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[56] Introductory treatments of paid loss development reserving procedures may be found in Salzmann [1984], Peterson [1981], pages 181–196, and Wiser [2001: FCAS].

The tail factor, or the loss development factor from the last observed development age to ultimate, is determined by statistical modeling techniques or by the adoption of external information. It is often shown separately in the worksheets, so that readers can see the method used to estimate it; see the exhibits below.

Paid loss development procedures may be distorted by changes in inflation rates. The simple method illustrated below is standard actuarial practice. It is appropriate only when inflation rates have remained steady for the entire experience period, and they are expected to remain at the same level in the immediate future.

A better procedure – now commonly used in the actuarial community – is to remove the effects of inflation from the historical loss triangles, perform the paid loss development analysis on "real dollar" amounts, and add back in expected future inflation. The expected future inflation may be either a deterministic rate or a set of stochastic interest rate paths.[57]

ILLUSTRATION: PAID LOSS DEVELOPMENT

We illustrate this procedure with simulated data for a long-tailed line of business (workers' compensation). Exhibit 3.4 shows the Part 3D entries as they would appear in the 20X9 Schedule P for accident years 20X0 through 20X9.[58]

[57] For the treatment of inflation using a deterministic procedure, see Hodes, Feldblum, and Neghaiwi [1999]; for the treatment using a stochastic procedure, see Hodes, Feldblum, and Blumsohn [1999].

[58] These data are based on actual Schedule P entries for a large commercial lines insurer that was acquired by a peer company in the mid-1990's. The figures have been disguised, and the accident years have been changed.

Exhibit 3.4: 20X9 Schedule P, Part 3D ($000)

Part 3	20X0	20X1	20X2	20X3	20X4	20X5	20X6	20X7	20X8	20X9
20X0	103	226	294	334	363	384	398	412	422	433
20X1		111	238	309	356	387	409	428	442	454
20X2			108	221	286	328	354	375	391	403
20X3				111	238	311	357	392	416	434
20X4					135	299	394	458	504	534
20X5						146	314	418	490	542
20X6							159	343	463	546
20X7								146	353	485
20X8									152	406
20X9										156

Paid Loss Link Ratios

Paid loss link ratios are the ratios of

i cumulative paid losses for a specific accident year at a given valuation date to
ii cumulative paid losses for the same accident year at a valuation date one year earlier.

For instance, the paid loss link ratio from two years to three years of development for accident year 20X6 is $463,000 divided by $343,000, or 1.350. The complete set of link ratios is shown in the table below.

Exhibit 3.5: 20X9 Schedule P, Paid Loss Link Ratios

	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 – 10
20X0	2.194	1.301	1.136	1.087	1.058	1.036	1.035	1.024	1.026
20X1	2.144	1.298	1.152	1.087	1.057	1.046	1.033	1.027	
20X2	2.046	1.294	1.147	1.079	1.059	1.043	1.031		
20X3	2.153	1.301	1.148	1.098	1.061	1.043			
20X4	2.215	1.318	1.162	1.100	1.060				
20X5	2.151	1.331	1.172	1.105					
20X6	2.157	1.350	1.179						
20X7	2.418	1.374							
20X8	2.671								

The row labels are accident years; the column captions are development intervals. The caption "2 to 3" means from two years of development to three years of development. We have rotated the triangle, turning the diagonals in Exhibit 3.4 into the columns in Exhibit 3.5.

i The second column in Exhibit 3.4 shows cumulative paid amounts on December 31, 20X1.
ii The second column in Exhibit 3.5 shows paid loss development from 1 year after the inception of the accident year to 2 years after the inception of the accident year.

Each column of Exhibit 3.5 is the ratio of two *diagonals* in Exhibit 3.4. The diagonals in Exhibit 3.4 represent development ages. The diagonals in Exhibit 3.5 represent calendar years.

Illustration: The second column in Exhibit 3.5 shows paid loss development from 1 year to 2 years, or from 12 months to 24 months. (Reserving actuaries generally speak in months of development, not years of development.) The link ratio of 2.671 for accident year 20X8 is the ratio of 406 to 152. The link ratio of 2.418 for accident year 20X7 is the ratio of 353 to 146.

No link ratio is calculated for the 20X9 accident year, since there is only one valuation. No link ratios are shown for the prior row, since the claims in this row stem from different accident years. For the prior years row, the time since inception of the accident year varies by claim.

not experienced any development past five years in the past, and it does not expect any development past five years in the future.

The illustration gives enough data to determine three historical link ratios for each development period. We use the straight average of the three observed link ratios.

The loss development factors are the backwards cumulative products of the link ratios. All link ratios past five years of development are unity, so the loss development factor from five years to ultimate is unity.

Reserve Adequacy

The indicated ultimate losses for each accident year equal the cumulative paid losses at the valuation date times the appropriate paid loss development factor to ultimate. For instance, accident year 20X9 has cumulative paid losses of $187,200 as of 12 months of development. We multiply by the loss development factor of 3.863 from 1 year to ultimate: $187,200 × 3.863 = $723,200.

For the four most recent accident years, the incurred losses shown in Part 2 are less than the indicated reserves from the paid loss development analysis. The table compares indicated ultimate losses to held ultimate losses. This is the same as comparing indicated reserves to held reserves, since the paid loss component of the two is the same. The total reserve deficiency is $270,000.

Expected Loss Reserve Estimation

Chain ladder paid loss development procedures require a credible base of paid losses in each accident year from which to estimate the future loss payments for that accident year. The chain ladder estimation procedure is less useful when most claims are not settled until several years after the occurrence date or when claim sizes are highly volatile. In these situations, the claims that have already been paid in the most recent accident years do not form a sufficiently credible base for estimation of future loss payments.

An alternative set of reserve estimation procedures relies on expected losses instead of payments made to date. The conceptual difference between chain ladder and expected loss reserving procedures is explained in the illustration below.[62]

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[62] The expected loss reserving method was first introduced by Bornhuetter and Ferguson [1972]. Textbook summaries of this method may be found in Salzmann [1974], Wiser [2001], and Peterson [1981]. The conceptual differences between chain ladder method and expected loss methods are examined in Brosius [1993] and Feldblum [2002: SB].

Illustration: The 20XX private passenger automobile earned premium is $100 million. The expected loss ratio for accident year 20XX is 80%, and 25% of the claim payments are expected to be made during the accident year.

The paid loss development factor from 12 months to ultimate is 4.000, since ¼ of the claim payments are expected during the first 12 months and ¾ are expected subsequently.

Scenario A: In January 20XX+1, the company shows $20 million of claim payments in accident year 20XX. It is estimating reserves for its 20XX Schedule P, Part 1B.

- The chain ladder paid loss development procedure indicates that ultimate 20XX losses are $20 million x 4.000 = $80 million. The indicated reserve = $80 million – $20 million = $60 million.
- The expected loss reserving method says that 75% of estimated ultimate losses will be paid after 12 months since inception of the accident year. Since the expected loss ratio is 80%, the indicated reserves are 75% x 80% x $100 million = $60 million.

Since the claim payments to date equal the expected claim payments to date, the chain ladder and expected loss reserving methods provide the same reserve indication.

Scenario B: In January 20XX+1, the company shows $25 million of claim payments in accident year 20XX. It is estimating reserves for its 20XX Schedule P, Part 1B.

- The chain ladder paid loss development procedure indicates that ultimate 20XX losses are $25 million x 4.000 = $100 million. The indicated reserve = $100 million – $25 million = $75 million.
- The expected loss reserving method says that 75% of estimated ultimate losses will be paid after 12 months since inception of the accident year. Since the expected loss ratio is 80%, the indicated reserves are 75% x 80% x $100 million = $60 million.

For the expected loss reserving method, we use the expected loss ratio when the book of business is priced, not the expected loss ratio at the reserve date.

Illustration: The expected losses after the accident year has expired are $25 million + $60 million = $85 million, and the expected loss ratio is 85%. For the expected loss reserving method, we use the original 80% expected loss ratio.

The differing reserve indications reflect different perspectives on the higher than expected claim payments in the first 12 months since inception of the accident year.

- The chain ladder method assumes that the higher claim payments in the first 12 months reflect higher expected losses in total. Just as the claim payments to date are 25% higher

than expected [25% = ($25 million – $20 million)/$20 million], the ultimate incurred losses are 25% higher than originally expected [($100 million – $80 million)/$80 million = 25%].

- The expected loss method assumes that the higher claim payments in the first 12 months reflect random loss fluctuations; they do not reflect higher total incurred losses. We continue with the original expected loss ratio to estimate future loss payments.

The proper interpretation of the higher than expected claim payments in the first 12 months depends on the type of claim.

- Workers' compensation indemnity benefits are paid weekly. Most of the payments in the first 12 months are partial payments, paid in accordance with statutory benefit schedules. Higher than expected partial payments are indicative of higher than expected incurred losses in total.
- In contrast, medical malpractice claims are relatively independent of each other. Higher than expected claim payments in the first 12 months probably reflect a few unusual settlements, not necessarily higher than expected total incurred losses.[63]

The expected loss reserving method requires an initial estimate of incurred losses for each accident year. The reserving actuary would normally use an expected loss ratio provided by the pricing actuary.

ILLUSTRATION: EXPECTED LOSS RESERVING METHOD

We develop reserve indications using the expected loss method for the workers' compensation illustration used earlier. The net workers' compensation earned premium in Schedule P, Part 1D are shown below (figures are in millions of dollars). For 20X1 through 20X5, the expected loss ratio for workers' compensation was 75%. In 20X6, marketplace competition worsened, and the expected loss ratio from 20X6 through 20X9 was 80%.

Year	Premium	Year	Premium	Year	Premium
20X1	600	20X4	850	20X7	1000
20X2	650	20X5	900	20X8	1100
20X3	700	20X6	950	20X9	1100

Data

---

[63] The chain ladder and expected loss reserving methods may be viewed as ideal cases: the chain ladder method gives full credibility to the observed experience as an estimator of the remaining loss payments, and the expected loss method gives no credibility to the observed experience as an estimator of the remaining loss payments. The Stanard-Bühlmann method and the least squares method give partial credibility to the observed experience; see below.

For lines of business with significant audits or retrospective premiums, the reserving actuary may use the net exposure year earned premium instead of the net calendar year earned premium. The net earned premium by exposure year equals Schedule P, Part 6D, section 1, column 11, minus Schedule P, Part 6D, section 2, column 11; see the discussion of Part 6 below in this paper.

The expected loss ratio by calendar year or by exposure year is not shown in the Annual Statement. The reserving actuary would use an estimate provided by the pricing actuary.

Expected Loss Factors

The expected loss factor at K months of development is the percentage of ultimate losses that will be paid between K months of development and ultimate. In the private passenger automobile illustration above, the expected loss factor at 12 months of development is 75%.

The expected loss factors may be derived from the loss development factors.

> *Illustration:* The paid loss development factor from 24 months to ultimate is 2.500. This implies that for each dollar of loss paid up through 24 months of development, an additional $1.50 will be paid after 24 months. The expected loss factor is $1.50/($1.00+$1.50) = 60%.

If LDF is the loss development factor from K months to ultimate, the expected loss factor at K months is (LDF–1)/LDF = 1 – 1/LDF.

Exhibit 3.10 shows the loss development factors, the expected loss factors, and the indicated reserves for the workers' compensation illustration earlier in this paper.

Illustration: Through most of the 1990's, insurers believed that asbestos claim activity had subsided. A surge in asbestos claims in 1999 and 2000 caused enormous adverse loss development for the prior years row for some insurers.

If the company has changed its mix of business or the type of policy forms over the ten year historical period, the estimated tail factor may not be appropriate for current conditions.

Illustration: The company may have switched its workers' compensation business from first dollar policies (or retrospectively rated policies) to large dollar deductible policies. These policy types have different expected tail factors: they are much higher for large dollar deductible policies than for first dollar policies or retrospectively rated policies.

Illustration: In the 1980's, companies switched from occurrence policies to claims-made policies in medical malpractice, and they added an absolute pollution exclusion in comprehensive general liability policies. Both these changes reduced the expected paid loss tail factor.

External Factors

The analyst may assume that the paid loss tail factor does not differ significantly by company at ten years of maturity. This may be a reasonable assumption for workers' compensation, where benefits are mandated by the state compensation system and are not tied to the policy form. The analyst may use a paid loss tail factor determined from rating bureau industry data or from another company's data. The caveats mentioned above should be considered.

Curve-Fitting

The standard actuarial technique for selecting paid loss tail factors is to fit a curve to the observed paid loss link ratios and to extend the curve past the most mature development interval. The inverse power curve is often used for this purpose; see Sherman [1984] and Hodes, Feldblum, and Blumsohn [1999].

This is the method of choice for actuarial analyses. Two caveats for this method should be considered:

- Two or more types of curves may provide a good fit to the observed data, but they may give different projections for the paid loss tail factor.
- If claims which settle quickly differ significantly from claims which remain open at ten years of maturity, the curve fitting should begin after several years of development.

Illustration: In workers' compensation, temporary total claims settle quickly, and they have little expected development at ten years of maturity. Most claims outstanding at ten years

of maturity are lifetime pension cases. The curve-fitting should begin at three or four years of maturity so as to eliminate the majority of temporary total claims.

Ultimate Losses

For the illustration in this section, we use a paid loss tail factor of 1.10 from ten years to ultimate. We can think of this as development continuing for nine more years in the following pattern:

- another two years of 1.020 link ratios
- three years of 1.010 link ratios
- four years of 0.005 link ratios

The "ultimate" losses in Exhibit 3.6 are the developed losses increased by 10 percent. These may be compared with the final incurred losses shown in Part 2, column 10. (The ultimate reported losses are shown as the sum of the "paid to date" and the "reserves" rows in Exhibit 3.6.) The ultimate paid losses total $6,221,000, and the incurred losses shown on Part 2 total $6,244,000. The Part 3 prospective test shows adequate reserves.[61]

ILLUSTRATION: PROSPECTIVE VALUATION

We show a private passenger automobile illustration that uses similar techniques. The 20X9 Schedule P, Parts 2B and 3B, show the following data (figures in thousands of dollars).

[61] In practice, reserve adequacy tests often show large discrepancies between indicated reserves and held reserves, particularly for the long-tailed lines of business. Compared to other liability, products liability, medical malpractice, and non-proportional reinsurance, though, workers' compensation reserves are more stable, since the benefits are fixed by statute, both in magnitude and in timing. The major uncertainty in indemnity benefits is the duration of disability on non-permanent cases and the mortality rates on permanent cases. For sufficiently large blocks of business, both of these have relatively compact distributions. The major uncertainty for medical benefits is the rate of inflation and the extent of utilization of medical services. Over a large enough block of business, these risks also have relatively compact distributions. Butsic [1988, p. 179] summarizes this view by saying that "Workers' Compensation reserves should have a lower risk than Other Liability reserves, even though the average payment durations are about the same, because Workers' Compensation loss reserves consist partly of fixed, more predictable, life pension benefits."

Exhibit 3.7: Extract from Part 2B - Private Passenger Automobile Liability: Incurred Losses & Defense and Cost Containment Expenses Reported at Year-End

Loss Year	'X4	'X5	20X6	20X7	20X8	20X9
20X0	–	–	477.6	477.6	477.6	477.6
20X1	–	–	490.8	500.8	490.8	490.8
20X2	–	–	460.2	460.2	460.2	460.2
20X3	–	–	476.0	470.4	470.4	470.4
20X4	–	–	591.0	609.4	603.3	603.3
20X5	–	–	579.7	627.0	691.8	650.4
20X6	–	–	738.2	775.1	784.8	783.1
20X7	–	–	–	584.0	601.1	599.4
20X8	–	–	–	–	608.0	631.4
20X9	–	–	–	–	–	624.0

Exhibit 3.8: Extract from Part 3B - Private Passenger Automobile Liability: Cumulative Paid Losses & Defense and Cost Containment Expenses at Year-End

Loss Year	'X4	'X5	20X6	20X7	20X8	20X9
20X0	–	–	477.6	477.6	477.6	477.6
20X1	–	–	490.8	490.8	490.8	490.8
20X2	–	–	460.2	460.2	460.2	460.2
20X3	–	–	428.4	470.4	470.4	470.4
20X4	–	–	472.8	548.4	603.3	603.3
20X5	–	–	376.8	501.6	588.4	650.4
20X6	–	–	206.7	465.1	627.9	728.4
20X7	–	–	–	175.2	390.7	527.4
20X8	–	–	–	–	182.4	410.4
20X9	–	–	–	–	–	187.2

Using the Schedule P data, we test the adequacy of the company's private passenger automobile liability loss and DCC reserves with a paid loss chain ladder analysis.

Link Ratios

We form paid loss link ratios for each development period. The diagonals of Schedule P have been converted into columns in the table below.

Exhibit 3.9: Private Passenger Automobile Liability: Paid Loss Link Ratios and Reserve Indications

Loss Year	1 – 2 years	2 – 3 years	3 – 4 years	4 – 5 years	5 – 6 years	6 – 7 years	7 – 8 years	8 – 9 years
20X0	–	–	–	–	–	–	1.000	1.000
20X1	–	–	–	–	–	1.000	1.000	1.000
20X2	–	–	–	–	1.000	1.000	1.000	–
20X3	–	–	–	1.098	1.000	1.000	–	–
20X4	–	–	1.160	1.100	1.000	–	–	–
20X5	–	1.331	1.173	1.105	–	–	–	–
20X6	2.250	1.350	1.160	–	–	–	–	–
20X7	2.230	1.350	–	–	–	–	–	–
20X8	2.250	–	–	–	–	–	–	–
20X9	–	–	–	–	–	–	–	–
Average	2.243	1.344	1.164	1.101	1.000	1.000	1.000	1.000
Cum LDF	3.863	1.722	1.282	1.101	1.000	1.000	1.000	1.000
Cum Paid	187.2	410.4	527.4	728.4	650.4	603.3	470.4	460.2
Indicated	723.2	706.7	676.1	801.9	650.4	603.3	470.4	460.2
Held	624.0	631.4	599.4	783.1	650.4	603.3	470.4	460.2
Adequacy	–99.2	–75.3	–76.7	–18.8	0	0	0	0

In practice, liability payment patterns extend for many years. This illustration is simplified, with no development past five years. The paid loss link ratio past five years are unity, and by the fifth year, all the cumulative paid loss figures equal the incurred loss figures. The company has

a. For accident year 20X9, $120 million of premium (30% × $400 million) has been processed so far, and $75 million of losses have been paid.
b. For accident year 20X8, $187.5 million of premium (50% × $375 million) has been processed so far, and $185 million of losses have been paid.

We do this for all ten accident years. The total processed premium is $2117.5 million. The total paid losses are $1700 million. The total premium that remains to be processed is $817.5 million. We form the equation

$2117.5 million : $1700 million :: $817.5 million : X

We solve for X, the total loss reserve, as X = $1700 × $817.5 ÷ $2117.5 = $656.3 million.

WORKERS' COMPENSATION ILLUSTRATION: STANARD-BÜHLMANN

We apply the Stanard-Bühlmann reserving method to the workers' compensation illustration. The earned premiums are not necessarily at the same adequacy level for all accident years. We used different expected loss ratios for the Bornhuetter-Ferguson expected loss method in the previous section of this paper. For the Stanard-Bühlmann application, we assume that we have no information about the adequacy level of the earned premiums, so we use the unadjusted premium figures from Schedule P, Part 1D.

Exhibit 3.13: Stanard-Bühlmann Method using Paid Losses (dollars in thousands)

Months	12	24	36	48	60	72	84	96	108
LDF to10 yrs	4.835	2.057	1.535	1.312	1.193	1.125	1.082	1.051	1.020
LDF to ultimate	5.319	2.263	1.689	1.443	1.312	1.238	1.190	1.156	1.122
Processing factor	0.188	0.442	0.592	0.693	0.762	0.808	0.840	0.865	0.891
Premium	$1100	$1100	$1000	$950	$900	$850	$700	$650	$600
Processed premium	$207	$486	$592	$658	$686	$687	$588	$562	$535
Unprocessed prem	$893	$614	$408	$292	$214	$163	$112	$88	$65
Losses paid to date	$156	$406	$485	$546	$542	$534	$434	$403	$454

We form totals from the nine accident years.

- The total processed premium is $5,001.
- The total unprocessed premium is $3,960.
- The total losses paid to date are $2,849.

We solve for the losses to be paid in the future, or the reserve:

$$\$5{,}001 : \$2{,}849 :: \$3{,}960 : Reserve$$
$$Reserve = \$2{,}849 \times \$3{,}960 / \$5{,}001 = \$2{,}256.$$

For completing Schedule P, we must allocate the reserves to accident year. We assume that the ratio of unprocessed premium to unpaid loss is constant from year to year. If the unprocessed premium for accident year "i" is UP_i, the reserve for accident year "i" is

$$Reserve_i = UP_i \times Reserve_{total} / UP_{total}$$

where UP_{total} is the total unprocessed premium and $Reserve_{total}$ is the total reserve.

Illustration: In the example above, the total unprocessed premium is $3,960,000, and the total reserve $2,256,000. The unprocessed premium for accident year 20X9 is $893,000. The indicated reserve for accident year 20X9 is $893,000 × $2,256,000 / $3,960,000 = $508,739.

LEAST SQUARES RESERVING METHOD

The least squares reserving method was developed by Dr J. Eric Brosius [1993] as a combination of the chain ladder reserving method and the expected loss reserving method. The least squares method uses linear regression to determine the optimal weighting of the chain ladder method and the expected loss method in each development period.

- The chain ladder reserving method assumes that the ultimate losses in each accident year equal the cumulative paid losses in that accident year times the loss development factor. The reserves in that accident year equal the ultimate losses minus the cumulative paid losses, or reserves = cumulative paid losses × (LDF – 1).
- The expected loss reserving method assumes that the reserves in any accident year equal the expected losses in that accident year times the expected loss factor.

Each method is reasonable in certain circumstances. For long term disability insurance, the benefits remaining to be paid to disabled policyholders is best estimated as a percentage of the benefits already paid. For casualty excess of loss reinsurance treaties, the losses to be paid in the future have little relation to the losses already paid in that accident year.

For most lines of business, some of the unpaid losses are better estimated as a function of the losses already paid and some of the unpaid losses are better estimated as a function of initial expected losses.

Let LDF_t = the loss development factor at development date "t"
XLF_t = the expected loss factor at development date "t"
$Paid_{i,t}$ = the paid losses for accident year "i" at development date "t"
XL_i = the expected losses for accident year "i"
$Unpd_{i,t}$ = the unpaid losses for accident year "i" at development date "t"

- The chain ladder reserving method says that $Unpd_{i,t} = (LDF_t - 1) \times Paid_{i,t}$.
- The expected loss reserving method says that $Unpd_{i,t} = XLF_t \times XL_i$.

The least squares reserving method uses a weighted average of these two estimates. If the weight for the chain ladder reserving method is "w," the indicated reserve is

$$Unpd_{i,t} = (1 - w) \times XLF_t \times XL_i + w \times (LDF_t - 1) \times Paid_{i,t}$$

Exhibit 3.10: Expected Loss Method using Paid Losses (dollars in millions)

Months	12	24	36	48	60	72	84	96	108
Premium	$1100	$1100	$1000	$950	$900	$850	$700	$650	$600
Expected loss ratio	80%	80%	80%	80%	80%	75%	75%	75%	75%
Expected losses	$880	$880	$800	$760	$720	$638	$525	$488	$450
LDF to10 yrs	4.835	2.057	1.535	1.312	1.193	1.125	1.082	1.051	1.020
LDF to ultimate	5.319	2.263	1.689	1.443	1.312	1.238	1.190	1.156	1.122
Expected loss factor	0.812	0.558	0.408	0.307	0.238	0.192	0.160	0.135	0.109
Loss reserve	$715	$491	$326	$233	$171	$122	$84	$66	$49

- The top row shows the months of development. The dollar figures and percentages are for the accident year at that age of development on December 31, 20X9. In the column marked "12," the LDF to ultimate is the loss development factor from 12 months to ultimate. The premium of $1,100 million is the premium for accident year 20X9, which is now at 12 months of development.

- The row labeled premium is the net earned premium in Schedule P, Part 1, column 3. If the premiums are subject to audits or retrospective adjustments, the analyst may use the exposure year net earned premiums from Schedule P, Part 6. For any exposure year, these are the cumulative direct earned premiums in Part 6, section 1 minus the cumulative ceded earned premiums in Part 6, section 2.

- The expected loss ratios are internal company estimates. The expected losses are the product of the earned premium and the expected loss ratio.

- The loss development factors to 10 years of development are taken from the chain ladder illustration above. The loss development factors to ultimate assume a tail factor of +10%: $4.836 \times 1.100 = 5.319$.

- The expected loss factor equals unity minus the reciprocal of the loss development factor: $1-1/5.319 = 0.812$.

- The loss reserve equals the expected losses times the excess loss factor: $\$880{,}000 \times 0.812 \approx \$715{,}000$.

The total reserve for these ten accident years is $2,258,000. The chain ladder paid loss development method used earlier gave a reserve indication of $2,260,000.

Expected loss reserving methods are frequently used either instead of chain ladder methods or as complements to chain ladder methods. These methods are equally applicable to paid losses or reported losses; see the discussion of reported loss reserve indications further below in this paper. The Stanard-Bühlmann reserving method and the least squares reserving method are expected loss reserving methods that are particularly useful for outside analysts.

THE STANARD-BÜHLMANN RESERVING PROCEDURE

Outside analysts do not know the expected loss ratio. Even the in-house expected loss ratio may not be sufficient to estimate the expected losses. The earned premium times the expected loss ratio is a suitable estimate only when the indicated premium is also the premium charged. The estimate must be adjusted when the premium in the rate manual is not the pricing actuary's indicated premium. It must be further adjusted when underwriters provide schedule credits and debits, as is commonly done in the commercial lines of business.

The Stanard-Bühlmann reserving method derives the expected losses from the historical experience. We explain first the intuition for this method by means of an illustration, and we then apply the method to the Schedule P workers' compensation data used above.

Percentages Paid

The Stanard-Bühlmann reserving method uses expected patterns of percentages paid at each development date. A paid loss development factor of LDF from "k" months to ultimate means that 1/LDF of total losses have been paid by the development date and (LDF–1)/LDF of total losses are expected to be paid subsequent to the development date.

> *Illustration:* The paid loss development factor from 12 months to ultimate is 5.000. The cumulative paid losses at 12 months of development is 1/5 = 20%. The percentage of losses expected to be paid after 12 months of development is (5–1)/5 = 80%.

For a Stanard-Bühlmann reserving method using reported losses instead of paid losses, we substitute reported losses for paid losses in all the computations.

- A paid loss reserving method gives the total (case + bulk + IBNR) reserve indication.
- A reported loss reserving method gives the bulk + IBNR reserve indication.

We show first the intuition for the Stanard-Bühlmann method, and we then apply the method to the workers' compensation illustration used in this paper.[64]

ILLUSTRATION: STANARD-BÜHLMANN RESERVING METHOD

We have determined the following percentages of losses that are paid by each development date from the inception of the accident year.

Exhibit 3.11: Stanard-Bühlmann Loss Lags

Loss Lag	Percent Paid	Loss Lag	Percent Paid
12 mos	30%	72 mos	85%
24 mos	50%	84 mos	90%
36 mos	65%	96 mos	94%
48 mos	75%	108 mos	97%
60 mos	80%	120 mos	99%

At December 31, 20X9, we have the following data on premiums and cumulative paid losses for the ten most recent accident years from Schedule P, Part 1.

Exhibit 3.12: Adjusted Premiums and Paid Losses by Accident Year

Year	Adjusted Premiums	Paid Losses	Year	Adjusted Premiums	Paid Losses
20X0	200 million	150 million	20X5	300 million	185 million
20X1	220 million	155 million	20X6	320 million	205 million
20X2	240 million	200 million	20X7	340 million	155 million
20X3	260 million	175 million	20X8	375 million	185 million
20X4	280 million	215 million	20X9	400 million	75 million

[64] Complete documentation of the Stanard-Bühlmann reserving method may be found in Stanard and Feldblum [2002: SB]. The Stanard-Bühlmann Practitioner's Guide explains the rationale for the expected loss reserving methods, the needed adjustments to premium, and illustrations of the method in various scenarios.

Premiums and Losses

In theory, the premiums should be adjusted for rate level changes and for loss cost trends so that the premiums are at the same level of adequacy for all accident years. If we have the needed information, we can make the appropriate adjustments. State regulators and outside analysts would not have the needed information, and even an in-house actuary might find the adjustments too difficult. We assume here that we lack the information needed for adjusting the earned premium, so we use the raw data in Schedule P, Part 1.[65]

To see the intuition for the Stanard-Bühlmann reserving method, consider year 20X9. The premium is $400 million. By 12 months from the inception of the accident year, 30% of the premium, or $120 million, has been processed into paid losses. The other 70% of the premium, or $280 million, has not yet been processed into paid losses.

The word "processed" warrants explanation. The premium does not *become* paid losses. Rather, there is some relationship between the $400 million of premium and the ultimate paid losses. We don't know this relationship, since we don't know the expected loss ratio and we don't know the level of premium adequacy. We know only that at 12 months of development, 30% of the losses should have been paid. The $120 million of "processed" premium has the same relationship to the losses that have already been paid as the other $280 million of premium has to the losses that are yet to be paid.

The chain ladder reserving method uses the accident year information to determine the relationship. The $120 million of premium that has already been processed corresponds to $75 million of paid losses. This implies that

$$\textit{\$120 million : \$75 million :: \$280 million : X}$$
$$X = \$75 \text{ million} \times \$280 \text{ million} / \$120 \text{ million} = \$175 \text{ million}.$$

This method gives high credibility to the $75 million of paid losses in accident year 20X9. If losses are volatile, we don't want to give too much credence to the $75 million of losses that have been paid as of 12 months for accident year 20X9.

Instead, we would like to combine the various accident years. For most purposes, we can not add dollars from two different years, since a dollar from year X is worth more than a dollar from year X+1 when the inflation rate is positive. But here we are comparing premiums to losses. To add the figures from different years, we assume that the change in premiums from year to year is about the same as the change in expected losses from year to year. We combine the processed premium from each year, and we combine the paid losses from each year.

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[65] For a complete review of the Stanard-Bühlmann reserving method, see Stanard and Feldblum [2002].

We assume that the premium is at the same level of adequacy for each accident year – that is, the expected loss ratio is the same for all accident years.[66] We divide by the premium:

$$\textit{Unpaid loss ratio}_{i,t} = (1 - w) \times XLF_t \times ELR + w \times (LDF_t - 1) \times \textit{Paid Loss Ratio}_{i,t}$$
$$\textit{Unpaid loss ratio}_{i,t} = \alpha + \beta \times \textit{Paid Loss Ratio}_{i,t}$$

We use least squares regression analysis to estimate optimal value of α and β.

Illustration: Least Squares Reserving Method

We show a simple illustration of the least squares reserving method, and we then apply the technique to the workers' compensation Schedule P exhibits used earlier.

The earned premiums and cumulative paid losses by accident year and development date are shown below.

Exhibit 3.14: Least Squares Reserving Method

Accident	Earned Prem	Paid Losses ($000's)			
Year	($000's)	12 mos.	24 mos.	36 mos.	48 mos.
20X2	1,700	595	935	1,156	1,275
20X3	1,900	760	950	1,140	1,330
20X4	2,000	600	1,100	1,400	1,600
20X5	2,200	1,100	1,320	1,430	
20X6	2,500	1,000	1,500		
1997	2,600	1,300			

We estimate the paid losses for accident year 20X5 at 48 months of development.

We have three mature accident years, 20X2-20X4, having losses at both 36 months and 48 months of development. Let "x" be the 36 month losses and "y" be the 48 month losses. We estimate y as a linear function of x:

$$y = a + b \times x$$

[66] This is the same assumption used for the Stanard-Bühlmann reserving method. If the premiums are not at the same adequacy level for all accident years, further adjustments would be necessary. See Stanard and Feldblum [2002: SB] for explanation of the premium adjustments.

We use least squared regression to estimate the parameters "a" and "b."

The regression analysis is proper only if the units in which "x" and "y" are expressed are not changing over time. Monetary inflation causes the value of a dollar to change over time, so we can't use the dollar amount of losses in our regression equation. The 20X2 losses are in dollars that are worth less in real terms than the dollars of 20X3 losses.

If the premiums are at the same level of adequacy in each accident year, the loss ratios are expected to remain the same over time. We perform the regression on the loss ratios, not on the absolute dollars of loss.[67]

We redefine the variables: "x" is the reported loss ratio at 36 months and "y" is the reported loss ratio at 48 months. The reported loss ratios at 36 months and at 48 months for accident years 20X2 – 20X4 are shown below:

Exhibit 3.15: Least Squares Estimation

Acc Yr	x	y	$(x - \bar{x})^2$	$(x-\bar{x})(y-\bar{y})$
20X2	68%	75%	0.000400	0.000000
20X3	60%	70%	0.003600	0.003000
20X4	70%	80%	0.001600	0.002000
Average	66%	75%	0.001867	0.001667

For accident year 20X2, *"x" = 1,156 / 1,700 = 68% and "y" = 1,275 / 1,700 = 75%.*

The minimum least squares parameters are

$$y = a + bx, \quad b = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}, \quad a = \bar{y} - b\bar{x}$$

Using the values in the table above, we get

b = 0.001667 / 0.001867 = 89.29%
a = 75% – 89.29% × 66% = 16.07%

[67] One often sees regression analyses spanning several years performed on nominal dollars. Such analyses are generally flawed; they would be improved by deflating the nominal dollars to a common base.

In accident year 20X5, the 36 month paid loss ratio is 65%. Using the values of "a" and "b" above, the 48 month paid loss ratio is estimated as

$$16.07\% + 89.29\% \times 65\% = 74.11\%$$

Since the earned premium for accident year 20X5 is $2.2 million, the estimated paid losses at 48 months equal $2.2 million $\times$ 74.11% = $1.63 million.

ILLUSTRATION: WORKERS' COMPENSATION DATA

We apply the least squares reserving method to the workers' compensation Schedule P triangle. The linear regression requires a credible set of data points. Performing the linear regression on two or three mature accident years often generates constant terms that are less than zero or slope terms that are less than unity. To avoid these problems, we generate the paid losses at 120 months of development by the chain ladder reserving method for accident years 20X0 through 20X4. We use the least squares reserving method to generate the paid losses at 120 months of development for the subsequent accident years.

We estimate the paid losses at 120 months of development from the paid losses at an earlier maturity by the linear regression equation below:

$$\text{paid loss at 120 months} = \alpha + \beta \times \text{paid loss at earlier maturity}$$

Illustration: For accident years 20X0 through 20X4, we estimate the paid losses at 120 months of maturity with the chain ladder reserving method. We then form the linear regression

$$\text{paid loss at 120 months} = \alpha + \beta \times \text{paid loss at 60 months}$$

We derive the values of α and β by a least squares linear regression analysis. Using the values of α and β together with the accident year 20X5 paid losses at 60 months of development, we derive the paid losses at 120 months for accident year 20X5.

MONETARY INFLATION

Monetary inflation changes the units in each accident year. Because the regression analysis is done over a period of years, the units in which α is expressed differ by year. For accident year 20X0, the units are 20X0 dollars; for accident year 20X1, the units are 20X1 dollars.

To convert the dollar values in the different years into comparable figures, we divide the paid loss amounts by that year's earned premium. If the premium figures are at the same adequacy level for each year, the loss ratios are in comparable units.[68]

We use the earned premium figures from Schedule P, Part 1 to determine the loss ratios. The earned premiums, in thousands of dollars, are the same as the premiums used for the expected loss reserving method and the Stanard-Bühlmann reserving method.

Exhibit 3.16: Earned Premium by Accident Year for Least Squares Reserving Method

Accident Year	Earned Premium	Accident Year	Earned Premium
20X0	$560	20X5	$900
20X1	$600	20X6	$950
20X2	$650	20X7	$1,000
20X3	$700	20X8	$1,100
20X4	$850	20X9	$1,100

We divide the paid losses by the earned premiums to convert the cumulative paid loss triangle into a paid loss ratio triangle.

[68] This is the same assumption used for the Stanard-Bühlmann reserving method. A rigorous analysis would adjust the earned premiums for their expected adequacy levels; see Standard and Feldblum [2002].

Exhibit 3.17: 20X9 Schedule P, Part 3D Loss Ratios

Pd LR	12 mo	24 mo	36 mo	48 mo	60 mo	72 mo	84 mo	96 mo	108 m	120 m
20X0	18.73	41.09	53.45	60.73	66.00	69.82	72.36	74.91	76.73	78.73
20X1	18.50	39.67	51.50	59.33	64.50	68.17	71.33	73.67	75.67	
20X2	16.62	34.00	44.00	50.46	54.46	57.69	60.15	62.00		
20X3	15.86	34.14	44.43	51.00	56.00	59.43	62.00			
20X4	15.88	35.18	46.35	53.88	56.29	62.82				
20X5	16.22	34.89	46.44	54.44	60.22					
20X6	16.74	36.11	48.74	57.47						
20X7	14.60	35.30	48.50							
20X8	13.82	36.91								
20X9	14.18									

For accident years 20X1 through 20X4, we derive the value in the "120 months" column using the paid loss development factors.

- For accident year 20X1, the paid loss development factor from 108 months to 120 months is 1.020, so the paid loss ratio at 120 months is 75.67% × 1.020 = 77.18%.
- For accident year 20X2, the paid loss development factor from 96 months to 120 months is 1.051, so the paid loss ratio at 120 months is 62% × 1.051 = 65.14%.
- For accident year 20X3, the paid loss development factor from 84 months to 120 months is 1.082, so the paid loss ratio at 120 months is 62% × 1.082 = 67.09%.
- For accident year 20X4, the paid loss development factor from 72 months to 120 months is 1.125, so the paid loss ratio at 120 months is 62.82% × 1.125 = 70.70%.

Using accident years 20X0 through 20X4 as a starting point, we estimate the indicated reserves for accident years 20X5 through 20X9 with the least squares method.

For accident years 20X0 through 20X4, we estimate the least squares regression with the 60 month cumulative paid loss as the independent variable and the 120 month cumulative paid loss as the dependent variable:

$$\text{paid loss at 120 months ("y")} = \alpha + \beta \times \text{paid loss at 60 months ("x")}$$

The observed values for accident years 20X0 through 20X4 are shown below.

Exhibit 3.18: Least Squares Reserving Method for Schedule P Illustration

Year	*Loss Ratio 60 mos: "x"*	*Loss Ratio 120 mos: "y"*	x^2	$x * y$
20X0	0.66000	0.78730	0.00354025	0.00414239
20X1	0.64500	0.77180	0.00198025	0.00240834
20X2	0.54460	0.65140	0.00312481	0.00370505
20X3	0.56000	0.67090	0.00164025	0.00189459
20X4	0.59290	0.70700	0.00005776	0.00008117
Average	0.60050	0.71768	0.00206866	0.00244631

The minimum least squares parameters are

$$y = \alpha + \beta x, \quad \beta = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}, \quad \alpha = \bar{y} - \beta \bar{x}$$

Using the values in the table above, we get

ß = 0.00244631 / 0.00206866 = 1.18256
α = 0.71768 – 0.60050 × 1.18256 = 0.00755 = 0.755%

We derive the values of α and ß by a least squares linear regression analysis. Using the values of α and ß together with the accident year 20X5 paid loss ratio at 60 months of development, we derive the paid loss ratio at 120 months for accident year 20X5.

- The paid loss ratio at 60 months of development is 60.22%.
- The projected paid loss ratio at 120 months of development is 0.755% + 1.18256 × 60.22% = 71.969%.

We continue in this fashion for all accident years. We explain the sequence of calculations below, though we do not show the arithmetic for the remaining accident years.

For accident year 20X6, we seek to project the paid loss ratio at 120 months of development from the paid loss ratio at 48 months of development. We use accident years 20X0 through 20X5 to determine the linear relationship between these two paid loss ratios that minimizes the sum of squared errors, exactly as we did above for paid loss ratios at 60 months of developments and 120 months of development using accident years 20X0 through 20X4.

The new values of α and β are $\alpha = 2.4512\%$ and $\beta = 1.261487$. For accident year 20X6, the paid loss ratio at 48 months of development is 57.4737%. The projected paid loss ratio at 120 months of development is $2.4512\% + 57.4737\% \times 1.261487 = 74.95\%$.

The table below shows the values of α and β for each accident year from 20X5 through 20X9, as well as the projected paid loss ratios for 120 months of development.

Exhibit 3.19: Least Squares Reserving Method for Schedule P Illustration

Accident Year	Alpha (A)	Beta (ß)	Paid Loss Ratio at 120 Mos	Earned Premium	Cum Pd Losses at 120 Mos
20X5	0.7504%	1.182611	71.97%	$900,000	$647,730
20X6	2.4512%	1.261487	74.95%	$950,000	$712,025
20X7	6.7305%	1.369435	73.15%	$1,000,000	$731,500
20X8	15.6391%	1.562814	73.32%	$1,100,000	$806,520
20X9	53.1247%	1.184733	69.93%	$1,100,000	$769,230

The calculated values of α are low for old accident years and high for recent accident years. This means that the expected loss method is appropriate for recent accident years and the chain ladder method is appropriate for older accident years. This conforms well to our intuition about reserving methods. For recent accident years, the cumulative paid losses to date are still sparse, and they provide only limited information about the projected ultimate losses. For older accident years, the cumulative paid losses to date are more credible, and we can use them to project ultimate losses.

We multiply the paid loss ratios at 120 months of development by the earned premium in each year to get the cumulative paid losses at 120 months of development. The remaining steps in the least squares reserving method are the same as for other reserving methods discussed earlier. We multiply the cumulative paid losses at 120 months of development by a 120 months to ultimate paid loss tail factor to get ultimate losses by accident year. These projected ultimate losses are compared with the reported losses by accident year to determine whether the reported loss reserves are adequate.

Considerations for Reserve Adequacy Testing

The Schedule P historical loss triangles are not always sufficiently homogeneous for accurate projections of reserve adequacy. Several illustrations are noted below, reflecting changes in the expected inflation rate, the insurance environment, state compensation systems, policy deductibles, policy exclusions, and company growth.

INFLATION ADJUSTMENTS

The paid loss development patterns in the illustration combine true development with the effects of inflation. Inflation is implicit in each paid loss link ratio. We assume that future inflation will be the same as the inflation implicit in the projected link ratio.

The effects of inflation on the loss payment pattern depends on the line of business. For workers' compensation, as for most lines, inflation affects *medical* benefits through the payment date. If inflation rises between the accident date and the time that the medical services are provided, we expect the workers' compensation medical benefits to be higher.

The effects of inflation on workers' compensation indemnity benefits depend on the state. In about half of the U.S. jurisdictions, indemnity payments that extend beyond two years have cost of living adjustments (COLA's), so inflation affects the indemnity reserves as well.

If inflation is expected to be higher in future years than it was during the historical Schedule P experience period, the paid loss chain ladder reserve indication is understated. Conversely, If inflation is expected to be lower in future years than it was during the experience period, the reserve indication is overstated.

These distortions are large even for small changes in the inflation rate. If the average loss is paid 5 years after the accident date, a one percentage point change in the inflation rate causes a 5 percentage point change in the combined ratio.

After the first two or three years, the workers' compensation reserves are dominated by lifetime pension cases, which take many years to settle. The average time to settlement of workers' compensation reserves is eight years. A one percentage point change in the future inflation rate causes a 8% change in the reserve indication.

CORRECTING FOR INFLATION BIAS

The following steps correct for the inflation bias in the reserve indication:

1. Select an appropriate inflation index for the line of business. For workers' compensation, we might use the medical CPI for medical benefits and wage inflation for indemnity benefits.[69] We assume that medical benefits are 100% sensitive to inflation, and indemnity benefits are 50% sensitive to inflation. Workers' compensation benefits are split relatively evenly between indemnity and medical benefits. Since medical benefits are

[69] Masterson [1968; 1992] illustrates econometric correlations of insurance loss cost trends with various inflation indices. The National Council on Compensation Insurance continues his work at the present time.

paid (on average) sooner than indemnity benefits, the reserves are split about 70% indemnity and 30% medical.[70]

2. Relate the workers' compensation benefit trends to the chosen index. The medical CPI shows changes in a fixed basket of goods. It does not incorporate the effects of increasing utilization of medical services, more complex medical procedures, and more expensive medical equipment. In general, workers' compensation medical benefit trends exceed the medical CPI by about four percentage points a year (see Feldblum [2002: wcr]). The overall workers' compensation benefit trend might be modeled as

   30% × (medical CPI + 4%) + 70% × wage inflation.[71]

3. From the cumulative Schedule P, Part 3 payment triangles, determine the corresponding incremental payment triangles by taking first differences between adjacent development periods. Detrend the incremental payments with the benefit trend index developed in the previous step to form a triangle of "real dollar" incremental payments.

4. Determine the corresponding cumulative "real dollar" paid loss triangle from the incremental triangle. Perform the paid loss chain ladder analysis to select projected link ratios in "real dollar" terms.

5. From expected future inflation estimates made by outside economists or by the analyst working with the Schedule P data, estimate future benefit trends. Combine the estimated future benefit trends with the real dollar link ratios to obtain the expected future nominal dollar link ratios. Use these adjusted link ratios to project reserve indications.

There are numerous variations on this procedure. Financial engineers tend to use stochastic interest rate paths and inflation rate paths. For an illustration of a deterministic inflation adjustment to reserve indications, see Hodes, Feldblum, and Neghaiwi (1999). For an illustration of the stochastic inflation adjustment, see Hodes, Feldblum, and Blumsohn (1999).

During periods of inflation rate stability, the chain ladder procedure shown earlier in this paper is sufficient. During periods of inflation rate volatility, the inflation adjustment described here is necessary to avoid large biases in the reserve indications.

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[70] Much of the medical costs are expended on temporary total cases and on "medical-only" cases, which are paid rapidly and may not even appear in the year-end reserves. In contrast, indemnity benefits may account for 90% or more of a long-term lifetime pension case, which remains in the reserves year after year.

[71] We are examining trend on a development period basis, so we make no adjustments for expected changes in the mix of business by classification. The trend examines changes in the cost per exposure, not changes in the type of exposures. In contrast, an accident year trend must also consider the effects of shifting mixes of business, such as the changes caused by shifts from a manufacturing to a service economy.

INSURANCE ENVIRONMENT

During the past thirty years, workers' compensation medical costs have increased more rapidly than indemnity costs, rising from 30% of benefits in the 1960's to about 50% in 2000. High medical care inflation, increasing use of physicians' services, more sophisticated and expensive medical equipment, and the absence of any limit on medical benefits in the workers' compensation system contribute to this. In addition, increasing deductibles and coinsurance levels in group health insurance plans, along with more sophisticated cost containment efforts by health insurers, have led to cost-shifting to workers' compensation.

Medical benefits are paid quickly, whereas indemnity benefits are paid as the income loss accrues; the paid loss link ratios are therefore higher for indemnity benefits. A rote Schedule P, Part 3 loss reserve adequacy projection uses link ratios developed from experience dominated by indemnity losses and applies them to experience with a higher percentage of medical losses, thereby distorting the results (see Woll [1981]).

Offsetting this effect are the increasing trends in paid loss link ratios for both medical and indemnity benefits, probably stemming from lengthening durations of disability and perhaps increasing attorney involvement in workers' compensation claims (NCCI [1992]). The lengthening durations of disability are abetted by more liberal decisions on the compensability of stress claims and of occupational illnesses (Millus [1987]; [1988]). They may be seen both in average disability by type of injury and by the shift of claims from temporary disability to permanent partial disability (Gardner [1989]). These trends have stopped and perhaps even reversed in the 1990's, probably because of the system reforms enacted in many jurisdictions.

The actuarial solution to these problems is to create more homogeneous data sets by dividing the workers' compensation experience (i) between medical and indemnity benefits and (ii) between long-term pension cases and other cases. Schedule P data do not show these splits.

STATE COMPENSATION SYSTEMS

Several jurisdictions, such as Massachusetts, New Jersey, and Pennsylvania, have revised their personal automobile no-fault compensation systems by increasing personal injury protection (PIP) benefits, modifying the tort threshold, or providing policyholder options (Marter and Weisberg [1991]; Musick and Szczepanski [1992]). PIP and residual bodily injury (RBI), although combined in Schedule P, have different paid loss development patterns. A change in the mix of benefits may distort the estimates of reserve adequacy.

Illustration: State X changes from a low monetary tort threshold to a strong verbal tort threshold. For a given amount of PIP benefits paid in the first year or two years since policy inception, we expect a greater volume of residual bodily injury (RBI) losses to appear at later maturities when the compensation system has a weak monetary threshold than when it has a strong verbal threshold. The paid loss link ratios should decline. A rote Schedule P, Part

3 loss reserve adequacy analysis may show a reserve deficiency even if none exists.

DEDUCTIBLES

In the 1990's, many insurers switched from first dollar workers' compensation policies and retrospectively rated policies to large dollar deductible (LDD) policies. With an LDD policy, the insurer handles all claims, but it assesses the employer (the insured) for the cost of benefits below the retention for each claim (see Feldblum [2002: wcr], Teng [1994], Brown and Schmitz [2000]).

LDD policies decrease state premium taxes and residual market assessments, both of which are levied on direct written premium in most states.[72] They avoid "dollar trading" on small claims, which pose no financial risk to the insured, and they provide greater incentives to the insured to provide a safe workplace and adequate safety procedures. They allow the insured to keep the premium dollars until they are needed to pay claims, enhancing the cash flow of the insured.

Similarly, many insurers use large dollar deductibles on general liability and commercial automobile policies, particularly when these lines are written in combination with workers' compensation for a large account.

Excess Development

Loss development factors (if they are more than unity) increase for higher layers of loss (Pinto and Gogol [1987]), for several reasons:

- If the loss amount before development exceeds the retention, all the development appears in the upper layer and none appears in the lower layer.
- If the loss amount before development is below the retention but after development it exceeds the retention, the development below the retention is capped and the development above the retention is infinite.
- In some lines of business, emergence of IBNR claims often involves large and complex claims. This occurs most often with latent disease claims, stress claims, and psychological injury claims (cf Feldblum [2002: wcr]).
- The size-of-loss distribution changes as the claims mature, becoming increasingly skewed towards high cost claims (see Pinto and Gogol [1987]).

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[72] Several large states are exceptions, notably New York, Massachusetts, and California.

Illustration: We examine a set of workers' compensation claims that remain open for two years or longer. We keep the illustration simple to highlight the effect of a retention.

The payment per claim at 12 months is uniformly distributed between $10,000 and $60,000. The cumulative payments for each claim are twice as large at 24 months. The LDD deductible is $50,000 per claim.

Total Development: The average size of a claim is $35,000 at 12 months and $70,000 at 24 months. The loss development link ratio from 12 months to 24 months is 2.000.

Excess Development: One fifth of the claims exceed the retention at 12 months of development. For these claims, the average amount above the retention is $5,000. The average cost per claim to the LDD insurer is 1/5 × $5,000 = $1,000.

At 24 months of development, the claims are uniformly distributed between $20,000 and $120,000. Claims between $50,000 and $120,000 has portions above the retention; these are 7/10 of the claims. Of the claims with portions above the retention, the average benefit paid by the insurer is $35,000, or ½ × ($120,000 – $50,000). The average cost per claim at 24 months of development is 7/10 × $35,000 = $24,500. The loss development link ratio from 12 months to 24 months is 24.500.

The use of historical experience based on first dollar policies to project loss development for LDD policies may severely understate the required loss development factors. For recommendations on developing LDD blocks of business, see Siewert [1996].

POLICY EXCLUSIONS

Insurance policy forms show two trends.

- For common perils, policies have become broader, covering various additional hazards.
- For unusual perils that affect only a small number of insureds but that may cause expensive losses, insurers tend to exclude the coverage from the basic policy and to use special endorsements or policies.

  Illustration: Before 1986, the standard CGL (Commercial General Liability) policy form used a pollution exclusion known as exclusion "f," which excluded liabilities resulting from pollution except when it was "sudden and accidental." In the 1980's, after passage of the CERCLA Act of 1980 which put the costs of remediation of abandoned toxic waste sites on the companies which has deposited wastes there, exclusion "f" was termed ambiguous by several state courts and interpreted to mean all unintentional pollution. In 1986, insurers

replaced exclusion "f" with an absolute pollution exclusion and covered the potential liabilities under separate environmental impairment policies.

Illustration: Asbestos hazards were originally covered under standard products liability forms. Asbestos exposures have proved far more expensive than imagined; even in the year 2000, there have been hundreds of thousands of asbestos claims related to policies written 30 or more years earlier. By the 1970's, many insurers had eliminated coverage of asbestos hazards from their unendorsed products liability forms and cover the exposures under special asbestos policies. Similar trends may occur for exposures related to firearms, cigarettes, and pharmaceutical drugs (such as Prozac).

Illustration: Terrorism losses were covered under most insurance policies before the World Trade Center losses of September 11, 2001. Several reinsurers may exclude terrorism losses from their reinsurance treaties. Primary insurers may do the same, and they may cover the hazard under separate forms. Terrorism coverage is needed primarily by large accounts in major urban centers, just as hurricane coverage is needed by insureds in costal areas, flood insurance is needed in flood plains, and earthquake insurance is needed along earthquake fault lines.

In each illustration above, the subsequent exclusion of coverage causes the historical experience to be extraordinary and unlikely to be repeated in the future. Users of Schedule P should examine the causes of high development in past years and check whether policy form changes lower the probability of these events occurring in the future.

COMPANY GROWTH AND DECLINE

If an insurer expands its writings over the course of a year, more claims are incurred in the latter part of the year than in the earlier. Paid loss development factors are higher for accident years with later average loss occurrence dates. A change in the rate of business growth may distort the projection of reserve adequacy.

Illustration: To avoid complex mathematics, we assume that claims are reported six months after occurrence of the accident and that case reserves are adequate. If the volume of business is steady over the course of the accident year, the reported loss development factor from 12 months since inception of the accident year to 24 months since inception of the accident year is 2.000. The rationale for this development factor is that claims which occur in the first six months of the accident year (half the claims) are reported by 12 months. Claims which occur in the latter six months of the accident year (the other half of the claims) are reported after 12 months but before 24 months.

If the volume of business during the accident year increases linearly over time, starting at $0 on January 1, one quarter of the claims occur in the first six months and three quarters of the

claims occur in the latter six months.[73] The reported loss development factor from 12 months to 24 months is 4.000, not 2.000. The user of Schedule P should examine the growth or decline of business over the historical period and adjust the loss development factors appropriately.

In summary, Part 3 of Schedule P is the major publicly available document for estimating reserve adequacy. However, one must be aware of the potential distortions caused by the lack of data homogeneity and shifts in mix of benefits to properly evaluate the statistical indications.

[73] Suppose the rate of loss occurrence is $0 per year at inception of the accident year, $100,000 per year at 6 months, and $200,000 per year at 12 months. The average rate of loss occurrence during the first six months is ½ × ($0 + $100,000) = $50,000, and the average rate of loss occurrence during the last six months is ½ × ($100,000 + $200,000) = $150,000. One quarter of the losses occur during the first six months and are reported by 12 months. Three quarters of the losses occur during the latter six months and are reported after 12 months.

Part 2 - Incurred Losses

Part 2 shows a triangle of net incurred losses and defense and cost containment expenses (DCC) by accident year and evaluation date. The Part 2 entries are the sum of paid amounts, case reserves, and bulk + IBNR reserves for both losses and DCC. Each entry in Part 2 equals the corresponding entry in Part 3 plus the loss and DCC reserves at that date.

Part 2 is designed as a retrospective test of loss reserve adequacy. If the insurer sets adequate reserves, the incurred losses for each accident year should show neither upward nor downward development.[74] The NAIC uses the Part 2 Summary exhibit for the loss reserve development tests in the Insurance Regulatory Information System (IRIS).

IRIS Loss Development Tests

For any accident year, column 10 of Part 2 shows incurred losses valued at the statement date, and column 9 shows the corresponding valuation one year earlier. If the insurer has reserved adequately, payments during the year are offset by a reduction of reserves, and there should be no change in incurred losses between valuation dates. Column 11 shows the latest year's change in incurred losses for each accident year except the most recent one (there is no "previous" valuation for the most recent accident year). Column 12 shows the change over the last two years in incurred losses for each accident year except the most recent two years.

Illustration: Exhibit 2.1 below shows a Schedule P, Part 2 triangle for workers' compensation.

- For accident year 20X1, the one-year adverse loss development is $520,000 – $521,000 = –$1,000; the two-year adverse loss development is $520,000 – $500,000 = +$2,000.
- For accident year 20X6, the one-year adverse loss development is $787,000 – $786,000 = +$1,000; the two-year adverse loss development is $787,000 – $761,000 = +$26,000.

The Part 2 Summary exhibit shows data for all lines of business combined. The one- and two-year adverse loss developments in the Summary exhibit are summed over all accident years (including the prior years row) and shown on row 12.

IRIS Retrospective Tests 9 and 10

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[74] This generalization assumes that the reserves are not discounted. It is also true if any discounts on the statement reserves are disclosed, so that Schedule P, Part 2 shows the undiscounted amounts. The generalization is not correct if the reserves contain an implicit interest discount, since the unwinding of the discount, or the amortization of the discount, shows up as apparent adverse development.

IRIS Tests 9 and 10 compare the one and two year adverse development to policyholders' surplus at the inception date of the development.

- IRIS Test 9 divides the one year reserve development from row 12 of the Summary exhibit by the policyholders' surplus at the end of the prior year.
- IRIS Test 10 divides the two year reserve development by the policyholders' surplus at the end of the second prior year.

A ratio of 20% or greater on either test is an exceptional score. Four or more exceptional scores on IRIS tests serves as a warning of potential financial weakness and may trigger a financial examination. An exceptional score on any of the three loss reserve adequacy tests (IRIS tests 9, 10, and 11) must be commented upon in the Statement of Actuarial Opinion.

The "Five Year Historical Data" exhibit of the Annual Statement, lines 68 through 72, shows the one and two year developments and the ratios for tests 9 and 10 for the five most recent Annual Statements.

Exhibit 2.1: One and Two Year Loss Development

One Year Loss Development	20XX	20XX–1	20XX–2	20XX–3	20XX–4
Development in estimated losses and loss expense incurred prior to current year					
Percent of development of loss and loss expense incurred to policyholders' surplus of prior year end					
Two Year Loss Development					
Development in estimated losses and loss expense incurred two years before the current year and prior year					
Percent of development of loss and loss expense incurred to reported policyholders' surplus of second prior year end					

IRIS Prospective Test 11

IRIS Test 11 is a prospective test of reserve adequacy. It is a regulatory test, not an actuarial test; it does not use the actuarial principles mentioned earlier. It is a simple formula that requires no independent judgment in selecting or smoothing factors.

IRIS Test 11 compares the outstanding loss ratios of three years. The *outstanding loss ratio* is the ratio of outstanding losses and loss adjustment expenses at a given statement date to the earned premium in that statement year. IRIS Test 11 updates the outstanding loss ratios

from the past two years by means of the one- and two-year reserve developments, and compares these ratios with the current year's outstanding loss ratio.

The losses and premiums in this ratio are not matched.

- The numerator is unpaid loss and loss adjustment expenses for all accident years.
- The denominator is earned premium for the current calendar year.

This mismatch constrains the usefulness of IRIS Test 11, since business volume growth or decline, changes in the mix of business between property and liability lines, and changes in the types of policies issued distort the "outstanding" loss ratio (Salzmann [1981], page 175).

Unpaid losses and loss adjustment expenses are reported on page 3, "Liabilities, Surplus and Other Funds," lines 1, 2, and 3.

- Line 1 shows total net loss reserves. It includes reinsurance payable on unpaid losses for business assumed by the reporting company. It is reduced for reinsurance recoverables on unpaid losses for business ceded by the reporting company.
- Line 2 shows reinsurance payable on paid losses for business assumed by the reporting company.
- Line 3 shows reserves for unpaid loss adjustment expenses (both DCC and AAO).
- Earned premium is shown on page 4, "Underwriting and Investment Exhibit: Statement of Income," line 1, column 1.

Illustration: The outstanding loss ratio for December 31, 20XX equals the outstanding loss and loss adjustment expenses at December 31, 20XX shown on page 3, lines 1 + 2 + 3, divided by the earned premium for 20XX shown on page 4, column 1, line 1.

TEST 11 OVERVIEW

To test reserve adequacy in 20XX, IRIS Test 11 examines the outstanding loss ratios in 20XX–1 and 20XX–2. An outstanding loss ratio in 20XX that is lower than the average of the outstanding loss ratios in the two preceding years may be a symptom of under-reserving.

Illustration: The outstanding loss ratios in 20XX, 20XX+1, and 20XX+2 are 125%, 120%, and 105%. The 20XX+2 outstanding loss ratio of 105% is well below the average 122.5% outstanding loss ratio of the preceding two years. The company may be experiencing financial problems, and it may weakened its loss reserves.

This simple computation may highlight instances of reserve weakening, but it does not uncover instances of persistently weak reserves. To correct this problem, the prior two years' outstanding loss ratios are adjusted for the one and two-year adverse loss development in the current year's Schedule P to determine *restated* outstanding loss ratios.

- The one year reserve development is added to the unpaid losses and loss adjustment expenses for the prior year. This sum is divided by the prior year's earned premium. The necessary figures are taken either from the "previous year" column in the current Annual Statement, pages 3 and 4, or from the "current year" column in the previous year's Annual Statement.
- The two year reserve development is added to the unpaid losses and loss adjustment expenses for the second prior year. This sum is divided by the second prior year's earned premium. The necessary figures are taken either from the "previous year" column in the previous year's Annual Statement, pages 3 and 4, or from the "current year" column in the second prior year's Annual Statement.

The average of these two restated outstanding loss ratios is multiplied by the current year's earned premium (from page 4, column 1, line 1, of the current year's Annual Statement) to determine the indicated outstanding losses and loss adjustment expenses. This figure, minus the reported unpaid losses and loss adjustment expenses (from page 3, column 1, lines 1+2+3), is the indicated reserve deficiency. A deficiency greater than 25 percent of policyholders' surplus (page 3, line 32, or page 4, line 20) indicates an exceptional score.

Illustration: IRIS Test 11

The 20X5 Schedule P, Part 2, Summary shows a one year adverse loss development of $3 million and a two year adverse loss development of $4 million. The following data are taken from the current and the two previous Annual Statements to compute the results of IRIS Test 11 (figures are in thousands of dollars).

Exhibit 2.2: IRIS Test 11: Input Data

	20X3	20X4	20X5
Earned premium	$12,000	$12,500	$19,000
Loss reserves	9,000	10,000	16,000
Reinsurance payable on paid losses	500	1,000	2,500
Loss adjustment expense reserves	2,500	4,000	4,500
Policyholders' surplus	$7,850	$8,900	$12,150

RESTATED OUTSTANDING LOSS RATIOS

The restated outstanding loss ratios for 20X3 and 20X4 are the restated loss reserves divided by the earned premium. The restated loss reserves are defined as the sum of loss reserves, LAE reserves, reinsurance payable on paid losses, and Schedule P, Part 2, Summary adverse loss development.

For 20X3, the restated loss reserves are

$9 million + $0.5 million + $2.5 million + $4 million = $16 million,

and the restated outstanding loss ratio is $16 million ÷ $12 million = 133.3%.

For 20X4, the restated loss reserves are

$10 million + $1 million + $4 million + $3 million = $18 million,

and the restated outstanding loss ratio is $18 million ÷ $12.5 million = 144.0%.

STATUTORY INDICATED RESERVES

The average restated outstanding loss ratio is (1.333 + 1.440) ÷ 2 = 1.386. The 20X5 earned premiums are $19 million, so the indicated unpaid losses are 1.386 x $19 million = $26.347 million. The held reserves at December 31, 20X5 are $23 million [= $16 million + $2.5 million + $4.5 million]. The indicated reserve deficiency is $26.347 million – $23 million = $3.347 million. Policyholders' surplus in 20X5 is $12,150,000. The ratio of $3.347 million to $12.15 million is 27.55%, which constitutes an exceptional score for IRIS Test 11. The figures are summarized in the table below.

Table 2.3: IRIS Test 11: Estimated Reserve Deficiency
(Figures in Thousands of Dollars)

Statement date	20X3	20X4	20X5
Loss reserves	$9,000	$10,000	$16,000
Reinsurance payable on paid losses	$500	$1,000	$2,500
Loss adjustment expense reserves	$2,500	$4,000	$4,500
Adverse loss development	$4,000	$3,000	—
Restated loss reserves	$16,000	$18,000	
Earned premium	$12,000	$12,500	
Restated outstanding loss ratio	1.333	1.440	
Average restated O/S loss ratio			1.387
Earned premium, current year			$19,000
Indicated loss reserves			$26,347
Held reserves at December 31, 20X5			$23,000
Indicated reserve deficiency			$3,347

Second Illustration

To ensure comprehension of the IRIS reserve adequacy test, we show a second illustration in abbreviated form. Readers are encourage to develop the IRIS Test 11 result and compare it to the procedure below.

The Annual Statements for years 20XX–2, 20XX–1, and 20XX show the following figures in millions of dollars.

Exhibit 2.4: IRIS Test 11, Illustration 2, Input Data

	20XX–2	20XX–1	20XX
Earned Premium (page 4, line 1)	$1,100	$1,500	$1,750
Loss Reserves (page 3, line 1)	1,500	2,000	3,000
Reinsurance payable on paid losses	200	300	300
LAE Reserves (page 3, line 2)	1,000	1,500	1,700
Policyholders' Surplus	$8,000	$9,000	$10,000

The 20XX Schedule P, Part 2 Summary shows one-year adverse loss development of 600 and two-year adverse loss development of 1,500. We calculate the IRIS Test 11 results for the 20XX statement date.

We determine the restated outstanding loss ratios for the two prior years: 20XX–2 and 20XX–1. We multiply the average of the two restated outstanding loss ratios by the 20XX earned premium to derive the Test 11 indicated reserves. We subtract the 20XX held reserves from the indicated reserves, and we divide the result by the 20XX policyholders' surplus. A quotient greater than 25% is an exception value for Test 11.

The restated outstanding losses in each prior year equals the sum of:

i. the loss reserves;
ii. the reinsurance payable on paid losses;
iii. the LAE reserves; and
iv. the adverse loss development from that prior year to the current statement date as indicated in the Schedule P, Part 2, Summary.

For 20XX–2, the restated outstanding losses are $1500 + $200 + $1000 + $1500 = $4,200 million. The restated outstanding loss ratio is the restated outstanding losses divided by the earned premium, or $4,200 / $1,100 = 3.818.

For 20XX–1, the restated outstanding losses are $2,000 + $300 + $1,500 + $600 = $4,400 million. The restated outstanding loss ratio is $4,400 / $1,500 = 2.933.

The average restated outstanding loss ratio in the two prior years is (3.818 + 2.933) / 2 = 3.376. The Test 11 indicated reserves for 20XX are 3.376 x $1,750 = $5,908 million.

The held reserves in 1998 are $3,000 + $300 + $1,700 = $5,000 million. The excess of the indicated reserves over the held reserves equals $5,908 – $5,000 = $908 million.

The ratio of the Test 11 indicated reserve deficiency to policyholders' surplus is $908 / $10,000 = 9.08%. This is less than 25%, so the Test 11 results are not exceptional.

Distortions

IRIS Test 11 uses all lines combined data, which is an extremely heterogeneous mixture. The test results are distorted by (i) company growth, (ii) changes in the mix of business by line, and (iii) changes in policy types. Each of these effects is explained below.

Growth

Rapid growth after a period of stability may indicate a reserve deficiency even if reserves are adequate, particularly if the company writes long-tailed lines of business. For workers' compensation or medical malpractice, the outstanding loss ratio may be as high as 300%, since losses are paid several years after the premium is collected.

The example above illustrates this problem. The company grew rapidly in 20X5, increasing its premium volume from $12.5 million to $19.0 million, an increase of $6.5 million. In comparison, the 20X4 increase in premium was only $12.5 million – $12.0 million = $0.5 million.

Loss reserves increased in 20X5 by $23 million – $18 million (after restatement for adverse loss development) = $5 million. This is the increase that we would expect for an additional $6.5 million of earned premium. Nevertheless, the company shows an exceptional score on IRIS Test 11.

The NAIC realizes that changes in premium volume may distort the results. Business growth overstates the reserve deficiency, though the NAIC believes the effect is not great: "Within the normal range of variations in premium from year to year, the distortion from changes in premium is not significant" (NAIC *IRIS Manual*, Test 11).

The outstanding loss ratio does not properly match losses in the numerator with premiums in the denominator. IRIS Test 11 is a holdover from days when many state insurance departments did not have actuarial or financial staff who could perform reserve adequacy tests and when reserving software to perform actuarial reserve adequacy tests was not available. The Annual Statements are now filed electronically (in addition to the hardbound copies), and software is available for complete actuarial analyses of reserve adequacy. It is hard to justify the continued use of IRIS Test 11.

Mix by Line

A change in the mix of business from long-tailed liability lines to short-tailed property lines may lead to an exceptional score on IRIS Test 11, even if reserves are adequate. Conversely, a

change in the mix of business from short-tailed property lines to long-tailed liability lines may prevent an exceptional score on IRIS Test 11, even if reserves are deficient.

Illustration: A company writes workers' compensation and commercial fire insurance.

- The expected outstanding loss ratio for workers' compensation is 250%.
- The expected outstanding loss ratio for commercial fire is 20%.

With a 50%–50% mix of business, the overall expected outstanding loss ratio is

$$50\% \times 250\% + 50\% \times 20\% = 135\%.$$

If the company shifts to a mix of 60% workers' compensation and 40% commercial fire, the overall expected outstanding loss ratio is $60\% \times 250\% + 40\% \times 20\% = 158\%$.[75] If the company shifts to a mix of 40% workers' compensation and 60% commercial fire, the overall expected outstanding loss ratio is $40\% \times 250\% + 60\% \times 20\% = 112\%$. A 10% shift in the mix of business leads to a 23% difference in the expected outstanding loss ratio.

If the company shifts from short-tailed property lines to long-tailed liability lines, a steady outstanding loss ratio may mask a reserve deficiency problem. Conversely, if the company shifts from long-tailed liability lines to short-tailed property lines, a decreasing outstanding loss ratio is expected, and it does not necessarily indicate a reserve deficiency problem.

The NAIC realizes that changes in the mix by line may distort the results. The NAIC recommends that "For companies which have had major shifts in product mix, the estimated reserve deficiency or redundancy should be calculated separately for the major product groups. . . ." (*ibid.*).

Policy Type

A shift in the mix of policy type may have an effect similar to a shift in the mix of business by line. For instance, a shift from first dollar workers' compensation policies to large dollar deductible workers' compensation policies may prevent an exceptional score on IRIS Test 11, even if reserves are deficient. A book of large dollar deductible workers' compensation policies has an exceedingly high outstanding loss ratio, since the losses are paid many years after the premium is collected. See the discussion above regarding mix of business for further discussion.

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[75] This is the steady-state expected outstanding loss ratio. The change in the observed outstanding loss ratio after a change in the mix of business is gradual, extending over several years.

Case Incurred (Reported) Loss Reserve Adequacy Tests

Part 2 includes bulk + IBNR reserves in addition to case reserves and paid losses. Actuaries project indicated reserves from historical experience, such as loss payments and reserves set by claims examiners, not from previous actuarial forecasts.

Part 4 of Schedule P shows the bulk + IBNR reserves carried by the company in past years in the same format as in Part 2. The difference between Parts 2 and 4 reflects the historical claims experience of the company. The case incurred (or reported) loss development patterns derived from this experience can be used to prospectively estimate reserve adequacy.

ILLUSTRATION: REPORTED LOSS DEVELOPMENT

We continue the illustration from the discussion of Part 3, using data from the same company.

Exhibit 2.5: 20X9 Schedule P, Part 2 ($000)

Part 2	20X0	20X1	20X2	20X3	20X4	20X5	20X6	20X7	20X8	20X9
20X0	563	524	514	501	494	482	485	486	486	486
20X1		578	554	528	526	519	518	518	521	520
20X2			487	495	486	478	478	476	475	475
20X3				523	519	520	517	520	522	522
20X4					603	637	649	661	666	667
20X5						708	708	700	708	707
20X6							740	761	786	787
20X7								800	800	802
20X8									860	866
20X9										898

For a well reserved company, Part 2 should show little upward or downward development along the rows. This illustration shows no significant development for accident years 20X2, 20X3, 20X5, 20X7, and 20X8.; downward development for accident years 20X0 and 20X1; and slight upward development for accident years 20X4 and 20X6. For all accident years combined, there is a 0.5 percent decline in incurred losses from the first report to the statement date.

Part 4 shows bulk and IBNR reserves. Since bulk and IBNR reserves are replaced by case reserves and payments as claims are reported and settled, we expect a steady decline along the rows.

Exhibit 2.6: 20X9 Schedule P, Part 4 ($000)

Part 4	20X0	20X1	20X2	20X3	20X4	20X5	20X6	20X7	20X8	20X9
20X0	348	177	114	82	61	41	36	26	20	12
20X1		326	190	119	85	62	47	35	28	20
20X2			265	166	113	76	60	46	40	31
20X3				296	167	114	81	60	50	38
20X4					328	194	131	95	74	58
20X5						410	231	142	100	62
20X6							438	246	170	118
20X7								462	246	146
20X8									515	238
20X9										560

The difference between Parts 2 and 4 shows case incurred (or reported) losses plus DCC. This new triangle may be used for a prospective test of loss reserve adequacy.

Exhibit 2.7: 20X9 Schedule P, Part 2 – Part 4 ($000)

Pt 2-4	20X0	20X1	20X2	20X3	20X4	20X5	20X6	20X7	20X8	20X9
20X0	215	347	399	419	433	442	449	460	466	474
20X1		252	363	409	441	457	471	483	493	500
20X2			222	329	373	402	418	430	435	444
20X3				227	352	406	436	460	471	484
20X4					275	443	518	566	592	609
20X5						298	477	558	608	645
20X6							302	515	616	670
20X7								338	554	656
20X8									345	628
20X9										338

LINK RATIOS AND DEVELOPMENT FACTORS

The reported loss link ratios shown below are formed in the same manner as the paid loss link ratios discussed earlier.

Exhibit 2.8: 20X9 Schedule P, Reported Loss Link Ratios

	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 – 10
20X0	1.614	1.150	1.050	1.033	1.021	1.016	1.024	1.013	1.017
20X1	1.440	1.127	1.078	1.036	1.031	1.025	1.021	1.014	
20X2	1.482	1.134	1.078	1.040	1.029	1.012	1.021		
20X3	1.551	1.153	1.074	1.055	1.024	1.028			
20X4	1.611	1.169	1.093	1.046	1.029				
20X5	1.601	1.170	1.090	1.061					
20X6	1.705	1.196	1.088						
20X7	1.639	1.184							
20X8	1.820								

Loss reserve projections that rely on reported (case incurred) loss development patterns are aided by knowledge of the insurer's case reserving practices, as well as of changes in these practices during the experience period. The three year average reported loss link ratios are higher than the corresponding five year averages for the first three maturities, so we have selected the three year averages as estimates for the future.

Exhibit 2.9: Reported Loss Development Test of Reserve Adequacy (dollars in $000)

	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9–10
Averages									
3 year	1.722	1.183	1.090	1.054	1.027	1.022	1.022		
5 year	1.675	1.175	1.084	1.048	1.027				
Select	1.720	1.180	1.090	1.050	1.030	1.020	1.020	1.010	1.010
Cumulative	2.539	1.476	1.251	1.148	1.093	1.061	1.041	1.020	1.010
Reported	$338	$628	$656	$670	$645	$609	$484	$444	$500
Developed	$858	$927	$821	$769	$705	$646	$504	$453	$505
Bulk Res	$520	$299	$165	$99	$60	$37	$20	$9	$5
Total Res	$702	$521	$336	$223	$163	$112	$70	$50	$51

For all accident years combined, the estimated ultimate incurred loss plus DCC is $6,188 thousand, and the reported incurred amounts on Part 2 are $6,244 thousand. The difference of less than 1 percent indicates accurate reserving.

Updating the Part 2 Exhibits

The figures for individual accident years in Part 2, except for those in the right-most column and the prior years row, may be copied from the corresponding entries in the previous Annual Statement. For the prior years row, a modification is required.

- The entries in the previous year's Schedule P for the prior row and for the first accident year should be divided between reserves and paid losses: paid losses are in Part 3 and reserves equal Part 2 minus Part 3.
- The reserves from the first two rows in the previous year's Schedule P are added together and posted directly to the current Schedule P.
- The current Schedule P payments are taken from Part 3.
- The sum of the reserves and the payments is the current year's prior years row on Part 2.

Illustration: We are completing the prior years row for the 2010 Schedule P. We illustrate the derivation of the 2007 statement date figure: the accident years 2000 and prior as of December 31, 2007. Assume the following figures are given in the 2009 Schedule P, Part 2, and in the 2010 Schedule P, Part 3:

- The 2009 Schedule P, Part 2, prior years row, shows $35 million at December 31, 2007, and the 2000 accident year shows $15 million at December 31, 2007.
- The 2009 Schedule P, Part 3, prior years row, shows $10 million at December 31, 2007, and the 2000 accident year shows $8 million at December 31, 2007.
- The 2010 Schedule P, Part 3, prior years row, shows $12 million at December 31, 2007.

We derive the figures for the 2010 Schedule P, Part 2 prior years row as follows:

- The reserves for the 2009 prior years row at December 31, 2007 are $35 million – $10 million = $25 million
- The cumulative paid losses for the 2009 prior years row at December 31, 2007 are $15 million – $8 million = $7 million.
- The required entry for the 2010 Schedule P, Part 2, prior years row, evaluated at December 31, 2007 is $25 million + $7 million + $12 million = $44 million.

The entries for the right-most column can be copied from Part 1. For each accident year, Part 2, column 10 equals columns 11 – 8 + 9 + 24 – 21 + 22 from Part 1. Columns 11 and 24 in Part 1 show total paid and unpaid losses plus loss adjustment expenses. Since Part 2 does not include AAO adjustment expenses, one must subtract the net AAO expenses. Columns 8 – 9 equal the net AAO paid (direct plus assumed minus ceded) and columns 21 – 2 equal the net AAO unpaid.

If the Part 1, column 24 entries are net of tabular discounts, one must add the tabular discounts by accident year to obtain the Part 2, column 10 entries. The tabular discounts are shown in Note 28 to the Annual Statement.

Reported loss development reserve procedures are particularly important for long tailed lines of business whose loss payments are small at early maturities, such as products liability and excess of loss reinsurance.

Illustration: Updating the Two-Year Lines

The following illustration puts together the procedures for Part 3, Part 2, and intercompany pooling agreements, and it clarifies the difference between the two year exhibits and the ten year exhibits.

The 20X3 Schedule P for XYZ Insurance shows the following data for auto physical damage.

Exhibit 2.11: Auto Physical Damage Incurred Losses

Schedule P – Part 2J – Auto Physical Damage Incurred Losses and DCC			
Year in which	Reported at Year End (in $000)		
Losses were Incurred	20X1	20X2	20X3
Prior	400	380	370
20X2	XXX	1000	1020
20X3	XXX	XXX	800

Exhibit 2.12: Auto Physical Damage Cumulative Paid Losses

Schedule P – Part 3J – Auto Physical Damage Cumulative Paid Losses and DCC			
Year in which	at Year End (in $000)		
Losses were Incurred	20X1	20X2	20X3
Prior	000	300	330
20X2	XXX	780	960
20X3	XXX	XXX	580

During 20X4, XYZ establishes an insurance subsidiary, ABC Insurance, and enters into a intercompany pooling arrangement in which each company gets 50% of the combined business. Neither company has any other reinsurance ceded or assumed.

For 20X4, the companies record the following:

Exhibit 2.13: Auto Physical Damage Calendar Year Transactions

Year in Which Losses Were	Losses and DCC Paid During 20X4		Reserves for Losses and DCC at the end of 20X4	
Incurred	XYZ	ABC	XYZ	ABC
Prior	16	0	10	0
20X2	40	0	20	0
20X3	200	0	50	0
20X4	400	300	150	100

We construct Schedule P, Part 2J and Part 3J for XYZ's 20X4 Annual Statement.

INTERCOMPANY POOLING

We begin with the pooling rules. We must form the 20X4 Schedule P exhibits for XYZ Insurance. In 20X4, XYZ formed a subsidiary, ABC Insurance, and established a 50%

intercompany pooling arrangement. Premiums and losses for XYZ and for ABC are pooled, and each company takes half.

In this illustration, ABC Insurance was not in existence during 20X2 and 20X3. This is not relevant for Schedule P. The Schedule P exhibits are restated to reflect the current intercompany pooling arrangements as if they were in effect in all prior years, even during years when one or more of the companies was not in existence.

Loss Payments

We begin with the prior years row in Part 3J, the paid loss triangle. In the paid loss triangles, the prior years row begins with "000." The 10-year exhibits for the long-tailed liability lines of business differ from the 2-year exhibits for the short-tailed property lines of business in the following respect.

- In the two year exhibits for the short-tailed property lines, the prior years row has two cells with figures preceded by one cell with "000." The entries begin in the same calendar year (20X3 in the illustration) as the entries for the oldest individual accident year (accident year 20X3 in the illustration).
- In the ten year exhibits, the "prior years" row has one cell with "000" followed by *nine* cells with figures. The oldest *individual* accident year has *ten* cells with figures. The entries for the prior years row begin one year after the entries for the oldest individual accident year.

We may restate this by saying that in the two year exhibits, the prior years row begins one year earlier in comparison to the ten year exhibits.

The same is true for the loss reserves. For the two year exhibits, Parts 2 and 4 begin with loss reserves for the prior years row at the date two years prior to the current statement date. Had we formed the two year exhibits by analogy to the ten year exhibits, we would have started the loss reserves for the prior years row at a date one year prior to the current statement date.

The rationale is that we need two years of real entries to show the two year development for IRIS Test 10. For the ten year lines of business, the entries needed for the two year adverse development test are available without the need to extend development back one year.

PRIOR YEARS ROW

We form the prior years row in the 20X4 Part 3J:

- The prior years row in the 20X3 Part 3J says that
  A. $300 was paid in calendar year 20X2 for accident years 20X1 and prior, and
  B. $330 – $300 = $30 was paid in calendar year 20X3 for accident years 20X1 and prior.

- For the prior years row in the 20X4 Part 3J we need to determine
  A. How much was paid in calendar year 20X3 for accident years 20X2 and prior, and
  B. How much was paid in calendar year 20X4 for accident years 20X2 and prior.

- From the 20X3 Part 3J we determine the amount paid in calendar year 20X3 for accident year 20X2 as $960 – $780 = $180. We add to this the $30 paid in calendar year 20X3 for accident years 20X1 and prior to get a total of $210 for Item 2.A above.

- The amount paid in calendar year 20X4 for accident years 20X2 and prior is $16 + $40 = $56. We add $56 and $210 to get $266, which is the final entry in the prior years row in the 20X4 all companies combined Part 3J (before the allocation to member companies).

INDIVIDUAL ACCIDENT YEARS

The remaining 20X4 Part 3J entries are straight-forward. Since the two companies participate in an intercompany pooling agreement, we first format the combined (all companies) Schedule P exhibits.

☞ The calendar year 20X3 payments for accident year 20X3 are the same as in the 20X3 Part 3J, or $580.

☞ The calendar year 20X4 payments are taken from the 20X4 experience:
  ✓ For accident year 20X3, the payments are $200. The cumulative accident year 20X3 payments as of December 31, 20X4 are $580 + $200 = $780.
  ✓ For accident year 20X4, the combined payments for the two companies are $400 + $300 = $700.

The 20X4 Part 3J for the two companies combined looks as follows:

Exhibit 2.14: Pooled Companies Cumulative Paid Losses

Years in which	Cumulative Paid Losses and DCC at Year End ($000)		
Losses were Incurred	20X2	20X3	20X4
Prior	000	210	266
20X3	XXX	580	780
20X4	XXX	XXX	700

Since the current pooling arrangement is 50% for each company, the 20X4 Part 3J for each company (XYZ and ABC) is exactly half of the combined Part 3J, as shown below.

Exhibit 2.15: Individual Companies Cumulative Paid Losses

Years in which Losses were Incurred	Cumulative Paid Losses and DCC at Year End ($000) 20X2	20X3	20X4
Prior	000	105	133
20X3	XXX	290	390
20X4	XXX	XXX	350

Loss Reserves

To form the 20X4 Part 2J, we add the loss reserves to the loss payments. From the 20X3 Parts 2J and 3J we form a triangle of loss reserves only, which is the difference between these two triangles:

Exhibit 2.16: Pooled Companies Loss Reserves

Year in which Losses were Incurred	Loss Reserves at Year End ($000) 20X1	20X2	20X3
Prior	400	80	40
20X2	XXX	220	60
20X3	XXX	XXX	220

For the 20X4 Part 2J, the entry in the upper-left corner is the loss reserves at December 31, 20X2 for accident years 20X2 and prior. From the triangle directly above, this is $80 + $220 = $300. In a similar fashion, we construct a triangle of loss reserves only for the 20X4 Schedule P, as shown below.

Exhibit 2.17: Pooled Companies Loss Reserves, Updated

Year in which Losses were Incurred	Loss Reserves at Year End ($000) 20X1	20X2	20X3
Prior	300	100	30
20X3	XXX	220	50
20X4	XXX	XXX	250

The December 31, 20X4 reserves are taken from the 20X4 experience exhibit. For accident year 20X4, we combined the reserves being held for XYZ and for ABC.

We add these reserves to the 20X4 Part 3J paid losses to get the 20X4 Part 2J (before the allocation to company).

Exhibit 2.18: Pooled Companies Incurred Losses

Years in which Losses were Incurred	Incurred Losses and DCC at Year End ($000) 20X2	20X3	20X4
Prior	300	310	296
20X3	XXX	800	830
20X4	XXX	XXX	950

We now allocate this triangle 50% to ABC and 50% to XYZ. The final Part 2J for each company looks as follows:

Exhibit 2.19: Individual Companies Incurred Losses

Years in which Losses were Incurred	Incurred Losses and DCC at Year End ($000) 20X2	20X3	20X4
Prior	150	155	148
20X3	XXX	400	415
20X4	XXX	XXX	475

PART 4 - BULK + IBNR RESERVES

Part 4 shows bulk + IBNR, or "actuarial," reserves, by accident year and evaluation date. These are reserves "for incurred but not reported claims, for reopened claims, for development on case reserves of reported claims, and for aggregate reserves on newly reported claims without specific case reserves" (Annual Statement *Instructions*). The use of Part 4 to derive case incurred (or reported) loss figures is described above.

Part 5 – Claim Counts

Parts 2, 3, and 4 of Schedule P allow the analyst to perform prospective reserve analyses using absolute dollar techniques, using either paid loss methods (Part 3) or reported loss methods (Parts 2 and 4).

Part 5 allows the analyst to perform claim count and average claim severity reserving analyses. Three claim count triangles are shown for the nine lines of business mentioned earlier in this paper (see page 35):

- Section 1: Cumulative direct plus assumed claims closed with loss payment
- Section 2: Direct plus assumed claims outstanding
- Section 3: Cumulative direct plus assumed claims reported

A triangle of direct plus assumed claims closed without loss payment can be derived from the three triangles shown, since reported claims equal the sum of

- claims outstanding,
- claims closed with loss payment, and
- claims closed without loss payment.

The total number of claims closed, both with and without loss payment, is the number of reported claims minus the number of claims outstanding.

Average Severity Reserve Analyses

Absolute dollar reserve analyses may be distorted by changes in (a) the volume of business, (b) inflation, or (c) case reserve adequacy. Claim count development is more stable. Average severity changes from accident year to accident year can be compared with inflation indices.

Illustration: Required reserves for the most recent accident year are difficult to quantify in long-tailed lines of business. Claim count / average severity reserving methods are often used for lines of business where losses take long to settle and are subject to substantial random fluctuation, as might be caused by unpredictable jury awards. (Medical malpractice provides a good example.) If the ultimate claim count can be estimated, and if average severities in the most recent accident year are assumed to be 8% higher than those in the previous accident year, the estimated ultimate losses are 108% × the ratio of claim counts in the most recent accident year to claim counts in the previous accident year. The ultimate losses minus the paid losses and the case reserves equals the indicated bulk + IBNR reserve.

Part 5 serves as an effective regulatory monitoring tool as well. Distressed insurers seeking to avoid regulatory scrutiny may artificially strengthen their surplus by (a) reducing case reserves, (b) not setting up compensating bulk reserves, and (c) paying claims more slowly. Whereas analyses of reserve adequacy based on absolute dollar figures may not uncover the problems, the claim count triangles would show two results:

- Reported claim counts and outstanding claim counts are not affected by reserve strengthening or weakening. The lower case and bulk + IBNR reserves depress the average severities, revealing the potential reserve problems.
- The slower claim settlement patterns are reflected by lower paid-to-reported claim ratios and higher open-to-reported claim ratios.

Illustration A: A company shows a 10% annual trend in average closed claim severities and a 2% annual trend in average outstanding claim severities. There has been no changes in claim settlement speed. A regulator might suspect that the company has weakened its loss reserves.

Illustration B: A paid loss development analysis does not show a reserve deficiency problem. However, the ratio of outstanding claims to reported claims at 12 months of development has increased from 30% to 45%. A regulator might suspect that the company is masking a reserve deficiency problem by delaying the settlement of claims.

ADJUSTING THE HISTORICAL TRIANGLES

Actuaries have developed techniques to correct for distortions caused by case reserve strengthening or weakening and for changes in claim settlement patterns (see Berquist and Sherman [1977]):

Changes in Claim Settlement

The paid loss development analysis using the Part 3 historical triangles uses "chronological" development ages: 12 months, 24 months, and so forth. If the company's loss settlement patterns are changing, the analyst may use "settlement" ages. Instead of using cumulative paid losses through 12 months, 24 months, and so forth, the analyst may use cumulative paid losses through the period of time when 25% of claims have been settled, 35% of claims have been settled, and so forth. This type of analysis requires the paid claim count histories of Part 5 (claims closed with payment).

CHANGES IN CLAIM SETTLEMENT: ILLUSTRATION

In past years, 50% of the automobile insurance liability accident year claims are settled during the accident year, another 30% are settled in the next 12 months, and the final 20% are settled

in the next 12 months. We summarize the cumulative claim settlement pattern as 50%-80%-100% for the first three years.

In an effort to control costs, the company has striven to settle claims more quickly during the most recent calendar year. The new pattern is 70%-90%-100% for the first three years. That is, 70% of the claims are settled during the accident year, another 20% are settled in the next 12 months, and the final 10% are settled in the next 12 months.

Small and simpler claims are settled more rapidly than large, complex claims. The pattern of loss payments is slower than the pattern of percentage of claims closed. In past years (before the recent revision of claim settlement practices), the pattern of loss payments was 33.3%, 66.7%, 100% in the first three years. That is, one third of losses were paid during the accident year, another third were paid in the next 12 months, and the final third were paid in the next 12 months.

In past years, the paid loss development factor from 12 months to ultimate in past years was 100% / 33.3% = 3.000, and the paid loss development factor from 24 months to ultimate was 100% / 66.7% = 1.500.

These historical paid loss development factors are too high for the current paid losses. Since a larger percentage of claims have been closed at each chronological age, a larger percentage of the losses have been paid by each development date, and there should be less paid loss development in subsequent periods.

BERQUIST-SHERMAN ADJUSTMENT

Instead of using cumulative paid losses, the reserving actuary may use the past experience to estimate the paid loss development factors from "50% of claims closed to ultimate" = 3.000 and from "80% of claims closed to ultimate" = 1.500. The analyst interpolates between these two figures to estimate the paid loss development factor from "70% of claims closed to ultimate." Simple linear interpolation gives a loss development factor of 2.000. In truth, the relationship between claims closed and losses paid is not linear, so the simple interpolation is not appropriate. Berquist and Sherman [1977] illustrate the procedure with an exponential relationship between claim settlement and loss payment.

The adjustment from chronological age to settlement age is important for actuarial loss reserving, but it must be used with caution. Many factors can cause changes in the claim settlement patterns without necessarily changing the loss payment pattern. For instance, an increase in nuisance claims, as had occurred in private passenger automobile and workers' compensation in the 1970's and 1980's, caused a large increase in the claim counts and the claim settlement speed, but no significant increase in the percentage of losses paid; see Conners and Feldblum [1998].

Changes in Case Reserve Adequacy

The case incurred (i.e., reported) loss development using Schedule P, Parts 2 and 4, may be distorted by changes in case reserve adequacy, even when these changes are compensated for by offsetting changes in bulk + IBNR reserve levels. To circumvent the problems caused by varying case reserve adequacy levels, one may restate the past case reserves based on the assumed inflation rate between the accident years.

Illustration: The average severity of personal automobile liability open claims at 12 months of development is $20,000 for accident year 20X9. The loss cost trend for private passenger automobile liability from accident year 20X8 to accident year 20X9 is 8%. We would expect the average outstanding clam severity in 20X8 at 12 months to have been about $20,000 / 1.08 = $18,519, or about $18,500. If the average value of open claims in 20X8 at 12 months differs significantly, the average case reserve adequacy level may have changed between 20X8 and 20X9.[76]

If the average value of open claims in accident year 20X8 at 12 months of development was $16,500, we might suspect that the claims department has been strengthening case reserves during the most recent calendar year (20X9). Replacing the observed value with the $18,500 expected value corrects for the distortion caused by changing reserve adequacy levels.

Suppose that the reported loss link ratio from 12 months to 24 months was 1.500 for accident year 20X8, when average case reserves were $16,500 at 12 months of development. This link ratio is too high for the 20X9 reported losses at 12 months of development, since the case reserves are stronger.

BERQUIST-SHERMAN ADJUSTMENT

To illustrate the necessary procedure to correct the distortion, suppose that the case reserves at 12 months of development in the previous year were composed of $100 million of paid losses and $100 million of case reserves. We separate the reported loss link ratio of 1.500 into two parts. The losses already paid in the first 12 months don't change in the next 12 months. The remaining reported losses – the case reserves – may be paid in the next 12

[76] To keep the illustrations in this paper simple, we do not consider credibility issues. In practice, we would not infer a change in the average case reserve adequacy level from a single observation of average outstanding claim severities. We would examine the relationship between average outstanding claim severities in calendar years 20X8 and 20X9 at various ages of development. If the difference between them is consistently different from the expected difference based on claim cost inflation, we might infer a change in case reserve adequacy levels.

months or may be re-estimated for a different amount. In addition, additional claims may be reported as IBNR losses.

Since the total reported losses increased by 50% from $200 million at 12 months to $300 million at 24 months and the losses already paid ($100 million) did not change, the case reserves increased by 100% from $100 million at 12 months to $200 million at 24 months.

The current case 20X9 reserves are more adequate by a factor of $18,500 / $16,500 = 1.121. We expect the current 20X9 case reserves to increase by 200% x $16,500 / $18,500 – 100% = 78.4% from 12 months to 24 months. The intuition for this is that the increase in the 20X8 case reserves from 12 months at December 31, 20X8 to 24 months at December 31, 20X9 was composed of two pieces: a +12.1% reserve strengthening and a +78.4% development increase from 12 months to 24 months.

The revised reported loss link ratio from 12 months to 24 months is (1.000 + 1.784) / 2 = 1.392. The figures are summarized in the table below, which assumes no change in exposure levels between accident years 20X8 and 20X9, but changes in reserve adequacy and monetary inflation.

Exhibit 5.1: Berquist-Sherman Adjustment for Changing Reserve Adequacy

Accident year	Paid loss at 12 months	Case reserves at 12 months	Reported losses at 12 months	Reported losses at 24 months	Reported loss development factor
20X8	$100 million	$100 million	$200 million	$300 million	1.500
20X9	$108 million	$121 million	$229 million	$324 million	1.415

A complete description of this procedure is presented by Berquist and Sherman [1977].

NET VS DIRECT PLUS ASSUMED

The claim count triangles in Part 5 show direct plus assumed business. The loss triangles in Parts 2, 3, and 4 show net business. If the company has a significant amount of ceded business, and if the ceding percentages of proportional treaties or the retentions in non-proportional treaties have changed over time, then the average severity analyses will be distorted.

The original rationale for showing the claim count triangles in Part 5 as direct and assumed business instead of net business was threefold.

First, it is difficult to measure net claim counts for business with ceded non-proportional reinsurance.

Illustration: A property is insured for $10 million, with an excess of loss reinsurance cover of $8 million above a $2 million retention. A claim is incurred for $5 million. The primary company pays $2 million and the reinsurer pays $3 million. There is one direct claim for the primary company. The reinsurer should presumably code this as one assumed claim. But is there 1 net claim, 0 net claims, or some intermediate number for the primary company? Coding net claims in the same percentage as net losses – 40% of a claim for the primary company – would be enormous work for little or no benefit.

Second, before 1993 the only claim counts shown in Schedule P were for the current valuation. These are the Part 1 and Part 3 claim count columns. The intention of these columns is to match the direct plus assumed claim counts with the direct plus assumed loss statistics. The difficulties in matching net vs. direct plus assumed business arose with the addition of historical claim count triangles to Schedule P in 1993.

Finally, when Part 5 was first formed, there was no reduction in claim counts for non-affiliated proportional ceded reinsurance. With the exception of intercompany pooling agreements, the Schedule P definition of net claim counts was the same as the Schedule P definition of direct plus assumed claim counts. This is no longer the case, since all proportional reinsurance reduces the direct plus assumed claim counts; see the discussion earlier in this paper.

AVERAGE VALUES OF OUTSTANDING CLAIMS

Both Part 1, column 25, "Number of Claims Outstanding," and Part 5, Section 2 allow one to determine the average value of an outstanding claim. A triangle of net case reserves by accident year may be formed as Part 2 – Part 3 – Part 4. This triangle includes both case loss reserves and case reserves for defense and cost containment (if the company holds such case reserves).

Direct plus assumed case reserves by accident year are in Part 1, column 13, which shows only the figures for the current statement date. The case reserves divided by the number of claims outstanding is the average value of an open case. A comparison of these values by accident year shows trends in average loss costs.

The trend in average outstanding claim severity is important for monitoring case reserve adequacy. An open claim loss severity trend lower than the closed claim loss severity trend may indicate case reserve weakening.

Illustration: The average loss cost trend for claims closed with payment is +8% per annum. This estimate is derived from the ratio of the Schedule P, Part 3 triangle to the Schedule P, Part 5, Section 1 triangle (closed with loss payment).

The average loss cost trend for open claims is +3% per annum. This estimate is derived from the ratio of the Schedule P, Part 2 – 3 – 4 triangle to the Schedule P, Part 5, Section 2 triangle (outstanding claims).

The 5 percentage point difference in the loss cost trends may indicate case reserve weakening, particularly if the company shows other signs of financial weakness.

COMPLETING THE PART 5 EXHIBITS

Part 5 has three sections: Section 1 shows cumulative claims closed with loss payment; section 2 shows claims outstanding; and section 3 shows cumulative reported claims.

Section 1 of Part 5 is similar to Part 3 for the individual accident years: Part 5 shows cumulative claims and Part 3 shows cumulative loss payments. The entries for the"prior years" row are different. In Part 3, the individual accident years show cumulative figures, and the "prior years" row shows cumulative loss payment beginning with the second calendar year shown along the top of the exhibit.

> *Illustration:* In the 2010 Annual Statement, the "prior years" row in Schedule P, Part 3 shows cumulative loss payments beginning from January 1, *2002* for accident years 2000 and prior.

Column 11 of Part 3, "number of claims closed with loss payment," shows the cumulative number of claims through the statement date for the individual accident years. Column 12 shows the corresponding number of claims closed without loss payment.

> *Illustration:* In the "prior years" row in the 2010 Annual Statement, Schedule P, Part 3, column 11 shows the cumulative number of claims closed with loss payment from January 1, 2002 through December 31, 2010 for accident years 2000 and prior.

Section 1 of Part 5 shows the cumulative number of claims closed with loss payment for the individual accident years at each December 31. For the individual accident years, column 10 of Part 5, Section 1 equals column 11 of Part 3. For the "prior years" row, Section 1 of Part 5 shows *incremental closings* in each calendar year, not the cumulative total. For the "prior years" row, column 10 of Section 1 of Part 5 does *not* equal column 11 of Part 3.[77]

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[77] Neither the NAIC *Instructions* nor the Schedule P exhibits mention this difference, though one item of the formatting of the exhibits alludes to it. The upper left hand cell of the Part 3 exhibits contains "000," indicating that the cumulative payments begin with the second column. These are the payments from the reserves held at the year-end date corresponding to the first column. The "prior years" closed claims shown in columns 11 and 12 of Part 3 correspond to the cumulative paid losses at the current statement date in column 11. In Section 1 of Part 5, the first cell in the "prior years" row does *not* contain "000," indicating that this row shows incremental closed claims, not cumulative closed claims. [I am indebted to Richard Roth for

Illustration: For accident year 2001, there are 5,000 claims closed with payment in each calendar year from 2001 through 2010. For accident years 2000 and prior, there are 10,000 claims closed with payment in each calendar year from 2001 through 2010.

For accident year 2001 in Part 5, Section 1, the counts are cumulative, so the company reports 5,000 in the 2001 column (column 1), 10,000 in the 2002 column (column 2), 15,000 in the 2003 column (column 3), and so forth, ending with 50,000 in the 2010 column (column 10). For the "prior years" row, the counts are incremental, so the company reports 10,000 claims in each column.

In column 11 of the Part 3 exhibit for accident year 2001, the company shows the cumulative count at the current statement date, or 50,000, as in Part 5, Section 1, column 10. For the "prior years" row, column 11 shows the cumulative claims closed since January 1, 2002, or 90,000, which differs from the entry in Part 5, Section 1, column 10 (which is 10,000).

Part 5, Section 2 shows claims outstanding at each year end. This figure is affected by the company's small claims handling procedures. Not all companies set up claim files for small claims that are expected to be settled quickly, as often occurs in personal automobile physical damage.

Part 5, Section 3, is similar to Part 5, Section 1. The individual accident years show the cumulative claims reported. The "prior years" row shows the incremental claims reported in each calendar year interval. The relationship that

cumulative reported claims = cumulative paid claims plus outstanding claims

holds for the individual accident years, but not for the "prior years" row.

For claims-made coverage, the Schedule P "incurral date" is the report date. Year 20XX in the left-most column means claims reported in 20XX, not claims with accident dates in 20XX. For the individual years shown in the left-most column, the figures in the initial diagonal are carried unchanged along each row. The entries in the "prior years" row should all be zero.

"Claims in transit" are a minor exception to these rules. A claim that is reported to the company on December 28, 20XX, may not be entered into the company's electronic files until January 10, 20XX+1. If the company prepares Schedule P immediately after the end of the year, the claim belongs in the year 20XX row but it may not show up until the year 20XX+1 column.

Electronic data processing files are not prevalent, and claims in transit for so long that they are not entered in time to the company's files are rare.

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explaining this to me.]

Part 6 – Premium Development

Part 6 shows the development of earned premium by exposure year, similar to the development of incurred losses by accident year in Part 2. Exposure year earned premium is not required elsewhere in the Annual Statement, and not all companies compile the requisite data.[78]

Accrued retrospective premiums and earned but unbilled premiums are most commonly analyzed by policy period, not by exposure year. Policyholders are concerned with the experience on their own contracts; the segmentation by exposure year is of little concern to them. Insurers are concerned with the effects of retrospective rating provisions and competitive adjustments on premiums. They use policy period data, not exposure year data.

The distribution of the current calendar year's earned premium to exposure years is shown in the right-most column (column 11), along with a reconciliation of the earned premium figures to those in Part 1 of Schedule P. Reconciliation to calendar year earned premium of earlier years uses the entries on the bottom row of Part 6; see below.

Exposure year premium figures are important for lines of business where premiums are affected by exposure audits, retrospective rating adjustments, or accounting lags in booking premiums. These lines are workers' compensation, other liability, products liability, commercial automobile, and reinsurance.

The text of this section deals with the Schedule P, Part 6 exhibits and the statutory accounting procedures directly tied to these exhibits. The post codification statutory accounting rules for audits and retrospective adjustments are complex. They are important background information for understanding Part 6 of Schedule P and the related Annual Statement pages, but a complete explanation of the issues would be too long for this chapter. We have placed this material in Appendix B. Readers may find this appendix helpful for mastering Part 6 of Schedule P.

Part 7 of Schedule P shows policy year triangles of premiums and losses on loss sensitive contracts. The concepts discussed here for the Part 6 exhibits are applicable to the Part 7 exhibits as well. To avoid repetition, we discuss both exposure year premiums and policy year premiums in the text below.

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[78] Only exposure years 1993 and subsequent need be reported in Schedule P, though companies may report entries for earlier years if they have the data. This provision has little effect now on the Part 6 exhibits.

The tax regulations in January 2000 regarding expected audits and retrospective premium adjustments affect the statutory accounting practices of many insurers. We explain the tax accounting rules in Appendix B as well.

PRINCIPLES

1. For most personal insurance policies, the premium is fixed at policy inception based on a known exposure base, such as car-years or house-years. For most commercial insurance policies, the premium depends on the activity of the insured during the policy period. Workers' compensation premium depends on the payroll during the policy term; products liability premium depends on the sales during the policy term. The written premium at policy inception is only a deposit premium.

2. For retrospectively rated policies, the premium depends on the loss experience of the insured, which is not known with certainty until the losses have been settled.

3. The insurer's estimated ultimate premium may differ from the written premium initially charged. For policies subject to audits, the initial premium may be below the estimated ultimate premium for competitive reasons. For retrospectively rated policies, the insurer expects to return premium to the employer at the first retrospective adjustment and to collect additional premiums at second and subsequent adjustments. Actual cash flow patterns and premium billing patterns differ by company and by policy. The Schedule P, Part 6 premium triangles show the premium billing patterns by line of business.

4. If the estimated ultimate premium differs from the premium actually billed, the insurer accrues the difference as a return premium (a retro debit) or as expected additional premium (a retro credit).[79] The premium triangles in Part 6 of Schedule P reflect the combined effects of exposure audits, retrospective rating, insurer accruals of return or additional premiums, and changes over time in these accruals.

Illustration: Retrospective Rating

A retrospectively rated workers' compensation policy is issued on January 1, 20XX with a premium rate of $1 per $100 of payroll. The premium rate is used for the deposit premium and the standard premium. On January 1, the insured employer estimates $200,000,000 of payroll for the coming year, so the initial written premium is $2,000,000. The retrospective rating formula for this illustration is

$$\textit{net premium} = 20\% \times \textit{standard premium} + 1.10 \times \textit{reported losses}.$$

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[79] The accrual rules were revised in 2002 for statutory accounting and in 2000 for tax accounting. The company's tax department may use the actuarial worksheets for Schedule P, Part 6 for the tax filing; see the appendix on accounting for audits and retrospective premium adjustments.

On February 15, 20XX+1, after the policy term has expired, the insurer audits the employer's payroll records. The true payroll for 20XX was $250,000,000, and the insurer bills the employer for an additional $500,000 of premium. The standard premium is $2.5 million.

Insurers often use low estimates for the coming year's payroll as competitive tools to produce low initial premium estimates. The final premium is revised upward in accordance with the payroll audit done after policy expiration. The insurer loses the investment income on the premium that is not collected until the end-of-year audit, but it retains the policy (Feldblum [1992: WCR]).

On July 1, 20XX+1, the first retro adjustment is processed. The retrospective rating formula uses reported losses, consisting of paid losses and case reserves; IBNR losses are not included. At the first retro adjustment, losses are still immature. The indicated retrospective premium is generally less than the estimated ultimate premium, resulting in a return premium to the employer (Berry [1980], Teng and Perkins [1996], Feldblum [1997: TP]).

At 18 months after policy inception (July 1, 20XX+1), the reported losses are $1,200,000, giving a retrospective premium of 20% × $2.5 million + 1.1 × $1.2 million = $1.82 million. The insurer returns $2,500,000 – $1,820,000 = $680,000 to the employer.

At second and subsequent adjustments, the reported losses increase as they develop to maturity, and the insurer collects additional premium from the employer. At 30 months after policy inception (July 1, 20XX+2), the reported losses may be $1,500,000, giving a retrospective premium of 20% × $2.5 million + 1.1 × $1.5 million = $2.15 million. The insurer bills the employer for an additional $2,150,000 – $1,820,000 = $330,000 of premium.

Calendar Year, Exposure/Accident Year, and Policy Year

Earned premium may be recorded by calendar year, exposure year, or policy year, and incurred losses may be recorded by calendar year, accident year, report year, or policy year. The Annual Statement reporting procedures are as follows:

Earned Premium

- Most accounting exhibits use calendar year premiums. These include the income statement; the Underwriting and Investment Exhibit, Part 2; the page 15 state exhibits; Schedule F; Schedule P, Part 1; Schedule T; and the Insurance Expense Exhibit.
- Schedule P, Part 6, shows exposure year earned premium. The reconciliation of Schedule P, Part 6 to Schedule P, Part 1 is shown in the last line of the right-most column of Part 6 (see below).
- Schedule P, Part 7 shows policy year earned premium for loss-sensitive contracts only.

Incurred losses

- Most accounting exhibits use calendar year losses. These include the income statement; the Underwriting and Investment Exhibit, Part 3; the page 15 state exhibits; Schedule F; Schedule T; and the Insurance Expense Exhibit.
- Schedule P, Parts 1 through 4 show accident year incurred losses for occurrence policies and report year losses for claims-made policies. The reconciliation of accident year incurred losses to calendar year incurred losses is not shown explicitly, but it can be derived in the same manner as for earned premiums.[80]
- Schedule P, Part 7 shows policy year incurred losses for loss-sensitive contracts only.

AUDIENCES

The four data types – calendar year, policy year, exposure/accident year, and report year – serve different audiences.

1. Calendar year data, which is final at the end of the year, is used for accounting statements in the United States. No actuarial estimates are needed. Calendar year data eliminates potential biases caused by consistent over- or under-reporting of initial estimates. However, calendar year data are the subject to smoothing of reported results.
2. Policy year data are used for policy pricing, particularly when policy conditions that affect the premiums and losses change over time, as is true for retrospectively rated policies.
3. Accident year and exposure year data are used for reserving, which requires data that are homogeneous in the age since the accident or since policy inception.
4. Report year data are used by claims personnel. Claims department efficiency is often measured by the lag between report and settlement of the claim.

ILLUSTRATION: DATE TYPES

The Part 6 triangles incorporate the effects of accrued retrospective premium estimates and the changes over time in these estimates. Some users of Schedule P are not aware that these estimates are included, and they mistakenly presume that the premium development patterns should reflect the progression of billed premiums.

Part 6 shows earned premium triangles; Part 7 shows both earned premium triangles and premium reserve triangles. Exposure year earned premiums are like accident year incurred losses, so Schedule P, Part 6 is the premium equivalent of the losses in Part 2. Accrued retrospective premium reserves and earned but unbilled premium reserves are bulk reserves,

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[80] The reconciliation is complicated by the differing treatments of loss adjustment expenses. In the historical triangles of Schedule P (Parts 2, 3, and 4), defense and cost containment adjustment expenses are combined with losses, and adjusting and other adjustment expenses are not shown. In the Underwriting and Investment Exhibit, loss adjustment expenses are shown only in total (i.e., DCC + AAO), separate from losses. In addition, Schedule P is gross of reserve discounts, whereas the other statutory exhibits are net of discounts.

like the loss reserves in Schedule P, Part 4. The earned premiums minus the premium reserves equal the billed premiums, which are similar to the reported losses shown as the difference between Part 2 and Part 4.

To highlight the effects of premium reserve estimates, we show the illustration in two parts. Part A assumes no estimates of IBNR losses, of future audits, or of accrued retrospective premiums. Part B includes these estimates.

Part 6 shows exposure year triangles; Part 7 shows policy year triangles. The illustration in this section shows the derivation of both exposure year and policy year premiums.

Illustration: A retrospectively rated annual workers' compensation policy is issued on October 1, 2003. The standard premium is $10,000, and the maximum premium is equal to 150% of the standard premium. The following transactions occur in this illustration:

- One loss occurs on March 1, 2004, with an initial reserve estimate of $8,000.
- On December 15, 2004, the payroll audit indicates that an additional $1,000 of premium should be billed. The standard premium is now $11,000, and the maximum premium is changed to $16,500.
- On November 1, 2005, the case reserve is revised to $25,000.
- On July 1, 2005, the first retrospective adjustment shows no additional or return premiums.
- On July 1, 2006, the second retrospective adjustment calls for an additional premium of $5,500. The $17,000 increase in the incurred losses results in only a $5,500 increase in the retrospective premium because of the premium maximum in the policy.

The contract is loss-sensitive, so its premium and loss amounts appear in both Part 6 and Part 7. The appropriate earned premium and incurred loss figures are as follows.

Calendar Year Accounting

Calendar year incurred losses equal calendar year paid losses plus the change in the reserve from the beginning of the year to the end of the year. In this illustration, there are no paid losses, but there are reserve changes.

- The 2003 incurred losses are zero.
- The 2004 incurred losses are $8,000 – $0 = $8,000.
- The 2005 incurred losses are $25,000 – $8,000 = $17,000.

Calendar year earned premiums (Schedule P, Part 1) equals written premium minus the change in the unearned premium reserves.

- The initial premium is split $2,500 for calendar year 2003 and $7,500 for calendar year 2004, reflecting the pro-rata earning of premium over the coverage period. The calendar

year 2003 written premium is $10,000 and the unearned premium reserve at December 31, 2003, is $2,500, so the calendar year 2003 earned premium is $10,000 – ($7,500 – $0) = $2,500.

- The audit premium of $1,000 is recorded as 2004 earned premium when it is billed. This is the meaning of the statutory accounting dictum that "audit premiums are earned when written." This dictum is correct when there are no estimates of future audits or when these estimates are not being considered.
- In practice, earned but unbilled premium reserves and accrued retrospective premium reserves are bulk reserves, set by the actuary. The audit premiums are earned in the accounting period when they are written. The decrease in the premium reserve is a negative earned premium in the period when the reserves are taken down.
- The retrospective premium of $5,500 is recorded as 2006 earned premium when it is billed.

This accounting treatment presumes that the premiums resulting from the exposure audit and the retrospective adjustment are unanticipated, and that the increase in losses is not anticipated in the IBNR reserve. If reserves are held for earned but unbilled (EBUB) premiums or accrued retrospective premiums, the accounting is different; see the discussion below.

Policy Year Accounting

Policy year incurred losses (Schedule P, Part 7, Section 2) are allocated to the effective date of the policy, regardless of the dates of loss occurrence or reporting.

- At December 31, 2003, policy year 2003 incurred losses are zero.
- At December 31, 2004, policy year 2003 incurred losses are $8,000.
- At December 31, 2005, policy year 2003 incurred losses are $25,000.

Policy year earned premium (Schedule P, Part 7, Section 4) is allocated to the effective date of the policy.

- At December 31, 2003, the (estimated ultimate) 2003 earned premiums are $10,000. Only ¼ of the premium has been earned by December 31, so the policy year 2003 earned premium as of December 31, 2003 is $2,500.
- At December 31, 2004, the revised 2003 earned premiums are $11,000 (written premium plus audit). The 2004 earned premiums (from this policy) are zero. All premium is coded to policy year 2003, regardless of when the premium is billed. At December 31, 2005, the policy year 2003 earned premium is still $11,000.
- At December 31, 2006, the revised 2003 earned premiums are $16,500 (written premium plus audit plus retrospective premium); the 2004, 2005, and 2006 earned premiums (from this policy) are zero.

Accident/Exposure Year Accounting

Accident year incurred losses (Schedule P, Parts 1, 2, 3, and 4) are coded to the date the loss occurrs (for occurrence policies) or to the date the loss is reported (for claims-made policies).

- At December 31, 2003, accident year 2003 incurred losses are zero.
- At December 31, 2004, accident year 2003 incurred losses are zero, and accident year 2004 incurred losses are $8,000.
- At December 31, 2005, accident year 2003 incurred losses are zero; accident year 2004 incurred losses are $25,000; and accident year 2005 incurred losses are zero.

Exposure year earned premiums (Schedule P, Part 6) are similar to accident year incurred losses. The earned premium is allocated by year based on the exposures in each year.

- At December 31, 2003, exposure year 2003 earned premiums are $2,500. If there are audits or retrospective adjustments in 2003 relating to policies that were issued and earned in previous years, they are coded as exposure year premium (for Part 6) or as policy year premium (for Part 7) relating to earlier years.
- At September 31, 2004, exposure year 2003 earned premiums are $2,500 and exposure year 2004 earned premiums are $7,500. The December 15, 2004 audit is distributed over the policy term, so on December 31, 2004, the exposure year 2003 earned premiums are $2,750, and the exposure year 2004 earned premiums are $8,250
- The $5,500 retrospective premium stems from a March 2004 loss, and one might presume that it should be coded to exposure year 2004. In practice, it is too complex to allocate retrospective premiums to exposure years based on the accidents which led to the premiums.[81] Instead, the retrospective premiums are allocated to exposure years as the audit premiums are allocated (in proportion to the coverage period): $1,375 to exposure year 2003 and $4,125 to exposure year 2004.

We will incorporate premium and loss reserves in this illustration after explaining the statutory accounting rules for exposure year premiums.

ACCOUNTING FOR EXPOSURE YEAR PREMIUMS

Part 6 shows premium development triangles separately for direct plus assumed business (Section 1) and for ceded business (Section 2). Net premium development is the difference between these two triangles. Direct plus assumed business is shown separately from ceded business since audit premiums and accrued retrospective premiums are more easily and accurately recorded for direct premiums than for ceded premiums.

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[81] In addition, the maximum premium caps the full policy year retrospective premium. It would be difficult to spread this cap by exposure year.

The historical loss triangles in Parts 2, 3, and 4 show *net* losses. For companies with significant reinsurance transactions, one must take care to compare net losses with net premiums. This is particularly true if there have been material changes in the ceded reinsurance arrangements during the historical period.

The accounting rules for Schedule P, Part 6 are as follows:

1. The individual exposure years show cumulative earned premiums. The earned premiums include (i) collected premiums, (ii) billed but uncollected premiums, (iii) earned but unbilled premiums, and (iv) accrued retrospective premiums. Only the earned portion of these components is included in the Part 6 exhibits.

   Illustration: A policy is written on July 1, 20XX for a written premium of $10,000. On December 31, 20XX, the actuary expects a final audit premium to be billed around September 20XX+1 for $2,000. The 20XX earned premium is

   $$50\% \times \$10{,}000 + 50\% \times \$2{,}000 = \$6{,}000.$$

2. The "prior years" row shows *incremental calendar year changes* to the earned premium for the prior exposure years. The Part 6 exhibits are like the Part 5 exhibits in this respect, not like the Part 3 exhibits.

   Illustration: The cumulative earned premiums at December 31, 2009, are $20 million apiece for exposure years 2000 and 2001. In 2010, there is an unanticipated retrospective adjustment of +$20,000 for an annual policy with a July 1, 2000, effective date. No other calendar year 2010 retrospective adjustments affect any exposure years 2001 and prior.

   For the 2010 Schedule P, column 10 of Part 6 shows (i) the cumulative total for the individual exposure years 2001 through 2010, and (ii) the calendar year transactions for exposure years 2000 and prior. The +$20,000 retrospective adjustment is divided evenly between exposure year 2000 and exposure year 2001, since the policy was in force from July 1, 2000 through June 30, 2001. Exposure year 2001 shows $20,010,000 in row 2, column 10, of Part 6. The prior year figure in row 1, column 10 is $10,000.

3. For all but the current calendar year, earned premiums need be distributed only to exposure years 1993 and subsequent. The distribution for earlier exposure years may be shown if the company desires and has the data. This rule becomes moot for the 2003 and subsequent Annual Statements; for most companies, it is no longer material for the 2001 and 2002 Annual Statements as well.

4. The distribution of the current calendar year's earned premiums to all exposure years (including the "prior years" row) is shown in column 11 of Part 6, to facilitate the

reconciliation with calendar year earned premiums. The entries in this column are incremental figures, not cumulative figures. The reconciliation procedure is explained below.

5. The final row of the Part 6 exhibits shows the Schedule P, Part 1 calendar year earned premiums. This facilitates the reconciliation of exposure year earned premiums with calendar year earned premiums.

To clarify the contents of the historical premium triangles in Part 6 and Part 7 of Schedule P, we show first a simple example of earned but unbilled premium and accrued retrospective premium, followed by the complete illustration of calendar year, exposure year, and policy year premiums that we began earlier.

Part 6 Illustration

A company issues a retrospectively rated workers' compensation policy with a deposit premium of $100,000 on January 1, 20XX. This illustration is deliberately simplified, so that the exposure year is the same as the policy year. Several large losses occur in 20XX. On December 31, 20XX, the company expects to collect an additional $40,000 in future retrospective adjustments, and it puts up an accrued retrospective premium asset (or contra-liability) of $40,000.

The company can collect additional premium only for reported losses, not for IBNR losses or for expected development on known claims. At the first retrospective adjustment on July 1, 20XX+1, the company collects $30,000 from the insured employer and reduces the accrued retrospective premium reserve to $10,000.

During the third quarter of 20XX+1, there is unexpectedly high development on the reported claims. By December 31, 20XX+1, the company raises the accrued retrospective premium reserve to $20,000.

The reporting in Parts 6 and 7 of Schedule P is as follows:

A. The 20XX exposure year earned premium in Part 6, as well as the 20XX policy year earned premium in Part 7, Section 4 is the written premium minus the change in the unearned premium reserve. The accrued retrospective premium reserve is a contra-liability, which went from $0 on January 1 to $40,000 on December 31. The 20XX earned premium is

$$\$100{,}000 - (-\$40{,}000 - \$0) = \$140{,}000.$$

B. The "net reserve for premium adjustments and accrued retrospective premiums at year end" in Section 5 of Schedule P, Part 7 shows the contra-liabilities as positive figures. The figure for policy year 20XX is $40,000 at December 31, 20XX.

C. In calendar year 20XX+1, Parts 6 and 7 of Schedule P show cumulative figures. The cumulative 20XX earned premium is the $130,000 paid plus the $20,000 remaining reserve, or $150,000.

An alternative view is helpful for the reconciliation with calendar year earned premium. The 20XX+1 calendar year earned premium is the written premium minus the change in reserves, or $30,000 – [–$20,000 – (–$40,000)] = $10,000.

This $10,000 is added to the $140,000 exposure year 20XX earned premium at December 31, 20XX to give a cumulative amount of $150,000 at December 31, 20XX+1.

D. The "net reserve for premium adjustments and accrued retrospective premiums at year end" in Section 5 of Schedule P, Part 7 for policy year 20XX at December 31, 20XX+1 is $20,000.

ACTUARIAL ESTIMATES

As a final illustration, we rework the example presented earlier in this section, using the company's estimates of earned but unbilled premiums and accrued retrospective premiums.

A retrospectively rated annual workers' compensation policy is issued on October 1, 2003. The standard premium is $10,000, and the maximum premium is equal to 150% of the standard premium. The following transactions occur in this illustration:

- On December 31, 2003, the reserving actuary estimates that the payroll audit at policy expiration will add $2,000 of premium.
- One loss occurs on March 1, 2004, with an initial reserve estimate of $8,000.
- On December 15, 2004, the payroll audit indicates that an additional $1,000 of premium should be billed. The standard premium is now $11,000, and the maximum premium is changed to $16,500.
- On December 31, 2004, the reserving actuary estimates bulk reserves for this policy of $6,000; this is primarily adverse development on known claims. The actuary also estimates an accrued retrospective premium reserve of $4,000.
- On July 1, 2005, the first retrospective adjustment shows no additional or return premiums.
- On November 1, 2005, the case reserve is revised to $25,000. On December 1, 2005, the claim is settled for $25,000.
- On December 31, 2005, the reserving actuary, using an aggregate bulk reserving method, changes the accrued retrospective premium reserve to $12,000.

- On July 1, 2006, the second retrospective adjustment calls for an additional premium of $5,500. The $17,000 increase in the incurred losses results in only a $5,500 increase in the retrospective premium because of the premium maximum in the policy.

In this illustration, we speak of the reserving actuary developing reserve indications for a single policy or for a single claim. In practice, this is rarely done. The reserve indications are based on aggregate data. They are estimated for accident years or policy years, not for individual claims or policies.

The illustration is heuristic. We show the component pieces of paid amounts, case reserves, and bulk reserves to clarify the statutory accounting principles. The accrued retrospective premium reserve of December 31, 2005 is an example of this. The reserving actuary used an aggregate reserving method, whereby the premium reserve is about ⅔ of the bulk loss reserve. Had the actuary used a per policy reserving method, the premium reserve would have been capped at $5,500.

Estimated Payroll Audit

The actuary's estimate of the earned but unbilled premium is included in the earned premium for the year. At December 31, 2003, the estimated earned premium for the policy is $10,000 deposit premium + $2,000 audit premium = $12,000. One quarter of the policy has been earned by December 31, so the 2003 earned premium is $3,000. The expected earned premium for 2004, as of December 31, 2003, is $9,000.

On September 30, 2004, the policy expires. The additional $9,000 of earned premium is charged to calendar year 2004 earned premium, exposure year 2004 earned premium, and policy year 2003 earned premium.

On December 15, 2004, the payroll audit yields only $1,000, not $2,000. The net earned premium from the payroll audit is the billed premium plus the change in reserve,[82] or

$$\$1{,}000 + (\$0 - \$2{,}000) = -\$1{,}000.$$

- For calendar year earned premiums, the net earned premium from the payroll audit of –$1,000 is allocated to 2004.
- For policy year earned premiums, the net earned premium from the payroll audit of –$1,000 is allocated to 2003.
- For exposure year earned premiums, the net earned premium from the payroll audit of –$1,000 is allocated ¼ to 2003 and ¾ to 2004.

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[82] We refer to the premium asset as the reserve, as is common practice in the industry. Were we to speak of the premium liability as the reserve, the earned premium would be the billed premium *minus* the change in the reserve.

ESTIMATED RETROSPECTIVE PREMIUMS

The same procedure is used for all other bulk reserves.

On December 31, 2004, the bulk reserves for this policy are $6,000 for losses and $4,000 for premiums. The actuary is using an aggregate premium reserving method with a ⅔ sensitivity factor.

- For calendar year accounting, both the bulk reserve for losses and the bulk reserve for premiums are assigned to 2004.
- For policy year accounting, both the bulk reserve for losses and the bulk reserve for premiums are assigned to 2003.
- For accident year accounting, the bulk reserves for losses are assigned to 2004.
- For exposure year accounting, the ¼ of the bulk reserve for premiums is assigned to 2003 and ¾ is assigned to 2004.

On December 31, 2005, the bulk reserve for premiums is revised to $12,000. The change in the bulk reserve is $12,000 – $4,000 = $8,000. This is assigned to calendar year 2005 and to policy year 2003. For exposure year accounting, ¼ is assigned to 2003 and ¾ is assigned to 2004.

On July 1, 2006, the bulk reserve for premiums is changed to a billed premium of $5,500. The net earned premium resulting from the retrospective adjustment is

$$\$5{,}500 + (\$0 - \$12{,}000) = -\$6{,}500.$$

This net earned premium is assigned to calendar year 2006 and to policy year 2003. For exposure year accounting, ¼ is assigned to 2003 and ¾ is assigned to 2004.

COMPLETING THE PART 6 EXHIBITS

An illustration should help clarify the reporting of premiums in Part 6 and the reconciliation with Part 1. Since the earned premium entries include the earned but unbilled premium and accrued retrospective premium reserves, a company which sets reserves accurately should show little development along the rows. Upward development indicates conservatism; downward development indicates over-optimistic reserves.

Exhibit 6.1: 20X9 Schedule P, Part 6 ($000's)

Part 6	20X0	20X1	20X2	20X3	20X4	20X5	20X6	20X7	20X8	20X9	(A)*
prior	25	15	10	8	6	5	4	4	3	3	3
20X0	500	480	485	488	490	495	495	497	498	499	1
20X1		520	525	523	520	530	540	538	540	542	2
20X2			550	555	555	560	555	550	552	555	3
20X3				580	585	590	592	595	595	597	2
20X4					620	630	700	690	700	700	0
20X5						700	710	720	720	730	10
20X6							750	750	740	760	20
20X7								800	820	810	-10
20X8									850	860	10
20X9										900	900
(B)**	525	515	570	594	630	740	841	802	878	941	941

* "A" = "Current Year Premiums Earned"
** "B" = "Earned premiums, Schedule P, Part 1"

The final row in the exhibit shows the calendar year earned premiums from Schedule P, Part 1, column 2 (direct plus assumed earned premiums). Consider calendar year 20X4. Of the $630,000 in earned premium, $620,000 is allocated to exposure year 20X4. $5,000 is allocated to exposure year 20X3, which is the difference between the cumulative figures of $585,000 and $580,000. A negative $3,000 is allocated to exposure year 20X1; in other words, the take down in the accrued retrospective premium reserve for exposure year 20X1 between 12/31/20X3 and 12/31/20X4 exceeded the additional premiums collected in this period for exposure year 20X1.

For the prior years row, the Part 6 entries are the incremental values themselves. The reconciliation is as follows:

The calendar year "X" earned premium =
the sum of the calendar year "X" column entries for individual exposure years
– the sum of the calendar year "(X–1)" column entries for individual exposure years
+ the calendar year "X" entry for the "prior years" row.

This reconciliation is possible only if the company shows entries for all exposure years. If entries are shown only for exposure years 1993 and subsequent, then any changes in earned

premium associated with previous exposure years simply disappear. The right-most column in the exhibit shows incremental premium changes for all exposure years during the current calendar year, to enable a reconciliation with the current calendar year earned premium.

Approximations

Part 6 is similar to Part 2; both show development of incurred amounts. In Part 2, however, payments and case reserves are related to particular losses, which are associated with specific accident years. Similarly, bulk reserves are generally determined by the development of accident year paid losses or reported losses, so bulk reserves also relate to specific accident years.

Return premium and additional premiums are associated with policies. The earned but unbilled premium reserves and the accrued retrospective premium reserves are generally determined from policy year triangles, not exposure year triangles. Most companies will convert the return premiums, additional premium collections, and reserve changes from a policy year basis to an exposure year basis by approximations. Nevertheless, since the primary purpose of Part 6 is to allow the computation of accurate exposure/accident year loss ratios, Part 6 uses exposure years, not policy years.

Part 7 – Loss Sensitive Contracts

Parts 1 through 6 of Schedule P were designed to monitor loss reserve adequacy. Part 7 was designed by the American Academy of Actuaries Task Force on Risk-Based Capital (RBC), and it has two purposes: (i) to determine the company's percentage of written premium and of reserves related to loss-sensitive contracts, and (ii) to determine the sensitivity of premiums and of reinsurance commissions to losses on these contracts.

- Parts 1 through 6 show experience on the company's entire book of business. Part 7 shows experience on loss sensitive contracts only.

- Part 7 is optional. It must be completed only if the company claims a reduction for loss sensitive contracts in its risk-based capital reserving risk charge or written premium risk charge. All other exhibits in Schedule P must be completed by all companies.

- Parts 1 through 6 show data by line of business. Section 1 of Part 7A and Part 7B use the same subdivision by line of business. Sections 2 through 5 of Part 7A and sections 2 through 7 of Part 7B are on an all lines combined basis. Loss sensitive contracts sold to large accounts often combine several lines of business, and it might be difficult to separate the premium sensitivity by line.

- The losses and claim counts in Parts 1 through 5 are on an accident year basis, and the earned premiums in Part 6 are on an exposure year basis. Accident year and exposure year are equivalent data types, though the former refers to losses or claims and the latter refers to premiums. The losses and premiums in Part 7 are on a policy year basis. No other exhibit in the Annual Statement is on a policy year basis.[83]

- Part 7A shows net experience on primary loss-sensitive contracts, and Part 7B shows net experience on reinsurance loss-sensitive contracts. The direct business is shown separately from the reinsured business because the RBC loss sensitive contract offset is 30% for primary policies and 15% for reinsurance treaties. The rationale for this difference is that workers' compensation retrospectively rated policies often have wider swings than sliding scale commissions have on reinsurance treaties.

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[83] Premium sensitivity is dependent on the retrospective rating plan parameters, which are analyzed on a policy year basis; see the "formula approach" in Teng and Perkins [1996].

RBC Underwriting Risk Charges

For most companies, the reserving risk charge (R_4) and the written premium risk charge (R_5) contribute the largest portions of total capital requirements. The risk-based capital formula provides a reduction in these charges for business written on loss sensitive contracts.

The reserving risk charge is the amount of capital needed to guard against unanticipated adverse development on existing reserves in a "worst case" scenario. The risk-based capital formula determines the worst case scenario based on industry-wide Schedule P experience from 1983 through 1992. The capital needed is reduced for the expected investment income on the assets backing the loss reserves.

Illustration: Based on historical industry-wide Schedule P data from 1983 through 1992, the risk-based capital formula estimates that workers' compensation loss reserves may develop adversely by 27.3% in a worst case scenario. The average discount factor for workers' compensation loss reserves in the risk-based capital formula is 87.2%.

In a worst case scenario, $100 of workers' compensation loss reserves may develop into $127.30 of paid losses. The assets needed now to fund $127.30 when the losses are paid equal $127.30 x 87.2% = $111.01. The reserving risk charge for workers' compensation is 11.0% of the held reserves.

Premium Sensitivity

If the workers' compensation policy is retrospectively rated – that is, the policy is a loss sensitive contract – the adverse development on loss reserves is at least partially offset by additional premium. Less capital is needed to guard against a worst case scenario.

Illustration: Suppose that for each dollar of additional loss, the insurer expects 40¢ of additional premium (retrospective premium credits). If $100 of loss reserves develops into $127.30 of paid losses, the insurer expects to collect additional premium of $27.30 x 40% = $10.92. The insurer needs $11.01 – $10.92 = $0.09 of capital for adverse development on a dollar of held reserves.

The sensitivity of retrospective premiums to losses varies widely among retrospectively rated policies. The retrospective rating formula itself generally has a sensitivity of at least unity. A dollar of loss may lead to a $1.10 or $1.15 of retrospective premium, where the extra ten or fifteen cents covers loss adjustment expenses and other loss related charges, such as state premium taxes and involuntary market burdens.

In practice, losses are capped in most retrospective rating plans, and retrospective premiums are limited by a maximum. The actual premium sensitivity depends on the parameters of the

retrospective rating plan, the shape of the insured's size-of-loss distribution, and the amount of the standard premium.

The premium sensitivity also depends on the maturity of the losses. The first losses to be reported are rarely capped, and the insured generally has not reached the maximum premium. The premium sensitivity is about unity. In contrast, adverse development on mature loss reserves generally occurs on large losses, which may have already been capped by the parameters of the retrospective rating plan. In a worst case scenario, the insured may also have reached the maximum premium. The premium sensitivity may be quite low, such as 20¢ or 30¢ for each additional dollar of loss reported.[84]

In 1993, the NAIC Working Group on Risk-Based Capital decided on conservative levels of premium sensitivity: 30% for primary contracts and 15% for reinsurance contracts. Companies which write retrospectively rated workers' compensation policies for large accounts have argued that the premium sensitivity on their books of business is significantly greater.[85] Sections 2 through 5 of Schedule P, Part 7A, and section 2 through 7 of Schedule P, Part 7B, are designed to provide the data for more accurate estimates of premium sensitivity.

Loss Reserve Adequacy and RBC Offsets

Schedule P, Part 7 is not related to the earlier parts of Schedule P. The ostensible reasons for the inclusion of the loss sensitive contracts exhibits in Schedule P are that

- The risk-based capital underwriting risk charges use the Schedule P line division, and the RBC loss sensitive contract offset uses the same line division.
- Premium sensitivity relates to reserve development, which is the subject matter of Schedule P.

The historical motivation for including these exhibits in Schedule P was more direct. The NAIC was concerned that companies might not properly classify their contracts if they report the figures in the risk-based capital submission. Companies would be less likely to classify

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[84] For discussions of premium sensitivity and its determinants, see Bender [1994], Mahler [1996], Teng and Perkins [1996], and Feldblum [1997: PDLD].

[85] The premium sensitivity depends on the types of plans sold by the insurance company. For a workers' compensation carrier selling wide-swing plans to large accounts, the sensitivity may be between 80% and 85% for the written premium risk loss sensitive contract offset and between 60% and 65% for the reserving risk loss sensitive contract offset. For a company selling narrow swing plans to small risks, the offsets are much smaller. For an analysis of premium sensitivity on plans sold to small accounts, see Bender [1994] and the discussion by Mahler.

a contract as loss sensitive if in fact it were not loss sensitive if the reporting were in Schedule P, since most companies treat the Schedule P submission with more care and diligence.[86]

Premiums, Commissions, Dividends

Loss sensitive contracts are of three types:

- For retrospectively rated primary contracts, the final premium depends on the losses incurred by the insured, subject to loss limits and premium maximums and minimums.
- For sliding scale reinsurance treaties, the reinsurance commission depends on the loss ratio experienced on the assumed book of business, subject to a maximum and minimum (see Clark [1996]).
- For many policyholder-dividend plans, the dividend payable to each insured depends on that insured's loss ratio or on the loss ratio of a classification group.

The risk-based capital principles are as follows:

- If the premium varies with losses and is sufficiently responsive, the policy is considered "loss sensitive."
- If the primary policy's commission varies with losses (e.g., contingent commissions), the policy is not considered a loss sensitive contract. Contingent commissions on direct business generally have narrow swings, so the sensitivity to losses is limited.
- If the reinsurance treaty's commission varies with losses (e.g., sliding scale commissions), the policy may be considered a loss sensitive contract. However, since the average responsiveness of reinsurance commissions and premiums to losses differs from the average responsiveness of primary premiums to losses, separate offsets are used for direct and for assumed business, and separate Part 7 exhibits are shown for primary business and for reinsurance contracts.
- Varying dividend rates do not make a policy loss sensitive. Policyholder dividends are generally optional, not contractual.

Definition of Loss-Sensitive Contracts

The risk-based capital underwriting risk factors are applied to loss reserves and to written premium, so Section 1 of Parts 7A and 7B determines the percentage of loss reserves and of written premium by line of business that relates to loss-sensitive business. Since the risk-based capital requirements are lower for loss-sensitive business, distressed companies have an incentive to classify their business as loss-sensitive, even if the loss-sensitivity is

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[86] The inability to reconcile the Part 7 data with other statutory exhibits make regulators especially uneasy. Vincent Laurenzano, in particular, advocated the inclusion of these exhibits in Schedule P to ensure the accuracy of the figures.

minimal. To prevent such abuse, a contract must fulfill the following six criteria to be classified as loss-sensitive:

1. An increase in losses can lead to an increase in net payment for that policy. If the loss sensitive item is not a monetary transaction, the contract is not loss sensitive.

2. The loss sensitive payment must be at least 75% of the loss on primary business and at least 50% of the loss on reinsurance treaties before the application of any limits. In other words, if losses on a retrospectively rated workers' compensation policy increase by $10,000, the retrospective premium must increase by at least $7,500 before the application of loss limits or maximum premium caps.

3. Maximum and minimum premiums, loss limits, and upper and lower bounds on the reinsurance commission may constrain an otherwise "loss sensitive" contract. For a contract to be classified as loss sensitive, the "swing" of the plan must be at least 20% for primary business and 10% for reinsurance treaties. The net amount payable when the loss experience is the worst possible must be at least 20% greater than the net amount payable when the loss experience is the best possible.

   Illustration: A retrospectively rated workers' compensation policy with a minimum premium of $9,000 and a maximum premium of $10,000 would not qualify as loss sensitive.

4. The maximum net payment must be at least 15% greater than the expected net payment for primary business and at least 7.5% greater than the expected net payment for reinsurance treaties.

   Illustration: A retrospectively rated workers' compensation policy with a minimum premium of $5,000, an expected premium of $10,000, and a maximum premium of $11,000 does not qualify as loss sensitive.

5. The loss sensitive payments must be either premiums or commissions. A policy with loss sensitive policyholder dividends does not quality as "loss sensitive."

6. The losses and the corresponding loss sensitive payments must flow through the income statement and the balance sheet.

   Illustration: A workers' compensation policy has a large dollar deductible of $100,000. For losses below $100,000, the insurance company settles the claims and pays the benefits, but the insured reimburses the insurer for these payments. One might characterize this policy as loss sensitive, since the greater the losses paid by the insurer, the greater the payments made by the insured. However, these amounts do not flow

through the income statement as incurred losses and as premiums, so the contract does not qualify as loss sensitive.

PART 7 HISTORICAL EXHIBITS

The Part 7 historical exhibits provide the historical data to quantify the sensitivity of premiums and reinsurance commissions to losses on an all-lines combined basis. These are Sections 2 through 5 for primary contracts and Sections 2 through 7 for reinsurance contracts.

- Sections 2 and 3 show incurred losses and bulk + IBNR loss reserves. They are similar to the Part 2 and Part 4 exhibits, except that the experience is subdivided by policy year, not by accident year.

- Section 4 shows earned premiums. It is similar to Part 6, except that policy year experience is shown, not exposure year experience. For the prior years row, see below.

- Section 5 shows bulk premium reserves. In general, companies do not hold "case basis" premium reserves. They hold "policy basis" unearned premium reserves reflecting the actual premiums they have recorded as written on each policy. Bulk premium reserves are the equivalent of the Section 3 bulk loss reserves, reflecting additional premiums (positive or negative) anticipated due to audits and other retrospective adjustments.

- Sections 6 and 7 of Part 7B show reinsurance commission exhibits. These sections are similar to the premium exhibits in Sections 4 and 5.

The premium and loss triangles show cumulative values.[87]

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[87] Some analysts have construed the Annual Statement *Instructions* to imply that the commission triangles show incremental values.

For earned premiums, the *Instructions* say:

> *Each reported estimate should be the estimate of the net earned premium as of each year-end, not the incremental amounts earned during each calendar year.*

For the commission triangles (Part 7B, Sections 6 and 7), the *Instructions* say:

> *An entry denoting the expectation of future additional commissions to be paid should be displayed as a negative value. An entry denoting the expectation of future earned commissions should be displayed as a positive value.*

It is likely that the NAIC intended no difference between the premium and commission triangles. The *Instructions* mean that an *expectation of future additional commissions to be paid should be displayed as a negative value* in the bulk commission reserve, just as expectation of future premiums to be returned are displayed as negative values in the bulk premium reserve. The full text of the Annual Statement *Instructions*

PREMIUM SENSITIVITY

Sections 2 through 5 of Part 7A and sections 2 through 7 of Part 7B were designed to quantify premium sensitivity.[88] We explain the intended use of these exhibits.

The risk-based capital reserving risk charge is based on the loss reserves – both case basis reserves and bulk + IBNR reserves – shown by the company's Schedule P, Part 2 minus Part 3. The reserving risk charge quantifies how much these reserves might develop adversely in a worst-case scenario. The loss sensitive contract offset factor quantifies how much additional premium would be expected if reserves develop adversely in this fashion.

Illustration – Premium Sensitivity

Illustration: The exhibits below show extracts from Schedule P, Part 7A, sections 2 through 5 (figures are in thousands of dollars). The actual exhibits contain ten policy years by ten development periods, but these extracts suffice to illustrate the quantification techniques. We quantify the premium responsiveness from 24 to 36 months and from 36 to 48 months.

Exhibit 7.1: Incurred Loss and DCC on Loss-Sensitive Contracts

Section 2	20X4	20X5	20X6	20X7
20X4	$1,000	$2,200	$2,400	$2,500
20X5		$1,100	$2,500	$2,650
20X6			$1,200	$3,000
20X7				$1,500

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makes this clear:

> *In Part 7B of Schedule P, for all reinsurance contracts where the commission paid to the cedant varies with losses, display the development of that commission in Section 6 and display any assets or liabilities accrued with respect to that commission in Section 7. An entry denoting the expectation of future additional commissions to be paid should be displayed as a negative value. An entry denoting the expectation of future earned commissions should be displayed as a positive value. An entry denoting the expectation of future return commissions should be displayed as a positive value.*

Although some readers of the Annual Statement *Instructions* perceive a difference between the premium and commission triangles, we do not see this difference. We advise companies to treat premiums and commissions in the same fashion.

[88] The term "premium sensitivity," as used in this paper, stems from the term "loss-sensitive contracts." Other actuaries use the term "premium responsiveness" to refer to the same phenomenon.

Exhibit 7.2: IBNR plus Bulk Loss and DCC on Loss-Sensitive Contracts

Section 3	20X4	20X5	20X6	20X7
20X4	$350	$550	$300	$200
20X5		$400	$600	$450
20X6			$450	$650
20X7				$500

Exhibit 7.3: Earned Premium on Loss-Sensitive Contracts

Section 4	20X4	20X5	20X6	20X7
20X4	$1,500	$3,150	$3,300	$3,350
20X5		$1,650	$3,600	$3,700
20X6			$1,800	$4,200
20X7				$2,000

Exhibit 7.4: Accrued Retrospective Premiums on Loss-Sensitive Contracts

Section 5	20X4	20X5	20X6	20X7
20X4	$0	$200	$150	$110
20X5		$0	$210	$155
20X6			$0	$220
20X7				$0

PART 7 DATA

These exhibits show policy year data, not accident year losses (as in Parts 2, 3, and 4 of Schedule P) or exposure year premiums (as in Part 6 of Schedule P). For each policy year in Section 2 of Part 7, the incurred losses as of 24 months are about twice the incurred losses as of 12 months.

The policy year 20X4 incurred losses as of 12 months are those losses on policies written in 20X4 that have occurred by December 31, 20X4. These are about half the policy year 20X4 losses, if policies are written evenly over the course of the year. By December 31, 20X5, all

of the policy year 20X4 losses have occurred (though they have not necessarily all been reported by this time), so the 24 month figure is about twice as great as the 12 month figure.[89]

The same comments about losses are true for Section 4, which shows the policy year earned premiums. By the end of the policy year, all the premiums have been written (though not necessarily collected yet), but only about half of these premiums have been earned.

INITIAL DEPOSITS

This example assumes that the initial written premiums are the estimated ultimate net premiums. We have done this for heuristic purposes, to simplify the expected cash flows. Although this is sometimes true, it is not always standard practice, for several reasons:

- *Payroll and sales estimates:* Some insureds provide understated payroll or sales projections to lower the deposit premiums.
- *Competition:* Insurers tend to accept understated exposure estimates to keep their deposit premiums competitive. For Schedule P, Part 7 the reporting company should use the estimated ultimate premium (not the premium used by the underwriter).
- *Taxes:* Companies may book a low written premium estimate to defer state premium taxes or federal income taxes.[90] State premium taxes are based on direct written premiums. The tax liability is not incurred until the company records the written premium.

If the initial written premium is the estimated ultimate net premium, there is no retrospective premium reserve at policy inception. At the first retrospective adjustment, some premiums are returned to policyholders, since not all losses have yet been recorded, even though the insurer expects some development on the reported losses. The accrued retrospective premium asset becomes positive after the first adjustment. For companies that charge initial

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[89] The actual distribution of insurance policy effective dates for large commercial accounts is skewed. Many corporations align the policy years on their insurance contracts with their internal accounting fiscal years, so that they can close their books at the end of one fiscal year and begin new books at the start of a new fiscal year. Insurance policies for large commercial accounts tend to have effective dates of January 1 (corresponding to a January – December fiscal year) or another quarter beginning date. At times, an insured requests an effective date of December 31 for tax purposes, if there is reason to allocate the insurance premium to a previous tax year.

[90] Even though the company reports its best estimate of ultimate earned premium, the low written premium estimate affects taxable income through the revenue offset provision (see the Appendix on revenue offset). As of the January 5, 2000 Treasury regulations, this manner of reducing taxable income is no longer permissible. Many underwriters and actuaries and not yet aware of this change in the tax regulations, and they continue to provide low written premium estimates. This is acceptable for statutory accounting, as long as the earned premium estimates are correct; see SSAP No. 53, "Property-casualty Contracts – Premiums." The company's tax officer, mindful of tax avoidance penalties, will "gross-up" the written premium, using the actuarial estimates of earned but unbilled premiums and accrued retrospective premiums. See Sarason, *et al.* [2002] for the tax regulations and Yoheved and Sarason [2002] for the statutory accounting rules.

premiums below the estimated ultimate net premium (for competitive reasons), the accrued retrospective premium asset will be positive from policy inception.

QUANTIFYING THE SENSITIVITY

The illustration is constructed to demonstrate the intended use of these exhibits. Consider first the premium sensitivity from 24 to 36 months. Only policy years 20X4 and 20X5 in the illustration are mature enough to show this sensitivity. For policy year 20X4, losses develop from $2.20 million at 24 months to $2.40 million at 36 months, for a change of $0.20 million. Premiums develop from $3.15 million at 24 months to $3.30 million at 36 months, for a change of $0.15 million. The premium sensitivity is $0.15 million / $0.20 million, or 75%.

For policy year 20X5, losses develop from $2.50 million at 24 months to $2.65 million at 36 months, for a change of $0.15 million. Premiums develop from $3.60 million at 24 months to $3.70 million at 36 months, for a change of $0.10 million. The premium sensitivity is $0.10 million / $0.15 million, or 67%.

As the estimated premium sensitivity from 24 months to 36 months, we might take the average of these two numbers. Alternatively, we might give more weight to the 20X5 policy year, particularly if the rating plan parameters had changed in 20X5.[91]

For the premium sensitivity from 36 months to 48 months, only policy year 20X4 is sufficiently mature to provide the needed figures. Losses develop from $2.40 million at 36 months to $2.50 million at 48 months, for a change of $0.10 million. Premiums develop from $3.30 million at 36 months to $3.35 million at 48 months, for a change of $0.05 million. The premium sensitivity is $0.05 million / $0.10 million, or 50%.

This is consistent with the operation of loss sensitive contracts. As reserves mature, premium sensitivity declines, since more losses are censored by the loss limit and more premiums are capped by the premium maximum. In addition, some retrospective rating plans are closed at late maturities.

This example was designed to illustrate the intended use of the Schedule P exhibits; it would rarely be encountered in practice. The incurred losses here develop smoothly upward, and the premiums follow them equally smoothly. A company which is well reserved should show flat incurred losses along development periods, and similarly flat earned premiums. The incurred losses in these triangles include IBNR and bulk reserves, and the earned premiums

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[91] The manner of selecting projected factors differs between loss reserving and premium sensitivity. Link ratios for loss emergence and settlement are largely beyond the insurer's control. The analyst may use a straight average or a weighted average of the observed link ratios. The factors for premium sensitivity depend on the plan parameters. If the lower sensitivity for the 20X5 policy year stems from a change in the plan parameters, the analyst may give dominant weight to the latest ratio.

include the accrued retrospective premium asset. The changes in incurred losses from period to period would be sometimes small and sometimes large, sometimes positive and sometimes negative, resulting primarily from random loss fluctuations. The changes in earned premiums from period to period would be equally variable, resulting again from random loss fluctuations as well as from censoring by loss limits and capping by the premium maximums.[92]

A well-reserved company would have two series of variable figures with means of zero, since favorable and adverse development are equally likely. The ratios of these series will be even more variable – sometimes very high, sometimes very low, sometimes positive, sometimes negative. These ratios may not reveal much about premium sensitivity. In fact, aggregate industry statistics from these sections of Schedule P, Part 7 have not yielded meaningful figures for tests of premium sensitivity.

Reported Losses and Billed Premium

Premium sensitivity does not deal with the relationship of changes in total earned premium to changes in total incurred losses. Rather, it deals with the relationship of changes in *billed premium* to changes in *reported losses*. Schedule P, Part 7 allows this analysis as well.

- Section 2 of Part 7 shows incurred losses, and Section 3 shows IBNR and bulk reserves. The difference between Sections 2 and 3 represents reported losses.
- Section 4 shows total earned premiums, and Section 5 shows the net reserve for premium adjustments and accrued retrospective premiums. The difference between Sections 4 and 5 represents billed premium.

We repeat the calculations for premium sensitivity using the simulated Schedule P, Part 7 exhibits provided above. For the premium sensitivity from 24 months to 36 months, we have data from both policy year 20X4 and policy year 20X5.

For policy year 20X4, reported losses develop from ($2.2 million – $0.55 million) = $1.65 million at 24 months to ($2.4 million – $0.3 million) = $2.1 million at 36 months, for a change of $2.1 million – $1.65 million = $0.45 million. Billed premium develops from ($3.15 million – $0.2 million) = $2.95 million at 24 months to ($3.3 million – 0.15 million) = $3.15 million at 36 months, for a change of $3.15 million – $2.95 million = $0.20 million. Premium sensitivity from 24 months to 36 months is $0.20 million / $0.45 million = 44.4%.

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[92] The date of recognition of additional losses or additional accrued retrospective premium reserves would add to the variability in the two series of changes, one of incurred losses and one of earned premiums. The reserving actuary may recognize the potential increase in ultimate losses in one year, but may not book the corresponding increase in the accrued retrospective premium reserves until some time later. See the discussion below regarding the time lag between premiums and losses.

For policy year 20X5, reported losses develop from ($2.50 million – $0.60 million) = $1.90 million at 24 months to ($2.65 million – 0.45 million) = $2.20 million at 36 months, for a change of $2.20 million – $1.90 million = $0.30 million. Billed premium develops from ($3.6 million – $0.21 million) = $3.39 million at 24 months to ($3.70 million – $0.155 million) = $3.545 million at 36 months, for a change of $3.545 million – $3.39 million = $0.155 million. Premium sensitivity from 24 months to 36 months is $0.155 million / $0.30 million = 51.7%.

Anticipated Emergence versus Unanticipated Development

The risk-based capital reserving risk charge seeks to quantify the amount of capital needed to guard against unanticipated adverse development of loss reserves. If the company's reserves would develop adversely by $15 million in a "worst-case" (but still reasonable) scenario, the company should hold $15 million of capital to ensure its solvency.

The figures calculated in the preceding section show the responsiveness of the retrospective premiums to the emergence of reported losses. They do not show the responsiveness of the retrospective premiums to the unanticipated adverse development of the incurred losses.

> *Illustration:* We are examining the premium sensitivity from 24 months to 36 months on a workers' compensation retrospectively rated book of business. The reported losses are $100 million at 24 months, and the anticipated reported losses at 36 months are $120 million. The expected ultimate losses are $150 million.
>
> Suppose we have estimated a historical premium sensitivity for this period of 50%. When reported losses increase by $20 million, the billed premium increases by $10 million (on average). We must infer the effects for large and unanticipated adverse loss development, as envisioned in the risk-based capital "worst case year" scenario. For example, if the ultimate losses are re-estimated at $180 million at 36 months instead of $150 million, will the accrued retrospective premium asset increase by an additional $15 million, or 50% of the additional losses of $30 million?

DECOMPOSITION OF ADVERSE DEVELOPMENT

We decompose the development of reported losses from $100 million at 24 months to $120 million at 36 months into two parts.

- Some temporary cases last a few months longer, and some medical benefits cost more than expected. This development is "rateable," and premium sensitivity is high.
- Some temporary total cases, such as lower back sprains, are reclassified into lifetime pension cases, when it becomes clear that the injured employee will not return to work. Only some of this development is "rateable." The rest of this development is truncated by the loss limits or the maximum premiums.

Large and unanticipated adverse loss development has a heavy proportion of this "non-rateable" element. The re-estimation of the ultimate losses from $150 million to $180 million may result from the reclassification of several back sprains as severe and permanent disabilities, or a judicial or legislative decision that certain disease claims are compensable. These claims are large and they are paid over a long period. A large part of these claims may not be rateable.

The premium sensitivity depends on the maturity of the losses as well as on the average loss ratio in the block of business. The emergence of anticipated losses differs from the unanticipated adverse development of the expected losses in that

- the anticipated losses are generally paid sooner than the unanticipated losses, and
- the anticipated losses occur at a lower loss ratio than do the unanticipated losses.

Since the anticipated losses are generally paid sooner and are generally in a lower loss ratio environment, they are associated with a stronger premium sensitivity. The figures derived from the historical triangles in Part 7 may not fully address the risk-based capital concerns.

Premium Billing Lags

When quantifying premium sensitivity, it is important to use corresponding premiums and losses. Premium billing occurs about 3 months after the retrospective adjustment. This implies that the premium billing lags the loss occurrence by 3 to 15 months.

> *Illustration:* A policy is effective from July 1, 20XX, through June 30, 20XX+1. Retrospective adjustments are done six months after the policy's expiration and every 12 months subsequently. For this policy, the retrospective adjustments will be done on each January 1, starting with January 1, 20XX+2. The resulting retrospective premium adjustments are billed to the policyholder (or returned to the policyholder) on each April 1.

Each retrospective premium is driven by losses that are reported between 15 months and 3 months prior to the premium billing date. For this policy, losses that are reported between January 1 and December 31 affect the premium adjustment that will be billed on April 1.

Illustration: The average lag between loss occurrence and premium billing is $\frac{1}{2} \times (3+15) =$ 9 months. If one does not use any lag, the results are distorted. To see this most clearly, suppose that

- the retrospective premium billing is done on July 1,
- all losses occur on July 1,
- there is 100% premium responsiveness, and
- the incurred losses alternate between $1,000 and $0 in succeeding years.

The Schedule P, Part 7, test of premium sensitivity would show the following:

Exhibit 7.5: Premium Sensitivity and Reporting/Billing Lags

Year	1	2	3	4	5	6
Change in incurred losses	$1,000	$0	$1,000	$0	$1,000	$0
Change in billed premium	$0	$1,000	$0	$1,000	$0	$1,000

The premium billing shows up a year after the loss occurs. In truth, there is 100% premium sensitivity, but Schedule P, Part 7 shows a −100% premium sensitivity.[93]

Simplistic tests of premium sensitivity may yield negative regression coefficients or seemingly random regression coefficients. The reserving actuary may think that the data are incorrect, when the problem is an improper matching of the premiums and losses. Actual examination of aggregate industry Schedule P, Part 7 data has not yielded meaningful information.

Prior Years Row

The Annual Statement *Instructions* comment on the data for the prior years rows in Sections 2, 3, 4, and 5 of Part 7A and Part 7B as follows:

> *[for losses:] The "prior" row should display the reported estimate of ultimate losses and defense and cost containment expense on a policy year basis for all policy years ten or more years older than the current policy year.*
>
> *[for premiums:] The "prior" row should display the reported estimate of net earned premium on a policy year basis for all policy years ten or more years older than the current policy year.*

These instructions do not make sense. Companies do not keep records of earned premiums and incurred losses on loss sensitive contracts written years ago. None of the Schedule P prior years rows asks for such data. The prior years rows use one of three types of data:

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[93] The date of recognition of additional losses or additional accrued retrospective premium reserves would add to the variability in the two series of changes. The reserving actuary may recognize the potential increase in ultimate losses in one year, but may not book the corresponding increase in the accrued retrospective premium reserves until some time later.

The actual calculations of the premium sensitivity use successive calendar years at the same adjustment date for successive blocks of business, not successive adjustments for a single block of business. The underlying concepts are the same, though the representation is more complex.

- Current reserves for all old years (the reserves in Part 2, Part 4, and Part 1).
- Current calendar year payments or receipts related to old years (payments in Part 1; claims in Part 5; and premiums in Part 6).
- Cumulative payments since the second calendar year in the triangle (Part 3).

The only procedure which makes sense for the incurred and earned triangles in Part 7 is the procedure used for Part 2 of Schedule P. This is a combination of the first method for the reserves and the third method for the payments.

The Part 2 procedure is useful for reserve adequacy testing. It is not helpful for quantifying premium sensitivity, which is the purpose of the Part 7 exhibits. The quantification methods described here do not make use of the prior years rows, since the premiums and losses stem from different policy years.

The format of the Part 7 exhibits is taken directly from the other parts of Schedule P. The designers of Schedule P, Part 7 had no intentions for the prior years row. This row is not used for quantifying premium sensitivity. Companies should not spend time trying to figure out the data needed for this row. The data are not used or checked by the NAIC.

Federal Income Taxes

The 1986 Tax Reform Act introduced several federal income tax provisions that are specific to property-casualty insurance. This section focuses on tax provisions and related statutory accounting requirements that rely on Schedule P. For a general treatment of federal income taxes relating to property-casualty insurance companies, with emphasis on items of particular concern to casualty actuaries, see Sarason, *et al.* [2002].

DATA SOURCES

The computation of federal income taxes relies on the following Annual Statement exhibits:

1. The tax computation begins with statutory pre-tax income from the Underwriting and Investment Exhibit: Part 1 for investment income and Parts 2, 2A, and 3 for underwriting income.[94]
2. The additional tax liability resulting from the revenue offset provision is calculated from Part 2 of the Underwriting and Investment Exhibit. The January 2000 tax regulations and the statutory accounting codification changes effective on January 1, 2001 affect the recognition of taxable revenue from earned but unbilled premiums and accrued retrospective premiums. The Schedule P, Part 6 exhibits may be used to adjust statutory income to taxable income; see Sarason, *et al.* [2002].
3. Schedule P, Part 1 is used to calculate the additional tax liability resulting (i) from the IRS loss reserve discounting provision and (ii) from anticipated salvage and subrogation

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[94] For most industries, the federal income tax liability is based on the generally accepted accounting (GAAP) statements of the company. For the property-casualty insurance industry, the federal income tax liability is based on statutory income. See the Treasury regulations, 2001FED 26,153, §1.832-4(a)(1): "Gross income means the gross amount of income earned during the taxable year from interest, dividends, rents, and premium income, computed on the basis of the underwriting and investment exhibit of the annual statement."

The Internal Revenue Code lists numerous adjustments, of which the following are the most important:

1. The earlier incurral of the tax liability resulting from revenue offset and loss reserve discounting.
2. The effects of anticipated salvage and subrogation and the discounting provisions relating thereto.
3. The reduction of the tax liability resulting from municipal bond income and the dividends received deduction, along with the limitation thereon.
4. The difference in the incurral dates of the tax liability resulting from the amortization and accrual rules for fixed-income securities.

In addition, the alternative minimum income tax provisions may cause an earlier incurral of the tax liability. All changes in the incurral dates of the tax liabilities may lead to deferred tax assets and liabilities on the statutory balance sheet.

recoveries. Schedule P, Part 3 may be used to determine the non-admitted portion of the deferred tax asset stemming from the loss reserve discounting.

4. Schedule D is used to determine the reduction in the tax liability resulting from municipal bond income and the dividends received deduction, as well as any additional or reduced tax liability resulting from the difference between statutory amortization of fixed-income securities and tax amortization of these securities. The company's optimal investment strategy depends on the anticipated taxable underwriting income, which depends on the Schedule P calculations.

This section covers IRS loss reserve discounting and the non-admitted portion of the resulting statutory deferred tax asset.

Loss Reserve Discounting

For statutory financial statements, calendar year incurred losses equal the losses paid during the year plus the change in the full value loss reserves from the beginning of the year to the end of the year. For federal income tax purposes, the incurred losses during the tax year equal the losses paid during the year plus the change in the *discounted* loss reserves from the beginning of the year to the end of the year.

The determination of discounted loss reserves relies on Schedule P. The valuation actuary may be asked to compute (i) the discounted loss reserves, (ii) the amount of the discount, (iii) the effects of bulk reserve changes on taxable income and the tax liability, (iv) whether the company should elect its own loss payment pattern, and (v) the optimal investment strategy for a given amount of bulk reserves or level of reserve adequacy.

The cost of capital is a major factor for the pricing of insurance contracts. The double taxation of the investment income on capital funds is a significant component of this cost. The IRS loss reserve discounting provisions and the statutory deferred tax asset affect the cost of holding capital for insurers.

Investment Income and Amortization

For long-tailed lines of business, the statutory accounting rules cause an underwriting loss during the policy term when losses occur. After policy expiration, the investment income on the assets backing the loss reserves provide steady and positive net income. For tax accounting, the expected investment income on the assets backing the loss reserves offsets the expected amortization of the interest discount in the reserves. The underwriting gain or loss is realized during the policy term, with no expected net gain or loss in subsequent years.

Complete (exact) offsetting depends on the following conditions:

a. There are no implicit (undisclosed) discounts in the statutory loss reserves.

b. The IRS discount rate equals the investment yield of the company.
c. The IRS loss payment pattern equals the actual liquidation pattern for the block of business.
d. The company holds fully discounted reserves, with disclosure of the amount of discount.

These conditions are not consistent with current statutory requirements, so complete offsetting is not expected. Nonetheless, they clarify the heuristic illustration below.

Illustration: Offsetting

A one day policy is written on December 31, 20XX for a net premium of $10,000. One loss occurs on December 31, 20XX, which is paid for $12,100 on December 31, 20XX+2. The term structure of interest rates is flat at 10% per annum. To simplify the illustration, we assume that the IRS loss payment pattern is the same as the actual loss payment pattern here.

In 20XX, statutory accounting shows an underwriting loss of $10,000 – $12,100 = $2,100. The $10,000 net premium is invested at 10% per annum. The investment income is $10,000 × 10% = $1,000 in 20XX+1 and $11,000 × 10% = $1,100 in 20XX+2. There is no underwriting gain or loss in 20XX+1 or 20XX+2, so these are the statutory income amounts.

If we assume a two year IRS loss payment pattern and a discount rate of 10% per annum, the discounted loss reserves are $12,100 / 1.100^2 = $10,000 at December 31, 20XX. Tax accounting shows no underwriting gain or loss in 20XX and a tax liability of $0 for 20XX.

In 20XX+1, investment income is $1,000. The discounted loss reserve on December 31, 20XX+1 is $12,100 / 1.100 = $11,000. The underwriting loss (or the offset to underwriting income) for tax year 20XX+1 equals the amortization of the interest discount on the loss reserves, or $11,000 – $10,000 = $1,000. The underwriting loss just offsets the investment income. The net taxable income is $0, and the tax liability is $0.

In 20XX+2, investment income is $1,100. The incurred loss offset to taxable underwriting income in 20XX+2 is the paid loss plus the change in the discounted loss reserve, or

$12,100 (paid on December 31, 20XX+2) + $0 – $11,000 = –$1,100.

This is the amortization of the interest discount on the 12/31/20XX+1 reserve of $11,000. It offsets the investment income in 20XX+2. The taxable income is $0, and the tax liability is $0.[95]

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[95] Some insurance personnel speak of the post-1986 federal income tax incurral pattern as a "prepayment of taxes by the insurance industry." This is correct from a statutory or GAAP perspective. The IRS would take the opposite view; before 1986 the Treasury helped fund the conservative insurance accounting practices.

DISCOUNTING PRINCIPLES

The discounted loss reserves are determined from three components:

- The undiscounted loss reserves, as shown in Schedule P, Part 1;
- The loss reserve discount rate, which is promulgated each year by the Treasury; and
- The loss payment pattern by line of business, which is determined from Schedule P data.

Illustration: The December 31, 20XX undiscounted loss reserves are $100 million. The loss reserve discount rate is 8% per annum. The $100 million of reserves will be paid in three parts: 50% on December 31, 20XX+1, 30% on December 31, 20XX+2, and 20% on December 31, 20XX+3.[96] The discounted loss reserves equal

$100 million x (50%/1.08 + 30%/1.08^2 + 20%/1.08^3) = $100 million x 0.879 = $87.9 million.

Undiscounted Loss Reserves

The Treasury assumes that the loss reserves in Schedule P, Part 1 are undiscounted values. If discounted values are shown, the losses may be "grossed up" to undiscounted amounts before application of the IRS loss reserve discounting procedure. The "gross-up" is permitted only if the amount of the discount is disclosed in (or with) the Annual Statement.[97]

Illustration: Schedule P, Part 1 is gross of non-tabular discount and net of tabular discount.

- A company incurs $10,000,000 of accident year 20XX workers' compensation losses, including lifetime pension claim reserves with a tabular discount of $1,000,000.
- The IRS loss reserve discount factor for workers' compensation accident year 20XX reserves is 85%.

If the company does not disclose the tabular discount in the Annual Statement, the offset to taxable income is $10 million x 85% = $8.5 million. If the company does disclose the tabular discount in the Annual Statement, the offset to taxable income is ($10 million + $1 million)

[96] This illustration is simplified. The actual procedure assumes mid-year payments and a longer loss payment pattern.

[97] See section 846(b)(2) of the Internal Revenue Code: "Adjustment If Losses Discounted on Annual Statement: If the amount of unpaid losses shown in the annual statement is determined on a discounted basis, and *the extent to which the losses were discounted can be determined on the basis of information disclosed on or with the annual statement*, the amount of the unpaid losses shall be determined without regard to any reduction attributable to such discounting."

× 85% = $9.35 million. The difference in taxable income is $9.35 million – $8.5 million = $0.85 million, and the difference in the tax liability is $0.85 million × 35% = $297,500.

DISCLOSURE AND TIMING COSTS

The difference between statutory income and taxable income in the illustration above is a timing difference; it will reverse in subsequent years. The cost to the company is the present value of the expected after-tax investment yield on this money.

Illustration: Suppose the pension reserves are paid (on average) twelve years after policy expiration, and the after-tax investment yield is 6% per annum. The cost to the company is

$$\$297{,}500 \times [\,(1.06^{12} - 1)\,/1.06^{12}] = \$297{,}500 \times 0.503 = \$149{,}651.61.^{98}$$

The required disclosure of *non-tabular* discounts by accident year and by line of business is provided in columns 34 (losses) and 35 (loss adjustment expenses) of Schedule P, Part 1. The required disclosure of *tabular* discounts is shown in note 28 (in the 2001 Annual Statement) to the financial statements, "Discounting of Liabilities for Unpaid Losses or Unpaid Loss Adjustment Expenses." For tabular discounts, the reporting company shows four items by line of business: (i) the mortality table used, (ii) the discount rate used, (iii) the amount of discounted reserves, and (iv) the amount of the tabular discount.[99]

[98] Because of the statutory deferred tax asset and the capital requirements imposed on insurance companies, the actual cost to equityholders is somewhat different; see Kelly, *et al.*, [2002] for a full discussion.

[99] The footnote does not require disclosure of the discount by accident year. Companies provide this information anyway, since it is needed to gross up the undiscounted reserves for tax purposes.

Limitation

The IRS is concerned that a company might claim such a large discount for its statutory loss reserves that the discounted tax-basis loss reserves would be greater than the Annual Statement loss reserves, thereby reducing the tax liability by means of discounting instead of increasing the tax liability. To prevent this, the discounted IRS loss reserves may not be greater than the loss reserves shown in the Annual Statement.[100]

Statutory accounting allows only limited discounting: tabular discounts and exceptional cases of non-tabular discounts. For tabular discounts, most companies use conservative interest rates, such as 3.5% or 4% per annum. For non-tabular discounts, the permissible discount rate for statutory accounting is rarely greater than the discount rate used for IRS loss reserve discounting; see SSAP No. 65 on "Property and Casualty Contracts."

In summary, the statutory loss reserves are rarely lower than the IRS discounted loss reserves. The workers' compensation "prior years" row (Part 1D) is an exception. These reserves are primarily indemnity reserves for lifetime pension cases, and many companies use tabular discounts. For this row, the "composite discount factor" used in the IRS discounting calculations assumes (on average) three more years of payment, whereas the pension cases in these reserves may have (on average) a future expected lifetime of 10 to 20 years.

ILLUSTRATION: THE LIMITATION

The workers' compensation prior years row shows unpaid losses and loss adjustment expenses of $30 million. In the Notes to the Financial Statements, the company reports a $10 million tabular discount for these claims. The IRS composite discount factor applicable to these reserves is 90%.

Without the limitation discussed above, the gross loss reserves are $30 million + $10 million = $40 million. The IRS discounted loss reserves are 90% × $40 million = $36 million. Since this exceeds the $30 million of statutory loss reserves, the IRS discounted loss reserves are capped at $30 million.

[100] See the Internal Revenue Code §846(a)(3): "In no event shall the amount of the discounted unpaid losses with respect to any line of business attributable to any accident year exceed the aggregate amount of unpaid losses with respect to such line of business for such accident year included on the annual statement."

Discount Rate

The discount rate varies by accident year. For each accident year, the discount rate is the 60 month moving average of the federal mid-term rates ending on the December 1 preceding the accident year. This rate is frozen and applies to that accident year's losses in all future calendar years. In tax parlance, the discount rate is "vintaged." The federal mid-term rate is the average rate on Treasury securities with 3 to 9 years remaining maturity.[101]

The federal mid-term rate is promulgated by the Treasury each month.[102] The 60 month moving average applicable to an accident year is promulgated by the Treasury during the accident year, and it can be determined as soon as the last federal mid-term rate has been announced.

Illustration: The loss reserve discounting rate for accident year 20X9 is the 60 month average of the federal mid-term rates from January 1, 20X4, through December 1, 20X8. It can be computed in December 20X8, before the inception of accident year 20X9, so that companies can effectively determine their tax strategies during 20X9.

Yield Projections

The market values of future cash flows are based on the current term structure of interest rates. The date that the liability was incurred is not relevant. In contrast, the IRS bases the discount rate on the incurral year of the liability. The rationale is that the insurance company uses the premium cash flows from the policy to purchase fixed-income securities to fund the future loss payments. The yield on the fixed-income securities is determined at the date of purchase. If the duration of the assets backing the reserves matches the duration of the loss liabilities,

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[101] See section 846(c)(2) of the Internal Revenue Code: "Determination of Annual Rate: The annual rate determined by the Secretary under this paragraph for any calendar year shall be a rate equal to the average of the applicable Federal mid-term rates (as defined in section 1274(d) but based on annual compounding) effective as of the beginning of each of the calendar months in the test period. The test period is the most recent 60-calendar-month period ending before the beginning of the calendar year for which the determination is made."

The federal mid-term rates are expressed as bond equivalent yields, since bond coupons are paid semi-annually in the United States. (A bond equivalent yield is a yield with semi-annual compounding.) The IRS loss reserve discounting procedure uses annual compounding, since it assumes that losses are paid in mid-year (i.e., once a year). The bond equivalent yields are converted to effective annual yields before averaging, using the formula $r_a = (1 + r_s/2)^2 - 1$, where r_a is the effective annual yield and r_s is the bond equivalent yield with semi-annual compounding. If the bond equivalent yield is 8% per annum, the equivalent effective annual rate is $(1 + 0.08/2)^2 - 1 = 8.16\%$.

[102] The yield among mid-term securities varies with the remaining maturity, in accordance with the term structure of interest rates. More recently issued securities tend to have slightly lower yields, since they are more marketable. The Secretary of the Treasury selects an appropriate average rate.

the losses will be paid from the coupon income and the principal repayment from these securities. The yield during the accident year is the relevant investment yield throughout the life of the policies.[103]

Loss Payment Pattern

The IRS determines the expected loss payment pattern by line of business from Schedule P, Part 1. Most discussions of the IRS loss reserve discounting procedure show the mechanics of the computation, with no explanation of the rationale. The approach here is the opposite. We consider first the rationale for the IRS procedure before explaining the mechanics of its computation. We use the figures in the prospective paid loss chain ladder development illustration earlier in this paper.

To determine the discounted reserves, we must we estimate the percentage of these reserves that will be paid in each subsequent calendar year. We use a sequence of three illustrations to clarify the procedure.

Illustration: We are computing the loss payment pattern for the 20X9 accident year reserves shown below. We use the historical data to estimate the percentages to be paid in each future calendar year.

[103] Whether a moving average rate or the current rate is a better predictor for future rates is an open question. Accountants often prefer average rates, on the assumption that the most recent monthly figure may be abnormally high or low. Some financial analysts presume that interest rates revert towards a long-term mean, and a 60 month moving average may be a better reflection of this mean. Other analysts presume that interest rates form a random walk, and the present term structure of interest rates is the best reflection of expected future rates. The dominant view is that the current rate is a better estimator of the rate during the next 12 months than the 60 month moving average is; see Dr Jonathan Benjamini and S. Feldblum, *Dynamic Financial Analysis: a Primer for the Practicing Actuary* [2002].

Exhibit Tx.1: 20X9 Schedule P, Part 3D ($000)

Part 3	20X0	20X1	20X2	20X3	20X4	20X5	20X6	20X7	20X8	20X9
20X0	103	226	294	334	363	384	398	412	422	433
20X1		111	238	309	356	387	409	428	442	454
20X2			108	221	286	328	354	375	391	403
20X3				111	238	311	357	392	416	434
20X4					135	299	394	458	504	534
20X5						146	314	418	490	542
20X6							159	343	463	546
20X7								146	353	485
20X8									152	406
20X9										156

MATURE ACCIDENT YEAR

Consider a single accident year. The 20X0 accident year, with estimated total losses of $486 thousand, shows the following percentages paid in calendar years 20X0 through 20X9:

Exhibit Tx.2: Loss Payment Pattern from the Single Accident Year 20X0 ($000)
(Data from Schedule P, Part 3, of the 20X9 Annual Statement)

Part 3	20X0	20X1	20X2	20X3	20X4	20X5	20X6	20X7	20X8	20X9
1. 20X0	$103	$226	$294	$334	$363	$384	$398	$412	$422	$433
2. perc'nt	0.212	0.465	0.605	0.687	0.747	0.790	0.819	0.848	0.868	0.891
3. incr'tl	0.212	0.253	0.140	0.082	0.060	0.043	0.029	0.029	0.021	0.023

- Row 1: The row labeled "20X0" shows the cumulative dollars (in thousands) of accident year 20X0 losses paid by December 31 of each calendar year from 20X0 through 20X9.
- Row 2: The row labeled "perc'nt" shows the cumulative percentages of accident year 20X0 losses paid by December 31 of the calendar year in each column.
- Row 3: The row labeled "incr'tl" shows the incremental percentages of accident year 20X0 losses paid in each calendar year.

The final row in the table above tells us that 21.2% of an accident year's incurred losses are paid during the accident year, another 25.3% are paid in the 12 months following the accident year, 14.0% are paid in the subsequent 12 months, and so forth. The final 1 – 89.1%, or 10.9%, are paid more than 10 years after the inception of the accident year.

This procedure relies on a single accident year that is already 10 years old. It has the following drawbacks:

- Settlement of large losses may distort the payment pattern in any one accident year.
- The loss payment pattern does not reflect any changes in the intervening nine years.
- This method ignores the information embedded in the observed liquidation of accident years 20X1 through 20X8.

The method used by the IRS differs in several respects, as explained below.

RECENT DATA

To use the most recent data, we examine the dollars paid in calendar year 20X9 divided by the total incurred losses for each accident year. The paid loss development illustration used earlier in this paper shows the following figures from Schedule P, Parts 2 and 3.[104]

Exhibit Tx.3: Loss Payment Pattern from Successive Accident Years ($000's)
(Data from Schedule P, Parts 2 and 3, from the 20X9 Annual Statement)

AccYr	20X0	20X1	20X2	20X3	20X4	20X5	20X6	20X7	20X8	20X9
Row 1	$422	$442	$391	$416	$504	$490	$493	$353	$152	$0
Row 2	$433	$454	$403	$434	$534	$542	$546	$485	$406	$156
Row 3	$11	$12	$12	$18	$30	$52	$53	$132	$254	$156
Row 4	$486	$520	$475	$522	$667	$707	$787	$802	$866	$898
Row 5	2.3%	2.3%	2.5%	3.4%	4.5%	7.4%	6.7%	16.5%	29.3%	17.4%

The rows show the following figures:

Row (1): Cumulative dollars of loss paid through December 31, 20X8 (from Part 3).
Row (2): Cumulative dollars of loss paid through December 31, 20X9 (from Part 3).
Row (3): Incremental dollars of loss paid in 20X9 (= row (2) minus row (1)).
Row (4): Incurred losses (from Part 2).

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[104] The accident years are shown along the horizontal axis of the table. In the exhibits used for the paid loss chain ladder development method, the accident years are shown along the vertical axis.

Row (5): Incremental dollars of loss paid as a percentage of incurred losses (row 3 / row 4).

Consider the column for accident year 20X4:

Row 1: $504,000 has been paid by 12/31/20X8, or 60 months since inception of the accident year.
Row 2: $534,000 has been paid by 12/31/20X9, or 72 months since inception of the accident year.
Row 3: $30,000 has been paid between 60 months and 72 months.
Row 4: The total accident year 20X4 incurred losses are $667,000.
Row 5: 4.5% (or $30,000 / $667,000) of the incurred losses are paid between 60 months and 72 months since inception of the accident year.

This procedure uses figures from Schedule P, Part 3, which shows cumulative paid losses at the current valuation date and the previous valuation date. The IRS used figures from Part 1, perhaps because Part 1 is an audited exhibit whereas Part 3 is not an audited exhibit. In addition, the Part 1 figures are for the current valuation date, so they are more easily verified than are historical figures from the previous valuation date.

Incremental Percentages and Cumulative Differences

For the lines of business with ten year exhibits, the IRS makes one additional change. The procedure outlined above uses the incremental paid loss percentages in each accident year to estimate the percentage of losses paid in each time interval. The IRS uses the difference in the cumulative paid loss percentages between successive accident years.

Exhibit Tx.4: Loss Payment Pattern Between Accident Years ($000's)
(Data from Schedule P, Parts 2 and 3, from the 20X9 Annual Statement)

AccYr	20X0	20X1	20X2	20X3	20X4	20X5	20X6	20X7	20X8	20X9
Row 1	$433	$454	$403	$434	$534	$542	$546	$485	$406	$156
Row 2	$486	$520	$475	$522	$667	$707	$787	$802	$866	$898
Row 3	89.1%	87.3%	84.8%	83.1%	80.1%	76.7%	69.4%	60.5%	46.9%	17.4%
Row 4	1.8%	2.5%	1.7%	3.1%	3.4%	7.3%	8.9%	13.6%	29.5%	17.4%

- Row (1) shows the cumulative paid losses at December 31, 20X9 for each accident year.
- Row (2) shows the incurred losses at December 31, 20X9 for each accident year.
- Row (3) shows the ratio of cumulative paid losses to incurred losses.
- Row (4) shows the differences in successive ratios. For accident year 20X9, nothing is paid before calendar year 20X9, so 17.4% of incurred losses are paid in the first 12 months. For losses paid between 12 months and 24 months, we reason as follows.

- ✓ From the 20X8 accident year, we infer that 46.9% of incurred losses are paid by 24 months since inception of the accident year.
- ✓ From the 20X9 accident year, we infer that 17.4% of incurred losses are paid by 12 months since inception of the accident year.
- ✓ This implies that 46.9% – 17.4% = 29.5% of incurred losses are paid between 12 months and 24 months since inception of the accident year.[105]

The figures in row (4) sum to 89.1%. This is the ratio of cumulative paid losses to incurred losses for accident year 20X0 . All the figures are available from Schedule P, Part 1.

This is the procedure used by the IRS, with one difference in the data used.

- The Part 1 figures used by the IRS include all loss adjustment expenses.[106]
- The Part 3 figures shown here include only defense and cost containment expenses.

IRS RATIONALE

We summarize the computations as follows:

i. For each accident year in Schedule P, Part 1, we calculate the cumulative paid losses at the current valuation date as a percentage of the incurred losses for that accident year.
ii. We take the difference between successive accident years to determine the expected percentage of incurred losses paid in each 12 month interval.
iii. We use this procedure for the ten accident years shown in Part 1. If the cumulative paid losses for the oldest year equal 100% of the incurred losses, we stop here. If the cumulative paid losses for the oldest year are less than 100% of the incurred losses, we extend the loss payment pattern for additional years, as described below.

The cumulative paid losses as of the current valuation date are shown in Part 1, column 11, "total net paid." The incurred losses at the current valuation date are shown in column 28, "total losses and loss expense incurred."

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[105] Rounding to a single decimal places causes the apparent discrepancy in some of these figures.

[106] See section 846(f)(2) of the Internal Revenue Code: *The term "unpaid losses" includes any unpaid loss adjustment expenses shown on the annual statement.*

Although the concepts are straight-forward, the implementation is complex. We explain the details with two illustrations.

The ABC Insurance Company elected to use its own loss payment pattern in the 2007 determination year. This election applies to accident years 2009 through 2013. It is now January 2011, and ABC is computing the loss payment pattern for computing discounted reserves for accident year 2011. The following figures are taken from ABC's 2009 Annual Statement, Schedule P, Part 1B (private passenger automobile liability).

Exhibit Tx.5: Private Passenger Automobile Liability Paid and Incurred Losses

Accident Year	Losses + LAE Paid (col 11)	Losses + LAE Incurred (col 28)
Prior	$250,000	$250,000
2000	270,000	275,500
2001	300,000	316,000
2002	320,000	348,000
2003	340,000	386,500
2004	350,000	421,500
2005	370,000	480,500
2006	380,000	550,500
2007	360,000	610,000
2008	330,000	687,500
2009	200,000	571,500

The 60 month rolling average of the federal mid-term rate, from January 2006 through December 2010, is 7% per annum.

Determination Year and Company Election

Year 2011 is not a determination year, so industry aggregate Schedule P data for a valuation date of December 31, 2009 would not be used to determine loss payment patterns. Determination years end in a "2" or a "7," and they use aggregate industry Schedule P data for statement dates ending in a "0" or a "5." As examples,

- For determination year 20X2, Schedule P data as of December 31, 20X0 are used.
- For determination year 20X7, Schedule P data as of December 31, 20X5 are used.

Once every five years (determination years), the company makes an election to use either

- the loss reserve discount factors developed by the Treasury, which are based on industry aggregate Schedule P data, or
- its own loss reserve discount factors, which are based on its own Schedule P data

The election is made with the company's tax filing for the determination year. It applies to that year and to the succeeding four years.

If the company elects to use its own payment patterns, it uses Schedule P data that are available before the beginning of each tax year. These are the Schedule P data from two years earlier.

In this illustration, the company makes an election with its 2007 tax filing to use its own Schedule P data. The election applies to the 2007 through 2011 accident years.

The 2009 Schedule P data for computation of the loss payment patterns for the 2011 accident year are available by March 1, 2010. The loss reserve discount rate is not available until mid-December 2010. The computation in this illustration is done between mid-December 2010 and early 2012 (before the 2011 tax filing).

The election to use one's own data applies to all applicable lines of business. These are all the Schedule P lines except (i) international and (ii) lines for which the company does not have ten years of experience. The old rule that the company's reserves for the line of business must be at least as great as those of 10% of the companies in the industry was explicitly revoked by the Treasury in 1991 on the grounds that it discriminated against small companies.[107]

An election lasts for five years – until the next determination year. The company can revoke its election to use its own Schedule P data before the completion of the five year period only with the acquiescence of the Treasury.

A company that has elected to use its own Schedule P data recomputes the loss payment patterns each year, based on the most recent Schedule P data filed with regulatory authorities before the beginning of the tax year. The most recent Schedule P filed before the beginning of tax year 2011 was filed by March 1, 2010, containing data as of valuation date December 31, 2009. The industry payment patterns are computed only once every five years.

The 60 month rolling average of federal mid-term rates ends with the month preceding the accident year, not with the month preceding the Schedule P valuation date. In this illustration, the 60 month rolling average ends with December 2010, not December 2008 or 2009.

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[107] Because of an oversight in the Insurance Accounting and Systems Association insurance accounting textbook, this rule still remains on the CAS examination syllabus in 2002.

VINTAGING

The loss reserve discount factors computed here are used for accident year 2011 only. The discount factors for previous accident years at every future valuation date have already been determined and frozen. In tax parlance, they are vintaged. They are not revised in subsequent calendar years.

We determine between 11 and 15 discount factors for accident year 2011. The first ten discount factors are used at valuation dates December 31, 2011 through December 31, 2020. The final one to five development factors are used at subsequent valuation dates. The development factors are combined into a composite development factor for the prior years row for valuation dates 2021, 2022, and subsequent; see below. The discount factors all use the 7% discount rate and the loss payment pattern computed here.

The application of the loss reserve discount factors is not clear from a cursory reading of the Internal Revenue Code. The chart below shows the valuation dates and accident years for the various loss reserve discount factors.

Exhibit Tx.6: Valuation Dates for Loss Reserve Discount Factors

Discount Factor	Accident Year	Individual / Composite	Tax Year (Valuation Date)	Schedule P Accident Year
12 mos	2011	individual	2011	2009
24 mos	2011	individual	2012	2008
. . .	. . .	. . .	. . .	. . .
120 mos	2011	individual	2020	2000
132 mos	2011	composite	2021	AY+10 **
144 mos	2011	composite	2022	AY+11 **
. . .	. . .	. . .	. . .	. . .

** There years are referred to in the Internal Revenue Code as AY+10 through AY+15. They appear as part of the Schedule P prior years row.

The first ten discount factors computed here apply to accident year 2011 only. They are used at valuation dates between 12 months and 120 months from inception of the accident year. These correspond to tax years 2011 through 2020. For subsequent valuation dates, the discount factor computed here is combined with discount factors for other accident years and applied to the Schedule P prior years row.

The final column matches the accident years in Schedule P with the future valuation dates at which time the loss reserve discount factors are applied. For example, the cumulative paid percentage for accident year 2008 at valuation date December 31, 2009 equals the expected cumulative paid percentage for accident year 2011 at valuation date December 31, 2012. Similarly, the cumulative paid percentage for accident year 2000 at valuation date December 31, 2009 equals the expected cumulative paid percentage for accident year 2011 at valuation date December 31, 2020.

Discounting Sequence

The loss reserve discount factor computation can be divided into a series of steps.

Step 1: We calculate the nominal (undiscounted) amounts for

Cumulative percentages paid,
Incremental percentages paid, and
Percentages unpaid.

Step 2: We calculate the adjustments for long-tailed lines of business – i.e., those with ten year Schedule P exhibits[108] – showing

Adjusted incremental percentages paid,
Long-tail extension of payments, and
Adjusted percentages unpaid.

Step 3: We apply the appropriate discount rate to obtain the

Discounted percentages unpaid, and
Loss reserve discount factors.

The logic of the procedure was outlined above. This section proceeds through the specific computations mandated by the Internal Revenue Code.

UNDISCOUNTED PERCENTAGES

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[108] The term "long-tailed" has three meanings, depending on context:

- The Schedule P meaning: lines with ten year exhibits versus two year exhibits.
- The actuarial meaning, denoting average length of time between premium collection and loss payment.
- The IRS meaning: a line is "long-tailed" if the losses unpaid after ten years exceed the losses assumed paid in the tenth year.

All the Schedule P long-tailed lines of business are likely to be classified by the IRS as long-tailed. The length of the tail for IRS purposes depends on the Schedule P entries for the ninth and tenth oldest year; see below.

The loss reserve discount factors for this illustration are calculated in Exhibit Disc.1 on page 196, 242.

- Column 2 shows the cumulative net paid losses and loss adjustment expenses by accident year at the current statement date, from Schedule P, Part 1, column 11.[109]

- Column 3 shows the incurred net losses and loss adjustment expenses by accident year at the current statement date, from Schedule P, Part 1, column 28. These entries include paid losses and loss adjustment expenses, case reserves, and bulk + IBNR reserves.

- Column 4 shows the cumulative percentage paid from inception of the accident year to the current statement date, or column 2 divided by column 3. For accident year 2009, the percentage is $200,000 / $571,500 = 35.00%. For accident year 2008, the percentage is $330,000 / $687,500 = 48.00%.

Assumed Incremental Percentage Paid

- Column 5 shows the expected incremental percentage paid in each 12 month period. These entries are the first differences of the series in the previous column:

  ✓ For accident year 2009, the cumulative percentage paid at 12 months since inception of the accident year is 35.00%. For the most recent accident year, the incremental percentage paid equals the cumulative percentage paid.

  ✓ For accident year 2008, the cumulative percentage paid at 12 months since inception of the accident year is 48.00%. This implies that 48.00% – 35.00% = 13.00% of incurred losses are paid between 12 months and 24 months since inception of the accident year.

Schedule P shows 10 accident years of data, from which we estimate 10 twelve-month intervals of expected loss payments. If any losses remain unpaid at the end of 10 years – that is, if the cumulative paid losses for the oldest accident year does not equal the incurred losses for that accident year – we assume that all these losses are paid in the eleventh year, with the following limitation.

The amount assumed to be paid in the eleventh year is capped by the amount assumed to be paid in the tenth year. The excess amount is assumed to be paid in the twelfth year, but it is also capped at the same limit. The remaining excess is assumed to be paid in the thirteenth year, and so forth. We continue in this fashion through the fifteenth year. The remaining excess is assumed to be paid in the sixteenth year, with no limit. The next illustration (other

[109] The net paid losses and net incurred losses are net of reinsurance recoverables and return premiums.

liability) shows the computation of an extended loss payment pattern. We defer further explanation of the procedure until we get to that illustration.

The Schedule P entries for the "prior years" row are not used in the computation of the loss reserve discount factors. The reserves and payments in this row relate to various accident years. A "composite" discount factor is used to determine the discounted loss reserves for the prior rows in Schedule P; see the discussion below.

In this illustration, the cumulative percentage paid for the ninth year (2001) is 94.94%, and the cumulative percentage paid for the tenth year (2000) is 98.00%. (The "n^{th}" year here means the "n^{th}" year working backwards from the current valuation date.)[110] The amount assumed to be paid from the end of the ninth year to the end of the tenth year is 98.00% – 94.94% = 3.06%. The amount still unpaid after 10 years is 100.00% – 98.00% = 2.00%. Since 2.00% is less than 3.06%, the full 2.00% is assumed to be paid in the eleventh year. No losses are assumed to be paid after 11 years.

Several of the commercial casualty lines of business have loss payment patterns extending beyond ten years; this is especially true for workers' compensation, other liability, products liability, and medical malpractice. For these lines of business, we don't expect the cumulative paid losses at the end of the tenth year to equal the incurred losses for that year.[111] The next illustration shows the adjustments used for these long-tailed lines of business.

DISCOUNTING COMPUTATIONS

- Column 6 shows the percentage of losses unpaid at the end of the accident year, which equals the complement of the cumulative percentage of losses paid. For accident year 2009 in the personal automobile illustration, the cumulative percentage of losses paid is 35.00%, and the percentage of losses unpaid at the end of the accident year is 100% – 35.00% = 65.00%.

- Column 7 shows the discounted percentage of losses unpaid at the end of the accident year. To compute these figures, we assume that all losses are paid at mid-year. We may

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[110] We estimate the amounts to be paid in future calendar years by looking at old accident years. The difference in the cumulative percentages paid between the n^{th} past accident year and the $(n+1)^{rst}$ past accident year is the percentage assumed to be paid between the end of the n^{th} calendar year from inception of the accident year to the end of the $(n+1)^{rst}$ calendar year from inception of the accident year. The n^{th} accident year working backwards from the most recent accident year corresponds to the n^{th} calendar year working forewards from the current statement date.

[111] The IRS computation of the loss reserve discount factors for all years is heavily influenced by the Schedule P entries for the ninth oldest accident year and the tenth oldest accident year. By random loss fluctuations, any long-tailed line of business may have an 11 year loss payment pattern one year and a 16 year loss payment pattern the next year.

use either (i) an iterative method, working backwards from the oldest accident year or (ii) a formula method.

We use the figures in the personal automobile illustration to explain the methods.[112]

Iterative Method

Two percent of the incurred losses are assumed to be paid in the eleventh year, labeled "AY + 10" in the exhibit. We assume that they are paid in mid-year. With a 7.0% discount rate, the discounted value of these losses at the preceding December 31 is $2\%/(1.070)^{0.5} = 1.93\%$.

Going backwards in accident years corresponds to going forwards in calendar years. The "current accident year" in this Schedule P exhibit is 2009, though the computed loss payment pattern is used for accident year 2011, not accident year 2009. The current valuation date for accident year 2011 for which this discount factor applies is December 31, 2011. Accident year AY+1 corresponds to calendar year 2011+1 = 2012. Accident year AY+10 corresponds to calendar year 2011 + 10 = 2021.[113]

To determine the discounted percentage of losses unpaid at the end of the ninth year, we combine two pieces:

- The percentage of losses assumed to be paid in the tenth year – which are assumed to be paid at mid-year – discounted for half a year to the end of the ninth year.
- The discounted percentage of losses unpaid at the end of the tenth year, discounted for an additional year to the end of the ninth year.

In the illustration, the two pieces are as follows.

- 3.07% of accident year 2011 losses are assumed to be paid in the middle of the tenth year, or July 1, 2020. They are discounted for half a year to December 31, 2019: $3.07\%/1.070^{0.5} = 2.97\%$.
- The discounted percentage of accident year 2011 losses unpaid at the end of the tenth year (December 31, 2020) is discounted for a full year: 1.93%/1.070 = 1.80%.

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[112] The assumption that all losses are paid at mid-year is a proxy for an even distribution of paid losses during the year. In truth, losses are paid (on average) earlier than the middle of the year, particularly for losses paid in the 2 or 3 years following the inception of the accident year. The IRS procedure provides a slightly longer discount period than is warranted. This reduces the offset to taxable income and increases the income tax liability. This bias is offset by the shorter payment patterns implicit in the IRS extension past ten years.

[113] For an excellent explanation of this technique, see Salzmann [1984], who uses a similar version to develop a reserving method for allocated loss adjustment expenses.

The sum of 2.97% and 1.80% is 4.77%. We continue in this fashion for all accident years. This is the iterative method.

Formula Method

Alternatively, formulas may be used for each year. the formula for the 2009 accident year in the Schedule P exhibit, which corresponds to accident year 2011 valued at December 31, 2011, is

$$(13.00\% \div 1.07^{0.5}) + (11.02\% \div 1.07^{1.5}) + \ldots + (3.07\% \div 1.07^{8.5}) + (2.00\% \div 1.07^{9.5}) = 52.26\%.$$

LOSS RESERVE DISCOUNT FACTORS

Column 8 shows the loss reserve discount factors used in the tax calculation. These factors are the discounted percentage of unpaid losses at the end of each year divided by the undiscounted percentage of unpaid losses at the end of that year. For accident year 2009 in the illustration, the loss reserve discount factor is 52.26% / 65.00% = 80.3944%. This corresponds to the loss reserve discount factor for accident year 2011 valued at December 31, 2011. Since these factors are used to determine the tax liability, the IRS demands 6 decimal place accuracy.[114]

These loss reserve discount factors apply to the 2011 accident year only. Suppose that at December 31, 2011, the accident year 2011 undiscounted reserves are $450,000. The corresponding discounted reserves are $450,000 x 80.3944% = $361,775.

The loss reserve discount factor in the preceding row, 81.6659%, is applied to the accident year 2011 reserves on December 31, 2012, not to the reserves of any other accident year. If the 2012 Schedule P reserves for accident year 2011 are $350,000, the 2012 discounted reserves for accident year 2011 are $350,000 x 81.6659% = $281,380.

[114] Six decimal place accuracy is not necessarily meaningful if the Schedule P entries have fewer than six significant digits. Since the paid and incurred entries are in thousands of dollars, they have fewer than six significant digits for small companies.

ILLUSTRATION: OTHER LIABILITY

The following figures are taken from the 2009 Annual Statement, Schedule P, Part 1H (other liability), of a company that has elected to use its own loss payment pattern for computing discounted reserves for accident year 2011.

Exhibit Tx.7: Other Liability Paid and Incurred Losses

Accident Year	Losses + LAE Paid (col 11)	Losses + LAE Incurred (col 28)
Prior	$235,000	$250,000
2000	50,000	55,500
2001	55,000	62,000
2002	60,000	70,000
2003	65,000	80,000
2004	70,000	96,000
2005	65,000	103,000
2006	60,000	115,000
2007	50,000	125,000
2008	35,000	140,000
2009	15,000	180,000

The 60 month rolling average of the federal mid-term rate from January 2006 through December 2010 is 7.0% per annum.

Extension of Payments

We retain the same accident years and discount rate from the previous illustration. We focus on the extension of payments for long-tailed lines of business.

The loss reserve discount factors are used for accident year 2011 only. In this illustration, we determine 15 separate loss reserve discount factors. The first ten discount factors are used for valuation dates December 31, 2011 through December 31, 2020. The 11th through the 15th discount factors are used at valuation dates December 31, 2021 through December 31, 2025 as part of the composite discount factor for accident years more than 10 years old (the "prior years" row in Schedule P). The calculation of the composite discount factor is explained below.

CAPPING

The amount assumed to be paid in the eleventh year is capped by the amount assumed to be paid in the tenth year. In this illustration, 90.09% – 88.71% = 1.38% of incurred losses are

assumed to be paid in the tenth year. The amount remaining unpaid after 10 years is 100.00% – 90.09% = 9.91% of the incurred losses. Only 1.38% is assumed to be paid in the eleventh year. The remaining 9.91% – 1.38% = 8.53% is assumed to be unpaid at the end of the eleventh year.

The 1.38% cap affects the subsequent years as well. The amount assumed to be paid in each of the five years immediately following the tenth year is the lesser of (i) the amount unpaid at the end of the previous year and (ii) the 1.38% cap. We show first an illustration with a loss payment pattern that does not extend through the 16th year before returning to the other liability illustration here.

> *Illustration:* Suppose that the IRS loss reserve discounting procedure for commercial automobile indicates that 90.90% is paid within 10 years and 88.10% is paid within nine years. This implies that 90.90% – 88.10% = 2.80% is paid in the tenth year. The amounts assumed to be paid in the 11th, 12th, and 13th years are also 2.80%. Only 9.10% – 3 × 2.8% = 0.70% remains unpaid after thirteen years. This is the amount assumed to be paid in the 14th year.

Whatever remains after 15 years is assumed to be paid in the 16th year, even if it exceeds the 1.38% cap.

> *Illustration:* In the other liability example above, 9.91% – 5 × 1.38% = 3.01% remains unpaid after 15 years, so 3.01% is assumed to be paid in the sixteenth year.[115]

EXTENDED DEVELOPMENT

As for the personal auto illustration, we show the iterative procedure and the formula method

Iterative Procedure: We begin the computation of the discounted percentages unpaid at the December 31 preceding the final loss payment. For this (other liability) illustration, the loss payment pattern extends through 16 years, so we begin the computation of the discounted percentage unpaid with the end of the fifteenth year.

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[115] See the Internal Revenue Code §§ 846(d)(3)(C) and (D), "Special rule for certain long-tail lines": In the case of any long-tail line of business, the period taken into account shall be extended (but not by more than 5 years), and the amount of losses which would have been treated as paid in the 10th year after the accident year shall be treated as paid in such 10th year and each subsequent year in an amount equal to the amount of the losses treated as paid in the 9th year after the accident year (or, if lesser, the portion of the unpaid losses not theretofore taken into account). To the extent such unpaid losses have not been treated as paid before the last year of the extension, they shall be treated as paid in such last year. The term "long-tail line of business" means any line of business if the amount of losses which would be treated as paid in the 10th year after the accident year exceeds the losses treated as paid in the 9th year after the accident year.

3.01% of the accident year 2011 incurred losses are assumed to be paid in the middle of the 16th year, or July 1, 2026. The discounted loss reserve at the end of the 15th year (or December 31, 2025) is $3.01\% / 1.070^{0.5} = 2.91\%$.

The discounted percentage unpaid at the end of the 14th year equals the sum of (i) the 2.91% discounted percentage unpaid at the end of the 15th year discounted for an additional full year and (ii) the 1.38% of the incurred losses assumed to be paid on July 1 of the 15th year discounted for half a year. This is $2.91\% / 1.070 + 1.38\% / 1.070^{0.5} = 4.05\%$. (The 0.01 percentage point difference from the figure in the exhibit is a rounding discrepancy.)

Formula Method: We calculate each discounted percentage unpaid by formula. For the 2011 valuation date for the 2011 accident year, the discounted percentage unpaid equals

$$(16.67\% \div 1.07^{0.5}) + (15.00\% \div 1.07^{1.5}) + \ldots + (1.38\% \div 1.07^{13.5}) + (3.01\% \div 1.07^{14.5}) = 71.32\%.$$

ILLUSTRATION: ACCIDENT YEARS AND VALUATION DATES

Associating particular accident years and valuation dates with the appropriate Schedule P exhibits and average discount rates is the most confusing part of the calculations. The following illustration highlights the relationships.

Best's *Aggregates and Averages* shows the following data for private passenger auto liability from the 2005 industry aggregate Schedule P, Part 1B (in thousands of dollars).

Exhibit Tx.8: Loss Reserve Discounting Valuation Dates: Input Data

Accident Year	Losses Paid	Losses Incurred
Prior	$15,871,690	$15,968,279
1996	11,959,296	12,024,227
1997	13,496,724	13,613,803
1998	15,261,632	15,431,377
1999	17,079,431	17,381,876
2000	17,960,909	18,514,492
2001	19,922,828	21,136,036
2002	20,799,050	23,244,356
2003	21,050,478	26,110,739
2004	19,316,816	29,486,820
2005	10,735,738	31,281,287

The 12 month averages of the federal mid-term rate for calendar years 2000 through 2009 are shown below:

Exhibit Tx.9: Federal Mid-Term Rates

Year	Average	Year	Average	Year	Average
2001	6.7%	2004	7.0%	2007	7.0%
2002	6.6%	2005	7.3%	2008	7.3%
2003	6.8%	2006	7.4%	2009	6.9%

We determine the loss reserve discount factor for accident year 2009 private passenger automobile liability reserves at the December 31, 2017 valuation date.

DISCOUNT RATE

The discount rate is the 60 month moving average from January 1, 2004 through December 1, 2008. This equals 1/5 × (7.0% + 7.3% + 7.4% + 7.0% + 7.3%) = 7.2%.

The discount rate is computed once and used for all accident year 2009 discount factors.

LOSS PAYMENT PATTERN

Year 2009 is not a determination year. The preceding determination year is 2007. The data used is from the 2005 Schedule P from Best's *Aggregates and Averages*. This loss payment pattern is used for accident years 2007 through 2011.

Valuation date December 31, 2017 is nine years after the inception of accident year 2009. The loss reserve discount factor depends on the percentages assumed to be paid in 2010, 2011, and subsequent years. These are the same percentages as the percentages of accident year 2007 reserves at December 31, 2015, assumed to be paid in 2016, 2017, and the subsequent years.

In the terms used in this paper, these are the percentages assumed to be paid in years 10, 11, and so forth, up through year 16. The exact number of years, as well as the percentages, depends on the loss payment pattern.

The 1996 accident year in the 2005 Schedule P exhibit shows that $11,929,296,000 / $12,024,227,000 = 99.46% of incurred losses are paid by the end of ten years. The remaining 0.54% of incurred losses is distributed to years 11 and subsequent.[116]

If 0.54% or more of losses were assumed to be paid in the tenth year, we would allocate the entire 0.54% of remaining losses to the eleventh year. To determine the amount assumed to be paid in the tenth year, we compare the 1996 and 1997 accident years. From the 1997 accident year, we infer that $13,496,724,000 / $13,613,803,000 = 99.14% of incurred losses are paid in the first nine years. The percentage assumed to be paid during the tenth year is 99.46% – 99.14% = 0.32%.

The cap on payments for years 11 through 15 is 0.32%, with payments exceeding the cap rolled over to the next year. 0.54% is unpaid after ten years. The maximum that can be allocated to year 11 is 0.32%. The remainder, or 0.22%, is allocated to year 12.

LOSS RESERVE DISCOUNT FACTORS

At December 31, 2017, 99.14% of the 2009 accident year losses are assumed to have been paid. The remaining 0.86% of losses are assumed to be paid on July 1 in years 2018, 2019, and 2020 in the ratio 0.32%:0.32%:0.22%. In other words,

- (0.32%) ÷ (0.86%) of the reserves will be paid on July 1, 2018;
- (0.32%) ÷ (0.86%) of the reserves will be paid on July 1, 2019; and
- (0.22%) ÷ (0.86%) of the reserves will be paid on July 1, 2020.

We discount these assumed payments back to December 31, 2017, at a 7.2% discount rate. The discount factor for year 10 is $1/(1.072)^{0.5}$, since these loss payments are being discounted from 7/1/2018 back to 12/31/2017. The total discounted reserves, as a percentage of the undiscounted reserves, are

Year 10 (7/1/2018)	$[(0.32\%) \div (0.86\%)] \div (1.072)^{0.5}$	= 35.94%
Year 11 (7/1/2019)	$[(0.32\%) \div (0.86\%)] \div (1.072)^{1.5}$	= 33.52%
Year 12 (7/1/2020)	$[(0.22\%) \div (0.86\%)] \div (1.072)^{2.5}$	= 21.50%

The loss reserve discount factor is 35.94% + 33.52% + 21.50% = 90.96%.

Patterns

In the other liability illustration, the loss reserve discount factors are similar for the ten accident years that are separately reported in Schedule P, ranging from 77% to 80%. Some actuaries

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[116] The calculations here use percentages with two decimal places. In practice, six significant digits are used for the IRS discount factors.

presume that loss reserve discount factors should be lowest (i.e., furthest below unity) at inception and should increase towards unity as the reserves become more mature. This presumption is that the amount of the discount as a percentage of the remaining reserves is greatest at early maturities and declines to zero at later maturities.

This presumption is correct for the true discount factor for an individual loss. Suppose a loss occurs on July 1, 20X1, and it will be paid on July 1, 20X9. The amount of the discount is greatest on December 31, 20X1, and it declines steadily thereafter.

This presumption is not correct for an accident year. If loss payments follow an exponential decay, as modeled by McClenahan [1975] and Butsic [1981], the loss reserve discount factor remains relatively constant as long as some claims remain unpaid. The expected discount factor depends on the rate of decay and the discount rate, not on the development period. As Butsic [1981] shows, if the loss payments follow an exponential decay, the average remaining time to settlement is constant over the lifetime of the reserves.[117]

The loss reserve discount factors in the other liability illustration increase steadily in the final six years, from 80% to about 97%. This is caused by the IRS assumption of a constant percentage of incurred losses paid in each development period during the extended part of the loss payment pattern, instead of the declining percentage of incurred losses assumed by an exponential decay pattern.[118] For instance, the other liability illustration uses a 1.38% figure for each development period. The assumption of a final lump sum payment in the last year, whether or not the payment pattern is extended, augments the upward trend in the loss reserve discount factors for mature periods.

Negative Percentages Paid

Because different accident years are used for the cumulative paid percentages, the incremental paid percentages paid may be negative. The negative assumed payments can appear in any year except the most recent one, though they are more likely to occur in the more mature accident years. For the IRS loss reserve discounting procedure, they are most problematic (i) when they occur in the most mature accident year, causing a negative cap for

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[117] For workers' compensation, the decay is slower than exponential. Temporary total claims dominate the early payments; most of these claims are settled within a year or two. Permanent partial disability and permanent total disability claims dominate the reserves for mature years. These claims may remain open for 30 or 40 years. The loss payment pattern is rapid initially but it is very slow by ten years of maturity. See also the discussion above of the Sherman inverse power curve estimate of the paid loss development tail factor.

This is a general statistical result. If we combine distributions with exponential decays, each with a different rate of decay, the combination has a decreasing rate of decay.

[118] The exponential decay assumes that a constant percentage of the remaining reserves (not of the total incurred losses) is paid in each development period.

the assumed payments in the extended loss payment pattern, or (ii) when they cause a negative loss reserve discount factor.[119]

NEGATIVE CAP

If the negative assumed loss payment occurs in the oldest accident year individually reported in Schedule P, the cap on the extended payments in all subsequent years would also be negative. To avoid this situation, a negative assumed loss payment in the oldest accident year is replaced by the average of the assumed loss payments in the three oldest years.[120]

Illustration: The 2009 Schedule P for a given line has the cumulative paid losses and incurred losses shown in Exhibit Tx.10.

Exhibit Tx10: Negative Assumed Loss Payments

Accident Year (1)	Paid Loss + LAE (2)	Incurred Loss + LAE (3)	Cumulative Paid/Incurred Ratio: (4)	Incremental Paid/Incurred Ratio: (5)	Undiscounted Percentage Unpaid: (6)
2000	$280,000	$300,000	93.33%	-3.64%	6.67%
2001	320,000	330,000	96.97%	9.47%	3.03%
2002	315,000	360,000	87.50%	5.92%	12.50%
2003	310,000	380,000	81.58%	6.58%	18.42%
2004	300,000	400,000	75.00%	7.25%	25.00%

[119] The true problem is not simply that negative assumed payments are unreasonable. The problem is that the prevalence of negative assumed payments highlights the inaccuracy of the entire calculation method. No estimation procedure is perfect. But the standard actuarial technique for determining loss payment patterns is reasonably accurate. An actuarial estimate of the future loss payments in a given year of 10% might mean a 90% confidence interval that the true expected loss payment is between 8% and 12%. In contrast, the IRS procedure is much less accurate. An estimate of the future loss payments in a given year of 10% might mean a 90% confidence interval that the true expected loss payment is between 5% and 20%. The accuracy diminishes for estimated loss payments close to 0%. An IRS estimate of the future loss payments in a given year of 1% might mean a 90% confidence interval that the true expected loss payment is between 0% and 15%.

[120] See the Internal Revenue Code §846(d)(3)(G): "If the amount of the losses treated as paid in the 9th year after the accident year is zero or a negative amount, subparagraphs (C)(ii) and (D) shall be applied by substituting the average of the losses treated as paid in the 7th, 8th, and 9th years after the accident year for the losses treated as paid in the 9th year after the accident year." A literal reading of this paragraph implies that the cap for the years subsequent to the tenth year is changed, but the negative assumed payment for the tenth year remains.

The negative assumed payment in the oldest accident year (2000) stems from a statistical fluctuation – slightly lower claims remaining open in the ninth year (2001) than expected.

The average assumed loss payment in the three oldest accident years is ⅓ × (–3.64% + 9.47% + 5.92%) = 3.92%. This figure replaces the –3.64% in accident year 2000 before the extended payment pattern is computed.

If the average of the three oldest accident years is still negative, the average of the four oldest accident years is used. If this average is still negative, the average of the five oldest accident years is used. One continues in this fashion until one comes to the average of all ten accident years. This average cannot be negative.

NEGATIVE DISCOUNT FACTORS

It is possible for one or more of the computed accident year discount factors to be zero or negative. A negative discount factor can result only if the assumed amount paid is also negative in some year. However, most negative assumed amounts paid do not cause negative discount factors.

A negative discount factor has no financial meaning. A discount factor of 80% means that the present value of a $100,000 future cash flow is $80,000. A rational investor with no risk aversion would be indifferent between $80,000 paid now and the $100,000 cash flow when it is actually paid. By the same interpretation, a discount factor of –40% would mean that an investor is indifferent between paying $40,000 now and receiving the $100,000 when the cash flow is actually received. This does not make sense.

Because a negative discount factor is not reasonable, the negative factor is replaced by an interpolated factor between the nearest positive discount factors on both sides. Simple linear interpolation is used.

Illustration: The computed loss reserve discount factors for accident years AY+7, AY+8, and AY+9 are +80%, –35%, and +85%. The negative discount factor of –35% is replaced by the interpolated factor of +80% + ½ (85% – 80%) = 82.5%.

Illustration: The computed loss reserve discount factors for accident years AY+6, AY+7, AY+8, and AY+9 are +70%, –35%, –45%, and +85%. The negative discount factors of –35% and –45% are replaced by the interpolated factors of +70% + ⅔ (85% – 70%) = 80% and +70% + ⅓ (85% – 70%) = 75%.

NEGATIVE DISCOUNT FACTORS AND NEGATIVE PAYMENTS

Negative discount factors stem from negative assumed loss payments. The negative assumed loss payments stem from the quirks of the IRS loss reserve discounting procedure, not from negative loss payments or from data errors in the company's historical records.[121]

If the negative assumed loss payment occurs in the oldest accident year shown in Schedule P, it is replaced by the average of the assumed loss payments in the three oldest accident years. If the negative assumed loss payment occurs in any other accident year, it is not changed. Only negative loss reserve discount factors are replaced by positive ones.

TAX LIABILITIES AND REFUNDS

If the computed loss reserve discount factors for accident years AY+7, AY+8, and AY+9 are +80%, +10%, and +85%, no change is made, though the +10% discount factor for year AY+8 is unreasonable. This sequence of discount factors causes a large tax liability in one year followed by a tax refund in the subsequent year for a given line of business.

Illustration: The expected loss reserves for accident year 20X1 are $50 million, $45 million, and $40 million at year-end 20X7, 20X8, and 20X9, with expected payments of $5 million in each year. The statutory incurred loss from the runoff of the reserves is $0 in each year. If the loss reserve discount factors are 80%, 10%, and 85%, the tax basis incurred losses are as follows (figures in millions of dollars).

Exhibit Tx.11: Unreasonable Loss Reserve Discount Factors (dollars in millions)

Calendar Year	Paid Loss	Change in Loss Reserve	Incurred Loss
20x8	$5	$45 x 10% – $50 x 80% = –$35.5	–$30.5
20x9	$5	$40 x 85% – $45 x 10% = $29.5	$34.5

This effect is submerged within the other tax liabilities and tax refunds of the company, and it is generally not noticeable. The majority of negative assumed loss payments produce positive but unreasonable loss reserve discount factors.

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[121] Negative loss payments are possible, though they are rare. They can result from unanticipated salvage and subrogation or from unanticipated reinsurance recoverables. They can also result from a failure to accrue anticipated salvage and subrogation or a failure to accrue anticipated reinsurance recoverable.

The company's interpretation of "net amounts" also affects the figures. Net paid losses in Schedule P means direct plus assumed paid losses minus ceded paid losses. One might presume that this means the direct plus assumed losses paid minus the reinsurance recoverables actually received. This is not the case. Net paid losses means the direct plus assumed losses paid minus the reinsurance recoverables received or anticipated on these loss payments. See SSAP No. 53, "Property-Casualty Contracts – Premiums," SSAP No. 62, "Property and Casualty Reinsurance," Yoheved and Sarason [2002], and Feldblum [2002: Schedule F].

Exhibits A.3 and A.4 on pages 244 and 245 illustrate this. Exhibit A.4 uses the same other liability illustration worked out above, with a change in the paid losses for accident year 2002 from $60,000 to $69,000. The incremental paid to incurred ratio for accident year 2001 becomes –9.86%, the discounted loss reserve for accident year 2002 becomes –1.36%, and the loss reserve discount factor for accident year 2002 is –95%. The negative loss reserve discount factor is replaced a positive factor of ½ × (82.5189% + 77.4439%) = 79.9814%.

Exhibit A.3 shows the same scenario, but the accident year 2002 paid losses are changed to $68,000, not $69,000. The incremental paid to incurred ratio for accident year 2001 becomes –8.43%, the discounted loss reserve for accident year 2002 becomes 0.02%, and the loss reserve discount factor for accident year 2002 is less than 1% (0.6645%). This scenario is also unreasonable, but it is retained by the IRS rules.[122]

Composite Discount Factors

The loss reserve discount factors calculated above are applied to the unpaid losses for the appropriate accident year. Schedule P shows loss reserves by accident year only for the ten most recent years, to which ten separate loss reserve discount factors are applied. The 11th through 15th loss reserve discount factors are applied to the reserves in the Schedule P prior years row, which is not divided into the component accident years.

The IRS loss reserve discounting procedure assumes that all losses are paid no later than the 16th year. The prior years row in Schedule P contain losses that will be paid in the 12th through the 16th year, which use the loss reserve discount factors for years AY+11 through AY+15. A composite discount factor is formed from the five individual discount factors for application to the prior years row.

Each discount factor is the ratio of discounted reserves to undiscounted reserves for a given accident year at a given valuation date. For instance, the "tenth" accident year 2010 discount factor for AY+10 represents the discounted reserves for accident year 2010 at December 31, 2020, divided by the undiscounted reserves for accident year 2110 at December 31, 2020. This discount factor is computed in tax year 2010, not in tax year 2020.

We explain the calculation of the composite discount factor by illustration.

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[122] The disregard for financial reason evident in these IRS rules diminishes the public's respect for the IRS loss reserve discounting procedure. The IRS would do well to amend the procedures in accordance with sound actuarial techniques. The Casualty Actuarial Society and the American Academy of Actuaries would do well to formally recommend the necessary changes to the U.S. Treasury. An interim correction would be to smooth the pattern of assumed payments. This would at least eliminate unreasonable factors, though ideally a sound actuarial procedure should be used instead.

ILLUSTRATION: COMPOSITE DISCOUNT FACTORS

For tax year 2019, Schedule P shows ten individual accident years: 2010 through 2019. Previous accident years – 2009 and prior – are grouped in the prior years row. Since the IRS loss reserve discounting procedure assumes that all losses are paid by the 16th year, we assume that the loss reserves in the prior years row represent losses from accident year 2005 through 2009.

We form a composite discount factor based on the following discount factors:

- Accident year 2005 discount factor for a valuation date 15 years after inception of year.
- Accident year 2006 discount factor for a valuation date 14 years after inception of year.
- Accident year 2007 discount factor for a valuation date 13 years after inception of year.
- Accident year 2008 discount factor for a valuation date 12 years after inception of year.
- Accident year 2009 discount factor for a valuation date 11 years after inception of year.

Some of these loss reserve discount factors use the same loss payment pattern. However, they all use different discount rates, and they are computed in separate years.

Suppose these five loss reserve discount factors are as shown below:

Exhibit Tx.12: Composite Discount Factor

Accident Year (1)	Valuation Date (2) **	Undiscounted Reserve (3)	Discounted Reserve (4)	Discount Factor (5)
2005	AY + 15	5.0%	4.8%	96.9%
2006	AY + 14	7.2%	6.8%	93.9%
2007	AY + 13	9.1%	8.3%	91.0%
2008	AY + 12	11.7%	10.3%	88.2%
2009	AY + 11	13.3%	11.4%	85.4%
Total	prior years row	46.3%	41.6%	89.8%

** For all the accident years, the valuation date is December 31, 2020. The Internal Revenue Code refers to this as AY+15 for accident year 2005, AY+14 for accident year 2006, etc.

The calculation of the individual discount factors has been explained earlier. Each discount factor in column 5 is the ratio of the discounted reserves in column 4 to the undiscounted reserves in column 3. The reserve figures in columns 3 and 4 are expressed as percentages of the corresponding year's incurred losses. We compute the total of the five percentages for

the discounted reserves and the undiscounted reserves. We divided these totals to obtain the composite discount factor for the prior years row.

Using a simple average to obtain the "total" row assumes that each year has the same volume of incurred losses. It might seem better to weight the discount factors by the actual percentage of incurred losses by accident year in the prior years row. However, the IRS bases the loss reserve discounting procedure on information contained in the Annual Statement. The distribution of the prior years row reserves by accident year is not found in the Annual Statement.

Taxpayer's Election

The Secretary of the Treasury revises the line of business loss payment patterns every five years, using aggregate (industry-wide) Schedule P data. The first loss payment patterns were determined in early 1987 for the 1987 through 1991 tax years.[123] The industry-wide Schedule P data were those contained in the most recent Best's *Aggregates and Averages* that was available in early 1987. This was the 1986 edition of Best's *Aggregates and Averages*, containing data from the 1985 Annual Statements.

The Treasury redetermines the loss payment patterns every five years; these are the years 1992, 1997, 2002, 2007, and so forth. The loss payment patterns apply to that year and the four subsequent years (1992-1996; 1997-2001; and so forth).

The loss payment patterns are determined once every five years, but the discount rate is recomputed each year. The loss reserve discount factors change each year, since the discount rate changes, even though the loss payment patterns may remain the same.

The Treasury recognizes that the aggregate industry loss payment patterns may not be appropriate for some insurers.

> *Illustration:* The aggregate industry-wide other liability loss payment pattern assumes a long average lag between the occurrence of accidents and the settlement of claims. Insurer ABC writes relatively quick settling premises and operations coverage for offices, showrooms, and retail stores. Since its claims settle more quickly than the industry averages, it should be able to use discount factors closer to unity, thereby giving higher discounted loss reserves, a greater offset to taxable income, and lower tax liabilities.

At determination years, each insurer may elect to use its own data to compute the loss payment patterns for the next five years. The election is made with the tax return for the determination year, which is filed a few months after the end of the year.

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[123] Preliminary loss payment patterns were determined in 1996 for review by the IRS staff and Congressional committees.

Illustration: On its 2007 tax return, filed in early 2008, Insurer ABC may elect to use its own data for the loss payment patterns used to compute the loss reserve discount factors for accident years 2007 through 2011.

If the insurer elects to use its own data, it recomputes the loss payment pattern each year, though each accident year's loss reserve discount factors are still "vintaged," or "frozen." For each accident year's loss reserve discount factors, the insurer uses the most recent Schedule P data that has been filed before the beginning of the accident year.

> *Illustration:* On its 2007 tax return, Insurer ABC elects to use its own data for the loss payment patterns used to compute the loss reserve discount factors for accident years 2007 through 2011. For the 2007 accident year, it uses 2005 Schedule P data; for the 2008 accident year, it uses 2006 Schedule P data; and so forth. This is the same "two year lag" as occurs with industry-wide loss reserve discount factors.

An election to use one's own data applies to all lines of business. An insurer may not elect to use its own data for some lines of business and the industry data for other lines.[124]

ELECTION RESTRICTIONS

For two types of business an insurer must use the industry-wide loss reserve discount factors and may not use its own data:

- An insurer may not use its own data for the international line of business or for the reinsurance lines of business.[125]
- An insurer's election to use its own data does not apply to any line of business for which it "does not have sufficient historical experience to determine a loss payment pattern" [IRC §846(e)(4)(A)].

The 1986 conference reports, as well as the 1988 Treasury regulation 88-100, interpreted the latter provision to mean that an insurer whose reserves in a given line of business were smaller than those of 90% of other insurers may not use its own data to determine the loss payment patterns.[126] Small companies complained that this provision discriminated against

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[124] See Treasury regulations 2001FED 26,330C, §1.846-2, Election by taxpayer to use its own historical loss payment pattern: "A taxpayer making the election must use its own historical loss payment pattern in discounting unpaid losses for each line of business that is an eligible line of business in that determination year."

[125] See Internal Revenue Code §846(e)(3) "No election under this subsection shall apply to any international or reinsurance line of business"; see also § 846(d)(3)(E).

[126] See Regulation 88-100, §III: "Until further guidance is issued, such statistically significant amount is business in at least the 10th percentile of industry-wide reserves for a line of business for the determination year

them. In 1991, the Secretary of the Treasury specifically revoked this provision. Instead, the insurer must have data for all ten accident years shown in Schedule P to use its own data for that line of business.[127]

The adequacy of an insurer's loss reserves has a large effect on its election to use its own data. An insurer with less adequate loss reserves than those of the industry is more likely to gain from using its own data.

> *Illustration:* In 20X9, the industry-wide Schedule P for a given line of business shows accident year 20X9 cumulative paid losses of $100 million and incurred losses of $400 million, indicating that 25% of losses are paid in the first 12 months. Insurer ABC, which holds less adequate loss reserves, shows $3 million of accident year 20X9 cumulative paid losses and $10 million of incurred losses, indicating that 30% of losses are paid in the first 12 months. Insurer ABC seems to pay its losses more rapidly, so its discount factor should be closer to unity, its offset to taxable income should be larger, and its tax liability should be smaller. In truth, insurer ABC may have the same loss payment pattern as the industry has, but it may be holding less adequate loss reserves.

ANTICIPATED SALVAGE AND SUBROGATION

The loss reserves that are an offset to taxable income must be net of anticipated salvage and subrogation.[128] If the insurer does not disclose that the unpaid losses in Schedule P are net of anticipated salvage and subrogation, the IRS assumes they are gross of anticipated salvage and subrogation and requires a reduction for the anticipated amounts. Column 23 of Schedule P, Part 1 provides this disclosure by accident year and by line of business.[129]

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with respect to which the election is made."

[127] See Treasury regulation 2001FED 26,330C, §1.846-2, Election by taxpayer to use its own historical loss payment pattern: "A line of business is an eligible line of business in a determination year if . . . the taxpayer reports losses and loss expenses incurred . . . for at least the number of accident years for which losses and loss expenses incurred for that line of business are required to be separately reported on that annual statement."

[128] See IRC §846(e): *An insurance company is required to take estimated salvage recoverable (including that which cannot be treated as an asset for state statutory accounting purposes) into account in computing the deduction for losses incurred.*

[129] See the Internal Revenue Code, section 846(2) "A company is allowed to increase the unpaid losses shown on its annual statement only if the company . . . discloses on its annual statement, by line of business and accident year, the extent to which estimated salvage recoverable is taken into account in computing the unpaid losses shown on the annual statement . . ."

The anticipated salvage and subrogation that must be subtracted from the unpaid losses is the discounted anticipated salvage and subrogation. The discount factors are determined by the Treasury. Companies may elect to use their own discount factors for loss reserves, but they must use the Treasury discount factors for anticipated salvage and subrogation.[130]

COMPUTATIONAL SEQUENCE

The sequence for determining the offset to taxable income from loss reserves is as follows:

Step 1. Total net losses and expenses unpaid are taken from Schedule P, Part 1, column 24.
Step 2. The salvage and subrogation anticipated from Schedule P, Part 1, column 23, is added.
Step 3. The tabular discounts for loss reserves from Note 27 are added. This amount is the unpaid losses gross of all discounts and of anticipated salvage and subrogation.
Step 4. The Schedule P, Part 1, loss reserves are gross of the non-tabular discounts shown in Schedule P, Part 1, columns 32 and 33. However, these non-tabular discounts must be disclosed as well.
Step 5. The gross loss reserves are discounted using either (i) the industry loss reserve discount factors published by the Treasury or (ii) the company's own loss reserve discount factors, depending on the election made by the company in the most recent determination year.
Step 6. The gross anticipated salvage and subrogation is discounted using the Treasury discount factors.
Step 7. The discounted anticipated salvage and subrogation is subtracted from the discounted loss reserves to give the discounted reserves net of anticipated salvage and subrogation. The change in these discounted reserves is the loss offset to taxable income.[131]

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[130] Until recently, companies did have the option of their own discount factors for anticipated salvage and subrogation. Treasury regulation 2001FED 26,153, §1.832-4, says that "except as otherwise provided in guidance published by the Commissioner in the Internal Revenue Bulletin, estimated salvage recoverable must be discounted either (1) by using the applicable discount factors published by the Commissioner for estimated salvage recoverable; or (2) by using the loss payment pattern for a line of business as the salvage recovery pattern for that line of business and by using the applicable interest rate for calculating unpaid losses under section 846(c)." Guidance explicitly revoking this choice was issued in 2001.

[131] The IRS has issued extensive rules relating to the 1991 "fresh start" for anticipated salvage and subrogation, with insurers classified as "grossers" and "netters," and to various permitted discount factors in earlier years. These rules are not relevant to current and future tax years.

The computation of the admitted portion of the deferred tax asset stemming from IRS loss reserve discounting is based on two items:

- the loss reserve discount factors by accident year and by line of business for the current valuation date and for the valuation date 12 months hence, and
- the company's loss payment pattern by line of business.

The IRS loss payment pattern is used to compute the loss reserve discount factors. The actuary's estimated loss payment pattern is used to compute the admitted portion of the deferred tax asset.

Of all the changes in the NAIC's codification project, the deferred tax asset stemming from IRS loss reserve discounting has the greatest effect on policy pricing and company valuation; see Kelly, *et al.* [2002: prms]. We present first the requisite background explanations of deferred tax assets and liabilities, and we illustrate the loss reserve discounting procedures that rely on Schedule P data.

Current Taxes vs Deferred Taxes

There are two ways of accounting for federal income taxes:

- The incurred tax liability is the tax liability actually incurred by the taxpayer, based on the provisions of the Internal Revenue Code, or
- The accrued tax liability is the tax liability implied by the company's balance sheet, whether GAAP or statutory.

Current taxes are the incurred tax liability. The current year's change to the deferred tax asset or liability is the difference between the incurred tax liability and the accrued tax liability.[132] The change to the deferred tax asset or liability is a direct charge or credit to surplus shown on line 24 of the NAIC Annual Statement.

Before 2001, insurers could not admit any deferred tax asset or liabilities on the statutory balance sheet. In contrast, GAAP recognizes deferred tax assets and liabilities if they are

[132] This definition uses a retrospective computation. SFAS 109 requires a prospective computation, which may be different if the tax rate changes or if there are other changes in tax regulations. For simplicity, we use the retrospective viewpoint at first. We explain the prospective viewpoint further below.

expected to be realized; see SFAS 109. With the implementation of codification in 2001, statutory accounting recognizes deferred tax liabilities and a portion of deferred tax assets.

Permanent Differences and Timing Differences

Tax accounting differentiates between permanent differences and timing differences, as defined below.

- *Permanent differences* are differences that do not reverse in later accounting periods. The tax exemption for municipal bond interest is a permanent difference.
- *Timing differences* are differences that reverse in later accounting periods. The revenue offset provision creates a timing difference between statutory income and taxable income.

An alternative perspective is to view permanent differences as differences in the tax rates applicable to different sources of income; see Kelly, *et al.* [2002: prms]. For property-casualty insurers, both corporate bond income and municipal bond income are taxable income, but the former has a 35% tax rate and the latter has a 5.25% tax rate.

Income Statement vs Balance Sheet

It is tempting to define timing differences as differences in the timing of income between the book income statement (i.e., GAAP or statutory) and the tax income statement. This is not correct.

> *Timing differences are differences between the tax income statement and the income statement implied by the GAAP or statutory balance sheet.*[133]

UNREALIZED CAPITAL GAINS AND LOSSES

For each accounting year, we compute the difference between the book value and the cost of the financial asset. The change in this difference from the previous year to the current year is the unrealized capital gain or loss. For common stocks, the book value is the market value.

Unrealized capital gains and losses are admitted on the statutory (as well as GAAP) balance sheet, though they do not flow through the income statement. They are direct charges and credits to surplus, not a portion of net income.

For tax purposes, capital gains and losses are not part of income until they are realized.

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[133] This definition is particularly relevant to the deferred tax liabilities and assets stemming from unrealized capital gains and losses. For the deferred tax assets stemming from revenue offset and loss reserve discounting, we could use the difference between statutory income and taxable income.

- Unrealized capital gains increase the book value of common stocks on the statutory balance sheet. There is no tax liability in the current tax year. Instead, the reporting company shows a deferred tax liability.
- Similarly, unrealized capital losses decrease the book value of common stocks on the statutory balance sheet. There is no tax refund in the current tax year. Instead, the reporting company shows a deferred tax asset.

Illustration

ABC Insurance Co buys common stock for $50 million on December 31, 20XX.

- On December 31, 20XX+1, the common stock are worth $40 million;
- On December 31, 20XX+2, the common stock are worth $60 million; and
- On December 31, 20XX+3, the common stock are worth $80 million.

The federal income tax rate is 35%. On December 31, 20XX+3, the ABC Insurance Company sells the common stock. We calculate the following accounting entries:

- The unrealized capital gains and losses in years 20XX+1, 20XX+2, and 20XX+3.
- The realized capital gains and losses in years 20XX+1, 20XX+2, and 20XX+3.
- The deferred tax assets and liabilities in years 20XX+1, 20XX+2, and 20XX+3.

Tax year 20XX+1

The market value of the stock has decreased by $10 million. The stock has not been sold yet, so the capital loss is unrealized. There are no realized capital gains and losses.

- On December 31, 20XX, book value – cost = $50 million – $50 million = $0.
- On Dec 31, 20XX+1, book value – cost = $40 million – $50 million = –$10 million.
- The unrealized capital gain or loss = –$10 million – $0 million = –$10 million.

The current balance sheet shows a decline of $10 million. When the stocks are sold, ABC Insurance Company will have an income loss of only $6.5 million, since the capital loss can offset other capital gains, and the company's tax liability will be reduced by $3.5 million. There is a $3.5 million deferred tax asset on the 20XX+1 balance sheet.

Tax year 20XX+2

The stock prices have increased. The unrealized capital gain is the *change* in the difference between book value and cost of the stocks. The unrealized capital gain for 20XX+2 is $20 million. The realized capital gain is again zero, since the stocks have not been sold.

- On December 31, 20XX+1, book value – cost = $40 million – $50 million = –$10 million.

- On December 31, 20XX+2, book value – cost = $60 million – $50 million = +$10 million.
- The unrealized capital gain or loss = +$10 million – (–$10 million) = +$20 million.

The company's balance sheet is $20 million stronger than it was a year ago. However, if the stocks were sold now, the company would realize a gain of only $13 million, since $7 million would go to taxes. The *change* in the deferred tax assets and liabilities is a credit of $7 million. Since we began with a deferred tax asset (a debit) of $3.5 million, we now have a deferred tax liability (a credit) of $3.5 million.

Tax year 20XX+3

The company sells the stock. The difference between market value and cost of the stocks is now $0 (since there are no more stocks on the balance sheet), so the unrealized capital gain is –$10 million.

- On December 31, 20XX+2, book value – cost = $60 million – $50 million = +$10 million.
- On December 31, 20XX+3, book value – cost = $0 million – $0 million = $0 million.
- The unrealized capital gain or loss = $0 million – ($10 million) = –$10 million.

The realized capital gain, which is defined as the sale price minus the purchase price, is +$30 million. The deferred tax assets and liabilities are now zero.[134]

Statutory Recognition of Deferred Tax Assets

All deferred tax liabilities are recognized on the statutory balance sheet. For most deferred tax assets, the admitted statutory portion equals the entire asset, and statutory accounting is the same as GAAP.[135] In certain instances, only a portion of the deferred tax assets are

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[134] Unrealized capital gains and losses give rise to deferred tax liabilities and assets, respectively. Realized capital gains and losses affect current taxes; they do not give rise to deferred tax assets and liabilities. An exception stems from the rule that capital losses can offset capital gains but not operating gains.

If capital losses exceed capital gains, the company may carry forward the unused capital losses. The tax rate times the unused capital loss is a deferred tax asset, not a deduction in current tax liabilities.

Capital losses can be carried forward a limited number of years. If during these years the company has not realized sufficient capital gains to offset all the capital losses, the remaining capital losses expire unused, and the deferred tax asset is removed.

[135] There are two potential differences between GAAP and statutory accounting even when the full deferred tax asset passes the 12 month test:

- Some companies use a valuation allowance on the GAAP balance sheet for deferred tax assets and liabilities that may not reverse.
- Some companies use fair values, or discounted values, for deferred tax assets and liabilities that may

recognized on the statutory balance sheet. This applies particularly to the deferred tax asset stemming from IRS loss reserve discounting for medium- and long-tailed lines of business.

SSAP No. 10, "Income Taxes," paragraph 10, says:

Gross DTAs shall be admitted in an amount equal to the sum of:

a Federal income taxes paid in prior years that can be recovered through loss carrybacks for existing temporary differences that reverse by the end of the subsequent calendar year;
b The lesser of:

i. The amount of gross DTAs, after the application of paragraph 10 a., expected to be realized within one year of the balance sheet date; or
ii. Ten percent of statutory capital and surplus as required to be shown on the statutory balance sheet of the reporting entity for its most recently filed statement with the domiciliary state commissioner adjusted to exclude any net DTAs, EDP equipment and operating system software and any net positive goodwill; and
iii. The amount of gross DTAs, after application of paragraphs 10 a. and 10 b., that can be offset against existing gross DTLs.

A gross deferred tax asset is admissible if it will reverse within one year, as required by paragraph (a) and by paragraph (b.i).

The limitation of 10% of surplus in paragraph (b.ii) is rarely applicable. Few companies have deferred tax assets that will reverse in the coming year and that exceed 10% of policyholders' surplus. The deferred tax asset stemming from IRS loss reserve discounting is large, but most of this deferred tax asset does not reverse within one year.

The offsetting against existing gross deferred tax liabilities mentioned in paragraph (b.iii) is relevant for companies with large unrealized capital gains from common stock holdings. The actuary should take this provision into account when quantifying the admitted portion of the deferred tax asset.

Common stock that has suffered an unrealized capital loss may be sold within the next 12 months to realize the tax benefits. A literal reading of the SSAP would permit the recognition of the deferred tax asset only if the company expects to realize the capital loss during the coming calendar year. In practice, most auditors do not require an explicit company expectation to realize the loss in order to admit the deferred tax asset.

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not reverse for many years.

Revenue Offset

The deferred tax asset stemming from revenue offset is similar to the deferred tax asset stemming from loss reserve discounting. For annual policies, the entire deferred tax asset will reverse during the coming year, and it is fully admitted on the statutory balance sheet.

BACKGROUND

All acquisition expenses flow through the statutory income statement when they are incurred. No deferred policy acquisition cost (DPAC) asset is entered on the statutory balance sheet.

On GAAP financial statements, acquisition expenses are capitalized on the balance sheet and amortized through the income statement over the term of the policy. The DPAC asset depends on the actual expenses incurred by the company.

For tax purposes, 20% of the written premium is treated as acquisition expenses that are capitalized and amortized over the term of the policy.[136] More precisely, the revenue offset provision defines the taxable earned premium.

- Statutory earned premium equals written premium minus the change in the unearned premium reserves.
- Taxable earned premium equals written premium minus 80% of the change in the unearned premium reserves.

ILLUSTRATION: DPAC OF 20%

An annual policy with a premium of $1,000 and acquisition expenses of $200 is written on December 31, 20XX.

- The statutory balance sheet shows a loss of $200. The written premium of $1,000 is offset by the unearned premium reserve of $1,000, and the incurred acquisition cost of $200 flows through the income statement.
- For tax purposes, the $1,000 written premium is offset by only $800 of unearned premium reserves, leaving a $200 gain. This $200 gain combined with the $200 acquisition cost yields a $0 net gain or loss.

The income implied by the statutory balance sheet – taxable income = –$200 – $0 = –$200.

In 20XX+1, statutory earned premium is $1000, since the entire unearned premium reserve is taken down over the course of the year. The taxable income is $800, since only 80% of the

[136] Life and health insurers and annuity writers have a similar "DAC-tax."

change in the unearned premium reserve is considered. For 20XX+1, the income implied by the statutory balance sheet – taxable income equals $1000 – $800 = $200.

At the end of 20XX+1, the statutory balance sheet equals the implied tax balance sheet. Both show net cash received of $1000 – $200, or the written premium minus the acquisition expense. The temporary balance sheet difference at December 31, 20XX fully reverses by December 31, 20XX+1.

At December 31, 20XX, taxable income is $200 greater than the income implied by the statutory balance sheet. The tax liability for 20XX is 35% × $200 = $70 greater than the tax liability that would be determined from the statutory balance sheet. Since the $70 difference will reverse over the coming 12 months, it is recognized as a deferred tax asset on the statutory balance sheet.

The deferred tax asset on the statutory balance sheet does not depend on the amount of actual acquisition expenses. In contrast, the deferred tax asset on the GAAP balance sheet depends on the size of the GAAP deferred policy acquisition cost asset relative to the 20% assumption in the revenue offset provision.

ILLUSTRATION: DPAC OTHER THAN 20%

A company writes and collects a $1000 annual premium on December 31, 20XX. Acquisition expenses of $250 are incurred (and paid) on December 31, 20XX. The marginal tax rate on underwriting income is 35%. All acquisition costs are deferrable under GAAP.

Taxable underwriting income for 20XX is $200 (taxable premium income from revenue offset) – $250 (acquisition expenses) = –$50. The tax outflow is a negative $17.50 (or a tax refund of $17.50).[137]

The taxable premium income may be evaluated in either of two ways.

- Taxable earned premium = written premium minus 80% of the change in the unearned premium reserves = $1000 – 80% × $1000 = $200.
- Taxable earned premium = statutory earned premium plus 20% of the change in the unearned premium reserves = $0 + 20% × $1000 = $200.

The tax liability is 35% times the taxable income: 35% × ($200 – $250) = –$17.50.

Taxable underwriting income for 20XX+1 equals $800 of taxable premium income. The tax outflow is $800 × 35% = $280.00. Written premium during the year is $0 and the unearned

[137] The tax refund stemming from negative taxable income offsets tax liabilities stemming from positive taxable income on other insurance contracts. There is no need to presume tax carrybacks or carryforwards.

premium reserve declines from $1000 to $0. We use the same two computation methods: (i) $0 – 80% × (–$1000) = $800, or (ii) $1000 + 20% × (–$1000) = $800.

A deferred tax asset of $70 stemming from the revenue offset provision is entered on the balance sheet on December 31, 20XX, and it is amortized over the course of the policy term. The full deferred tax asset from revenue offset is recognized on the statutory balance sheet, since it reverses within 12 months of the balance sheet date (for annual policies).

On GAAP financial statements, the book income for 20XX is $1000 – $0 = $1000, since all acquisition expenses are capitalized. The taxable income is –$50 (as above), and the tax liability is –$17.50 (i.e., a refund). GAAP shows a deferred tax liability (not an asset) of $17.50, exactly offsetting the tax refund.

LOSS RESERVE DISCOUNTING

The statutory incurred losses are the paid losses plus the change in the undiscounted loss reserves. The taxable incurred losses are the paid losses plus the change in the *discounted* loss reserves. The difference between statutory and taxable incurred losses is a timing difference. The change in the deferred tax asset is 35% of this difference.

Illustration: A policy is issued on January 1, 20XX, for a premium of $1000 and expenses of $200. Losses of $800 are incurred in 20XX, of which half are paid in 20XX and half are paid in 20XX+1. The IRS loss reserve discount factor at the 12 month valuation is 90%. For simplicity, we assume that the companies earns no investment income.

- The statutory incurred losses in 20XX are $400 of paid losses plus $400 of loss reserve change = $800. Statutory income is $1000 – $200 – $800 = $0. The accrued taxes on income of $0 is $0.
- The taxable incurred losses in 20XX are $400 of paid losses plus $360 of change in discounted loss reserves = $760. Taxable income is $1000 – $200 – $760 = $40. The tax liability on $40 is $14.

The difference between the income implied by the statutory balance sheet and taxable income is $0 – $14 = –$14. The gross deferred tax asset is $14.

Only the portion of the deferred tax asset that reverse within 12 months is admitted on the statutory balance sheet. We examine the statutory income and taxable income for 20XX+1.

- The statutory incurred losses in 20XX+1 are $400 of paid losses plus –$400 of loss reserve change = $0. There is no premium or expense in 20XX+1, so statutory income is $0. The accrued taxes on income of $0 is $0.

- The taxable incurred losses in 20XX+1 are $400 of paid losses plus –$360 of change in discounted loss reserves = $40. There is no premium or expense in 20XX+1, so taxable income is $0 – $40 = –$40. The tax liability is 35% × (–$40) = –$14.

The full difference between statutory and taxable income reverses in 20XX+1, so the full deferred tax asset of $14 is admitted on the statutory balance sheet.

Twelve Month Reversal

We present the formula for computing the admitted portion of the deferred tax asset stemming from loss reserve discounting. The computations are done separately by line of business and by accident year.

Illustration: For accident year 20XX in a given line of business, the loss reserve discount factors are Z_1 at December 31, 20YY, and Z_2 at December 31, 20YY+1. Let "R" be the held loss reserves at December 31, 20YY. Let "P" be the percentage of accident year 20XX reserves that will be paid during calendar year 20XX.

- At December 31, 20YY, the difference between statutory and taxable income for accident year 20XX is $R \times (1 - Z_1)$. The gross deferred tax asset is $35\% \times R \times (1 - Z_1)$.
- At December 31, 20YY+1, the difference between statutory and taxable income for accident year 20XX is $R \times (1 - P) \times (1 - Z_2)$. The gross deferred tax asset is $35\% \times R \times (1 - P) \times (1 - Z_2)$.
- The admitted portion of the deferred tax asset on the statutory balance sheet at December 31, 20YY is $35\% \times R \times [(1 - Z_1) - (1 - P) \times (1 - Z_2)]$.

The value of "P" depends on the actuary's best estimate of the loss payment pattern. It is not the same as the IRS loss payment pattern. To estimate the pattern, we must derive actuarially justified discount factors.

Actuarial Discount Factors

The percentage of losses expected to be paid by each valuation date is the reciprocal of the paid loss development factor.[138] We reproduce below the paid loss development factors from the illustration earlier in this paper.

[138] See Feldblum [2002: SB] for a full discussion of this topic.

Exhibit DTA.1: Paid Loss Development Test of Reserve Adequacy

	1 yr	2 yrs	3 yrs	4 yrs	5 yrs	6 yrs	7 yrs	8 yrs	9 yrs
Pd LDF's	4.835	2.057	1.535	1.312	1.193	1.125	1.082	1.051	1.020
LDF w/ tail	5.319	2.263	1.689	1.443	1.312	1.238	1.190	1.156	1.122
Reciprocal	18.8%	44.2%	59.2%	69.3%	76.2%	80.8%	84.0%	86.5%	89.1%
Incr'tl Pd %	18.8%	25.4%	15.0%	10.1%	6.9%	4.6%	3.2%	2.5%	2.6%

The rows in the table are described below.

- The "Pd LDF's" are the paid loss development factors from each development date to 10 years of maturity, derived from Schedule P, Part 3, data. The paid loss development factor from 1 year to 10 years of maturity is 4.835.
- The "LDF w/ tail" is the paid loss development factors from each development date to ultimate, using a tail factor of +10%. The paid loss development factor from 1 year to ultimate is 5.319.
- The "Reciprocal" of the paid loss development factor to ultimate shows the percentage of losses paid by the development date. The cumulative losses paid by 1 year after the inception of the accident year is 1/5.319 = 18.8% of ultimate paid losses.
- The "Incr'tl Pd %" is the incremental paid losses during each development period as a percentage of ultimate paid losses. The losses paid between 1 year and 2 years after inception of the accident year are 44.2% – 18.8% = 25.4% of ultimate paid losses.

Loss Reserve Discounting

For GAAP financial statements, the deferred tax asset from loss reserve discounting is treated in the same fashion as the deferred tax asset from revenue offset. Both are fully recognized on the balance sheet.

ILLUSTRATION

In the other liability loss reserve discounting illustration in this paper, the accident year 2009 loss reserves for statutory and GAAP balance sheets on December 31, 2009 are $180,000 – $15,000 = $165,000. The corresponding discounted tax basis loss reserves are

$$\$165{,}000 \times 77.8022\% = \$128{,}373.63.$$

The difference between the GAAP loss reserves and the tax basis loss reserves is

$$\$165{,}000.00 - \$128{,}373.63 = \$36{,}626.37.$$

The addition to taxable income stemming from loss reserve discounting for accident year 2009 at December 31, 2009 is $36,626.27 x 35% = $12,819.23. This is the deferred tax asset on the GAAP balance sheet.

The admitted portion of the deferred tax asset on the statutory balance sheet depends on the portion of the loss reserve that will still be unpaid in one year's time. This is an actuarial estimate; it is not the IRS provision used in the loss reserve discounting calculation. We may estimate this amount from Schedule P, Part 3, as discussed earlier.

Suppose the projected paid loss link ratios for other liability are 8.000 at 12 months of development and 5.000 at 24 months of development.

- At 12 months of development, 1/8.000 = 12.5% of incurred losses have been paid and 1 – 1/8.000 = 87.5% of incurred losses are still unpaid.
- At 24 months of development, 1/5.000 = 20.0% of incurred losses have been paid and 1 – 1/5.000 = 80.0% of incurred losses are still unpaid.

We expect 80.0% / 87.5% = 91.428571% of the December 31, 2009, accident year 2009 loss reserves to remain unpaid at December 31, 2010. This amount is $165,000 x 91.4285714% = $150,857.14. The expected IRS discounted reserves at December 31, 2010 equal this amount times the IRS loss reserve discount factor for accident year 2009 at 24 months of development, or 78.7611% in the other liability illustration:

$150,857.14 x 78.7611% = $118,816.75.

Schedule P Interrogatories

The Schedule P Interrogatories contain seven questions. Five of these have been discussed above along with the relevant Schedule P exhibits:

- *Interrogatory 1* shows a ten year exhibit of extended loss and expense reserves on claims-made policies for medical malpractice, other liability, and products liability. The caption for the first column says: "years in which premiums were earned and losses were incurred." The extended loss and expense reserves are policy reserves. They do not relate to earned premiums or incurred losses. It is unclear how the extended loss and expense reserves should be distributed by year in this exhibit.

- *Interrogatory 2* discloses whether the company has followed the revised NAIC definitions of defense and cost containment and adjusting and other adjustment expenses.

- *Interrogatory 3* relates to the distribution of adjusting and other adjustment expenses payments and reserves by accident year.

- *Interrogatory 4* discloses loss reserve discounting and the resulting difference between the Underwriting and Investment Exhibit and Schedule P.

- *Interrogatory 5* discloses the net premiums in force for fidelity and surety business. Some companies use premiums in force to estimate the reserves for these lines of business.

- *Interrogatory 6* discloses whether claim counts are per claim or per claimant.

The seventh interrogatory relates to estimates of reserve adequacy:

> *Interrogatory 7: The information provided in Schedule P will be used by many persons to estimate the adequacy of the current loss and expense reserves, among other things. Are there any especially significant events, coverage, retention or accounting changes which have occurred which must be considered when making such analyses?*

The NAIC left this question quite general, so that companies would describe freely any changes in their experience. The Annual Statement *Instructions* list several items that should be described in this interrogatory:

- A change in the method of counting claims.
- The intercompany pooling of only a portion of the business.
- Changes in the intercompany pooling arrangement.

Other material changes should also be noted. For example, if a company revises its tabular discount for permanent disability indemnity benefits on workers' compensation claims, either by changing the interest rate or by discounting different blocks of claims, this should be noted.

Reserve Margins

Calendar year underwriting results for the long-tailed lines of business are influenced by the adequacy of reserve margins for previously reported claims and by the strength of case and bulk reserves for newly reported claims.

- If the held reserves at the beginning of the calendar year were inadequate, the adverse loss development will dampen the current year's reported results.
- If inadequate reserves are set up for newly reported claims, the calendar year reported results will look better than they actually are.

Ultimate claim costs in the liability lines of business are difficult to predict, since they are influenced by numerous external factors, such as unexpected judicial decisions, new causes of action, and social developments affecting claims consciousness and jury awards. Moreover, insurance underwriting cycles may lead company managements to smooth reported earnings by alternately strengthening and weakening loss reserves.

Schedule P allows one to compare reported calendar year results with actual accident year results. Calendar year results are shown in the Underwriting and Investment Exhibits for net earned premiums on Part 2, column 4, and net losses incurred on Part 3, column 7. The calendar year loss ratio is shown in Part 3, column 8.

The corresponding calendar/accident year figures are shown in Schedule P, Part 1, columns 3 and 28. A triangle of accident year / exposure year loss ratios may be formed from the Part 2 and Part 6 triangles. As noted earlier, one should adjust the Part 6 triangles to a net of reinsurance basis.

Reserve Margin Controversy

Reserve margins have long been a controversial topic among casualty actuaries. Some actuaries maintain that discretionary reserve margins are improper, since they hamper accurate analysis of reserve adequacy. Other actuaries believe that reserve margins are sometimes appropriate or unavoidable.

Illustration: A company may change its bulk reserves gradually from quarter to quarter, reducing the volatility in the actuarial reserve estimates. The smooth progression of

liabilities over time may better reflect management's reserving philosophy than the actuary's statistical estimates. As long as the held reserves exceed the minimum reserves considered to be reasonable, management's actions are not necessarily improper.

Illustration: The statutory full-value reserves depend on the inflation rate between the accident date and the payment date of the losses. As the inflation rate changes, the full-value reserves should change as well, though the present value of the reserves does not necessarily change if the discount rate moves in tandem with the inflation rate. The company may use a long-term average inflation rate in its reserve estimates, and it may not revise the estimates with quarterly or yearly changes in the inflation rate.[139]

Changes in reserve margins may also stem from smoothing of calendar year results over underwriting cycles. The Schedule P, Part 2 triangles allow an analysis of reserve margin changes over calendar years. Casualty actuaries have used these triangles to examine three commonly held propositions about reserve margins.

- Companies tend to move together. Some years, many companies are strengthening reserves; in other years, many companies exhibit reserve weakening.
- Lines of business tend to move together. A company may seek to smooth overall operating results, not line of business results.
- Reserve margin changes tend to offset earnings volatility over the course of the underwriting cycle.

None of these propositions is universally accepted. Schedule P allows regulators and financial analysts to examine the industry's response to underwriting cycles, interest rate changes, and inflation rate changes.

[139] The risk-based capital formula uses a flat 5% discount rate for its investment income offset. Since it uses a fixed discount rate, it should use a fixed long-term average inflation rate for the losses well.

UNDER-RESERVING

Loss reserves may be inadequate for various reasons:

- Unforeseeable future developments cause mis-estimation of reserve indications. The surge in asbestos claims in 1999 and 2000 is an example of severe adverse development that was not expected by insurance industry actuaries or lawyers.
- Companies in financial distress may hide their weakness by reducing the bulk reserves for long-tailed lines of business.
- Companies writing long-tailed lines of business may value their reserves at a non-zero valuation rate.

This paper takes no position on the general adequacy of industry reserves. Several studies, however, have seen under-reserving as a contributing factor to many insurance insolvencies (Best's [1991]; AAA [1991], page 166; Hartman [1992]).

ACTUARIAL OPINION

Schedule P reflects the company's estimates of indicated reserves, which is not necessarily the same as the reserving actuary's estimate. To shift the onus of ensuring accurate reserve estimates, the NAIC requires that a "Statement of Actuarial Opinion Regarding Loss and Loss Adjustment Expense Reserves" accompany the Annual Statement.

The Statement of Actuarial Opinion is signed by a qualified actuary appointed by the company's Board of Directors. Each year, the actuary presents a report to the Board of Directors explaining the procedures used to arrive at the opinion and the conclusions embodied in it (NAIC Blanks Task Force, Attachment N of October 1991 meeting; Lamb [1991; 1992]; Witcraft [1992]). The American Academy of Actuaries Committee on Property-Liability Financial Reporting publishes a *Practice Note* each year providing guidance to actuaries in completing the Statement of Actuarial Opinion.

The Statement of Actuarial Opinion must comment on the reasonableness of the reserves for six items, three of which are taken from Schedule P (paragraph 8 of the NAIC *Instructions*):

A. Reserve for unpaid losses (page 3, line 1)
B. Reserve for unpaid loss adjustment expenses (page 3, line 3)
C. Reserve for unpaid losses – direct and assumed (Schedule P, Part 1, Summary exhibit, totals from columns 13 and 15)

D. Reserve for unpaid loss adjustment expenses – direct and assumed (Schedule P, Part 1, Summary exhibit, totals from columns 17, 19, and 21)
E. The extended loss and expense reserves (Schedule P Interrogatory 1)
F. The Page 3 write-in item reserve, "Retroactive reinsurance reserve ceded or assumed."

If the company writes certain types of property-casualty policies with durations of 13 months or longer, the actuary must also opine on the unearned premium reserves for these policies. This requirement relates to product warranty and mechanical breakdown policies; see SSAP No. 65, "Property and Casualty Contracts," paragraphs 21-31. The unearned premium reserves for these contracts depends on actuarial estimates of future losses and expenses.

Schedule P contains management's best estimate of the indicated reserves. The Statement of Actuarial Opinion does not contain the Appointed Actuary's estimate. Rather, it contains the Appointed Actuary's opinion whether management's estimate is reasonable.

> *Illustration:* Management's best estimate of the indicated reserves is $8 billion; this is the amount shown on page 3, line 1. The Appointed Actuary believes that the best estimate of the indicated reserves is $8.5 billion. However, the actuary considers the range of reasonableness to be $7.5 billion to $9.5 billion. The actuary would issue an unqualified opinion.[140]

SCOPE OF THE STATEMENT

Annual Statement *Instruction* 12, paragraph (11), describes the scope of the statement:

> *The actuary should comment in the scope section on each of the following topics, describing the effect of each on loss or loss expense reserves: retroactive reinsurance, financial reinsurance, and reinsurance collectibility, asbestos exposures and environmental exposures. The actuary should also comment on and describe the effects of any additional topics, such as discounting, salvage/subrogation, and underwriting pools and associations which in the actuary's judgment materially affect loss or loss expense reserves. If the company reserves will create exceptional values using the NAIC IRIS tests 9 (One Year Reserve Development to Surplus), 10 (Two Year Reserve Development to Surplus) and 11 (Estimated Current Reserve Deficiency to Surplus), the actuary should include an explanation.*

The following topics relate to the Schedule P entries:

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[140] The American Academy of Actuaries Committee on Property-Liability Financial Reporting defines the range of reasonable estimates as the "range of estimates that would be produced by alternative sets of assumptions that the actuary judges to be reasonable, considering all information reviewed by the actuary. . . The range of reasonable estimates is narrower, perhaps considerably, than the range of possible outcomes of the ultimate settlement value of the reserve."

Anticipated salvage and subrogation: Management's estimate of the anticipated salvage and subrogation is shown in column 23 of Part 1. The Appointed Actuary should comment on the reasonableness of this estimate if it affects reserve adequacy.

Discounts: Non-tabular loss reserve discounts are shown in Part 1, columns 32 and 33. Tabular discounts are disclosed in Note 28 to the Annual Statement. In the Statement of Actuarial Opinion, the actuary should comment on both tabular discounts, which may affect workers' compensation and accident & health loss reserves and non-tabular discounts, which might be used for all lines of business.

Pools and Associations: The ceded and assumed entries in Schedule P include amounts for voluntary and involuntary pools. Some of these ceded and assumed entries may be large, such as those for workers' compensation residual market pools in the late 1980's and early 1990's. The Appointed Actuary must comment whether the company uses the pool's estimates of required or booked reserves, or whether the company independently estimates the needed reserves.

Retroactive reinsurance denotes the transfer of financial obligation with the following three attributes:

- the losses have already occurred
- the primary company's surplus is increased and
- the consideration paid to the reinsurer is determined by present value techniques.[141]

Retroactive reinsurance is not reflected in the Schedule P exhibits, though it affects policyholders' surplus and statutory income (see Feldblum [2002: SchF]).

Financial reinsurance refers to arrangements in which the reinsurance company does not incur timing and underwriting risk; see SSAP No. 62, "Property and Casualty Reinsurance." A lack of timing risk or underwriting risk precludes a transaction from being considered reinsurance in statutory reports.

Reinsurance Collectibility: Part 1 of Schedule P shows both gross and net loss reserves, but it does not indicate the expected collectibility of reinsurance recoverables. Schedule F imposes statutory penalties for unauthorized and slow-paying reinsurers and for overdue reinsurance (Simon and Visner [1992]; Feldblum [2002]). The Statement of Actuarial Opinion

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[141] The NAIC *Instructions* to the Statement of Actuarial Opinion (section 11) provide this three-fold definition: "For the purpose of this instruction, "retroactive reinsurance" refers to any agreement which increases the transferring insurer's Surplus to Policyholders as a result of the transferee undertaking any loss obligation already incurred and for which the consideration paid by the transferring insurer is derived from present value or discounting concepts." See also SSAP No. 62, "Property and Casualty Reinsurance," paragraph 22.

should comment on any anticipated collection problems on reinsurance recoverables.[142] The actuary completing Schedule P should be familiar with the provision for reinsurance from Schedule F and with other information about reinsurance collectibility.

Paragraph 10 of the NAIC *Instructions* to the Statement of Actuarial Opinion require the opinion actuary to write that

> *In forming my opinion on the loss and loss adjustment expense reserves, I relied upon data prepared by the responsible officers or employees of the company or group to which it belongs. I evaluated that data for reasonableness and consistency. I also reconciled that data to Schedule P Part 1 of the company's current annual statement.*

The Practice Note issued by the Committee on Property-Liability Financial Reporting explains the reconciliation to Schedule P as follows:

A. *each of the following types of data, if relied on significantly in forming the actuarial opinion (on a net or direct plus assumed basis), were reconciled to Schedule P: paid losses, incurred (case basis) losses, paid defense and cost containment expenses, incurred (case basis) defense and cost containment expenses, paid adjusting and other expenses, and earned premiums;*

B. *the reconciliation consisted of comparing the changes from the prior year-end values (e.g., current calendar year paid losses and changes in case basis loss reserves), in detail by line of business and year in which losses were incurred to the extent that such detail was relied upon significantly and is provided in Schedule P; . . .*

The Appointed Actuary keeps work papers showing the reconciliation to Schedule P for seven years from the date of the opinion.

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[142] The NAIC *Instructions* to the Statement of Actuarial Opinion say: "Before commenting on reinsurance collectibility, the actuary should solicit information from management on any collectibility problems, review ratings given to reinsurers by a recognized rating service, and examine Schedule F for the current year for indications of regulatory action or reinsurance recoverable on paid losses over 90 days past due. The comment should also reflect any other information the actuary has received from management or which is publicly available about the capability or willingness of reinsurers to pay claims. The actuary's comments do not imply an opinion on the financial condition of any reinsurer."

Appendix A: Accounting for Audits and Retrospective Adjustments

The Schedule P, Part 6 exhibits may be used by the IRS to ensure that companies are complying with the January 2000 tax regulations regarding the recording of expected audit premiums and retrospective adjustments. Companies must book the estimated ultimate premiums on the policy effective date for tax purposes. An understanding of both statutory and tax accounting for audits and retrospective adjustments is essential for tax compliance. This appendix is background information on the accounting rules.

General Principles

A. Statutory accounting has two methods of recording written premium and computing the earned premium for policies with audits or retrospective adjustments, which we label "Method 1" and "Method 2" below.[143]
B. For statutory accounting purposes, companies may use either method. For tax purposes, companies must use Method 1 (the adjustment to written premium).
C. There are two financial statement reporting procedures for earned but unbilled premiums and for accrued retrospective premiums. The Annual Statement uses one procedure for the income statement and the other procedure for the balance sheet. Both sets of figures are supported by the Underwriting and Investment Exhibit, Parts 2, 2A, and 2B.
D. There are two methods for determining the non-admitted portion of the accrued retrospective premiums (SSAP No. 66, "Retrospectively Rated Contracts," paragraph 9).

A. Accounting Methods

SSAP Number 53, "Property-casualty Contracts – Premiums," paragraph 9 says:

> *Adjustments to the premium charged for changes in the level of exposure to insurance risk (e.g., audit premiums on workers' compensation policies) are generally determined based upon audits conducted after the policy has expired. Reporting entities shall estimate audit premiums, the amount generally referred to as earned but unbilled (EBUB) premium, and shall record the amounts as an adjustment to premium, either through written premium or as an adjustment to earned premium. The estimate for EBUB may be determined using actuarially or statistically supported aggregate calculations using historical company unearned premium data, or per policy calculations.*

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[143] The methods are shown in SSAP Number 53, "Property-Casualty Contracts – Premiums," paragraphs 9-12, and SSAP Number 66, "Retrospectively Rated Contracts," paragraphs 6-8.

- Method 1 records the earned but unbilled premium through written premium.
- Method 2 records the earned but unbilled premium as an adjustment to earned premium.

Illustration: A workers' compensation policy with a written premium of $10,000 is issued on January 1, 20XX. On December 31, 20XX, the company's actuary anticipates that an additional $2,000 of premium will be billed at the final audit.

The estimated earned premium in 20XX is $12,000. The calendar year earned premium is calculated as the written premium minus the change in the unearned premium reserve. The additional $2,000 in earned premium must stem from either an additional $2,000 of written premium or a decrease of $2,000 in the unearned premium reserve.

Method 1: The $2,000 expected audit premium is coded as 20XX written premium, giving a total written premium of $12,000. All premium has been earned by December 31, and the unearned premium reserve at the end of the year is $0. The earned premium equals the written premium minus the change in the reserve, or $12,000 – ($0 – $0) = $12,000.

Method 2: The 20XX written premium remains $10,000. The $2,000 audit premium will be coded as a 20XX+1 written premium when it is billed, not as a 20XX written premium when it is estimated. The $2,000 earned but unbilled premium is treated as a contra-liability, or a negative unearned premium reserve. The traditional end-of-year unearned premium reserve resulting from the $10,000 deposit premium is $0. The net unearned premium reserve is $0 – $2,000 = –$2,000. The earned premium is the written premium minus the change in reserve, or $10,000 – (–$2,000 – $0) = $12,000.

Companies may use Method 1 for some policies and Method 2 for other policies. The two methods produce different written premiums and unearned premium reserves. The differences offset each other, and the earned premiums are the same for each method. The final Schedule P, Part 6 entries should not depend on the accounting method, though the means of computing the figures depends on the accounting method.

B. Statutory vs Tax Accounting

Method 2 defers some of the written premium until the audit is billed or the retrospective adjustment is processed. Taxes and assessments based on written premiums, such as state premium taxes and state assessments, are similarly deferred.

Method 1 shows a higher written premium than Method 2 and a correspondingly higher unearned premium reserve. Since only 80% of the unearned premium reserve is an offset to taxable income ("revenue offset"), Method 1 speeds up the income tax liability. Until January 2000, this was an additional incentive to use Method 2. The tax regulations of January 5, 2000 require companies to use Method 1 to compute the unearned premium reserve for

federal income tax purposes; Method 2 is not acceptable tax accounting.[144] Nonetheless, Method 2 remains the more common method for statutory accounting.

The effects of the two methods of the federal income tax liability is illustrated below. Method 1 gives the higher tax liability, and it is now mandated by the IRS.

PREMIUM ACCOUNTING ILLUSTRATION

A workers' compensation policy with a written premium of $10,000 is issued on July 1, 20XX. On December 31, 20XX, the company's actuary anticipates that an additional $2,000 of premium will be billed at the final audit.

The estimated earned premium in 20XX is $6,000. The statutory earned premium is calculated as the written premium minus the change in the unearned premium reserve. The tax-basis earned premium is calculated as the written premium minus 80% of the change in the unearned premium reserve.

Method 1: The $2,000 expected audit premium is coded as 20XX written premium, giving a total written premium of $12,000. Half of the premium has been earned by December 31, and the unearned premium reserve at the end of the year is $6,000. The statutory earned premium equals the written premium minus the change in the reserve, or $12,000 – ($6,000 – $0) = $6,000. The tax-basis earned premium equals the written premium minus 80% of the change in the reserve, or $12,000 – 80% × ($6,000 – $0) = $7,200.

Method 2: The 20XX written premium remains $10,000. The earned but unbilled premium equals $1,000, since only 50% of the audit premium is earned. This $1,000 is treated as a negative unearned premium reserve. The traditional unearned premium reserve at the end of the year resulting from the $10,000 deposit premium is $5,000. The net unearned premium reserve is $5,000 – $1,000 = $4,000. The statutory earned premium is the written premium minus the change in reserve, or $10,000 – ($4,000 – $0) = $6,000. The tax-basis earned premium equals the written premium minus 80% of the change in the reserve, or $10,000 – 80% × ($4,000 – $0) = $6,800.

Taxable income is $400 greater in Method 1 than in Method 2. Method 2 is no longer permitted for tax accounting by the January 2000 tax regulations.

C. FINANCIAL STATEMENT REPORTING PROCEDURES

The statutory income statement shows earned premiums, for which there is no difference between Method 1 and Method 2. For Method 1, the accrued retrospective premiums are an

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[144] The January 2000 tax regulations were proposed in January 1997, but they were not put into final form until January 2000.

addition to written premiums. For Method 2, the accrued retrospective premiums are an offset to the unearned premium reserves.

Before the Tax Reform Act of 1986, both methods had the same effect on taxable income. The revenue offset provision in the 1986 Act unduly increased the tax on companies using Method 1, since no acquisition expenses had yet been paid on the anticipated audits.

Many companies use Method 2 to compute the premiums earned from audits. Similarly, the statutory income statement computes the earned premium from an unearned premium reserve that is *net* of earned but unbilled premiums and accrued retrospective premiums.

The statutory balance sheet shows the unearned premium reserve *gross* of earned but unbilled premiums and accrued retrospective premiums, and it shows separate assets for earned but unbilled premiums and accrued retrospective premiums. This is true regardless of the method used to calculate the earned premiums. The rationale is to provide additional disclosure and to facilitate the computation of the non-admitted portion of the earned but unbilled premium and accrued retrospective premium assets.

ILLUSTRATION – INCOME STATEMENT AND BALANCE SHEET

We use the same scenario as in a previous illustration. A workers' compensation policy with a written premium of $10,000 is issued on January 1, 20XX. On December 31, 20XX, the company anticipates that an additional $2,000 of premium will be billed at the final audit.

The statutory income statement uses Method 2. The unearned premium reserve is –$2,000, the written premium is $10,000, and the earned premium is $12,000.

The statutory balance sheet shows the earned but unbilled premiums and the accrued retrospective premiums as separate assets, so that the non-admitted portion may be deducted. The gross asset is added back to the net unearned premium reserve for the balance sheet liability. The entries shown for this illustration are as follows:

- Earned but unbilled premiums, gross (page 2, line 10.2, column 1): $2,000
- Earned but unbilled premiums, non-admitted (page 2, line 10.2, column 2): $200
- Earned but unbilled premiums, net (page 2, line 10.2, column 3): $1,800
- Unearned premium reserves (page 3, line 10): $0

D. NON-ADMITTED ASSET

There are two methods of computing the non-admitted portion of the accrued retrospective premium asset:[145]

1. Ten percent of the unsecured accrued retrospective premium asset is not admitted.
2. The non-admitted portion varies by policy, depending on the credit rating of the insured.

Companies must use the same method for all policies. A company may not use the second method for insureds with high credit ratings and the first method for insureds with low credit ratings.

Schedule P, Part 6 uses the gross accrued retrospective premiums, not the net admitted amounts.

ACCRUED RETROSPECTIVE PREMIUM RESERVES

For tax purposes, companies must establish reserves for audit premiums and accrued retrospective premiums; they generally show the reserves on their statutory statements as well. The Annual Statement has three terms for such premium reserves.

- *Earned but unbilled* (EBUB) premiums are primarily audit premiums for past exposures that have not yet been billed by the insurer.[146] They are shown (in total) on the balance sheet, page 2, line 10.2, and by line of business in the Underwriting and Investment Exhibit, Part 2A, "Recapitulation of All Premiums," page 8, column 3.

- *Accrued retrospective premiums based on experience* (ARP's) are the net additional premiums expected from future retrospective adjustments on retrospectively rated contracts (see SSAP, Number 66, "Retrospectively Rated Contracts"). Net additional premiums means expected future additional premiums minus expected future return premiums. They are shown in total on the balance sheet, page 2, line 10.3, and in the Underwriting and Investment Exhibit, Part 2A, "Recapitulation of All Premiums," page 8, line 35, column 5.

- *Reserve for rate credits and retrospective premiums based on experience* is the accrued retrospective premiums plus rate credits given on group accident and health insurance.

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[145] The gross accrued retrospective premium asset is shown on page 2, column 1, line 10.3. The non-admitted portion is shown in column 2 of line 10.3, and the net admitted portion is shown in column 3. The statutory surplus shown on the liability side of the balance sheet is based on the net asset. The change from the previous year to the current year in the non-admitted portion of the accrued retrospective premium asset is a direct charge to surplus on page 4, line 25.

[146] SSAP Number 53, "Property-Casualty Contracts – Premiums," paragraph 9, says that *reporting entities shall estimate audit premiums, the amount generally referred to as earned but unbilled (EBUB) premium.*

It is shown by line of business in the Underwriting and Investment Exhibit, Part 2A, "Recapitulation of All Premiums," page 8, column 4.[147]

Some actuaries use the term *earned but not reported* (EBNR) premiums, based on the acronym for incurred but not reported (IBNR) losses.

If the company expects to return premium to the insured at the retrospective adjustment, the premium reserve is a liability. If the company expects to collect additional premium from the insured at the retrospective adjustment, the premium reserve is an asset. Generally, expected future premium collections exceed expected premium returns. The premium reserve is used here to refer to the net asset; this is the statutory usage in the Annual Statement.

Statutory Accounting Principles

The statutory accounting principles are as follows:

If accounting method 1 is used for earned but unbilled premiums (see above), the earned but unbilled premium affects the written premium and the unearned premium reserves. The earned but unbilled premiums are included in columns 1 and 2 of the Underwriting and Investment Exhibit, Part 2A, "Recapitulation of All Premiums," page 8. They are not included in column 3, "earned by unbilled premium."

If accounting method 2 is used for earned but unbilled premiums (see above), the earned but unbilled premium do affect the written premium or the unearned premium reserves. The earned but unbilled premiums are included in column 3 of the Underwriting and Investment Exhibit, Part 2A, "Recapitulation of All Premiums," page 8. These entries are negative amounts; they offset the unearned premium reserves shown in columns 1 and 2.

The reserve for rate credits or retrospective adjustments based on experience are negative amounts showing the net accrued retrospective premiums and the accident and health insurance rate credits in column 4 of the Underwriting and Investment Exhibit, Part 2A, "Recapitulation of All Premiums," page 8. These entries are also negative amounts; they offset the unearned premium reserves shown in columns 1 and 2.

The net unearned premium reserves shown in column 5 of the Underwriting and Investment Exhibit, Part 2A, are the sum of columns 1 through 4. These adjusted unearned premium reserves are used to calculate the earned premiums in Part 2 of the Underwriting and Investment Exhibit ("Premiums Earned" on page 7). The total earned premiums for all lines of business combined is carried to line 1 of the statutory income statement (page 4).

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[147] Not all companies agree on the definitions of these terms, and this paper makes no attempt to clarify the differences of opinion.

The "accrued retrospective premium based on experience" for all lines of business combined is removed from the unearned premium reserve on line 35 of Part 2A of the Underwriting and Investment Exhibit, and the net amount (the "balance") is shown on line 37. Since the "accrued retrospective premium" is a contra-liability, though it shown as a positive figure in the Annual Statement, line 37 should equal line 34 plus line 35. [In contrast, the "reserves for rate credits or retrospective adjustments based on experience" shown in column 4 of Part 2A are shown as negative figures when they are contra-liabilities.]

The line 37 unearned premium reserve is carried to the liability side of the balance sheet, page 3, line 9: "unearned premium reserves." The accrued retrospective premiums on line 35 of Part 2A are carried to the asset side of the balance sheet, page 2, column 1, line 10.3. The non-admitted portion is deducted in column 2, and the net admitted portion is shown in column 3.[148]

[148] For most other items, the incurred amount on the income statement equals the paid or received amount on the cash flow statement plus or minus the change in reserves on the balance sheet. For premiums, this relationship does not hold, since there are different treatments of accrued retrospective premiums in the income statement and on the balance sheet.

Appendix B: Revenue Offset

For other industries, sales constitute revenues for income tax purposes. Similarly, premium due is the taxable revenue (as well as the statutory and GAAP revenue) for life insurance companies. For property-casualty insurance companies, earned premium is the revenue for both statutory and taxable income, not written premium or collected premium.

For the statutory income statement, earned premium equals written premium minus the change in the unearned premium reserves. For taxable income, earned premium equals written premium minus 80% of the change in the unearned premium reserves.[149] [150]

- A change in written premium with no change in earned premium does not affect statutory income, whereas
- A change in written premium with no change in earned premium affects the unearned premium reserve and changes the tax liability by means of the revenue offset provision.

Statutory and taxable income also differ in their treatments of accrued retrospective premiums (see Appendix A).

Illustration: Single Policy

An insurer writes a policy with a $10,000 written premium on December 31, 20XX, and it pays $2,000 in agents' commissions on that day. Losses of $8,000 are incurred and paid evenly through the policy term. There are no other expenses or losses on this policy. We assume that losses are paid when they are incurred so that we need not deal with IRS loss reserve discounting.

The unearned premium reserve for this policy is $0 on January 1, 20XX, and $10,000 on December 31, 20XX. The change in the unearned premium reserve during the year is $10,000. The earned premium in 20XX is $10,000 of written premium minus the $10,000

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[149] See the Treasury regulations, 2001FED 26,153, §1.832-4(a)(3): "The determination of premiums earned on insurance contracts during the taxable year begins with the insurance company's gross premiums written on insurance contracts during the taxable year, reduced by return premiums and premiums paid for reinsurance. This amount is increased by 80 percent of the unearned premiums on insurance contracts at the end of the preceding taxable year, and is decreased by 80 percent of the unearned premiums on insurance contracts at the end of the current taxable year."

[150] Life insurance companies and annuity writers are subject to a DAC-tax that is identical in concept though more complex than the property-casualty tax provision explained here; see Atkinson and Dallas [2000], chapter 9.

change in the unearned premium reserve, or $0. Expenses during 20XX are $2,000, and statutory income during 20XX is –$2,000. Without revenue offset, the federal income tax liability would be 35% × –$2,000 = –$700, or a $700 tax refund.

The unearned premium reserve on December 31, 20XX+1, is $0. The change in the unearned premium reserve during 20XX+1 is –$10,000. The earned premium in 20XX+1 is $0 of written premium minus the –$10,000 change in the unearned premium reserve, or $0 – (–$10,000) = +$10,000. Losses of $8,000 are incurred and paid in 20XX+1. The statutory income is $10,000 – $8,000 = $2,000. The tax liability (ignoring revenue offset) would be 35% × $2,000 = $700.

Statutory accounting recognizes a loss at policy inception and a gradual profit during the remainder of the policy lifetime, thereby preventing companies from recognizing income until it has been fully earned.[151]

Were there no revenue offset provision in the tax code, the U.S. Treasury would fund part of the initial underwriting loss at policy inception. The illustration above shows a tax refund of $700 in 20XX and a tax liability of $700 in 20XX+1. Before 1987, statutory accounting helped the insurance industry defer its tax liabilities. Steady growth (in nominal dollar terms) led to persistent deferral of tax liabilities.

Direct and Indirect Methods

The Tax Reform Act of 1986 introduced the revenue offset provision of the Internal Revenue Code. The provision may be stated in two equivalent ways. These two perspectives are used in the two fashions of computing taxable income and the federal income tax liability, which are termed here the "direct method" and the "indirect method." The direct method is easier to understand; the indirect method is the method actually used in the Internal Revenue Code for computing taxable income.

1. *Direct method:* The taxable earned premium equals the taxable written premium minus 80% of the change in the unearned premium reserve. This may be stated as "only 80% of the change in the unearned premium reserve is an offset to taxable income."

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[151] Some analysts see a conservative bend in statutory accounting's write-off of pre-paid acquisition costs when they are incurred, particularly in comparison with GAAP's capitalization and amortization of the deferred policy acquisition cost asset. This is not quite correct. Statutory accounting is correct accounting from a tangible asset perspective, since the pre-paid acquisition costs are often incurred whether or not the company retains the policy. International accounting standards follow statutory accounting on this issue. GAAP capitalizes an "imaginary" asset called DPAC to match revenues and expenses and show a better portrayal of the company's profitability. However, statutory accounting is unduly conservative in its double treatment of underwriting expenses: once when they are incurred and a second time in the gross unearned premium reserves. See Yoheved and Sarason [2002] for further discussion of GAAP and statutory accounting of property-casualty insurance companies.

2. *Indirect method:* Twenty percent of the change in the unearned premium reserve is an *addition* to statutory income for computing taxable income.

We can use either method for the illustration.

Direct method: The taxable earned premium in 20XX equals the taxable written premium minus 80% of the change in the unearned premium reserve, or $10,000 – 80% × ($10,000 – $0) = $2,000 in 20XX. Agents' commissions are $2,000 on December 31, 20XX. Taxable income is $2,000 – $2,000 = $0, and the tax liability is $0.

In 20XX+1, the taxable earned premium equals $0 – 80% × ($0 – $10,000) = $8,000. The losses incurred and paid in 20XX+1 are $8,000. The taxable income is $8,000 – $8,000 = $0, and the tax liability is $0.

Indirect method: Twenty percent of the change in the unearned premium reserve in 20XX is 20% × ($10,000 – $0) = $2,000. The statutory income in 20XX is –$2,000. Taxable income is –$2,000 + $2,000 = $0, and the tax liability is $0.

In 20XX+1, twenty percent of the change in the unearned premium reserve is 20% × ($0 – $10,000) = –$2,000. The statutory income in 20XX+1 is +$2,000. The taxable income is +2,000 – $2,000 = $0, and the tax liability is $0.

ILLUSTRATION B: TWO YEARS

An insurer writes a policy with a $10,000 written premium on July 1, 20XX, and it pays $2,000 in agents' commissions on that day. Losses of $8,000 are incurred evenly over the policy term, and they are paid when they are incurred. On July 1, 20XX+1, the insurer renews the policy for a written premium of $15,000, and it pays $3,000 in agents' commissions on that day. Losses of $12,000 are incurred evenly over the policy term, and they are paid when they are incurred. There are no other expenses on these policies.

Illustration B shows the importance of computing the *change* in the unearned premium reserve during the year. The statutory unearned premium reserve equals $0 on December 31, 20XX–1, $5,000 on December 31, 20XX, $7,500 on December 31, 20XX+1, and $0 on December 31, 20XX+2.

CALENDAR YEAR 20XX

Statutory earned premium is $10,000 written premium minus the ($5,000 – $0) = $5,000 change in the unearned premium reserve; the earned premium is $5,000. Expenses are $2,000, and incurred losses are $4,000. The statutory income in 20XX is $5,000 – $2,000 – $4,000 = –$1,000. There are two methods to calculate the taxable income.

a. *Direct method:* The taxable earned premium is taxable written premium minus 80% of the change in the unearned premium reserve, or $10,000 – 80% × ($5,000 – $0) = $6,000. The taxable income is $6,000 – $2,000 – $4,000 = $0, and the tax liability is $0.
b. *Indirect method:* Twenty percent of the change in the unearned premium reserve is 20% × ($5,000 – $0) = $1,000. The statutory income in 20XX is –$1,000. The taxable income is –$1,000 + $1,000 = $0, and the tax liability is $0.

CALENDAR YEAR 20XX+1

Statutory earned premium is $15,000 written premium minus the ($7,500 – $5,000) = $2,500 change in the unearned premium reserve; the earned premium is $12,500. Expenses incurred and paid on January 1, 20XX+1 are $3,000, and incurred losses during the year are $4,000 (first six months) + $6,000 (latter six months) = $10,000. The statutory income is $12,500 – $3,000 – $10,000 = –$500. There are two methods to calculate taxable income.

a. *Direct method:* The taxable earned premium is the taxable written premium minus 80% of the change in the unearned premium reserve, or $15,000 – 80% × ($7,500 – $5,000) = $13,000. Expenses and losses are the same as for statutory income. The taxable income is $13,000 – $3,000 – $10,000 = $0, and the tax liability is $0.
b. *Indirect method:* Twenty percent of the change in the unearned premium reserve is 20% × ($7,500 – $5,000) = $500. The statutory income in 20XX+1 is –$500. The taxable income is –$500 + $500 = $0, and the tax liability is $0.

CALENDAR YEAR 20XX+2

Statutory earned premium is $0 written premium minus the ($0 – $7,500) = –$7,500 change in the unearned premium reserve, or $7,500. Expenses incurred in 20XX+2 are $0, and incurred losses during the year are $6,000. Statutory income is $7,500 – $6,000 = $1,500.

There are two methods to calculate the taxable income.

a. *Direct method:* The taxable earned premium is $0 – 80% × ($0 – $7,500) = $6,000. The taxable income is $6,000 – $6,000 = $0, and the tax liability is $0.
b. *Indirect method:* Twenty percent of the change in the unearned premium reserve is 20% × ($0 – $7,500) = –$1,500. The statutory income in 20XX+2 is $1,500. The taxable income is $1,500 + –$500 = $0, and the tax liability is $0.

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Exhibit A.1: Private Passenger Automobile Loss Reserve Discount Factors

Accident Year (1)	Paid Loss + LAE (2)	Incurred Loss + LAE (3)	Cumulative Paid/Incurred Ratio (4)	Incremental Paid/Incurred Ratio (5)	Undiscounted Percentage Unpaid (6)	Discounted Percentage Unpaid (7)	Loss Reserve Discount Factor (8)
AY + 15							
AY + 14							
AY + 13							
AY + 12							
AY + 11							
AY + 10				2.00%	100.00%	0.00%	
2000	$270,000	$275,500	98.00%	3.07%	2.00%	1.93%	96.6735%
2001	$300,000	$316,000	94.94%	2.98%	5.06%	4.77%	94.1800%
2002	$320,000	$348,000	91.95%	3.99%	8.05%	7.34%	91.2271%
2003	$340,000	$386,500	87.97%	4.93%	12.03%	10.71%	89.0399%
2004	$350,000	$421,500	83.04%	6.03%	16.96%	14.78%	87.1281%
2005	$370,000	$480,500	77.00%	7.98%	23.00%	19.65%	85.4281%
2006	$380,000	$550,500	69.03%	10.01%	30.97%	26.07%	84.1740%
2007	$360,000	$610,000	59.02%	11.02%	40.98%	34.04%	83.0660%
2008	$330,000	$687,500	48.00%	13.00%	52.00%	42.47%	81.6659%
2009	$200,000	$571,500	35.00%	35.00%	65.00%	52.26%	80.3944%

Exhibit A.2: Other Liability Loss Reserve Discount Factors

Accident Year (1)	Paid Loss + LAE (2)	Incurred Loss + LAE (3)	Cumulative Paid/Incurred Ratio (4)	Incremental Paid/Incurred Ratio (5)	Undiscounted Percentage Unpaid (6)	Discounted Percentage Unpaid (7)	Loss Reserve Discount Factor (8)
AY + 15			100.00%	3.01%	0.00%	0.00%	
AY + 14			96.99%	1.38%	3.01%	2.91%	96.6736%
AY + 13			95.61%	1.38%	4.39%	4.05%	92.3385%
AY + 12			94.23%	1.38%	5.77%	5.12%	88.7803%
AY + 11			92.85%	1.38%	7.15%	6.12%	85.6177%
AY + 10	$235,000	$250,000	91.47%	1.38%	8.53%	7.06%	82.7122%
2000	$50,000	$55,500	90.09%	1.38%	9.91%	7.93%	79.9988%
2001	$55,000	$62,000	88.71%	3.00%	11.29%	8.74%	77.4439%
2002	$60,000	$70,000	85.71%	4.46%	14.29%	11.07%	77.4718%
2003	$65,000	$80,000	81.25%	8.33%	18.75%	14.66%	78.1822%
2004	$70,000	$96,000	72.92%	9.81%	27.08%	21.76%	80.3309%
2005	$65,000	$103,000	63.11%	10.93%	36.89%	29.82%	80.8185%
2006	$60,000	$115,000	52.17%	12.17%	47.83%	38.44%	80.3644%
2007	$50,000	$125,000	40.00%	15.00%	60.00%	47.69%	79.4828%
2008	$35,000	$140,000	25.00%	16.67%	75.00%	59.07%	78.7611%
2009	$15,000	$180,000	8.33%	8.33%	91.67%	71.32%	77.8022%

Exhibit A.3: Other Liability Loss Reserve Discount Factors

Accident Year (1)	Paid Loss + LAE (2)	Incurred Loss + LAE (3)	Cumulative Paid/Incurred Ratio (4)	Incremental Paid/Incurred Ratio (5)	Undiscounted Percentage Unpaid (6)	Discounted Percentage Unpaid (7)	Loss Reserve Discount Factor (8)
AY + 15			100.00%	3.01%	0.00%	0.00%	
AY + 14			96.99%	1.38%	3.01%	2.91%	96.6736%
AY + 13			95.61%	1.38%	4.39%	4.05%	92.3385%
AY + 12			94.23%	1.38%	5.77%	5.12%	88.7803%
AY + 11			92.85%	1.38%	7.15%	6.12%	85.6177%
AY + 10	$235,000	$250,000	91.47%	1.38%	8.53%	7.06%	82.7122%
2000	$50,000	$55,500	90.09%	1.38%	9.91%	7.93%	79.9988%
2001	$55,000	$62,000	88.71%	-8.43%	11.29%	8.74%	77.4439%
2002	$68,000	$70,000	97.14%	15.89%	2.86%	0.02%	0.6645%
2003	$65,000	$80,000	81.25%	8.33%	18.75%	15.38%	82.0371%
2004	$70,000	$96,000	72.92%	9.81%	27.08%	22.43%	82.8251%
2005	$65,000	$103,000	63.11%	10.93%	36.89%	30.45%	82.5297%
2006	$60,000	$115,000	52.17%	12.17%	47.83%	39.03%	81.5980%
2007	$50,000	$125,000	40.00%	15.00%	60.00%	48.24%	80.4018%
2008	$35,000	$140,000	25.00%	16.67%	75.00%	59.59%	79.4482%
2009	$15,000	$180,000	8.33%	8.33%	91.67%	71.80%	78.3276%

Exhibit A.4: Other Liability Loss Reserve Discount Factors

Accident Year (1)	Paid Loss + LAE (2)	Incurred Loss + LAE (3)	Cumulative Paid/Incurred Ratio (4)	Incremental Paid/Incurred Ratio (5)	Undiscounted Percentage Unpaid (6)	Discounted Percentage Unpaid (7)	Loss Reserve Discount Factor (8)
AY + 15			100.00%	3.01%	0.00%	0.00%	
AY + 14			96.99%	1.38%	3.01%	2.91%	96.6736%
AY + 13			95.61%	1.38%	4.39%	4.05%	92.3385%
AY + 12			94.23%	1.38%	5.77%	5.12%	88.7803%
AY + 11			92.85%	1.38%	7.15%	6.12%	85.6177%
AY + 10	$235,000	$250,000	91.47%	1.38%	8.53%	7.06%	82.7122%
2000	$50,000	$55,500	90.09%	1.38%	9.91%	7.93%	79.9988%
2001	$55,000	$62,000	88.71%	-9.86%	11.29%	8.74%	77.4439%
2002	$69,000	$70,000	98.57%	17.32%	1.43%	-1.36%	-95.3447%
2003	$65,000	$80,000	81.25%	8.33%	18.75%	15.47%	82.5189%
2004	$70,000	$96,000	72.92%	9.81%	27.08%	22.52%	83.1368%
2005	$65,000	$103,000	63.11%	10.93%	36.89%	30.53%	82.7436%
2006	$60,000	$115,000	52.17%	12.17%	47.83%	39.10%	81.7523%
2007	$50,000	$125,000	40.00%	15.00%	60.00%	48.31%	80.5167%
2008	$35,000	$140,000	25.00%	16.67%	75.00%	59.65%	79.5341%
2009	$15,000	$180,000	8.33%	8.33%	91.67%	71.86%	78.3932%