WORKERS' COMPENSATION RATEMAKING

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Manual ratemaking for Workers' Compensation insurance policies is a complex and continually evolving process. The transition to a loss costs environment in many jurisdictions compels company actuaries to be familiar with all ratemaking procedures. This reading goes through the standard ratemaking procedures step-by-step, notes alternative methods, and discusses the issues with which company actuaries must deal. Heuristic illustrations are provided in each section, and fully documented rate filing exhibits are provided at the end.

[This study note was prepared as educational material for the Part 6 CAS examination. Gail Ross and Wendy Johnson assisted in determining the scope of this reading and the format that would be most beneficial for actuarial candidates. I am indebted to Howard Mahler, Charles McClenahan, Gary Venter, Gary Josephson, Peter J. Murdza, John Gardner, William Robin Gillam, Michael Dolan, Roger Hayne, Kathleen C. Nomicos, Nancy Treitel, C. Walter Stewart, Barbara Mahoney, Deborah Rosenberg, and Kevin Thompson, who made numerous corrections and additions to earlier drafts. The extensive reviews and rewriting by Mahler, McClenahan, Venter, and Josephson are particularly appreciated. The views expressed here do not necessarily represent the position of the Casualty Actuarial Society, the Liberty Mutual Insurance Company, the National Council on Compensation Insurance, the Minnesota Workers' Compensation Insurers Association, or of any other organization. Any errors in this reading are the author's own.]

Note to Candidates

The CAS Syllabus Committee seeks to provide Part VI candidates with study material that describes up-to-date ratemaking procedures for property-casualty insurance. This study note documents the manual ratemaking procedures for Workers' Compensation currently used by bureau and company actuaries.

Fundamental ratemaking principles are contained in the text of the study note. Disputed issues and specific problems are discussed in the footnotes. Additional readings are referenced in the notes and in the bibliography. Annotated rate filing exhibits are contained in the appendix.

The text of this study note is required reading for the Part 6 examination. No examination questions will be based exclusively on the footnotes, the references, or the detailed rate filing exhibits in the appendix.

Candidates are not responsible for procedures documented in the illustrative exhibits in the appendix if they are not also discussed in the text of the study note. Candidates are indeed responsible, however, for methods discussed in the text and illustrated in the exhibits in the appendix. For instance, the text reviews the various types of classification pure premiums and discusses how they are used in developing manual rates. Candidates may find it useful to review the exhibits in the appendix to ensure that they understand the procedures described in the text.

Similarly, candidates are responsible for the text of the study note, not for the footnotes. The examination questions will not test items that are discussed only in the footnotes or details that are added in the footnotes. Some footnotes, however, further explain statements in the text. Candidates should review these footnotes to ensure that they understand the procedures in the text of the study note.

Candidates who have not worked with workers' compensation insurance may be surprised by the complexity of current ratemaking procedures. It is helpful for candidates first approaching workers' compensation ratemaking to understand the structure of the ratemaking procedures before studying the details. The first three sections of this study note (introduction, overview, and definitions) are an outline of much of the following sections. Particularly on the first reading, candidates should keep the general framework in mind as they delve into each section.

Workers' Compensation ratemaking procedures are changing rapidly, as the industry enters a loss cost pricing environment. The Syllabus Committee expects this study note to be revised as new ratemaking procedures are developed to meet changing needs. Moreover, the Syllabus Committee intends to issue additional study notes for other topics on the examination syllabus.

Part VI candidates have an important role to play in improving the quality of the syllabus readings. If you find sections of this study aid to be unclear, or if you believe the study material could be improved, please write to the author of the study aid or to the Syllabus Committee chairperson with your suggested improvements (addresses are in the CAS yearbook).

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Section 1: Introduction

". . . the present plan merely represents the latest stage in the gradual evolution of an ideal rate-making method . . ." – Barber [1936], page 151.

Workers' Compensation pricing procedures are changing rapidly. Until the mid-1980's, the National Council on Compensation Insurance and regional bureaus developed advisory rates, which were adopted by most carriers. Independent pricing was largely confined to uniform rate deviations or policyholder dividends.

The advent of open competition in Workers' Compensation has stimulated a renewed examination of pricing procedures. In many states, the bureaus now provide only loss costs, not advisory rates. Carriers must independently justify the profit and contingency provisions, expense loads, investment income offsets, and sometimes even loss development and trend factors.

Intensifying competition compels carriers to review other components of the premium rate as well: the loss costs estimates, the experience rating modification, and the classification system. The large involuntary pool burdens and special fund assessments necessitate additional analysis of expense costs. Finally, carriers must evaluate the cost implications of the Workers' Compensation reforms now being enacted in state legislatures.

Rate making procedures were often similar among the various bureaus. For instance, the traditional full credibility standards and the "three halves" partial credibility formula have little actuarial justification, yet they have been used consistently by the rating bureaus. But the similarities are decreasing. Pricing actuaries – as well as the rating bureaus – now use a variety of methods for developing and trending both losses and premiums, evaluating law amendments, and determining profit and contingency provisions.

This reading has three purposes:

- It explains the pricing procedures currently used by the rating bureaus. Some procedures are common to most lines of business; these are reviewed briefly. Others are unique to

Workers' Compensation, such as the pricing of law amendments and the determination of classification relativities; these are explained in more detail.

The bureau rate making procedures are complex. Simplified examples are included with the text to clarify the exposition. Complete exhibits from recent rate filings, with accompanying annotations, are included in the appendices.

- Pricing actuaries, both with rating bureaus and with private insurers, have developed alternative rate making procedures for many aspects of Workers' Compensation pricing, particularly for loss development, loss and loss ratio trends, credibility, and profit and contingency provisions. For some of these procedures, there no longer is a "standard" procedure; the NCCI even uses different loss development procedures in different states. This paper reviews several of the alternative procedures and explains the rationale for each.

- Several aspects of Workers' Compensation rate making have recently been examined by economists and financial analysts, and some new procedues are now being used by the rating bureaus and private insurers. The most important of these relate to the economic incentives of law amendments and refinements of the classification system; see Sections 10 and 14. The advent of open competition and various Workers' Compensation reforms increase the need for accurate actuarial quantification of the complex effects of law amendments and classification systems.

This introductory reading can not do justice to all aspects of Workers' Compensation rate making, particularly to the procedures that are still evolving. Rather, this paper explains the basics, and directs the interested reader to more advanced articles on each subject.

Section 2: Overview

The pricing actuary determines premium rates that suffice for anticipated losses and expenses during the future policy period and that provide the insurer with a reasonable profit. Rates may be determined in two ways:

- The *loss ratio method* quantifies the needed revision from current rates.
- The *pure premium method* quantifies the required rate per unit of exposure.

The two methods are mathematically equivalent, though each has advantages and drawbacks (Stern [1965]; McClenahan [1990], pp. 36-40; Brown [1993]). Workers' Compensation uses the loss ratio method for overall statewide indications and the pure premium method for classification rates.

The segmentation of data offers another dichotomy for rate making. The actuary may revise rates for the state as a whole and then allocate the revision by classification. Alternatively, he or she may determine either classification rates or classification relativities and combine these into a statewide revision. In the past, Workers' Compensation emphasized the statewide rate revision. The rate changes for some classifications, termed "non-reviewed," ignored their specific experience and used the overall (industry group) revision. There is now growing emphasis on classification rates – all classifications are examined to some degree.

A. Ratemaking Variety

Workers' Compensation ratemaking procedures differ among the various bureaus, carriers, and jurisdictions. The differences occur in every part of the rate review. Even basic items, such as "What experience should be used?" receive divergent treatment.[1]

[1] For instance, until the early 1980's, the NCCI used equal weightings of the most recent two policy years and the most recent calendar year. In 1983, the NCCI changed to equal weightings of the most recent policy year and calendar/accident year, as New York uses. In response to the Milliman and Robertson review of their ratemaking procedures, the NCCI is again using two policy years. Pennsylvania uses equal weightings of three projections: The most recent calendar year (incurred losses), a paid loss projection from the most recent policy year, and an incurred

Ratemaking procedures must be flexible. For instance, Section 15 notes that classification pure premium changes were once limited by "the statutory benefit change + 50% *x* the industry group change ± 25%" and are now often limited by "the overall rate revision ± 25%." These limits are arbitrary: some pricing actuaries abide by them, some do not. And rare is the pricing actuary who feels entirely constrained by them. Consideration must always be given to judgmental or underwriting factors when determining rate levels.

A comprehensive survey, noting the procedures used by each bureau and by some of the major carriers, would be ill suited for the actuarial candidate first approaching Workers' Compensation ratemaking. Instead, this reading lists the prevalent (or a prevalent) procedure. If two or more procedures are used by different bureaus or carriers, this reading sometimes lists more than one. Review of a single procedure should not be interpreted as an endorsement.

B. The Extent of the Task

> *"Present-day rate making procedure . . . is in serious danger of being overbalanced by sheer weight of complexity."* – Michelbacher [1919], page 249.

Bureau rate making procedures are often complex. The complexity begins with basic elements, such as "What earned premium should be used: manual, standard, or net?" or "What exposure base should be used: total payroll, limited payroll, or man-hours?" It extends through the final aspects of the review, such as "How should classification relativities be determined? How much weight should be given to the classification's experience, the overall statewide experience, and the countrywide experience for that classification?"

This reading covers the fundamentals of Workers' Compensation manual rate making. It does not deal with individual risk rating plans, except insofar as experience rating affects the ratio of manual to standard premiums and retrospective rating affects premium development patterns. It does not deal with financial pricing models, or with issues of open competition versus

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loss projection from the most recent policy year. Minnesota uses equal weightings of paid loss projections from the most recent policy year and the most recent calendar/accident year. As supplementary information, it shows indications from case incurred loss projections and from total incurred loss projections. Many private carriers examining rate adequacy use longer experience periods, since the available data are less extensive.

administered pricing, except insofar as these affect the pricing actuary's work.

C. The Structure of this Reading

The following sections comprise this reading:

- Section 3 notes the complexities of experience, exposures, premiums, losses, and expenses.
- Section 4 discusses the exposure bases used in pricing (total payroll, limited payroll, and man-hours), the rationale for each, and the modifications used for certain employers.
- Section 5 explains the adjustments applied to historical data: development, trend, and statutory changes.
- Section 6 discusses premium development and bringing premium to current level.
- Section 7 discusses loss development: incurred loss development, paid loss development, system changes affecting development patterns, and credibility weighting procedures.
- Section 8 discusses loss cost trends and loss ratio trends, estimated using either insurance data or econometric data. This section explains the differences between (a) indemnity and medical trends and (b) CPI wage and medical care inflation indices. It then discusses the changes in the Workers' Compensation environment and their effects on loss cost trends.
- Section 9 shows how to quantify the direct effects of statutory amendments: replacement rates, lengths of disability, waiting periods, and benefit limitations.
- Section 10 discusses the indirect "incentive" effects of statutory amendments on claim frequency and durations of disability. This section notes the types of incentive effects; the magnitude of these effects; the variations by type of injury and worker characteristics; and the effects of medical fee schedules and limits on attorney reimbursement.

- Section 11 deals with involuntary market burdens and methods of quantifying them. It presents explanations for the growth of the pools and the implications for pricing, and discusses alternative Workers' Compensation products that alleviate the burdens.

- Section 12 deals with differences between large and small risks and the ratemaking procedures used to compensate for them, such as expense constants and loss constants. It describes the reasons for these differences: per policy expenses, economic incentives from experience rating modifications, and economies of scale.

- Section 13 shows the calculation of the overall statewide rate change, along with several factors peculiar to Workers' Compensation rate making, such as premium discounts and assessments for special funds.

- Section 14 deals with classification systems. It shows the rationale for the current classification system, describes the differences between classification by product type and by job characteristics, and discusses alternative classification dimensions, such as (a) age and sex of the work force, (b) group health benefits provided by the employer, (d) territory and claims consciousness, and (c) financial health of the industry.

- Section 15 deals with classification rate making: (a) industry group relativities, (b) underlying pure premiums, state indications, countrywide indications, (c) law differentials and experience differentials, and (d) classification credibility procedures.

- Section 16 deals with occupational disease claims, such as asbestosis, stress claims, and psychological disorders. Of particular concern to the pricing actuary are (i) accident year or policy year effects versus (ii) report year or calendar year effects, and how these effects should be included in loss development and trend.

- Section 17 concludes this reading with current issues, such as the evolving loss costs environment and alternative Workers' Compensation products.

- The appendices show illustrative exhibits from a recent Workers' Compensation rate filing.

Section 3: Definitions

Ratemaking methods involve several elements: experience periods, exposures, premium, losses, and expenses. Each of these poses special problems in Workers' Compensation.

A. Experience

The pricing actuary may use policy year, calendar year, or calendar/accident year experience.

- *Policy year* experience considers premiums and losses arising from policies issued in a given period, such as January 1, 1993, through December 31, 1993. It directly matches the premiums and losses arising from a given block of policies, which calendar year experience does not do. Policy year experience is most important when underwriting changes occur, such as a shift from full coverage to large deductible policies, or a new emphasis on certain classes. Total policy year experience for a complete block of business is available from aggregate financial reports. Experience for individual risks and classifications is available from the Unit Statistical Plan. Since the last policy issued in policy year 1993 does not expire until the end of 1994, policy year experience is less "mature" than similarly aged calendar year or calendar/accident year experience.[2]

- *Calendar year* experience reflects the financial statement transactions during a given period. Calendar year 1993 earned premiums are defined as (i) premiums written in 1993, plus (ii) the unearned premium reserve at December 31, 1992, minus (iii) the unearned premium reserve at December 31, 1993. (Many companies now calculate earned premium as the annual premium times the percentage of the year that the policy is in force, thereby avoiding reliance on financial statement unearned premium reserves; cf. Linquanti [1978]

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[2] "Maturity," as used here, refers to the degree of development until all values are final (see Section 5). For instance, both premium and loss development factors are generally greater for policy year 1994 experience than for calendar/accident year 1994 experience or for calendar year 1994 experience. As Gary Josephson has pointed out to me, this usage is not truly correct, since calendar year development is not comparable to policy year development (see Section 6). Moreover, policy year 1994 experience and calendar/accident year 1994 experience refer to different periods, so comments on their relative maturity are not always meaningful. Nevertheless, this usage is common in many actuarial circles, and the reader should understand the terms.

and Morgan [1991] .) Calendar year 1993 incurred losses are (i) losses paid during 1993, plus (ii) loss reserves at December 31, 1993, minus (iii) loss reserves at December 31, 1992.

Calendar year experience is available only in aggregate, not for individual classifications. Moreover, calendar year experience is affected by premium audits and retrospective premium adjustments related to policies issued in previous years and by loss reserve changes related to accidents occurring in previous years, so the premium and loss experience may be mismatched. However, calendar year experience (by definition) does not develop further, so it is more mature than similarly aged policy year or accident year experience, though not necessarily more accurate.

- *Calendar/Accident year* experience represents premiums earned and losses occurring during a given period. Premiums are either calendar year premiums or earned premiums adjusted for audits and retrospective "earned but not reported" (EBNR) premium changes. Losses represent payments and reserves for accidents occurring in the given period. Calendar/accident year experience is most important when economic or regulatory changes, such as inflation or law amendments, affect expected insurance experience.[3]

The use of calendar year premium with accident year losses is appropriate in lines of business that are not subject to exposure audits or retrospective adjustments. Some pricing actuaries therefore relate accident year losses to the corresponding "exposure year earned premium": that is, premium earned that relates to coverage provided in a given period. This is the premium earned during a given time period after consideration of exposure audits and

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[3] Benbrook [1958], page 20, lists eight advantages of accident year over policy year experience, in that it:

(1) reduces the lag between the experience period and the effective date of the rates;
(2) shows the trend in loss costs and frequencies more clearly and accurately;
(3) produces a more mature body of loss experience at each reporting date;
(4) makes it possible to give greater credibility to the latest year of the experience period;
(5) eliminates earned factors used to adjust policy year experience when reported as of 12 months;
(6) makes it possible to produce average paid claim costs and claim frequencies for calendar or fiscal year periods from the same basic loss cards used to compile accident year losses;
(7) permits the use of fiscal year experience periods ending other than December 31; and
(8) is more readily understood.

Only the second of these items seems a definite advantage of accident year experience.

retrospective adjustments.

Ratemaking should balance the considerations of stability, responsiveness, and equity (Greene and Roeber [1925], page 256). Policy year experience, being the most homogeneous, represents stability; calendar year experience, being the most recent, represents responsiveness (Kallop [1975], pages 73, 76). Early ratemaking procedures for statewide indications used the latest two policy years and the latest calendar year of experience.[4]

Classification ratemaking determines relativities, not absolute rate levels. Since many classes are small, the overriding considerations are stability and credibility, both of which "point to the use of as long a period of experience as can be used without justifying the charge of 'obsolete data'" (Greene and Roeber [1925], page 257). Policy year experience from the unit statistical plan is used, for periods ranging from two to five years (see Section 15).

Many rating bureaus have replaced calendar year experience with calendar/accident year experience and have shortened the experience period. In December 1983, the NCCI began using one policy year and one calendar/accident year of experience (NCCI [1985: Acc Year], page 1).[5]

Few individual carriers have sufficient experience to base rate indications on a single year of experience. Some carriers performing independent rate analyses from their own data are using longer experience periods with weighting schemes borrowed from other lines of business.

B. Exposures

Workers' Compensation exposure may be measured by total payroll, limited payroll, or man-hours of work. Total payroll is now used for most employments in most jurisdictions. Payroll closely reflects indemnity losses; it is already available, since it is used for tax filings; and it is easily audited.

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[4] See Marshall [1954] and Kallop [1975]; Greene and Roeber [1925], p. 257, show three policy years for the NCCI's "permanent rate making method."

[5] In 1993, the NCCI began using two policy years of experience in some states.

Indemnity benefits have maximum and minimum limits, so one would expect that they would vary less than wages do. Similarly, since medical benefits are not constrained by wages, they should vary less by worker than wages vary. Until the mid-1970's, the normal exposure base was "limited payroll," or payroll limited to a certain wage per worker, which was intended to relate to the maximum indemnity benefits.[6]

Higher wage workers performing the same tasks as lower wage workers, such as union versus non-union workers, may not necessarily incur higher medical benefits. Some analysts have suggested a "man-hours" exposure base for medical benefits, though the number of man-hours is not easily verified. To compensate for potential inequities, a few jurisdictions use more responsive experience rating plans for certain classifications (see Section 4).

C. Premiums

Premium may be manual, standard, or net. Bureau rate making uses *standard* premium for the statewide rate revision, or premium after application of the experience rating plan modification. Since large firms have better average experience than small firms do, and large firms receive greater experience rating plan credibilities, the plan generally provides more credits than debits. The aggregate *manual* premiums therefore differ from the corresponding standard premiums, and offsets (termed "off balance adjustments") are used in several procedures (see Section 13).

Carriers collect *net* premiums, or premiums after application of premium discounts and retrospective rating plan adjustments. In fact, manual and standard premiums are of little concern to large retrospectively rated accounts. As open competition spreads in Workers' Compensation, the importance of net premium for ratemaking may grow.[7]

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[6] Until the mid-1970's, payroll was limited to $300 a week in most jurisdictions (Kallop [1975], page 64). Limited payroll fails to consider the additional exposure from extra hours worked or the greater medical care sometimes sought by higher paid employees; see Section 4.

[7] Similarly, the "rate level change" is the revision in manual premiums. The actual premium level change is influenced by other factors as well, such as the experience rating off-balance, premium discounts, and retrospective rating plan parameters.

D. Losses

Ratemaking procedures for some lines of business treat the "frequency" and "severity" components of losses separately. Ratemaking procedures in the liability lines, such as Personal Automobile, Other Liability, and Products, use basic limits losses in statewide reviews and excess limits losses for increased limits factors (Stern [1965], Lange [1966], Miccolis [1977]). Property ratemaking excludes catastrophe losses from the statewide review and substitutes a separate catastrophe provision (Hurley [1973]).[8]

Since Workers' Compensation statewide rates have historically been set by rating bureaus working with a large volume of industry data, only a minor exclusion of catastrophic losses is used, and the 1% catastrophe provision used many years ago has long since been dropped.[9] Carriers examining rate adequacy from their own data may wish to exclude excess losses, since the variation in claim severity is so great in Workers' Compensation, and incorporate a catastrophe provision.

E. Expenses

Expenses vary by carrier, jurisdiction, and size of risk. For certain expenses, the bureaus use a ratio to the first $5,000 of standard premium. Average expense provisions dropped from about 34% of premium in the 1960's to about 18% of premium in the 1990's (NCCI [1991A], page 27; Best's [1991A], page 119), and some low-cost carriers have expense ratios of 10 to

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[8] Individual risk rating in Workers' Compensation follows the same pattern. The experience rating plan divides losses into primary and excess portions (Venter [1987], King and Gillam [1990], Gillam [1990; 1991]). The retrospective rating plan divides losses into a "ratable" portion, which is included in the plan, and an excess portion, for which an insurance charge is used (Skurnick [1974], Snader [1990]).

[9] For calendar year experience, Kallop [1975] notes that "the amount of loss for a single or multiple accident is limited to 5% of the standard earned premium for the preceding calendar year. . . . At one time, a much lower limit was applicable for excluding losses from catastrophes. However, there was a one cent loading in the rates for catastrophes. There is no catastrophe charge applicable today" (page 74). On the catastrophe charge, see Marshall [1954], page 21: "An additional loading of $.01 is added to the manual rate as otherwise determined as a catastrophe rate. For compensation ratemaking purposes a catastrophe is any accident involving injury to two or more persons. The amount of losses included in the ratemaking procedure for such cases is limited to the two most costly cases or twice the average value, whichever is greater."

15% of premium. State specific assessments and involuntary market burdens, which can be as high as 40% of premium, are treated as budgetary expense provisions, as part of incurred losses, or as adjustments to incurred losses (see Sections 11 and 13). As jurisdictions move to bureau loss costs, individual carriers must deal with these expenses independently.

Until recent years, Workers' Compensation bureau ratemaking determined rate level revisions by dividing the experience loss ratio by a permissible loss ratio, as is done in other lines of business (Marshall [1954]; Kallop [1975]). In administered pricing states, the NCCI now explains the rate level change by the changes in each element to clarify the reasons for the rate revision.

Section 4: Exposures

Insurance premiums are based on estimates of future losses. Since premium rates must be determined before the future losses occur, the actuary needs an exposure base that reflects "the hazard which is measured by the losses" (Dorweiler [1929]).

Workers' Compensation loss costs depend on three factors:

- The occurrence of occupational injuries and diseases.
- The filing of a claim by the injured or diseased worker.
- The compensation provided for these injuries and diseases.

The likelihood of occurrence of physical accidents for a given employee may be measured by the amount of time worked. The hourly wage, though, is inversely correlated with this hazard, since lower paid and inexperienced workers are more likely to suffer accidents than more experienced workers are.

The compensation provided for a given physical injury depends on the worker's earnings, which is the product of the hourly wage and the amount of time worked. Indemnity benefits are set as a percentage of the employee's wage, subject to minimum and maximum limitations. Higher paid employees are also more likely to seek expensive medical treatment, so medical benefits vary with wages as well. For both indemnity and medical benefits, though, the correlation between payroll and loss costs is not exact.

A. Total Payroll, Limited Payroll, and Man-Hours

Three exposure bases have been used for Workers' Compensation: *Total payroll* is now used in almost all jurisdictions, though there is a cap on the salaries of certain company officers, sole proprietors, and partners. *Limited payroll*, or payroll limited by a maximum amount for each employee, was the standard exposure base until the mid-1970's. In theory, the payroll limitation reflects the state's maximum indemnity benefit. Once benefits are constrained by the statutory maximum, additional wage increases should not increase the losses. *Man-hours*

worked has been suggested as an exposure base for medical benefits, and it has been used for both indemnity and medical benefits by the Washington State Fund since the mid-1970's.

When average wage levels vary among employers in the same classification, the use of total payroll as an exposure base becomes controversial. Higher wage paying employers, as well as highly paid unions, have argued that a total payroll exposure base unfairly raises their premiums. Indemnity benefits for these workers are capped; in theory, they should be no higher than similarly capped benefits paid to workers receiving a slightly lower wage. Medical benefits are unlimited for all workers, so they should not depend on total payroll. Thus, the use of total payroll as the exposure base causes these employers to pay a higher premium though their employees may not receive commensurately higher benefits.

Nevertheless, there are several reasons for the use of total payroll as the exposure base.

- *Accuracy (Predictability):* Total payroll may be more predictive of losses, for both indemnity and medical benefits, than either limited payroll or man-hours worked. Higher paid employees are more aware of Workers' Compensation benefits, seek higher quality medical treatment, and are more likely to engage attorneys to represent their claims.[10] The statutory limits on indemnity benefits have only a partial effect on these influences.

- *Reliability (Availability):* Dorweiler [1929] recommends that an exposure base should be "should be practical and preferably already in use." Total payroll is reported on federal income tax statements, so it is available and verifiable. Limited payroll is not used for any

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[10] Cf. Retterath [1991], page 14: "Higher wage earners have a greater expectation from medical care. Higher wage earners tend to be in more urban areas which have access to a greater variety of medical specialists and state-of-the-art medical technologies, all of which carry with them higher medical costs. Additionally, one could expect the duration to increase due to additional knowledge of the workers compensation system that a higher wage earner generally has. Also, most union shops, which generally are higher wage earners, have in-depth knowledge as to all associated benefit programs including workers compensation." Similarly, Hilton [1986], page 43, notes that ". . . higher paid workers are more aware of the full range of their rights under workers compensation and fussier about the quality of the medical care they receive" and "they are more likely to engage an attorney who will press their claim toward the maximum, to say nothing of the added costs when claims are controverted."

Oregon examined experience differences between higher and lower wage paying employers in the same industry classification and found that loss ratios were somewhat lower for higher paying employers than for lower paying employers among medium sized firms, but not among small firms (*PNAIC* [1986]; Bouska [1990], page 17). The average discrepancy was much lower than expected if one took no consideration of benefit awareness, type of medical treatment, and attorney involvement in compensation claims.

purpose other than Workers' Compensation premiums, so it is subject to manipulation by insureds. Similarly, man-hours is not available for salaried employees.

- *Inflation-sensitivity:* Workers' Compensation benefit costs are increasing by 10% to 15% a year. Were man-hours used as an exposure base, this cost increase would have to be offset by equivalent rate increases, which many state regulators are reluctant to allow. Payroll, however, is inflation-sensitive, so a portion of the increased loss costs is offset by inflationary exposure increases, thereby decreasing the need for a rate increase (Hilton [1986], p. 43; Retterath [1991], page 19).

B. High Wage Payers

Although total payroll is considered by some actuaries to be the best of the available exposure bases, it is not perfect. These imperfections adversely affect both the employers purchasing the coverage as well as the insurers providing the benefits, since high wage paying employers who perceive the exposure base to be unfair are more likely to self-insure. The pricing actuary may need to correct potential distortions in premium rates in order to retain good business. Two methods of adjusting rates for preferred risks paying high wages are as follows:

- *Classification refinement:* Average wage level may be used as a classification variable, giving lower classification relativities to employers paying higher wages. Alternatively, industry classes with a wide range of wage levels may be divided into sub-classes, such as a union construction class versus a non-union construction class (Bouska [1989], page 17).

- *Individual risk rating:* A more responsive – but still actuarially justified – experience rating plan may enhance rate equity, at least for mature risks. The NCCI's Loss Ratio Adjustment Program was used for this purpose in several jurisdictions in the late 1980's, until the general experience rating plan was revised to give more credibility to small risks (see NCCI memorandum NE-89-1; Venter [1987]).

As open competition spreads among the states, there will be more emphasis on such competitive adjustments to premium rates.

Section 5: Experience Adjustments

". . . the goal of the ratemaking process is to determine rates which will, when applied to the exposures underlying the risks being written, provide sufficient funds to pay expected losses and expenses; maintain an adequate margin for adverse deviation; and produce a reasonable return on (any) funds provided by investors."

– McClenahan [1990], page 33

Ratemaking is prospective. When preparing a rate review, the actuary asks: "Will premiums collected during the future policy period be sufficient to cover expected losses and expenses?" To determine the needed rates, historical experience must be adjusted for expected differences between the experience period and the future policy period.

Three types of adjustments are described below: development, trend, and benefit changes.

A. Development

For Workers' Compensation, as well as for most lines of insurance, observed data reported soon after the close of the experience period may not fully reflect ultimate values. Workers' Compensation premiums are adjusted by payroll audits about three to six months after the policy expires. Loss estimates are revised as the extent of the injury becomes clearer. Some expenses, such as contingent commissions and guaranty fund assessments, have similar lags.

Many rate making values become better known with the passage of time. For instance, ultimate loss costs are known only after all claims are settled. The observed losses depend on the valuation date. *Development* is the change in the observed values over time.[11]

Even when the observed values differ significantly from ultimate values (i.e., development is great), the *pattern* of development may be stable. For instance, the paid losses at the end of an

[11] Compare Cook [1970], page 2: "A calculated past ratio of mature to immature data is called a loss development factor," or CAS [1988], page 58: "Development is defined as the change between valuation dates in the observed values of certain fundamental quantities that may be used in the loss reserve estimation process"; so also Wiser [1990], page 161). Weller [1991] says: "Often the values of observations change as we learn more about the subject that we are studying. Actuaries call such changes 'development.'"

accident year may be only a fraction of the ultimate value. But this fraction may be relatively stable: 20% of losses may be paid in the first 12 months of one accident year, 21% in the first 12 months of the next accident year, 19% in the first 12 months of the next year. The observed values plus a stable development pattern allows a good estimate of the ultimate values.

External events may change development patterns. For instance, the 1986 federal income tax amendments caused some insurers to modify their Workers' Compensation premium booking procedures and thereby changed premium development patterns. Similarly, statutory modifications of maximum durations of indemnity benefits, or the introduction of escalating benefits for long-term disability cases, change loss development patterns. The actuary must quantify the effects of these changes when estimating ultimate values (see Sections 6 and 7).

B. Trend

Inflation causes nominal values to change over time. For instance, payrolls increase with wage inflation, and medical benefits increase with physicians' fees. Often, real values are affected as well, as when accident frequency changes with technological improvements in workplace safety.

Actuaries attribute loss cost trends to three causes: economic inflation, social inflation, and other trends. *Economic inflation* is the change over time in the purchasing power of a dollar. It is measured by econometric indices, such as a CPI index or a GNP deflator, though it will vary by benefit type (e.g., the medical inflation rate differs from the wage inflation rate). *Social inflation* is the change over time in public attitudes that affect insurance losses, such as changing claims consciousness, more liberal jury awards, and changing expectations of compensation. *Other trends*, such as frequency trends, are systematic non-monetary changes affecting insurance values, such as a decline in workplace fatalities resulting from OSHA regulations or from the movement from a manufacturing to a service economy.[12]

Trends may be estimated both from insurance data, such as historical claim sizes, and from external econometric data, such as CPI indices (Masterson [1968]). Internal trends are

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12 For example, the results of greater workplace safety and better medical treatment are vividly reflected in the ratio of fatalities to permanent total disabilities, which has declined from 15 to 1 at the beginning of this century to about 1 to 1 now; cf. Downey and Kelly [1918], page 261.

preferred when forces besides economic inflation affect insurance values. External trends are useful when the trend values chosen must be justified to regulators, when the future trend is expected to differ from the historical average, or when insufficient internal data are available.

If the exposure base is not inflation sensitive, such as car-years in Personal Auto, only loss trends are used. If the exposure base is inflation sensitive but not necessarily related to loss inflation, such as receipts in Products Liability, separate premium and loss trends are used.

In Workers' Compensation, the exposure base (payroll) is inflation sensitive and directly related to indemnity benefits. Most rating bureaus examine the trends in "on-level" loss ratios. [The on-level loss ratio is the loss ratio after historical premiums have been adjusted to current rate levels and losses have been adjusted to current benefit levels.] The divergences between (i) inflation indices (whether wage or medical) and (ii) benefit trends (whether indemnity or medical), and the need to explain these differences to regulators, lead some pricing actuaries to prefer separate premium and loss trends (see Section 8).

C. Benefit Changes

Workers' Compensation statutory benefits are frequently modified by legislative enactments. For instance, a state may raise the weekly maximum for indemnity benefits, increase the maximum duration of benefits, or change the administrative handling of cases.

Benefit changes have both direct and indirect effects. For example, if the statutory indemnity benefit is raised 20%, indemnity claim costs will rise 20%. In practice, the higher benefit level may encourage greater filing of claims and longer durations of disability. These indirect "economic incentives" may raise indemnity claim costs another 10%, though the actual effect depends on the benefit structure, the characteristics of the workforce, and the economic environment. This is currently an ongoing area of research, and the indirect effects are not yet fully understood (see Sections 9 and 10).

The direct effects are removed from loss and premium trends. The indirect incentive effects work more slowly and are harder to quantify. It is difficult to determine to what extent loss cost

trends in excess of wage or medical inflation stem from economic incentives caused by statutory benefit changes and to what extent they stem from changing social expectations unrelated to specific laws.

Section 6: Premiums

Premium adjustments are more complex in Workers' Compensation than in most other lines of business. This section covers several topics:

- Types of premium: manual, standard, and net.
- Premium development: effects of policy type, payment plans, and tax provisions.
- Rate level changes affecting new and renewal policies ("experience changes").
- Rate level changes affecting all policies in force ("law amendment changes").

We defer the discussion of exposure trends to the section on losses, since the primary concern there is the *relative* trends in exposures versus benefits.

A. Types of Premium

The final product of the pricing actuary's work is a rate manual, showing the *manual* premium for each risk. The premiums collected are *net* premiums, which incorporate manual rates, premium discounts, individual risk rating modifications, and expense constants.

Bureau ratemaking uses *standard* earned premium, which the NCCI ([1990], Part IV, p. 2, sheet 1) defines as the "earned premium for the state resulting from standard rating procedures after the application of:

1. Experience rating plan adjustments,
2. Expense Constants, and
3. Loss Constants,

but prior to the application of

1. Deviations from NCCI Designated Statistical Reporting rates or pure premiums
2. Deviation from published NCCI experience rating plan modification factors,
3. Retrospective rating plan adjustments,
4. Other individual risk rating plan adjustments (e.g., Schedule Rating),
5. Premium discounts,
6. Expense modification program adjustments,
7. Payment of policyholder dividends, and

8. Premium credits for small deductible coverage."[13]

As the bureaus turn to loss costs instead of advisory rates in several jurisdictions, the definition of "pure premium" will become particularly important. For instance, the type or amount of loss adjustment expenses included in pure premiums may vary from state to state.[14]

B. Premium Development

Premium development in Workers' Compensation results from several factors. Since premium depends on payroll, the final premium is generally determined by audit after the policy expires. For prospectively rated policies, the audit is booked about three months after the policy expires. For retrospectively rated policies, the audit is usually booked at first adjustment, or six to nine months after the policy expires.[15]

The premium development pattern depends on several elements:

- *The types of plans permitted by the state and offered by each carrier:* California, for instance, has restrictions on retrospective rating plans that make countrywide development patterns inapplicable for this jurisdiction. Some insurers emphasize retrospective rating plans; others use prospective plans as much as possible. Development factors derived from industry data may not be appropriate for a particular insurer.

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[13] Residual market burdens are also included in standard premium, though quantification procedures for the burden are still evolving; see Section 11.

[14] Readers should be familiar with several other terms used by the NCCI as well. *Company level* standard earned premium is standard earned premium after the application of deviations from bureau rates or pure premiums. Net earned premiums are after all adjustments except policyholder dividends (NCCI [1990], Part IV, page 2, sheet 2). Experience on excess policies is excluded from both standard and net earned premium (*ibid.*, Part IV, page 2, sheet 3; but contrast Watford [1991]). Losses on small deductible policies are reported gross of the employer payments (*ibid.*, Part IV, page 2, sheet 4). Since alternative Workers' Compensation programs are spreading rapidly now (see Sections 11 and 18), the pricing actuary must know what components are included in each type of premium.

On the adjustment from manual premium to standard earned premium, see Sections 13 and 17. Marshall [1954], page 27, defines "collectible" premium as manual premium adjusted by the experience rating off-balance factor. If this factor is correctly determined, then collectible premium should equal standard premium.

[15] See WCRB [1981; 1991]. Retrospectively rated insureds pay or receive the difference between the additional audit premiums and the first retrospective return. Holding the audit until first adjustment avoids the statutory charge to surplus that would result from a premium that is more than 90 days overdue (see Vinci [1991]).

- *The relationship between the originally estimated premium and the final audited premium:* If the written premium is estimated from the previous year's experience, but the insured is growing rapidly, the final audited premium will exceed the estimate. Some underwriters use the deposit premium as a competitive tool, using a low estimate to attract policyholders.

- *The premium booking pattern:* Before 1986, booking premium in advance of collection had no effect on taxable income, since the written premiums were offset by the unearned premium reserve. The "revenue offset" provision of the 1986 Tax Reform Amendments allows only 80% of the change in the unearned premium reserve as an offset to taxable income. Many Workers' Compensation carriers now book premium when it is collected, rather than when the policy is written (NAIC [1990]). Moreover, the National Residual Market pool asks servicing carriers to remit premiums as they are booked, thereby providing an additional incentive to delay the booking.

Paid loss development depends primarily on external factors: emergence of claims, payment patterns, and durations of disability. Premium development depends on internal company operations as well: auditing procedures, marketing strategy, and accounting policy.[16] The actuary must discuss the auditing and accounting policies with other personnel in his company before choosing development factors.

Policy Year vs. Calendar Year Development

Development factors are needed for policy year premium, but not necessarily for calendar year premium. Suppose that

- Full estimated policy year premium is booked at inception, $1 million a month in 1992.
- Premium develops upward by 10% at the final audit, six months after the policy expires.

At December 31, 1993, policies issued between January 1 and June 30, 1992, have completed

[16] Premium development stemming from exposure audits may also depend on economic conditions. Some underwriters base the deposit premium on the previous year's exposure. In periods of expansion, payroll increases, so final audits may be larger; in periods of recession, payroll is flat or decreases, so final audits may be smaller. Private studies on a large book of Workers' Compensation business partially confirm this phenomenon.

their final audits, whereas policies issued between July 1 and December 31, 1992, have not. The reported policy year premium at 12/31/93 is

$$(6)(\$1{,}000{,}000)(1.1) + (6)(\$1{,}000{,}000), \text{ or } \$12{,}600{,}000.$$

At December 31, 1994, all policies have completed their final audits, so the premium is (12)($1,000,000)(1.1), or $13,200,000. The premium development factor for 24 to 36 months is 1.048 (= $13.2 million ÷ $12.6 million).

Calendar year premiums include audit premiums from past policies. If the premium volume is steady, then the current year's audits, which actually relate to past exposures, are about equal to next year's audits, which relate to the current exposures. In the example above, if premium of $1 million a month was written in 1991 and the premium development pattern is not changing, the calendar year booked premium in 1992 is $13.2 million [= (12)($1,000,000) for this year's exposures, plus (12)($1,000,000)(0.1) for last year's exposures].

In general, premium volume increases with wage inflation (payroll) and rate revisions (loss trends in excess of wage inflation, and increases in statutory benefits). [Conversely, in recessionary periods, or when insureds leave the Workers' Compensation market for self-insurance or excess plans, premium volume may decrease.] If the 1991 writings were only $900,000 a month, then the calendar year 1992 booked premium would be $13.08 million [=(12)($1,000,000) + (12)($900,000)(0.1)].

The effort needed to separate audits relating to different exposure periods is often greater than the benefit from more accurate premium figures. Estimating the development based on growth rates and audit practices is sufficient for calendar year premiums. In this example, a growth rate ("G") of 11% per annum and a final audit ratio ("A") of 10% provides a calendar year development factor of 0.9% [= (1+G)(1+A) / (1+G+A), or (1.11)(1.1)/(1.21) = 1.009].[17]

[17] This development converts calendar year earned premium to exposure year earned premium, so it is most appropriate for calendar/accident year experience. Note that this development is not observable in the data calls currently prepared for the rating bureaus. [I am indebted to C. Walter Stewart, Roy Morell, and Charles McClenahan for this perspective on "exposure year earned premium."]

Premiums develop faster than losses. The NCCI and most other rating bureaus use five reports for policy year premium development in their rate filings. Development from first to third report is significant; further development factors are near unity.[18]

C. Bringing Premium to Current Rate Level

The rate review assesses the adequacy of the current premium rates. If rates were inadequate or redundant in the past, but have since been modified, the modified rates must be assessed, not the historical rates.

The pricing actuary examines the revenues that would have been collected during the experience period had premium rates been at the current level.[19] Two procedures may be used for this:

- *Extending Exposures:* Each policy in force during the experience period is re-rated at current rates. In lines of business where all premiums are at manual rates and rate revisions differ greatly by classification, deductible levels, and amount of insurance (such as Homeowners'), this procedure is often used.[20]

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[18] For the statewide indication, the exhibits in the appendix use a premium development factor of 1.017 from first to second report; subsequent factors are unity. For classification pure premiums derived from less mature Unit Statistical Plan data, slightly higher factors are used.

[19] Similarly, expenditures will be examined at current benefit levels and future cost levels.

[20] See Walters [1974]. McClenahan [1990], page 42, says: "Where the capability exists, the best method for bringing past premiums to an on-level basis is to re-rate each policy using current rates. . . . This method is referred to as the extension of exposures technique. . . . When extension of exposures cannot be used, an alternative, called the parallelogram method, is available."

Until the 1970's, extending exposures was used in Workers' Compensation rate making as well. Marshall [1956], page 19, comments: "Rather than trying to adjust the premiums to the level of current rates by flat factors, we go back to the payroll exposures by classification and multiply such exposures for each classification by the appropriate current classification rate." Marshall uses Unit Statistical Plan data, which has exposure data, to determine overall rate levels. Current ratemaking procedures use financial data, which lack exposure information, for overall rate levels, so extending exposures can not be used.

Early Workers' Compensation pricing used countrywide classification data adjusted to the state's statutory benefit level, by either "law differentials" or "experience differentials," using techniques similar to extending exposures (Michelbacher [1916]; Rubinow [1917]; see also Section 15).

- *Premium Adjustment Factors:* Aggregate premiums earned during the experience period are adjusted for subsequent rate revisions. This procedure, illustrated below, is now used for most lines of business, including Workers' Compensation.

Policy Year Illustrations

As a simple illustration, suppose $1 million of premium was earned during policy year 1992, a +10% rate change was implemented on January 1, 1993, no rate revisions were made in 1991 or 1992, and the pricing actuary is now setting rates for 1994. The premiums that would have been earned in 1992 at the current rate levels, or $1.1 million [= $1 million increased by 10%], are used in the rate review.

When rate revisions affect only part of the premiums earned during the experience period, the adjustment may be determined by "index factors" and "earnings percentages." The type of rate change affects the earnings percentages. Rate filings based on experience, used to correct for past inadequacy or redundancy of premiums, affect new and renewal policies only. Rate changes stemming from law amendments, used to adjust premiums for a statutory modification of benefits, usually affect all policies in force, in addition to new and renewal policies.

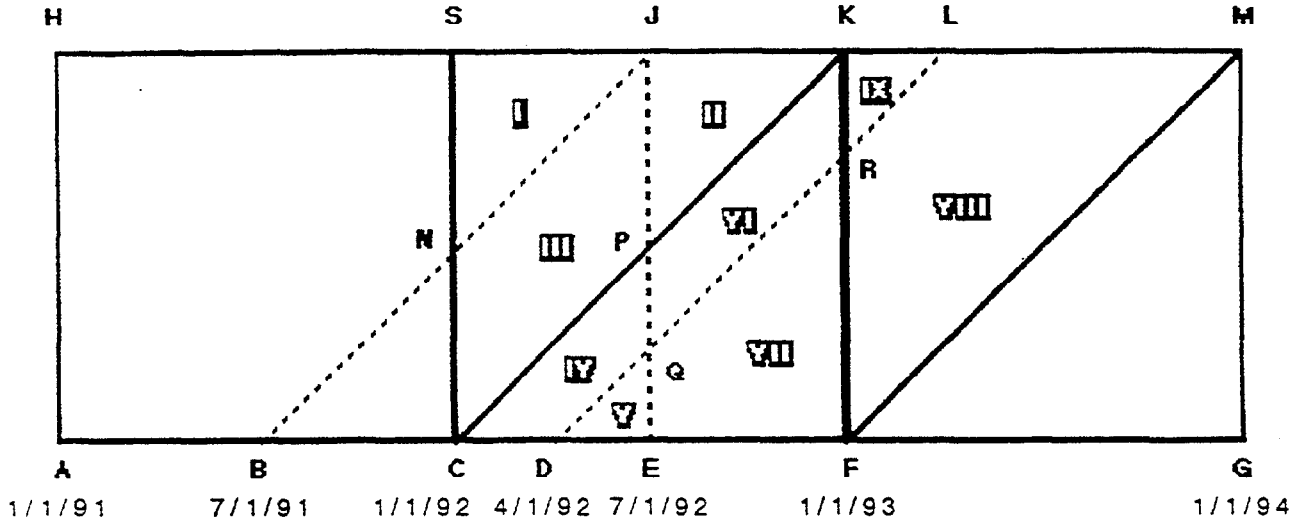
Let us continue the example above, but suppose also that three rate changes occurred in 1991 and 1992: Experience rate changes of +5% on July 1, 1991, and of -8% on April 1, 1992, and a law amendment change of +15% on July 1, 1992. We will determine "on-level" factors for both 1992 policy year earned premium and 1992 calendar year earned premium.

Policy year earned premiums are derived from policies written in that year, so only the 4/1/92 and the 7/1/92 rate changes need be considered. The 1992 calendar year earned premiums are derived from policies written in 1991 and 1992. Rate revisions effective since 1/1/91 must be considered.

Geometric Representations

The premium earning pattern is represented geometrically in the chart below. The horizontal

axis represents chronological time, and the vertical axis represents policy duration, or the "portion of the policy term expired" (Miller and Davis [1976], page 118; McClenahan [1990], page 43). For instance, point "D" represents the inception of a policy on April 1, 1992; point N represents the midpoint of an annual policy written on July 1, 1991.



Policy year 1992 earned premium is represented by the parallelogram *CKMF*: policies written between 1/1/92 and 12/31/92 and expiring between 1/1/93 and 12/31/93. Calendar year 1992 earned premium is represented by the square *CSKF*. The square contains part of the earned premium from policies written between 1/1/91 and 12/31/92. A policy written on 7/1/91 contributes its last 6 months to 1992 earned premium; a policy written on 1/1/92 contributes all its earned premium; and a policy written on 10/1/92 contributes its first three months of earned premium.

All policy year 1992 earned premium is affected by the July 1, 1991, experience rate change of +5% [represented by the diagonal line from "B" to "J"]. Since this rate change affects both the policy year 1992 premium and the current rates, no adjustment need be made to the experience. The experience rate change of –8% of April 1, 1992 [the diagonal line from "D" to "L"] affects only policies that are written or renewed between 4/1/92 and 12/31/92. Were premium writings evenly distributed through the year, it would affect three quarters of the policy year 1992 earned premium. Since Workers' Compensation writings, particularly for

large accounts, are heavily weighted toward January 1, less than 75% of the policy year 1992 earned premiums are affected by this change.

The July 1, 1992, law amendment change of +15% affects all policies in force, so it is shown as a vertical line from "E" to "J". It affects the earned premium in area *EPKMF*; it has no effect on earned premium in the triangle *CPE*. Were premium writings evenly distributed through the year, it would affect seven eighths of the policy year 1992 earned premium. Since more workers' compensation business is written in the first half of the year than in the second half, the law amendment change affects less than seven eighths of the 1992 earned premium.

Index Factors and Earnings Percentages

"Index factors" representing the change in the premium rate are assigned to areas of the graph:

- The rate before the first change that affects the premium is assigned an index factor of unity. In the illustration above and the table below, this is represented by area IV (*CPQD*).
- Triangle V (*DQE*) is affected by the 4/1/92 experience rate change but not by the 7/1/92 law amendment change, so it is assigned an index factor of 0.920 [that is, –8%].
- Area VI + IX (*QPKR*) is affected by the 7/1/92 law amendment change but not by the 4/1/92 experience rate change, so it is assigned a factor of 1.150.
- Area VII + VIII (*EQLMF*) is affected by both of the rate changes mentioned above, so it is assigned a factor of 1.058 [= 0.920 *x* 1.150].
- The current index, which reflects the 1/1/93 rate change of +10% as well, is 1.164 [= 1.058 *x* 1.100].

The "earnings percentages" depend on the pattern of premium writing. If policies are written evenly through the year (as is true for many small risks and some residual market pools), then the percentages are the relative sizes of each area of the chart.[21] In the illustration, we have

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[21] This procedure actually relies on a second assumption as well, as Marshall [1954], page 33, points out: "In addition to assuming an even distribution of business throughout the calendar year, it is further assumed that the entire earned premium arose either from policies becoming effective during the calendar year or during the previous calendar year . . ." In other words, the procedure in the text does not account for premium developed from audits.

Many filings use separate exhibits for experience and benefit changes. The geometric representation in the text is for heuristic purposes; in practice, most filings simply show effective dates and the types of policies to which the change applies. Kallop [1975], pages 103-104, includes the "adjustment for expense constant removal" in the on-

(1) Area	(2) Index Factor	(3) Earnings Percentage	(4) Product (2)*(3)	(5) Adjustment Factor (col 2 current ÷ col 4 total)
IV (*CPQD*)	1.000	3/32 = 0.094	0.094	
V (*DQE*)	0.920	1/32 = 0.031	0.029	
VI+IX (*QPKR*)	1.150	5/32 = 0.156	0.179	
VII+VIII (*EQLMF*)	1.058	23/32 = 0.719	0.760	
Total			1.062	1.096
Current	1.164			

The exhibit above says:

> "In policy year 1992, 9.4% of the earned premium was written at the original rate level; 2.9% was written at a rate level 8% lower; 15.6% was written at a rate level 15% higher; and 71.9% was written at a rate level 5.8% higher. The average 1992 rate level was 6.2% higher than it was on January 1, 1992. Since the current rate level is 16.4% higher, the policy year 1992 earned premium must be increased by 9.6% [=1.164 ÷ 1.062]."

Policy Effective Dates

In practice, many large Workers' Compensation policies are effective on January 1 or July 1. To illustrate the necessary revision in the "earnings percentages," suppose that 30% (by dollar volume) of the policies have effective dates in January, 10% in July, and 6% in each of the other months (as might be the case for a "national risks" book of business). To simplify, we assume that all policies are written on the first of the month.[22]

The January 1 policies, which represent 30% of the premium, spend six months in area IV (*CPQD*). Similarly, the February 1 policies, 6% of the premium, spend five months in area IV, and the March 1 policies, also 6% of the premium, spend four months there. The earnings percentage for area VI is

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level calculation as well (see Section 12).

[22] Unpublished studies show that for large Workers' Compensation accounts, the average effective date is the second or third day of the month, so this assumption is reasonable. The NCCI [1985], and the Minnesota Bureau [1991], page 58, similarly assume effective dates on the first of each month.

$$(30\%)(6/12) + (6\%)(5/12) + (6\%)(4/12) = 0.195.$$

The earnings percentages are determined similarly for each area in the graph, and the on-level factor calculation is shown below.

(1) Area	(2) Index Factor	(3) Earnings Percentage	(4) Product (2)*(3)	(5) Adjustment Factor (col 2 current ÷ col 4 total)
IV (*CPQD*)	1.000	0.195	0.195	
V (*DQE*)	0.920	0.030	0.027	
VI+IX (*QPKR*)	1.150	0.225	0.259	
VII+VIII (*EQLMF*)	1.058	0.550	0.582	
Total			1.063	1.095
Current	1.164			

The NCCI uses a countrywide distribution of policy effective dates, since there is little observed variance among the states. NCCI [1985: Distribution], page 2, summarizes the effects:

> *"Based on an actual distribution of policy effective dates, a rate (benefit) increase occurring after January 1 of the experience period will tend to lower the standard rate level indication. This is because less weight will be given to that rate (benefit) increase due to the large conglomeration of policies written on January 1. Conversely, a rate (benefit) decrease will have the opposite effect."*[23]

[23] For more advanced treatments of on-level calculations, see Ross [1975], Miller and Davis [1976], and Karlinski [1977]. Not all premium stems from manual rates. Expense constants are added to each risk, and large risks receive premium discounts; see Section 12. The conversion of earned standard to manual premium, to adjust for the experience rating plan off-balance, is discussed in Section 13.

Section 7: Loss Development

Expected losses during the future policy period are estimated from losses incurred during the experience period, after three adjustments:

- Losses are developed to ultimate values.
- Losses or loss ratios are trended to expected future levels.
- Losses are adjusted for changes in statutory benefits or administrative systems.

This section deals with development; the following sections discuss trends and benefit changes.

A. Causes of Loss Development

Loss development has two meanings:

- Reported values of accident or policy year losses "develop" over time, as additional information becomes known.
- The pricing actuary, when using accident year or policy year data, "develops" reported losses to ultimate values.

The ratemaking objective is that the development adjustment performed by the actuary should correspond to the empirical development that will occur over time.

Development stems from several causes.

- *Delayed reporting or recording of claims:* Occupational injuries are reported quickly, since the employer must ensure that weekly benefit payments are provided. Some occupational diseases, such as asbestosis or silicosis, have long reporting lags (see Section 16). Overall, though, Workers' Compensation has relatively little pure IBNR, with most claims reported within three months after policy expiration.

- *Development on reported claims:* Expected loss costs may change as the extent of the injury becomes clearer. One worker with an apparently mild injury may become permanently

disabled, whereas another worker, with a more serious injury, may return sooner to work than expected.

Some development on known cases is a normal element of claims handling. Suppose that most lower back injuries settle for $5,000 apiece, but an unidentifiable 10% of these claims become permanent disabilities with a $50,000 average cost. Most claims examiners will set a $5,000 reserve on each case, and let the actuaries determine the needed bulk reserve. [The indicated bulk reserve in this example would be $4,500 times the number of lower back cases.] Other development on known claims may result from case reserve inadequacies or redundancies.

- *Reopened claims:* Workers' Compensation claims may be reopened if an apparently healed injury or disease manifests itself a second time, or if the injured worker fails to recuperate as expected.

- *Unwinding of interest discounts:* Most states allow or require tabular reserve discounts on the indemnity benefits of permanent disability and fatality cases, usually at a 3.5% or 4% annual interest rate.[24] As the benefits are paid, the interest discount "unwinds," and cumulative incurred losses show upward development.

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[24] Some jurisdictions allow greater discounts. See, for instance, §4117(b) of the New York insurance laws, which allows a 5% discount on all Workers' Compensation loss and loss adjustment expense reserves, whether indemnity or medical benefits, pension or non-pension cases:

"§4117(b)(1): For all such compensation policies where losses were incurred more than three years prior to the date of determination, such reserves shall be the sum of the present values, at five percent interest per annum, of the determined and estimated unpaid losses computed on an individual case basis plus the estimated unpaid loss expenses computed in accordance with subsection (b) hereof.

"§4117(b)(2): Where losses were incurred during the three years immediately preceding the date of determination, such reserves shall be the sum of the reserves for each year, which shall be calculated in accordance with any method adopted or approved by the National Association of Insurance Commissioners and shall be not less than the sum of the present values, at five percent interest per annum, of the determined and estimated unpaid losses computed on an individual case basis plus the estimated unpaid loss expenses computed in accordance with subsection (b) hereof."

Some carriers and rating bureaus apply tabular discounts to both the indemnity and medical portions of permanent disability cases; see, for instance, Grannan [1993]. The NAIC Blanks Task Force is presently considering the proper treatment of tabular discounts in statutory accounting.

B. Development Procedures

Reserving actuaries use a variety of procedures and data segmentations to adjust for loss development, along with analysis of changes in the mix of benefits, injury types, or disability durations (see below). Pricing actuaries generally use chain ladder loss development procedures, separately for indemnity and medical benefits, of the following types:

- Paid losses
- Case incurred losses: i.e., paid losses plus case reserves
- Incurred losses including IBNR and other bulk reserves
- Paid losses for early valuations, and incurred losses for later valuations (sometimes referred to "paid to fourth" or "paid to eighth").

In the past, pricing actuaries generally used case incurred loss triangles to project ultimate losses. Case reserve adequacy, however, may be affected by Claims Department reserving philosophy and perhaps even by attempts to smooth earnings through the underwriting cycle (Ryan and Fein [1988]; Cholnoky and Cohen [1989], pages 1-3; Butsic [1989], page 15). Many pricing actuaries prefer paid loss development to project ultimate losses (Retterath [1990]). This section uses an incurred loss illustration; the appendix shows a more detailed paid loss development example.[25]

Exhibit 7.1 shows reported indemnity benefits (i.e., paid losses plus case reserves, but no supplemental or bulk reserves) by accident year and valuation date.[26] The "accident year" may be any fiscal period; it need not run from January to December. To allow for the reporting of claims occurring at the end of the accident year, some carriers use development dates of "15 months," "27 months," and so forth. Unit Statistical Plan developments show valuations at

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[25] Milliman and Robertson, in their NAIC sponsored review of NCCI ratemaking procedures, suggested that no single loss development procedure is appropriate in all instances. They recommend that "an average of the ultimate losses resulting from the paid loss development and paid plus outstanding (with the latter to be replaced eventually by paid plus case) loss development projections should be used as the primary basis for rate indications." ("Outstanding" here refers to case reserves plus case supplemental reserves, but not pure IBNR reserves.) In addition, they recommend that deviations from the primary method should be made when diagnostic tests so indicate. See Milliman & Robertson [1991], Volume III, Section IIB, Part 1, p. 36, and NCCI memorandum AC-91-29.

[26] For further explanation of the incurred loss chain ladder loss development procedure, see Salzmann [1984] or Peterson [1981].

"first report," "second report" and so forth (that is, 18 months, 30 months, etc.).

Exhibit 7.1: WC Reported Indemnity Benefits, by Accident Year and Valuation Date ($000)

Acc. Yr.	12 mo	24 mo	36 mo	48 mo	60 mo	72 mo	84 mo	96 mo	108 mo	120 mo
1982	215	347	399	419	433	442	449	460	466	471
1983	252	363	409	441	457	471	483	493	500	
1984	222	329	373	402	418	430	435	444		
1985	227	352	406	436	460	471	484			
1986	275	443	518	566	592	609				
1987	298	477	558	608	645					
1988	302	515	616	670						
1989	338	554	656							
1990	345	628								
1991	338									

Link ratios, or "age to age factors," are the ratio of incurred losses at one valuation date to the corresponding incurred losses at the previous valuation date. For example, the accident year 1989 link ratio from one year to two years, or 24 months to 36 months, is $656,000 divided by $554,000, or 1.18.

Exhibit 7.2: WC Indemnity Incurred Link Ratios

Acc. Yr.	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 to 10
1982	1.61	1.15	1.05	1.03	1.02	1.02	1.02	1.01	1.01
1983	1.44	1.13	1.08	1.04	1.03	1.03	1.02	1.01	
1984	1.48	1.13	1.08	1.04	1.03	1.01	1.02		
1985	1.55	1.15	1.07	1.06	1.02	1.03			
1986	1.61	1.17	1.09	1.05	1.03				
1987	1.60	1.17	1.09	1.06					
1988	1.70	1.20	1.09						
1989	1.64	1.18							
1990	1.82								

No link ratios are determined for the 1991 accident year, as there is only one valuation. Exhibit 7.3 shows averages of the most recent three and five link ratios. Since an upward trend is apparent in the first four columns, the three year averages are selected.[27]

[27] When a historical trend in link ratios is clear and the cause of the trend is understood, many actuaries use the most recent observed ratio, or even a projected future ratio. When the trend is uncertain or its cause is not understood, an average of recent figures may be preferred, with more weight for the most recent years. [I am indebted to Gary Josephson and Howard Mahler for this clarification.]

Exhibit 7.3: WC Selected Link Ratios, Development Factors, and Ultimate Losses ($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 to 10
Averages									
3 year	1.72	1.18	1.09	1.05	1.03	1.02	1.02		
5 year	1.68	1.17	1.08	1.05	1.03				
Select	1.72	1.18	1.09	1.05	1.03	1.02	1.02	1.01	1.01
Cumulative	2.54	1.48	1.25	1.15	1.09	1.06	1.04	1.02	1.01
Case Incurred	338	628	656	670	645	609	484	444	500
Ult. Incurred	859	927	821	769	705	646	504	453	505

The loss development factors are the cumulative products of successive link ratios (e.g., in the "6 to 7" column, 1.06 = 1.02 *x* 1.02 *x* 1.01 *x* 1.01). The loss development factors are multiplied by the corresponding indemnity incurred losses to project ultimate losses. For instance, the $628,000 case incurred losses for accident year 1990 are multiplied by the 1.48 development factor to give estimated ultimate losses of $927,000 for this accident year. [This estimate ignores any development beyond the tenth year, which is discussed below.]

Loss Development Tail Factors

The loss payout pattern for Workers' Compensation has steadily been lengthening, and it now shows the longest duration for any line of business except Medical Malpractice, Products Liability, and casualty excess of loss reinsurance (cf. Woll [1987]). In the early years of Workers' Compensation ratemaking, three reports were considered sufficient for loss development (Marshall [1954], page 24). By the 1970's, the period was lengthened, first to five unit statistical reports, and then to additional reports from financial data aggregates.

In the 1990's, many insurers show strong upward development on both paid and case incurred losses continues for over 15 years. In 1988, the NCCI began expanding its Policy Year and Calendar-Accident Year calls for data:

> *"Starting with the calls due in 1988, both calls [Policy Year and Calendar-Accident Year] are being expanded to include an additional seven-years worth of data. An additional one year will be added with each year until 1994 when there will be 15 years of data on the two calls"* (NCCI [1990D], Part IV, page 1).

The NCCI uses a "last valuation to ultimate" tail factor (originally "eighth to ultimate"; as additional data were compiled, the tail factor became "ninth to ultimate," "tenth to ultimate," and so forth). The eighth to ultimate tail factor is the development from eighth to ninth, from ninth to tenth, from tenth to eleventh, and so on. When making rates in 1992, and using the triangle procedure illustrate above, the actuary might use eighth to ninth development for accident years 1980 through 1982, ninth to tenth development for accident years 1979 through 1981, and so forth. In each case, the development is related to the associated accident years. For instance, the eighth to ninth development for accident year 1982 is related to accident year 1982 losses at the eighth valuation.

Complete data by accident year are not yet available for the bureaus for all late valuations. But if the volume of business is not changing significantly, as is often true when aggregate industry data are used, the losses at ninth valuation for accident year 1981 are about equal to the losses at ninth valuation for accident year 1982.[28] As a rough approximation, the development

- from eighth to ninth valuation for accident year 1982,
- from ninth to tenth valuation for accident year 1981,
- from tenth to eleventh valuation for accident year 1980, and so on,

can all be related to accident year 1982 losses at eighth valuation to estimate the "eighth to ultimate" tail factor. Altervatively,

All the loss developments in the list above occur in calendar year 1990. Thus, the required tail factor is the total loss development in calendar year 1990 for all accident years prior to 1982 divided by accident year 1982 losses valued at December 31, 1989.[29] For instance, if

- Losses for accident year 1982 valued at 12/31/1989 = $ 40 million,
- Losses for accident years prior to 1983 valued at 12/31/1989 = $200 million, and
- Losses for accident years prior to 1983 valued at 12/31/1990 = $205 million,

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[28] Inflationary changes make the 1982 losses greater. Since some of the tail development stems from claims that are 20 or 30 years old, there is surely an inflationary increase in volume, if not a true exposure increase. The NCCI and others now include a "growth factor" adjustment to correct for this; see the rate filing exhibits in the appendix.

[29] See Salzmann [1984], pages 57-66 and 101-111, for a more complete discussion of this approximation and of its potential problems.

then the eighth to ultimate tail factor is 1 + ($205 – $200)/($40) = 1.125.

Several such estimates are made: e.g., an estimate for accident year 1982 valued at 12/31/1989, accident year 1981 valued at 12/31/1988, and accident year 1980 valued at 12/31/1987. Detailed exhibits should help clarify this procedure to the reader. The exhibits in the appendix show eighth to ultimate, tenth to ultimate, and eleventh to ultimate tail factors, each for various accident years.

Credibility for Loss Development

The ultimate indemnity benefits in the illustrative exhibits above are less than $1 million a year. Since the average claim severity for the most costly types of claims, such as permanent total disability, is over $250,000, actual experience fluctuates more widely than in this heuristic example. Losses are the largest and most volatile component of insurance costs. Inaccurate estimates of ultimate losses may lead to unprofitable or uncompetitive indications.

Rating bureaus may have sufficient data for credible loss projections; individual carriers generally do not. The company actuary determining rate indications from a single company's data has several alternatives:

- *Use multiple reserving methods to estimate ultimate losses:* Unfortunately, most other methods are equally dependent on data credibility.

- *Use expected loss ratios to project ultimate losses* (Bornhuetter and Ferguson [1972]): Actuaries should indeed test the reasonableness of projections by examining implied loss ratios and average loss severities (Berquist and Sherman [1977]). Reserving actuaries may compare ultimate losses with the expected loss ratios used in pricing. But for the pricing actuary to use expected loss ratios to estimate historical experience is putting the cart before the horse, so this procedure is not used.

- *Credibility weighting of statewide and countrywide experience:* Statewide link ratios fluctuate because of random loss occurrences. Credibility weighting with countrywide link ratios smooths some of the random fluctuations. Alternatively, one might weight statewide

link ratios with those for groups of states with similar benefit patterns; see Lange [1966].

- *Credibility weighting of company with industry experience:* Industry experience smooths out much of the random fluctuations observed in small data bases. However, since development patterns may vary widely from company to company, industry development factors must be applied cautiously to individual company experience.

The Insurance Services Office uses a credibility weighting of statewide and countrywide loss development link ratios for General Liability rate making (Graves and Castillo [1990], pages 652-657). Statewide credibility is highest at early maturities, where state differences are significant, and lowest at late maturities, where state data are sparse.

Workers' Compensation loss development patterns are different. At late maturities, development is influenced by statutory maximums on benefit durations or dollar amounts, so state differences are great. At early durations, payment patterns may be less affected by statute (though benefit levels vary by jurisdiction).[30] It is unclear whether state credibility should increase or decrease with maturity.

Trends in Loss Development

Exhibit 7.2 shows an upward trend in the link ratios in the first four columns. Exhibit 7.4 shows industry-wide paid loss link ratios, for both indemnity and medical benefits, where this trend is even more evident (NCCI [1992A]; Retterath [1990; 1991B]; cf. also Scheibl [1976], page 65).

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30 For example, Barbara Mahoney has pointed out to me several reasons for the higher paid loss link ratios in Pennsylvania than in Texas (see NCCI [1991A]; Chamber of Commerce [1990]): (a) Until January 1991 Texas had a 401 week limit on most indemnity benefits; Pennsylvania allowed longer durations; (b) Pennsylvania provided higher average weekly benefits than Texas did, which encouraged Pennsylvania claimants to remain disabled; and (c) lump sum settlements were common in Texas, but were not permitted in Pennsylvania (except for commutations of some temporary total and permanent partial cases). See the full study of benefit durations by the Pennsylvania bureau [1991], as well as the analyses by the Workers' Compensation Research Institute (WCRI) [1991: Pennsylvania] and the Association of American Insurers [1992].

Exhibit 7.4: Industrywide Workers' Compensation Paid Loss Link Ratios

Accident Year	Indemnity			Medical		
	1 to 2	2 to 3	3 to 4	1 to 2	2 to 3	3 to 4
1980			1.150			1.057
1981		1.368	1.157		1.124	1.058
1982	2.390	1.366	1.173	1.707	1.120	1.055
1983	2.489	1.406	1.175	1.795	1.127	1.060
1984	2.554	1.414	1.187	1.814	1.137	1.066
1985	2.535	1.432	1.186	1.863	1.151	1.071
1986	2.516	1.434	1.193	1.878	1.157	1.076
1987	2.607	1.445	1.193	1.958	1.169	1.077
1988	2.629	1.457		1.959	1.170	
1989	2.727			2.002		

Accurate estimates of loss development and trend factors are crucial for insurance pricing. The upward trends in the paid loss link ratios reflect changes in the Workers' Compensation environment. The percentage of permanent partial cases among all indemnity claims is rising, the durations of disability for temporary total cases is lengthening, and utilization of medical services is increasing (Kaufman [1990], Appel [1989]).[31] These phenomena are rarely anticipated by claims examiners, since the duration of disability depends on economic conditions, permanent partial benefits may not be awarded until years after the accident, and the utilization of medical services is related to employer provided group health plans (see Section 14). These changes therefore cause upward trends in the link ratios.

C. Loss Adjustment Expenses

There are several methods of including underwriting and claim expenses when reviewing rates:

- Actual incurred or paid amounts (e.g., allocated loss adjustment expenses in the Commercial Casualty lines of business).
- Dollar amount expenses added to each policy (e.g., Workers' Compensation expense constants [see Section 12]; Personal Automobile expense flattening procedures).

[31] NCCI [1991A], page 35, also attributes the lengthening duration of claims in part to increasing attorney involvement in workers compensation cases.

- Expenses added as a proportion of premium (e.g., commissions, premium taxes).
- Expenses added as a proportion of losses (e.g., unallocated loss adjustment expenses; certain Workers' Compensation assessments [see Section 13]).

Allocated loss adjustment expenses (ALAE) are those expenses that can be directly related to particular claims, such as defense attorney fees and court costs.[32] Workers' Compensation pricing actuaries use several of these methods for including loss adjustment expenses:

- A ratio of all loss adjustment expenses to premium may be included as an expense element when determining the permissible loss ratio. This was the Workers' Compensation ratemaking procedure in the early 1950's; Marshall [1954], pages 57-58, uses a ratio of 8.2% to standard premium.

- In December 1954 the NCCI revised its procedures to provide that "loss adjustment expense, in lieu of being treated for ratemaking as a percentage of standard premium, be treated as a percentage of losses, and be combined with such losses, in accordance with the procedure followed in automobile and general liability insurance" (Marshall [1954], page 78). The ratio used by the NCCI was 13.0% in the early 1970's, 12.5% in the late 1970's, and 12.0% in the late 1980's.[33]

- Legal defense costs vary greatly by state, being higher in more litigious jurisdictions. The NCCI is now revising its ratemaking procedure to include allocated loss adjustment expense with losses and to apply an unallocated loss adjustment expense factor to the sum of losses and allocated expenses. [This is the procedure in the liability lines of business, and it was Milliman and Robertson's recommendation in their review of NCCI ratemaking procedures.] To the extent that the ratio of adjustment expenses to losses varies by jurisdiction or class, this revision should lead to more equitable rates.

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[32] The NCCI (memorandum Act-92-6, Exhibit 15-2, "Definition of Allocated Loss Adjustment Expenses") has recently proposed that all medical cost containment charges also be included in ALAE.

[33] Best's [1991A], page 119, shows an industry ratio of 12.8% for 1990, and the NCCI is again using 12.5% in some states. Some carriers who use in-house counsel to handle litigated claims have ratios below 10%.

Section 8: Loss Trends and Loss Ratio Trends

Inflation raises the nominal costs of insurance premiums and losses. Accordingly, the pricing actuary adjusts historical experience with inflation trends to project future cost levels. In lines with exposure bases that are not inflation sensitive, such as Personal Auto liability, only losses are trended. In lines with exposure bases that are inflation sensitive but are not directly related to cost trends, such as General Liability, premiums and losses are trended separately.

In Workers' Compensation, the exposure base, payroll, is inflation sensitive. Indemnity benefits are a function of wages, so the indemnity loss cost trend is affected by the same factors as the exposure trend. During the 1960's, when industrial productivity increases were high and so wages rose rapidly, medical inflation was also similar to wage inflation.

The NCCI uses a loss ratio trending procedure, with credibility adjustments based on the goodness of fit of the empirical observations with an exponential trend. Since inflation of wages and indemnity benefits should be similar, the complement of credibility for indemnity was originally set at "no trend." Empirical data shows that indemnity benefits have been increasing more rapidly than wages in most jurisdictions, so the NCCI now uses the countrywide trend for the credibility complement. Since medical inflation differs from wage inflation, the complement of credibility for medical is the countrywide medical trend, with different figures for states with an effective medical fee schedule and states with no schedule.[34]

A. Inflation and Benefit Trends

> *"When wage rates are increasing, payrolls are increased and more premiums are collected. Indemnity losses which are based on wages will increase, but not to the same extent as premiums. Therefore, rate levels as otherwise calculated should be reduced in order to avoid excessive premiums."* – Allen [1952], page 59.

Forty years ago, Workers' Compensation pricing actuaries wondered whether premium rates should be reduced because of wage inflation. Edward Allen presented the "wage factor" procedure

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[34] Marshall [1954] and Kallop [1975] use no trend procedure; in their reviews of Kallop's paper, Gruber [1976] and Scheibl [1976] note that New York and the NCCI began using trend procedures. NCCI [1985] describes the loss ratio trending procedure which it used for rate filings from the mid 1980's through the early 1990's.

along with arguments for and against it. Harwayne [1953] noted that the "wage factor represents a technical adjustment to reflect recent conditions and is therefore on a par with the adjustment of experience to reflect current rate levels and current law levels" (page 28). Skelding [1953] noted the higher benefit trends than wage trends and says that "the injection of a so-called wage trend factor in the compensation rate structure would be a tragic mistake" (page 21).[35]

During the late 1970's and 1980's, loss cost trends for both medical and indemnity benefits have far exceeded wage inflation: about 14% per annum for medical, 10% for indemnity, and 6% for wage, though the observed trends vary by jurisdiction and by year. In general, the disparity between wage inflation and Workers' Compensation benefit trends has been increasing: although wage inflation has declined from 8% in the late 1970's to 4% in the mid-1980's, neither medical nor indemnity benefit trends have fallen as much.[36]

The persistent disparity between wage inflation and WC benefit trends is too great to ignore. It stems from several causes, among which are

- Technological advances in medical treatment: more expensive equipment and complex therapeutic procedures.
- Increasing utilization of medical services, even for minor injuries.

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[35] Wage level factors were often used in early ratemaking analyses. For instance, the 1918 Pennsylvania rate revision used an average factor of 0.92 for all classifications except coal mining (Downey and Kelly [1918], page 266). Such factors are more justified when the state has a low indemnity benefit maximum (*ibid.*, page 266-267). Gruber [1976], p. 57, notes that "due to the inflationary growth of payroll and therefore the growth of premium without any compensating increase in risk, a wage factor is used to decrease the New York experience-indicated rates."

[36] On medical, indemnity, and wage trends, see Ryan and Fein [1988], pages 43-45, Hager [1991], page 7, and NCCI [1991A], page 32. Kaufmann [1990], using state data for one insurer, finds a consistently higher Workers' Compensation medical severity trend than the CPI medical costs index; see also the studies by the California WC Rating Bureau. Before the 1970's, the relationship of Workers' Compensation medical costs and wage inflation was less clear. NCCI [1991A], page 29, notes that "prior to [1975], wage inflation had generated enough premium to overcome indemnity and medical loss changes." [Boden and Fleischman [1989] and Victor and Fleischman [1990] note that Workers' Compensation medical benefit trends were lower than medical inflation during the early and mid-1970's but greater than medical inflation in the 1980's.] Early studies have often shown a higher trend for medical benefits than for wages (Mowbray [1919]; Greene and Roeber [1925], page 255; Skelding [1953]). Summarizing the difficulties facing the Workers' Compensation industry, Countryman [1990], page 59, notes that "inordinate cost escalation is the root cause that threatens the system and inadequate rates are merely the result."

- Patient "claim shifting" from employer provided health insurance plans with high deductibles and co-insurance payments to first-dollar Workers' Compensation benefits; physician "cost shifting" from limited reimbursement plans, such as Medicare, to higher reimbursement private insurance coverages, such as Workers' Compensation.
- Lengthening durations of disability, particularly when replacement work is not available.
- Increasing frequency/compensability of high-cost psychological injuries and occupational diseases in certain jurisdictions.
- Greater attorney involvement in Workers' Compensation claims.[37]

Loss cost trends are frequently contested in rate filings, especially if the causes of the trend are neither intuitive nor explained. The use of loss ratio trends masks these causes: it is more difficult to interpret increases in loss ratios than in average claim costs.[38]

B. Internal Data and External Indices

Trend factors can be based on either (i) observed changes in average benefit costs or (ii) econometric modeling of loss cost trends with external inflation indices, such as the CPI. When the causes of the observed trends are not well understood, observed benefit trends may be more reliable. Econometric modeling, however, separates the influences on loss cost trends into their components, such as economic inflation, utilization, durations of disability, and claim filing patterns. Similarly, analyses of attorney involvement in insurance claims may explain rises in claim frequency, average claim severity, and loss adjustment expenses. Econometric modeling and analysis of attorney involvement provide qualitative justification for Workers' Compensation trend factors.

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[37] See Appel [1989]; Boden and Fleischman [1989]; Victor and Fleischman [1990]; Borba [1989]; Pillsbury [1991]. Appel notes several additional factors, such as (a) rising costs of medical malpractice coverage and defensive medicine, (b) demand creation by physicians, and (c) an oversupply of physicians in urban areas. Gots [1990], pages 39-40, also notes the expectations of consumers for high quality medical care.

[38] Note particularly the observation by Mintel [1983], p. 167: ". . . several insurance commissioners have rejected trending evidence based on an analysis of internal loss and expense experience presented in support of a rate filing in favor of external evidence of factors outside insurance company control that may affect future losses." Perkins [1922], page 272, also argues for separate payroll and loss projection factors.

Loss ratio trends incorporate both claim severity and claim frequency. If exposures and losses are trended separately, both claim severity and claim frequency trends should be estimated.

In other lines of business, increases in claim frequency often stem from the addition of small, marginal claims. In Personal Auto, for example, severe injuries always led to insurance claims. The increasing claims consciousness of the public, combined with greater attorney involvement in insurance claims, however, causes a higher incidence of small claims. This phenomenon depresses average claim costs (though not enough to offset economic and social inflation).

In Workers' Compensation, increases in claim frequency often result from newly mandated compensability of occupational diseases, psychological injuries, and stress claims, or from attempts to use Workers' Compensation as a substitute for early retirement. These are all high cost claims, so increases in claim frequency may raise average claim severity.

C. Loss and Exposure Trends

Exposure grows by increases in hourly wages and increases in the number of workers; only the former is needed for the trend calculation. Historical experience and future projections of average hourly wages are published by econometric consulting firms, such as DRI or Wharton.

The loss cost trend may be estimated in two ways:

- Fit average claim severities values to a curve. Average claim severities may be incurred values (case incurred losses divided by reported claims) or paid values (paid losses on closed claims divided by the number of closed claims). The observed values are usually fit to either a straight line or an exponential curve.

- Compare average incurred or paid values to an econometric index. For medical benefits, the econometric index may be the CPI medical cost index, ideally adjusted for regional

differences. For indemnity benefits, the index may be an average wage level index.[39]

Linear and Exponential Trends

Until recently, Workers' Compensation used linear trend factors. If the average cost of an indemnity case was $2,000 in 1992, and a 10% per annum trend was expected, the assumed average indemnity cost was $2,200 for 1993, $2,400 for 1994, $2,600 for 1995, and so forth. The expected trend was determined by fitting a linear regression (McClenahan [1990], page 51):

$$y = ax + b$$

where y is the average claim cost in each year,
a is the annual trend,
x is an index for the year, and
b is a constant.

Linear trends tend underestimate future costs when inflation is multiplicative, not additive, with the understatement becoming greater as the inflation rate rises or the projection period lengthens. In the example above, with a 1992 average cost and a 10% expected trend compounded annually, the assumed future costs should be $2,200 in 1993, $2,420 in 1994, $2,662 in 1995, and so forth. The corresponding regression is

$$y = be^{ax}$$

where the parameter and variables have the same meaning.

In June 1990, the NCCI converted to an exponential trend function, as is used in other liability lines of business. To fit the exponential model, the exponential equation can be transformed into a linear equation by taking natural logarithms (McClenahan [1990], page 51):

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[39] For instance, Howard Mahler has pointed out to me that the Workers' Compensation Rating Bureau of Massachusetts uses Massachusetts specific wage data, a CPI medical care index for Boston and a market basket index for the Northeast U.S.A. See also DRI [1991]: "The Workers' Compensation Insurance Rating Bureau of California has asked the Cost Information Service of DRI/McGraw-Hill to develop and forecast an input price (market basket) index that measures escalation in operating costs of California hospitals. The hospital escalation projection will be used by the Bureau's Actuarial Committee in developing premiums for workers' compensation insurance" (Exhibit 2, Sheet 4), and "Over the period 1985 to 1990, the escalation rate of the California index was higher than that of the national index in every year other than 1988, reflecting the relative relationship of the corresponding wage proxies" (Exhibit 2, Sheet 3).

$$ln\ (y) = ax + ln\ (b)$$

Methods for solving these equations are reviewed in Wheelwright and Makridakris [1989], pages 163-170, or DeGroot [1975], p. 501. See the appendix for a complete illustration.]

Econometric Indices

Workers' Compensation benefit trends are partially dependent on monetary inflation: indemnity benefits are linked to wage levels, and medical benefits are linked to medical inflation. Economists provide projections of future inflation indices, and expected benefit trends may be derived from these (Masterson [1968]).

Such techniques are particularly important when macro-econometric changes affect expected inflation. For instance, Workers' Compensation benefit trends were over 15% per annum in the early 1980's, when monetary inflation was high. Some actuaries expect benefit trends to be lower in the early 1990's, since monetary inflation has decreased.

During the 1980's, benefit trends have exceeded monetary inflation, since "social inflation" and "cost shifting" affect Workers' Compensation benefits. A regression of benefit trends on inflation trends yields a positive constant factor. For instance, a regression of medical benefits on the medical CPI index may yield

$$Medical\ benefits = medical\ CPI + 5\%.$$

Thus, a medical CPI trend of 8% one year would imply an expected Workers' Compensation medical benefits trend of 13%.

The table below illustrates this procedure, using simulated Workers' Compensation medical data and the medical CPI inflation index.

Accident Year	Incurred Medical Benefits	Medical Claim Count	Average Severity	Medical Benefit Trend	Medical CPI Trend
1979	4,714	12,405	380		
1980	5,680	12,850	442	16.3%	11.0%
1981	6,782	13,067	519	17.5	10.7
1982	7,965	12,993	613	18.1	11.6
1983	8,793	12,420	708	15.5	8.6
1984	10,919	13,365	817	15.3	6.3
1985	12,745	13,544	941	15.2	6.3
1986	15,103	13,881	1,088	15.6	7.7
1987	18,044	14,493	1,245	14.5	6.6
1988	21,926	15,650	1,401	12.5	6.5
1989	25,389	16,008	1,586	13.2	7.6
1990	29,077	16,109	1,805	13.8	9.1

The data show a spread of about 4 to 7 points between the medical benefit trend and the medical CPI trend. For a 1991 medical CPI of 8 to 9% expected in 1990, the expected 1991 medical benefit trend is about 13.5%. The two exhibits following this section show the relationship between CPI indices and workers' compensation benefit trends in graphical form.

D. Loss Ratio Trends

The Workers' Compensation exposure base, payroll, is inflation sensitive. Average wage changes, though, have been about 5 to 10 points below average benefit trends in many jurisdictions. Instead of using separate trends for benefits and premiums, the workers' compensation rating bureaus generally use a loss ratio trend.

Policy year or accident year loss ratios are formed with premium at current rate levels and losses at current benefit levels. A consistent non-zero loss ratio trend indicates consistently different benefit and premium trends. The loss ratio trend may be applied to the developed experience period loss ratio to project expected loss ratios in the future policy period.

The observed loss ratio trends vary over time and by jurisdiction. They stem from numerous factors, as Michelbacher [1919], page 244, notes:

> Such a comparison [of loss ratios over time] measures collectively such factors as changes in wage level, amendments to the benefit schedules, greater liberality on the part of administrative claim bodies in interpreting workmen's compensation laws, a possible tendency on the part of claimants to malinger and to present fraudulent claims, the influence of immigration and emigration, variations in accident frequency and severity rates or in employment and unemployment, and, in fact, any and all influences acting upon the cost.

The pricing actuary should investigate the probable causes of the trend, since changes in the causes affect the expected future trend. For instance,

- If the primary cause is economic incentives of statutory amendments, then the enactment of a law change should be carefully examined for its potential influence on the benefit trend (see Section 10).

- If the primary cause is a "tendency to malinger and present fraudulent claims," then the organization of an insurance fraud unit may reduce the future trend rate.

- If the primary cause is "variations in unemployment," then macroeconomic developments will influence the future benefit trend (see Section 14).

For a complete illustration of loss ratio trends, see the exhibits in the appendix.

Credibility for Trend

Observed benefit trends in small states fluctuate widely from year to year. The NCCI loss ratio trend procedure considers the "goodness of fit" of the observed annual trends to an exponential curve. The "squared residual," or the square of the difference between the observation and the fitted point, measures the explanatory power of the regression. The smaller the sum of the squared residuals for all policy years, the greater is the credibility accorded to the statewide trend.[40]

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[40] Scheibl [1976], page 64, notes the earlier credibility procedure: "Subsequent to the presentation of Mr. Kallop's paper, the National Council introduced loss ratio trend into its ratemaking procedure to recognize the imbalance of social and economic inflationary influences on premiums and losses. . . . Observed trends are adjusted for credibility using a Spearman Rank Correlation D-statistic approach." These credibility procedures are unusual. Milliman and Robertson recommend that the NCCI adopt a "Bayesian credibility [procedure] for weighting state and countrywide trend indications. . . . credibility should be based on a measure of volume, or possibly 'volume plus a

A variety of trend factors may be used for the complement of credibility. Originally, a trend factor of unity was used as the complement for the indemnity loss ratio trend, on the supposition that wage inflation should be about the same as indemnity benefit trends (NCCI [1985]). In October 1990, the NCCI began using the countrywide indemnity trend as the complement for the statewide trend. For medical benefits, the countrywide trend is used as the complement, though the trend figure depends on the type of medical fee schedule in the state under review. Using policy year 1985-1989 data, NCCI's countrywide trends were:

Indemnity:	+7.0%
Medical – Jurisdictions with effective fee schedules:	3.6
Jurisdictions without effective fee schedules:	12.5
Medical – All Jurisdictions:	10.4

E. Length of the Trend Period

The trend period extends from the average accident date in the experience period to the average accident date in the future policy period.[41]

- *Policy Year Experience:* A policy year considers accidents resulting from policies issued in a given time period. For instance, policy year 1992 covers accidents resulting from policies issued between January 1, 1992, and December 31, 1992. These policies are in force from 1/1/92 to 12/31/93, and the average accident date is 1/1/93, assuming a uniform distribution of policy writing during the year.

- *Accident Year Experience:* An accident year considers accidents occurring in a given time period, so the average accident date is the midpoint of that period (assuming no change in

constant,' instead of the current quality of the line fit." In 1992, the NCCI therefore recommended that the limited fluctuation standard for trend credibility be changed to a Bayesian standard based on loss volume. More advanced discussions of credibility procedures for trend may be found in Hachemeister [1975] and Venter [1986]

[41] Some actuaries divide this period into two components: (a) A trend period running from the midpoint of the experience period to the final date for which empirical data are available; and (b) a projection period from this final date to the average accident date in the future policy period.

exposures). Thus, the average accident date for accident year 1992 is 7/1/92.

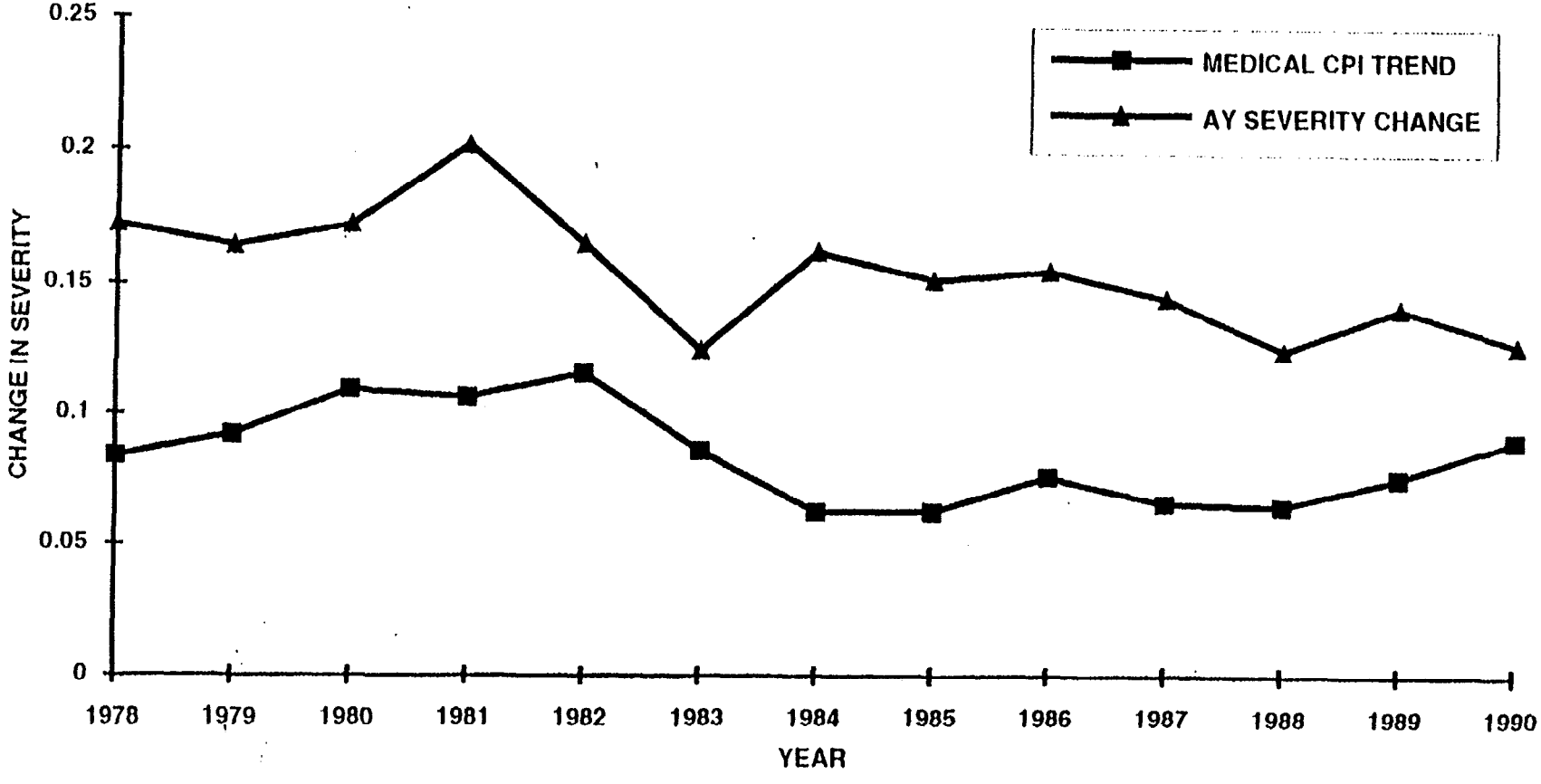
- *Calendar Year Experience:* Calendar year experience considers financial transactions occurring in a given time period. For losses, these consist of paid losses and changes in loss reserves. Since both paid losses and changes in loss reserves relate to accidents occurring the past, the average accident date for calendar year experience is often before the midpoint of the period. Since the true average accident date can not be easily quantified, the assumption of the midpoint of the calendar year is commonly used.

A rate review using experience from policy year 1989 and accident year 1990 to set rates for policy year 1992 has average accident dates of

- January 1, 1990, for policy year 1989.
- July 1, 1990, for accident year 1990.
- April 1, 1990, for the experience as a whole.
- January 1, 1993, for policy year 1992.

The length of the projection period is therefore 2.75 years: 4/1/90 to 1/1/93.

WC MEDICAL


MEDICAL CPI TREND
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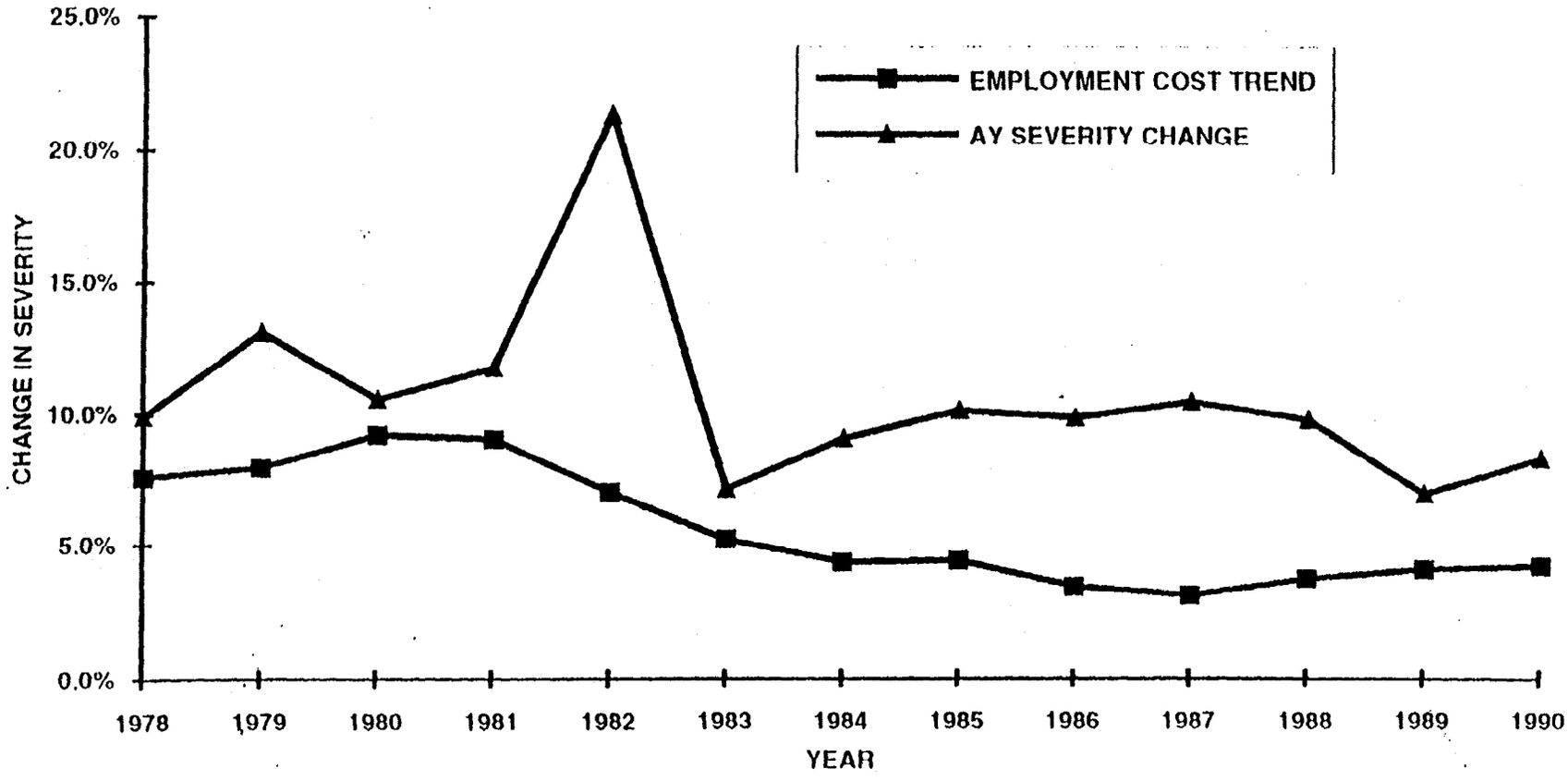

Section 9: Law Amendments – Direct Effects

Workers' Compensation benefits are set by statute, not by policy provisions. The benefits provided vary greatly by state and over time. When a state revises benefit levels, the compensation system, or administrative procedures, insurers must forecast the probable effects of the changes on loss costs and payment patterns.

Benefit revisions include changes in indemnity compensation as a percentage of pre-injury wage, in the duration of scheduled benefits, in the length of waiting periods and retroactive periods, in maximum and minimum weekly indemnity payments, in the use of cost of living adjustments (COLAs), and in the type, if any, of medical fee schedules. Changes in the compensation system include changes in the types of injuries and diseases covered, the medical practitioners reimbursed, and the overall comprehensive system changes (compare Florida's partial acceptance of twenty-four hour coverage). Changes in administrative procedures include changes in the provisions for managed medical care, attorney reimbursement, qualifications of judges who decide Workers' Compensation disputes, and adjudication of claims.

During the past two decades, average Workers' Compensation benefit levels have risen sharply, stimulated both by the 1972 recommendations of the National Commission on State Workmen's Compensation Laws and by social concerns for injured workers. Actuaries incorporate these "law amendments" in rate filings, by estimating the effect of statutory revisions on anticipated indemnity payments.

Law amendments have both direct and indirect effects. The direct effects are those resulting from the revised benefit provisions, assuming no change in underlying claim frequency, durations of disability, or other measures of system utilization. [Note carefully the distinction: a direct effect of a statutory amendmeant many change the duration of compensation for a disability, not the observed duration of the disability itself.] Fratello [1955] shows how to estimate these effects from wage distributions, injury type distributions, loss frequency and severity distributions, and statutory benefit changes. His procedures are explained in this section. The following section deals with the indirect (incentive) effects of law amendments.

The direct effects discussed below are

- Changes in the replacement rate.
- Changes in the duration of benefits for permanent disabilities.
- Changes in the length of the waiting period.
- Changes in the maximum and minimum benefit limitations.
- Changes in the payment base (gross earnings versus net take-home pay).
- Changes in cost of living adjustments.
- Movement to a wage loss compensation system.

A. Quantifying the Effects

Several methods may be used to price law amendments.

- The historical experience may be restated to reflect the new benefit levels. For instance, a permanent partial claim that occurred during the experience period may have paid losses plus case reserves of $120,000. The pricing actuary would consider the type of injury and the revised benefit provisions (e.g., compensation rate, duration of indemnity payments) to determine the cost under the new law.

  Repricing all claims after every law amendment is an arduous undertaking. Except for certain infrequent but severe claims, such as fatal accidents, this procedure is impractical. The following adjustments simplify the analysis.

- Average parameters may be determined for each injury type. For instance, the average age of a permanently disabled worker may be 45 years, with an average life expectancy of another 30 years. The percentage effect of the new benefit provisions by type of injury on average workers is applied to all claims of that injury type.

  Kallop [1975], page 75, summarizes this procedure:

  > "Whenever benefits change, say the maximum benefits increase, the effect of the law change is determined for each type of injury. This is accomplished by developing monetary costs under the old law, and under the new law, based on (1) the old and new benefit provisions using an accident distribution table in the case of permanent partial

cases, (2) a dependency distribution table for fatal cases, (3) a disability table in the case of temporary total cases and (4) a standard wage distribution table to measure the effect of the maximum and minimum weekly limitations in computing the average weekly benefit for each type of injury.

This is the procedure used by the NCCI and some other bureaus.

- A simulated group of representative claims is examined under the old and new benefit provisions. Instead of one 45 year old permanently disabled worker, the simulation group may have 3,000 claims, with disabled workers of various ages and life expectancies. The Massachusetts Workers' Compensation Rating and Inspection Bureau uses this approach.

The text below describes the types of benefit changes commonly encountered, and it explains several quantification methods.

B. Replacement Rates

Workers' Compensation reimburses the injured employee for a certain percentage of his or her pre-injury wage, such as two thirds of gross earnings, or 80% of net (after-tax) pay. If the payment base is not revised, then the effect of a change in the replacement rate is easily quantified. For instance, a change from 65% to 70% of gross earnings has a direct effect of +7.7% [= 70% ÷ 65%], ignoring the effects of maximum and minimum benefit limits.

C. Duration of Benefits

In many jurisdictions, indemnity benefits for permanent disabilities are limited in duration. For instance, the statute may limit compensation for permanent total disability to 10 years, compensation for loss of an arm to 400 weeks, or compensation for dependent children of a fatally injured worker until attainment of age 21.

A statutory change in the limit affects the expected benefit costs, depending on the distribution of injuries by age of the injured worker, the distribution of the number of dependents, and the discount rate used to value the benefits. For instance, the effect of a change from a 10 year to a lifetime limit on compensation for permanent total disability depends on

- the frequency of total permanent disability among all indemnity claims,
- the average age of the injured employee, or the distribution of ages of injured employees, and
- the discount rates (both mortality and interest) used to value the benefit.

If benefits are paid to dependents upon the death of the injured worker, the number and ages of dependents must also be considered. Actual benefit analyses are complex, with separate exhibits for each dependency group.

D. Waiting Periods

Workers' Compensation indemnity benefits have no dollar deductibles paid by the injured worker, but they have "waiting periods," or initial days of disability for which no compensation is paid. For example, no indemnity payments may be made for the first three days of disability. For a disability extending five days, the income lost during the last two days only is reimbursed.

Many states also have retroactive periods: if the disability extends beyond the retroactive period, then compensation is paid even for income lost during the waiting period. For instance, if the retroactive period is 14 days, and the disability lasts 30 days, then indemnity benefits are paid for all 30 days.[42]

Changes in the waiting period or retroactive period may be priced with a disability table (also termed "duration table" or "table of durations"). Disability tables, used extensively in premium determination for health insurance, show the distribution of disabilities by duration (e.g., 6% last one day, 4% last 2 days, etc.). The waiting and retroactive periods under the old and revised laws are applied to the disability table to determine the effect of the revision on benefit costs.

The incentive effects of changes in the waiting period or retroactive period are strong. The

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[42] In addition, some jurisdictions waive the waiting period for certain cases, such as those involving hospitalization.

pattern of disability by duration depends on the replacement rate and the waiting period. If the waiting period is 7 days, one may find that 6% of disabilities last one day, 4% last two days, 3% last three days, and 87% last four or more days. But if the waiting period is revised to 3 days, workers with minor injuries have an incentive to lengthen their durations of disability, since they will receive compensation for disabilities lasting more than three days. The distribution of disabilities may change to 4% lasting one day, 3% lasting two days, 2% lasting three days, and 91% lasting four or more days.[43]

E. Maximum and Minimum Limitations

Indemnity benefits in most jurisdictions are constrained by minimum and maximum limitations. For instance, the compensation may be 66.7% of the pre-injury gross wage, subject to a minimum of $100 a week and a maximum of 100% of the state average weekly wage. Thus, the statutory compensation rate is 66.7%, but the average effective compensation rate may be different.

A change in the limitations changes the expected indemnity costs. The required rate revision depends on the ratio of the average benefit before and after the change in the limitations.

The traditional analysis uses a wage distribution of all injured employees. The exhibit below shows cumulative percentages of workers and of wages at various wage levels. [This illustration is heuristic only; the figures do not correspond to actual wage distributions.[44]]

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[43] See Kidwell, *et al.* [1985A; 1985B] for complete discussions of the new SOA disability tables and the potential incentive effects.

[44] I am indebted to Howard Mahler for the example and much of the text in this section.

	Ratio to Average Wage	Cum Percent of Workers	Cum Percent of Wages
	0.50%	8%	3%
(Minimum benefit limit)	0.75	32	18
	1.00	58	41
	1.25	77	62
(Maximum benefit limit)	1.50	88	78

In this example, the maximum benefit is equal to the state average weekly wage (SAWW), and the minimum benefit is equal to half the SAWW.[45] The compensation rate is two thirds of the worker's preinjury wage, subject to maximum and minimum limitations. The average benefit is computed as follows:

- Workers earning at least one and a half times the SAWW receive the maximum benefit. [Two thirds of 1.5 times the SAWW equals the SAWW.] These benefits, as a percentage of wages, are $^2/_3 \times 1.5 \times (100\% - 88\%) = 12\%$.

- Workers earning no more than three fourths of the SAWW receive the minium benefit.[46] [Two thirds of 0.75 times the SAWW equals half the SAWW.] These benefits, as a percentage of wages, are $^2/_3 \times ^3/_4 \times 32\% = 16\%$.

- Workers earning between three fourths of the SAWW and one and a half times the SAWW receive benefits equal to two thirds of their pre-injury wages. These benefits, as a percentage of wages, are $^2/_3 \times (78\% - 18\%) = 40\%$.

Adding up the three sets of workers gives average benefits equal to 68% of the state average

[45] At the maximum benefit limit, the compensation ratio (66.7%) times the ratio to the state average wage (150%) equals the state average wage.

[46] The common minimum benefit limit is the lower of the statutory limit and the actual pre-injury wage. For simplicity, we have assumed in this example an absolute minimum, which is paid even if it exceeds the pre-injury wage, as is true in some jurisdictions (cf. Pennsylvania [1991]; WCRI [1990]). Although the direct effects of this statutory difference are small, there are additional incentive effects on claim filing.

weekly wage. One computes the average benefit before and after the change in the maximum and minimum limitations. The direct effect of the change in limitations is the ratio of the average benefit after the statutory change to the average benefit before the change.

F. Payment Base

Sometimes the payment base is revised as well, such as a change from 66% of gross earnings to 80% of net take-home (after-tax) pay. Income tax rates are greater for higher paid employees, and indemnity benefits are constrained by maximum and minimum amounts. A wage distribution table and an income tax rate schedule are needed to quantify the direct effect. One must consider federal income taxes, Social Security taxes, state income taxes, and any other effects on "take home pay." [In each instance, assume a change from 66% of gross earnings to 80% of after-tax pay.]

- Within any tax rate band, the effect of the change is uniform across wage rates if the maximum and minimum limitations do not affect the reimbursement, either before or after the change. If the tax rate is 34% for annual incomes between $25,000 and $40,000, then after-tax pay is 66% of gross income. The direct effect of this change is a 20% reduction in benefits. [A change from 66% of gross income to 80% of after-tax income equals a change from 66% of gross income to (80%)(66%) of gross income, or a reduction of 20%.]

- Within any tax band, if the maximum or minimum limitation affects the reimbursement both before and after the change, there is no direct effect (unless the limitation is changed).

- If the maximum or minimum limitation affects the reimbursement either before or after the change, but not both, one may reformulate the problem as (i) a change in reimbursement plus (ii) a change in limitation. The effect of change in reimbursement is quantified by ignoring the limitations, and a second effect is quantified from the "change" in limitation.

  For example, with no limitations, the direct effect from the change in reimbursement in the example above is a 20% reduction. Some benefits that would have been constrained by the

maximum benefit before change may no longer be constrained. So reformulate the problem as (i) a change in replacement rates accompanied by a 20% reduction in the maximum benefit limit, plus (ii) a 25% increase in the maximum benefit limit.

G. Cost of Living Adjustments

Cost of living adjustments, or COLA's, also affect the effective reimbursement rate, particularly for permanent total disability and fatal claims. State compensation systems differ as to

- whether COLA's are used,
- how they are determined, and
- how frequently they are applied.

The effects of a COLA adjustment may be quantified either by revising the expected benefit payments or by changing the discount rate in the annuity calculation. For instance, suppose a disabled worker receives $400 a week as a lifetime annuity, and a law amendment change introduces an annual COLA adjustment equal to the rate of inflation. To price the benefit change, one may value an increasing annuity (see Jordan [1975] or Neill [1977]).

COLA adjustments have powerful incentive effects, in addition to the direct effects mentioned above. In an inflationary environment, unadjusted compensation benefits decline in real value, providing incentives to return to work. COLA adjustments stabilize the real value of the benefits, thereby reducing the return to work incentives. In general, COLA adjustments lengthen the durations of disability; see Section 11.

H. Wage Loss

Two jurisdictions, Florida and Louisiana, implemented "wage loss" compensation systems in the 1980's. The cost implications of a statutory change to wage loss compensation are complex. When benefits for permanent partial disabilities are scheduled, the injured worker may receive the statutory compensation level even if there is no actual earnings loss. Valuing this benefit requires accident distribution and wage distribution tables. In a wage loss system, the benefits

depend on the difference between pre-injury and post-injury wages. Valuing this benefit requires estimates of the expected wage loss for each type of injury.

Wage loss compensation systems also have incentive effects. When permanent partial benefits are scheduled, disabled workers may refrain from excessive medical treatment. Under wage loss systems, continuing medical care may support the contention of disability. One may expect higher medical costs if indemnity benefits are converted to a wage loss system.

The incentive effects are difficult to quantify, and other factors may magnify or reduce them. For instance, Florida did not show high medical benefit trends in the early 1980's, despite the implementation of wage loss (Boden and Fleischman [1989]). [See the following section for a complete discussion of the incentive effects of law amendments.]

Sections 10: Law Amendments – Incentive Effects

> *"Enough experience has now developed so that we know with reasonable exactness what change in cost an amendment to the workmen's compensation law will carry with it. If the waiting period is reduced or the percentage of wages, which is the basis of compensation payments, is increased or any one of numerous changes in benefits is made, we can foretell almost with certainty just what the result will be when measured in terms of cost."*
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> – Michelbacher [1919], page 245.

Actual loss costs have generally climbed more quickly after law amendments than the traditional projections predicted, since strong but indirect economic incentives are generated by legislative enactments. In particular, statutory revisions affect the following:

1. *Claim Filing:* Greater benefits and easier access to compensation stimulate more reports.

2. *Durations of Disability:* Higher benefit levels and the removal or weakening of time limits on indemnity payments cause durations of disability to lengthen.

3. *Mix of Claims:* Changes in reimbursement levels by type of injury affect the expected mix of claims, particularly for temporary total and permanent partial disabilities.

4. *Non-Compensation Medical Benefits:* Changes in the deductible and coinsurance provisions in governmental or group health plans cause "claim shifting" to the workers' compensation system and thereby affect the claim frequency of occupational injuries and diseases.

5. *Attorney Involvement:* Changes in administrative procedures may influence attorney involvement in compensation claims, which in turn affects claim frequency and severity.

6. *Compensable Injuries and Diseases:* Changes in the definition of occupational injury and disease affect the types of claims reported.

Direct effects are usually evident more quickly than indirect effects. The indirect effects are

often hard to disentangle from loss trends, but separating indirect economic incentives from loss trends is essential for competitive pricing. For instance, suppose a statutory amendment or court decision defines certain "stress" claims as compensable. The incentive effects are gradual. As workers and attorneys learn what types of stress claims may be pressed, and as they see other workers receiving benefits for stress claims, there will be a steady rise in claim frequency. Insurers who can predict these effects can more accurately price their products.

If the indirect effects of law amendments are not properly priced, the increase in stress claims will appear as a loss ratio trend or as a loss cost trend. This may mislead the pricing actuary, for two reasons:

- The rate of increase in stress claims will be greatest soon after the law amendment and will taper off to zero after several years.

- The rate of increase in stress claims will vary by classification, depending on the types of stress claims deemed compensable.

A. Claim Frequency

The indirect economic effects of law amendments on claim frequency and durations of disability should be quantified by econometric analyses, not merely by *a priori* intuition. Butler and Worrall [1983], for instance, consider the effects of benefit levels on claim frequency for temporary total, major permanent partial, and minor permanent partial injuries. Using data from 38 states and 6 years, they regress injury rates on wage levels, benefit levels, and several demographic and policy variables, such as the proportion of newly hired workers, the percent of the work force which is unionized, and the statutory waiting period. Wage and benefit levels have significant effects: "injury claims increase as wages fall and as benefits increase." They arrive at 40% as a "conservative estimate of the overall elasticity." In other words, a 10% increase in benefit levels directly increases loss costs by 10% and indirectly increases costs by causing a 4% rise in claim frequency. Similarly, Butler and Appel [1983] find that both wage and benefit levels affect claim frequency: injury claims increase as wages fall and as benefits increase.

Gardner [1989], page xiii, summarizes previous studies as "A 20 percent [temporary total disability] benefit increase is estimated to have a 7 percent increase on [the number of] temporary disability claims." The NCCI [1991], in an admitted understatement, uses a 1% overall indirect effect of statutory amendments. Other rating bureaus sometimes avoid quantifying the indirect effects explicitly and include them, by default, in the loss ratio trend (see below). Much additional research is needed to refine the quantification of incentive effects.

A New York Example

In 1990, New York increased the maximum benefit for temporary partial disabilities from $150 a week to $340 a week. The direct effect of this change was only a slight increase (1.6%) in temporary partial benefits.

A more complete analysis must consider several aspects of the pre-1990 New York benefits:

- Temporary partial claims were infrequent, accounting for a small percentage of benefits.[47]

- The average weekly indemnity payment on temporary partial claims was $77.04, well below the maximum of $150. For temporary total claims, the average weekly benefit was $266.03, close to the pre-1990 maximum of $300.00.

  Two factors contribute to this disparity. First, temporary partial benefits are two thirds of the *difference* between pre-injury and post-injury wages, whereas temporary total benefits are two thirds of pre-injury wages. Second, the low maximum for temporary partial benefits induced high wage workers to avoid these claims and return to work full time.

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[47] As John Gardner has pointed out to me, one must differentiate between claim type and benefit type. In New York, temporary partial claims accounted for 1% of benefits. However, this means that 1% of benefits were paid for claims that remained temporary partial at closure (Gardner calls this "claim type"). Many claims begin as temporary partial but develop into permanent partial or total disabilities, so more than 1% of benefits are paid as temporary partial benefits (Gardner calls this "benefit type"). Rating bureaus code data by claim type, but the effects of law amendments depend on benefit type. The scarcity of data by benefit type hampers accurate quantification of the incentive effects of benefit changes.

Both factors are important. The increase in the maximum benefit does not affect the first factor. But it removes the disincentive for filing temporary partial claims, so it may increase claim frequency. Moreover, since temporary partial claims often develop into permanent partial claims, claim frequency for all partial claims may increase.

The effect of benefit levels on claim frequency depends on the subjectivity of the injury: permanent total disability claims are least affected by benefit provisions and temporary disability claims are most affected (Butler and Worrall [1983]). In other words, if a workers sustains a severe injury and becomes a quadraplegic, he or she will file a compensation claim regardless of the benefit level. But if the injury causes a mild back sprain, the worker must decide whether the benefits of filing a compensation claim outweigh the loss of income. There are no hard rules for estimating these incentive effects, since they depend on various aspects of the benefit system. Given the low pre-1990 frequency of temporary partial claims in New York, the pricing actuary might estimate that the frequency will increase substantially. The incentive effects occur gradually, so even *post hoc* tests of these presumptions are difficult.[48]

Benefit Levels and Claim Frequency

There are several explanations for the relationship between benefit levels and claim frequency, each of which demands a different response from the pricing actuary. As benefits are increased, workers may have more incentive to file claims, less incentive to be careful on the job, or more incentive to bear additional risk on the job. Economic research on "compensating differentials" pertains to the last of these three.[49] As benefit levels increase, workers chose riskier occupations, since the economic loss from industrial accidents diminishes. Although there is

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[48] The Workers' Compensation Research Institute in Cambridge, Massachusetts, is presently examining the expected incentive effects of the New York benefit change. Both the lack of good data and the past incentive effects of the New York benefit system complicate this task. For instance, New York has shown almost no loss ratio trend during the 1980's, despite the strong trends in most other jurisdictions. Some pricing actuaries presume that the low historical benefits in New York were a steadily increasing disincentive to file compensation claims or to stay on disability. Distentagling the incentive effects of benefit changes from other forces affecting loss ratio trends is difficult; see below in the text.

[49] "Compensation differentials" are the additional wages paid to induce employees to work at riskier or less desirable jobs; see Dorsey [1983] or Worrall and Appel [1988].

some evidence for this effect, the influence on overall workers' compensation costs is probably minor.

Higher benefit levels may cause employees to be less careful on the job. However, employers have more control over workplace hazards. Higher benefit levels induce large employers, whose policies are experience rated or retrospectively rated, to emphasize safety controls and loss prevention activities.[50] The employer incentives probably override the employee incentives regarding job safety. For instance, OSHA finds a continuing decline in workplace fatalities and severely disabling injuries over the past decade, though this stems from both employer safety incentives and the transition from a manufacturing to a service economy.

For claim filing, however, employee incentives generally override the employer and macroeconomic effects. Moreover, increased filing of minor claims may increase the number of major claims as well. For instance, reductions in the waiting period may stimulate numerous temporary total claims for short durations of disability. Some of these temporary total claims then develop into permanent partial claims, as accident victims become accustomed to the compensation benefits.[51]

B. Durations of Disability

Economists have also examined the effects of benefit levels on the duration of disability. Economists often apply a "reservation wage" model derived from unemployment studies to the analysis of Workers' Compensation durations of disability. The reservation wage is the amount

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[50] Gardner [1989], page 79, summarizes several studies: "Chelius and Smith (1983) found no significant effect from less-than-full experience rating on injury rates. But Butler and Worrall (1988) found that, in larger firms, which are likely to have a higher degree of experience rating than are smaller firms, indemnity costs differ less in response to benefit differences than they do in smaller firms. Their data were observations at the establishment level in eleven risk classes in thirty-eight states for 1980 and 1981. Ruser (1985) analyzed BLS [Bureau of Labor Statistics] time-series data for twenty-four manufacturing industries in forty-one states from 1972 through 1979: He found the response of injury rates to benefit changes to be four times higher in small firms than in large firms. Similarly, with data in one state – South Carolina – over the long period from 1940 through 1971, Worrall and Butler (1988) also found that industries with relatively more employees per firm had smaller changes in injury rates when benefits increased than did industries with fewer employees per firm." See also Harrington [1988] and Chelius [1974; 1982; 1983]).

[51] Workers' Compensation has a wide variation in claim severity, with many small claims for each severe claim. A shift of even a small percentage of minor claims to a more severe category may have a large effect on total costs.

required to induce an individual to accept an employment offer. For injured workers, the benefit level is similar to the reservation wage: as benefit levels increase, injured workers are less likely to return to work (Butler and Worrall [1985], page 718; Dionne and St-Michel [1991], page 41).[52]

Several phenomena hinder the quantification of duration effects.

- Many claims are "censored from above" in that the disability has not yet ended.
- The future duration of a claim may be dependent on the past duration: that is, the longer a worker has been receiving disability benefits, the less likely he is to return to work.[53]
- The effect of benefit levels on the duration of disability varies by type of injury: it is strongest when the disability is hard to monitor, as in temporary total low back claims, and it is weakest for more severe claims.

The incentive effect of benefit levels on the duration of disability is strong. The estimated amount varies with the type of injury and the assumed dependence of future duration on past duration. A 10% rise in benefit levels appears to raise durations of disability by at least 2% (Butler and Worrall [1985], page 722; Gardner [1989], pages xiii, xv). For *temporary total low back claims*, if one assumes that the longer a worker is on disability, the less he or she

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[52] More accurately, the reservation wage depends on all alternative opportunities the worker has. Compensation benefits are one such opportunity. When the benefit levels change, the opportunity set changes, so the reservation wage *may* change. I am indebted to John Gardner for this clarification.

[53] Cf. Butler and Worrall [1985], pages 720-721: "This is a case of duration dependence – as the length of time on a claim increases, the instantaneous rate at which one changes from disability to nondisability status will decrease and expected duration will increase. Simply put, the longer one is on a claim the less likely one is to leave it to return to the work force when duration dependence is present. . . . Perhaps the length of a claim makes it increasingly difficult to return to work because of depreciation in market-oriented human capital." Quantifying duration dependence is difficult in non-homogeneous samples: "Unfortunately, in the presence of unobserved heterogeneity across claimants duration dependence may appear to characterize the sample data even if it does not exist for any of the individual observations. . . . Even if the transition rate out of Workers' Compensation is fixed to each individual, because the impact of the unobservable differences sort out higher hazard individuals first, there will appear to be some duration dependence" (page 721). True duration dependence is a behavioral phenomenon: the disability experience changes the individual's incentive to return to work. Apparent duration dependence is a statistical phenomenon. Suppose two workers file compensation claims; they have equivalent injuries, but other factors cause different return to work incentives. [For instance, a workers with a large family and little savings may have a greater need for full wages.] The disability experience may not change the return to work incentives of any individual worker, but it will appear that workers who remain on disability longer have less incentive to return to work. Separating the behavioral and statistical phenomena in heterogeneous Workers Compensation samples is difficult.

desires to resume regular employment, a 10% rise in the benefit level may induce as much as a 9% increase in the length of disability (Butler and Worrall [1985]). (If one includes a 4% rise in claim frequency for the reasons discussed above, the total loss cost increase is 25% [1.10 x 1.09 x 1.04 – 1.00 = +25%].)[54] This phenomenon, however, is weaker for other types of injury, and other economists dispute its overall strength. The "duration elasticity" for all Workers' Compensation claims combined is probably between 10% and 40%.[55]

The incentive effects vary with the compensation system. In states with wage loss benefits for permanent disability claims, such as Florida, the award depends on the post-injury wages earned by the employee, thereby increasing incentives to stay out of work (Gardner [1989], pages xvi-xvii, 2; Brainerd [1987]). In addition, when benefit increases vary by type of injury, the mix of claims will shift towards those injury types whose benefits increase most.

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[54] Similarly, Gardner [1989], page xv, says: "The literature suggests that a 20 percent increase in temporary total benefits (replacement rates) to all benefit recipients would increase aggregate payments by *at least* 30 percent. This reflects the direct effect of 20 percent and an average of at least 10 percent in additional utilization. Duration would increase by at least 4 percent, while claim-filing rates would rise by about 6 percent." In a recent study of the statutory increase in the maximum weekly indemnity benefit in Connecticut from 100% to 150% of the average weekly wage, Gardner [1991] found that the indirect effects were as great as the direct effects, suggesting that the previous estimates may have been understated.

Gardner [1989], page 40, also summarizes a study by Dionne and St.-Michel [1991A; 1991B] that differentiates "between cases that are relatively easy to diagnose, in which no moral hazard component emerges, and those that are difficult to diagnose (back and spinal disorders). . . They find durations of disability to be an average of approximately 10 percent longer overall among claimants who are treated more favorably by the plan. Those claimants with difficult-to-diagnose injuries who are favorably treated under the disability plan have durations of disability about 30 percent longer than those with similar injuries who are treated less favorably; those with easily diagnosed injuries show no difference in duration from more favorable treatment under the plan."

[55] Butler and Worrall [1988] tested the wage reservation model for the distribution of Workers' Compensation loss costs with curve fitting techniques. Indemnity costs are the product of three variables:

- the probability of filing a successful claim,
- the duration of disability, and
- the benefit level.

A pure chance generation of costs, with no effect of benefit levels on claim frequency or disability durations, would suggest a lognormal distribution of losses, whereas a reservation wage model would suggest a Weibull distribution of losses. The consistency of the reservation wage model with the observed distribution of losses is a check on the reasonableness of the economic incentives phenomenon.

Long-Term Disability Studies

Life and health actuaries have analyzed the effects of benefit provisions and economic conditions on long-term disability (Kidwell *et al.* [1985a; 1985b]). For instance, long-term disability termination rates dropped in the late 1970's, in response to worsening unemployment, and they rose in the early 1980's, as the economy prospered. Similarly, more generous provisions in employer provided group health insurance plans cause lower termination rates from disability.

Long-term disability benefits vary widely among health insurance companies as well as among policyholders of a given carrer, so the effects of benefit levels on the duration of disability can be discerned. The effects of policy provisions are more difficult to quantify in Workers' Compensation, since benefits are mandated by state statute. Casualty actuaries can use the health insurance results as an aid in predicting the probable effects of statutory revisions in Workers' Compensation.

C. Claimant Characteristics

The indirect effects on claim reporting and durations of disability vary by claimant characteristics (Borba [1989]). Three groups of accident victims show the largest effects:

1. *Non-Primary Wage Earners:* If benefit levels during disability are lower than the pre-injury wage, primary wage earners often feel compelled to return to work. Secondary wage earners, such as spouses of the primary wage earner, show a greater response to economic incentives.[56]

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[56] Much of this research is from analysis of unemployment insurance. These studies were done when most women were secondary wage earners, so they may have limited applicability to present day conditions. Gardner [1989], pages xiii-xiv, notes: "A wide variety of studies document the greater labor market responses of women, especially married women, to economic incentives. An early study found that a 20 percent increase in wages would produce a 40 percent increase in work activity among women but only a 7 percent increase among men. Later studies indicate that the decisions of married women are the most sensitive, and their responsiveness grows with the size of their husband's earnings. The responsiveness of single men exceeds that of married men." and page 56: ". . . married claimants have greater durations of disability payments. Their findings may suggest a greater willingness to file lost-time claims when there is another (actual or potential) income earned in the family."

2. *Low-Income Employees:* Lower income employees are affected by changes in maximum disability benefit levels more than higher income employees are. Moreover, they have less assets and are more dependent on current income. Benefit level changes have the greatest indirect economic effects on lower wage earners.[57]

3. *Older Employees:* Benefit level increases may induce some older employees to use Workers' Compensation payments as "early retirement," for two reasons. First, older employees, with lower expenses, may be satisfied with disability benefits. Second, younger employees often desire regular employment, with its opportunities for promotions and advancement. Older employees, with little chance of additional work advancement, may be more content with disability payments (Gardner [1989], pages 60, 62).

Thus, the indirect effects of benefit level changes vary not only by type of injury but also by type of industry, based on the distribution of workers by age, income level, and primary versus secondary wage earners. The effects are strongest on low paying work with older employees or employees who are secondary wage earners. The effects are weakest on high paying work with young, upwardly mobile, primary wage earners.

D. Non-Compensation Medical Benefits

Changes in non-compensation medical benefits in both public and private plans affect Workers' Compensation loss costs. For instance, a state may require that employer provided group health plans include a Health Maintenance Organization (HMO) option. Physicians employed by HMO's have an economic incentive to label injuries and diseases as "work-related." HMO physicians receive no benefit from non-occupational injuries, since they are compensated by salary for such cases. By deeming the injury or disease to be work related, they may bill the Workers' Compensation carrier directly (see Section 15).

Most group health plans have deductibles and coinsurance payments incurred by the employee. These create economic incentives for employees to consider their injuries or diseases as "work-

[57] So Gardner [1989], page 58; but contrast Gardner [1991], where a benefit changein Connecticut affecting only the highest 10% of wage earners had a large incentive effect.

related," since Workers' Compensation is a first dollar coverage with no employee contribution.[58]

Health actuaries, academics, and insurance research organizations have analyzed the effects of policy provisions and administrative procedures on containing medical care costs. Medical fee schedules and peer review are being used or considered in various states for Workers' Compensation.[59] The pricing actuary must quantify the likely effects of such enactments on Workers' Compensation loss costs.

E. Attorney Involvement

Workers' Compensation is intended to be a "no-fault" compensation system with little litigation or claim controversion. Attorney representation of Workers' Compensation claims has risen sharply in several states, with concomitant lengthening of disability durations and greater claim severities.

The AIRAC studies on Personal Automobile insurance suggest that attorneys cause greater "economic damages," by encouraging accident victims to stay out of work and to incur large medical bills (AIRAC [1988; 1989], IRC [1990]). Similarly, Gardner [1989], page 2, finds that "incentives to remain away from work are even stronger when attorneys are negotiating [Workers' Compensation] settlements." Butler and Worrall [1985], page 719, using a multiple regression analysis, conclude that "when a lawyer represents a claimant the length of stay on Workers' Compensation will tend to increase . . . "[60]

Many states specify the reimbursement for plaintiffs' attorneys in Workers' Compensation

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[58] See Borba and Eisenberg-Haber [1988]. Adoption of "twenty-four" hour coverage, with similar medical benefits for occupational and non-occupational injuries and diseases, may shift some Workers' Compensation costs back to group health plans (Bateman [1991]; Bateman and Veldman [1991]).

[59] Whether a state has a strong medical fee schedule affects NCCI's medical loss ratio trend; see Section 8.

[60] This effect is greatest when the insurance compensation is assured, such as in Personal Injury Protection or Workers' Compensation. Under tort liability systems, claimants may be loath to incur large medical bills or income losses, since they may never be reimbursed.

cases. In Massachusetts, for instance, most plaintiffs' attorneys' fees are paid by insurers according to a set fee schedule. The 1991 Texas reform, which restricted payments for plaintiffs' attorneys, may reduce claim filings and claim severity (Gallagher [1990]).[61] Pricing actuaries must estimate the effects of legislation affecting attorney involvement in insurance claims, to determine whether Workers' Compensation in particular states will be profitable.

F. Compensable Injuries and Diseases

The states vary in the statutory compensability of (i) latent diseases, (ii) diseases that are only partially work related, and (iii) stress claims. In California, for instance, stress claims are often deemed compensable and are becoming increasingly frequent (see Parry [1988], Barge [1988], Staten and Umbeck [1983], Victor [1988], Marcus [1988]).

Occupational disease claims and injuries treated by psychiatrists and psychologists have higher average severities than "traumatic" injuries (Marks [1984], Durbin [1987]). Statutory amendments that allow compensability of latent diseases and stress claims may have a great effect on overall loss costs.

Plaintiff attorneys often seek tort liability compensation for latent diseases, such as asbestosis (Millus [1987]). Whereas workers' compensation reimbursement generally requires physical disability and actual medical bills, court awards under General Liability coverage may be granted for a increased "likelihood" of future disability or medical problems. Also, class action suits are more common in General Liability cases. Statutory changes that affect recoveries under tort liability will indirectly affect claim filings under Workers' Compensation.

G. Loss Cost Trends

Workers' Compensation loss cost trends and loss ratio trends are influenced by statutory amendments. Present rate making procedures adjust historical loss experience for the direct

[61] The Texas reform was declared unconstitutional by a lower court(*Garcia*) in 1991. This decision was upheld by the appellate court in late 1993, and the case may proceed to the state Supreme Court.

effects of statutory revisions. The indirect effects appear as part of the loss ratio trend (see Section 8). If the historical indirect effects are included in trend factors, and indirect effects from current statutory revisions are estimated separately, one may double count these effects. If one ignores the indirect effects of current statutory revisions, one may underestimate the short term effects. If one adjusts historical statutory amendments for the indirect effects and removes the loss ratio trends, one may overlook other economic or social influences on loss costs.

The ideal is a complete analysis of direct and indirect effects of historical and current statutory revisions, along with a residual loss ratio trend. Such analyses, however, are often impractical. The pricing actuary should at least be consistent between the prospective "incentive" adjustments to current data and the loss cost trend adjustments to historical data.

H. A Caveat

The effects of benefit changes on claim frequency and severity depend on many factors, such as present benefit levels, type of injury, and the administration of the compensation system. The economists studying these effects are careful to qualify their projections, to note the types of injuries and claimant populations to which they apply. Gardner [1989] provides a list of dozens of studies on each topic with the varying results they produced. Fein [1991], pages 25-26, and Gallagher [1990] note the difficulty of predicting the effects of the Texas Senate Bill 1 (effective January 1, 1991). Flat, didactic statements about incentive effects are simply misleading.

> *"It is well documented that a 20% increase in benefits results in a 7% increase in claims and a 4% increase in duration of such claims."*
>
> – DeCarlo and Minkowitz [1991], page 445.

Section 11: Involuntary Market Burdens

Workers' Compensation risks unable to obtain coverage in the voluntary market are insured in involuntary pools, or "residual markets." The pools in most states run operating deficits, which are funded by private insurance carriers in proportion to direct written premium. The pools now constitute about 25% of countrywide business, so the "involuntary market burden" is large. Pricing actuaries generally consider the involuntary market burden as an expense element in setting voluntary market rates (NCCI [1991], pp. 38-39; Gustavson and Treischmann [1985]; Fein [1991], page 20).[62]

The involuntary market burden is the operating loss of the pools, not the underwriting loss (White [1988], page 46). One may quantify the burden by discounting cash flows for involuntary market business, by combining voluntary and involuntary market cash flows in an Internal Rate of Return model, or by calculating an investment income offset factor to be subtracted from the underwriting loss.

The actuary must also estimate the profit or loss from servicing involuntary market business (Littmann [1990]). For servicing carriers, the net effect of the involuntary market is the operating loss from pool business and the profit (or loss) from servicing involuntary risks.

The pricing actuary has several tasks with regard to the involuntary markets:

- *Profitability:* Understand the causes of pool size and pool deficit by jurisdiction, in order to estimate the expected profitability of Workers' Compensation business.

- *Pricing:* Calculate the residual market burden, which is used as an expense element in pricing voluntary risks.

- *Strategy:* Forecast the expected residual market burden for alternative Workers'

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62 In some jurisdictions, such as New York, risks that private insurers are unwilling to service can obtain coverage from a state fund, thereby obviating the need for an involuntary market.

Compensation programs, such as excess coverage or large dollar deductibles, in order to help determine company strategy for future business.

A. Profitability: Size of the Involuntary Markets

There are several explanations for large involuntary insurance markets. All contribute to the involuntary market problem, but each implies a different solution.

Rate Adequacy

Rate inadequacies cause the line of business to be unprofitable or only marginally profitable. In the late 1980's, for instance, as Workers' Compensation profitability declined, the involuntary markets grew rapidly. Statewide rate increases would reduce the involuntary market share.[63]

Competition

When involuntary market rates are competitive with voluntary market rates, an involuntary market risk may have little incentive to seek voluntary market coverage. Involuntary market surcharges would reduce the involuntary market share.[64]

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[63] So Freeman [1991], page 22: "Why have so many residual market run amok? According to most observers, rate inadequacy heads the list of reasons"; see also Eisenberg and Vieweg [1987]. (McNamara [1984], page 15, gives the same explanation for automobile assigned risk plans: "The root cause of the availability problem is unquestionably the belief of underwriters that the overall rate levels, or the rates for particular classes and/or territories, are inadequate.") Note, however, that Workers' Compensation insurers continued using rate deviations and policyholder dividends averaging over 10% of premium through the 1980's. Some analysts believe that higher manual rates might lead to increased deviations or dividends, not simply to reductions in the involuntary market share (though they would have an effect).

[64] Huber [1986], page 54, provides an illustration: "In Maine, the regulatory disallowance of the plan managements's authority to mandate a retrospective rating plan for an account representing $4.3 million in premium resulted in the plan's forced provision of a substantially more competitive price than the voluntary market would provide. The same situation prevailed in Tennessee." Hofmann [1992], page 9, notes that ". . . today's commercial insurance buyers know how to exploit bureau rates that are too low (by *voluntarily* purchasing coverage through assigned risk plans) . . ." Similarly, Mintel [1983] sees competitive involuntary market rates as a major cause of the growth of certain Personal Automobile assigned risk plans; see also Aetna [1978], page 89.

Mintel [1985] notes an even more insidious effect of residual markets that are organized as reinsurance pools instead of assigned risk mechanisms, as is true for Workers' Compensation in most jurisdictions. Residual market pooling "is anti-competitive because it fails to reward efficient insurers" (page 376). Insurers handling voluntary risks

The NCCI is attempting to mitigate this phenomenon, wherever state regulation permits:

> "[The residual market] does not, and should not, guarantee that such coverage will be at a price that is competitive or lower than in the voluntary market. To eliminate this possibility, NCCI has filed a plan change to recognize that an offer of any reasonable rating plan approved for use in a state would be considered an offer of voluntary coverage and failure to accept such an offer would exclude the risk from the residual market" (NCCI [1991A], page 38).

Hager [1991; see also 1992A; 1992B], pages 2-3, lists five NCCI programs that should reduce the competitiveness of the pools, thereby depopulating them. The anticipated effects of such programs affect the actuary's forecast of the involuntary market load.

- Higher deposit premium requirements for involuntary risks.
- Payroll verification plans to avoid willful understatement of payrolls.
- Elimination of premium discounts for involuntary risks.
- Premium rate differentials between the involuntary and voluntary markets, ranging up to 25%.
- Two loss sensitive experience rating plans designed for involuntary risks: the Assigned Risk Adjustment Program (ARAP) and the Assigned Risk Rating Program (ARRP), which more accurately reflect adverse historical experience.

Classification Refinement

Uniform risk classification schemes do not allow insurers to charge different manual rates to risks of different quality. Risks of poor quality that are not surcharged end up in involuntary markets. More accurate risk classification schemes would reduce the involuntary market share

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promote workplace safety programs and carefully examine suspicious claims, as long as the expected reduction in losses is greater than the expenses incurred. Servicing carriers for residual market pools have the opposite incentive, since they cede the loss costs to the entire industry but they retain the expense costs. Underwriting expense ratios and loss adjustment expense ratios are often lower for residual market risks than for voluntary risks, whereas the loss ratios are higher. As a result, it is hard for insureds to leave the pools once they have joined them. Regardless of the true hazards, they have lost much of the loss engineering services and claims handling services provided to voluntary market risks, so their loss ratios increase.

The NCCI is aware of these problems. The solutions being considered include (i) allowing direct assignment of risks, as is done in Personal Auto, instead of reinsurance pools and (ii) using "Dutch auctions" to determine servicing carriers. (A Dutch auction is a reserve auction: the lowest bidder wins the contract.] Such changes must be coordinated with state insurance departments, so implementation will be slow. The pricing actuary should be able to quantify the relative merits of direct assignments as well as the expected cost effects of pool depopulation, both of which depend on the incentive effects discussed above.

(Joskow [1973]; Brunner [1985]).

Classification inefficiency in competitive markets is often used to explain large automobile involuntary markets. [Massachusetts, for instance, does not allow classification by sex, limits classification by territory, and has an involuntary market facility that during the 1980's insured over half the Personal Auto risks.] This explanation is particularly appropriate for Workers' Compensation, which had a rapid spread of "open competition" in the late 1980's, but retains a one-dimensional classification scheme (see Section 14).

Insurance Expenses

Some underwriting and administrative expenses vary more with the number of policies than with premium. An expense loading proportional to written premium assigns too little expenses to small risks, and the expense constants in some states may be insufficient to cover these "per policy" costs. As a result, small risks are often unable to obtain coverage from voluntary carriers and end up in the residual market.[65] Larger expense loadings for small risks would reduce the involuntary market share (see also Section 12 on loss and expense cost differences between large and small risks).

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[65] Compare Chelius and Smith [1986], page 5: "If small businesses are not regarded as desirable clients, one can conclude that their possibly higher premiums per dollar of loss reflect higher overhead costs that are not fully recouped by insurance companies because of rigidities in the ratemaking process." They note that "small businesses are consistently and heavily over-represented in both assigned risk pools and competitive state funds. For example, the average premium paid in 1983 by those firms obtaining insurance from assigned risk pools was $1,812, while the average premium written by stock insurance companies in that same year was about $5,000" (pages 5-6). So also Huber [1986], page 52: "A review of the 20 most populous classes of the NCCI-managed reinsurance pools tells us that most accounts are small . . ." Compare also Freedman [1991], page 110: ". . . in workers comp . . . the carriers left in a particular market may have minimum premiums which are so excessive that smaller insureds are forced into the residual market." Klein [1986], page 105, referring to the Michigan Workers' Compensation involuntary market facility, notes that "the placement facility insures a higher percentage of policies than payroll. Also, the percentage of payroll insured in the facility has fluctuated more widely over time than has the percentage of policies. This implies that smaller employers have a greater probability of being in the facility and are more likely to stay there when it is being depopulated."

The NCCI contests these observations: "In 1990, NCCI performed studies which refuted some common misconceptions concerning the demographics of the residual market. Although small risks account for approximately 75 percent of the residual market, they account for approximately that same percentage of the voluntary market" (NCCI [1991A], page 37). So also White [1988], page 39: "The composition of the residual market by size of insured does not differ significantly from the voluntary market except on the very high end of accounts in the million dollar range." See also Fein [1990B], page 31.

B. Pricing: Calculating the Burden

Residual market assessments generally vary with voluntary market writings. [In several states, "take-out" credit programs modify the assessment base for risks recently taken out of the pool. When such programs are used significantly by carriers, the assessment base may differ from the direct voluntary written premiums.] Thus, the operating loss on involuntary market risks may be considered an expense for voluntary market risks. To calculate the "residual market burden," the pricing actuary determines the net loss after investment income for involuntary market risks and divides this amount by voluntary market premium.[66] There are several ways of doing this.

Investment Income Offset

The NCCI provides combined ratios by state for the involuntary market pools. An "investment income offset" is derived from Insurance Expense Exhibit data as Part II, column 18 ("Investment Gain on Funds Attributable to Insurance Transactions") divided by column 2 ("Net Premiums Earned") for row 16 ("Workers' Compensation"). Industry-wide figures for 1990 give $4,172 million ÷ $30,812 million, or 13.5% (Best's [1991A]).[67]

There are several problems with this calculation:

- Column 18 in Part II of the Insurance Expense Exhibit excludes investment income on capital funds, which is allocated entirely to column 20: "Investment Gain Attributable to Capital and Surplus." It is unclear how the column 20 figure should be distributed between voluntary and involuntary risks. (In the pre-1992 Insurance Expense Exhibit, investment gains on capital funds were attributed to the "Capital and Surplus Account" and were not allocated to lines of business. This was accomplished by allocating all stock dividends and all capital gains and losses to the capital and surplus account. In the 1992 Insurance Expense

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66 Published values of "residual market burdens" are often on a nominal (undiscounted) basis. The actuary calculating present values or economic costs must convert these values to a discounted basis.

67 This industry wide calculation uses the old Insurance Expense Exhibit, or Part II, line 11 ("Net Investment Income Gain or Loss") divided by line 2 ("Net Premiums Earned") for column 16 ("Workers' Compensation").

Exhibit, surplus is allocated to lines of business, and all investment gains are treated equally; see Feldblum [1993].) Conversely, insurance transactions must support the "double taxation" of investment income on shareholders' capital, implying that the pre-tax 13.5% figure is too high (see Myers and Cohn [1987]).

- The timing of premium and loss cash flows differs between the voluntary and involuntary markets. Involuntary risks are written by servicing carriers; other member companies are charged assessments. Involuntary premiums are collected earlier, since retrospective rating plans are not used and required premium deposits are often larger than in the voluntary market. The IEE investment income offset, which is based on net loss reserves and unearned premium reserves, reflects the cash flows of all business, most of which is voluntary.

- The IEE investment income offset is based on the investment income received in the current calendar year, not the investment income expected in the future for the current policy year. The offset is distorted by changes in business growth and market interest rates (Butsic [1990]; Bingham [1992]).

- The investment income offset differs by state, since benefit provisions and loss payment patterns differ by state (see Section 7 above).

Discounted Cash Flows

Premium collections and loss payments may be discounted to the policy inception date to determine the economic loss from involuntary market risks. The premium collection and loss payment patterns should be those of the given state's involuntary market.

This approach can be used by both servicing carriers and other member companies. The servicing carrier would consider premium, loss, and expense transactions with both the policyholder and the pool. Other insurers would consider only premium and loss transactions with the pool.

Pricing considerations include:

- *Data Availability:* Some insurers do not keep the necessary records of cash flows to and from the pools by policy year, though industry statistics are compiled by the NCCI.

- *Complexity:* If the insurer does not use financial pricing models for its voluntary risks, the modeling work required may be great.

- *Discount Rate:* The actuary may select a conservative, risk free rate (e.g., Treasury notes), or an expected new money investment rate (e.g., investment grade bonds). Since all other values in the rate review are on a pre-tax basis, a pre-tax discount rate should be used (see ASB No. 20 [1992]), §5.4.4).

Involuntary Load Illustration

There are no set procedures for calculation the involuntary market load; current methods differ by carrier and by jurisdiction.[68] The pricing actuary must estimate

- The operating loss of the pool during the future policy period, and
- The market share of the pool during the future policy period.

Historical loss ratios for involuntary business may be obtained from the bureau managing the pool. The operating loss is either

- The undiscounted loss ratio plus an expense ratio (servicing carrier allowance, producer fee, and administrative expenses) minus an investment income offset, or
- The discounted loss ratio plus an expense ratio.

For instance, the undiscounted loss ratio may be 110%, the expense ratio may be 30%, and the investment income offset may be 20%, for an operating loss of 20%.

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[68] For a complete illustration of calculating residual market burdens, see Mahler and Liu [1993].

The future market share of the pool may be estimated as the current market share adjusted for the anticipated effects of residual market programs. For instance, higher premium deposit amounts and the elimination of premium discounts may encourage more large risks to seek coverage in the voluntary market, thereby reducing the involuntary market burden.[69] Other developments also affect the anticipated market share of the pool. Factors that increase the share include

- risks leaving the voluntary market for self-insurance plans or excess coverage, and
- regulatory suppression of voluntary market rates, leading insurers to tighten underwriting restrictions.

For instance, the most recent market share of the pool may be 18%, a new involuntary market experience rating plan is expected to reduce this 2 points, and the exodus of risks from the voluntary market to self-insurance and excess coverage is expected to increase this 4 points, for a projected future involuntary market share of 20%.

The market share of the involuntary pool is converted into a ratio of involuntary to voluntary premium. For instance, a 20% involuntary market share is a 25% ratio of involuntary to voluntary premium [20% ÷ (1 − 20%) = 25%].

The involuntary market burden is the product of the pool operating loss and the ratio of involuntary premium to assessable voluntary premium.[70] Thus, a 20% operating loss times a

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[69] Fein [1990A], page 5, estimates that "the residual market programs have reduced the burden on the voluntary market by two percentage points." Some of these programs, such as rate differentials, reduce both the involuntary market share and the involuntary operating loss.

[70] Not all voluntary premium is included in the assessment base used to allocate the residual market costs. For instance, excess policies are not included in the assessment base in most jurisdictions. In addition, carriers taking direct assignments from the pools may not receive an assessment. Countrywide, the assessment base is about 96% of the voluntary market premium, though this varies by jurisdiction (see the 1992 NCCI memorandum ACT-92-4], Exhibit 10–2–I). The pricing actuary must also consider the effects of business growth or contraction, both for his or her company and for the pool, to estimate market shares and assessment bases for the future policy year.

25% ratio of involuntary to voluntary premium is a 5 point involuntary market burden.[71]

C. Strategy: Forecasting the Burden

Involuntary market burdens that are anticipated to be high may induce some insurers to leave the state, to restrict writings, or to develop alternative insurance programs. Much insurance for large risks at lower layers of coverage is "dollar trading": the insurer collects premium which it returns in loss payments. The insured, meanwhile, incurs servicing charges for the insurer's costs of issuing policies and handling claims.

Alternative Workers' Compensation programs

In a jurisdiction with a large involuntary market burden, this servicing charge rises, and full coverage programs may become uneconomical. To alleviate this problem, some insurers are developing alternative programs, such as excess coverage, administrative services only (or management assistance for a self-insurance program), and large dollar deductible policies. State regulations affect the types of programs offered in each jurisdiction.

As an example, suppose an insurer has a 3% market share in a jurisdiction with a 15% involuntary market burden. Its voluntary market operating ratio is 90%, but with the involuntary market burden, its net operating ratio is 105%.

A conversion to policies with large deductibles, with a two thirds reduction in written premium, may cause the following:

- Market share drops to 1%, since premium is only one third as large.[72]
- The insurer continues to handle all claims. The insured pays the benefit costs, and the

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[71] Actual loads vary greatly by state. The NCCI currently estimates a countrywide average of nearly 15% on a nominal (undiscounted) basis, though estimates by private carriers vary considerably. Jurisdictions with high involuntary market shares require large involuntary market loads, ranging from 25 to 50% or more. The full indicated load is not always permitted by state regulators.

[72] This illustration is heuristic only. In practice, such conversions take time and are often restricted to certain classes or size categories of risks.

insurer pays the loss adjustment costs. [Much of the premium in some large deductible plans is for claims handling expenses.]

- The insurer uses a larger percentage "profit and contingencies" provision to accommodate the variability in the higher layers of coverage. Although the percentage provision is higher, the dollar amount is lower, since the total premium is lower. Thus, the insured's premium plus the self-funded benefit costs are lower than the premium under the full coverage policy.
- The larger percentage profit provision causes the voluntary market operating ratio to drop to 80%. With the involuntary market burden, the net operating ratio is 95%.

In this example, the cost to the insured is lower, the claims operations remain essentially unchanged, and the insurer's profitability rises. Of course, if all carriers in the market follow this strategy, the residual market burden of each remains unchanged in dollar amounts. The operating loss of the pool is unaffected by the types of plans offered in the voluntary market, so the voluntary market must still cover the same total assessment. The pricing actuary must consider both the strategic plans of his or her own carrier as well as the aggregate actions of all peer companies in the marketplace.

In sum, the actuary's task in pricing alternative Workers' Compensation programs is complex. He or she must

- Forecast industry use of alternative programs.
- Develop pricing techniques for excess layers of coverage. Workers' Compensation does not use increased limits factors. Instead, the actuary may use excess loss factors from retrospective rating techniques (cf. Simon [1965]; Gillam [1991]).[73]
- Determine the appropriate profit provision for the greater variability in excess layers of coverage (cf. Miccolis [1977]).
- Quantify the anticipated effects of newly implemented involuntary market programs.

[73] The pricing actuary should review how the excess loss factors were derived. Depending on the application, one may want to include or exclude risk loads, loss adjustment expenses, and so forth.

Section 12: Large vs. Small Risks

> *". . . the small risk does not have the same incentive to provide for efficient and extensive accident prevention work, first, because such work requires an expenditure of money and second, because it does not reduce the cost of insurance. Furthermore, it must be borne in mind that many small employers do not keep accurate and adequate payroll records and, in certain industries, are tempted to conceal and do conceal considerable portions of the payrolls actually expended. . . . The problem of premium collection is also very acute in case of a small risk where frequent changes of the insurable interests, disappearance of the assured, reluctance to pay additional premium upon audit and other similar conditions, make it well nigh impossible to collect the full premiums due. On the other hand, the expenses of handling the records of the books of the company and of preparing reports to various boards, bureaus and supervisory authorities are percentage-wise considerably higher for those risks than for risks with substantial premium volume."*
>
> – Kormes [1936], page 46.

Small risks on average have higher loss ratios and higher expense ratios than large risks have. Expense constants, loss constants, premium discounts, and experience rating plans recognize these differences. This section discusses the reasons for these differences and some ratemaking techniques that adjust for them.

A. Expenses

Some underwriting expenses, such as setting up files, do not vary much by size of policy. The proportional expense loading used in Workers' Compensation ratemaking assumes that expenses are directly proportional to premium, thereby undercharging the small risk and overcharging the large risk. If no other expense component were incorporated in pricing, small risks would be unprofitable and may have difficulty obtaining coverage (Barber [1934]).

A flat "expense constant" is added to each risk's premium. The amount varies by jurisdiction and must be adjusted for inflation (Chelius and Smith [1986]). The NCCI is now using $140 in

most states, though the size of the expense charge depends on regulatory approval.[74]

Expense Constants and Expense Ratios

Certain ratemaking adjustments are applicable to the manual premium, not to the expense constant premium. For instance, the "on-level" procedure determines how much premium would have been collected had the policies been issued at the current rates. Rate revisions affect the manual rates, not necessarily the expense constant. The expense constant premium applicable in each year must therefore be removed at the beginning of the on-level procedure, and the current expense constant must be added at the end (cf. Kallop [1975]).

Premiums derived by extending exposures from Unit Statistical Plan data do not include expense constants. Premiums derived from financial data include the expense constants. In the past, when the expense constant differed by size of risk, removing the expense constant premium required a distribution of risks by size (cf. McConnell [1952], page 31; Marshall [1954]; Kallop [1975]). Now that the expense constant is uniform for all risks, removing the expense constant premium requires only a policy count.

Expense ratios derived from Insurance Expense Exhibit data include expense constants. To avoid double counting, the pricing actuary must remove the expense constant premium from the expense loading. For instance, suppose the insurer's book of business shows

net written premium:	$45 million
average premium discount:	10%
number of policies:	2,000
expense constant:	$150 per policy

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[74] Originally, the expense constant was used only for small risks: "The loss and expense constants applied to risks producing annual premiums of less than $400 prior to July 1, 1934 and to risks producing annual premiums of less than $500 on and after July 1, 1934" (Hipp [1936], page 258). In reply, Kormes [1936], page 267, notes that ". . . the author feels that an expense constant is not necessarily attributable to small risks since if it is based on the theory that there are certain constant expenses per policy it should, in practical application, be charged as a sort of a policy fee on all risks." Marshall [1954], pages 20-21, and Kallop [1975], page 65, retain the expense constant as a charge only for small risks. Eventually, the difficulty of publicly justifying this procedure led to the present application to all policies.

Expense constants vary by rating bureau and sometimes even by jurisdictions for NCCI states. New Jersey [1992], page 3, for intance, uses a $75 expense constant for all classifications except for Private Residence – Household Employee risks where the Expense Constant remained at $15."

Standard premium is $45 million ÷ 0.9 = $50 million. Total expense constant premium is 2,000 *x* $150 = $300,000. The proportional expense loading (for general expense and other acquisition costs) must therefore be reduced by $300,000 ÷ $50,000,000 = 0.6%.

The determination of the expense constant poses special problems in a loss cost environment. Many "fixed expenses," such as advertising, overhead administrative costs, and underwriting salaries, are not easily allocated to policies or premiums. It is unclear whether bureaus will continue to provide advisory expense constants in most jurisdictions, or whether company actuaries must independently select the constants.[75]

B. Losses

Loss experience is generally better on large risks than on small risks. This is evident in various ways:

- The experience rating plan generally shows a higher ratio of credits to debits for large risks than for small risks (cf. Dorweiler [1934]).
- Small risks are more likely to be assigned to involuntary markets than large risks are (Chelius and Smith [1986]; Huber [1986]).
- Independent studies of experience by premium size generally show higher loss ratios for small risks than for large risks.[76]

Several explanations of this phenomenon are often given:

- The experience rating plan does not just measure loss experience; it provides an incentive for safety procedures. Poor loss experience for a firm subject to an experience rating plan

[75] Most general expenses do not vary significantly by state. Presumably, expense constants determined for administered pricing states are similar to those that would be determined in other states, so they can be used for loss cost jurisdictions as well.

[76] Chelius and Smith [1986], however, find that the ratio of premiums to losses is slightly higher for small risks than for medium sized risks, suggesting that small risks have slightly better loss experience than average. Cf. also Harrington [1988].

increases the cost of insurance in future years. Similarly, good loss experience decreases the future cost of insurance. The more weight that is given to a firm's own experience, the greater is the employer's incentive to reduce claim costs. Since the experience of large firms receives greater credibility than the experience of small firms, large firms have greater incentives to reduce losses.[77]

- Safety programs require large fixed costs: installing guards on machines, replacing dangerous equipment, implementing safety programs, and hiring on-site medical personnel. The large expenditures required may be more cost-effective for large firms than for small firms.[78]

- Small risks may not incur severe injuries with sufficient frequency to warrant post-injury and back-to-work programs.

Loss Constants

Loss constants, or flat dollar premium additions either for all insureds or for small insureds, are a means of flattening the loss ratios by size of risk. Loss constants were once a standard component of the Workers' Compensation premium. They were applied only to risks below a certain size, and they varied by industry group and jurisdiction. Loss constants have been dropped in most states. In 1990, the NCCI recommended that loss constants be reinstituted in those states whose experience indicated a need for them. To avoid an appearance of unfair discrimination or rate redundancy, "the loss constant would be applied to all risks with a

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[77] Opinions differ as to whether experience rating actually provides such an incentive effect and how great this effect is, particularly compared with the incentive effects of self-insurance. For a variety of studies, see Victor [1982; 1985]; Victor, Cohen, and Phelps [1982]; Chelius [1982; 1983]; Chelius and Smith [1983]; Ruser [1985]; Worrall and Butler [1988].

[78] Cf. Hipp [1936], page 259: "It may be that small risks are inherently more hazardous than large risks. Regardless of expense, small risks may not be readily susceptible to accident prevention methods." Cf. also Perkins [1922], pages 273-274.

Gary Venter has pointed out to me that "large and small risks may differ in off-the-books payroll that is only reported after an injury." In other words, payroll may be understated for small firms, so expense and loss ratios may be higher.

concurrent rate offset to make the program revenue-neutral" (NCCI memorandum AC-90-23).[79]

The calculation of the loss constant is illustrated below for two scenarios: one in which the loss constant is applied only to risks with annual premium less than $1,000, and one in which the loss constant is applied to all risks.

Loss Constants Applied to Small Risks Only

Suppose the historical experience is as shown below.

Calculation of Loss Constants

Premium Range	Number Of Risks	Earned Premium	Incurred Losses	Loss Ratio	Loss Constant	Loss Constant Premium	Loss Ratio
$0 – $1,000	500	$ 300,000	$240,000	80%	$40	$20,000	75%
> $1,000	500	2,000,000	1,500,000	75	0	0	75

Loss constants will be used for risks with annual premium of $1,000 or less. Observed experience for these risks shows premium of $300,000 and incurred losses of $240,000, for a loss ratio of 80%. For risks with annual premium greater than $1,000, the total premium is $2,000,000 and incurred losses are $1,500,000, for a loss ratio of 75%. There are 500 risks in each group.

The loss constant is chosen such that the new loss ratio for risks with annual premiums of $1,000 or less becomes 75%. Since the incurred losses are $240,000, the premium must be $320,000 to produce a loss ratio of 75%. That is, an additional "loss constant" premium of $20,000 is needed. Since there are 500 risks, the loss constant must be $40.

The loss constant premium must be offset in the manual rate premium. Thus, the manual rate must be reduced by $20,000 ÷ $2,300,000, or 0.87%. Each group would now have an equal

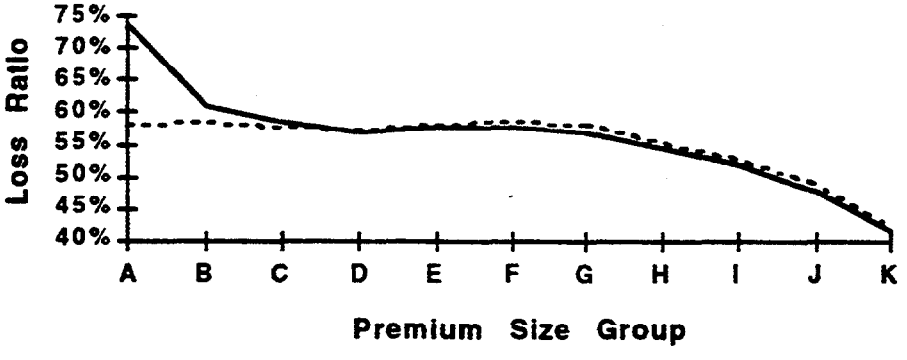
[79] The NCCI recommendation has not yet been implemented. Texas has retained its loss constant applicable to small risks only. The Delaware Compensation Rating Bureau (Circular No. 661) adopted a $45 loss constant, effective in May 1992, applicable to all risks. Loss cost systems may stimulate increasing diversity among carriers and jurisdictions.

loss ratio of 75.6% [= 75% + (1 − 0.0087)].

Loss Constants Applied to All Risks

The NCCI used countrywide Unit Statistical Plan experience for 1988 through 1990 to calculate loss constants by state (NCCI memorandum Act-90-23). The experience showed steadily declining loss ratios to standard earned premium as the risk size increased, as shown by the solid line below. Use of a loss constant for all risks flattens the loss ratios for smaller risks, as shown by the dotted line.

The countrywide average indicated loss constant is $104, though this figures differs markedly by state. With an offsetting premium rate reduction of 1.78%, the average indicated loss constant is $102.15.



There are eleven premium sizes, ranging from $0 – $999 ("A") to $1 million and up ("K"). Note that the loss constants flatten the high loss ratios for small risks, but have little effect on the low loss ratios for large risks.

The pricing actuary should understand the causes of differing loss experience by size of risk. Those relating to sunk costs may be remedied by expense constants; those relating to economic incentives for safety programs may be remedied in part by varying the experience rating plan; those relating to economies of scale for safety programs can sometimes by remedied by loss control efforts provided by the insurer and by loss constants. The goal is to reduce the expected accident costs as much as practical and to set a premium rate that reflects these costs.

Section 13: Statewide Rate Change

Traditional rate making procedures compare the loss ratio derived from experience with a target loss ratio. The target loss ratio uses anticipated expense costs during the future policy period, not the expense costs in the experience period or those underlying the current rates. For instance, if the experience loss ratio is 81% and the target loss ratio is 72%, then the indicated rate revision is +12.5% [= (81% ÷ 72%) − 1].[80]

Regulatory hearings on Workers' Compensation bureau rate filings frequently focus on changes in the expense provisions and trend factors. Were there no loss cost trend or benefit changes, one might presume that rate indications should be near unity, or "no change," since the exposure base is inflation sensitive. In practice, changes in the involuntary market burden, differences between loss trends and wage trends, increasing utilization of the compensation system, and modifications of assessment rates and other expense elements necessitate premium rate revisions.

Many rating bureaus and private carriers have therefore modified their rate filing formats, to show the components of the indicated rate revision caused by

- the historical experience,
- changes in benefit provisions,
- changes in the loss ratio trend, and
- changes in the expense provisions – such as production expenses, general expenses, loss adjustment expenses, involuntary market burdens, state premium taxes, state assessments, expense constant offsets, the experience rating plan off-balance, the schedule rating plan off-balance, anticipated policyholder dividends, and the underwriting profit load.

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[80] The experience loss ratio uses developed and trended losses at current benefit levels and developed and trended premiums at current rate levels. [In practice, a single loss ratio trend may be used; see Section 8.] The target loss ratio is also termed the permissible loss ratio, the expected loss ratio, or the target cost ratio. [As the NCCI uses these terms, the permissible and expected loss ratios include loss adjustment expenses, but the target cost ratio does not; see the 1990 NCCI memorandum AC-90-17). This procedure is used in other lines of business, and it was used in Workers' Compensation until the 1980's (cf. McClenahan [1990]; Marshall [1954]; Kallop [1975]). On the importance of using anticipated expense costs during the future policy period, not historical expense costs during the experience period, see Morison [1965].

A. Countrywide vs. State Expenses

Expense provisions may be divided into two types:

- *Production and General Expenses:* Production and general expenses do not vary significantly by jurisdictions, and most carriers use countrywide averages. Some of these expenses vary with the number of policies issued, not the amount of premium written. Thus, the expense costs as a percentage of premium decline as the size of the risk increases.

  Manual rates uses a gross ratio for the first $5,000 of standard premium, and apply premium discounts for larger risks. Two premium discount scales are published by the rating bureaus: a "non-stock" scale for participating carriers, and a "stock" scale for non-participating carriers. The table below shows sample expense provisions and premium discounts used in the 1980's:[81]

Expense Provisions by Size of Risk

Premium Layer	Stock Companies: Production Expense	Stock Companies: General Expenses	Stock Companies: Premium Discount	Non-Stock Discount
First $5,000	15.0%	6.9%	—	—
Next $95,000	7.5	5.5	9.5%	2.0%
Next $400,000	6.0	4.8	11.9	4.0
Over $500,000	6.0	4.3	12.4	6.0

- *State-Specific Expenses:* Several expense provisions vary by state: premium taxes, assessments, involuntary market burdens, expense constants, and underwriting profit provisions. The variation stems from

[81] For the premium discount scales used in the 1970's, see Kallop [1975], page 68. The NCCI is re-examining expenses by size of risk, so the premium discount scales may be revised (see the 1991 NCCI memorandum AC-91-65). One incentive for this review was the Milliman and Robertson study of NCCI ratemaking procedures, which criticized the Council for (i) using potentially overstated expense provisions, (ii) using only stock company expenses in the statewide reviews, and (iii) not up-dating the premium discount scales. Expense differences by carrier, particularly for mutual companies, are also reflected in the policyholder dividend scales.

- State statutes for premium taxes and assessments.
- The size and profitability of the residual market (see Section 11).
- Regulatory approval for expense constants.
- Differences in cash flow patterns and state regulation of underwriting profit provisions.

B. Expense Provisions

Several items make the expense ratio calculations more complex in Workers' Compensation than in other lines of business:

- *Type of Carrier:* Mutual carriers have traditionally used lower premium discounts and higher policyholder dividends. Rating bureaus therefore provide "non-stock" and "stock" premium discount scales. A carrier may use either premium discount scale, regardless of its corporate structure, as long as it applies the discount scale consistently to all business.

  As in other lines of insurance, expense provisions vary among carriers, particularly production expenses, general expenses, the schedule rating plan off-balance, and the desired underwriting profit load. Industry-wide averages are not always meaningful. For instance, if a carrier's agency contracts call for a 12% commission rate, an industry-wide average of 15% may be less relevant. Moreover, since many expenses vary by size of risk, the pricing actuary must consider the effects of the size of risk distribution in each book of business.

- *Standard vs. Net Expense Provisions:* Since many production and general expenses are related more to the number of policies than to the dollar amount of premium, the percentage provision for these expenses declines as the size of the risk increases. The traditional rate making procedure is to show these expense provisions as a percentage of the first $5,000 of standard premium, and to include a premium discount scale as a separate rating component.

  This simplifies the rate making task, but it may lead to regulatory questions: "Why does the carrier show a 15% production expense allowance if it pays on average only 10%?" [The other 5% is subtracted from the rate in the premium discount scale.] Some filings therefore show expense provisions as a percentage of both standard premium and net premium: the former for setting the rates, the latter for justifying the rates.

- *Underwriting Profit Provision:* The "traditional" ratemaking formula includes a 2.5% underwriting profit provision for Workers' Compensation. The long lag between premium collection and average benefit payment in this line provides substantial investment income. For instance, the average 1990 industry ratio from Insurance Expense Exhibit data of "net investment income gain or loss" to "net premiums earned" is 13.5% (Best's [1991A]); if capital gains are included, as well as investment income on surplus funds, the ratio is about 20%.

  Many jurisdictions require that investment income be considered in Workers' Compensation rate filings. The NCCI uses an internal rate of return pricing model to support its rate filings in these jurisdictions. The Massachusetts Workers' Compensation Rating and Inspection Bureau and several private carriers use discounted cash flow models.[82]

  Profit provisions are complex, and this reading does not further discuss this issue. The reader should be aware, however, that

  - The selected profit provision may greatly affect the rate indication.
  - Many jurisdictions require an analysis of investment income in a rate filing.
  - The profit provision may vary by state and over time, because of differences in cash flow patterns, economic conditions, tax code changes, and similar factors.

Changes in Expense Provisions

In administered pricing states, NCCI rate filings use the expense provision underlying the current rates to determine the target cost ratio and show separately the effects of changes in the expense provisions. For example, suppose the premium tax rate is modified from 4% to 3%, and other expense provisions total 25%. The target cost ratio underlying the current rates is 71%, and the new target cost ratio is 72%. Suppose also that the developed and trended loss ratio derived from experience is 75%. Then

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[82] On the NCCI model, see Feldblum [1992], Cummins [1990], and Griffin, Jones, and Smith [1983]. For the Massachusetts model, see Myers and Cohn [1987]; for discounted cash flow models, see Butsic and Lerwick [1990] or Bingham [1990]. Surveys of these models may be found in Robbin [1991], D'Arcy and Doherty [1989], and Mahler [1985].

- the indication based on experience is the experience loss ratio divided by the current target cost ratio, or +5.6% [1.056 = 75% / 71%],
- the effect of the change in state taxes is −1.4% [0.986 = 71% / 72%], and
- the overall indicated rate change is +4.1% [1.041 = 1.056 *x* 0.986].[83]

In a loss cost environment, individual carriers must select expense, profit, and trend provisions. In administered pricing states, the NCCI separately quantifies the effects of changes in each expense provision. The procedure used in other lines of business, and in Workers' Compensation until the 1980's, is illustrated by Kallop [1975].

C. Special Assessments

Many states assess Workers' Compensation carriers for second injury funds, cost of living adjustments for certain escalating benefits, guarantee fund payments for insolvent carriers, or administrative expenses of Workers' Compensation Boards. Three types of assessment bases are used:

- *Premiums:* Assessments for Guarantee Funds and involuntary markets are generally allocated to insurers based on direct written premium of the preceding calendar year. These assessments are usually included as an expense provision in the rates. They are not unique to Workers' Compensation, though they are often larger for this line of business.

- *Benefits:* Certain assessments, particularly those for second injury funds, are included as a percentage of benefits – either paid or incurred benefits, and either total benefits or indemnity benefits. Assessments based on paid benefits are particularly difficult to predict, since a change in the assessment rate will retroactively change the loss costs for policies issued in the past. Historical data are insufficient for ratemaking. Rather, the pricing actuary must forecast the future assessment rates, based on discussions with the Government Affairs or Legal Departments at his company or rating bureau.

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[83] The NCCI uses this format for loss ratio trends as well. The loss ratio trend factor underlying the current rates is divided out of the premium in the experience loss ratio. This is equivalent to multiplying the loss ratio by the current trend factor. The effect of the *change* in trend factor is applied separately, after the "indication based on experience" has been determined.

- *Specific Injury Types:* Many jurisdictions levy assessments on no-dependency death claims for their Second Injury Funds (see Larson and Burton [1985]).

The Minnesota Special Compensation Fund, which covers both second injuries and certain escalating benefits, illustrates these assessments:

> "This fund covers a second injury which is substantially greater, because of a pre-existing physical impairment, than would have resulted from the second injury alone. The Fund pays for all compensation in excess of 52 weeks of monetary benefits and $2,000 in medical expenses. If the second injury results in a permanent partial disability, the Fund pays the difference between the compensation payable for the second injury and the greater disability. The Fund also reimburses insurers for payments of Supplementary Benefits. The benefits are paid where the employee's weekly compensation rate is less than two-thirds of the Statewide Average Weekly Wage, to bring the employee's benefits up to this minimum standard of living. Additionally, the Fund makes direct payment of benefits to inured workers whose employers were uninsured or self-insured and are now bankrupt" (Minnesota [1991], page 149).

The assessment has two parts:

- 31% of paid indemnity benefits, and
- $25,000 for each no-dependency death case, and the difference between $25,000 and benefits paid for dependency death cases, if paid benefits were less than $25,000.

Bureau rate making procedures often treat assessments levied on specific injury types as paid losses and those levied on total losses or on premiums as expense items. For instance, NCCI [1990], Part IV, page 2, sheet 3, states:

> "Where the compensation law states that, in connection with certain types of injury a specified amount shall be paid into special funds (e.g., a Second Injury Fund), and that such amounts are in addition to the compensation payable to the injured worker or his dependents, then the combined total amount shall be reported as incurred indemnity losses. Examples are: (1) payments in no-dependent death claims, and (2) a specified percentage of the permanent partial award. However, any special payments to the states assessed on total premium writing, total losses paid or incurred, or total indemnity losses paid or incurred instead of on a per claim basis shall not be reported as losses to the rating bureau. In other words, special funds or assessments are reported as incurred losses only when the assessment is levied on certain types of injuries."[84]

[84] Cf. also Kallop [1975], page 79: "Taxes which are levied in the form of assessments based on losses are accounted for in the modification of policy year and calendar year losses to current level. . . . Assessments based on losses that are limited to certain types of injury such as a sum payable to a Second Injury Fund in a no-dependent death case are included in the experience reported to the National Council and, therefore, no factor is required."

The pricing actuary should take care to allocate paid assessments and recoveries to the proper policy or accident years. For instance, a carrier may code some assessments as paid benefits, others as "taxes" or expenses, the gross benefit paid as losses, and the recovery from the state fund as an offset to losses. To ensure the proper evaluation of experience, all assessments and recoveries relating the same accident should be assigned to the same period.

D. Miscellaneous Considerations

Numerous additional procedures are used for specific types of risks or in specific instances. The most important of these, disease provisions for certain classes or in certain jurisdictions, is discussed in Section 16. Other topics are noted briefly below.

- *F-Classes:* Workers' Compensation benefits for workers in the "Federal" classifications are determined by the U.S. Longshore and Harbor Workers' Compensation Act. Because the benefit provisions differ, rates for these classes are determined separately, though the ratemaking procedures do not differ significantly.

- *Ex-Medical Policies:* Insureds which provide on-site medical services, such as hospitals and certain large factories, may elect to provide their own medical benefits. [The insurer provides indemnity benefits.] Because the insurer is responsible for medical benefits not paid by the employer, and the insurer may provide additional medical services to hasten the injured employee's return to work, some provision for medical expenses must be included in the premium rates. Ratemaking for ex-medical coverage is covered in Peters [19__].

- *Off-Balances:* The experience rating plan and the schedule rating plan may not provide equal credits and debits. Large employers generally show better experience than small employers show, because of either the safety incentives provided by the individual risk rating plans or the economies of scale in purchasing safety equipment (see Section 12). Since the experience rating plan accords more credibility to the experience of larger firms, it generally provides an average credit. Similarly, schedule rating plans are often used as

competitive tools: they are geared towards credits, not debits (Kulp and Hall [1968]).[85]

The off-balance in both the experience rating plan and the schedule rating plan may be large, and the pricing actuary must include an appropriate offset in the manual rates. Procedures for determining the offset are reviewed in Michelbacher [1914], Mowbray [1914], and Marshall [1954].

- *Policyholder Dividends:* Manual rates, premium discount scales, and policyholder dividends are intertwined. A revision of anticipated policyholder dividend rates may require corresponding changes in premium rates or discounts.

  These changes are carrier specific: they are determined as much by competitive considerations as by actuarial science. There are no "standard" procedures here.

[85] Early actuarial discussions of Workers' Compensation ratemaking debated the propriety of off-balance provisions for the individual risk rating plans in manual ratemaking procedures (Downey [1917]). [The off-balance is the ratio of aggregate standard premium to aggregate manual premium, or the "manual premimum weighted average modification" (Gillam [1992], page 10).] The experience rating plan is mandatory and relatively uniform in most states. In contrast, schedule rating plans are prohibited in many jurisdictions and vary by carrier even where permitted (see Kulp and Hall [1968]). Bureau filings include off-balance provisions only for the experience rating plan. Private carrier rate indications may include off-balance provisions for schedule rating as well.

Section 14: Classification Systems

"But the uninitiated are scarcely prepared to learn that the hazard of digging a six-foot trench and laying the pipe therein is doubled if sewage rather than water is to flow through the trench . . ."

– Downey [1915], page 12

The previous sections describe the pricing procedures for overall statewide rate revisions. But insureds are not charged "overall statewide rates." Since the risk of injury varies among insureds – for instance, miners face greater occupational hazards than retail clerks do – manual rates vary accordingly. Risk classification is the means of differentiating among insureds and aligning the premium charged with the risk of loss.

A. Industry Group and Occupation

Risk classification systems may be multidimensional or unidimensional. Personal automobile insurance uses a multidimensional system. Risks are classified by driver characteristics, use of the vehicle, territory, and driving history. Although each dimension by itself has limited explanatory power, they measure different influences on loss cost (SRI [1979]; Woll [1991]). The combination of the classification variables improves the power of the risk assessment system.

Workers' Compensation has a unidimensional classification system. Insureds are divided into three industry groups: manufacturing, contracting, and all other. Each industry group is then subdivided into classifications based on the products manufactured or the services provided. For example, the manufacturing industry group contains classifications for jewelry manufacturing, motorcycle manufacturing, and refrigerator manufacturing (see, for instance, Mowbray [1921]; NCCI [1989A]).

Occupational injuries and diseases are related to industrial processes and operations, not necessarily to products and services. Welders face greater hazards than accountants, regardless of the industry in which they work. Some actuaries have suggested that the classification

system should differentiate by occupation, not by industry.[86]

The current classification scheme considers the business of the employer, not the occupation of the employee. For instance, a restaurant may have cooks, busboys, waiters, cashiers, entertainers, and bartenders. Each employee may be subject to different risks, yet they are all classified as restaurant workers.

Classification by occupation would entail verification problems: How many employees are cooks? How many are cashiers? The present Workers' Compensation classification system uses product as a *proxy* for occupation. Producers of the same product are assumed to use similar manufacturing processes, so the product produced is a rough measure of workplace hazards. Certain employees, however, such as clerical workers, draftsmen, salespersons, and drivers, are termed "standard exceptions" and are separately classified.[87]

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[86] Downey [1915] perceives the industry classification system as flawed (page 10: "The existing 'casualty' insurance classification of industries is a relict of employers' liability. . . . it is not adapted to the broader needs of compensation insurance; it is a thing of shreds and patches; it was never conceived as a whole nor based upon any reasoned principle of taxonomy"), and he presents forceful arguments for classification by occupation. The closer relationship of occupational hazard to occupation than to industry is mentioned in the text of this reading. Downey also notes that competition compels insurer to continuously refine the industry classification system until the individual classes are too small for credible rate making. Since there are fewer industrial processes than industrial products, classification by occupation leads to more accurate pricing.

Downey has a jaundiced view of competition: "Whatever may be true of competition in service, or even in rates, competition in misclassification is an unmixed evil" (page 23). Actuarial equity in classification is similarly of little concern: "That every commodity shall bear its specific accident cost . . . is neither practically attainable nor especially important." The countervailing argument is that the industry classification system in Workers' Compensation was feasible only because of the administered pricing system and the lack of open competition.

In his discussion of Downey's paper, Gustav Michaelbacher [1915] gives a vigorous defense of classification by industry. In particular, he argues that classification by occupation would reduce safety incentives for the employer, since the rate for each occupation would be based on a diverse set of firms: "Dr. Downey's plan, if put into practical application without any modification whatsoever, would largely do away with the "Safety First" movement. If employers were to find their establishments divided by processes and grouped for insurance purposes with a resulting rate covering all of the risks in a given class, they would not be particularly interested in making their individual plant as safe as possible, for they would feel somehow that they were being assessed for accidents occurring in processes carried on in the worst possible manner and would consequently have no incentive to make their own plant as safe as it possibly could be made" (page 30). This argument seems specious. Classification by occupation would provide incentives to eliminate the more dangerous processes and operations and would thereby reduce the overall injury rate.

[87] Kallop [1975], page 63: "The fundamental concept underlying workers' compensation ratemaking and pricing is that the exposure to risk of each employer is in part a function of the business in which he is engaged. Because it is expected that each employer engaged in the same type of business would have a similar distribution of employees

A unidimensional classification system is often less efficient than a multidimensional one. The Workers' Compensation classification scheme is sometimes justified by the large number of class (over 600). Moreover, the manual rate is adjusted by a mandatory experience rating plan as well as by voluntary schedule rating and retrospective rating plans. The importance of the individual risk rating plans stems from (i) the stability of injury experience by firm, (ii) the variation in injury experience between firms, and (iii) the inefficiency of the manual classification system.

B. Other Classification Dimensions

Several other classification dimensions are powerful predictors of Workers' Compensation loss costs in many instances. Among the important variables are

- workforce characteristics, such as age and sex,
- group health benefits provided by the employer,
- territory – which may be related to claims consciousness and attorney involvement, and
- the financial health of the employer and of its industry.[88]

As open competition spreads in Workers' Compensation and carriers seek strategic advantages,

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performing comparable functions, it follows that a single all-inclusive classification is the most practical method of determining premium." Downey [1915], page 16, takes the opposite view: "The number and character of operations, and consequently the kind and degree of hazard, differ widely as between establishments turning out the same finished product." On the practical issues, see also Black [1915], page 27: "The principle objection to process classification is the impossibility of determining the actual payrolls expended on the different processes."

Regardless of the statistical correlations, there is a public policy reason for classifying risks by product, as Webster [1987], page 158, notes: "Society was to shift the burden of industrial accidents from the injured worker to the purchaser of the manufactured product."

[88] Numerous other variables also affect compensation costs. For instance, hospital costs differ between urban and rural areas, leading to disparate medical costs for injured employees. Similarly, the employer's commitment to workplace safety influences expected claim frequency. The pricing actuary must determine which classification dimensions are most important, whether the use of each classification variable is feasible (i.e., whether values for the variable can be reasonably determined), and whether the classification dimension should be considered by the actuary setting up a rating scheme or by the underwriter selecting insureds.

classification systems will be refined.[89] The predictive power of the classification variable is the primary determinant of its usefulness for pricing. In addition, the actuary must consider issues of (i) data availability, (ii) quantification, (iii) administrative practicality, and (iv) social acceptance of each classification variable (AAA [1990]). For instance,

- *Availability:* Data on personal characteristics of the workforce are not now gathered by compensation insurers, though health and disability insurers use these attributes.
- *Quantification:* The influences of group health benefits on Workers' Compensation costs are difficult to quantify, because employer provided group health plan provisions are so varied.
- *Social Acceptance:* Rating by territory raises social acceptability issues, even more in Workers' Compensation than in Personal Automobile.[90]

Rating bureaus are concerned that a proliferation of classification systems will impair the integrity of industry-wide data bases and hamper the application of a mandatory experience rating plan (AIA [1982]; Berquist, et al. [1991]). Conversely, some private insurers believe that adherence to a uniform classification system and the use of a mandatory experience rating plan are impediments to true open competition (see Hofmann [1992] for a general discussion). This reading takes no position in this debate. It simply notes that underwriters, agents, and private carriers examine various risk characteristics when offering Workers' Compensation coverage. The pricing actuary should attempt to quantify their effects to enhance the value of the ratemaking recommendations.

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[89] See McNamara [1984] for the relationship between price competition and classification refinement. Cf. also Pomeroy [1990], page 26, who notes the NAIC project goal of determining whether Workers' Compensation classifications are appropriate. Hofmann [1991A], pages 130-131, suggests that "it may be desirable to have fewer classes, i.e., classes based on the nature of an employer's business, than we have presently and collect additional data on other rating variables related to territorial differences, size of employer, and other considerations that may be shown to have a correlation with workers compensation costs."

[90] Territorial rate differentials in Personal Automobile insurance are sometimes justified by alleged differences in road maintenance and driving hazards. Territorial rate differentials in workers' compensation invite criticism of alleged discrimination by socio-economic status and racial group.

C. Workforce attributes

The distribution by age and sex of the workforce affects the expected medical and disability benefits. These distributions have long been used by health insurance actuaries for premium determination in employer provided group plans. Since many of the relationships between personal characteristics and health benefits stem from non-occupational illnesses, such as gynecological treatment for young women or cardiovascular illnesses for older individuals, the health insurance studies must be adjusted for pricing Workers' Compensation policies.

This section focuses on age, whose relationship to Workers' Compensation benefits is clear. In particular, we examine age in relationship with claim frequency, claim severity, and experience rating plan modifications.

Health care costs for *non-occupational illness* rise steeply with age, so employer provided health plans for small groups depend on the age distribution of the workforce. *Occupational injuries* are more frequent among inexperienced workers, who are generally young.[91] Durations of disability for a given injury are longer for older workers, primarily for physiological reasons but also because workers near retirement may use compensable disabilities as substitutes for early retirement.[92] Dillingham [1983], page 238, presents the following Workers' Compensation claim frequency and severity figures for New York indemnity cases in 1970:

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[91] So Worrall, Appel, and Butler [1987B], pages 7-8: ". . . younger workers are far more likely to be workers compensation claimants." The frequency of occupational *diseases*, however, often depends on the length of the exposure period. The longer an employee has worked, the greater is his or her exposure to toxic substances. Thus, disease frequency is higher for older workers, who have had more exposure. Similarly, Victor [1990B], page 5, notes that "Older workers are more likely to have diseases associated with both the workplace and the aging process: hearing loss, joint diseases, back problems, cardiac and respiratory diseases, and cancers." Cf. also Victor [1990A], page 18.

[92] So Worrall, Appel, and Butler [1987B], p. 9: "Age significantly increases the costs of medical utilization . . ." The effects on indemnity benefits are equally great. Butler and Worrall [1985], page 719, restate the "retirement" cause in more formal terms: "Since the older one is, the shorter the subsequent stream of wages upon returning to work, one would expect age to decrease the hazard rate." Their regression analysis supports this hypothesis.

As David Appel has pointed out to me, one must consider the effects of age on premiums as well. Older workers generally are more senior and higher paid. Their higher average loss costs may be offset by the greater payroll.

Average Claim Frequency and Severities
New York Workers' Compensation Indemnity Cases, 1970

Age Group	Claim Frequency Per 500 Workers	Average Claim Severity	Average Loss Costs
Less than 25 Years	13.83	$ 753	$10,414
25-44 Years	9.28	1,385	12,853
45 Years & Older	9.20	1,798	16,542

One can sometimes rely on the experience rating plan to mitigate rate inequities. But this rating plan does not substitute for classification by workforce attributes, for two reasons.

- The experience rating plan has less effect on small and medium sized risks, where the age distributions of the workforce vary considerably.

- The experience rating plan aggravates the problem of varying age distributions. A small firm with many older workers will have high expected loss costs but low expected frequency. Since the experience rating plan emphasizes claim frequency, not claim severity, it may indicate a credit, not a debit. Conversely, a small firm with many young workers will have low expected loss costs but high expected frequency, and it may receive an experience rating debit instead of a credit.[93]

D. Group health benefits

During the late 1980's, many employers increased deductibles and coinsurance payments for group health insurance plans. Workers' Compensation remains a first dollar coverage: medical losses are reimbursed in full, with no deductibles or coinsurance payments. Some accident victims file for Workers' Compensation benefits even when the injuries are not necessarily

[93] Moreover, the claim severity disparity between younger and older workers is most evident in serious cases. The experience rating plan divides losses into primary and excess portions, with a low cutoff point for small firms (Venter [1987]; Gillam [1991]).

work related.[94]

Medical care practitioners have similar economic incentives to label injuries "work-related" and therefore compensable. Physicians in HMO's, for instance, receive no additional compensation for injuries or illnesses covered by group health plans but full reimbursements for those covered by Workers' Compensation. Similarly, chiropractic treatments are often covered under Workers' Compensation but may be excluded under certain group health plans.

A firm with a generous group health care plan, such as a fee for service plan with low deductibles and co-payments, may have low expected Workers' Compensation costs. Conversely, a plan with high deductibles or co-payments, or a plan emphasizing Health Maintenance Organizations or Preferred Provider Associations, may have high expected compensation costs. Ducatman [1987], page 52, presents data for eight federal shipyards showing a strong correlation between the percentage of workers enrolled in HMO's and the average Workers' Compensation costs per capita. He concludes that "increases in present prepaid plan enrollments were accompanied by substantial increases in workers' compensation costs."

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[94] Ducatman [1987], page 51, summarizes this: "When individuals have access to parallel health insurance systems, they can be relied upon to use them advantageously. When one system [group health] severely constrains costs and services, and the other [Workers' Compensation] provides full access to health services without additional cost, the unconstrained system will predictably prove more popular." Hager [1991], page 9, writes: ". . . medical inflation within the workers compensation system has been running 50 percent higher than general medical inflation. . . . because compensation is the last medical insurance system that generally prohibits deductibles and coinsurance, provides for unlimited medical benefits, and makes it difficult for insurers and employers to use HMO- and PPO-type mechanisms." Borba and Eisenberg-Haber [1988] find that Workers' Compensation claims for sprains and strains (soft tissue injuries) are more common on Mondays than on other days of the week, suggesting that non-occupational injuries occurring on weekends are being reimbursed by the Workers' Compensation system. They note that "there may be economic incentives for a worker to attribute an off-the-job injury to a workplace incident. In particular, medical expense reimbursement and indemnity benefits for lost work time may be more complete under workers compensation insurance than under accident and health plans" (page 52). Cf. also Ellenberger [1990], page 50: "A former chairman of the insurance industry's rate-setting body (the NCCI) said, "Employees of small businesses – far less likely to have group health insurance as a fringe benefit – may be turning to workers' compensation as a means of providing medical care for injuries caused by non-work related incidents."

HMO Enrollment and Workers Compensation Costs, Fiscal 1983

Shipyard	% HMO Enrollment	WC Costs Per Capita	Shipyard	% HMO Enrollment	WC Costs Per Capita
A	0%	$ 347	E	53%	$ 756
B	0	370	F	53	930
C	<1	477	G	83	1,181
D	39	723	H	66	2,325

The type of group health insurance plan provided by the employer, as well as changes in the group health plan provisions, must be considered by the actuary when pricing Workers' Compensation policies. Because of the variety of group health plans and the constantly evolving nature of many provisions, an objective classification scheme may be difficult to devise. Rather, the Workers Compensation actuary must understand the qualitative influences on benefit costs and provide rough estimates of their magnitude.

E. Territory

Workers' Compensation manual rates do not vary by territory within a state. In other lines of business, such as Personal Auto, territory is a powerful classification dimension. In the past, many actuaries presumed that traffic congestion, road conditions, and similar "physical" factors were the major influences on loss cost differences by territory. Recent studies have suggested that equally important factors are attorney involvement in insurance compensation systems and differing proclivities to file personal injury claims. For example, the AIRAC attorney involvement studies showed that claim severity was higher in urban areas than in rural areas – not because of differences in economic damages per claim (which are higher in rural areas) but because of the greater percentage of urban claims that are represented by attorneys (AIRAC [1988; 1989]). Similarly, the "BI/PD ratio" studies showed that the incidence of physical accidents was more similar across territories than the incidence or severity of Bodily Injury claims (IRC [1990]; Woll [1991]).

Workers' Compensation is a no-fault coverage, abrogating the employee's right to sue in exchange for statutory benefits. Yet attorney involvement in compensation claims is increasing

rapidly, along with total benefit costs (Borba [1989], page 67). The effects of the trial bar are evident in three areas:

Claim Frequency

Many compensation claims, such as some soft-tissue injuries, stress claims, and disease claims, are of dubious validity. Oftentimes, a worker suffering from stress, moderate hearing loss, or a minor back sprain will press a compensation claim only if encouraged by an attorney.

The relationship between physical injury and insurance claim is clearest in the BI/PD studies undertaken by the Insurance Research Council [1990]. Personal Auto Property Damage (PD) claims depend primarily on physical accidents; Bodily Injury (BI) claims depend on the injured party's claims consciousness and on attorney involvement as well. The ratio of BI claims to PD claims measures the proclivity of the public to press insurance claims.

The Personal Automobile BI/PD ratio by territory is a good predictor not only of Auto loss costs but also of Workers' Compensation benefit costs. Exhibit 15.E.1 shows Insurance Service Office BI/PD ratios by Personal Auto rating territory in Florida, and Exhibit 15.E.2 shows attorneys per capita in each Florida county. Lawyers are more concentrated in the southern half of the state (e.g., Dade, Palm Beach, and Polk counties) than in the northern half (e.g., Jackson county). Similarly, the BI/PD ratios are higher in the southern territories than in the northern ones. Finally, both automobile loss costs and Workers' Compensation benefit costs are greater in the southern half of Florida than in the northern half.

Economic Damages

Attorneys raise claim costs not only by persuasive arguments in litigated cases but also by "building up" the economic damages.[95] The greater the damages, the larger the award; the

[95] AIRAC [1989], pages 10-11, compared automobile personal injury claims where an attorney represented the plaintiff with claims where the victim sought compensation without legal aid. The ratio of insurance payments to physical damages, about 2 to 1, was the same for each group. But the attorney-represented claimants had two to three times the average costs for medical treatment and lost workdays that the non-represented claimants had. An alternative explanation is that claimants are more likely to seek legal aid in severe cases. However, the same relationships appear even when claims are stratified by type of injury.

larger the award, the higher the attorney's fees. Many lawyers encourage claimants to seek repetitive medical treatment and to refrain from work. This incentive to aggravate claims is unrelated to the type of compensation system, whether liability or no-fault, Personal Automobile or Workers' Compensation. As long as the award varies with damages, the attorney benefits from increased loss costs.[96]

Medical Treatment

The type of medical treatment received by the claimant influences both economic damages and insurance compensation. Medical practitioners who deal with injuries that are difficult to objectively assess, such as psychologists, physical therapists, and chiropractors, may sometimes provide treatment primarily to collect the insurance compensation. Geographical location is often correlated with such phenomena. For instance, Workers' Compensation stress claims are more common in certain regions of California than in other areas, whether because of judicial liberality or psychological positions (Borba [1989], page 63).[97]

In sum, territory is an important classification dimension because of social differences by region. (The use of territory is more difficult for Workers' Compensation rating than for automobile rating because some risks have multiple plants. However, this is no different from multi-state risks, which the rate making procedures accommodate.) The actuary must

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Weisberg and Derrig [1991] and Marter and Weisberg [1991] examine potentially fraudulent and built up automobile insurance claims in Massachuseets. They note that the type of injury and treatment, such as "soft-tissue" injuries, excessive chiropractic care, and a prolonged recovery, were often deemed by claims examiners as signs of possible build-up. Certain law firms and health-care providers were so commonly associated with suspicious claims that their involvement in a case roused suspicions of fraud.

[96] Butler and Worrall [1985], page 719, note that "when a lawyer represents a claimant, the length of stay on Workers' Compensation will tend to increase, since the transition rate from Workers' Compensation decreases." Similarly, NCCI [1991A], page 35, attributes the increasing paid loss link ratios to greater attorney involvement in Workers' Compensation claims. Attorney involvement also increases defense fees. Pillsbury [1992] estimates that "litigation costs [in California] accounted for more than $1 billion out of $6 billion in total workers' compensation costs in1988."

[97] Similarly, 1989 Personal Auto claims in Lawrence, Massachusetts, were predominantly sprains and strains, treated by chiropractors, often represented by the same attorneys, with little variance in the length of treatment or the claim medical charges – symptoms of potential fraud (Weisberg and Derrig [1991]; Marter and Weisberg [1991]). Regarding Workers' Compensation, New Jersey [1992], page 1, notes "Recent national sudies suggest that statutes which permit employer selection of medical provider afford the greatest opportunity for cost savings."

understand these influences on Workers' Compensation costs and incorporate them into pricing and marketing strategy.

F. Financial Health

Economic conditions affect Workers' Compensation claim frequency and durations of disability. Occupational injuries often stem from workers' inexperience with industrial equipment or workplace hazards. During prosperous periods, when firms hire new and less experienced workers, speed up production, and expand overtime work, claim frequency rises (NCCI [1991], page 34; Walters [1992], page 22; ISO [1991]). Claim severity, however, is low, since employees are eager to return to work and jobs are available.

The opposite pattern occurs during recessions. Most employees are experienced, since there is little new hiring, and production is slack; claim frequencies are low. Durations of disability lengthen, however, since there are few jobs available, and alternative employment opportunities for partially disabled workers are rare.

Victor and Fleischman [1990], reanalyzing data gathered by Boden and Fleischman [1989], find a strong effect of economic conditions on average claim severity, which they attribute to three causes:

> "First, higher unemployment may *increase utilization* of workers' compensation income benefits as workers without jobs seek to retain income from whatever sources are available. Some of those unemployed will make claims that they would not have otherwise made, and extend the durations of the claims as long as possible or until job opportunities surface. Some who are receiving benefits will find that they no longer have jobs to which they can return. They seek to extend the duration of benefits. Some with residual disabilities find that they are especially at a competitive disadvantage in the labor market when unemployment rises. In each of these instances, workers may use more medical care in their efforts to establish entitlement or retain benefits.
>
> "Second, when unemployment is higher, some employed workers with relatively minor injuries will be *more reluctant to file* workers' compensation claims, fearing that they may be more vulnerable to lay-off if not currently working. When some minor claims are not brought, it makes the average costs of a claim – medical as well as indemnity – appear to be increasing, as the fraction of more serious cases rises.
>
> "And third, when unemployment rises, the *experience and injury mix* of employed workers

changes. Less experienced workers are laid-off, and more experienced workers retained. Less experienced workers tend to be younger, and have more frequent, but less serious injuries. As a consequence, the average severity of injury and average medical costs would increase."[98]

For the individual firm, this relationship is even stronger. Impending layoffs often precipitate an increase of Workers' Compensation claims for minor injuries and latent disease claims, since disability benefits generally exceed unemployment benefits in both duration and amount.[99] Two resulting principles of Workers' Compensation pricing have been suggested, though strong empirical support is hard to produce:

- In a declining industry susceptible to disease claims, the actuary should expect rising costs.
- If a firm faces financial problems that may lead to workforce reductions, the actuary should expect a higher incidence of soft-tissue claims, disease claims, and stress claims.

This section has reviewed six classification dimensions: industry, occupation, workforce attributes, group health plan provisions, territory, and financial condition. An administered pricing system requires less classification refinement, and bureau rate making procedures rely primarily on industry. In an open competition environment, however, classification efficiency

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[98] Victor [1990A], page 17, summarizes these results: "Evidence is emerging that workers' compensation benefits are more heavily used in times of economic distress. The severe recession that hit Michigan saw a surge in claims by workers taking early retirement from automobile companies . . . The recession in Texas saw an increase rate of claim filing and a significant increase in the duration of lost time . . ." Similarly, New Jersey [1992], page 1, says "In times of a flourishing economy and high employment levels, claim frequency remains relatively stable and premiums, pushed by wages, increase. On the other hand, during recessionary periods claim frequency usually increases and premiums remain flat or decrease."

The actual effects of economic conditions on claim frequency and severity are uncertain, most evidence is anecdotal, and generalizations may be premature. Mowbray and Black [1915], p. 425, write: ". . . accident frequency per unit of exposure tends to rise and fall as production rises and falls . . ." and ". . . during times of . . . extreme depression . . . there is a slight lengthening of the average period of disability when compared with that during normal times." Greene and Roeber [1925], pages 254-255, suggest that ". . . the speeding up of industry [in 1916] due to war contracts had increased the accident rate" and that ". . . the depression of 1921-22 marked the beginning of a period of rising compensation costs." See also Whitney and Outwater [1923], pages 153-155.

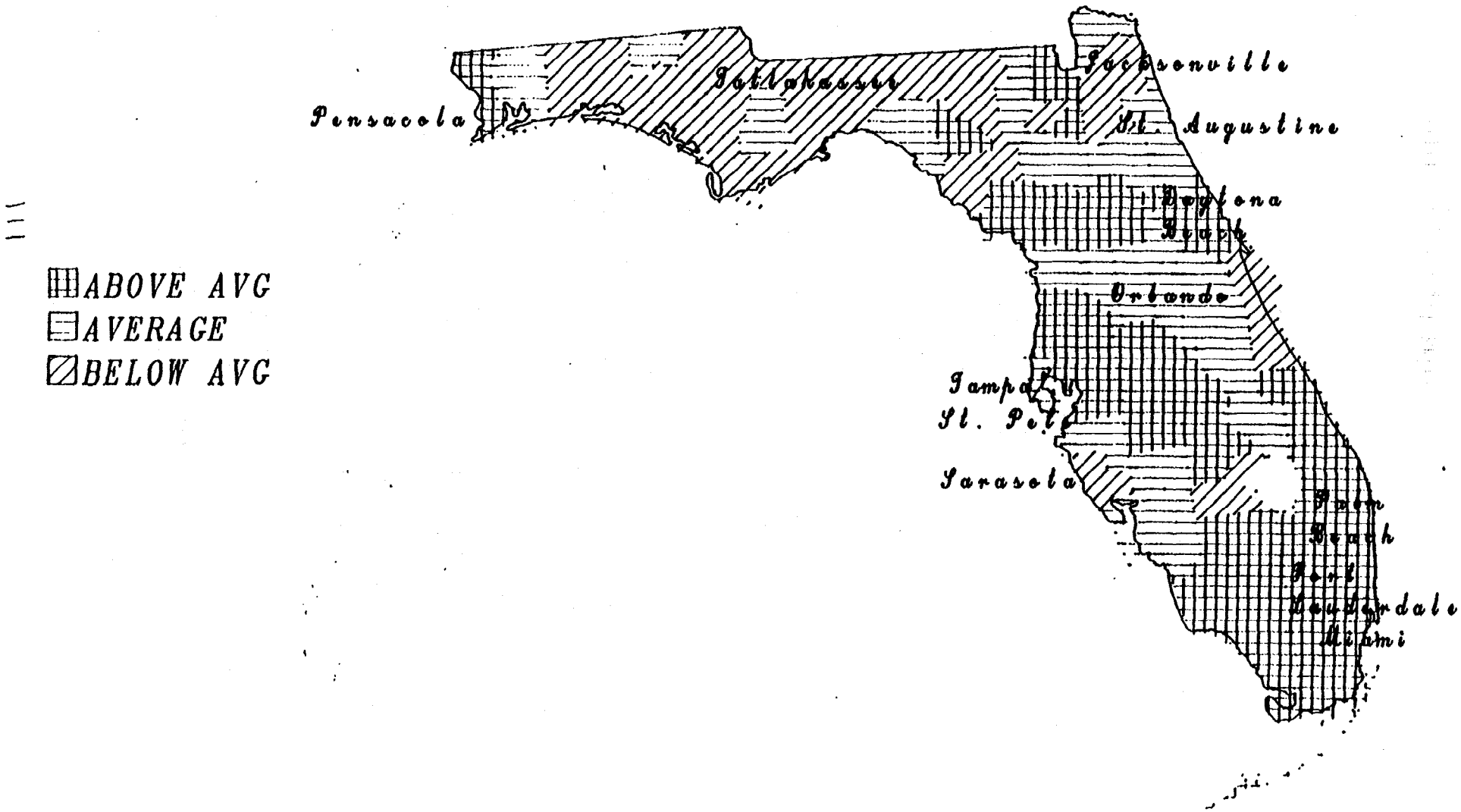
[99] Cf. Marshall [1954], page 71: ". . . there are many employees working in foundries and similar dusty industries who have already contracted silicosis to some degree and need only to be thrown out of work to become a compensation claim." Marshall also notes ". . . the expected 'catastrophic' nature of the emergence of claims for dust diseases in the event of an economic depression . . ." (page 61). Kischuk [1986], page 120, commenting on health insurance, notes that "experience with the disability income business is cyclical and tends to follow trends in unemployment. When unemployment is high, disability claims increase; when unemployment is low, disability claims decrease and recoveries occur."

can produce a competitive advantage. (In an administered pricing environment, the same information can aid underwriting decisions.) The pricing actuary must understand these influences on claim costs and how each classification variable might be used in setting policy premiums.

FLORIDA
ATTORNEYS PER 1,000 PERSONS
BY COUNTY

BELOW AVERAGE
AVERAGE
ABOVE AVERAGE
STATE CAPITAL

FLORIDA
RATIO OF BI TO PD 3 YR. CLAIM COUNTS
BY ISO TERRITORY



Section 15: Classification Rate Making

"The work of . . . applying the conversion factors to the state losses was carried on at night by a special crew so that the working sheets might be used to the maximum advantage. Thus, as rapidly as the actual losses were entered in the day time they were converted at night, both jobs going forward simultaneously. The night crew also calculated pure premiums wherever necessary and obtained territorial and country-wide totals of payroll and converted losses. Later, when the day force had completed its work of entering the raw state experience, it checked the calculations of the night force."

". . . the reader will appreciate that the establishment for 1,000 classifications of basic pure premiums, with the necessary exceptions for states and regions, is by no means a task that can be disposed of in a short time. In the 1920 revision over two solid months were consumed by this phase of the work." – Michelbacher [1919], pages 224, 230.

A. Early Procedures

Workers' Compensation was introduced in the early part of the twentieth century on a state by state basis. To determine initial premium rates for each new state, actuaries used the experience from certain large states, such as Massachusetts, where Workers' Compensation was already in effect. Two consequences of this approach were

- Since statutory benefits differ by state, adjustments must be made to other states' experience. In actuarial terminology, each state's experience must be "reduced" to the benefit level of the state under review (cf. Rubinow [1917]).

  The benefit level relativities among states vary by type of injury. For instance, State A's indemnity benefits may be double State B's for permanent total disability, 40% more for temporary disability, and the same for medical benefits. Classification pure premiums were therefore separated into "serious," "non-serious," and "medical" components, and "partial reduction factors" were used for each.

  The separation into partial pure premiums has other uses as well, such as determining rates for excess coverage and large dollar deductible policies, since loss costs on excess layers are influenced more by serious claims than by non-serious claims. Moreover, the traditional

credibility formula uses different full credibility values for each component. Since serious losses show more random fluctuation than non-serious losses show, different full credibility standards are indicated for each.[100]

- Since there were no existing rates when each state first adopted Workers' Compensation, a pure premium ratemaking method was implemented. Now, however, the pure premiums are used to determine classification relativities, by means of a "test correction factor" (see below).[101]

Each state soon developed its own experience. Reliance on countrywide experience was less necessary, and several problems emerged in determining "reduction" factors:

- States with independent rating bureaus, such as New York, Pennsylvania, Massachusetts, and California, often had different classification systems or different definitions of specific classes. Mapping classification systems between states, and then forming reduction factors with pencil and paper, became an elaborate task – as the quotation from Michelbacher shows.

- Regional differences led to different hazards for the same class in different states. For instance, mining in the Eastern United States is not comparable to mining in the Western part of the country. Further subdivisions of classes to resolve this problem led to insufficient state experience and further increases in the work load.

- Theoretical reduction factors based on statutory benefit provisions should equal empirical reduction factors based on experience. Actual differences between these sets of reduction factors were large, suggesting that many state differences result from the administration of the Workers' Compensation system, economic incentives to file claims, and judicial

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[100] Cf. Mahler [1989], page 190, Rule 2C: "The less random variation in an estimate the more weight it should be given. In other words, the more useful information and the less noise, the more the weight." Note that for the same number of serious and non-serious indemnity claims, the traditional formula assigns greater credibility to the serious partial pure premium, whereas Mahler assigns greater credibility to the non-serious partial pure premium.

[101] "While the process proceeds in terms of pure premiums - and thus suggests that we are dealing with absolute levels - in fact the process is one of determining the proper *relative* level among the classifications" (Dropkin [1977], page 87).

philosophy regarding awards.[102]

The *South Eastern Underwriters* Supreme Court decision of 1945 and the subsequent McCarren-Ferguson Act made state rate regulation a prerequisite for anti-trust exemption. The NAIC Model Rate Regulatory laws adopted in each state encouraged the use of state experience.[103] Workers' Compensation pricing actuaries abandoned the use of countrywide experience in favor of reliance strictly on state experience.[104]

B. Industry Group Relativities

Workers' Compensation experience is divided into three industry groups: manufacturing, contracting, and all other. Unit Statistical Plan (USP) data, but not financial data, are available by industry group and by classification. The USP data are more detailed than financial data (e.g., USP codes losses by injury type), but they are less recent.

Rate level change relativities are determined for industry groups; *pure premiums* are determined by class. Factors to convert USP experience levels to financial experience levels are not needed for industry group relativities if they apply uniformly to all business, though these factors are needed for classification pure premiums.

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[102] Cf. especially Johnson [1953], page 14, who shows wide differences between "law" and "experience" differentials. Johnson attributes much of the difference to differing benefit provisions and liberality of administration of the Workers' Compensation system among the several states. Similarly, Appel notes that "statutory benefit levels . . . in many instances are not highly correlated with actual paid benefit levels. California is an excellent example of this phenomenon. The state statutory benefit levels are about 50 percent of the national average, but actual paid benefits are about 135 percent of the national average" (Victor, Appel, Gardner, and Edwards [1992], page 92). See also Power and Shows [1988], page 311, for a comparison of premiums and benefit levels in Florida.

[103] The actual language of the law is "Due consideration shall be given to past and prospective loss experience within and outside this state . . ." (Carlson [1951], page 16). Although loss experience external to the state may be used, some state regulators object if state data is available.

[104] See Harwayne [1977], page 74: "Historically, classification ratemaking depended to a large extent upon national pure premiums, that is, pure premiums were derived from observations of the countrywide classification experience. Differences in pure premium from state to state depended upon measured differences in benefit levels provided by workers' compensation law in each state. Subsequently, this approximation to costs under individual state laws was abandoned as being too crude." See also Marshall [1954], page 12, and NCCI [1990D], Part II, page 2, sheet 3.

Traditional ratemaking procedures determine industry group average loss ratios, using three policy years of USP data, with premiums brought to current rate levels and losses brought to current benefit levels. The industry group relativity is the USP loss ratio for that industry group divided by the USP loss ratio for all industry groups combined. The industry group relativities will be applied to classification pure premiums (see below).[105]

C. Reviewed and Non-Reviewed Classifications

With six or seven hundred classes in each state, many of which have little experience, statewide data alone are rarely sufficient. In the old bureau ratemaking procedure, classes were divided between "reviewed classifications," which received some credibility for at least one of the partial pure premiums, and "non-reviewed classifications," which received no credibility at all. Industry group rate revisions were used for the non-reviewed classifications.

This procedure perpetuated any existing rate inadequacies or redundancies in non-reviewed classifications. For instance, if a non-reviewed classification's rate was 20% inadequate, but the average industry group rates were reasonable, the rate for that particular class may never be corrected (Johnson [1948], page 10; Harwayne [1977], page 74).

In 1976, the National Council on Compensation Insurance revised its classification ratemaking procedure. NCCI classification pure premiums are now a weighted average of

- The present on-level pure premiums for that class: these are the existing rates updated for law amendments and the industry group indicated rate change.
- Statewide experience indicated pure premiums for that class, based on the most recent three policy years of data. [Some other bureaus use longer experience periods: for example, New Jersey uses five years, as Milliman and Robertson recommend for the NCCI as well.]

[105] Various refinements can be made to industry group relativities. Minnesota, for instance, anticipates different loss ratio trends by industry group. Average wage increases are slightly lower for manufacturing and contracting industries than for service industries, so the manufacturing and the contracting industry groups should have higher loss ratio trends. Some actuaries have questioned whether the division into three industry groups is too simplistic; perhaps a more refined division into, say, a dozen industry groups, would be more appropriate.

- National pure premiums for that class, adjusted for the particular state's overall experience.[106]

For classification ratemaking, losses are limited, to prevent potential distortions from large, random loss fluctuations. The limitations are related to the self-rating point in the experience rating plan. (Since the revised experience rating plan has no self-rating point, the self-rating point in the old experience rating plan is used; see Gillam [1990; 1991]). The NCCI limits are 10% of the self-rating point for single claims and 20% for multiple claims.[107]

D. Classification Pure Premiums

Partial pure premiums are developed separately for serious indemnity, non-serious indemnity, and medical benefits. Serious losses consist of fatalities, permanent total disability, and major permanent partial disability. Non-serious losses consist of minor permanent partial disability and temporary total disability. Medical losses consist of all medical claims (Kallop [1975], page 82).[108] In each group, three sets of partial pure premiums are combined to develop

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[106] Dropkin [1977], page 88, summarizes the historical development: ". . . we can see in the adoption of the present procedure an almost classic example of Hegelian dialectic with its stages of thesis, antithesis and synthesis:

Thesis	–	Original, historical use of national experience.
Antithesis	–	Post Public Law 15 use of state experience.
Synthesis	–	Present, blended use of both state and national experience."

See also Carlson [1951], page 36: "In the old workmen's compensation procedure, the framework taken as a norm consisted of a set of national classification pure premiums. . . . A few years ago the use of underlying pure premiums in lieu of national pure premiums was substituted in the workmen's compensation procedures also."

[107] Other bureaus use different limits. For instance, Minnesota limits single losses to 20% and multiple losses to 40% of the self-rating point. Kallop [1975], page 71, notes an additional constraint as "The amount of disease loss that can enter any one class in any one policy year is limited to 25% of the self-rating point used in experience rating." Milliman and Robertson, in their review of the NCCI ratemaking procedures, recommend "further testing to determine if certain classes have different expected losses above the loss limitations than the remaining classes in their industry group."

[108] Some actuaries have suggested that medical losses be divided into serious and non-serious components, for the same reason as the disability losses: "Since most of these high medical costs are associated with serious indemnity claims, it might be desirable to segregate medical losses into three subdivisions according to the kind of injury of the accompanying indemnity loss, e.g., serious, non-serious, and non-compensable medical. . . . the serious medical pure premium might take the class credibility of the serious indemnity losses and similar treatment

classification proposed pure premiums:

- Underlying pure premiums brought to the present rate level,
- Indicated pure premiums, and
- National pure premiums adjusted to the state's benefit or experience level.

Underlying Pure Premiums

The *underlying pure premiums* are the final approved pure premiums in the preceding rate revision. In the traditional NCCI ratemaking procedure, the "test correction factor" and the most recent benefit level change may not be included with the *proposed pure premium* in the preceding revision, so modifications must be applied to obtain the underlying pure premiums (see the exhibits in the appendix).[109]

The rate level calculation uses standard earned premium; the final rates use manual premium. The proposed pure premiums in the preceding review are adjusted by the "manual to standard earned" premium ratios at that time to form manual rates. The underlying pure premiums in the current review should reflect the present "manual to standard earned" premium ratios.

With some exceptions, the manual rates have not changed in the intervening year. But the average experience rating plan off-balance may have changed, and the average standard earned premium may have changed accordingly. To bring last year's proposed pure premiums in line with the current "manual to standard earned" premium ratios, they must be multiplied by last year's manual to standard ratio and divided by the current year's manual to standard ratio.

These adjusted underlying pure premiums must be multiplied by the industry group rate indication in the current review. Since the industry group *relativity* may be applied to all three types of pure premiums (underlying, indicated, and national), the pricing actuary adjusts last year's proposed pure premium by the overall statewide indication in the present review,

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might be accorded to non-serious medical" (Barber [1935], p. 156).

[109] The test correction factor balances the pure premium changes by classification to the overall change; see below in the text.

and then adjusts the "derived by formula" pure premiums by the industry group relativity.

Indicated Pure Premiums

The *indicated pure premium* is the class's benefit costs divided by the class's payroll. Since the classification pure premiums are determined from Unit Statistical Plan data and the overall statewide indication is determined from financial data, the average classification indicated rate change may not equal the overall indicated rate change. An offsetting adjustment is made for this. For instance, if the financial data indicated rate change is +15%, and the USP data indicated rate change is +5%, then each classification indicated pure premium is multiplied by 1.095 [= 1.150 / 1.050].[110]

National Pure Premiums

The *national pure premium* is determined from the experience of other states, after it is brought to the experience level of the state under review. For instance, suppose that State A (the state under review) shows average non-serious pure premiums of $1.50 for class X, $2.50 for class Y, and $2.00 for class Z, each of which has $1 million in payroll. State B (one of the states in the national experience), with benefit levels about twice as high as those in State A, may show average non-serious pure premiums of $3.50 for class X, $4.50 for class Y, and $4.00 for class Z, each of which has $5 million in payroll.

One can not compare the unadjusted pure premiums in the two states, since the benefit levels differ. Adjusting the figures by comparing the statutory benefits may be misleading, since some differences may be due to varying administration of the Workers' Compensation system in the two states, or different levels of "claims consciousness," or different judicial philosophies.[111]

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[110] See the "Financial Data Adjustment" in the appendix. The adjustment depends on the other modifications made to financial and USP data. In the illustrative rate filing in the appendix, for instance, both sets of losses are developed to an eighth report, but neither is trended. Since the USP data is about two years older than the financial data, the financial data adjustment used there is roughly the magnitude of two years of loss ratio trend.

[111] Downey and Kelly [1918], pages 249-250, present three methods of converting national to statewide experience: "Three methods have at different times been projected or employed for reducing losses experienced under dissimilar scales of benefit to a common denominator. (a) The so-called "actuarial" or "theoretical" method

Instead, the current NCCI procedure is to compare the average experience in the two states. Since the three classes have the same payroll, the average pure premium in State A is $2.00 [=($1.50 + $2.50 + $2.00)/3]. Similarly, the average pure premium in State B is $4.00 [=($3.50 + $4.50 + $4.00)/3]. Therefore, each pure premium in State B is multiplied by 0.50 [=$2.00/$4.00] before being used for State A pure premium determination.[112]

Reduction of National Experience to State Experience

	State A		State B		Reduction	State B Adjusted
Class	Premium	Payroll	Premium	Payroll	Factor	Pure Premium
Class X	$ 1.50	$ 1 M	$ 3.50	$ 5 M		$ 1.75
Class Y	2.50	1 M	4.50	5 M		2.25
Class Z	2.00	1 M	4.00	5 M		2.00
Reduction Factor					0.50	

computes the cost of compensation under any given act by applying the legal scale of benefits to a standard frequency-distribution of accidents by severity of injury. The total cost so calculated is divided by the total calculated cost of the same accidents under a standard or "basic" act to obtain the "law differential," which is then used to convert the reported losses under the given act to the level of the basic act. This method has hitherto been employed in conjunction with a flat "law differential," but it is equally applicable to the development of partial or fractional differentials. (b) The "loss experience" method consists in comparing realized pure premiums for a large number of classifications and arriving thereby at an average ratio which is then applied to the reported losses of each classification in turn. This method has been advocated only in connection with partial differentials. (c) Lastly, the reported monetary losses may be ignored and the projected losses for a given jurisdiction arrived at by applying to the reported accidents of each jurisdiction the experienced average cost of similar injuries in the given jurisdiction ["accident experience" method]."

[112] Sample calculations are shown in Harwayne [1977], page 80, and Dropkin [1977], page 89-91. Harwayne provides the following formulas (p. 79): "For any state i, the state average serious pure premium PP_i is computed as:

$$PP_i = \Sigma_j({}_iL_j \div {}_iP_j)\ {}_kP_j \div \Sigma_j\ {}_kP_j$$

The modified national serious pure premium for classification j when revising state k is:

$$\text{serious pure premium} = \Sigma_{i \neq k}\ {}_iL_j\ (PP_k \div PP_i) \div \Sigma_{i \neq k}\ {}_iP_j$$

where ${}_iL_j$ = serious losses for classification j in state i, and
where ${}_iP_j$ = payroll in hundreds for classification j in state i."

It is unclear whether company actuaries will be forming national pure premiums in a loss costs environment.

Classification Credibility

> *"The criteria for 100% credibility has been set on a judgment basis . . ."* – Marshall [1954], page 47.

Workers' Compensation classification rate making uses a unique "classical" credibility procedure. The partial pure premium for a classification is accorded full credibility if the *expected losses* equal or exceed a certain multiple of the average claim cost. The multiple differs for serious, non-serious, and medical claims; the table below shows the standards used by several actuaries or bureaus (Marshall [1954]; Greene and Roeber [1925], p. 259, followed by most other actuaries, such as Barber [1935] and Kallop [1975]; Mahler [1989]).

Full Credibility Standards

	Marshall	Greene & Roeber; Barber; Kallop	Mahler	Current NCCI
Serious	50 Ser.	25 Ser.	175 Ser.	25 Ser.
Non-serious	300 NS	300 NS	120 NS	300 NS
Medical	240 NS	240 NS	190 NS	300 Ind.

Ser. = Average cost of a serious case; NS = average cost of a non-serious case;
Ind. = Average cost of an indemnity case, whether serious or non-serious (medical pure premiums include medical portions of both serious and non-serious cases).

The full credibility standards proposed by Greene and Roeber [1925] for the "permanent ratemaking method" were based more on practicality than on theoretical justification. Serious losses show more loss cost fluctuation than non-serious cases do. But they are also infrequent: even at a full credibility standard of only 25 cases, many classes had little or no credibility for serious cases. Mahler used an empirical test to determine optimal full credibility standards by asking: "What full credibility standard would minimize the mean squared error in the resulting class rates?"[113]

[113] As Mahler notes, though, "Rule 2A: The procedure is generally forgiving of small 'errors' in the weights," so the difference in accuracy for non-serious and medical partial pure premiums resulting from the revised full credibility standards is minor (Mahler [1989], pages 190, 192); see also Mahler [1986]).

The expected cost per case used to determine full credibility standards are derived from indicated experience. Partial credibility is determined with a $^3/_2$ exponent rule, which is justified by the "higher credibility values that it provides for small classifications" (Kallop [1975]).[114] That is, the expected losses required for X% credibility equals the expected losses at the full credibility standard times $(X\%)^{3/2}$.

In the current NCCI ratemaking procedures, the complement of the credibility value is given (a) partially to the national classification experience brought to the state benefit level and (b) partially to the state's industry group experience (Harwayne [1977]). The credibility of the national classification experience is determined by actual claim counts.

The credibility accorded to the national classification experience is limited to one half of the remaining credibility. For instance, if the indicated pure premiums receive a credibility of 40%, the credibility of the national pure premiums is limited to 30% [= one half of 60%].

The "derived by formula" pure premiums are the sum of the products of each pure premium and its credibility. That is,

"derived by formula pure premium" =
- indicated pure premium x state classification credibility
+ • national pure premium x national classification credibility
+ • underlying pure premium x complement of credibility.

The derived by formula classification pure premiums are capped in many states by the overall

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Optimal full credibility standards depend on

- The degree of random fluctuation in the indicated pure premium,
- The reasonableness of the estimate assigned the complement of the credibility, and
- The method used to measure accuracy (e.g., mean squared error).

For a more complete discussion, see Mahler [1990]. Practical considerations also affect the standards chosen: "Is the difference in accuracy sufficient to justify a change in method?" "How does the preference of some insureds for lower full credibility standards, thereby allowing greater weight for their own experience, affect the standards?"

[114] Mahler [1989] found that this formula for partial credibility worked about as well as several alternative procedures used in other lines of business.

rate change ± 25%.[115]

The pure premium changes by classification within each industry group are adjusted to balance to the overall industry group change, by applying to each a "test correction factor." The overall effect of the classification pure premium changes are determined by extending the exposures in each class by the old and new pure premiums.

[115] Earlier procedures used a limit of "the statutory benefit change + (50% *x* the industry group change) ± 25%"; see Kallop [1975]. The capping procedures eliminates extreme indications that might otherwise result from the (linear) credibility weighting procedure; see Mahler [1989] for further discussion.

Section 16: Disease Claims

Workers' Compensation reimburses losses stemming from work-related injuries and occupational diseases, and premium rates must make provision for both of these. Disease claims, however, pose unusual challenges for the pricing actuary. An unadjusted inclusion of these claims in the standard ratemaking procedures may distort the indications. This section reviews the problems in the treatment of disease claims, as well as some potential solutions.

A. Latency

The experience of the recent past is used to predict loss costs in the future policy period. The adjustments discussed earlier in this reading – development, trend, and benefit changes – are needed to make the past and future periods comparable.

Some diseases, such as asbestosis, have long latency periods. The indicated rates must cover such claims stemming from exposures in the future policy period. But no claims from long latency diseases that are attributable to exposures in the most recent policy years are yet evident in the experience. Rather, these claims affect the development patterns – particularly the tail factors from the last valuation date to ultimate.

B. Calendar Year Effects

If development patterns are stable, losses that affect only link ratios (not the observed experience) provide useful information. For instance, if asbestosis claims regularly emerge 10 years after the worker's exposure, and if the relative volume of asbestosis claims to all Workers' Compensation benefits remains steady, then asbestosis claims would raise the ninth to tenth valuation loss development link ratios and increase the estimated ultimate incurred losses.

In practice, the frequency and severity of many Occupation Disesase claims depend on social expectations and judicial precedents, not simply on the date of occurrence. Disease claims should be analyzed by report year and calendar year, in addition to policy year or accident year.

[The policy year of coverage is most important if policy exclusions, limits, or reinsurance retentions affect the net loss.]

C. Trend

Loss cost trends show changes in average frequencies or severities. These changes may stem from economic inflation or other social forces.

Occupational disease claims, stress claims, and psychiatric illnesses are more costly than the average traumatic injury.[116] If a judicial decision or statutory enactment leads to increased filing of such claims, there will be an apparent trend in average claim costs. Since the increased filing may be a non-recurring phenomenon, it is not always appropriate to use this trend for projecting future costs.

For instance, suppose that Occupational Disease claims have twice the average severity of traumatic injury claims. 1,000 injury claims are reported each year, for an average severity of $10,000 in 1992 and $11,000 in 1993 (i.e., a 10% average severity trend). A statutory enactment effective on January 1, 1993, broadening the compensability of certain illnesses, leads to the reporting of 100 disease claims as well, with an average severity of $22,000.

	Injury Claims		Disease Claims		All Claims		
	Claim Count	Average Cost	Claim Count	Average Cost	Claim Count	Total Cost	Average Cost
1992	1,000	$ 10,000	0	0	1,000	$ 10 million	$ 10,000
1993	1,000	11,000	100	22,000	1,100	13.2 million	12,000

The actual severity trend from 1992 to 1993 is 10%. But the inclusion of newly compensable Occupational Injury claims causes an apparent trend of 20%. Clearly, one must include the experience of disease cases in the ratemaking procedures, but in this example it would produce an inappropriate trend factor.

[116] Millus [1987], page 56, notes that "figures indicate that the cost of indemnity in stress cases is double that of cases not involving stress elements becasue of the length of time such claimants remain out of work." Millus [1988], page 39, cites an Aetna Life and Casualty study which "indicated that claims filed for mental health treatment were more than 70% higher than were the health insurance claims which did not involve mental problems."

D. Classification and Jurisdiction

The frequency of occupational disease claims varies greatly by classification and jurisdiction. Because of changing social expectations about compensability for certain diseases, past experience may not be the best guide for future loss costs. Rather, some pricing actuaries separate Occupational Disease provisions into three components:

- A provision derived from past experience, for classifications with histories of asbestosis, silicosis, hearing loss, and similar claims.
- A provision based on actuarial judgment for classifications with likely exposure to claims that lack credible past experience, such as stress claims, psychiatric claims, and various new injuries (e.g., carpal tunnel syndrone).
- A provision for all classifications, to cover unexpected exposures.

Similar considerations apply to jurisdictions. Some states, such as California and Illinois, are believed to have high exposure to claims for intangible injuries, such as stress claims and psychiatric illnesses. The differences among jurisdictions stem from several factors: state statutes regarding compensability, judicial interpretation of work-related illnesses, and the political forcefulness of segments of the medical community.[117]

The incidence of many illnesses, stress ailments, and psychological disorders may not vary as much as their compensability, their perceived relationship to the workplace, and the claim filing practices of workers. Changes in judicial, regulatory, statutory, or social currents may precipitate filing of claims for existing illnessses or injuries. Actuarial judgment is needed to set contingency provisions for each jurisdiction and classification.

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[117] Cf. DeCarlo and Minkowitz [1991], page 445: "In the last few years, there has been an unprecendented increase in claims in which neither the mental stimulus nor the resulting mental disability is associated with any physical event. Additionally, in the 1980s and into the 1990s, there is a growing, and perhaps even a majority, trend that recognizes the compensability of such claims."

E. Pricing Principles for Occupational Diseases

The previous subsections suggest that past experience understates future disease benefit costs. The opposite relationship is also possible. In the 1970's, insurers feared that many asbestos claims would be filed against Workers' Compensation carriers. Plaintiff attorneys have since found it more lucrative to file these claims under General Liability coverages. Workers' Compensation claims require evidence of injury as well as actual lost wages or medical bills. General liability claims are often settled more generously by insurers to avoid potentially large lawsuits (Duckworth [1988]; Field and Victor [1988]; Millus [1988], page 40).

Thus, future loss costs may be higher or lower than past expectations. There are many ways of dealing with disease losses; there are no "standard" methods. The following principles may help guide the actuary first encountering the pricing problems for occupational diseases. The reader should take these principles as suggestions only, for they will evolve in tandem with the Workers' Compensation environment.

- Non-traditional claims, such as stress claims, psychological disorders, and some Occupational Disease claims, should be examined separately from traditional claims.

- The influence of latent disease claims on loss development patterns should be analyzed for report year and calendar year effects.

- The effects of changing reporting patterns and compensability for high-cost disease and stress claims on average severity trends should be removed when making future projections. Future reporting patterns and compensability for these claims should be estimated separately, and an appropriate provision should be added to the premium rate to cover these claims.

- Three part provisions should be estimated by classification and jurisdiction: (a) a provision based on past experience, (b) a provision based on expected future experience, and (c) a general contingency provision for unanticipated claims.

Section 17: Epilogue

"The greatest difficulties in insurance ratemaking do not require access to data or a knowledge of complicated mathematics, but rather the appropriate exercise of informed judgment."

– Mintel [1983], page 2

Until the 1980's, Workers' Compensation was a stable and profitable line of business. Revenues fluctuated rather mildly, crises were short-lived, insurance programs endured, and pricing techniques changed but slowly.

In the late 1970's and 1980's, some parts of the Workers' Compensation system began to unravel. Costs increased, new types of claims emerged, durations of disability lengthened, attorney involvement increased, profits declined, residual markets grew, and better risks began leaving the insurance market. Insurers and rating bureaus have responded with alternative risk management programs, changes to the involuntary pools, and cost containment measures.

As the Workers' Compensation system evolves, pricing actuaries must modify the ratemaking procedures. This section discusses the emerging issues in Workers' Compensation pricing.

A. Loss Costs

The complexities of pricing insurance products, particularly for long-tailed lines like Workers' Compensation, led to administered pricing systems and the partial antitrust exemption embodied in the McCarren-Ferguson Act.[118] In the 1950's and 1960's, rating bureau actuaries developed rates for each line of business. Member companies generally adhered to these rates or deviated by systematic percentages across all classes. The statutory requirements for Workers' Compensation insurance, and the public policy objectives of timely and certain compensation for injured employees, led some states to require membership in

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[118] In an administered pricing system, "all insurers use uniform rates, filed by a rating bureau, which have received the prior approval of the state insurance department" (Klein [1986], p. 79). In a competitive rating system, "rates are not set by a rating bureau or subject to prior approval but are established by market forces" (*ibid.*, page 80).

rating bureaus and prior approval regulation for rate changes, even if less restrictive regulations were used in other lines.

Administered pricing systems sometimes constrain innovative marketing strategies and ratemaking programs. The Personal Lines of insurance, with their large volumes of homogeneous risks, have less need for rating bureaus. Independent, low-cost carriers developed successful ratemaking strategies, and they soon dominated the profitable markets.

By the mid-1980's, pricing independence and innovation was spreading to the Commercial Lines, for several reasons:

- *Saturation:* After "skimming the cream" of the Personal Lines markets, the large direct writers entered the corresponding Commercial Lines markets: small businessowners, Commercial Automobile, CMP, and Personal Lines reinsurance.

- *Imitation:* The dominant Commercial Lines writers observed the successes of independent Personal Lines carriers and began experimenting with similar programs of their own.

- *Judicial Developments:* The right of rating bureaus to require rate adherence by their members was curtailed by the courts in the 1950's. Judicial decisions in the 1980's began chipping away at the McCarren-Ferguson partial antitrust exemption.

- *Politics:* The rising costs of insurance has encouraged some consumer activists and politicians to find inefficiencies and excessive profits in administered pricing systems.

- *Actuarial Expertise:* Casualty actuaries have become more proficient, rate making techniques have evolved, and low-cost, efficient computers have been developed. Even moderate sized carriers can now develop rates independently.

In 1989, the Insurance Services Office announced a transition from advisory rates to loss costs, and by the early 1990's, the National Council on Compensation Insurance followed suit. The coming roles of the rating bureau and company actuaries may vary by jurisdiction, depending on

the loss cost system implemented in each state.[119]

B. Elements of Loss Cost Systems

In a loss cost system, the rating bureau does not determine advisory rates. Rather, it provides historical loss data so that member companies can develop their own rates. Loss cost systems vary by jurisdiction. The following section outlines the probable roles of the rating bureau and carriers during the 1990's in loss cost jurisdictions.

Rating bureaus will provide:

- Historical exposure, pure premium, claim count, paid loss, and incurred loss data.
- Development factors, either to ultimate or to an advanced valuation.
- Cost implications of legislative or regulatory changes.
- Factors to bring pure premiums and benefits to current levels.

Member companies must determine

- Underwriting and acquisition expenses reflecting their own operations.
- Underwriting profit provisions.

Differences of opinion exist for several ratemaking procedures:

- *Loss cost trends:* Rating bureaus would like to retain authority to trend losses (Hager [1992], page 193). This is particularly true in Workers' Compensation, where the trend factors are influenced by complex social and economic developments. Some regulators and consumer activists believe that rating bureaus should provide data only. Projections about future changes in loss costs should be left to the carriers.

- *Involuntary pool burdens:* Rating bureaus administer the pools, and they have the best information for estimating their likely costs. As with trending, however, the

[119] Klein [1986], page 84, is skeptical of the alleged differences in Workers' Compensation: "Despite its traditional acceptance, an informational basis for regulation of workers' compensation insurance is not persuasive. It is not evident why it is necessary for regulators to force insurers to use uniform rates and classifications. Presumably, those insurers who would find it advantageous to share cost data on a uniform basis should be able to do so without governmental oversight as is the case in other property-casualty insurance lines." See also Bailey [1982], Countryman [1982], AIA [1982], and Appel and Gerofsky [1985; 1987]. Appel presents a summary of the effects of competitive rating by jurisdiction in Victor, Appel, Gardner, and Edwards [1992], tables 1 and 4.

involuntary market burdens are projections about future costs. Some analysts believe that rating bureaus should provide the needed data (e.g., market shares, pool operating margins, pool underwriting and rating programs), but member carriers should calculate the burden.

- *Assessments:* Assessment rates do not vary by carrier, so a quantification by the bureau seems efficient. However, there is no need for industry-wide data to estimate the assessment costs.

Unresolved issues with major implications for Workers' Compensation ratemaking include:

- *Experience rating plans:* Until recently, the Workers' Compensation experience rating plan was uniform among insurers and mandatory in almost all jurisdictions. Rating bureaus argue that a mandatory and uniform experience rating plan promotes equity among employers and encourages safety programs. Some insurers respond that the mandatory plan constrains innovative pricing programs; competitive markets require more flexible plans.

- *Classifications:* The most powerful competitive advantages in insurance pricing result from more efficient or more discriminating classification systems. The variety of potential classification dimensions in Workers' Compensation make classification freedom particularly enticing for some insurers. Rating bureaus are concerned, however, that the use of multiple classification systems will destroy the integrity of the Workers' Compensation database and hinder the compilation of industry-wide loss costs.

- *Economic incentives from law amendments:* The indirect incentive effects of statutory benefit changes and reforms of the compensation system are sometimes as great as the direct effects. Presently, rating bureaus quantify the direct cost effects of proposed legislation, which carriers apply to both existing and new policies. The indirect incentive effects are harder to quantify: they vary among groups of insureds and by type of compensation system. It is unclear how the indirect effects will be handled in a loss cost environment.

Some jurisdictions will leave these functions to rating bureaus; others will hand them to the individual carriers. Workers' Compensation pricing actuaries must be competent to deal with these issues as they arise.

Appendices A-E: Rate Filing Illustrations

Workers' Compensation rate filings vary by state, by insurer (or bureau), and by purpose. This section contains exhibits from a recent rate filing to illustrate the methods in use.[120] The pricing actuary should not simply copy these exhibits. Rather, he or she must determine what procedures are needed for each filing and devise the exhibits accordingly.

Minnesota

Each year, the Minnesota Workers' Compensation Insurers Association produces a pure premium review for an effective date of January 1, including the cost implications of benefit changes effective each October 1. The January 1992 review indicates

- an experience increase of +6.1%,
- a benefit change cost increase of +0.4%,
- for a total change of +6.5%.

This Minnesota review uses experience from policy year 1989 and calendar/accident year 1990. Premiums are developed and brought to current level. Losses are developed to an eighth report, not to ultimate, and are not trended. No expenses, whether claim expenses, general expenses, taxes, or assessments, are included in the advisory pure premiums. However, the Minnesota review contains information to aid the pricing actuary in determining these factors.[121]

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[120] This study note has been prepared for the May 1994 Part VI examination. Future versions of this study note will include exhibits showing the quantification of residual market burdens, of the direct and indirect effects of law amendments, and of changes in expense provisions. Readers interested in these subjects may review Mahler and Liu (1993) on residual market burdens, Butler and Worrall (1983; 1985) on the incentive effects of law amendments, and recent NCCI filings for the direct effects of law amendments and the treatment of changes in expense provisions. The Butler and Worrall papers have recently been added to the Part IX examination syllabus. None of these papers are required for the Part VI examination.

[121] The Minnesota exhibits, used with permission of Mr. Craig A. Anderson, Vice President of Actuarial Services at the Minnesota Workers' Compensation Insurers' Association, are particularly clear. They serve as valuable instructional material for the new actuary first approaching workers' compensation ratemaking. These exhibits are education material only. The inclusion of these exhibits in an examination syllabus study aid should not be interpreted as an endorsement by the CAS of any results or procedures of the Minnesota Workers' Compensation Insurers' Association.

A.1: Premium Development – Financial Data

Workers' Compensation exposures are determined by audit after the expiration of the policy. In addition, for loss sensitive insurance contracts, such as retrospectively rated policies, the premium is adjusted each year as losses are settled, until no further changes are expected.

Thus, policy year premiums develop over time, as audit and retrospective adjustments are made. Exhibit Appen.A.1 (page 54) shows the industry-wide premium development factors.[122] Almost all the development occurs by the second report; development factors beyond the second report are selected as unity.[123]

A.2: Premium Development - Unit Statistical Plan Data

Exhibit Appen.A.2 (page 123), shows premium development factors derived from Unit Statistical Plan (USP) data, which are used for determining classification pure premiums. These USP data are less mature than financial data, so the premium development factors are slightly higher: 1.021 for first to second report, 1.002 for second to third report, and unity thereafter.[124]

Since industry-wide premium volume is relatively stable from year to year, no premium development factors are deemed to be needed for calendar/accident year experience. [See Section 6.B for further discussion of this topic.]

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122 The page numbers in parentheses following the exhibit numbers refer to the page numbers in the 1992 Minnesota filing, not to page numbers in this study aid. Some of the exhibits are labeled in the Miinnesota filing (e.g., "Minnesota Exhibit B-19"). For these exhibits, no relabeling is used in this study note.

123 Note that the right-most column, "1st to 5th report," is the product of the factors along the diagonal, not along the row. For instance, the last observed figure in this column, 1.014, is the product of 1.010, 1.004, 0.999, and 1.001, not the product of 1.014, 0.998, 0.982, and 1.001. As noted in Section 5.A, premium development patterns vary by company, depending on the rating plans and policy payment forms offered. Industry-wide development patterns may not be applicable to an individual company's experience.

124 The Unit Statistical Plan first report is 18 months after policy inception. Were policy effective dates uniformly distributed through the year, financial data first report would also be 18 months after policy inception, on average. Since the distribution is skewed towards January 1, financial data first report is more than 18 months after policy inception, on average.

B. Bringing Pure Premium to Current Level

Three items are used to bring pure premiums to the current level:

- The distribution of writings by effective date.
- A history of pure premium level changes.
- A calculation of pure premium "on-level" factors.

B.1 Distribution of Writings by Effective Date

Minnesota Exhibit B-21 (page 85) shows the distribution of premiums by month. The title says "Derivation of Benefit On-Level Factors," though this distribution is also used to calculate the calendar/accident year on-level factors for experience rate changes. The filing assumes that all policies are written on the first of each month.

January has the largest volume, since many insureds desire January 1 policies. February has the smallest volume, since a February policy is often adjusted to a January 1 effective date.

B.2 Rate Change History

In Minnesota, experience rate changes are effective on January 1 and benefit changes are effective on October 1. The relevant experience rate revisions are a +2.7% change on January 1, 1990, and a –2.8% change on January 1, 1991.

Statutory benefit changes are shown in Minnesota Exhibit B-19 (page 83): "Derivation of Benefit Current Level Factors." The medical benefit factors are unity since 1982. This is generally true in states where Workers' Compensation medical benefits are unlimited.[125]

For the statewide pure premium level change, the benefit adjustment factors are "weighted by

[125] In some states with medical fee schedules, changes in these schedules are treated as law amendments for ratemaking purposes.

type of injury." For classification pure premiums, the individual factors are needed, since

- the mix of losses by type of injury differs by classification, and
- the benefit adjustment factors differ by type of injury.

B.3 Distribution of Policy Effective Dates

Minnesota Exhibit B-22 (page 86), "Derivation of Benefit On-Level Factors," determines the weights for policy year 1988. (The same weights are used for policy years 1986 and 1987.)

- Column 1 shows the percentage of premium effective in each month: 18.2% for January, 5.0% for February, and so forth.

- All January policies are assumed to be effective on January 1 and expire on December 31. They spend 9 months at the 10/1/87 – 9/30/88 benefit level (Area A), 3 months at the 10/1/88 – 9/30/89 benefit level (Area B), and 0 months at the 10/1/89 – 9/30/90 benefit level (Area C), as shown in columns 2, 5, and 8, respectively. Similar calculations are made for each effective month.

- Columns 3, 6, and 9 are columns 2, 5, and 8 divided by 12, thereby converting months into fractions of a year.

- Columns 4, 7, and 10 are these fractions times the distribution of effective dates by month (column 1). The totals of columns 4, 7, and 10 are the percentages of the policy year earned premium at each benefit level.

B.4 On-Level Factors by Type of Injury

Minnesota Exhibit B-20 (page 84), "Calculation of Factors to Adjust Unit Stat.Plan Losses to Benefit Level Effective October 1, 1990," determines benefit on-level factors for policy years 1986, 1987, and 1988. [These three policy years are used for classification pure premiums. The statewide pure premium indication uses policy year 1989 and calendar/accident year

1990.] Policies issued in 1986 may provide benefits at the 10/1/85, 10/1/86, or 10/1/87 levels. For instance, a policy issued on January 1, 1986, provides 9 months of coverage at the 10/1/85 benefit level and 3 months at the 10/1/86 benefit level. A policy issued on December 1, 1986, provides 10 months of coverage at the 10/1/86 benefit level and 2 months at the 10/1/87 benefit level.

- The 10/1/85 benefits are the "base" level, and subsequent benefit levels are shown as cumulative changes. For instance, the 1.191 "cumulative effect of amendments" for Permanent Total disabilities effective on 10/1/89 is the product of 1.048, 1.041, 1.037, and 1.053.

- The percentages of policy year earned premium derived in Exhibit B-22 are shown in the three right-most columns in Exhibit B-20 (page 84), "Distributions of Business." The average benefit levels shown in the middle rectangle are the products of the "cumulative effects of amendments" in the upper rectangle and the respective distribution of business. For instance, the 1.117 average benefit level for Permanent Total disabilities for policy year 1988 is derived as

$$1.117 = (1.091)(0.364) + (1.131)(0.619) + (1.191)(0.017).$$

- The "Amendment Factors" in the bottom rectangle are the current (10/1/90) cumulative amendment effects from the top rectangle divided by the average benefit levels from the middle rectangle. For instance, the 1.104 amendment factor for Permanent Total disabilities for policy year 1988 is the 1.233 "cumulative effect of amendments" at 10/1/90 divided by the 1.117 average benefit level for policy year 1988.

B.5 Statewide On-Level Factors

For the statewide rate indication, all injury types are combined. The Minnesota filing has two exhibits, one for policy year 1989 and one for calendar year 1990, reproduced here as Exhibits Appen.B.5a and Appen.B.5b (pages 47 and 48). Each exhibit shows "current level factors," or on-level factors, for pure premium level changes, indemnity benefit changes, and

medical benefit changes.

The pure premium advisory rate changes are effective on January 1 of each year, so the policy year current level factor is the current cumulative index divided by the cumulative index for that policy year. [In Exhibit Appen.B.5a (page 47), this is 0.998 ÷ 1.000 = 0.998.]

The calendar year current level factor depends upon the distribution of policy effective dates. Policies written after January 1, 1989, but before January 1, 1991, affect 1990 earned premiums. [All January 1989 policies are assumed to be written on January 1, 1989, so they have no effect on 1990 earned premium.] February 1989 policies are assumed to be written on February 1, 1989, so $^{11}/_{12}$ of the policy affects 1989 earned premium and $^{1}/_{12}$ affects 1990 earned premium. Using the distribution of policies by effective date from Exhibit B-21, the percentage of 1989 writings earned in 1990 is 40.2%:

$$(0*18.2\% + 1*5.0\% + 2*7.1\% + 3*10.5\% + 4*8.5\% + 5*7.4\% + 6*10.5\% + 7*5.1\% + 8*6.2\% + 9*8.0\% + 10*6.9\% + 11*6.5\%) \div 12 = 40.2\%.$$

Similarly, the percentage of 1990 writings earned in 1990 is 59.8%:

$$(12*18.2\% + 11*5.0\% + 10*7.1\% + 9*10.5\% + 8*8.5\% + 7*7.4\% + 6*10.5\% + 5*5.1\% + 4*6.2\% + 3*8.0\% + 2*6.9\% + 1*6.5\%) \div 12 = 59.8\%.$$[126]

Indemnity benefit changes by type of injury are shown in Exhibit B-19 (see above). The "Policy Year 1989 Indemnity Benefits" uses a weighted average of the benefit changes by type of injury to determine overall current level factors. The policy year weights (0.364, 0.619, and 0.019) are discussed above.

The "Accident Year 1990 Indemnity Benefits" calculation is similar to the policy year

[126] The calculations shown here actually give 40.3% and 59.7%, because only one decimal place is shown.

calculation, but the experience period and the weights are different.[127] The current level factors for medical benefits are unity, since there were no statutory changes.

C. Developing and Adjusting Losses

The adjustments to losses have great effect on the indicated rates, since they are large and uncertain. The Minnesota filing develops losses to an eighth report and brings losses to the current benefit level; it does not

- Develop losses from an eighth report to ultimate,
- Trend losses from the experience period to the future policy period,
- Add loss adjustment expenses, or
- Add loss based assessments.

However, the filing contains informational exhibits for these items. In a loss costs environment, bureaus may provide data and illustrative exhibits, but company actuaries must perform the actual adjustments to the experience. The division between what may be performed by the bureau and what must be supplied by the individual insurer differs by state and will presumably evolve over time.

C.1 Loss Development: First to Eighth Report

The Minnesota filing uses a paid loss development ("chain-ladder") procedure from first to eighth report and applies a "paid to incurred" ratio as a tail factor. The previous (1991) Minnesota filing used an incurred loss development procedure. Because different loss development procedures lead to different indicated pure premiums, the Minnesota filing provides complete loss development exhibits for three types of data: paid losses, incurred losses

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127 The footnote to the Minnesota exhibit comments that "weights are based on a distribution of Minnesota premium by effective month." Since

- Benefit changes apply to both new and exiting policies,
- The volume of business by year is assumed to be stable, and
- This is an accident year calculation,

the distribution of premium by effective month does not affect the weights.

excluding IBNR (i.e., paid losses plus case reserves), and total incurred losses. In addition, full pure premium exhibits are provided for each development procedure.

The Minnesota filing notes that

> *" . . . several facets of the benefit delivery system have changed since the benefit reform legislation in 1984. For example, the distribution of claim types has changed with claims involving temporary partial benefits becoming more common. . . . Additional analysis of loss development patterns was performed through curve fitting. These results indicated that the paid loss development approach provided the most reliable indication based on data evaluated through December 31, 1990."*

In other words, reform legislation may affect not only benefit levels and administration of the system, but also the distribution of injury by type (see Section 10.A). The distribution of injury by type, in turn, affects the loss development patterns (see Section 7.B).

Exhibit Appen.C.1a (page 50) shows Minnesota policy year indemnity paid loss development from first through eighth report. The link ratios, or report to report factors, have declined since 1984. [See, for example, the column labeled "4th to 5th report": the pre-1984 factors average 1.132; the 1984 and 1985 factors average 1.098.] The Minnesota WC Insurers' Association uses the average of the most recent two link ratios for development through the fifth report, and downward selected link ratios for development from fifth through eighth reports. The development factor from first through eighth reports is 3.509, as shown in the right most column and "selected" row.

This factor develops paid losses at first report to paid losses at eighth report. Only part of the incurred losses have been paid through the eighth report, so the 3.509 factor must be divided by the expected "paid to incurred" ratio at that time. The bottom half of Exhibit Appen.C.1a (page 50) shows paid to incurred ratios at various valuations. Since data is not yet available for policy years after 1984, the "average of all" at eighth report is selected, or 0.775.

The development factor from paid losses at first report to incurred losses at eighth report is therefore 3.509 ÷ 0.775, or 4.528. This factor is applied to policy year 1989 paid indemnity losses valued at December 31, 1990 ($81,359,039); see Exhibit Appen.B.5a (page 47), rows 5 and 6.

Similar exhibits are shown for policy year medical benefits, accident year indemnity benefits, and accident year medical benefits (Exhibits Appen.C.1b, Appen.C.1c, and Appen.C.1d [pages 51-53]). Note that

- Medical benefits are paid sooner than indemnity benefits. Paid medical benefits are greater than paid indemnity benefits at first report ($89,957,850 > $81,359,039; see Exhibit Appen.B.5a [page 47], rows 5 and 10), but the indemnity paid loss development factor exceeds the corresponding medical factor (4.528 > 2.225; see Exhibit Appen.B.5a [page 47], rows 6 and 11).

- Policy year 1989 is more mature than accident year 1990. Policy year 1989 benefits paid by Dec. 31, 1990 exceed accident year 1990 benefits paid at that date, but the accident year loss development factors exceed the policy year development factors. (Compare the indemnity benefits section in Exhibits Appen.B.5a [page 47], rows 5 and 6, and Exhibit Appen.B.5b [page 48], rows 4 and 5: $81,359,039 > $37,982,722, but 4.528 < 9.364.)

Appendix 8 of the Minnesota filing (not reproduced here) shows (a) paid plus case loss [i.e., incurred loss excluding IBNR] and (b) incurred loss development factors, for both policy year and accident year experience. Appendix 1 of the Minnesota filing shows the indicated pure premium level changes based on the "paid plus case" loss development and incurred loss development. The results are summarized on page 1 of the filing, in the table reproduced below:

Experience Period	Paid Loss Development	Incurred Loss Excluding IBNR Development	Incurred Loss Development
Policy Year 1989	+9.3%	+4.5%	+6.6%
Accident Year 1990	+3.7	+2.8	+7.3
Averages	+6.5	+3.7	+7.0

C.2 Eighth to Ultimate Development

In Workers' Compensation, substantial loss development continues even after the eighth report. For instance, the observed link ratios for "paid plus case losses" are about 1.025 from 6th to 7th report and 1.015 from 7th to 8th report, suggesting that link ratios above unity continue for several more years.

The development from first to eighth reports is dependent upon averages of observed patterns. The development from eighth report to ultimate depends to a greater degree upon actuarial judgment. It is not included in the advisory pure premium filing. Rather, the Minnesota filing says (page 3):

> *"Policy year and accident year eighth to ultimate loss development factors applicable to indemnity and medical losses have been included in Appendix 2 for your information. . . . Carriers that wish to maintain the relativities as indicated above and to reflect the industry average eighth to ultimate development factor of 1.110 need only apply a single factor of 1.110 to each pure premium base rate to reflect loss development beyond an eighth report. Carriers that choose to address long-term loss development in some other fashion may opt to either remove or modify the relativities at their discretion. It should be pointed out that a review of individual carrier eighth to ultimate development factors continues to reveal wide differences between carriers. Carriers should closely examine their own company's industrywide results."*[128]

Appendix 2 is reproduced here as Exhibits Appen.C.2 through Appen.C.5d (pages 102-109). Minnesota uses 5 methods, with 3 variants for each of the first 2 methods, for estimates ranging from 1.092 to 1.162 (see the right-most column of Exhibit Appen.C.2 [page 102]). The selected factor of 1.110 is distributed by type of injury (serious indemnity, non-serious indemnity, and medical; see below).

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[128] Just as there are differences among carriers in the eighth to ultimate development factors, there are offsetting differences in the paid to incurred ratio at eighth report. When selecting factors, the actuary must carefully examine how his company's experience relates to that of the industry as a whole.

C.3 Eighth to Ultimate Development – Method 1

Method 1 determines the eighth to ultimate tail factor as

- the adverse loss development in a given calendar year
- for policy or accident years at eighth report or older, divided by
- the average eighth report losses for these policy or accident years (see Exhibit Appen.C.3 [page 103]).

At December 31, 1989, policy years 1981 and prior are at an eighth report or older. At December 1989, indemnity losses for these policy years were valued as $2,105,319,064; at December 1990, these losses were values as $2,134,692,280 (Exhibit Appen.C.3 [page 103], policy year section, rows 2 and 3). Thus, the calendar year 1990 adverse loss development for these policy years was $29,373,216 (Exhibit Appen.C.3 [p 103], policy year section, row 4).

In theory, this loss development should be compared to the weighted average of losses at eighth report for all the policy years involved, where the weights are the percent of development that stems from each policy year. These figures are not readily available. Since most of the development stems from the most recent policy years at 8th report or older, Method 1 uses the average reported losses for the three most recent policy years at 8th report or older. For the first example, these are policy years 1979 through 1981, whose average eighth report indemnity losses are $248,806,468 (Exhibit Appen.C.3 [p. 103], policy year section, row 1).

The ratio of $29,373,216 to $248,806,468 is 0.118, so the required tail factor is 1.118 (Exhibit Appen.C.3 [page 103], policy year section, row 5).

The same procedure is done for medical benefits, yielding a tail factor of 1.189, and for all benefits combined, for a tail factor of 1.136. Note that the link ratios from first to eighth report are higher for indemnity than for medical benefits, but the tail factor from eighth to ultimate is higher for medical. Indemnity benefits pay out more slowly than medical benefits, so the link ratios for the first eight valuations are higher for indemnity, both for paid and incurred loss developments. The tail factor stems from serious cases: fatalities, permanent

total disabilities, and major permanent partial disabilities. Reserves at eighth valuation are generally stronger for indemnity benefits than for medical, since the indemnity benefits are fixed by statute and can be more easily estimated. [Note that the "paid to incurred" ratios at eighth report are lower for indemnity (policy year: 0.775) than for medical (policy year: 0.840); see Exhibits Appen.C.1a and Appen.C.1b (pages 50 and 51).] Thus the tail factor to ultimate is often higher for medical benefits.

This procedure is performed for three loss developments: calendar years 1990, 1989, and 1988. One-year, two-year, and three-year averages are carried to Exhibit Appen.C.2 (page 102).

The bottom half of Exhibit Appen.C.3 (page 103) shows accident year tail factors from eighth report to ultimate. Since accident year experience at eighth report is less mature than policy year experience at eighth report, the accident year tail factors are higher. For instance, the indemnity benefit tail factor using calendar year 1990 loss development is 1.118 for policy year and 1.142 for accident year. However, the greater maturity of the policy year experience at eighth report causes the eighth report policy year losses to be greater than the eighth report accident year losses (see Exhibit Appen.B.5a [page 47], row 8, and Exhibit Appen.B.5b [page 48], row 7: $372,814,453 > $357,448,560).[129]

C.4 Eighth to Ultimate Development – Method 2

Method 1 divides the calendar year loss development by a three year average of eighth report losses. Method 2 divides the calendar year loss development by the eighth report losses for the policy or accident year that expires eight years previously (see Exhibits Appen.C.4a and Appen.C.4b [pages 104-105]). For instance, consider the last row in Exhibit Appen.C.4a [page 104]. The policy years 1981 and prior losses valued at December 31, 1989, and December 31, 1990, as well as the difference between them, are the same as in Exhibit Appen.C.3 [page 103]. The $29,373,216 indemnity difference is divided by policy year indemnity losses valued at December 31, 1989 ($234,449,121) to give an eighth to ultimate tail factor of

[129] In truth, the policy year tail factor should be applied to policy year losses and the accident year tail factor to accident year losses. Since the filing uses the average eighth report losses for the pure premium indication, the average eighth to ultimate tail factor is provided for information.

1.125. This procedure is performed for five different years, for indemnity and medical benefits, and for policy year and accident year experience.[130] The one-year, two-year, and three-year averages are carried to Exhibit Appen.C.2 [page 102].

C.5 Eighth to Ultimate Development – Methods 3, 4, and 5

Methods 1 and 2 use a chain ladder loss development procedure from first to eighth reports and the aggregate calendar year loss development procedure from eighth report to ultimate. The bureaus are now collecting data beyond eighth report (see Section 6.A). Data through 10th report was available in 1990 and through 11th report in 1991.

Method 3 extends the chain ladder procedure through the 10th report and uses the aggregate calendar year procedure for 10th report to ultimate (Exhibits Appen.C.5a and Appen.C.5b [pages 106-107]). Method 4 extends the chain ladder procedure through the 11th report and uses the aggregate calendar year procedure for 11th report to ultimate (Exhibits Appen.C.5c and Appen.C.5d [pages 108-109]). For instance, in Method 4, the policy year link ratio from eighth to eleventh reports is 1.037 for indemnity benefits and 1.019 for medical benefits, for a combined factor of 1.031 (Exhibit Appen.C.5c [page 108], policy year section, row labeled "Avg-All"). The eleventh to ultimate policy year tail factors are 1.059 for indemnity and 1.183 for medical, for a combined factor of 1.088 (Exhibit Appen.C.5c [page 108], policy year section). The product of 1.031 and 1.088 is 1.121, which is carried to Exhibit Appen.C.2 [page 102].

Method 5 uses curve fitting techniques, as the footnote to Exhibit Appen.C.2 [page 102] says. No supporting exhibits are provided in the Minnesota filing.

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[130] The Method 2 tail factors are consistently higher than the Method 1 tail factors (see Exhibit Appen.C.2 [page 102]). This implies that losses valued at eighth report have been declining over the experience period. This seems counter-intuitive; it is true for indemnity losses in Exhibit Appen.C.4a [page 104] but not for medical losses. Note that the three year average losses valued at eighth report in Method 1 do not tie to the corresponding losses in Method 2. For instance, the 1979-1981 average indemnity losses valued at eighth report in Exhibit Appen.C.3 [page 103] is $248,806,468. The corresponding number in Exhibit Appen.C.4a [page 104] is $238,703,532 [= ($246,125,516 + $235,535,958 + $234,449,121) ÷ 3]. Such discrepancies are sometimes caused by different carriers used for each policy year. This does not seem to be the case here, since the 1981 and prior losses valued at December 31, 1989, tie exactly between the two exhibits.

C.6 Development by Type of Injury

The financial data used for overall statewide indications provides development histories through eighth report (used for advisory pure premiums) and additional history through the eleventh report (used for the loss development tail factor). Development patterns differ by type of injury, being highest for permanent total disabilities and lowest for temporary disabilities. Since classes have different expected mixes of types of injury, the overall development patterns are not appropriate for determining classification pure premiums.

Data by type of injury is available from the Unit Statistical Plan, which provides five reports. Case incurred loss development patterns by type of injury are provided in Appendix 7, pages 123-138, of the Minnesota filing (not reproduced here). Development from fifth report to ultimate obtained from financial data is allocated entirely to serious cases.

The exhibits show development triangles of

- indemnity losses,
- medical losses,
- total losses, and
- claim counts

for six types of injury:

- death,
- permanent total,
- major permanent partial,
- minor permanent partial,
- temporary total, and
- medical only.

The Unit Statistical Plan does not show bulk reserves or benefit payment transactions, so only "paid plus case reserve" development triangles are shown.

C.7 Adjustments to Current Benefit Levels

The Minnesota filing adjusts the indemnity losses to current benefit levels by applying factors of 1.012 for policy year 1989 experience (Exhibit Appen.B.5a [page 47], row 7) and 1.005 for accident year experience (Exhibit Appen.B.5b [page 48], row 6). These are the same

factors included in the premium adjustment; they are derived from Exhibits Appen.A.1b and Appen.A.1c [pages 55-56].

The Minnesota filing excludes the indirect (incentive) effects of law amendments from the adjustments to current benefit level, but includes them in the loss ratio trend procedure (see below). For Minnesota, this is reasonable, since the benefit level changes have been similar each year (see Section 10).

If benefit level changes vary significantly from year to year, this procedure may over- or underestimate the required pure premium level change. For instance, suppose there were a large benefit increase on January 1, 1991, with a +20% direct effect and a +10% incentive effect. The 1992 filing would underestimate the required pure premiums, since it assumes a +20% increase in losses when +32% [= 1.10 *x* 1.20] should be expected. The 1993 and 1994 filings may overestimate the required pure premiums. The +32% increase has shown up in the observed losses, and the +10% incentive effect is also incorporated in the loss ratio trend factor. But if there are no large benefit changes after 1991, the trend factor is too high.

As noted in Section 10, the most accurate procedure is to separately quantify the incentive effects and include them in the law amendment factors, not in the trend factors. However, this is needed only when benefit changes vary from year to year, so it is not necessary for the Minnesota filing. Moreover, the quantification is difficult; including all incentive effects in the loss ratio trend is easier.

D.1 Benefit Trends

Workers' Compensation benefits are increasing more rapidly than payrolls. The exhibits in this section show a loss ratio trend applied to developed loss ratio (the Minnesota method). NCCI rate filings remove the previous trend from premiums to provide trended loss ratios, and the *change* in loss ratio trend is applied to the modified loss ratios. Some bureaus and insurance companies use benefit trends estimated from econometric indices or from internal data.

Appendix 3 of the Minnesota filing, reproduced here as Exhibits Appen.D.1a through Appen.D.1c [pages 110-112], shows indemnity and medical loss ratio trend factors. The medical loss ratio trend is reviewed here (Exhibit Appen.D.1a [page 110]); the procedure for determining the indemnity trend is the same.

Minnesota derives the annual trend factors by fitting loss ratios developed to an eighth valuation to an exponential curve. The final trend factor is selected after examining the statewide and countrywide indicated trends. The "goodness of fit" of the observed loss ratios to the fitted curve is examined, though no formal credibility weighting is used.

- Line 1 shows the *policy year*. Policy year data has traditionally been used in Workers' Compensation, for rate indications, classification pure premiums, and loss ratio trends.[131]

- Line 2 is a *time index* used for the regression. It is used on lines 18 and 19 to determine the length of the trend period.

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[131] Benbrook [1956], page 56, notes that "Accident year experience shows pure premiums and claim frequencies for consecutive calendar or fiscal year periods; so that data for any given year can be compared with data for subsequent years, and any trend that develops is readily apparent. On the other hand, similar data on a policy year basis cover a period of two calendar years and do not reflect the true loss conditions for any given year." Accident year loss ratios may eventually replace the policy year loss ratios in the trend calculations.

Some actuaries derive loss cost trends from closed claim severities on a settlement year basis, since this provides the most recent data (cf. the Fast Track trend indices for Personal Auto). In the liability lines of business, where lump sum payments are influenced by public sentiment and economic inflation through the payment date, this procedure is especially useful. In Workers' Compensation, where weekly indemnity benefits may be paid for decades and the amounts are determined by pre-injury wages along with cost of living adjustments (in some jurisdictions), closed claim severities are less appropriate.

- Line 3 shows *standard earned premium*, valued at December 31, 1990. The policy year 1989 figure, $518,435,490, agrees with the premium shown on Exhibit Appen.B.5a (page 47), line 1.

- Line 4 shows *development factors*, as calculated on Exhibit Appen.A.1a (page 54).

- Line 5 shows *on-level factors*. The policy year 1989 figures, 0.998, agrees with the factor shown on Exhibit Appen.B.5a (page 47), line 3, or Exhibit Appen.A.1b (page 55), "Policy year 1989 Pure Premium" section, right most column.

- The *adjusted premium* on line 6 is the product of lines 3, 4, and 5.

- Line 7 shows *medical losses*, valued at December 31, 1990. The policy year 1989 figure, $89,957,850, agrees with Exhibit Appen.B.5a (page 47), line 10.

- Line 8 shows *development factors* derived from the paid loss experience. The policy year 1989 figure, 2.226, agrees with Exhibit Appen.B.5a (page 47), line 11. All the factors can be derived from Exhibit Appen.C.1c (page 51). For instance, the policy year 1985 figure, 1.288, is the product of the selected link ratios from 5th through 8th report, divided by the selected paid to incurred ratio at 8th report, or (1.035 * 1.025 * 1.020) ÷ 0.840 = 1.288. The development factors do not include the 8th to ultimate tail factor.

- Line 9 shows the *medical on-level factors*, which are unity for all policy years. [The indemnity factors are different from unity. For the 1989 year, the indemnity factor of 1.012 shown on Exhibit Appen.D.1a (page 110), line 9, agrees with Exhibit Appen.B.5a (page 47), line 7.]

- The *adjusted losses* on line 10 is the product of lines 7, 8, and 9.

- Line 11 shows the *developed loss ratios* at current rate and benefit levels. The policy year 1989 figure, 0.3806, agrees with Exhibit Appen.B.5a (page 47), line 14. These loss ratios are the dependent ("y") variables in the exponential fit.

- To convert the exponential trend to a linear trend, the *natural logarithms* of the dependent variables are used on Line 12 (see Section 8.C). The exponential curve is $y = be^{ax}$, or ln (y) = ax + ln (b) (compare McClenahan [1990], page 51).

- Lines 13 through 17 determine the *parameters* of the exponential fit. [For determining the regression coefficients, see Wheelwright and Makridakris [1989], page 150; or DeGroot [1975], page 501, equation (5)].

- Lines 18 and 19 determine the length of the *trend period.* Policy year 1989 and accident year 1990 are used for the experience, with 50% weight given to each. The midpoint of policy year 1989 is January 1, 1990; the midpoint of accident year 1990 is July 1, 1990. Thus, the midpoint of the experience period is April 1, 1990, for a time index ("x" value) of 4.250 (Line 18). The effective date of the pure premium change is January 1, 1992 (i.e., policy year 1992). The average date of the future loss occurrence is January 1, 1993, or a time index ("x" value) of 8.000 (line 19).

- Line 11 shows the observed loss ratio, and line 15 shows the fitted loss ratio. The *squared residual* on line 20 is the square of the difference between lines 11 and 15. For policy year 1989, for example, $(0.3860 - 0.3756)^2 = 0.000025$. The sum of the squared residuals for all five observations, 0.000162, is a measure of the goodness of fit.

- The *annual statewide medical trend* factor on line 21 is "e" raised to the 0.101 power (line 16): $1.107 = e^{0.101}$ (note the slight rounding error).

- The *countrywide medical trend* on line 22 (10.5%) is separately derived (not shown in the Minnesota filing); see Section 8.D.

- The *selected trend* of +10.0% on line 23 is lower than either the Minnesota or countrywide values, perhaps reflecting the lower inflation of the early 1990's.

- The trend period is 2.75 years (line 19 minus line 18), so the trend adjustment is $1.12^{2.75}$

= 1.300 (line 24).

Exhibit Appen.D.1c (page 112) combines the indemnity and medical trends.

- Line 1 shows the policy year 1989 indemnity losses, valued at December 31, 1990, developed to eighth report and at current benefit levels. Line 2 shows the corresponding figure for medical losses.

- Lines 3 and 4 are the indemnity and medical loss ratio trends. Line 5 is the weighted average of the these trend factors: {(372,814,453 *x* 1.129) + (200,246,174 *x* 1.300)} ÷ (372,814,453 + 200,246,174) = 1.189.[132]

E. Classification Pure Premiums

Minnesota exhibits B-1 through B-5 (pages 65–69) illustrate the determination of classification pure premiums for Class 1925, in the manufacturing industry group. The Minnesota filing also shows complete pure premium exhibits for one class in the contracting and "all other" industry groups (Exhibits B-6 through B-15 [pages 70–79]). Abbreviated exhibits are shown for other classes.

E.1 Classification Data

Exhibit B-1 (page 65) shows 1986 through 1988 policy experience for class 1925: claim counts and benefits (indemnity and medical separately) by type of injury, and payrolls. Death and permanent total claims are infrequent; there were none for class 1925 in the experience period.

Exhibit B-2 (page 66) adjusts the Unit Statistical Plan data to fully developed financial data levels at current benefit levels.

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[132] Since the eighth to ultimate development tail factors are higher for medical benefits than for indemnity benefits, and the medical loss ratio trend is greater than the indemnity loss ratio trend, the "indicated overall trend factor" on line 5 should be slightly higher.

- *Unmodified losses* are taken from Exhibit B–1 (page 65). Note that partial pure premiums are determined for (i) indemnity serious, (ii) indemnity non-serious, and (iii) medical. In Exhibit B–2 (page 66), medical benefits are divided between serious and non-serious cases, since different development factors are applied to them (see below). The modified losses for medical serious and medical non-serious are then combined, and the subsequent exhibits do not differentiate between them.

- Losses are brought to the *10/1/90 Benefit Level*, which is the most recent benefit level known when the partial pure premium exhibits are produced. [The adjustment for the October 1, 1991, benefit change is made on Exhibit B-5 (page 69), line 3.] The factors to bring losses to the 10/1/90 benefit level are shown on Exhibit B-20 (page 84). [The column on the top of Exhibit B-2 (p. 66) equals the final row on Exhibit B-20 (page 84).]

- The *development factors* take losses to an eighth report; moreover, they include a relativity factor for eighth report to ultimate. That is, the +11% indicated eighth report to ultimate loss development tail factor is provided for information only; it is not applied to the financial data losses in the overall pure premium indications. This tail factor is allocated by type of injury (see below, Exhibits B-17 and B-18 [pages 81 and 82]).[133] The *relativity* of the tail factor for each injury type to the overall tail factor is included in the loss development factors shown on Exhibit B-2 (page 66).[134]

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[133] The fifth to ultimate loss development factors are allocated to serious cases only, since "minor permanent partial, temporary total indemnity and medical only benefit payments have virtually all concluded by a fifth report; any additional development can be assumed to be due wholly to adjustments on larger, more serious claims" (Minnesota [1991], pages 57-58).

[134] Exhibit B-2 (page 66) uses the same development factor for all serious cases (2.659 for policy year 1988). In fact, development is low for death cases and high for permanent total disability (see Appendix 7 of the Minnesota filing, not reproduced here).

Development factors for aggregate experience are not always appropriate for classification pure premiums. The development factor for permanent total disability is an "identification" factor: it relates to late identification of claims as permanent totals and to reserve increases as reported cases are reidentified as permanent total disability claims, not to new reportings or to underestimates of incurred costs on already identified cases. Already identified permanent total cases may not be appropriate base for projecting future identifications. Rather, new identifications derive from cases now recorded as permanent partial or temporary total, so the number of such claims would be a better base. Compare Balcarek [1961], who projects future reopenings from the number of recently closed claims, not from claims already reopened. Alternatively, one may use premiums or exposures as a base (Bornhuetter and Ferguson [1972]). This procedure used here overcharges classes with early identification of permanent total claims.

- The *Financial Data Adjustment* brings the Unit Statistical Plan experience to financial data levels. Financial data indicates an overall pure premium revision of +6.1% (see Exhibit Appen.B.5c [page 49]). On-level pure premiums, determined by extending exposures at 1/1/91 levels from Unit Statistical Plan data for policy years 1986 through 1988 are $1,719,638,180. The financial data is on a standard earned premium basis, but extending exposures yields manual pure premiums. Applying standard earned to manual premium ratios to the USP data yields standard earned pure premiums of $1,700,633,869. Total adjusted on-level losses for these three policy years are $1,545,914,596, which indicates a pure premium revision of –9.1%. The ratio of the financial data indication (1.061) to the USP indication (0.909) is the Financial Data Adjustment (1.167).

- Total payroll is the normal exposure basis for Workers' Compensation, though limited payroll is used for certain company officers, sole proprietors, and partners. The Minnesota limit for executive officers was changed from $500 a week to $800 a week, thereby increasing the payroll subject to rating and necessitating a rate decrease. The 0.991 rate decrease is shown in the *Executive Officer Offset* column.

- Losses used for classification pure premium are limited more sharply than losses used for overall statewide indications (see Sections 3 and 15). Specifically,

  > *"Individual claim amounts are subject to a maximum limit of 20% of the current self-rating point. The limit in this filing is $329,000 . . . The actual incurred losses for each multiple claim accident are limited such that the total loss for the accident does not exceed 40% of the current self-rating point. This limit is $658,000"* (Minnesota [1991], page 57).[135]

- The Unit Statistical Plan losses shown on Exhibit B-24 (page 88) are unlimited, so the 1.167 "Financial Data Adjustment" on Exhibit B-2 (page 66) takes unlimited USP

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and undercharges classes with late identification (see Alff [1979]).

[135] The NCCI uses 10% and 20% of the old self-rating point (Gillam [1991]). For the statewide pure premium level indications, Minnesota uses paid losses from the most recent policy and accident years. Paid benefits exceeding $329,000 within one year are rare, so this type of limit would not affect the overall indications anyway. In theory, one could limit the losses used to determine paid loss development factors, but the benefits would not justify the additional work required.

experience to unlimited financial data experience. The 1.055 *Unlimited to Limited* factor shown in the second to right-most column takes limited USP experience to unlimited USP experience.[136]

- The *Modified Losses* are the unmodified losses multiplied by the factors in the next five columns. For instance, for policy year 1988 major permanent partial claims, $20,000 *x* 1.009 *x* 2.659 *x* 1.1.67 *x* 0.991 *x* 1.055 = $65,469.

The experience is summed over policy year and type of injury into three groups – serious indemnity, non-serious indemnity, and medical – in the lower right corner of Exhibit B-2 (page 66).

E.2 Classification Credibility

Minnesota Exhibit B-29 (pages 93 and 94) shows the full credibility standards used for classification pure premiums (see Section 15).

- The *number of cases* on line 1 is the sum of the case counts from Exhibit B-2 (page 66) for all classes. [The number of cases is not needed for medical, since the full credibility standard is 80% of the non-serious standard.] Similarly, the *modified losses* on line 2 are the sum of the modified losses from the lower right corner of Exhibit B-2 (page 66) for all classes. The *average cost per case* on line 3 is line 2 divided by line 1.

- The *full credibility standards* are the expected losses for 25 cases for serious indemnity, 300 cases for non-serious indemnity, and 80% of the non-serious standard for medical, as shown on lines 4 and 5 (see Section 15).

- Each classification's credibility is based on its expected losses, which in turn are based on the underlying pure premium. The full credibility standards are based on historical average claim costs (though modified by the Exhibit B-2 [page 66] adjustments), which differ from

136 Actually, this adjustment is relevant only to serious indemnity and medical losses: a higher factor should be used for them, and a unity factor for non-serious cases.

expected claim costs based on underlying pure premiums. Modifying the expected losses in each class to reflect historical average claim costs is tedious. Instead, the full credibility standards based on historical average claim costs are modified to reflect underlying pure premiums (see Marshall [1954] for a full discussion).

- Line 6 shows the expected losses based on underlying pure premiums. [These are at manual rate levels, not standard premium levels; see the discussion of the Financial Data Adjustment in Exhibit B-2 (page 66).] The total for all injury types combined is less than the total of modified historical losses, so the full credibility standards for each partial pure premium must be multiplied by 0.961 (line 7), to give the standards shown on line 8.

Exhibit B-3 (page 67) shows the credibility for each pure premium in class 1925. The payroll is taken from the lower left corner of Exhibit B-2 (page 66) and divided by 100 (the exposure base is "payroll in hundreds of dollars"). The underlying pure premiums shown in column 2 equal line 6 on Exhibit B-4 (page 68) [see the discussion below]. The expected losses in column 3 are the product of columns 1 and 2.

The credibilities are determined by the "three-halves" rule: For a credibility of X and a full credibility standard of $Y, the expected losses must be at least $(X^{3/2})(\$Y)$. For example, $0.58^{3/2} = 0.4417144$, and $0.4417144 * \$2,634,774 = \$1,163,819$.[137]

E.3 Underlying, Indicated, National, and Formula Pure Premiums

Each class has an "present on rate level pure premium," an "indicated pure premium," and a "national pure premium," which are combined to provide a "derived by formula pure premium" (see Section 15). Minnesota Exhibit B-4 (page 68) shows the required calculations.

- Line 1 shows the *proposed pure premiums* from the January 1, 1991, pure premium filing. Two items were applied after the 1/1/91 formula pure premiums were derived: the *test*

[137] The Minnesota filing provides an exhibit of credibility factors in 1% intervals associated with each level of expected losses.

correction factor (line 2) and the October 1, 1990, *benefit level change* (line 3).[138]

- The classification relativities determine the required *earned* pure premiums. Last year's formula pure premiums were multiplied by the *manual to standard earned premium ratio* to determine manual pure premiums (see Section 13 and Exhibit B-5 [page 69], line 7, below); last year's factor is therefore applied on line 4.

- The indicated and national pure premiums are at a standard earned level, so the manual premiums must be divided by this year's manual to standard earned ratio on line 5.

- Line 6 shows the pure premium *underlying the present rates*: the product of lines 1 through 4 divided by line 5. This is last year's final manual pure premium divided by the current manual to standard earned ratio.

- The overall indicated statewide pure premium change is +6.1% (line 7), which produces the *pure premium underlying the present rates* but brought to the indicated rate level (line 8). Since one needs the indicated industry group pure premium change, the industry group *relativity* is applied to the "derived by formula" pure premiums on Exhibit B-5 [page 69], line 4.

- Payrolls and modified losses are taken from the lower left and right corners of Exhibit B-2 (page 66) and shown on lines 9 and 10; they determine the *indicated pure premiums* on line 11. The *credibility factors* are taken from Exhibit B-3 (page 67).

- *National pure premiums* are calculated as described in Section 15 and are shown on line 13. *Credibility weights* for national pure premiums and for present on rate level pure premiums are shown on lines 14 and 15.

- The *derived by formula* pure premiums (line 16) are the weighted average of the
  - present on rate level pure premiums (line 8),

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[138] Similarly, these two items are applied after the 1/1/92 formula pure premiums are derived in the present filing; see Exhibit B-5, lines 3 and 6. The factors from last year's Exhibit B-5 are reproduced on this year's Exhibit B-4, lines 2 and 3.

- indicated pure premiums (line 11), and
- national pure premiums (line 13),

weighted by the credibility factors shown on lines 15, 12, and 14, respectively.

Note the variance among present on rate level, indicated, and national pure premiums, especially for serious indemnity claims. For this class, the indicated pure premium is only half as large as the current pure premium, but the national pure premium is twice as great as the current pure premium. Deaths, permanent totals, and major permanent partials are infrequent injuries, with great variance in claim severity. This provides enormous latitude for actuarial judgment. The ratemaking formula provides a starting point; the underwriter or company actuary must decide whether the final rate is too high or too low.

E.4 Proposed Pure Premiums

Exhibit B-5 derives the proposed pure premiums:

- The *derived by formula pure premiums* on line 1 are taken from Exhibit B-4 (page 68), line 16.

- Trend factors were not incorporated into the statewide pure premium indications. Rather, trend factors of 1.129 for indemnity, 1.300 for medical, and 1.189 overall, were shown for information only. Exhibit B-5 (page 69) assumes that the insurer applies some trend factor (whether +18.9%, 0%, or some other factor) to the overall pure premium indications. Since the indicated trends differ for indemnity and medical, the partial pure premiums must be adjusted by the *trend relativities*. For indemnity, the relativity is 1.129 ÷ 1.189, or 0.950; for medical, the relativity is 1.300 ÷ 1.189, or 1.093 (line 2).

- Line 3 adds the adjustment for the October 1, 1991, *statutory change* in the minimum and maximum weekly benefits. The effect of the change is +0.7% for all indemnity, or +0.5% for serious cases and +1.1% for non-serious cases.[139]

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[139] The Minnesota filing, Appendix 6 (page 122), shows the effects of the benefit change in detail: +0.4% for deaths; +2.1% for permanent total; +0.3% for major permanent partial; +0.6% for minor permanent partial; and +1.4% for temporary total.

- Line 4 applies the *industry group differential* (see Exhibits B-24 and B-25 [pages 88 and 89]). The underlying pure premiums were multiplied by the overall pure premium indication In Exhibit B-4 (page 68), with no adjustment for industry group relativities.[140]

- The *adjusted pure premiums* on line 5 are the product of the preceding four lines.

- The adjusted pure premiums are credibility weighted averages of the underlying, indicated, and national pure premiums. Moreover, several classification pure premiums are capped (see Section 15). When applied to the exposures by class, they may not produce the desired total pure premiums, as required by the overall pure premium indications. In the Minnesota manufacturing industry group, they are 0.41% too high, so the classification pure premiums are multiplied by a *test correction factor* of 0.9959 (line 6).

- These calculations provide standard earned pure premiums. Since the experience rating plan is not perfectly balanced (it generally provides more credits than debits), the earned pure premiums must be multiplied by a manual to standard earned premium ratio to offset the experience rating plan "off-balance" (line 7). This factor is derived in Exhibit B-27 (not covered in this documentation).

- The final manual pure premiums on line 8 are the products of the adjusted pure premiums, the test correction factor, and the manual to earned ratio.

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[140] Since there are many classes within each industry group, the industry group differential derives primarily from the experience of other classes. That which derives from the experience of this class is double counted, but this effect is minor.

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Determination of Pure Premium Level Change for Policy Year 1989 Based on Paid Losses

Pure Premium		
(1)	Standard earned pure premium valued as of December 31, 1990	518,435,490
(2)	Pure premium development factor	1.017
(3)	Factor to adjust pure premium to January 1, 1991 pure premium level	0.998
(4)	Premium available for benefit costs: (1)x(2)x(3)	526,194,396
Indemnity Losses		
(5)	Paid indemnity losses valued as of December 31, 1990	81,359,039
(6)	Paid indemnity loss development factor	4.528
(7)	Factor to adjust indemnity losses to October 1, 1990 benefit level	1.012
(8)	Adjusted indemnity losses: (5)x(6)x(7)	372,814,453
(9)	Indemnity pure premium loss ratio: (8)/(4)	0.709
Medical Losses		
(10)	Paid medical losses valued as of December 31, 1990	89,957,850
(11)	Paid medical loss development factor	2.225
(12)	Factor to adjust medical losses to October 1, 1990 benefit level	1.000
(13)	Adjusted medical losses: (10)x(11)x(12)	200,156,216
(14)	Medical pure premium loss ratio: (13)/(4)	0.380
Indicated Change in Pure Premium Level		
(15)	Total adjusted losses: (8)+(13)	572,970,669
(16)	Indicated change in pure premium level: (15)/(4)	1.089

Determination of Pure Premium Level Change for Accident Year 1990 Based on Paid Losses

Pure Premium		
(1)	Standard earned pure premium valued as of December 31, 1990	544,933,895
(2)	Factor to adjust pure premium to January 1, 1991 pure premium level	0.982
(3)	Premium available for benefit costs: (1)x(2)	535,125,085
Indemnity Losses		
(4)	Paid indemnity losses valued as of December 31, 1990	37,982,722
(5)	Paid indemnity loss development factor	9.364
(6)	Factor to adjust indemnity losses to October 1, 1990 benefit level	1.005
(7)	Adjusted indemnity losses: (4)x(5)x(6)	357,448,560
(8)	Indemnity pure premium loss ratio: (7)/(3)	0.668
Medical Losses		
(9)	Paid medical losses valued as of December 31, 1990	50,109,086
(10)	Paid medical loss development factor	3.894
(11)	Factor to adjust medical losses to October 1, 1990 benefit level	1.000
(12)	Adjusted medical losses: (9)x(10)x(11)	195,124,781
(13)	Medical pure premium loss ratio: (12)/(3)	0.365
Indicated Change in Pure Premium Level		
(14)	Total adjusted losses: (7)+(12)	552,573,341
(15)	Indicated change in pure premium level: (14)/(3)	1.033

Determination of Overall Pure Premium Level Change

Experience

(1)	Indicated pure premium level change based on policy year 1989	1.089
(2)	Indicated pure premium level change based on accident year 1990	1.033
(3)	Average indicated pure premium level change is equal to [(1)+(2)]/2	1.061

Legislation

(4)	Overall effect of October 1, 1991 change in the minimum and maximum weekly benefits	1.004

Overall

(5)	Final overall change in pure premium level: (3)x(4)	1.065

Industry Group

Industry Group	(6) Industry Group Differential	(7) Industry Group Pure Premium Level Change (5)x(6)
Manufacturing	1.030	1.097
Contracting	1.019	1.085
All Other	0.976	1.039

MINNESOTA

POLICY YEAR INDEMNITY LOSS EXPERIENCE

Indemnity Paid Loss Development Factors

Year	1st-2nd Report	2nd-3rd Report	3rd-4th Report	4th-5th Report	5th-6th Report	6th-7th Report	7th-8th Report	1st-8th Report
1978							1.055	3.920
1979						1.064	1.048	3.532
1980					1.085	1.062	1.045	3.783
1981				1.124	1.100	1.074	1.045	3.419
1982			1.209	1.128	1.102	1.056	1.045	3.637
1983		1.389	1.169	1.143	1.066	1.055		
1984	1.705	1.306	1.193	1.101	1.076			
1985	1.675	1.325	1.160	1.095				
1986	1.693	1.308	1.182					
1987	1.740	1.330						
1988	1.781							
Ave-All	1.719	1.332	1.183	1.118	1.086	1.062	1.048	3.660
Ave-Hi/Lo Elim	1.713	1.321	1.181	1.118	1.087	1.061	1.046	3.604
Ave-Last Two	1.761	1.319	1.171	1.098	1.071	1.056	1.045	3.530
Selected	1.761	1.319	1.171	1.098	1.076	1.050	1.040	3.509

Indemnity Paid to Incurred Loss Ratios

Year	1st Report	2nd Report	3rd Report	4th Report	5th Report	6th Report	7th Report	8th Report
1977								.748
1978							.716	.745
1979						.739	.760	.774
1980					.739	.772	.757	.770
1981				.692	.730	.746	.764	.792
1982			.613	.674	.710	.740	.801	.818
1983		.484	.606	.665	.732	.757	.782	
1984	.309	.484	.591	.655	.714	.750		
1985	.290	.456	.567	.666	.685			
1986	.279	.453	.572	.638				
1987	.277	.451	.569					
1988	.267	.456						
1989	.280							
Ave-All	.284	.464	.586	.665	.718	.751	.763	.775
Ave-Hi/Lo Elim	.282	.462	.585	.665	.722	.748	.766	.771
Ave-Last Two	.274	.454	.571	.652	.700	.754	.792	.805
Selected								.775

MINNESOTA

POLICY YEAR MEDICAL LOSS EXPERIENCE

Medical Paid Loss Development Factors

Year	1st-2nd Report	2nd-3rd Report	3rd-4th Report	4th-5th Report	5th-6th Report	6th-7th Report	7th-8th Report	1st-8th Report
1978							1.030	1.835
1979						1.032	1.023	1.764
1980					1.030	1.028	1.026	1.792
1981				1.047	1.040	1.032	1.024	1.842
1982			1.072	1.046	1.037	1.029	1.025	1.907
1983		1.135	1.064	1.055	1.028	1.027		
1984	1.316	1.108	1.073	1.045	1.035			
1985	1.308	1.115	1.060	1.050				
1986	1.293	1.134	1.069					
1987	1.354	1.134						
1988	1.375							
Ave-All	1.329	1.125	1.068	1.049	1.034	1.030	1.026	1.830
Ave-Hi/Lo Elim	1.326	1.128	1.068	1.048	1.034	1.030	1.025	1.828
Ave-Last Two	1.365	1.134	1.065	1.048	1.032	1.028	1.025	1.879
Selected	1.365	1.134	1.065	1.048	1.035	1.025	1.020	1.869

Medical Paid to Incurred Loss Ratios

Year	1st Report	2nd Report	3rd Report	4th Report	5th Report	6th Report	7th Report	8th Report
1977								.838
1978							.812	.823
1979						.833	.837	.842
1980					.849	.870	.862	.866
1981				.785	.810	.815	.809	.821
1982			.758	.798	.805	.817	.843	.857
1983		.675	.743	.773	.811	.825	.856	
1984	.525	.670	.744	.781	.809	.847		
1985	.465	.642	.707	.755	.790			
1986	.486	.635	.708	.754				
1987	.486	.640	.737					
1988	.467	.662						
1989	.493							
Ave-All	.487	.654	.733	.774	.812	.835	.837	.841
Ave-Hi/Lo Elim	.483	.654	.733	.774	.809	.831	.837	.840
Ave-Last Two	.480	.651	.723	.755	.800	.836	.850	.839
Selected								.840

MINNESOTA

ACCIDENT YEAR INDEMNITY LOSS EXPERIENCE

Indemnity Paid Loss Development Factors

Year	1st-2nd Report	2nd-3rd Report	3rd-4th Report	4th-5th Report	5th-6th Report	6th-7th Report	7th-8th Report	1st-8th Report
1979							1.058	7.211
1980						1.075	1.052	6.227
1981					1.107	1.088	1.061	7.049
1982				1.158	1.109	1.089	1.052	6.910
1983			1.311	1.152	1.128	1.058	1.053	7.539
1984		1.528	1.244	1.167	1.083	1.059		
1985	2.469	1.498	1.259	1.139	1.087			
1986	2.285	1.505	1.235	1.145				
1987	2.446	1.523	1.272					
1988	2.676	1.541						
1989	2.771							
Ave-All	2.529	1.519	1.264	1.152	1.103	1.074	1.055	6.991
Ave-Hi/Lo Elim	2.530	1.519	1.258	1.152	1.101	1.074	1.054	6.941
Ave-Last Two	2.724	1.532	1.254	1.142	1.085	1.059	1.053	7.231
Selected	2.724	1.532	1.254	1.142	1.085	1.059	1.050	7.210

Indemnity Paid to Incurred Loss Ratios

Year	1st Report	2nd Report	3rd Report	4th Report	5th Report	6th Report	7th Report	8th Report
1978								.712
1979							.748	.763
1980						.729	.767	.768
1981					.724	.766	.762	.771
1982				.668	.707	.727	.756	.811
1983			.531	.646	.686	.745	.777	.803
1984		.399	.545	.616	.684	.722	.751	
1985	.168	.379	.521	.604	.700	.718		
1986	.152	.356	.511	.609	.658			
1987	.134	.355	.514	.614				
1988	.134	.345	.507					
1989	.131	.366						
1990	.127							
Ave-All	.141	.367	.522	.626	.693	.735	.760	.771
Ave-Hi/Lo Elim	.138	.364	.519	.621	.694	.731	.759	.776
Ave-Last Two	.129	.356	.511	.612	.679	.720	.764	.807
Selected								.770

MINNESOTA

ACCIDENT YEAR MEDICAL LOSS EXPERIENCE

Medical Paid Loss Development Factors

Year	1st-2nd Report	2nd-3rd Report	3rd-4th Report	4th-5th Report	5th-6th Report	6th-7th Report	7th-8th Report	1st-8th Report
1979							1.029	3.101
1980						1.033	1.026	2.959
1981					1.037	1.034	1.027	3.070
1982				1.057	1.037	1.034	1.023	3.158
1983			1.108	1.062	1.053	1.027	1.026	3.399
1984		1.189	1.082	1.059	1.038	1.030		
1985	2.020	1.187	1.088	1.051	1.045			
1986	1.972	1.179	1.097	1.059				
1987	2.021	1.207	1.099					
1988	2.081	1.216						
1989	2.175							
Ave-All	2.054	1.196	1.095	1.058	1.042	1.032	1.026	3.140
Ave-Hi/Lo Elim	2.041	1.194	1.095	1.058	1.040	1.032	1.026	3.109
Ave-Last Two	2.128	1.212	1.098	1.055	1.042	1.029	1.025	3.283
Selected	2.128	1.212	1.098	1.055	1.042	1.030	1.020	3.271

Medical Paid to Incurred Loss Ratios

Year	1st Report	2nd Report	3rd Report	4th Report	5th Report	6th Report	7th Report	8th Report
1978								.810
1979							.851	.854
1980						.840	.855	.852
1981					.821	.844	.838	.827
1982				.766	.797	.822	.828	.847
1983			.718	.783	.796	.825	.845	.871
1984		.619	.703	.748	.787	.810	.840	
1985	.305	.576	.697	.744	.785	.814		
1986	.277	.561	.667	.719	.773			
1987	.271	.580	.695	.759				
1988	.276	.557	.701					
1989	.270	.594						
1990	.276							
Ave-All	.279	.581	.697	.753	.793	.826	.843	.844
Ave-Hi/Lo Elim	.275	.578	.699	.754	.791	.825	.844	.845
Ave-Last Two	.273	.576	.698	.739	.779	.812	.843	.859
Selected								.840

MINNESOTA

PREMIUM DEVELOPMENT FACTORS

Policy Year	1st to 2nd Report	2nd to 3rd Report	3rd to 4th Report	4th to 5th Report	1st to 5th Report
1981				1.000	0.998
1982			0.999	1.001	1.030
1983		0.996	1.007	1.007	1.034
1984	1.003	1.008	1.005	1.002	1.008
1985	1.014	0.998	0.982	1.001	1.014
1986	1.024	1.001	0.999		
1987	1.023	1.004			
1988	1.010				
Ave-All	1.015	1.001	0.998	1.002	1.016
Ave-Hi/Lo Elim	1.016	1.001	1.001	1.001	1.019
Ave-Last Two	1.017	1.003	0.991	1.002	1.013
Selected	1.017	1.000	1.000	1.000	1.017

MINNESOTA

Determination of Policy Year Current Level Factors

Policy Year 1989 Pure Premium

Date	Pure Premium Level Change	Cumulative Index	Weight *	Average Effect In Experience Period	Current Level Factor = Current Index/Avg. Effect
1/1/89	Base	1.000	1.000	1.000	0.998
1/1/90	1.027	1.027			
1/1/91	0.972	0.998			
				1.000	

Policy Year 1989 Indemnity Benefits

Date	Benefit Change	Cumulative Index	Weight *	Average Effect In Experience Period	Current Level Factor = Current Index/Avg. Effect
10/1/88	Base	1.000	0.364	0.364	1.012
10/1/89	1.012	1.012	0.619	0.626	
10/1/90	1.007	1.019	0.017	0.017	
				1.007	

Policy Year 1989 Medical Benefits

Date	Benefit Change	Cumulative Index	Weight *	Average Effect In Experience Period	Current Level Factor = Current Index/Avg. Effect
10/1/88	Base	1.000	0.364	0.364	1.000
10/1/89	1.000	1.000	0.619	0.619	
10/1/90	1.000	1.000	0.017	0.017	
				1.000	

* Weights are based on a distribution of Minnesota premium by effective month. Exhibit B contains an example of how the weights are calculated.

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Determination of Accident Year Current Level Factors

Calendar Year 1990 Pure Premium

Date	Pure Premium Level Change	Cumulative Index	Weight *	Average Effect In Experience Period	Current Level Factor = Current Index/Avg. Effect
1/1/89	Base	1.000	0.402	0.402	0.982
1/1/90	1.027	1.027	0.598	0.614	
1/1/91	0.972	0.998			
				1.016	

Accident Year 1990 Indemnity Benefits

Date	Benefit Change	Cumulative Index	Weight *	Average Effect In Experience Period	Current Level Factor = Current Index/Avg. Effect
10/1/89	Base	1.000	0.750	0.750	1.005
10/1/90	1.007	1.007	0.250	0.252	
				1.002	

Accident Year 1990 Medical Benefits

Date	Benefit Change	Cumulative Index	Weight *	Average Effect In Experience Period	Current Level Factor = Current Index/Avg. Effect
10/1/89	Base	1.000	0.750	0.750	1.000
10/1/90	1.000	1.000	0.250	0.250	
				1.000	

* Weights are based on a distribution of Minnesota premium by effective month. Exhibit B contains an example of how the weights are calculated.

EXHIBIT B-1

Summary of Actual Payroll and Limited Loss Experience for Class 1925 (Manufacturing)

Policy Period - 1/88 to 12/88 (1st report)

Payroll 19,811,284

Type of Injury	Indemnity	Medical	Case Count
Death			
Permanent Total			
Major Permanent Partial	20,000	20,000	1
Minor Permanent Partial	129,789	135,857	15
Temporary Total	64,099	60,077	42
Medical Only		16,334	84

Policy Period - 1/87 to 12/87 (2nd report)

Payroll 18,759,518

Type of Injury	Indemnity	Medical	Case Count
Death			
Permanent Total			
Major Permanent Partial	125,877	56,220	3
Minor Permanent Partial	15,378	17,877	5
Temporary Total	62,830	44,993	51
Medical Only		18,059	92

Policy Period - 1/86 to 12/86 (3rd report)

Payroll 15,265,915

Type of Injury	Indemnity	Medical	Case Count
Death			
Permanent Total			
Major Permanent Partial	205,422	132,041	3
Minor Permanent Partial	20,523	9,429	4
Temporary Total	30,404	25,030	9
Medical Only		9,503	59

EXHIBIT B-2

Derivation of Loss and Payroll for Class Code 1925

Policy Period - 1/88 to 12/88 (1st report)

	Case Count	Unmodified Loss	10/1/90 Benefit Level	Development Factor	Financial Data Adjustment	Executive Officer Offset	Unlimited to Limited	Modified Loss
Death	0	0	1.011	2.659	1.167	0.991	1.055	0
Permanent Total	0	0	1.104	2.659	1.167	0.991	1.055	0
Major P. P.	1	20,000	1.009	2.659	1.167	0.991	1.055	65,469
Serious	1	20,000	xx	xx	xx	xx	xx	65,469
Minor P. P.	15	129,789	1.018	0.808	1.167	0.991	1.055	130,256
Temp. Total	42	64,099	1.040	0.808	1.167	0.991	1.055	65,719
Non-Serious	57	193,888	xx	xx	xx	xx	xx	195,974
Medical-Serious	xx	20,000	1.000	2.059	1.167	0.991	1.055	50,244
Medical-Non-Serious	xx	212,268	1.000	0.814	1.167	0.991	1.055	210,817
Medical Total	xx	232,268	xx	xx	xx	xx	xx	261,061

Payroll 19,811,284

Policy Period - 1/87 to 12/87 (2nd report)

	Case Count	Unmodified Loss	10/1/90 Benefit Level	Development Factor	Financial Data Adjustment	Executive Officer Offset	Unlimited to Limited	Modified Loss
Death	0	0	1.015	1.722	1.167	0.991	1.055	0
Permanent Total	0	0	1.146	1.722	1.167	0.991	1.055	0
Major P. P.	3	125,877	1.013	1.722	1.167	0.991	1.055	267,908
Serious	3	125,877	xx	xx	xx	xx	xx	267,908
Minor P. P.	5	15,378	1.025	0.884	1.167	0.991	1.055	17,001
Temp. Total	51	62,830	1.057	0.884	1.167	0.991	1.055	71,629
Non-Serious	56	78,208	xx	xx	xx	xx	xx	88,630
Medical-Serious	xx	56,220	1.000	1.456	1.167	0.991	1.055	99,873
Medical-Non-Serious	xx	80,929	1.000	0.876	1.167	0.991	1.055	86,498
Medical Total	xx	137,149	xx	xx	xx	xx	xx	186,371

Payroll 18,759,518

Policy Period - 1/86 to 12/86 (3rd report)

	Case Count	Unmodified Loss	10/1/90 Benefit Level	Development Factor	Financial Data Adjustment	Executive Officer Offset	Unlimited to Limited	Modified Loss
Death		0	1.019	1.378	1.167	0.991	1.055	0
Permanent Total	0	0	1.196	1.378	1.167	0.991	1.055	0
Major P. P.	3	205,422	1.017	1.378	1.167	0.991	1.055	351,248
Serious	3	205,422	xx	xx	xx	xx	xx	351,248
Minor P. P.	4	20,523	1.033	0.904	1.167	0.991	1.055	23,383
Temp. Total	9	30,404	1.076	0.904	1.167	0.991	1.055	36,083
Non-Serious	13	50,927	xx	xx	xx	xx	xx	59,467
Medical-Serious	xx	132,041	1.000	1.258	1.167	0.991	1.055	202,669
Medical-Non-Serious	xx	43,962	1.000	0.900	1.167	0.991	1.055	48,274
Medical Total	xx	176,003	xx	xx	xx	xx	xx	250,943

Payroll 15,265,915

Three Year Totals

	Payroll	Unmodified Losses	Modified Losses
Serious	53,836,717	351,299	684,625
Non-Serious	53,836,717	323,023	344,071
Medical	53,836,717	545,420	698,375

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EXHIBIT B-3

Derivation of State Credibility - Code 1925

	(1) Payroll (hundreds)	(2) Pure Premium	(3) Expected Loss (1)x(2)	(4) State Credibility
Serious	538,367.17	2.180	1,173,640	58%
Non-Serious	538,367.17	0.687	369,858	63%
Medical	538,367.17	1.032	555,595	96%

See Exhibit-29, pages 93 and 94, for a table of credibility criteria.

MINNESOTA

EXHIBIT B-4

Sample Underlying, Present On Level, and Formula Pure Premium Calculations By Industry Group (Manufacturing - Code 1925)

	Serious	Non-Serious	Medical
1. Proposed Pure Premiums from last approved Classification Pure Premium Exhibits	2.164	0.679	1.032
2. Test Correction Factor from last approved full Experience Revision	1.02141	1.02141	1.02141
3. Effect of October 1, 1990 benefit change	1.007	1.011	1.000
4. Manual to Earned Ratio from last year	0.995	0.995	0.995
5. Manual to Earned Ratio from current year	1.016	1.016	1.016
6. Underlying Present Pure Premium: (1) x (2) x (3) x {(4) / (5)}	2.180	0.687	1.032
7. Present on Rate Level Factor	1.061	1.061	1.061
8. Present on Rate Level Pure Premium (6) x (7)	2.313	0.729	1.095
9. Payroll, Policy Years 1986 - 1988	53,836,717	53,836,717	53,836,717
10. Losses, Policy Years 1986 - 1988	684,625	344,071	698,375
11. Indicated Pure Premium (10) / (9) x 100	1.272	0.639	1.297
12. State Credibility	58%	63%	96%
13. Pure Premium Indicated by National Relativity	4.125	1.013	2.461
14. National Credibility, limited to {100 - (12)} / 2	21%	18%	2%
15. Excess Credibility, 100 - (12) - (14)	21%	19%	2%
16. Derived by Formula Pure Premium {(11) x (12)} + {(13) x (14)} + {(8) x (15)}	2.090	0.723	1.316

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EXHIBIT B-5

Calculation of Pure Premium Base Rate - Code 1925 (Manufacturing)

	Serious	Non-Serious	Medical	Total
1. 1992 Derived by Formula Pure Premiums	2.090	0.723	1.316	4.13
2. Adjustment for Trend Relativities	0.950	0.950	1.093	
3. Adjustment for October 1, 1991 Benefit Change	1.005	1.011	1.000	
4. Adjustment for Industry Group Differentials	1.030	1.030	1.030	
5. Adjusted Pure Premiums, unrounded (1)x(2)x(3)x(4)	2.055	0.715	1.482	4.25
6. Test Correction Factor	0.9959	0.9959	0.9959	
7. Ratio of Manual to Earned Premium	1.016	1.016	1.016	
8. Proposed Pure Premiums (5)x(6)x(7)	2.080	0.724	1.499	4.30

EXHIBIT B-6

Summary of Actual Payroll and Limited Loss Experience for Class 3724 (Contracting)

Policy Period - 1/88 to 12/88 (1st report)

Payroll 55,269,811

Type of Injury	Indemnity	Medical	Case Count
Death			
Permanent Total			
Major Permanent Partial	1,278,264	621,031	34
Minor Permanent Partial	138,422	137,531	31
Temporary Total	283,071	321,214	134
Medical Only		117,221	542

Policy Period - 1/87 to 12/87 (2nd report)

Payroll 52,782,058

Type of Injury	Indemnity	Medical	Case Count
Death	400,751	384	1
Permanent Total	71,184	50,000	1
Major Permanent Partial	1,840,009	811,927	32
Minor Permanent Partial	202,270	142,753	26
Temporary Total	271,879	243,304	137
Medical Only		91,801	472

Policy Period - 1/86 to 12/86 (3rd report)

Payroll 45,653,837

Type of Injury	Indemnity	Medical	Case Count
Death			
Permanent Total			
Major Permanent Partial	1,125,685	585,745	15
Minor Permanent Partial	172,408	74,626	25
Temporary Total	205,730	195,128	111
Medical Only		78,975	443

EXHIBIT B-7

Derivation of Loss and Payroll for Class Code 3724

Policy Period - 1/88 to 12/88 (1st report)

	Case Count	Unmodified Loss	10/1/90 Benefit Level	Development Factor	Financial Data Adjustment	Executive Officer Offset	Unlimited to Limited	Modified Loss
Death	0	0	1.011	2.659	1.167	0.991	1.055	0
Permanent Total	0	0	1.104	2.659	1.167	0.991	1.055	0
Major P. P.	34	1,278,264	1.009	2.659	1.167	0.991	1.055	4,184,341
Serious	34	1,278,264	xx	xx	xx	xx	xx	4,184,341
Minor P. P.	31	138,422	1.018	0.808	1.167	0.991	1.055	138,919
Temp. Total	134	283,071	1.040	0.808	1.167	0.991	1.055	290,226
Non-Serious	165	421,493	xx	xx	xx	xx	xx	429,145
Medical-Serious	xx	621,031	1.000	2.059	1.167	0.991	1.055	1,560,151
Medical-Non-Serious	xx	575,966	1.000	0.814	1.167	0.991	1.055	572,029
Medical Total	xx	1,196,997	xx	xx	xx	xx	xx	2,132,180
Payroll	55,269,811							

Policy Period - 1/87 to 12/87 (2nd report)

	Case Count	Unmodified Loss	10/1/90 Benefit Level	Development Factor	Financial Data Adjustment	Executive Officer Offset	Unlimited to Limited	Modified Loss
Death	1	328,685	1.015	1.722	1.167	0.991	1.055	700,932
Permanent Total	1	71,184	1.146	1.722	1.167	0.991	1.055	171,395
Major P. P.	32	1,801,652	1.013	1.722	1.167	0.991	1.055	3,834,515
Serious	34	2,201,521	xx	xx	xx	xx	xx	4,706,842
Minor P. P.	26	202,270	1.025	0.884	1.167	0.991	1.055	223,617
Temp. Total	137	271,879	1.057	0.884	1.167	0.991	1.055	309,956
Non-Serious	163	474,149	xx	xx	xx	xx	xx	533,573
Medical-Serious	xx	858,804	1.000	1.456	1.167	0.991	1.055	1,525,641
Medical-Non-Serious	xx	477,858	1.000	0.876	1.167	0.991	1.055	510,740
Medical Total	xx	1,336,662	xx	xx	xx	xx	xx	2,036,381
Payroll	52,782,058							

Policy Period - 1/86 to 12/86 (3rd report)

	Case Count	Unmodified Loss	10/1/90 Benefit Level	Development Factor	Financial Data Adjustment	Executive Officer Offset	Unlimited to Limited	Modified Loss
Death	0	0	1.019	1.378	1.167	0.991	1.055	0
Permanent Total	0	0	1.196	1.378	1.167	0.991	1.055	0
Major P. P.	15	1,118,405	1.017	1.378	1.167	0.991	1.055	1,912,345
Serious	15	1,118,405	xx	xx	xx	xx	xx	1,912,345
Minor P. P.	25	172,408	1.033	0.904	1.167	0.991	1.055	196,437
Temp. Total	111	205,730	1.076	0.904	1.167	0.991	1.055	244,160
Non-Serious	136	378,138	xx	xx	xx	xx	xx	440,597
Medical-Serious	xx	576,125	1.000	1.258	1.167	0.991	1.055	884,289
Medical-Non-Serious	xx	348,729	1.000	0.900	1.167	0.991	1.055	382,937
Medical Total	xx	924,854	xx	xx	xx	xx	xx	1,267,226
Payroll	45,653,837							

Three Year Totals

	Payroll	Unmodified Losses	Modified Losses
Serious	153,705,706	4,598,190	10,803,528
Non-Serious	153,705,706	1,273,780	1,403,315
Medical	153,705,706	3,456,513	5,435,788

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EXHIBIT B-8

Derivation of State Credibility - Code 3724

	(1) Payroll (hundreds)	(2) Pure Premium	(3) Expected Loss (1)x(2)	(4) State Credibility
Serious	1,537,057	6.726	10,338,246	100%
Non-Serious	1,537,057	0.976	1,500,168	100%
Medical	1,537,057	3.335	5,126,085	100%

See Exhibit-29, pages 93 and 94, for a table of credibility criteria.

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EXHIBIT B-9

Sample Underlying, Present On Level, and Formula Pure Premium Calculations By Industry Group (Contracting - Code 3724)

	Serious	Non-Serious	Medical
1. Proposed Pure Premiums from last approved Classification Pure Premium Exhibits	6.793	0.982	3.392
2. Test Correction Factor from last approved full Experience Revision	0.98613	0.98613	0.98613
3. Effect of October 1, 1990 benefit change	1.007	1.011	1.000
4. Manual to Earned Ratio from last year	1.041	1.041	1.041
5. Manual to Earned Ratio from current year	1.044	1.044	1.044
6. Underlying Present Pure Premium: (1) x (2) x (3) x {(4) / (5)}	6.726	0.976	3.335
7. Present on Rate Level Factor	1.061	1.061	1.061
8. Present on Rate Level Pure Premium (6) x (7)	7.136	1.036	3.538
9. Payroll, Policy Years 1986 - 1988	153,705,706	153,705,706	153,705,706
10. Losses, Policy Years 1986 - 1988	10,803,528	1,403,315	5,435,788
11. Indicated Pure Premium (10) / (9) x 100	7.029	0.913	3.536
12. State Credibility	100%	100%	100%
13. Pure Premium Indicated by National Relativity	6.913	0.945	2.725
14. National Credibility, limited to {100 - (12)} / 2	0%	0%	0%
15. Excess Credibility, 100 - (12) - (14)	0%	0%	0%
16. Derived by Formula Pure Premium {(11) x (12)} + {(13) x (14)} + {(8) x (15)}	7.029	0.913	3.536

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EXHIBIT B-10

Calculation of Pure Premium Base Rate - Code 3724 (Contracting)

	Serious	Non-Serious	Medical	Total
1. 1992 Derived by Formula Pure Premiums	7.029	0.913	3.536	11.48
2. Adjustment for Trend Relativities	0.950	0.950	1.093	
3. Adjustment for October 1, 1991 Benefit Change	1.005	1.011	1.000	
4. Adjustment for Industry Group Differentials	1.019	1.019	1.019	
5. Adjusted Pure Premiums, unrounded (1)x(2)x(3)x(4)	6.838	0.894	3.938	11.67
6. Test Correction Factor	1.0555	1.0555	1.0555	
7. Ratio of Manual to Earned Premium	1.044	1.044	1.044	
8. Proposed Pure Premiums (5)x(6)x(7)	7.536	0.985	4.340	12.86

EXHIBIT B-11

Summary of Actual Payroll and Limited Loss Experience for Class 0170 (All Others)

Policy Period - 1/88 to 12/88 (1st report)

Payroll 2,238,973

Type of Injury	Indemnity	Medical	Case Count
Death			
Permanent Total			
Major Permanent Partial			
Minor Permanent Partial	14,427	10,600	2
Temporary Total	12,293	11,019	8
Medical Only		3,792	20

Policy Period - 1/87 to 12/87 (2nd report)

Payroll 2,261,046

Type of Injury	Indemnity	Medical	Case Count
Death			
Permanent Total			
Major Permanent Partial	50,050	26,602	2
Minor Permanent Partial	6,944	10,000	1
Temporary Total	9,621	9,206	10
Medical Only		4,779	21

Policy Period - 1/86 to 12/86 (3rd report)

Payroll 2,341,200

Type of Injury	Indemnity	Medical	Case Count
Death			
Permanent Total			
Major Permanent Partial			
Minor Permanent Partial	513	1,175	1
Temporary Total	2,658	10,495	5
Medical Only		3,294	20

EXHIBIT B-12

Derivation of Loss and Payroll for Class Code 0170

Policy Period - 1/88 to 12/88 (1st report)

	Case Count	Unmodified Loss	10/1/90 Benefit Level	Development Factor	Financial Data Adjustment	Executive Officer Offset	Unlimited to Limited	Modified Loss
Death	0	0	1.011	2.659	1.167	0.991	1.055	0
Permanent Total	0	0	1.104	2.659	1.167	0.991	1.055	0
Major P. P.	0	0	1.009	2.659	1.167	0.991	1.055	0
Serious	0	0	xx	xx	xx	xx	xx	0
Minor P. P.	2	14,427	1.018	0.808	1.167	0.991	1.055	14,479
Temp. Total	8	12,293	1.040	0.808	1.167	0.991	1.055	12,604
Non-Serious	10	26,720	xx	xx	xx	xx	xx	27,083
Medical-Serious	xx	0	1.000	2.059	1.167	0.991	1.055	0
Medical-Non-Serious	xx	25,411	1.000	0.814	1.167	0.991	1.055	25,237
Medical Total	xx	25,411	xx	xx	xx	xx	xx	25,237
Payroll	2,238,973							

Policy Period - 1/87 to 12/87 (2nd report)

	Case Count	Unmodified Loss	10/1/90 Benefit Level	Development Factor	Financial Data Adjustment	Executive Officer Offset	Unlimited to Limited	Modified Loss
Death	0	0	1.015	1.722	1.167	0.991	1.055	0
Permanent Total	0	0	1.146	1.722	1.167	0.991	1.055	0
Major P. P.	2	50,050	1.013	1.722	1.167	0.991	1.055	106,523
Serious	2	50,050	xx	xx	xx	xx	xx	106,523
Minor P. P.	1	6,944	1.025	0.884	1.167	0.991	1.055	7,677
Temp. Total	10	9,621	1.057	0.884	1.167	0.991	1.055	10,968
Non-Serious	11	16,565	xx	xx	xx	xx	xx	18,645
Medical-Serious	xx	26,602	1.000	1.456	1.167	0.991	1.055	47,258
Medical-Non-Serious	xx	23,985	1.000	0.876	1.167	0.991	1.055	25,635
Medical Total	xx	50,587	xx	xx	xx	xx	xx	72,893
Payroll	2,261,046							

Policy Period - 1/86 to 12/86 (3rd report)

	Case Count	Unmodified Loss	10/1/90 Benefit Level	Development Factor	Financial Data Adjustment	Executive Officer Offset	Unlimited to Limited	Modified Loss
Death	0	0	1.019	1.378	1.167	0.991	1.055	0
Permanent Total	0	0	1.196	1.378	1.167	0.991	1.055	0
Major P. P.	0	0	1.017	1.378	1.167	0.991	1.055	0
Serious	0	0	xx	xx	xx	xx	xx	0
Minor P. P.	1	513	1.033	0.904	1.167	0.991	-1.055	584
Temp. Total	5	2,658	1.076	0.904	1.167	0.991	1.055	3,155
Non-Serious	6	3,171	xx	xx	xx	xx	xx	3,739
Medical-Serious	xx	0	1.000	1.258	1.167	0.991	1.055	0
Medical-Non-Serious	xx	14,964	1.000	0.900	1.167	0.991	1.055	16,432
Medical Total	xx	14,964	xx	xx	xx	xx	xx	16,432
Payroll	2,341,200							

Three Year Totals

	Payroll	Unmodified Losses	Modified Losses
Serious	6,841,219	50,050	106,523
Non-Serious	6,841,219	46,456	49,467
Medical	6,841,219	90,969	114,562

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EXHIBIT B-13

Derivation of State Credibility - Code 0170

	(1) Payroll (hundreds)	(2) Pure Premium	(3) Expected Loss (1)x(2)	(4) State Credibility
Serious	68,412	1.490	101,934	11%
Non-Serious	68,412	0.991	67,796	20%
Medical	68,412	2.329	159,332	41%

See Exhibit-29, pages 93 and 94, for a table of credibility criteria.

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EXHIBIT B-14

Sample Underlying, Present On Level, and Formula Pure Premium Calculations By Industry Group (All Others - Code 0170)

	Serious	Non-Serious	Medical
1. Proposed Pure Premiums from last approved Classification Pure Premium Exhibits	1.405	0.931	2.212
2. Test Correction Factor from last approved full Experience Revision	1.05943	1.05943	1.05943
3. Effect of October 1, 1990 benefit change	1.007	1.011	1.000
4. Manual to Earned Ratio from last year	0.986	0.986	0.986
5. Manual to Earned Ratio from current year	0.992	0.992	0.992
6. Underlying Present Pure Premium: (1) x (2) x (3) x {(4) / (5)}	1.490	0.991	2.329
7. Present on Rate Level Factor	1.061	1.061	1.061
8. Present on Rate Level Pure Premium (6) x (7)	1.581	1.051	2.471
9. Payroll, Policy Years 1986 - 1988	6,841,219	6,841,219	6,841,219
10. Losses, Policy Years 1986 - 1988	106,523	49,467	114,562
11. Indicated Pure Premium (10) / (9) x 100	1.557	0.723	1.675
12. State Credibility	11%	20%	41%
13. Pure Premium Indicated by National Relativity	2.350	0.738	2.598
14. National Credibility, limited to {100 - (12)} / 2	44%	40%	29%
15. Excess Credibility, 100 - (12) - (14)	45%	40%	30%
16. Derived by Formula Pure Premium {(11) x (12)} + {(13) x (14)} + {(8) x (15)}	1.917	0.860	2.181

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EXHIBIT B-15

Calculation of Pure Premium Base Rate - Code 0170 (All Others)

	Serious	Non-Serious	Medical	Total
1. 1992 Derived by Formula Pure Premiums	1.917	0.860	2.181	4.96
2. Adjustment for Trend Relativities	0.950	0.950	1.093	
3. Adjustment for October 1, 1991 Benefit Change	1.005	1.011	1.000	
4. Adjustment for Industry Group Differentials	0.976	0.976	0.976	
5. Adjusted Pure Premiums, unrounded (1)x(2)x(3)x(4)	1.786	0.806	2.327	4.92
6. Test Correction Factor	1.0283	1.0283	1.0283	
7. Ratio of Manual to Earned Premium	0.992	0.992	0.992	
8. Proposed Pure Premiums (5)x(6)x(7)	1.822	0.822	2.373	5.02

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EXHIBIT B-16

Selected Unit Statistical Plan Development Factors

	Selected Development Factors				Cumulative Development Factors			Adjusted Development Factors		
	1st-2nd	2nd-3rd	3rd-4th	4th-5th	3rd-5th	2nd-5th	1st-5th	3rd-5th	2nd-5th	1st-5th
Premium	1.021	1.002	1.000	1.000	1.000	1.002	1.023	---	---	---
Serious Indemnity	1.577	1.262	1.131	1.076	1.217	1.524	2.403	1.217	1.521	2.349
Non-Serious Indemnity	0.934	0.980	1.000	1.003	1.003	0.983	0.918	1.003	0.981	0.897
Serious Medical	1.444	1.159	1.061	1.034	1.097	1.272	1.836	1.097	1.269	1.795
Non-Serious Medical	0.949	0.975	0.997	1.002	0.999	0.974	0.924	0.999	0.972	0.903

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EXHIBIT B-17

Derivation of 5th to 8th Report Development
& 8th to Ultimate Relativities

			Serious Indemnity	Non Ser Indemnity	Total Indemnity	Serious Medical	Non Ser Medical	Total Medical	Total Losses
1	Unlimited Losses (Modified by On Level Factors)	88	117,504,740	77,126,260	194,631,000	54,006,116	89,432,963	143,439,079	338,070,079
		87	183,024,702	67,616,683	250,641,385	71,373,330	75,642,169	147,015,499	397,656,884
		86	181,367,660	60,724,180	242,091,840	64,544,549	62,238,131	126,782,680	368,874,520
2	Loss Development (1st-5th; without prem devel)	88	2.403	0.918		1.836	0.924		
		87	1.524	0.983		1.272	0.974		
		86	1.217	1.003		1.097	0.999		
3	5th Report Adjusted Losses (1)x(2)	88	282,363,890	70,801,907	353,165,797	99,155,229	82,636,058	181,791,287	534,957,084
		87	278,929,646	66,467,199	345,396,845	90,786,876	73,675,473	164,462,349	509,859,194
		86	220,724,442	60,906,353	281,630,795	70,805,370	62,175,893	132,981,263	414,612,058
		Tot	782,017,978	198,175,459	980,193,437	260,747,475	218,487,424	479,234,899	1,459,428,336
4	5th to 8th Report Loss Development				1.085			1.035	
5	Losses @ 8th Report (3)x(4)				1,063,509,879			496,008,120	1,559,517,999
6	Difference (5)-(3)				83,316,442			16,773,221	
7	Allocated 8th Report Losses		865,334,420	198,175,459	1,063,509,879	277,520,696	218,487,424	496,008,120	1,559,517,999
8	5th to 8th Report Loss Development		1.107	1.000	1.085	1.064	1.000	1.035	1.069
9.	Ave PY & AY 8th to Ultimate LDF				1.110			1.110	
10.	Ultimate Losses (7)x(9)				1,180,495,966			550,569,013	1,731,064,979
11.	Difference (10)-(7)				116,986,087			54,560,893	
12.	Allocated Ultimate Losses		982,320,507	198,175,459	1,180,495,966	332,081,589	218,487,424	550,569,013	1,731,064,979
13.	Ave PY & AY 8th to Ultimate LDF (12)/(7)		1.135	1.000	1.110	1.197	1.000	1.110	1.110
14	8th to Ultimate PY & AY Relativities (13)/1.110		1.023	0.901	1.000	1.078	0.901	1.000	1.000
15	5th to 8th Report Development & 8th to Ultimate Relativities (14)x(8)		1.132	0.901	1.085	1.147	0.901	1.035	1.069

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EXHIBIT B-18

Derivation of Final USP Adjustment Factors

	Cumulative Development Factors			Fifth to 8th Dev. & 8th to Ult. Rel	Cumulative Adjustment Factors*		
	3rd-5th	2nd-5th	1st-5th		3rd-Ult	2nd-Ult	1st-Ult
Serious Indemnity	1.217	1.521	2.349	1.132	1.378	1.722	2.659
Non-Serious Indemnity	1.003	0.981	0.897	0.901	0.904	0.884	0.808
Serious Medical	1.097	1.269	1.795	1.147	1.258	1.456	2.059
Non-Serious Medical	0.999	0.972	0.903	0.901	0.900	0.876	0.814

* Development to 8th Report and using 8th to Ultimate Relativities.

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EXHIBIT B-19

Derivation of Benefit Current Level Factors

The incurred benefit costs are adjusted to reflect the cost impact of statutory benefit changes which have become law subsequent to the start of each policy period. The effects of these laws by type of injury are shown in the following table:

Date	Fatal	Permanent Total	Major Permanent Partial	Minor Permanent Partial	Temporary Total	Medical
10/1/76	1.011	1.097	1.030	1.030	1.032	1.000
1/1/77	1.000	1.001	1.000	1.000	1.001	1.000
10/1/77	1.134	2.230	1.096	1.097	1.137	1.000
10/1/78	1.004	1.048	1.014	1.015	1.023	1.000
10/1/79	1.005	1.061	1.021	1.019	1.030	1.000
10/1/79	0.979	1.000	0.965	1.000	1.000	1.000
10/1/79	0.996	0.963	0.999	1.000	1.000	0.995
10/1/80	1.006	1.060	1.023	1.021	1.030	1.000
1/1/81	0.565	0.918	0.864	0.864	0.918	0.844
10/1/81	1.011	1.078	1.024	1.022	1.035	1.000
10/1/82	1.009	1.076	1.021	1.020	1.033	1.000
10/1/83	1.009	1.068	1.020	1.019	1.030	1.000
10/1/84	1.005	1.055	1.005	1.008	1.023	1.000
10/1/85	1.003	1.030	1.002	1.005	1.013	1.000
10/1/86	1.004	1.048	1.004	1.008	1.020	1.000
10/1/87	1.004	1.041	1.004	1.007	1.017	1.000
10/1/88	1.004	1.037	1.004	1.007	1.015	1.000
10/1/89	1.006	1.053	1.005	1.009	1.021	1.000
10/1/90	1.004	1.035	1.003	1.006	1.014	1.000

The factors listed above are then weighted by type of injury for each policy period. The calculation of factors which adjust the benefits for each policy period to the October 1, 1990 benefit level are displayed on the following exhibits.

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EXHIBIT B-20

Calculation of Factors to Adjust Unit Stat Plan Losses to Benefit Level Effective October 1, 1990

Cumulative Effect of Amendments	Fatal	Permanent Total	Major Permanent Partial	Minor Permanent Partial	Temporary Total	Medical	Distributions of Business 1986	1987	1988
Base	1.000	1.000	1.000	1.000	1.000	1.000	.364		
10/1/86	1.004	1.048	1.004	1.008	1.020	1.000	.619	.364	
10/1/87	1.008	1.091	1.008	1.015	1.037	1.000	.017	.619	.364
10/1/88	1.012	1.131	1.012	1.022	1.053	1.000		.017	.619
10/1/89	1.018	1.191	1.017	1.031	1.075	1.000			.017
10/1/90	1.022	1.233	1.020	1.038	1.090	1.000			
Average Benefit Level of Policy Years									
1986	1.003	1.031	1.003	1.005	1.013	1.000			
1987	1.007	1.076	1.007	1.013	1.031	1.000			
1988	1.011	1.117	1.011	1.020	1.048	1.000			
Amendment Factor to 10/1/90 Law Level									
1986	1.019	1.196	1.017	1.033	1.076	1.000			
1987	1.015	1.146	1.013	1.025	1.057	1.000			
1988	1.011	1.104	1.009	1.018	1.040	1.000			

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EXHIBIT B-21

Derivation of Benefit On-Level Factors

Distribution of Premium by Month

	Premium	Percentage Distribution
January	437,883,970	18.2%
February	121,068,321	5.0%
March	171,649,119	7.1%
April	253,271,487	10.5%
May	205,143,810	8.5%
June	177,767,054	7.4%
July	253,227,368	10.5%
August	121,682,437	5.1%
September	150,457,777	6.2%
October	193,585,025	8.0%
November	165,259,645	6.9%
December	157,360,545	6.5%
	2,408,356,558	100.0%

* Based on policies written between 1/1/86 and 12/31/88.

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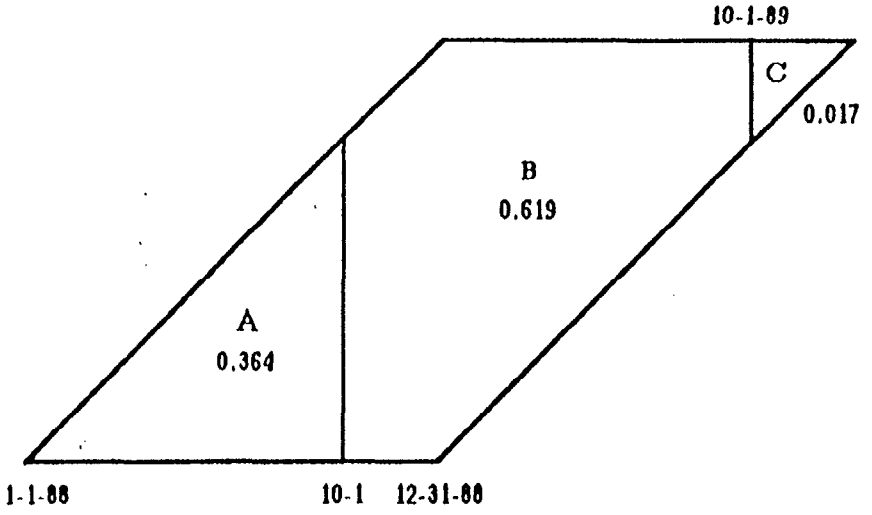
EXHIBIT B-22

Derivation of Benefit On-Level Factors



Determination of Weights for Policy Year 1988

	(1) % Modified Premium (Exh. B-21)	(2) # of Months of Policy in Area A	(3) % of Year in Area A =(2)/12	(4) Portion of Policy in A =(1)*(3)	(5) # of Months of Policy in Area B	(6) % of Year in Area B =(5)/12	(7) Portion of Policy in B =(1)*(6)	(8) # of Months of Policy in Area C	(9) % of Year in Area C =(8)/12	(10) Portion of Policy in C =(1)*(9)
anuary	0.182	9	0.750	0.137	3	0.250	0.046	0	0.000	0.000
ebruary	0.050	8	0.667	0.033	4	0.333	0.017	0	0.000	0.000
arch	0.071	7	0.583	0.041	5	0.417	0.030	0	0.000	0.000
pril	0.105	6	0.500	0.053	6	0.500	0.053	0	0.000	0.000
ay	0.085	5	0.417	0.035	7	0.583	0.050	0	0.000	0.000
une	0.074	4	0.333	0.025	8	0.667	0.049	0	0.000	0.000
uly	0.105	3	0.250	0.026	9	0.750	0.079	0	0.000	0.000
ugust	0.051	2	0.167	0.009	10	0.833	0.042	0	0.000	0.000
eptember	0.063	1	0.083	0.005	11	0.917	0.058	0	0.000	0.000
ctober	0.080	0	0.000	0.000	12	1.000	0.080	0	0.000	0.000
lovember	0.069	0	0.000	0.000	11	0.917	0.063	1	0.083	0.006
ecember	0.065	0	0.000	0.000	10	0.833	0.054	2	0.167	0.011
				0.364			0.621			0.017

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EXHIBIT B-23

Statistical Plan Adjustment Factor Calculations

		For All Classification Codes Except 0908, 0909, 0912, 0913, 7708	For Classification Codes 0908, 0909, 0912, 0913, 7708
1.	Statistical Plan Indicated Change in Pure Premium Level	0.909	0.909
2.	Financial Data Policy Year and Accident Year Indicated Change in Pure Premium Level	1.061	1.061
3.	Financial Data Adjustment Factor (2)/(1)	1.167	1.167
4.	Offset for Executive Officers	0.991	1.000
5.	Factor for Ratio of Unlimited to Limited Losses	1.055	1.055
6.	Total Statistical Plan Adjustment Factor (3)x(4)x(5)	1.220	1.231

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EXHIBIT B-24

Statistical Plan Loss Ratios and Industry Group Differentials

Industry Group	Policy Year	Standard Earned Premium @ 1-1-91 Pure Premium Level	Losses On 10-1-90 Law Level	USP Loss Ratio	Industry Group Differentials	Industry Group Differentials Adjustment Factor	Final Industry Group Differentials
Mfg	1988	151,925,491	143,418,536				
	1987	144,454,591	144,283,527				
	1986	131,604,835	111,003,070				
	Total	427,984,917	398,705,133	0.932	1.025	1.005	1.030
Cont	1988	137,404,903	149,208,813				
	1987	144,354,554	140,733,502				
	1986	145,944,623	105,508,048				
	Total	427,704,080	395,450,363	0.925	1.018	1.001	1.019
All Others	1988	288,778,633	266,132,799				
	1987	283,322,758	260,106,766				
	1986	272,843,481	225,519,535				
	Total	844,944,872	751,759,100	0.890	0.979	0.997	0.976
Totals	1988	578,109,027	558,760,148				
	1987	572,131,903	545,123,795				
	1986	550,392,939	442,030,653				
	Total	1,700,633,869	1,545,914,596	0.909	1.000	1.000	1.000

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EXHIBIT B-25

INDUSTRY GROUP DIFFERENTIAL ADJUSTMENT FACTOR CALCULATION

Policy Year Financial Data

	Indemnity	Medical
1985	283,606,318	130,953,008
1986	286,798,595	139,136,223
1987	344,301,942	171,506,799
1988	358,380,842	193,272,032
1989	398,273,812	224,444,836

Average Weekly Earnings by State and Industry Group

	Manufacturing	Contracting	All Others
1983	409.84	423.79	272.59
1984	435.83	453.66	283.15
1985	453.90	470.79	290.90
1986	454.46	471.91	288.27
1987	480.24	483.89	319.91
1988	488.87	532.91	336.02
1989	500.21	498.25	357.79

Trend Factors from 1-1-88 to 4-1-90

Indemnity Losses (IL)	Medical Losses (ML)	AWW (M)	AWW (C)	AWW (AO)	AWW (TOT)
1.165	1.246	1.066	1.063	1.094	1.079

Effect of Med/Ind Wage Trends by Industry Group

Manufacturing: (ML)/(M)	1.169
Contracting: (ML)/(C)	1.172
All Others: (ML)/(AO)	1.139
Total: (IL)/(TOT)	1.080

Indicated Losses	(i) Indemnity	(m) Medical	(t) Total	Expected Losses
Manufacturing:	267,841,748	130,863,385	398,705,133	427,984,917
Contracting:	292,452,707	101,958,275	394,410,982	427,704,080
All Other:	494,229,648	254,755,092	748,984,740	844,944,873
Total:	1,054,524,103	487,576,752	1,542,100,855	1,700,633,870

Factors to Adjust Current Differentials: {(i)*1.080+(m)(Med. Trend)}/(t)

Manufacturing:	1.109	Normalized:	1.005
Contracting:	1.104		1.001
All Other:	1.100		0.997
Total:	1.103		1.000

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EXHIBIT B-26

Large Claim Adjustment Sample Calculations by Industry Group

In accordance with the standard ratemaking procedure, single claims have been limited to 20% of the current self-rating point ($329,000), and multiple claim accidents have been limited to 40% of the current self-rating point ($658,000).

Large Claim Experience Examples

	Industry Group	Class Code	No. of Cases	Amount Indemnity	Amount Medical	Amount Retained Indemnity	Amount Retained Medical
Policy Year 1988	Manufacturing	4034	1	560,000	2,500	327,538	1,462
Policy Year 1987	Contracting	3724	1	400,751	384	328,685	315

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EXHIBIT B-27

Standard Earned Premium to Manual Premium Calculation

Policies Becoming Effective During Period	(1) Policy Year Standard Earned Premium	(2) Premium at Policy Year Manual Rates	(3) Ratio of Std. Earned to Manual Premium (1)/(2)	(4) Ratio of Manual to Std. Earned (2)/(1)
Manufacturing				
1-1-86/12-31-86	200,713,555	196,227,435		
1-1-87/12-31-87	220,317,248	219,444,055		
1-1-88/12-31-88	239,870,894	256,007,537		
Total	660,901,697	671,679,027	.984	1.016
Contracting				
1-1-86/12-31-86	149,689,683	157,099,733		
1-1-87/12-31-87	161,438,787	168,012,522		
1-1-88/12-31-88	161,605,259	168,361,405		
Total	472,733,729	493,473,660	.958	1.044
All Other				
1-1-86/12-31-86	375,032,979	365,661,684		
1-1-87/12-31-87	416,612,319	414,772,950		
1-1-88/12-31-88	454,816,127	456,075,812		
Total	1,246,461,425	1,236,510,446	1.008	0.992
All Groups				
1-1-86/12-31-86	725,436,217	718,988,852		
1-1-87/12-31-87	798,368,354	802,229,527		
1-1-88/12-31-88	856,292,280	880,444,754		
Total	2,380,096,851	2,401,663,133	.991	1.009

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EXHIBIT B-28

Credibility Assignment Calculations

Credibility is an assignment of a numerical measure or weight to the predictive value of data. The customary practice is to specify a standard for full (or 100%) credibility and to graduate downward to 0%, as the volume of data fails to meet the full standards. The credibility weights assigned to the indicated pure premium vary in 1% intervals, depending upon the volume of expected losses (i.e., the product of the underlying pure premium and the payroll in one hundred dollar units). It has been determined that for a classification to have sufficient exposure to losses to base its pure premium solely upon that classification's experience, expected losses should amount to 25 times the average statewide serious loss for full serious credibility, 300 times the average statewide non-serious loss for full non-serious credibility, and 80% of the non-serious standard for full medical credibility.

The expected losses credibility criteria for assigning 100% credibility to an indicated partial pure premium is determined as follows:

	Serious	Non-Serious	Medical	Total
1. Number of Cases - All Classes	9,100	84,588	xxx	93,688
2. Modified Losses - All Classes*	997,978,500	215,942,351	573,143,087	1,787,063,938
3. Average Cost Per Case (2) / (1)	109,668	2,553		19,075
4. Basis of 100% Credibility - Number of Cases	25	300	xxx	xxx
5. 100% Credibility Criteria on Actual Losses (3) x (4)**	2,741,700	765,900	612,720	xxx
6. Expected Losses Based on Underlying Pure Premium†	960,643,381	221,588,169	535,977,639	1,718,209,189
7. Factor to Adjust from Actual to Underlying (6) / (2)	xxx	xxx	xxx	0.961
8. Expected Losses Required for 100% Credibility (5) x (7)	2,634,774	736,030	588,824	xxx

* Based on policy years 1986, 1987, and 1988.

** 100% Credibility Criteria for Medical equals 80% of Non-Serious Criteria.

† Expected losses in line (6) are the sum of the product of the total payroll in $100 units times the underlying pure premiums for all classes.

Partial credibilities are determined by a three-halves formula; that is, the product of the square root of the cube of any given credibility value and the full credibility standard determines the minimum volume of expected losses necessary to achieve the given credibility value. The credibility table for Minnesota is provided on Exhibit B-29, pages 93 and 94.

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EXHIBIT B-29

Statistical Plan Credibility Criteria

Credibility	Serious Criteria	Non-Serious Criteria	Medical Criteria
100%	2,634,774	736,030	588,824
99%	2,595,351	725,017	580,014
98%	2,556,127	714,060	571,248
97%	2,517,103	703,158	562,527
96%	2,478,279	692,313	553,850
95%	2,439,657	681,524	545,219
94%	2,401,238	670,791	536,633
93%	2,363,022	660,116	528,092
92%	2,325,012	649,497	519,598
91%	2,287,207	638,936	511,149
90%	2,249,609	628,433	502,747
89%	2,212,220	617,989	494,391
88%	2,175,041	607,602	486,082
87%	2,138,072	597,275	477,820
86%	2,101,314	587,007	469,606
85%	2,064,770	576,798	461,439
84%	2,028,441	566,649	453,320
83%	1,992,326	556,561	445,249
82%	1,956,429	546,533	437,226
81%	1,920,750	536,566	429,253
80%	1,885,291	526,660	421,328
79%	1,850,052	516,816	413,453
78%	1,815,036	507,034	405,628
77%	1,780,244	497,315	397,852
76%	1,745,676	487,659	390,127
75%	1,711,336	478,066	382,452
74%	1,677,224	468,536	374,829
73%	1,643,341	459,071	367,257
72%	1,609,690	449,670	359,736
71%	1,576,271	440,335	352,268
70%	1,543,087	431,065	344,852
69%	1,510,139	421,861	337,489
68%	1,477,429	412,723	330,179
67%	1,444,959	403,653	322,922
66%	1,412,730	394,649	315,720
65%	1,380,745	385,714	308,571
64%	1,349,004	376,847	301,478
63%	1,317,511	368,050	294,440
62%	1,286,266	359,321	287,457
61%	1,255,273	350,663	280,531
60%	1,224,532	342,076	273,661
59%	1,194,047	333,560	266,848
58%	1,163,819	325,115	260,092
57%	1,133,850	316,744	253,395
56%	1,104,143	308,445	246,756
55%	1,074,700	300,220	240,176
54%	1,045,524	292,069	233,656
53%	1,016,617	283,994	227,195
52%	987,981	275,995	220,796
51%	959,619	268,072	214,457
50%	931,533	260,226	208,181

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EXHIBIT B-29

Statistical Plan Credibility Criteria

Credibility	Serious Criteria	Non-Serious Criteria	Medical Criteria
49%	903,727	252,458	201,967
48%	876,204	244,770	195,816
47%	848,966	237,160	189,728
46%	822,016	229,632	183,706
45%	795,357	222,185	177,748
44%	768,993	214,820	171,856
43%	742,927	207,538	166,031
42%	717,162	200,341	160,273
41%	691,702	193,229	154,583
40%	666,551	186,202	148,962
39%	641,712	179,264	143,411
38%	617,190	172,413	137,931
37%	592,988	165,653	132,522
36%	569,111	158,982	127,186
35%	545,564	152,404	121,924
34%	522,350	145,920	116,736
33%	499,476	139,530	111,624
32%	476,945	133,236	106,589
31%	454,764	127,039	101,631
30%	432,938	120,942	96,754
29%	411,472	114,946	91,957
28%	390,374	109,052	87,241
27%	369,649	103,262	82,610
26%	349,304	97,579	78,063
25%	329,347	92,004	73,603
24%	309,785	86,539	69,231
23%	290,626	81,187	64,950
22%	271,880	75,950	60,760
21%	253,555	70,831	56,665
20%	235,661	65,833	52,666
19%	218,210	60,957	48,766
18%	201,211	56,209	44,967
17%	184,679	51,590	41,272
16%	168,626	47,106	37,685
15%	153,067	42,759	34,208
14%	138,018	38,556	30,844
13%	123,498	34,499	27,599
12%	109,525	30,596	24,477
11%	96,124	26,852	21,482
10%	83,319	23,275	18,620
9%	71,139	19,873	15,898
8%	59,618	16,654	13,324
7%	48,797	13,631	10,905
6%	38,723	10,817	8,654
5%	29,458	8,229	6,583
4%	21,078	5,888	4,711
3%	13,691	3,825	3,060
2%	7,452	2,082	1,665
1%	2,635	736	589
0%	0	0	0

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Alternative Pure Premium Level Changes

This appendix provides the results of applying various types of development factors to both policy year and accident year experience. Supporting documentation for the development factors utilized in this appendix are located in Appendix 8. Please note that, regardless of the development procedure used, the losses at an eighth report have been converted to an incurred loss basis. The incurred excluding IBNR to incurred ratios used in these calculations are also located in Appendix 8. The losses on the following exhibits have been adjusted to the 10/1/90 benefit level.

The following exhibits are included in this appendix:

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Determination of Pure Premium Level Change for Policy Year 1989 Based on Incurred Excluding IBNR Losses

Pure Premium		
(1)	Standard earned pure premium valued as of December 31, 1990	518,435,490
(2)	Pure premium development factor	1.017
(3)	Factor to adjust pure premium to January 1, 1991 pure premium level	0.998
(4)	Premium available for benefit costs: (1)x(2)x(3)	526,194,396
Indemnity Losses		
(5)	Incurred excluding IBNR indemnity losses valued as of December 31, 1990	225,037,210
(6)	Incurred excluding IBNR indemnity loss development factor	1.592
(7)	Factor to adjust indemnity losses to October 1, 1990 benefit level	1.012
(8)	Adjusted indemnity losses: (5)x(6)x(7)	362,558,349
(9)	Indemnity pure premium loss ratio: (8)/(4)	0.689
Medical Losses		
(10)	Incurred excluding IBNR medical losses valued as of December 31, 1990	156,656,025
(11)	Incurred excluding IBNR medical loss development factor	1.182
(12)	Factor to adjust medical losses to October 1, 1990 benefit level	1.000
(13)	Adjusted medical losses: (10)x(11)x(12)	185,167,422
(14)	Medical pure premium loss ratio: (13)/(4)	0.352
Indicated Change in Pure Premium Level		
(15)	Total adjusted losses: (8)+(13)	547,725,771
(16)	Indicated change in pure premium level: (15)/(4)	1.041

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Determination of Pure Premium Level Change for Accident Year 1990 Based on Incurred Excluding IBNR Losses

Pure Premium		
(1)	Standard earned pure premium valued as of December 31, 1990	544,933,895
(2)	Factor to adjust pure premium to January 1, 1991 pure premium level	0.982
(3)	Premium available for benefit costs: (1)x(2)	535,125,065
Indemnity Losses		
(4)	Incurred excluding IBNR indemnity losses valued as of December 31, 1990	179,278,284
(5)	Incurred excluding IBNR indemnity loss development factor	2.007
(6)	Factor to adjust indemnity losses to October 1, 1990 benefit level	1.005
(7)	Adjusted indemnity losses: (4)x(5)x(6)	361,610,574
(8)	Indemnity pure premium loss ratio: (7)/(3)	0.676
Medical Losses		
(9)	Incurred excluding IBNR medical losses valued as of December 31, 1990	132,427,443
(10)	Incurred excluding IBNR medical loss development factor	1.406
(11)	Factor to adjust medical losses to October 1, 1990 benefit level	1.000
(12)	Adjusted medical losses: (9)x(10)x(11)	186,192,985
(13)	Medical pure premium loss ratio: (12)/(3)	0.348
Indicated Change in Pure Premium Level		
(14)	Total adjusted losses: (7)+(12)	547,803,558
(15)	Indicated change in pure premium level: (14)/(3)	1.024

Determination of Pure Premium Level Change for Policy Year 1989 Based on Incurred Losses

Pure Premium		
(1)	Standard earned pure premium valued as of December 31, 1990	518,435,490
(2)	Pure premium development factor	1.017
(3)	Factor to adjust pure premium to January 1, 1991 pure premium level	0.998
(4)	Premium available for benefit costs: (1)x(2)x(3)	526,194,396
Indemnity Losses		
(5)	Incurred indemnity losses valued as of December 31, 1990	290,426,498
(6)	Incurred Indemnity loss development factor	1.274
(7)	Factor to adjust indemnity losses to October 1, 1990 benefit level	1.012
(8)	Adjusted indemnity losses: (5)x(6)x(7)	374,443,399
(9)	Indemnity pure premium loss ratio: (8)/(4)	0.712
Medical Losses		
(10)	Incurred medical losses valued as of December 31, 1990	182,469,808
(11)	Incurred Medical loss development factor	1.010
(12)	Factor to adjust medical losses to October 1, 1990 benefit level	1.000
(13)	Adjusted medical losses: (10)x(11)x(12)	184,294,506
(14)	Medical pure premium loss ratio: (13)/(4)	0.350
Indicated Change in Pure Premium Level		
(15)	Total adjusted losses: (8)+(13)	558,737,905
(16)	Indicated change in pure premium level: (15)/(4)	1.062

Determination of Pure Premium Level Change for Accident Year 1990 Based on Incurred Losses

Pure Premium		
(1)	Standard earned pure premium valued as of December 31, 1990	544,843,429
(2)	Factor to adjust pure premium to January 1, 1991 pure premium level	0.982
(3)	Premium available for benefit costs: (1)x(2)	535,036,247
Indemnity Losses		
(4)	Incurred indemnity losses valued as of December 31, 1990	298,925,755
(5)	Incurred Indemnity loss development factor	1.284
(6)	Factor to adjust indemnity losses to October 1, 1990 benefit level	1.005
(7)	Adjusted indemnity losses: (4)x(5)x(6)	385,739,773
(8)	Indemnity pure premium loss ratio: (7)/(3)	0.721
Medical Losses		
(9)	Incurred medical losses valued as of December 31, 1990	181,769,349
(10)	Incurred Medical loss development factor	1.025
(11)	Factor to adjust medical losses to October 1, 1990 benefit level	1.000
(12)	Adjusted medical losses: (9)x(10)x(11)	186,313,583
(13)	Medical pure premium loss ratio: (12)/(3)	0.348
Indicated Change in Pure Premium Level		
(14)	Total adjusted losses: (7)+(12)	572,053,356
(15)	Indicated change in pure premium level: (14)/(3)	1.069

APPEN.C.2

MINNESOTA

SUMMARY OF 8TH TO ULTIMATE LOSS DEVELOPMENT FACTORS

	Policy Year	Accident Year	Average
Method 1			
Latest Year	1.136	1.159	1.148
2-Year Ave	1.094	1.108	1.101
3-Year Ave	1.080	1.104	1.092
Method 2			
Latest Year	1.142	1.181	1.162
2-Year Ave	1.097	1.121	1.109
3-Year Ave	1.081	1.111	1.096
Method 3			
Latest Year	1.123	1.152	1.138
2-Year Ave	1.094	1.108	1.101
Method 4	1.122	1.146	1.134
Method 5	1.121	1.133	1.127
Selected			1.110

Notes: Derivation of factors based on Methods 1, 2, 3, and 4 are provided in this Appendix. The factors shown in Method 5 are based on implied 8th to Ultimate loss development factors utilizing curve fitting techniques.

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APPEN.C.3

8TH TO ULTIMATE LOSS DEVELOPMENT

Method 1

POLICY YEAR 8TH TO ULTIMATE

	Indemnity	Medical	Total
1. 79-81 Average 8th Report	248,806,468	84,478,389	333,284,857
2. 81 & Prior @ 12-31-89	2,105,319,064	848,185,262	2,953,504,326
3. 81 & Prior @ 12-31-90	2,134,692,280	864,192,271	2,998,884,551
4. Difference (3)-(2)	29,373,216	16,007,009	45,380,225
5. 8th to Ultimate Factor 1+((4)/(1))	1.118	1.189	1.136
1. 78-80 Average 8th Report	238,263,417	75,899,695	314,163,112
2. 80 & Prior @ 12-31-88	1,738,427,690	703,216,184	2,441,643,874
3. 80 & Prior @ 12-31-89	1,745,414,418	712,452,990	2,457,867,408
4. Difference (3)-(2)	6,986,728	9,236,806	16,223,534
5. 8th to Ultimate Factor 1+((4)/(1))	1.029	1.122	1.052
1. 77-79 Average 8th Report	225,702,897	72,704,019	298,406,916
2. 79 & Prior @ 12-31-87	1,559,007,478	645,575,980	2,204,583,458
3. 79 & Prior @ 12-31-88	1,572,636,373	647,885,073	2,220,521,446
4. Difference (3)-(2)	13,628,895	2,309,093	15,937,988
5. 8th to Ultimate Factor 1+((4)/(1))	1.060	1.032	1.053
		2-Year Ave	1.094
		3-Year Ave	1.080

ACCIDENT YEAR 8TH TO ULTIMATE

	Indemnity	Medical	Total
1. 80-82 Average 8th Report	232,119,537	82,008,465	314,128,002
2. 82 & Prior @ 12-31-89	2,155,640,486	859,184,678	3,014,825,164
3. 82 & Prior @ 12-31-90	2,188,622,844	876,254,192	3,064,877,036
4. Difference (3)-(2)	32,982,358	17,069,514	50,051,872
5. 8th to Ultimate Factor 1+((4)/(1))	1.142	1.208	1.159
1. 79-81 Average 8th Report	231,929,168	76,527,085	308,456,253
2. 81 & Prior @ 12-31-88	1,828,970,340	726,592,080	2,555,562,420
3. 81 & Prior @ 12-31-89	1,837,147,046	736,000,942	2,573,147,988
4. Difference (3)-(2)	8,176,706	9,408,862	17,585,568
5. 8th to Ultimate Factor 1+((4)/(1))	1.035	1.123	1.057
1. 78-80 Average 8th Report	240,934,782	77,931,058	318,865,840
2. 80 & Prior @ 12-31-87	1,669,584,539	674,573,687	2,344,158,226
3. 80 & Prior @ 12-31-88	1,692,839,179	681,915,463	2,374,754,642
4. Difference (3)-(2)	23,254,640	7,341,776	30,596,416
5. 8th to Ultimate Factor 1+((4)/(1))	1.097	1.094	1.096
		2-Year Ave	1.108
		3-Year Ave	1.104

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ALTERNATIVE POLICY YEAR 8TH TO ULTIMATE
LOSS DEVELOPMENT

Method 2

Policy Year	INDEMNITY Incurred Indemnity @ 12/31/85	INDEMNITY Incurred Indemnity @ 12/31/86	INDEMNITY Difference	INDEMNITY Estimated 8th to Ult Loss Devel	MEDICAL Incurred Medical @ 12/31/85	MEDICAL Incurred Medical @ 12/31/86	MEDICAL Difference	MEDICAL Estimated 8th to Ult Loss Devel	Combined 8th to Ult LDF
1977	159,319,515				52,296,868				
Prior to1977	722,211,019				349,289,126				
1977 & Prior	881,530,534	900,157,682	18,627,148	1.117	401,585,994	411,554,174	9,968,180	1.191	1.135
	@ 12/31/86	@ 12/31/87			@ 12/31/86	@ 12/31/87			
1978	250,085,263	250,346,444			77,809,418	76,822,912			
Prior to1978	1,055,136,656	1,075,096,319			488,208,830	500,064,688			
1978 & Prior	1,305,821,919	1,325,442,763	19,620,844	1.078	566,018,248	576,887,600	10,869,352	1.140	1.093
	@ 12/31/87	@ 12/31/88			@ 12/31/87	@ 12/31/88			
1979	246,125,516	253,095,026			82,066,429	81,969,000			
Prior to1979	1,312,881,962	1,319,541,347			563,509,551	565,916,073			
1979 & Prior	1,559,007,478	1,572,636,373	13,628,895	1.055	645,575,980	647,885,073	2,309,093	1.028	1.049
	@ 12/31/88	@ 12/31/89			@ 12/31/88	@ 12/31/89			
1980	235,535,958	236,733,065			74,671,733	74,858,836			
Prior to1980	1,502,891,732	1,508,681,353			628,544,451	637,594,154			
1980 & Prior	1,738,427,690	1,745,414,418	6,986,728	1.030	703,216,184	712,452,990	9,236,806	1.124	1.052
	@ 12/31/89	@ 12/31/90			@ 12/31/89	@ 12/31/90			
1981	234,449,121	238,496,832			86,071,119	86,843,819			
Prior to1981	1,870,869,943	1,896,195,448			762,114,143	777,348,452			
1981 & Prior	2,105,319,064	2,134,692,280	29,373,216	1.125	848,185,262	864,192,271	16,007,009	1.166	1.142
							Average		1.094
							Ave-Last Two		1.097
							Ave-Last Three		1.081

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ALTERNATIVE ACCIDENT YEAR 8TH TO ULTIMATE LOSS DEVELOPMENT

Method 2

	INDEMNITY				MEDICAL				
Accident Year	Incurred Indemnity @ 12/31/85	Incurred Indemnity @ 12/31/86	Difference	Estimated 8th to Ult Loss Devel	Incurred Medical @ 12/31/85	Incurred Medical @ 12/31/86	Difference	Estimated 8th to Ult Loss Devel	Combined 8th to Ult LDF
1978	192,077,421				61,703,800				
Prior to1978	741,958,331				341,084,862				
1978 & Prior	934,035,752	945,813,673	11,777,921	1.061	402,788,662	408,788,873	6,000,211	1.097	1.070
	@ 12/31/86	@ 12/31/87			@ 12/31/86	@ 12/31/87			
1979	249,144,187	254,862,497			79,360,514	79,673,250			
Prior to1979	1,154,059,757	1,162,981,676			503,029,820	507,217,232			
1979 & Prior	1,403,203,944	1,417,844,173	14,640,229	1.059	582,390,334	586,790,482	4,400,148	1.055	1.058
	@ 12/31/87	@ 12/31/88			@ 12/31/87	@ 12/31/88			
1980	249,003,733	255,395,854			83,963,323	84,934,520			
Prior to1980	1,420,580,806	1,437,503,325			590,610,364	596,980,943			
1980 & Prior	1,669,584,539	1,692,899,179	23,254,640	1.093	674,573,687	681,915,463	7,341,776	1.087	1.092
	@ 12/31/88	@ 12/31/89			@ 12/31/88	@ 12/31/89			
1981	214,514,636	218,134,495			74,672,119	75,652,721			
Prior to1981	1,614,455,502	1,619,012,551			651,919,961	660,348,221			
1981 & Prior	1,828,970,340	1,837,147,046	8,176,706	1.038	726,592,080	736,000,942	9,408,862	1.126	1.061
	@ 12/31/89	@ 12/31/90			@ 12/31/89	@ 12/31/90			
1982	200,127,483	205,817,374			76,117,021	76,913,279			
Prior to1982	1,956,513,003	1,982,805,470			783,067,657	799,340,913			
1982 & Prior	2,156,640,486	2,188,622,844	32,982,358	1.165	859,184,678	876,254,192	17,069,514	1.224	1.181

Average	1.092
Ave-Last Two	1.121
Ave-Last Three	1.111

ALTERNATIVE 8TH TO 10TH AND 10TH TO ULTIMATE LOSS DEVELOPMENT

Method 3

Policy Year

Policy Year	Indemnity 8th-9th	Indemnity 9th-10th	Indemnity 8th to 10th	Medical 8th-9th	Medical 9th-10th	Medical 8th to 10th	Combined Indemnity & Medical 8th to 10th	Combined Indemnity & Medical 10th to Ult	8th to Ult
1978	0.999	1.028		0.987	0.992				
1979	1.029	1.001		0.999	1.006				
1980	1.005	1.019		1.003	1.006				
1981	1.017			1.009					
Avg - All	1.013	1.016	1.029	1.000	1.001	1.001	1.019		
							Last Year	1.102	1.123
							2-Year Ave	1.074	1.094

Accident Year

Accident Year	Indemnity 8th-9th	Indemnity 9th-10th	Indemnity 8th to 10th	Medical 8th-9th	Medical 9th-10th	Medical 8th to 10th	Combined Indemnity & Medical 8th to 10th	Combined Indemnity & Medical 10th to Ult	8th to Ult
1979	1.023	1.035		1.003	0.997				
1980	1.025	1.008		1.012	1.004				
1981	1.017	1.011		1.014	1.001				
1982	1.028			1.010					
Avg - All	1.023	1.018	1.041	1.010	1.001	1.011	1.030		
							Last Year	1.118	1.152
							2-Year Ave	1.076	1.108

MINNESOTA

10TH TO ULTIMATE LOSS DEVELOPMENT

POLICY YEAR

	INDEMNITY				MEDICAL				
Policy Year	Incurred Indemnity @ 12/31/88	Incurred Indemnity @ 12/31/89	Difference	Estimated 10th to Ult Loss Devel	Incurred Medical @ 12/31/88	Incurred Medical @ 12/31/89	Difference	Estimated 10th to Ult Loss Devel	Combined 10th to Ult LDF
1978	234,681,961	233,126,358			69,356,629	71,415,967			
Prior to1978	1,021,875,528	1,028,951,269			481,534,948	487,814,037			
1978 & Prior	1,256,557,489	1,262,077,627	5,520,138	1.024	550,891,577	559,230,004	8,338,427	1.120	1.046
	@ 12/31/89	@ 12/31/90			@ 12/31/89	@ 12/31/90			
1979	258,796,110	264,403,745			84,558,389	85,032,007			
Prior to1979	1,354,099,478	1,368,901,859			594,761,574	608,993,709			
1979 & Prior	1,612,895,588	1,633,305,604	20,410,016	1.079	679,319,963	694,025,716	14,705,753	1.174	1.102
								Average	1.074

ACCIDENT YEAR

	INDEMNITY				MEDICAL				
Accident Year	Incurred Indemnity @ 12/31/88	Incurred Indemnity @ 12/31/89	Difference	Estimated 10th to Ult Loss Devel	Incurred Medical @ 12/31/88	Incurred Medical @ 12/31/89	Difference	Estimated 10th to Ult Loss Devel	Combined 10th to Ult LDF
1979	242,448,565	242,309,387			72,231,504	73,357,450			
Prior to1979	1,133,024,764	1,135,783,605			501,538,109	508,506,733			
1979 & Prior	1,375,473,329	1,378,152,972	2,679,643	1.011	573,769,613	581,864,183	8,094,570	1.112	1.034
	@ 12/31/89	@ 12/31/90			@ 12/31/89	@ 12/31/90			
1980	260,496,341	267,268,097			86,515,018	86,179,725			
Prior to1980	1,456,421,182	1,473,263,118			612,336,085	628,870,131			
1980 & Prior	1,716,917,523	1,740,529,215	24,611,692	1.094	698,850,103	715,049,856	16,199,753	1.187	1.118
								Average	1.076

MINNESOTA

ALTERNATIVE 8TH TO 11TH AND 11TH TO ULTIMATE LOSS DEVELOPMENT

Method 4

Policy Year

Policy Year	Indemnity 8th-9th	Indemnity 9th-10th	Indemnity 10th to 11th	Indemnity 8th to 11th	Medical 8th-9th	Medical 9th-10th	Medical 10th to 11th	Medical 8th to 11th	Combined Indemnity & Medical 8th to 11th	Combined Indemnity & Medical 11th to Ult	8th to Ult
1978	0.999	1.028	0.994		0.987	0.992	1.030				
1979	1.029	1.001	1.022		0.999	1.006	1.006				
1980	1.005	1.019			1.003	1.006					
1981	1.017				1.009						
Avg - All	1.013	1.016	1.008	1.037	1.000	1.001	1.018	1.019	1.031	1.088	1.122

Accident Year

Accident Year	Indemnity 8th-9th	Indemnity 9th-10th	Indemnity 10th to 11th	Indemnity 8th to 11th	Medical 8th-9th	Medical 9th-10th	Medical 10th to 11th	Medical 8th to 11th	Combined Indemnity & Medical 8th to 110th	Combined Indemnity & Medical 11th to Ult	8th to Ult
1979	1.023	1.035	1.000		1.003	0.997	1.016				
1980	1.025	1.008	1.026		1.012	1.004	0.996				
1981	1.017	1.011			1.014	1.001					
1982	1.028				1.010						
Avg - All	1.023	1.018	1.013	1.055	1.010	1.001	1.006	1.017	1.042	1.100	1.146

MINNESOTA

11TH TO ULTIMATE LOSS DEVELOPMENT FACTORS

POLICY YEAR

	INDEMNITY				MEDICAL				
Policy Year	Incurred Indemnity @ 12/31/89	Incurred Indemnity @ 12/31/90	Difference	Estimated 11th to Ult Loss Devel	Incurred Medical @ 12/31/89	Incurred Medical @ 12/31/90	Difference	Estimated 11th to Ult Loss Devel	Combined 11th to Ult LDF
1978	251,531,439	258,393,996			77,593,695	78,390,453			
Prior to1978	1,102,568,039	1,110,607,863			517,167,879	530,603,256			
1978 & Prior	1,354,099,478	1,368,001,859	14,802,381	1.059	594,761,574	608,993,709	14,232,135	1.183	1.088

ACCIDENT YEAR

	INDEMNITY				MEDICAL				
Accident Year	Incurred Indemnity @ 12/31/89	Incurred Indemnity @ 12/31/90	Difference	Estimated 11th to Ult Loss Devel	Incurred Medical @ 12/31/89	Incurred Medical @ 12/31/90	Difference	Estimated 11th to Ult Loss Devel	Combined 11th to Ult LDF
1979	263,176,029	269,088,965			80,767,231	82,540,727			
Prior to1979	1,192,245,153	1,204,174,153			531,567,854	546,329,404			
1979 & Prior	1,455,421,182	1,473,263,118	17,841,936	1.068	612,335,085	628,870,131	16,535,046	1.205	1.100

Appendix .

MINNESOTA

Calculation of Industry Indemnity Trend Factors

Paid Loss Development

I. Basics						
1. Policy Year	1985	1986	1987	1988	1989	Total
2. Time Index, x	1	2	3	4	5	15
II. Premium						
3. Standard Premium	385,502,575	403,031,361	424,824,222	486,014,398	518,435,490	
4. Development Factor	1.000	1.000	1.000	1.000	1.017	
5. On Level Factor	1.137	1.110	1.134	1.024	0.998	
6. Adjusted Premium (3) x (4) x (5)	438,316,428	447,364,811	481,750,668	497,678,744	526,194,396	
III. Losses						
7. Indemnity Losses	164,497,287	152,377,777	156,427,575	124,604,061	81,359,039	
8. Development Factor	1.516	1.665	1.949	2.571	4.528	
9. On Level Factor	1.044	1.038	1.030	1.022	1.012	
10. Adjusted Losses (7) x (8) x (9)	260,350,514	263,349,941	314,023,664	327,404,896	372,814,453	
IV. Data for Trend Factor						
11. Loss Ratio (10)/(6), y	0.5940	0.5887	0.6518	0.6579	0.7085	
12. Ln(y)	-0.521	-0.530	-0.428	-0.419	-0.345	-2.243
13. x squared (2)x(2)	1	4	9	16	25	55.000
14. xLn(y) (2)x(12)	-0.521	-1.060	-1.284	-1.676	-1.725	-6.266
15. Fitted Indemnity Loss Ratio	0.5822	0.6098	0.6388	0.6691	0.7009	
16. A: [N*Sum(14)-Sum(2)*Sum(12)]/[N*Sum(13)-Sum(2)*Sum(2)]						0.046
17. B: e^[(Sum(12)-Sum(16)*Sum(2))/N]						0.556
18. Time Index for 4-1-90 - Midpoint of Experience:						5.250
19. Time Index for 1-1-93 - Midpoint of Adv. Loss Cost Effective Period						8.000
20. Squared Residual	0.000139	0.000445	0.000169	0.000125	0.000058	0.0009366
21. Annual Minnesota Indemnity Trend						4.6%
22. Annual Countrywide Indemnity Trend						5.0%
23. Selected Annual Indemnity Trend						4.5%
24. Indemnity Trend Factor [(1 +(23)^[19)-(18)]].						1.12

Appendix 3

MINNESOTA

Calculation of Industry Medical Trend Factors

Paid Loss Development

I. Basics						
1. Policy Year	1985	1986	1987	1988	1989	Total
2. Time Index, x	1	2	3	4	5	15
II. Premium						
3. Standard Premium	385,502,575	403,031,361	424,824,222	486,014,398	518,435,490	
4. Development Factor	1.000	1.000	1.000	1.000	1.017	
5. On Level Factor	1.137	1.110	1.134	1.024	0.998	
6. Adjusted Premium (3) x (4) x (5)	438,316,428	447,364,811	481,750,668	497,678,744	526,194,396	
III. Losses						
7. Medical Losses	87,593,985	88,791,463	102,575,837	102,968,584	89,957,850	
8. Development Factor	1.288	1.350	1.438	1.630	2.226	
9. On Level Factor	1.000	1.000	1.000	1.000	1.000	
10. Adjusted Losses (7) x (8) x (9)	112,821,053	119,868,475	147,504,054	167,838,792	200,246,174	
IV. Data for Trend Factor						
11. Loss Ratio (10)/(6), y	0.2574	0.2679	0.3062	0.3372	0.3806	
12. Ln (y)	-1.357	-1.317	-1.184	-1.087	-0.966	-5.911
13. x squared (2)x(2)	1	4	9	16	25	55.000
14. xLn(y) (2)x(12)	-1.357	-2.634	-3.552	-4.348	-4.830	-16.721
15. Fitted Medical Loss Ratio	0.2501	0.2768	0.3065	0.3393	0.3756	
16. A: [N*Sum(14)-Sum(2)*Sum(12)]/[N*Sum(13)-Sum(2)*Sum(2)]						0.101
17. B: e^[(Sum(12)-Sum(16)*Sum(2))/N]						0.226
18. Time Index for 4-1-90 - Midpoint of Experience:						5.250
19. Time Index for 1-1-93 - Midpoint of Adv. Loss Cost Effective Period						8.000
20. Squared Residual	0.000053	0.000079	0.000000	0.000004	0.000025	0.000162
21. Annual Minnesota Medical Trend						10.7%
22. Annual Countrywide Medical Trend						10.5%
23. Selected Annual Medical Trend						10.0%
24. Medical Trend Factor [(1 +(23)^[19)-(18)]						1.300

Determination of Overall Trend Factor
(Paid Development)

1.	Adjusted Indemnity Losses for Policy Year 1989, valued as of December 31, 1990	372,814,453
2.	Adjusted Medical Losses for Policy Year 1989, valued as of December 31, 1990	200,246,174
3.	Indemnity Trend Factor	1.129
4.	Medical Trend Factor	1.300
5.	Indicated Overall Trend Factor	1.189

WORKERS COMPENSATION STATISTICAL PLAN PREMIUM DEVELOPMENT FACTORS

STANDARD EARNED PREMIUM

Policy Year	1st Report	2nd Report	3rd Report	4th Report	5th Report
1976				254,566,501	254,566,501
1977			342,968,553	342,968,553	342,968,553
1978		426,074,908	426,070,330	426,073,581	426,073,581
1979	480,385,394	480,967,043	481,812,075	481,812,443	482,119,792
1980	469,512,626	470,257,246	471,020,810	471,773,989	471,639,333
1981	444,623,078	444,845,043	445,199,939	445,156,296	445,156,296
1982	387,249,564	399,216,137	399,161,139	399,161,139	399,161,139
1983	455,733,399	473,523,017	473,523,017	473,523,017	473,523,017
1984	536,136,560	536,123,475	538,535,673	538,535,673	538,535,673
1985	625,194,896	637,054,672	639,576,330	639,576,330	
1986	724,174,215	728,993,087	731,828,312		
1987	785,716,918	806,131,181			
1988	870,397,065				

DEVELOPMENT FACTORS

	Age to Age				Cumulative		
	1st-2nd	2nd-3rd	3rd-4th	4th-5th	3rd-5th	2nd-5th	1st-5th
				1.000	1.000	1.000	1.001
			1.000	1.000	1.000	1.002	1.004
		1.000	1.000	1.000	1.000	1.002	1.003
	1.001	1.002	1.000	1.001	1.003	1.004	1.015
	1.002	1.002	1.002	1.000	1.000	1.000	1.039
	1.001	1.001	1.000	1.000	1.000	1.000	1.000
	1.031	1.000	1.000	1.000	1.000	1.004	1.023
	1.039	1.000	1.000	1.000	1.000	1.004	1.011
	1.000	1.004	1.000	1.000	1.000	1.004	1.030
	1.019	1.004	1.000				
	1.007	1.004					
	1.026						
Avg	1.014	1.002	1.000	1.000	1.000	1.002	1.016
Avg-Hi/Lo Elim	1.012	1.002	1.000	1.000	1.000	1.002	1.014
Avg-Last Two	1.017	1.004	1.000	1.000	1.000	1.004	1.021
Selected (Mid 4 of Latest 6)	1.021	1.002	1.000	1.000	1.000	1.002	1.023