

IRS Loss Reserve Discounting

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CAS Study Note

Errata have been added at the end of this study note. The errata contain the following four corrected tables:

- **Table 1** replaces **Exhibit 2** on page 8.
- **Table 2** replaces **Exhibit 3** on page 11.
- **Tables 3 and 4** are corrected exhibits for the appendix. Although the appendix is not part of the syllabus reading, these are provided for reference so that the study note may be a resource in practical workplace applications.

— *Errata added 8 February 2008*

*CAS EXAM STUDY NOTE:
IRS LOSS RESERVE DISCOUNTING*

INTRODUCTION

This paper discusses statutory incurred losses, tax basis incurred losses, and IRS loss reserve discount factors.

- Calendar year statutory incurred losses are paid losses plus the change in full value loss reserves from the beginning to the end of the year.
- Tax basis incurred losses are paid losses plus the change in the *discounted* loss and loss adjustment expense reserves from the beginning to the end of the year.¹
- The IRS reserve discount factors are ratios of discounted to undiscounted loss reserves. They are by Schedule P line of business.² The actual loss payment pattern for the block of business is not relevant.

Illustration: The average lag between premium collection and loss payment for large dollar deductible workers' compensation business with a \$500,000 deductible may be twenty years. The average lag for first dollar workers' compensation business is about five to six years. The IRS loss reserve discount factors are the same for the two sets of business, since both use the Schedule P, Part 1D (workers' compensation) factors.

INVESTMENT INCOME AND AMORTIZATION: STATUTORY VS ECONOMIC INCOME

For long-tailed lines of business, statutory accounting may show an underwriting loss during the policy term when losses occur and positive investment income on the assets backing the reserves as the losses are settled. This accounting forces insurers to hold additional capital supporting full value loss reserves. It ensures the company can meet its claim obligations in adverse scenarios, but it does not reflect the economics of the business.

Illustration: An insurer writes a book of medical malpractice business, with an expense ratio of 30% and a discounted loss ratio of 65%, leaving a 5% profit margin after consideration of investment income on funds attributable to insurance transactions. The loss ratio is discounted to policy inception. Suppose medical malpractice losses are paid (on average) five years after occurrence, and the risk-free interest rate is 7% per annum.

The ultimate (undiscounted) loss ratio is $65\% \times 1.07^{5.5} = 94.30\%$, assuming half a year between premium collection and loss occurrence plus five years from loss occurrence until payment. The statutory underwriting profit margin is $1 - 30\% - 94.3\% = -24.3\%$. This loss is offset by investment income in later years from assets backing the loss reserves.

The statutory accounting presentation is a large underwriting loss followed by several years

of investment gains. Before 1986, the Treasury helped fund the underwriting loss by giving a large tax refund during the policy term and recouping the funds as the losses were paid from the investment income on the assets backing the reserves.

The economic income during the policy term is the present value of future profits, or the net premium minus the present value of the loss payments. By using discounted losses as the offset to taxable income, the IRS taxes the economic profit, not the underwriting profit.³ As the losses are settled, the investment income on the assets backing the loss reserves offsets the amortization of the interest discount in the reserves. The full gain or loss is realized during the policy term, with no expected gain or loss in subsequent years.⁴

Illustration: Offsetting

A policy is written on January 1, 2004, for a premium equal to the fair value (discounted value) of expected losses and expenses. The expected losses are \$13,310 paid (on average) 2½ years after the accident date: July 1, 2004 + 2½ years = December 31, 2006. For simplicity, the cost of holding capital is zero, the insurer earns its required return from investment of capital and surplus funds, the profit margin in the premium is zero, the term structure of interest rates is flat at 10% per annum, the IRS loss payment pattern is the actual loss payment pattern, the IRS discount rate is 10%, and no risk margin is needed for the actuarial fair value of the reserves.

The fair value of the expected losses at policy inception is $\$13,310 / 1.10^3 = \$10,000$. The pure premium (excluding expenses) is \$10,000. Consider statutory vs economic income.

Statutory accounting shows an underwriting loss of $\$10,000 - \$13,310 = \$3,310$ in 2004 and no gain or loss in 2005 and 2006. The investment income is $\$10,000 \times 10\% = \$1,000$ in 2004, $\$11,000 \times 10\% = \$1,100$ in 2005, and $\$12,100 \times 10\% = \$1,210$ in 2006, for a total of \$3,310.

For a two year loss payment pattern and a discount rate of 10% per annum, the discounted reserves are $\$13,310 / 1.100^2 = \$11,000$ at 12/31/2004. The tax basis underwriting income of $-\$1,000$ offsets the \$1,000 of investment income, and the tax liability is zero.

In 2005, investment income is $\$11,000 \times 10\% = \$1,100$. The discounted loss reserve on 12/31/2005 is $\$13,310 / 1.100 = \$12,100$. The underwriting loss (or the offset to underwriting income) for tax year 2005 is the amortization of the interest discount on the reserves, or $\$12,100 - \$11,000 = \$1,100$. The underwriting loss offsets the investment income, and the tax liability is zero.

In 2006, investment income is $\$12,100 \times 10\% = \$1,210$. The incurred loss offset to taxable underwriting income in 2006 is the paid loss plus the change in the discounted loss reserve, or $\$13,310$ (paid on 12/31/2006) + $\$0 - \$12,100 = -\$1,210$. This is the amortization of the interest discount on the 12/31/2005 reserve of \$11,000. It offsets the investment income in 2006, and the tax liability is zero.⁵

DISCOUNTING PRINCIPLES

The discounted loss reserves are determined from three components:

- The undiscounted loss reserves
- The discount rate promulgated each year by the Treasury.
- The loss payment pattern by line of business

The undiscounted loss reserves and the loss payment pattern are from Schedule P. The illustration below shows the concepts, though the details differ from the IRS computation. The IRS procedure is explained below.

Illustration: The 12/31/2004 undiscounted loss reserves are \$100 million. The loss reserve discount rate is 8% per annum. The \$100 million of reserves will be paid in three parts: 50% on 12/31/2005, 30% on 12/31/2006, and 20% on 12/31/2007.⁶ The discounted loss reserves are

$$\$100 \text{ million} \times (50\%/1.08 + 30\%/1.08^2 + 20\%/1.08^3) = \$100 \text{ million} \times 0.879 = \$87.9 \text{ million.}$$

Undiscounted Loss Reserves

The Treasury assumes that the loss reserves in Schedule P, Part 1, are undiscounted values. If the loss reserves are discounted and the amount of the discount is disclosed in (or with) the Annual Statement, the losses may be grossed up before application of the IRS loss reserve discounting procedure.⁷

Schedule P, Part 1, is gross of non-tabular discount and net of tabular discount, so the adjustment is normally for tabular discounts. If the Schedule P workers' compensation reserves for a given accident year are \$10 million, including \$1 million of tabular discount, and the applicable IRS discount factor is 85%, the discounted reserves are $(\$10 \text{ million} + \$1 \text{ million}) \times 85\% = \9.35 million .⁸

Discount Rate

The discount rate varies by accident year. For each accident year, the discount rate is the 60 month moving average of the federal mid-term rates ending December 1 of the preceding accident year. This rate is *vintaged* (frozen) and applies to that accident year's losses in all future calendar years. The federal mid-term rate is the average rate on Treasury securities with 3 to 9 years remaining maturity.⁹ The federal mid-term rate is promulgated by the Treasury each month.¹⁰ The 60 month moving average for an accident year can be determined once the last federal mid-term rate has been announced.

Illustration: The loss reserve discounting rate for accident year 2009 is the 60 month average of the federal mid-term rates from January 1, 2004, through December 1, 2008. It can be computed in December 2008, before the inception of accident year 2009, so that

companies can determine tax strategy for 2009.

The market values of future cash flows are based on the current term structure of interest rates; the date that the liability was incurred is not relevant. In contrast, the IRS discount rates are based on the year the loss occurred. The rationale is that the insurer uses the premiums to buy fixed-income securities to fund the future loss payments. The yield on the fixed-income securities is set at the purchase date. If the duration of the assets backing the reserves matches the duration of the loss liabilities, the losses will be paid from the coupon income and the principal repayment from these securities. The yield during the accident year is the relevant investment yield throughout the life of the policies.¹¹

Loss Payment Pattern

The IRS procedure applies an calendar year payment pattern to an accident year of loss reserves. Pricing actuaries often use quarterly payment patterns. The IRS uses annual periods, since only annual data are shown in Schedule P. It assumes a payment date of July 1 each year, as a proxy for an even distribution of payments during the year.

Suppose now is 12/31/2010, and one derives a loss payment pattern for the accident year 2011 reserves in future calendar years to compute discounted losses. Let p_i be the percentage of the reserves paid in each future calendar year i : p_1 is the percentage paid in 2012, p_2 is the percentage paid in 2013, and so forth. Assuming a payment date in the middle of each year and a risk-free interest rate r_f , the discounted loss reserves are the full value loss reserves times $(p_1 / (1+r_f)^{0.5} + p_2 / (1+r_f)^{1.5} + p_3 / (1+r_f)^{2.5} + \dots$. Actuaries use payment patterns of 30 or 40 years for the long-tailed lines of business. Since Schedule P shows 10 year loss triangles, the IRS is constrained by the available data; it uses a ten year loss payment pattern plus a five year extension for long-tailed lines of business.¹²

The percentages p_i are estimated from historical data.¹³ If the loss payment pattern is stable, the percentage of accident year 2011 losses paid in 2012 is the same as the percentage of accident year 2008 losses paid in 2009. This percentage can be determined from the 2009 Schedule P, which is available by year end 2010. Similarly, the percentage of accident year 2011 losses paid in 2013 is the same as the percentage of accident year 2007 losses paid in 2009. The complete table is:

- percentage of 2000 losses paid in 2009 = percentage of 2011 losses paid in 2020.
- percentage of 2001 losses paid in 2009 = percentage of 2011 losses paid in 2019.
- percentage of 2002 losses paid in 2009 = percentage of 2011 losses paid in 2018.
-
- percentage of 2007 losses paid in 2009 = percentage of 2011 losses paid in 2013.
- percentage of 2008 losses paid in 2009 = percentage of 2011 losses paid in 2012.

The percentages in the left hand column are determined from the 2009 Schedule P.

Incremental Percentages and Cumulative Differences

Actuarial estimates of loss payment patterns use paid loss triangles (Schedule P, Part 3). The actuarial methods are explained in Appendix A of this paper, along with their advantages over the IRS method. The IRS uses Schedule P, Part 1, not Part 3, for several reasons:

- Part 3 contains only defense and cost containment expenses, not adjusting and other expenses; Part 1 contains all loss adjustment expenses (see below).¹⁴
- Part 1 is an audited exhibit; Part 3 is not.¹⁵
- Some actuarial methods rely on judgment to select paid loss development factors. The IRS method eliminates any judgment.¹⁶

Schedule P, Part 1, shows cumulative paid losses and incurred losses by accident year. At a given valuation date, each accident year is at a different maturity.

Illustration: In the 2009 Schedule P, accident year 2009 is at 12 months of maturity, accident year 2008 is at 24 months of maturity, ..., and accident year 2000 is at 120 months of maturity. The loss reserve discount factors for accident year 2011 are derived from the 2009 Schedule P, as explained further below.

If the actual loss payments are not distorted by random loss fluctuations, the ratio of cumulative paid losses to incurred losses by accident year is the cumulative percentage of losses *expected to be paid* at each valuation date. The first differences of these ratios is the incremental percentage of losses expected to be paid in each 12 month interval.

Illustration: The figures from the 2009 Schedule P, Part 1, in the table below show the cumulative percentages of losses paid by December 31, 2009, for the ten accident years 2000 through 2009.¹⁷

*Exhibit 1: Loss Payment Pattern Between Accident Years (\$000,000)
(Data from Schedule P, Part 1, from the 2009 Annual Statement)*

<i>Accident Year</i>	<i>Cumulative Paid Losses</i>	<i>Incurred Losses</i>	<i>Cumulative Percentage Paid</i>	<i>Incremental Percentage Paid</i>
2000	433	486	0.891	0.018
2001	454	520	0.873	0.025
2002	403	475	0.848	0.017
2003	434	522	0.831	0.031
2004	534	667	0.801	0.034
2005	542	707	0.767	0.073
2006	546	787	0.694	0.089
2007	485	802	0.605	0.136
2008	406	866	0.469	0.295
2009	156	898	0.174	0.174

- For the 2009 accident year, \$156 million of losses are paid and the estimated incurred losses are \$898, so 17.4% of incurred losses are paid by 12 months.
- For the 2008 accident year, \$406 million of losses are paid and the estimated incurred losses are \$866, so 46.9% of incurred losses are paid by 24 months.

If the actual figures are valid proxies for the expected figures and the loss payment pattern has not changed between the two years, $46.9\% - 17.4\% = 29.5\%$ of losses are paid from 12 to 24 months.

The percentages are of incurred losses, both paid and unpaid. The loss reserve discount factors, which derive discounted reserves from undiscounted reserves, are ratios:

- The numerator is discounted unpaid losses as a percentage of incurred losses.
- The denominator is undiscounted unpaid losses as a percentage of incurred losses.

Illustration: Loss reserve discount factors for accident year 2011 at each valuation date (12 months of maturity, 24 months of maturity, and so forth) are derived from Schedule P data in Exhibit 1. For accident year 2011, 12 months of maturity is December 31, 2011.

The denominator is the nominal (undiscounted) unpaid losses at 12 months, or $29.5\% + 13.6\% + \dots = 1 - 17.4\% = 82.6\%$. If p_j is the cumulative percentage of losses paid by year j (or $12j$ months), the denominator is $1 - p_j$.

The numerator is the discounted unpaid losses at 12 months. The losses in each calendar year are assumed to be paid at mid-year, or July 1.

- The 29.5% of incurred losses paid from 12 to 24 months are paid from January 1, 2012, to December 31, 2012; the IRS assumes they are paid on July 1, 2012. They are

discounted for six months to the valuation date of 12/31/2011. As a percentage of incurred losses, they are $29.5\% / (1 + R)^{1/2}$.

- The 13.6% of incurred losses paid from 24 to 36 months are paid from January 1, 2013, to December 31, 2013; the IRS assumes they are paid on July 1, 2013. They are discounted for 1½ years to the valuation date of 12/31/2011. As a percentage of incurred losses, they are $13.6\% / (1 + R)^{1/2}$.

Each future valuation date is computed similarly. The numerator is

$$29.5\% / (1 + R)^{1/2} + 13.6\% / (1 + R)^{1/2} + \dots$$

The terms in the numerator are not complete, since Schedule P shows only ten accident years. The oldest accident year (2000) indicates that 89.1% of losses are paid by 120 months of maturity, so 10.9% of losses remain unpaid at that time. Schedule P does not show the payment pattern after ten years. The IRS has an extension of payments procedure to model the payment pattern after ten years; see below.

The numerator and denominator of the ratio are percentages of incurred losses. Multiplying by accident year 2011 incurred losses gives

- denominator: accident year 2011 *undiscounted* loss reserves at 12 months of maturity
- numerator: the corresponding *discounted* reserves.

The loss reserve discount factor at 24 months is similar; the differences are:

- The denominator is the nominal (undiscounted) unpaid losses at 24 months, or $13.6\% + 8.9\% + \dots = 1 - 46.9\% = 53.1\%$.
- The numerator is the discounted unpaid losses at 24 months. The 29.5% of incurred losses paid from 12 to 24 months have already been paid and they no longer appear in the ratio. The 13.6% of incurred losses paid from 24 to 36 months are assumed to be paid on July 1, 2013. They are discounted for six months to the valuation date of December 31, 2012. As a percentage of incurred losses, they are $13.6\% / (1 + R)^{1/2}$.

Each remaining term is the same as in the loss reserve discount factor for 12 months, except the exponent is reduced by one. The numerator is

$$13.6\% / (1 + R)^{1/2} + 8.9\% / (1 + R)^{1/2} + \dots$$

The loss reserve discount factor at 24 months may be higher or lower than the factor as 12 months.¹⁸

Determination Year and Company Election

Once every five years (determination years), the company elects to use either the discount factors developed by the Treasury, based on industry aggregate data from Best's *Aggregates and Averages*, or discount factors derived from its own Schedule P. The

election is made with the company's tax filing for the determination year, and it applies to that year and the next four years.

If the company elects to use its own payment patterns, it uses the most recent Schedule P data available before the beginning of each accident year. For accident year 200X, it uses the Schedule P data in its 200X-2 Annual Statement.

If the company uses its own data to determine the loss payment pattern, the patterns are updated each year. In contrast, the aggregate (industry) loss payment patterns are *vintaged* and updated only in determination years. Determination years end in a 2 or a 7, and they use aggregate industry data for statement dates ending in a 0 or a 5.¹⁹

- For determination year 2002, data as of 12/31/2000 are used.
- For determination year 2007, data as of 12/31/2005 are used.

ILLUSTRATION A: No EXTENSION OF PAYMENTS

An insurer elects to use its own loss payment pattern in the 2007 determination year; this election applies to accident years 2007 - 2011. It is now July 1, 2010, and the pricing actuary is setting premium rates for policy year 2011. Losses from policies written in 2011 fall into accident years 2011 and 2012. The insurer estimates discount factors for accident year 2011. The figures below are taken from the company's 2009 Schedule P, Part 1.

Exhibit 2: Casualty Line of Business Paid and Incurred Losses

Accident Year	Losses + LAE Paid	Losses + LAE Incurred
Prior	250,000	250,000
2000	270,000	275,500
2001	300,000	316,000
2002	320,000	348,000
2003	340,000	386,500
2004	350,000	421,500
2005	370,000	480,500
2006	380,000	550,500
2007	360,000	610,000
2008	330,000	687,500
2009	200,000	571,500

The discount rate is the 60 month rolling average of the federal mid-term rate, from January 2006 through December 2010. At July 1, 2010, 54 months are available; the last six months are estimated. For this illustration, we assume that the estimated 60 month moving average is 7% per annum.

The loss reserve discount factors are for accident year 2011 only. The discount factors for

previous accident years at every future valuation date have already been determined.²⁰

PAID TO INCURRED PERCENTAGES

Exhibit 2 shows the computations, using figures from Schedule P, Part 1. Column 2 shows the cumulative net paid losses and LAE by accident year at the current statement date, and column 3 shows the corresponding incurred net losses and LAE. Column 4 shows the cumulative percentage paid from inception of the accident year to the current statement date (column 2 ÷ column 3). For accident year 2009, the percentage is $\$200,000 / \$571,500 = 35\%$; for accident year 2008, the percentage is $\$330,000 / \$687,500 = 48\%$.

ASSUMED INCREMENTAL PERCENTAGE PAID

Column 5, the expected incremental percentage paid in each year, is the first difference of the previous column:

- For accident year 2009, the cumulative percentage paid at 12 months since inception of the accident year is 35%. For the most recent accident year, the incremental percentage paid is the cumulative percentage paid.
- For accident year 2008, the cumulative percentage paid at 24 months since inception of the accident year is 48%. This implies that $48\% - 35\% = 13\%$ of incurred losses are paid between 12 and 24 months since inception of the accident year.

The ten accident years in Schedule P give ten annual intervals of expected loss payments. Any losses unpaid at the end of 10 years are assumed to be paid in the eleventh year, as long as it is less than the amount assumed paid in the tenth year. The next illustration shows the IRS extension of payments when the amount unpaid after ten years is larger.

The cumulative percentage paid is 94.94% for the ninth year (2001) and 98.00% for the tenth year (2000).²¹ The amount assumed to be paid from the end of the ninth year to the end of the tenth year is $98.00\% - 94.94\% = 3.06\%$. The amount unpaid after 10 years is $100\% - 98\% = 2\%$. Since $2\% < 3.06\%$, the 2% is assumed to be paid in the eleventh year.

DISCOUNTING COMPUTATIONS

Column 6, the percentage unpaid at the end of the accident year, is the complement of the cumulative percentage paid. For accident year 2009, the cumulative percentage paid is 35%, and the percentage unpaid at the end of the accident year is $100\% - 35\% = 65\%$.

Column 7 shows the discounted percentage of losses unpaid at the end of the accident year, assuming that all losses are paid at mid-year.²² One may use an iterative method, working backwards from the oldest accident year, or a formula method.

2% of incurred losses are assumed to be paid in the middle of the 11th year (AY+10); at a 7% discount rate, the discounted value at the preceding year end is $2\% / (1.070)^{0.5} = 1.93\%$.

Going backwards in accident years corresponds to going forwards in calendar years. The

most recent accident year in the exhibit is 2009; the computed payment pattern is used for accident year 2011. Accident year AY+1 corresponds to calendar year 2011+1 = 2012. Accident year AY+10 corresponds to calendar year 2011 + 10 = 2021.

The discounted percentage of losses unpaid at the end of the ninth year is the percentage of losses assumed to be paid in the middle of the tenth year discounted for half a year to the end of the ninth year plus the discounted percentage of losses unpaid at the end of the tenth year, discounted for an additional year to the end of the ninth year.

These two pieces are 3.07% of accident year 2011 losses assumed to be paid in the middle of the tenth year (July 1, 2020) discounted for half a year to 12/31/2019: $3.07\%/1.070^{0.5} = 2.97\%$; plus the discounted percentage of accident year 2011 losses unpaid at the end of the tenth year (12/31/2020), discounted for a full year: $1.93\%/1.070 = 1.80\%$. The sum is 4.77%. Continue in this iterative fashion for all accident years.

Alternatively, formulas may be used for each year. The formula for the 2009 accident year in the Schedule P exhibit, corresponding to accident year 2011 valued at 12/31/2011, is

$$(13.00\% \div 1.07^{0.5}) + (11.02\% \div 1.07^{1.5}) + \dots + (3.07\% \div 1.07^{8.5}) + (2.00\% \div 1.07^{9.5}) = 52.26\%.$$

LOSS RESERVE DISCOUNT FACTORS

Column 8, the loss reserve discount factors, is the discounted percentage of unpaid losses at the end of each year divided by the undiscounted percentage at that time. For accident year 2009, the discount factor is $52.26\% / 65.00\% = 80.3944\%$. This is the discount factor for accident year 2011 valued at 12/31/2011. If the accident year 2011 undiscounted reserves at 12/31/2011 are \$450,000, the discounted reserves are $\$450,000 \times 80.3944\% = \$361,775$.

The loss reserve discount factor in the preceding row, 81.6659%, is applied to the accident year 2011 reserves on 12/31/2012. If the year end 2012 reserves for accident year 2011 are \$350,000, the discounted reserves are $\$350,000 \times 81.6659\% = \$281,380$.

ILLUSTRATION B – LONG-TAILED EXTENSION OF PAYMENTS

Illustration B shows the extension of the loss payment pattern beyond the eleventh year. Amounts unpaid at the end of ten years are assumed to be paid in the eleventh year, capped by the amount assumed to be paid in the tenth year. The excess is assumed to be paid in the twelfth year, and it is capped at the same limit. The excess is assumed to be paid in the thirteenth year, and so forth. Continue in this fashion through the fifteenth year. The remaining excess is assumed to be paid in the sixteenth year, with no limit.

Illustration: Suppose 90.90% is paid within 10 years and 88.10% is paid within nine years, implying that $90.90\% - 88.10\% = 2.80\%$ is paid in the tenth year. The amounts assumed to be paid in the 11th, 12th, and 13th years are also 2.80%. $9.10\% - 3 \times 2.8\% = 0.70\%$ remains unpaid after thirteen years and is assumed to be paid in the 14th year.

The following figures are taken from the 2009 Annual Statement, Schedule P, Part 1H (other liability), of a company that has elected to use its own loss payment pattern for computing discounted reserves for accident year 2011.

Exhibit 3: Paid and Incurred Losses

Accident Year	Losses + LAE Paid	Losses + LAE Incurred
Prior	235,000	250,000
2000	50,000	55,500
2001	55,000	62,000
2002	60,000	70,000
2003	65,000	80,000
2004	70,000	96,000
2005	65,000	103,000
2006	60,000	115,000
2007	50,000	125,000
2008	35,000	140,000
2009	15,000	180,000

The 60 month rolling average of the federal mid-term rate, from January 2006 through December 2010, is 7.0% per annum.

Accident year 2011 has from 10 to 15 discount factors. The first ten discount factors are used at valuation dates 12/31/2011 through 12/31/2020. The final five discount factors are used at subsequent valuation dates; they are combined into a composite discount factor for the prior years row for valuation dates 2021, 2022, . . . , 2025. The chart below shows the discount factors and the applicable valuation dates.

Exhibit 4: Valuation Dates for Loss Reserve Discount Factors

Discount Factor	Accident Year	Individual / Composite	Tax Year (Valuation Date)	
12 mos	2011	individual	Y	2011
24 mos	2011	individual	Y+1	2012
...
120 mos	2011	individual	Y+9	2020
132 mos	prior	composite	Y+10	2021
144 mos	prior	composite	Y+11	2022
..
180 mos	prior	composite	Y+14	2025

The IRS payment pattern assumes all losses are paid by the sixteenth year, and no accident year 2011 losses remain unpaid after 2025. Unpaid losses more than ten years old are not identified by accident year in Schedule P. The IRS assumes the losses in the prior years row are 10 to 15 year old. They stem from the accident years in the composite factor for the prior years row, not from older accident years.

Illustration: The loss payment pattern for some lines (workers' compensation, commercial liability) may extend for 30 or 40 years. Suppose accident year 2011 losses remain unpaid at 12/31/2026. The IRS procedure assumes these reserves stem from accident years 2012 - 2016, not from accident year 2011. The composite discount factor for these reserves is based on the calculations for accident years 2012 - 2016, not accident year 2011.

The amount assumed to be paid in the eleventh year is capped by the amount assumed to be paid in the tenth year. $90.09\% - 88.71\% = 1.38\%$ of incurred losses are assumed to be paid in the tenth year; the amount unpaid after 10 years is $100\% - 90.09\% = 9.91\%$ of the incurred losses. 1.38% is assumed to be paid in the eleventh year; the excess is rolled forward and capped in each year. The amount assumed to be paid in each of the five years following the tenth year is the lesser of (i) the amount unpaid at the end of the previous year and (ii) the 1.38% cap. Whatever remains after 15 years is assumed to be paid in the 16th year, even if it exceeds the 1.38% cap. Here, $9.91\% - 5 \times 1.38\% = 3.01\%$ remains unpaid after 15 years, so 3.01% is assumed to be paid in the sixteenth year.²³

The iterative method begins with the computation of the discounted percentages unpaid at the year end preceding the final loss payment. The loss payment pattern here extends through 16 years, so one begins with the end of the fifteenth year. 3.01% of the accident year 2011 incurred losses are assumed to be paid in the middle of the 16th year, or July 1, 2026. The discounted loss reserve at the end of the 15th year (or 12/31/2025) is $3.01\% / 1.070^{0.5} = 2.91\%$.

The discounted percentage unpaid at the end of the 14th year is (i) the 2.91% discounted percentage unpaid at the end of the 15th year discounted for an additional full year plus (ii) the 1.38% of the incurred losses assumed to be paid on July 1 of the 15th year discounted

for half a year; this is $2.91\% / 1.070 + 1.38\% / 1.070^{0.5} = 4.05\%$.

Alternatively, calculate each discounted percentage unpaid by formula. For the 2011 valuation date for the 2011 accident year, the discounted percentage unpaid is

$$(16.67\% \div 1.07^{0.5}) + (15.00\% \div 1.07^{1.5}) + \dots + (1.38\% \div 1.07^{13.5}) + (3.01\% \div 1.07^{14.5}) = 71.32\%.$$

Two Year Lines

Lines of business with two accident years in Schedule P use a three year payment pattern.

- The percentage of losses paid from 12 to 24 months is the difference in the cumulative paid to incurred ratios from 12 to 24 months.
- The percentage of losses paid in each of the next two 12 month intervals is half the unpaid losses at 24 months.

Illustration: Suppose the cumulative paid to incurred ratios for auto physical damage are 70% at 12 months and 90% at 24 months. The loss payment pattern is 70% for 0 to 12 months, 20% for 12 to 24 months, 5% for 24 to 36 months, and 5% for 36 to 48 months.

{fn: No extension of payments applies to two year lines. Negative implied payments are possible, but they are rare. If the cumulative paid to incurred ratios for auto physical damage are 90% at 12 months and 70% at 24 months, the loss payment pattern is 90% for 0 to 12 months, -20% for 12 to 24 months, 15% for 24 to 36 months, and 15% for 36 to 48 months.}

LOSS RESERVE DISCOUNTING: APPENDIX

Patterns

The unwinding of the interest discount on the loss reserves affects the pattern of income recognition. In Illustration B, the loss reserve discount factors are similar for the first ten accident years, ranging from 77% to 80%.²⁴

The discount factors increase in the final six years from 80% to about 97%, because the IRS assumes a constant percentage of incurred losses paid in each year during the extended part of the loss payment pattern. The lump sum payment in the last year further augments the upward trend in the loss reserve discount factors for mature years.

Negative Assumed Payments

Different accident years are used for the cumulative paid percentages. Random loss fluctuations may cause an older accident year to have a lower cumulative percentage paid

than a more recent accident year, and the incremental payments may be negative. The negative assumed payments can appear in any year except the most recent one. They often occur in more mature accident years for small books of long-tailed business.

The IRS uses the negative assumed incremental payments in the same manner as positive payments. Adjustments are made to avoid two scenarios:

- A negative cap for the assumed payments in the 11th through 15th years.
- Negative loss reserve discount factors.²⁵

If the negative assumed loss payment occurs in the tenth year, the cap on the extended payments in subsequent years would be negative. This causes negative payments in the 10th through 15 years and a large positive payment in the 16th year. To avoid this situation, the cap is revised to the average of the assumed loss payments in the three oldest years.²⁶

Illustration: The 2009 Schedule P for a given line has the cumulative paid losses and incurred losses shown in the table below.

Exhibit 5: Negative Assumed Loss Payments

Accident Year (1)	Paid Loss + LAE (2)	Incurred Loss + LAE (3)	Cumulative Paid/Incurred Ratio: (4)	Incremental Paid/Incurred Ratio: (5)	Undiscounted Percentage Unpaid: (6)
2000	\$280,000	\$300,000	93.33%	-3.64%	6.67%
2001	\$320,000	\$330,000	96.97%	9.47%	3.03%
2002	\$315,000	\$360,000	87.50%	5.92%	12.50%
2003	\$310,000	\$380,000	81.58%	6.58%	18.42%
2004	\$300,000	\$400,000	75.00%	7.25%	25.00%

The negative assumed payment in the oldest accident year (2000) stems from a statistical fluctuation – fewer claims remaining open in the ninth year (2001) than expected or more claims remaining open in the tenth year than expected. The average assumed loss payment in the three oldest accident years is $\frac{1}{3} \times (-3.64\% + 9.47\% + 5.92\%) = 3.92\%$; this is the cap for the 11th and subsequent years.

If the average of the three oldest accident years is still negative, the average of the four oldest years is used; if this average is still negative, the average of the five oldest years is used. Continue until the average of ten years, which must be positive.

NEGATIVE DISCOUNT FACTORS

Most negative assumed amounts paid do not cause negative discount factors. If the negative incremental paid is large enough, the discount factors may also be negative.

A discount factor of 80% means that the present value of a \$100,000 future cash flow is

\$80,000. An investor with no risk aversion would be indifferent between \$80,000 paid now and the \$100,000 cash flow when it is actually paid. Similarly, a discount factor of -40% would mean that an investor is indifferent between paying \$40,000 now and receiving the \$100,000 when the cash flow is actually received. This does not make sense. Because a negative discount factor is not reasonable, the negative factor is replaced by a linear interpolation between the nearest positive discount factors on both sides.

Illustration: If the computed loss reserve discount factors for accident years AY+7, AY+8, and AY+9 are $+80\%$, -35% , and $+85\%$, the negative discount factor of -35% is replaced by the interpolated factor of $+80\% + \frac{1}{2}(85\% - 80\%) = 82.5\%$.

If the computed loss reserve discount factors for accident years AY+6, AY+7, AY+8, and AY+9 are $+70\%$, -35% , -45% , and $+85\%$, the negative discount factors of -35% and -45% are replaced by the interpolated factors of $+70\% + \frac{2}{3}(85\% - 70\%) = 80\%$ and $+70\% + \frac{1}{3}(85\% - 70\%) = 75\%$.

Negative discount factors stem from negative assumed loss payments, which stem from the quirks of the IRS loss reserve discounting procedure, not from negative loss payments or from data errors in the company's historical records.²⁷ If the computed loss reserve discount factors for accident years AY+7, AY+8, and AY+9 are $+80\%$, $+10\%$, and $+85\%$, no change is made, though the $+10\%$ discount factor for year AY+8 is unreasonable. This sequence of discount factors causes a large tax liability in one year followed by a tax refund in the following year.

Illustration: The expected loss reserves for accident year 2001 are \$50 million, \$45 million, and \$40 million at year-end 2007, 2008, and 2009, with expected payments of \$5 million in each year. The loss payments are offset by reserve reductions, so the statutory incurred loss does not change as the losses mature. Taxable income should show a small underwriting loss each year that is offset by investment income on the assets backing the reserves.

If the loss reserve discount factors are 80% , 10% , and 85% , the tax basis incurred losses are as follows (figures in millions of dollars).

Unreasonable Loss Reserve Discount Factors (dollars in millions)

<i>Calendar Year</i>	<i>Paid Loss</i>	<i>Change in Loss Reserve</i>	<i>Incurred Loss</i>
2008	\$5	$\$45 \times 10\% - \$50 \times 80\% = -\$35.5$	$-\$30.5$
2009	\$5	$\$40 \times 85\% - \$45 \times 10\% = \$29.5$	$\$34.5$

This effect is submerged within the other tax liabilities and tax refunds of the company, and it is generally not noticeable. A negative assumed loss payment may produce positive but unreasonable loss reserve discount factors.

Tables 3 and 4 illustrate this. Table 3 uses the same other liability illustration worked out above, with a change in the paid losses for accident year 2002 from \$60,000 to \$69,000. The incremental paid to incurred ratio for accident year 2001 becomes -9.86% , the

discounted loss reserve for accident year 2002 becomes -1.36% , and the loss reserve discount factor for accident year 2002 is -95% . The negative loss reserve discount factor is replaced with a positive factor of $\frac{1}{2} \times (82.5189\% + 77.4439\%) = 79.9814\%$.

Table 4 shows the same scenario, but the accident year 2002 paid losses are changed to \$68,000, not \$69,000. The incremental paid to incurred ratio for accident year 2001 becomes -8.43% , the discounted loss reserve for accident year 2002 becomes 0.02% , and the loss reserve discount factor for accident year 2002 is less than 1% (0.6645%). This scenario is also unreasonable, but it is retained by the IRS rules.²⁸

When faced with anomalous discount factors, the pricing actuary has two alternatives:

- Although the loss reserve discount factor may not be reasonable, this factor determines the actual cost of the policy, and it is used in policy pricing just as any other cost.
- The anomalous loss reserve discount factor will revert to a normal discount factor next year (if the company uses its own loss payment pattern) or at the next determination year (if the company uses the industry loss payment pattern). The premium rates should not fluctuate from year to year because of tax idiosyncracies. Replace the anomalous loss reserve discount factor with the expected value for that valuation date.

The second alternative is proper. Insurance products are priced in a competitive market. The pricing actuary determines the price for the insurance product, not a price tied to the insurer that sells the product. The anomalous tax factors discussed here generally apply to a single company; even when they result from industry loss payment patterns, they would rarely affect the market price for the policy. The anomalous factors should not affect the premiums.²⁹

COMPOSITE DISCOUNT FACTORS

The loss reserve discount factors are applied to the unpaid loss shown in the Annual Statement. Each accident year's unpaid losses are shown separately in Schedule P for ten valuation dates. For these valuation dates, the loss reserve discount factor calculated for that accident year is applied to its unpaid losses.

At later valuation dates, unpaid losses are shown in the Schedule P prior years row. They are not shown separately by accident year, so the accident year's loss reserve discount factors for the eleventh through fifteenth valuation dates can not be applied. Instead, a composite discount factor is used for all losses unpaid more than ten years since the accident date.

The IRS loss reserve discounting procedure assumes that all losses are paid no later than the 16th year. This implies that the prior years row in Schedule P contain losses that will be paid in the 12th through the 16th year, which use the loss reserve discount factors for years AY+11 through AY+15. The composite discount factor is formed from the discount factors from the five accident years whose losses are assumed to comprise the reserves in the prior years row. The illustration below shows the composite discount factor.

ILLUSTRATION: COMPOSITE DISCOUNT FACTORS

An insurer computes loss reserve discount factors for accident year 2009. It determines up to 15 discount factors from the 2007 Schedule P.

The first ten discount factors will be used for accident year 2009 unpaid losses as shown in the Schedule P exhibits for the 2009 through 2018 Annual Statements. For the 2019 Annual Statement, the accident year 2009 unpaid losses are commingled with the unpaid losses from earlier accident years in the Schedule P prior years row.³⁰

Since the IRS assumes all losses are paid by the 16th year, it assumes the loss reserves in the prior years row in the 2019 Schedule P are for losses from accident years 2005 - 2009. It forms a composite discount factor based on the following discount factors:

- Accident year 2005 discount factor for a valuation date 15 years after inception of year.
- Accident year 2006 discount factor for a valuation date 14 years after inception of year.
- Accident year 2007 discount factor for a valuation date 13 years after inception of year.
- Accident year 2008 discount factor for a valuation date 12 years after inception of year.
- Accident year 2009 discount factor for a valuation date 11 years after inception of year.

If industry patterns are used, some of these loss reserve discount factors use the same loss payment pattern; if individual company data are used, they use separate loss payment patterns. They use different discount rates, and they are computed in separate years.

Suppose these five loss reserve discount factors are as shown below:

Exhibit 6: Composite Discount Factor

<i>Accident Year (1)</i>	<i>Valuation Date (2)</i>	<i>Undiscounted Reserve (3)</i>	<i>Discounted Reserve (4)</i>	<i>Discount Factor (5)</i>
2005	AY + 15	5.0%	4.8%	96.9%
2006	AY + 14	7.2%	6.8%	93.9%
2007	AY + 13	9.1%	8.3%	91.0%
2008	AY + 12	11.7%	10.3%	88.2%
2009	AY + 11	13.3%	11.4%	85.4%
Total	prior years	46.3%	41.6%	89.8%

The calculation of the individual discount factors has been explained earlier. Each discount factor in column 5 is the ratio of the discounted reserves in column 4 to the undiscounted reserves in column 3.³¹ The reserve figures in columns 3 and 4 are expressed as percentages of the corresponding year's incurred losses. Compute the total of the five percentages for the five discounted reserves and for the five undiscounted reserves, and divide these totals to obtain the composite discount factor for the prior years row.³²

Taxpayer's Election

The Secretary of the Treasury revises the line of business loss payment patterns every five years, using aggregate (industry-wide) Schedule P data. The first loss payment patterns were determined in early 1987 for the 1987 through 1991 tax years.³³

The industry-wide Schedule P data are from the most recent edition of Best's *Aggregates and Averages*. In early 1987, this was the 1986 edition, containing data from the 1985 Annual Statements.

The Treasury redetermines the loss payment patterns every five years: 1992, 1997, 2002, 2007, and so forth. The loss payment patterns apply to that year and the four subsequent years (1992-1996; 1997-2001; and so forth).

The loss payment patterns are determined once every five years, but the discount rate is recomputed each year. The discount *rate* changes, even though the loss payment patterns remains the same, so the loss reserve discount factors change each year.

The Treasury recognizes that the aggregate industry loss payment patterns may not be appropriate for some insurers.

Illustration: The aggregate industry-wide other liability loss payment pattern assumes a long average lag between the occurrence of accidents and the settlement of claims. Insurer ABC writes relatively quick settling premises and operations coverage for offices, showrooms, and retail stores. Its claims settle more quickly than the industry averages, so its discount factors should be closer to unity, giving higher discounted loss reserves, a greater offset to taxable income, and lower tax liabilities.

At determination years, each insurer may elect to use its own data to compute the loss payment patterns for the next five years. The election is made with the tax return for the determination year, which is filed a few months after the end of the year.

Illustration: On its 2007 tax return, filed in early 2008, Insurer ABC may elect to use its own data for the loss payment patterns used to compute the loss reserve discount factors for accident years 2007 through 2011.

If the insurer elects to use its own data, it recomputes the loss payment pattern each year. Each accident year's loss reserve discount factors are computed at the inception of that year and not changed. But for each new accident year, the insurer uses the most recent Schedule P data that has been filed before the beginning of the accident year.

Illustration: On its 2007 tax return, Insurer ABC elects to use its own Schedule P data for accident years 2007 through 2011. For the 2007 accident year, it uses 2005 Schedule P data; for the 2008 accident year, it uses 2006 Schedule P data; and so forth.

An election to use one's own data applies to all lines of business. An insurer may not elect to use its own data for some lines of business and the industry data for other lines.³⁴

ELECTION RESTRICTIONS

For two types of business an insurer must use the industry-wide loss reserve discount factors and may not use its own data:

- The international line of business and the reinsurance lines of business.³⁵
- Any line of business for which it “does not have sufficient historical experience to determine a loss payment pattern” [IRC §846(e)(4)(A)].

The 1986 conference reports and the 1988 Treasury regulation 88-100 interpreted the latter provision to mean that an insurer whose reserves in a line of business were smaller than those of 90% of other insurers may not use its own data to determine the loss payment patterns.³⁶ Small companies complained that this provision discriminated against them. In 1991, the Secretary of the Treasury revoked this interpretation. Instead, the insurer must have data for all ten accident years shown in Schedule P to use its own data for that line of business.³⁷

The adequacy of an insurer’s loss reserves affects its election to use its own data. An insurer with less adequate reserves than those of the industry gains from using its own data.

Illustration: In 2009, the industry-wide Schedule P for a given line of business shows accident year 2009 cumulative paid losses of \$100 million and incurred losses of \$400 million, indicating that 25% of losses are paid in the first 12 months. Insurer ABC, which holds less adequate loss reserves, shows \$3 million of accident year 2009 cumulative paid losses and \$10 million of incurred losses, indicating that 30% of losses are paid in the first 12 months. Insurer ABC seems to pay its losses more rapidly, so its discount factor should be closer to unity, its offset to taxable income should be larger, and its tax liability should be smaller. In truth, insurer ABC may have the same loss payment pattern as the industry has, but it may be holding less adequate loss reserves.

ANTICIPATED SALVAGE AND SUBROGATION

The loss reserves that are an offset to taxable income must be net of anticipated salvage and subrogation.³⁸ Unless the insurer discloses that the unpaid losses in Schedule P are net of anticipated salvage and subrogation, the IRS assumes they are gross of anticipated salvage and subrogation and requires a reduction for the anticipated amounts. Schedule P, Part 1, column 23, provides this disclosure by accident year and by line of business.³⁹

Subtract the discounted (not nominal) anticipated salvage and subrogation from the unpaid losses. The discount factors are determined by the Treasury. Companies may elect to use their own discount factors for loss reserves, but they must use the Treasury discount factors for anticipated salvage and subrogation.⁴⁰

COMPUTATIONAL SEQUENCE

The sequence for determining the loss reserve offset to taxable income is as follows:

- Total net losses and expenses unpaid are taken from Schedule P, Part 1, column 24.
- The salvage and subrogation anticipated from Schedule P, Part 1, column 23, is added.
- The *tabular* discounts for loss reserves from the notes to the financial statements are added to get the unpaid losses gross of all discounts and of anticipated salvage and subrogation. The Schedule P, Part 1, loss reserves are already gross of the *non-tabular* discounts disclosed in the two penultimate columns in Part 1.
- The gross loss reserves are discounted using either (i) the industry loss reserve discount factors published by the Treasury or (ii) the company's own loss reserve discount factors, depending on the election made by the company in the most recent determination year.
- Anticipated salvage and subrogation is discounted with the Treasury discount factors.
- The discounted anticipated salvage and subrogation is subtracted from the discounted loss reserves to give discounted reserves net of anticipated salvage and subrogation. The change in these discounted reserves is the loss reserve offset to taxable income.

ACTUARIAL LOSS PAYMENT PATTERNS

Negative incremental paid losses and negative loss reserve discount factors stem from the first differences of cumulative paid percentage from separate accident years. Even if the discount factors are positive, they may be highly distorted by random loss fluctuations.

The distortions can be dampened (and the negative factors eliminated) three ways.

- Using Schedule P, Part 3, instead of Part 1, retains the IRS method and eliminates the negative incremental paid losses.
- The ratio of cumulative paid losses to incurred losses is the reciprocal of the paid loss development factor. A chain ladder reserving method applied to Schedule P, Part 3, may use an average of several historical age-to-age link ratios, giving more accurate loss reserve discount factors.
- Schedule P data are sparse, especially for small insurers. The projected age-to-age link ratios may be fit to a curve to smooth the factors and extend them beyond ten years of maturity.

The table below shows the figures from Schedule P, Parts 2 and 3, for the first example in this paper.⁴¹

- The right most column in the 2009 Schedule P, Part 3, triangles is the cumulative losses paid by 12/31/2009.
- The penultimate column shows the corresponding amount paid by 12/31/2008.
- The difference between these two columns is the amount paid in 2009.
- This difference divided by the ultimate losses for each accident year is the percentage paid in 2009.

- The ultimate losses by accident year are in the right-most column of Schedule P, Part 2.⁴²

*Exhibit 7: Loss Payment Pattern from Successive Accident Years (\$000,000)
(Data from Schedule P, Parts 2 and 3, in the 2009 Annual Statement)*

<i>Accident Year (1)</i>	<i>Cum Paid by 2008 (2)</i>	<i>Cum Paid by 2009 (3)</i>	<i>Paid in 2009 (4)</i>	<i>Ultimate Losses (5)</i>	<i>Percentage Paid (6)</i>
2000	\$422	\$433	\$11	\$486	2.26%
2001	\$442	\$454	\$12	\$520	2.31%
2002	\$391	\$403	\$12	\$475	2.53%
2003	\$416	\$434	\$18	\$522	3.45%
2004	\$504	\$534	\$30	\$667	4.50%
2005	\$490	\$542	\$52	\$707	7.36%
2006	\$463	\$546	\$83	\$787	10.55%
2007	\$353	\$485	\$132	\$802	16.46%
2008	\$152	\$406	\$254	\$866	29.33%
2009		\$156	\$156	\$898	17.37%
<i>Total</i>					96.11%

The columns show the following figures:

- Column (2): Cumulative dollars of loss paid through 12/31/2008 (from Part 3),
- Column (3): Cumulative dollars of loss paid through 12/31/2009 (from Part 3).
- Column (4): Incremental dollars of loss paid in 2009 (= column (2) minus column (1)).
- Column (5): Incurred losses (from Part 2).
- Column (6): Incremental paid loss as a percentage of incurred loss (= col 4 / col 5).

Consider the row for accident year 2004:

- Col 2: \$504,000 has been paid by 12/31/2008, or 60 months since inception of the accident year.
- Col 3: \$534,000 has been paid by 12/31/2009, or 72 months since inception of the accident year.
- Col 4: \$30,000 has been paid between 60 months and 72 months.
- Col 5: The total accident year 2004 incurred losses are \$667,000.
- Col 6: 4.5% (or \$30,000 / \$667,000) of the incurred losses are paid between 60 and 72 months since inception of the accident year.

Column 6 in the table above may not sum to 100% even if all losses are paid by ten years. If the insurer settled claims more (less) quickly in more recent calendar years, the total of the percentages above is more (less) than 100%.

If the oldest accident year in the Exhibit has Z% of losses paid by ten years, normalize the

percentages in Column 6 so their sum is Z%. In this illustration, the oldest accident year has 89.1% of losses paid by ten years, and the total in Column 6 is 96.11%. Multiply each percentage in Column 6 by $89.1\% / 96.11\% = 0.927$.

The normalized percentages from a paid loss triangle retains the IRS method and eliminates the random fluctuations that distort the loss reserve discount factors.⁴³

Averages and Smoothing

The procedure described above replicates the IRS procedure and eliminates the distortions that cause negative incremental payments and negative loss reserve discount factors. It keeps the IRS procedure and removes the need for interpolating.

Actuaries would not use this procedure because it relies on a single pair of points for each payment and uses no averaging or smoothing. A simpler and more accurate procedure uses paid loss development factors from Schedule P, Part 3. One derives the factors by the chain ladder reserving method.⁴⁴ Each paid loss development factor is ultimate incurred losses divided by the cumulative paid losses at a given maturity. The reciprocal of the development factor is the ratio of cumulative paid losses to incurred losses.⁴⁵

YIELD PROJECTIONS

For prospective pricing, the actuary must project future yields. The pricing requirements are most easily seen by illustration.

Illustration – Projected Yields: The pricing actuary is setting rates for policies effective from July 1, 2004, through June 30, 2005; the last policy written under the new rates remains in effect through June 30, 2006. The losses on these policies extend from July 1, 2004, through June 30, 2006, spanning accident years 2004, 2005, and 2006.

To project loss reserve discount factors, the pricing actuary estimates federal mid-term rates through December 1, 2005. If the rate analysis is done during fourth quarter 2003, the actuary projects rates through the end of 2005, or about two years.

To project rates, either (i) the most recent monthly mid-term rate, or an average of recent rates, is repeated for future months, or (ii) the projected rates are set equal to the current forward rates. The second method relies on the pure expectations hypothesis for the term structure of interest rates and is favored by some investment analysts.

Illustration: Projecting Treasury Rates: The term structure of interest rates on January 1, 2004, is upward sloping, as shown in the table below.

Exhibit 8: *Term Structure of Interest Rates*

<i>Term</i>	<i>Spot Rate</i>	<i>Term</i>	<i>Spot Rate</i>
<i>1 year</i>	5.00%	<i>5 years</i>	6.90%
<i>2 years</i>	6.00%	<i>6 years</i>	7.00%
<i>3 years</i>	6.40%	<i>7 years</i>	7.10%
<i>4 years</i>	6.70%	<i>8 years</i>	7.10%

One projects the five year spot rates for 2005, 2006, and 2007, based on the forward rates implied by the term structure of interest rates.

- The five year spot rate on Jan 1, 200X+1, is estimated as $(1.070^6 / 1.05)^{1/5} - 1 = 7.40\%$.
- The five year spot rate on 1/1/200X+2, is estimated as $(1.071^7 / 1.06^2)^{1/5} - 1 = 7.54\%$.
- The five year spot rate on 1/1/200X+3, is estimated as $(1.071^8 / 1.064^3)^{1/5} - 1 = 7.52\%$.

After a period of falling interest rates, the IRS loss reserve discount factors provide a larger discount than is financially warranted. After a period of rising interest rates, the IRS loss reserve discount factors provide a smaller discount than is financially warranted.

PAYMENT PATTERN PROJECTIONS

If the company uses the industry factors, the loss payment pattern is fixed until the next determination year. The pricing actuary projects only federal mid-term rates, by repeating the most recent rates or using forward rates.

At determination years, the payment pattern may change considerably. One can not project the future Schedule P data for the industry accurately enough to estimate the IRS payment patterns. To price policies covering accident years beyond a future determination year, the actuary may use a loss payment pattern based on an actuarial projection, with adjustments for the expected increase in the IRS factors after 60 months of maturity.⁴⁶ If the IRS payment pattern has been stable, as may be true for high volume lines like personal auto liability, the actuary may continue using the same pattern.

If the company uses its own Schedule P data, loss reserve discount factors can sometimes be estimated for one additional accident year. Factors for the subsequent years may be based on an actuarial projection. In practice, projecting Schedule P even for one additional year is time-consuming, and the actuary may use the actuarial projection for all years, with any needed adjustments for the expected IRS differences.

Illustration A: In July 2008, the pricing actuary estimates loss reserve discount factors for accident years 2009, 2010, and 2011. The industry payment patterns were determined in 2007 for accident years 2007 through 2011; no estimates are needed. If the company uses its own loss payment patterns, the accuracy of the projection differs by accident year.

- Accident year 2009 uses loss payment patterns based on the 2007 Schedule P, which

is available by July 2008; the only projection is for federal mid-term rates from July 2008 through December 2008.

- Accident years 2010 and 2011 use loss payment patterns based on the 2008 and 2009 Schedule P entries. The discount factors are sensitive to random loss fluctuations. The effort of projecting Schedule P entries outweighs the benefits.

Unless the IRS discount factors have proved stable in past years, the actuary may use the actual loss payment pattern for the line of business.⁴⁷

Illustration B: In July 2010, the pricing actuary estimates loss reserve discount factors for accident years 2011, 2012, and 2013. The industry loss payment patterns are determined in 2012 for accident years 2012 through 2016.

- Accident year 2011 loss payment patterns are based on industry-wide 2005 Schedule P figures, which are available by the summer of 2006.
- Accident year 2012 and 2013 loss payment patterns use industry 2010 Schedule P figures, which are not available until the summer of 2011. The IRS payment patterns are sensitive to random loss fluctuations, and projected industry Schedule P figures are not accurate. The payment patterns should be calculated by actuarial methods through the tenth year and extended to the 16th year by the IRS procedure.⁴⁸

CONCLUSION

Computing tax basis incurred losses is essential for pricing long-tailed lines of business, since the differences between IRS loss reserve discount factors and actuarial discount factors may be large. Tax law is complex, and some practicing actuaries may not have the expertise to project future tax liabilities. This paper gives pricing actuaries the expertise needed to project tax basis incurred losses.

¹ For tax purposes, loss adjustment expenses (LAE) are reported on a paid basis since unpaid losses include any unpaid LAE; see Treasury regulation §846(f)(2); I am indebted to Bill Gilles for this clarification.

² Combined factors are used for the Schedule P Lines of Homeowners-Farmowners, Commercial Multi-Peril, and Special Liability.

³ During the late 1980's and early 1990's, it was fashionable to say that insurers pre-paid federal income taxes on underwriting income. This is Orweillian double-think: before 1986, the Treasury funded part of the loss created by statutory accounting; after 1986, the IRS taxes the economic income.

Discounted loss reserves show economic income if (i) the discount rate is appropriate, (ii) economic risk margins are used if needed, either for the discount rate or the loss reserves, and (iii) distributable earnings determined from statutory accounting use discounted reserves. Many financial analysts assume that underwriting risk is diversifiable, so loss reserves should be discounted at a duration matched risk-free rate, such as the mid-term federal rates used by the IRS; see also Woll [1987] and Lowe [19**]. SSAP 65, *Property-Casualty Insurance Contracts*, uses a maturity-matched Treasury yield as the maximum discount rate for non-tabular discounts. Butsic [1988] argues for a risk-adjusted rate about 300 basis points below the risk-free rate, and his perspective is widely used in the actuarial community. Conger, Hurley, and Lowe [20**] argue for a risk margin based on the variability of loss reserves. They use a stochastic reserving model by

Hodes, Feldblum, and Blumsohn [1999] to estimate reserve uncertainty and argue that a broad view of systematic risk encompasses more than just covariance with market returns. Feldblum [2006] argues for a risk margin based on the cost of holding capital. The perspectives of these authors differ, but they all conclude that the IRS loss reserve discounting procedure over-states the economic income of insurers.

⁴ The offsetting is exact if the company holds fully discounted reserves (with disclosure), the IRS discount rate equals the investment yield, and the IRS loss payment pattern equals the liquidation pattern of the losses.

⁵ The double taxation of the investment income on capital and surplus funds combined with statutory surplus and reserve requirements as well as any economic risk margins appropriate for loss reserves upset this equilibrium. They are not considered in this heuristic example.

⁶ The actual tax procedure assumes mid-year payments and a longer loss payment pattern.

⁷ See section 846(b)(2) of the Internal Revenue Code: "Adjustment If Losses Discounted on Annual Statement: If the amount of unpaid losses shown in the annual statement is determined on a discounted basis, and *the extent to which the losses were discounted can be determined on the basis of information disclosed on or with the annual statement*, the amount of the unpaid losses shall be determined without regard to any reduction attributable to such discounting." The required disclosure of *non-tabular* discounts by accident year and by line of business is provided in columns 34 (losses) and 35 (loss adjustment expenses) of Schedule P, Part 1. The required disclosure of *tabular* discounts is shown in the notes to the financial statements, "Discounting of Liabilities for Unpaid Losses or Unpaid Loss Adjustment Expenses."

⁸ The IRS is concerned that a company might claim so large a discount for its statutory loss reserves that the discounted tax-basis loss reserves are greater than the Annual Statement loss reserves, thereby reducing the tax liability. To prevent this, the discounted IRS loss reserves may not be greater than the loss reserves shown in the Annual Statement. See the Internal Revenue Code §846(a)(3): "In no event shall the amount of the discounted unpaid losses with respect to any line of business attributable to any accident year exceed the aggregate amount of unpaid losses with respect to such line of business for such accident year included on the annual statement."

The statutory loss reserves are generally greater than the IRS discounted loss reserves. Statutory accounting allows only limited discounting: tabular discounts and exceptional cases of non-tabular discounts. For tabular discounts, most companies use conservative interest rates, such as 3.5% or 4% per annum. For non-tabular discounts, the permissible discount rate for statutory accounting is rarely greater than the discount rate used for IRS loss reserve discounting; see SSAP No. 65 on "Property and Casualty Contracts," paragraph 12.

The workers' compensation prior years row (Part 1D) is an exception. These reserves are primarily indemnity reserves for lifetime pension cases, and many companies use tabular discounts. For this row, the composite discount factor used in the IRS discounting calculations assumes (on average) three more years of payment, whereas the pension cases in these reserves may have future expected lifetimes of up to 20 or 30 years. A company with negative reserves (from anticipated salvage and subrogation or expected reinsurance recoverables) in an accident year would also face the limitation, since discounting the reserve makes it less negative and raises its dollar value.

Illustration: Suppose the workers' compensation prior years row shows unpaid losses and LAE of \$30 million. In the *Notes to the Financial Statements*, the company reports a \$10 million tabular discount for these claims. The IRS composite discount factor applicable to these reserves is 90%. Without the limitation, the gross loss reserves are \$30 million + \$10 million = \$40 million. The IRS discounted loss reserves are 90% × \$40 million = \$36 million. Since this exceeds the \$30 million of statutory loss reserves, the IRS discounted reserves are capped at \$30 million.

⁹ See section 846(c)(2) of the Internal Revenue Code: "Determination of Annual Rate: The annual rate determined by the Secretary under this paragraph for any calendar year shall be a rate equal to the average of the applicable Federal mid-term rates (as defined in section 1274(d) but based on annual compounding) effective as of the beginning of each of the calendar months in the test period. The test period is the most

recent 60-calendar-month period ending before the beginning of the calendar year for which the determination is made.”

The federal mid-term rates are expressed as bond equivalent yields, since bond coupons are paid semi-annually in the United States. (A bond equivalent yield is a yield with semi-annual compounding.) The IRS loss reserve discounting procedure uses annual compounding, since it assumes that losses are paid in mid-year (i.e., once a year). The bond equivalent yields are converted to effective annual yields before averaging, using the formula $r_a = (1 + r_s/2)^2 - 1$, where r_a is the effective annual yield and r_s is the bond equivalent yield with semi-annual compounding. If the bond yield is 8% per annum, the effective annual rate is $(1 + 0.08/2)^2 - 1 = 8.16\%$.

¹⁰ The yield among mid-term securities varies with the remaining maturity, in accordance with the term structure of interest rates. More recently issued securities tend to have slightly lower yields, since they are more marketable. The Secretary of the Treasury selects an appropriate average rate.

¹¹ The IRS uses a 60 month moving average, on the assumption that the most recent monthly figure(s) may be abnormally high or low. Similarly, some financial analysts presume that interest rates revert towards a long-term mean, and a 60 month moving average may be a better reflection of this mean than the current rates. Other analysts (the dominant view) presume that interest rates form a random walk, and the present term structure of interest rates is the best reflection of expected future rates..

¹² At a 7% discount rate, the discount factor for a loss paid in the seventeenth year (after the end of the IRS loss payment pattern) is $1/1.07^{16.5} = 32.75\%$ or about one third. If 3% of losses remain unpaid after 16 years, the IRS discounted reserves are off by about half a percent at the first valuation date. At later valuation dates, the distortion is greater.

¹³ Further below we show the standard actuarial method of estimating loss payment patterns; here we focus on the IRS method to derive the loss reserve discount factors.

¹⁴ This is not a strong objection to using Part 3 of Schedule P. The historical triangles in Schedule P deliberately exclude adjusting and other expenses because they are distributed to accident years by an arbitrary formula; losses and defense and cost containment expenses relate to particular claims and can be objectively assigned to accident years.

¹⁵ This is not a serious objection. The Part 3 entries all appear in Part 1 as well, either in the current Schedule P or in the schedules of previous years. The NAIC cross-checks ensure that the historical figures in the Schedule P triangles match the figures in Part 1 of previous years.

¹⁶ The desire for an objective method to prevent under-estimates of the tax liability causes the IRS to retain loss reserve discount factors that are clearly distorted, such as a factor showing discounted reserves as 5% of undiscounted reserves. Actuaries can set formal rules to deal with random loss fluctuations, but professional judgment is the most practical method.

¹⁷ Losses in this illustration include all loss adjustment expenses, both defense and cost containment and adjusting and other.

¹⁸ Actuarial factors often decline as losses mature, reflecting the slow payment schedules on long-term claims, with litigated court cases and lifetime pensions. The IRS factors assume no payments beyond the 16th year, and they usually start increasing toward unity by 60 months of maturity.

¹⁹ The Tax Reform Act was passed in 1986, so the first year using discounted reserves was 1987.

²⁰ In tax parlance, they are *vintaged*; they are not subsequently revised.

²¹ The n^{th} year here means the n^{th} year working backwards from the current valuation date. We estimate the amounts to be paid in future calendar years by looking at old accident years. The difference in the cumulative percentages paid between the n^{th} and $(n+1)^{\text{st}}$ past Schedule P accident years is the percentage assumed to be paid between the end of the n^{th} and the $(n+1)^{\text{st}}$ calendar years from inception of the accident year to which the factors apply. The n^{th} accident year working backwards from the most recent Schedule P accident year corresponds to the n^{th} calendar year working forwards from the current tax year.

²² The assumption that all losses are paid at mid-year is a proxy for an even distribution of loss payments during the year. In truth, losses are paid slightly earlier than the middle of the year, particularly for the first year or two following the accident year. The IRS procedure provides a slightly longer discount period than is warranted. This reduces the offset to taxable income and increases the income tax liability. This bias is offset by the shorter payment patterns implicit in the IRS extension past ten years.

²³ See the Internal Revenue Code §§ 846(d)(3)(C) and (D), "Special rule for certain long-tail lines": In the case of any long-tail line of business, the period taken into account shall be extended (but not by more than 5 years), and the amount of losses which would have been treated as paid in the 10th year after the accident year shall be treated as paid in such 10th year and each subsequent year in an amount equal to the amount of the losses treated as paid in the 9th year after the accident year (or, if lesser, the portion of the unpaid losses not theretofore taken into account). To the extent such unpaid losses have not been treated as paid before the last year of the extension, they shall be treated as paid in such last year. The term "long-tail line of business" means any line of business if the amount of losses which would be treated as paid in the 10th year after the accident year exceeds the losses treated as paid in the 9th year after the accident year.

²⁴ A constant loss reserve discount factor is not unexpected. If loss payments follow an exponential decay, the average remaining time to settlement is constant over the lifetime of the reserves, and the discount factors are the same as long as some losses are unpaid. The expected discount factor depends on the rate of decay and the discount rate, not on the development period. See McClenahan [1975], Butsic [1981], and Barnett and Zehnwrith [200*], who assume an exponential decay for the loss payment pattern. For workers' compensation, the decay is slower. Most early payments are temporary disability claims, which often settle within a year or two. Permanent disability claims dominate the reserves for mature years; some of these claims remain open for 30 or 40 years. The loss payment pattern is rapid at first but slows at later maturities. The loss reserve discount factors get farther from one as the losses mature. Sherman [19**] shows this pattern for the major commercial liability lines of business. He uses an inverse power curve, which has a slower decay than an exponential curve. This also implies loss reserve discount factors that get farther from one as the losses mature.

One might reason that ultimately all claims are settled, so the loss reserve discount factors must eventually approach one. This is not correct. When all claims are settled, the loss reserve discount factor is not defined. If one claim remains open, it might not settle for several years, even if it occurred decades earlier, and the loss reserve discount factor remains far from one.

²⁵ The true problem is not simply that negative assumed payments are unreasonable. The prevalence of negative assumed payments highlights the inaccuracy of the calculation method. The IRS procedure may not be biased for the first ten years, but it is distorted both upward and downward by random loss fluctuations. No estimation procedure is perfect, but the standard actuarial techniques for determining loss payment patterns are reasonably accurate. There is no justification for using a complex, inaccurate method when simpler and more accurate alternatives are available.

We do not evaluate the bias of the IRS method. The inaccuracies cause a downward bias, since a true 85% discount factor may become as low as 0% but no higher than 100%. The extension of payments causes an upward bias, since the true payment pattern is longer than assumed by the IRS. The overall bias is unclear.

²⁶ See the Internal Revenue Code §846(d)(3)(G): "If the amount of the losses treated as paid in the 9th year after the accident year is zero or a negative amount, subparagraphs (C)(ii) and (D) shall be applied by substituting the average of the losses treated as paid in the 7th, 8th, and 9th years after the accident year for the losses treated as paid in the 9th year after the accident year." The cap for the years subsequent to the tenth year is changed, but the negative assumed payment for the tenth year remains.

²⁷ Negative loss payments are possible, though they are rare. They can result from unanticipated salvage and subrogation (or a failure to accrue anticipated salvage and subrogation) or from unanticipated reinsurance recoverables (or a failure to accrue anticipated reinsurance recoverable).

The company's interpretation of *net amounts* also affects the figures. Net paid losses in Schedule P means direct plus assumed paid losses minus ceded paid losses. This doesn't mean the direct plus assumed losses paid minus the reinsurance recoverables actually received. Net paid losses means the direct plus assumed losses paid minus the reinsurance recoverables *received or expected* on these loss payments.

See SSAP No. 53, "Property-Casualty Contracts – Premiums," which says that earned premium must reflect expected audits, recoveries, and retro adjustments, not just the premiums actually received. Similarly, SSAP No. 62, "Property and Casualty Reinsurance," distinguishes statutory accounting from GAAP for loss entries. GAAP codes direct losses, with expected reinsurance recoverables shown as assets. Statutory accounting uses the expected *net* figure, based on estimates of expected recoveries and reimbursements.

²⁸ The disregard for financial reason evident in these IRS rules diminishes the public's respect for the IRS loss reserve discounting procedure. The IRS would do well to amend the procedures in accordance with sound actuarial techniques, and the actuarial societies would do well to recommend the needed changes to the U.S. Treasury. An interim correction would be to smooth the pattern of assumed payments. This would eliminate unreasonable factors, though ideally a sound actuarial procedure should be used.

²⁹ The *Variance* reviewer commented: "Taxes are an expense like any other. The goal of the pricing actuary is not to figure out what the equilibrium market price should be. Rather the pricing actuary maximizes profits, subject to what is known about market pricing."

Maximizing profits depends on the price elasticity of demand facing the insurer. We use two assumptions to set optimal rates.

Assumption #1: The product market for insurance policies is competitive, at least for new business, subject to lack of consumer information in some lines. The equilibrium price is set by the market, and the individual insurer adapts to it. If the equilibrium price is \$1,000 per exposure and the insurer's cost (including the appropriate return on capital) is \$1,050 per exposure, the insurer can not raise the premium 5%. If the price elasticity of demand is high, raising the premium rate causes a loss of market share, which reduces long-term profits. If the cost difference between the market and the insurer is temporary, the insurer should generally incur the loss for the temporary period and retain its market share.

If the insurer could raise prices without losing market share and eventual profits, it would do so even if its costs were \$1,000 per exposure and raise profits by \$50 per exposure. Other insurers would do this as well, and the market price would be \$1,050 per exposure. But the market price is \$1,000 per exposure, indicating that raising the price causes a loss of profits.

Similarly, if the insurer's cost is \$950 per exposure, and the cost difference is temporary, the insurer may do better by charging \$1,000 and gaining an extra \$50 of profits. Lowering the price to \$950 for a temporary period and then switching back to \$1,000 may leave no long-term change in market share and no increase in profits.

If the cost difference is permanent, the insurer may charge a price between \$950 and \$1,000 so that the combined effect of increased market share and higher rates maximizes long-term profits. The tax differences are temporary, reversing within a few years.

Assumption #2: The insurer sets prices to maximize long-term profits. If the distortion in the IRS loss reserve discount factors is temporary, raising or reducing rates one year with an offsetting rate change a few years later is reasonable *if all insurers follow this pattern*. If the insurer goes against the grain, it suffers lower retention rates with higher new business expenses and losses. Insurers maximize profits by keeping high retention rates, lowering new business expenses and loss costs.

³⁰ As Bill Gilles has pointed out to me, “not all companies use composite factors for years 11+. If a company maintains data that breaks out the prior years, this breakout may be used for discounting with individual factors.”

³¹ Each discount factor is the ratio of discounted reserves to undiscounted reserves for a given accident year at a given valuation date. For instance, the tenth accident year 2010 discount factor AY+10 represents the discounted reserves for accident year 2010 at 12/31/2020, divided by the undiscounted reserves for accident year 2010 at 12/31/2020. This discount factor is computed in tax year 2010, not in tax year 2020.

³² Some tax analysts have suggested that it be better to weight the discount factors by the actual percentage of the company’s incurred losses by accident year in the prior years row. However, the IRS bases the loss reserve discounting procedure on information contained in the Annual Statement. The distribution of the prior years row reserves by accident year is not found in the Annual Statement.

³³ Preliminary loss payment patterns were determined in 1986 for review by the IRS staff and Congressional committees.

³⁴ See Treasury regulations 2001FED 26,330C, §1.846-2, Election by taxpayer to use its own historical loss payment pattern: “A taxpayer making the election must use its own historical loss payment pattern in discounting unpaid losses for each line of business that is an eligible line of business in that determination year.”

³⁵ See Internal Revenue Code §846(e)(3) “No election under this subsection shall apply to any international or reinsurance line of business”; see also § 846(d)(3)(E).

³⁶ See Regulation 88-100, §III: “Until further guidance is issued, such statistically significant amount is business in at least the 10th percentile of industry-wide reserves for a line of business for the determination year with respect to which the election is made.”

³⁷ See Treasury regulation 2001FED 26,330C, §1.846-2, Election by taxpayer to use its own historical loss payment pattern: “A line of business is an eligible line of business in a determination year if . . . the taxpayer reports losses and loss expenses incurred . . . for at least the number of accident years for which losses and loss expenses incurred for that line of business are required to be separately reported on that annual statement.”

³⁸ See IRC §846(e): “An insurance company is required to take estimated salvage recoverable (including that which cannot be treated as an asset for state statutory accounting purposes) into account in computing the deduction for losses incurred.”

³⁹ See the Internal Revenue Code, section 846(2) “A company is allowed to increase the unpaid losses shown on its annual statement only if the company . . . discloses on its annual statement, by line of business and accident year, the extent to which estimated salvage recoverable is taken into account in computing the unpaid losses shown on the annual statement . . .”

⁴⁰ Until recently, companies did have the option of their own discount factors for anticipated salvage and subrogation. Treasury regulation 2001FED 26,153, §1.832-4, says that “except as otherwise provided in guidance published by the Commissioner in the Internal Revenue Bulletin, estimated salvage recoverable must be discounted either (1) by using the applicable discount factors published by the Commissioner for estimated salvage recoverable; or (2) by using the loss payment pattern for a line of business as the salvage recovery pattern for that line of business and by using the applicable interest rate for calculating unpaid losses under section 846(c).” Guidance explicitly revoking this choice was issued in 2001.

⁴¹ Losses in Schedule P, Parts 2 and 3, include defense and cost containment, but not adjusting and other expenses. This is not a material drawback. The adjusting and other expenses in Schedule P are distributed to accident year by formula. Schedule P, Part 1, give no information about the *actual* pattern of adjusting and other expenses. If desired, we can add adjusting and other expenses by the same formula allocations.

⁴² The ultimate loss may also be taken from Part 1 of Schedule P as incurred losses minus adjusting and other expenses (both paid and reserves).

⁴³ Negative incremental percentages paid occur only if the actual net payments in Schedule P are negative. This might occur if reinsurance recoverables received differ from those anticipated or salvage and subrogation received differs from anticipated salvage and subrogation.

⁴⁴ See Feldblum, "Completing and Using Schedule P," *CAS Forum* (200*).

⁴⁵ Actuarial judgment in selecting age-to-age link ratios is hard to place in tax procedures. Averages of empirical data are not efficient in small samples, so actuaries fit the empirical payment pattern to a curve. The IRS is reluctant to use methods requiring statistical expertise that most taxpayer do not have.

⁴⁶ If the IRS discount factors have a consistent bias, the actuary may adjust the projected factors. For very long-tailed lines of business like medical malpractice, products liability, and workers' compensation, the actual loss payment pattern extends over 20 to 30 years, but the IRS loss payment pattern ends in the 16th year. The prior years row in Schedule P receives a composite discount factor that is the straight average of the 11th through 16th year factors. For workers' compensation and commercial liability products with high deductibles, the difference is material, and the actuary should use the quicker payment pattern implied by the IRS factors.

⁴⁷ The loss payment pattern is for the Schedule P line of business, not the block of business being priced. To price large dollar deductible workers' compensation policies, we use the loss reserve discount factors for all workers' compensation business.

⁴⁸ One might presume that continuing the same loss payment patterns for accident years 2012 and 2013 is a reasonable solution. But the loss payment patterns for accident years 2007 through 2011 are sensitive to the random loss fluctuations in the 2005 Schedule P entries. A better approach is to estimate the loss payment pattern for the first ten years and use the IRS procedure to extend for the next five years.

The pricing actuary may be tempted to rely on the tax department's projections of future loss reserve discount factors, particularly if the tax department says they can make such estimates. The tax department generally means that they can estimate the factors at the beginning of the accident year 200X instead of waiting for the official promulgation of the factors by the Secretary of the Treasury in the latter half of the year. This is not a projection; this is simply an independent computation of the factors. The tax department has no need to project loss reserve discount factors for future years.

ERRATA to IRS Loss Reserve Discounting

By Sholom Feldblum, FCAS, FSA, MAAA

8 February 2008

The errata to “IRS Loss Reserve Discounting” by Sholom Feldblum contain the following four corrected tables:

- **Table 1** replaces **Exhibit 2** on page 8.
- **Table 2** replaces **Exhibit 3** on page 11.
- **Tables 3 and 4** are corrected exhibits for the appendix. Although the appendix is not part of the syllabus reading, these are provided for reference so that the study note may be a resource in practical workplace applications.

Table 1: Illustration A: Private Passenger Automobile Loss Reserve Discount Factors

Accident Year (1)	Paid Loss + LAE (2)	Incurred Loss + LAE (3)	Cumulative Paid/Incurred Ratio (4)	Incremental Paid/Incurred Ratio (5)	Undiscounted Percentage Unpaid (6)	Discounted Percentage Unpaid (7)	Loss Reserve Discount Factor (8)
AY + 15							
AY + 14							
AY + 13							
AY + 12							
AY + 11							
AY + 10				2.00%	100.00%	0.00%	
2000	\$270,000	\$275,500	98.00%	3.07%	2.00%	1.93%	96.6735%
2001	\$300,000	\$316,000	94.94%	2.98%	5.06%	4.77%	94.1800%
2002	\$320,000	\$348,000	91.95%	3.99%	8.05%	7.34%	91.2271%
2003	\$340,000	\$386,500	87.97%	4.93%	12.03%	10.71%	89.0399%
2004	\$350,000	\$421,500	83.04%	6.03%	16.96%	14.78%	87.1281%
2005	\$370,000	\$480,500	77.00%	7.98%	23.00%	19.65%	85.4281%
2006	\$380,000	\$550,500	69.03%	10.01%	30.97%	26.07%	84.1740%
2007	\$360,000	\$610,000	59.02%	11.02%	40.98%	34.04%	83.0660%
2008	\$330,000	\$687,500	48.00%	13.00%	52.00%	42.47%	81.6659%
2009	\$200,000	\$571,500	35.00%	35.00%	65.00%	52.26%	80.3944%

Table 2: Illustration B: General Liability Loss Reserve Discount Factors

Accident Year (1)	Paid Loss + LAE (2)	Incurred Loss + LAE (3)	Cumulative Paid/Incurred Ratio (4)	Incremental Paid/Incurred Ratio (5)	Undiscounted Percentage Unpaid (6)	Discounted Percentage Unpaid (7)	Loss Reserve Discount Factor (8)
AY + 15			100.00%	3.01%	0.00%	0.00%	
AY + 14			96.99%	1.38%	3.01%	2.91%	96.6736%
AY + 13			95.61%	1.38%	4.39%	4.05%	92.3385%
AY + 12			94.23%	1.38%	5.77%	5.12%	88.7803%
AY + 11			92.85%	1.38%	7.15%	6.12%	85.6177%
AY + 10	\$235,000	\$250,000	91.47%	1.38%	8.53%	7.06%	82.7122%
2000	\$50,000	\$55,500	90.09%	1.38%	9.91%	7.93%	79.9988%
2001	\$55,000	\$62,000	88.71%	3.00%	11.29%	8.74%	77.4439%
2002	\$60,000	\$70,000	85.71%	4.46%	14.29%	11.07%	77.4718%
2003	\$65,000	\$80,000	81.25%	8.33%	18.75%	14.66%	78.1822%
2004	\$70,000	\$96,000	72.92%	9.81%	27.08%	21.76%	80.3309%
2005	\$65,000	\$103,000	63.11%	10.93%	36.89%	29.82%	80.8185%
2006	\$60,000	\$115,000	52.17%	12.17%	47.83%	38.44%	80.3644%
2007	\$50,000	\$125,000	40.00%	15.00%	60.00%	47.69%	79.4828%
2008	\$35,000	\$140,000	25.00%	16.67%	75.00%	59.07%	78.7611%
2009	\$15,000	\$180,000	8.33%	8.33%	91.67%	71.32%	77.8022%

Table 3: Other Liability Negative Loss Reserve Discount Factors

Accident Year (1)	Paid Loss + LAE (2)	Incurred Loss + LAE (3)	Cumulative Paid/Incurred Ratio (4)	Incremental Paid/Incurred Ratio (5)	Undiscounted Percentage Unpaid (6)	Discounted Percentage Unpaid (7)	Loss Reserve Discount Factor (8)
AY + 15			100.00%	3.01%	0.00%	0.00%	
AY + 14			96.99%	1.38%	3.01%	2.91%	96.6736%
AY + 13			95.61%	1.38%	4.39%	4.05%	92.3385%
AY + 12			94.23%	1.38%	5.77%	5.12%	88.7803%
AY + 11			92.85%	1.38%	7.15%	6.12%	85.6177%
AY + 10	\$235,000	\$250,000	91.47%	1.38%	8.53%	7.06%	82.7122%
2000	\$50,000	\$55,500	90.09%	1.38%	9.91%	7.93%	79.9988%
2001	\$55,000	\$62,000	88.71%	-9.86%	11.29%	8.74%	77.4439%
2002	\$69,000	\$70,000	98.57%	17.32%	1.43%	-1.36%	-95.3447%
2003	\$65,000	\$80,000	81.25%	8.33%	18.75%	15.47%	82.5189%
2004	\$70,000	\$96,000	72.92%	9.81%	27.08%	22.52%	83.1368%
2005	\$65,000	\$103,000	63.11%	10.93%	36.89%	30.53%	82.7436%
2006	\$60,000	\$115,000	52.17%	12.17%	47.83%	39.10%	81.7523%
2007	\$50,000	\$125,000	40.00%	15.00%	60.00%	48.31%	80.5167%
2008	\$35,000	\$140,000	25.00%	16.67%	75.00%	59.65%	79.5341%
2009	\$15,000	\$180,000	8.33%	8.33%	91.67%	71.86%	78.3932%

Table 4: Other Liability Loss Reserve Discount Factors: Distortions

Accident Year (1)	Paid Loss + LAE (2)	Incurred Loss + LAE (3)	Cumulative Paid/Incurred Ratio (4)	Incremental Paid/Incurred Ratio (5)	Undiscounted Percentage Unpaid (6)	Discounted Percentage Unpaid (7)	Loss Reserve Discount Factor (8)
AY + 15			100.00%	3.01%	0.00%	0.00%	
AY + 14			96.99%	1.38%	3.01%	2.91%	96.6736%
AY + 13			95.61%	1.38%	4.39%	4.05%	92.3385%
AY + 12			94.23%	1.38%	5.77%	5.12%	88.7803%
AY + 11			92.85%	1.38%	7.15%	6.12%	85.6177%
AY + 10	\$235,000	\$250,000	91.47%	1.38%	8.53%	7.06%	82.7122%
2000	\$50,000	\$55,500	90.09%	1.38%	9.91%	7.93%	79.9988%
2001	\$55,000	\$62,000	88.71%	-8.43%	11.29%	8.74%	77.4439%
2002	\$68,000	\$70,000	97.14%	15.89%	2.86%	0.02%	0.6645%
2003	\$65,000	\$80,000	81.25%	8.33%	18.75%	15.38%	82.0371%
2004	\$70,000	\$96,000	72.92%	9.81%	27.08%	22.43%	82.8251%
2005	\$65,000	\$103,000	63.11%	10.93%	36.89%	30.45%	82.5297%
2006	\$60,000	\$115,000	52.17%	12.17%	47.83%	39.03%	81.5980%
2007	\$50,000	\$125,000	40.00%	15.00%	60.00%	48.24%	80.4018%
2008	\$35,000	\$140,000	25.00%	16.67%	75.00%	59.59%	79.4482%
2009	\$15,000	\$180,000	8.33%	8.33%	91.67%	71.80%	78.3276%