Feldblum (Loss Reserve Discounting)

Outline

Underwriting income is defined as premium – underwriting & acquisition expenses – incurred losses. This paper focuses on the incurred losses component of underwriting income.

I. Statutory vs. Tax-Basis Loss Reserves

Statutory calendar year incurred losses are equal to paid losses plus the change in **undiscounted** loss reserves from the beginning to the end of the year.

Tax-basis incurred losses are equal to paid losses plus the change in **discounted** loss reserves from the beginning to the end of the year.

In both cases above, we are considering losses AND loss adjustment expenses.

Undiscounted incurred losses are equal to discounted incurred losses over the life of the claims. To see why this is true, consider a claim that is estimated to be paid for $\$L$ in N years. Assuming an interest rate of r, the discounted value of that claim at time zero is $\frac{L}{(1+r)^N}$. Assuming a positive interest rate, this amount will be smaller than the undiscounted value of that claim. This produces an interest discount. This interest discount will unwind over the subsequent N years as follows:

$$\frac{L}{(1+r)^N} + \sum_{t=1}^{N} \frac{L}{(1+r)^{t-1}} - \frac{L}{(1+r)\hat{}t} = L$$

Notice that the total discounted incurred loss at the end of N years is equal to the undiscounted incurred loss of L.

As we can see from the formula above, loss reserve discounting affects the pattern of income recognition. Since tax accounting does not recognize losses as quickly as statutory accounting, taxable income is recognized more quickly than statutory income. The impact is especially

meaningful for long-tailed lines of business. To see the difference between tax and statutory income, let's look at two examples.

Example 1: An insurer writes policies with the following characteristics:

- Expense ratio = 30%
- Discounted loss ratio = 65%
- Losses occur six months after the policy is written
- Losses are paid five years after they occur
- Losses are discounted using an interest rate of 7% per annum

Since the discounted loss ratio is 65%, the undiscounted loss ratio is found by "undoing" the discounting calculation. Thus, the undiscounted loss ratio is $(0.65)(1.07^{5.5}) = 0.943$. Note that the 5.5 comes from the fact that losses are paid five years after they occur AND that losses occur six months after the policy is written.

In this example, the statutory income is 1 – 0.30 – 0.943 = -0.243 and the taxable income is 1 – 0.30 – 0.65 = 0.05. The statutory income will be positive in subsequent years as it recognizes investment income on the assets supporting the loss. The taxable income will be zero in subsequent years since the investment income on the assets supporting the loss will be **offset by the amortization of the interest discount in the reserves (i.e. the unwinding of the interest rate)**.

Example 2: A policy written on January 1, 2014 for a premium of $10,000 has one loss on 12/31/2014 that is paid for $13,310 on 12/31/2016. The term structure of interest rates is 10% per annum. In addition, the IRS discount rate is also 10%. Further assume that the IRS loss payment pattern is the same as the actual payment pattern. Statutory and tax accounting by year are as follows:

- **2014**
    - **Statutory accounting**
        - Using the undiscounted losses of $13,310, the underwriting loss is $3,310 ($10,000 - $13,310)

        - Investment income is \$10,000(10%) = \$1,000, where the 10% comes from the term structure of interest rates
    - **Tax accounting**
        - Using the discounted losses of $\frac{\$13,310}{(1.10)^2} = \$11{,}000$, the underwriting loss is \$1,000 (\$10,000 - \$11,000), where the discount rate of 10% comes from the IRS discount rate
        - Investment income is \$10,000(10%) = \$1,000, where the 10% comes from the term structure of interest rates
        - Notice that the underwriting loss of \$1,000 offsets the \$1,000 of investment income giving a tax liability of zero
- **2015**
    - **Statutory accounting**
        - The underwriting loss is zero since the full undiscounted loss does not change
        - Investment income is (\$10,000 + \$1,000)(10%) = \$1,100. Notice here that we are earning interest on interest
    - **Tax accounting**
        - Due to the unwinding of the interest rate, the discounted reserves change from \$11,000 to $\frac{\$13,310}{1.10} = \$12{,}100$. Thus, the underwriting loss is \$1,100 (\$11,000 - \$12,100)
        - Investment income is (\$10,000 + \$1,000)(10%) = \$1,100
        - Notice that the underwriting loss of \$1,100 offsets the \$1,100 of investment income giving a tax liability of zero
- **2016**
    - **Statutory accounting**
        - The underwriting loss is zero since the full undiscounted loss does not change
        - Investment income is (\$10,000 + \$1,000 + \$1,100)(10%) = \$1,210

- **Tax accounting**
  - Paid losses plus the change in discounted reserves equals \$13,310 + (\$0 – 12,100) = \$1,210 (i.e. underwriting loss of \$1,210)
  - Investment income is (\$10,000 + \$1,000 + \$1,100)(10%) = \$1,210
  - Notice that the underwriting loss of \$1,210 offsets the \$1,210 of investment income giving a tax liability of zero

In the second example above, the statutory incurred losses differed from the tax-basis incurred losses. However, on an aggregate basis (i.e. more than one claim), the incurred losses will be equal for both bases **if incurred losses by calendar year are not increasing or decreasing**. The higher statutory incurred losses at the accident date should equal the accrual of interest for losses from previous accident years.

Prior to the **Tax Reform Act of 1986**, tax-basis underwriting come equaled statutory income. As we showed in example 2 above, this meant that the taxable income was lower earlier on in the life of claim which reduced an insurer's tax liability. This essentially gave insurers **interest free loans equal to the tax rate times the present value of the interest discount in the full value loss reserves**. These loans were amortized over the life of the claims.

Tax-basis discounted loss reserves are determined from the following three things:

1) Undiscounted loss reserves
2) Treasury discount rates
3) Loss payment patterns

We will now cover these three elements in more detail in the next three sections.

II. Undiscounted Loss Reserves

Undiscounted loss reserves can **usually** be found on Schedule P. We say "usually" because it's possible for Schedule P loss reserves to include tabular discounts. If tabular discounts are included in the Schedule P loss reserves, then they must be grossed up for the discounts before applying the IRS discount factor. For example, if the Schedule P workers' compensation reserves for a given accident year are \$10M, including \$1M of tabular discount, then the undiscounted reserves are

$11M. If the IRS discount factor is 85%, the final discounted reserves would be ($11M)(0.85) = $9.35M.

Although not common, it's possible for the IRS discounted reserves (i.e. reserves based on the IRS discount factor) to be greater than the statutory loss reserves. When this occurs, the final tax-basis loss reserves must be **capped at the statutory loss reserves**. In other words, the tax-basis loss reserves are not allowed to exceed the statutory loss reserves.

Example: A company's workers' compensation reserves for the "prior years" is $30M, which include $10M of tabular discounts. The IRS discount factor for these reserves is 90%. Thus, the IRS discounted reserves are ($30M + $10M)(0.90) = $36M. Since $36M > $30M, the tax-basis reserves are capped at $30M.

In the example above, we specifically mentioned that the reserves were related to workers' compensation reserves for the "prior years." Since these reserves are primarily indemnity reserves for lifetime pensions cases, companies typically use tabular discounts. These tabular discounts generally assume expected lifetimes of 10 to 20 years whereas the IRS discount factors only assume three more years of payments. This is why the tabular discounts for these types of reserves are often greater than the discounts underlying the IRS discounted reserves.

III. Treasury Discount Rates

IRS loss reserve discounting assumes that insurers buy investment grade Treasury securities when they collect the policy premium. Statutory accounting shows investment grade bonds at amortized values, which implies that the discount rate used for the bond cash flows is the **rate when the bond was purchased**, not the current rate. Since tax-basis values of bonds are equal to the statutory values, they also use the rate when the bond was purchased.

To match the unwinding of the interest discount on the loss reserves with the investment income on the supporting assets (for example, the investment grade bonds mentioned above), the loss reserve discount is **fixed** during the policy year and applies to all losses in the accident year until the settle. The loss reserve discount rate **should use the best estimate of interest rates over the life of the claims**. The following describes the Treasury discount rate used for IRS loss reserve discounting:

- For each AY, the discount rate is the 60-month moving average of the federal mid-term rates ending on the December 1 preceding the accident year
- The federal mid-term rate is the average rate on Treasury securities with 3 to 9-year remaining maturities

Example: The loss reserve discount rate for AY 2019 is the 60-month average of the federal mid-term rates from January 1, 2014 through December 1, 2018. It can be computed in mid-December 2018, before the inception of accident year 2019.

Note that the approach shown in the example above creates a timing difference between the average discount rate and the average loss date. The average loss date for AY 2019 is July 1, 2019. The average mid-term rate of the 60-month moving average is June 15, 2016, which is three years earlier. Thus, if the interest rates have been declining (increasing), then the tax-basis discounted reserves will be less (more) than market consistent discounted reserves.

IV. Loss Payment Patterns

The IRS derives the loss payment pattern from ratios of paid losses in past accident years to ultimate losses for those years. The IRS uses a ten-year loss payment pattern plus a five-year extension for long-tailed lines of business. Note that payment patterns take AY reserves and break them out into future calendar year payments.

Assuming payments in the middle of each calendar year and a risk-free interest rate r_f, the general formula for discounted loss reserves is as follows:

$$\text{Discounted Reserves} = \text{Undiscounted Ultimate Losses} \times \left[\left(\frac{p_1}{(1+r_f)^{0.5}}\right) + \left(\frac{p_2}{(1+r_f)^{1.5}}\right) + \ldots\right]$$
$$= \text{Undiscounted Reserves} \times \text{Discount Factor}$$

where p_i is the percentage of ultimate losses paid in each future calendar year *i*.

In the rest of this section, we will show how to calculate the p_i for each calendar year AND how those are used to calculate the discount factors. Calculating the p_i for each calendar year is

complicated due to how the IRS chose to implement loss payment patterns. Let's contrast the IRS approach with the standard actuarial approach.

The **standard actuarial approach** to determining loss payment patterns does one of the following:

- Divides the incremental losses paid in each development period by the ultimate losses to determine the percent paid in that period
- Divides the incremental losses paid in each development period by the unpaid losses (i.e. reserves) at the beginning of the period

Example: The following table illustrates the first method from the standard actuarial approaches above:

AY	Cum. Paid by 2008 ($000,000)	Cum. Paid by 2009 ($000,000)	Paid in 2009 ($000,000)	Ultimate Losses & DCC ($000,000)	Percentage Paid
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%

The cumulative paid columns come from Schedule P, Part 3. The "Paid in 2009" column is calculated by subtracting the "Cum. Paid by 2008" column from the "Cum. Paid by 2009" column. The ultimate losses & DCC come from Schedule P, Part 2. The percentage paid column is calculated by dividing the "Paid in 2009" column by the "Ultimate Losses & DCC" column.

One thing to note above is that the percentage paid is based on the 2009 calendar year only. In practice, the paid percentages would be based on the entire triangle to smooth random fluctuations in the data.

The **IRS payment pattern approach** is a bit different. Rather than taking differences between maturities for the same accident year (as shown in the actuarial approach), the IRS approach takes differences between accident years at one valuation. Let's look at an example:

Example: The following table illustrates the IRS approach for deriving a loss payment pattern:

AY	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Cum. Paid by 2009 ($000,000)	433	454	403	434	534	542	546	485	406	156
Ultimate Losses & DCC ($000,000)	486	520	475	522	667	707	787	802	866	898
Ratio of Cum. Paid Losses to Ultimate Losses & DCC	0.89	0.87	0.85	0.83	0.80	0.77	0.69	0.60	0.47	0.17
Percentage Paid	2%	2%	2%	3%	3%	8%	9%	13%	30%	17%

The "Percentage Paid" row is found by subtracting adjacent columns on the "Ratio of Cum. Paid Losses to Ultimate Losses & DCC" row.

As one can see from the table above, the cumulative paid losses for the oldest AY (i.e. AY 2000) do NOT equal its ultimate losses & DCC. This is why the ratio of 0.89 is less than 1. In this case, we must extend the payment pattern for up to six additional years.

Payment Patterns with No Extension

For the following example, let's assume that we want to calculate the loss reserve discount factors for AY 2011. To do this, we will use the insurer's 2009 Schedule P (we will explain why the 2009 Schedule P is used later on in the outline). This brings up an **important point**. We are always determining loss reserve discount factors for **a single accident year at future valuation points**. Once these discount factors are calculated, they are **vintaged**, which means they are not revised. Although the insurer's 2009 Schedule P consists of accident years less than or equal to 2009, we are NOT determining discount factors for those years. This has already occurred. We are only determining discount factors for AY 2011.

Given a 60-month moving average of the federal mid-term interest rates equal to 7% per annum, the loss reserve discount factors are calculated in the table below (all dollar figures have the $000,000 omitted):

AY (1)	Cum. Paid & DCC (2)	Ultimate Loss & DCC (3)	Cum. Paid/Ultimate Losses Ratio (4)	Incr. Paid/Ultimate Losses Ratio (5)	Undisc. Percentage Unpaid (6)	Disc. Percentage Unpaid (7)	Discount Factor (8)
AY +10			100.00%	2.00%	0.00%	0.00%	
2000	270	275.5	98.00%	3.07%	2.00%	1.93%	96.67%
2001	300	316	94.94%	2.98%	5.06%	4.77%	94.18%
2002	320	348	91.95%	3.99%	8.05%	7.34%	91.23%
2003	340	386.5	87.97%	4.93%	12.03%	10.71%	89.04%
2004	350	421.5	83.04%	6.03%	16.96%	14.78%	87.13%
2005	370	480.5	77.00%	7.98%	23.00%	19.65%	85.43%
2006	380	550.5	69.03%	10.01%	30.97%	26.07%	84.17%
2007	360	610	59.02%	11.02%	40.98%	34.04%	83.07%
2008	330	687.5	48.00%	13.00%	52.00%	42.47%	81.67%
2009	200	571.5	35.00%	35.00%	65.00%	52.26%	80.39%

Here are some notes on the table above:

- Column 4 is found by dividing column 2 by column 3
- Column 5 is found by differencing the cumulative ratios in column 4. For instance, the incremental paid ratio in AY 2000 is (.98 – 0.9494) = 0.307 (off due to rounding)
- Column 6 is one minus column 4
- Column 7 is calculated using one of two methods. We will describe them below
- Column 8 is column 7 divided by column 6
- The first row says "AY + 10" because the discount factors are used for AY 2011 at future valuation points (as stated earlier). For example, the AY 2009 discount factor of 0.8039 will be used to determine AY 2011 discounted reserves as of 12/31/2011 (i.e. the 2011 tax year). The AY 2008 discount factor of 0.8167 will be used to determine the AY 2011 discounted reserves as of 12/31/2012 (i.e. the 2012 tax year). If we continue this pattern, we see that

the discounted reserves will be equal to the undiscounted reserves by the "AY + 10 = 2011+ 10 = 2021" tax year. In other words, in tax year 2021, no discount factor will be applied

- As mentioned in the bullet above, there is no discounting required in tax year 2021. The remaining 2% of losses will be paid out in 2021. Hence, there is no extension of the payment pattern past year eleven

The first approach for determining the discounted unpaid percentages in column (7) is known as the **iterative method**. It's called the iterative method because we start with the oldest year and then move to younger years in an iterative fashion. As an example, here is how the iterative method is used to calculate the discounted unpaid percentages for AYs 2000 – 2002:

- AY 2000 – The discounted unpaid percentage is $\frac{2\%}{1.07^{0.5}} = 1.93\%$
- AY 2001 – The discounted unpaid percentage is $\frac{3.07\%}{1.07^{0.5}} + \frac{1.93\%}{1.07} = 4.77\%$. Notice that we are discounting the incremental paid percentage for AY 2001 by half a year (i.e. payments are made in the middle of the year) AND the discounted unpaid percentage for AY 2000 by one year (unpaid losses represent a point in time so that must be brought back a full year)
- AY 2002 – The discounted unpaid percentage is $\frac{2.98\%}{1.07^{0.5}} + \frac{4.77\%}{1.07} = 7.34\%$. Again, notice that we are incorporating the final result for AY 2001 to arrive at a result for AY 2002. Hence, it's iterative

Alternatively, we could simply discount all of the future incremental paid percentages and ignore the discounted unpaid percentages. This is known as the **formula method**. As an example, here is how the formula method is used to calculate the discounted unpaid percentages for AYs 2000 – 2002:

- AY 2000 – The discounted unpaid percentage is $\frac{2\%}{1.07^{0.5}} = 1.93\%$
- AY 2001 – The discounted unpaid percentage is $\frac{3.07\%}{1.07^{0.5}} + \frac{2\%}{1.07^{1.5}} = 4.77\%$
- AY 2002 – The discounted unpaid percentage is $\frac{2.98\%}{1.07^{0.5}} + \frac{3.07\%}{1.07^{1.5}} + \frac{2\%}{1.07^{2.5}} = 7.34\%$

So, **how do we actually use the discount factors**? If the undiscounted reserves for AY 2011 at 12/31/2011 are $450,000, then the discounted reserves are $450,000(0.8039) = $361,755 at 12/31/2011. If the undiscounted reserves for AY 2011 are $350,000 at 12/31/2012, then the discounted reserves are $350,000(0.8167) = $285,845 at 12/31/2012.

Payment Patterns with Extension

Similar to the previous example, we are determining discount factors for AY 2011. However, the data in this example has a longer tail and requires a payment pattern extension. Here is the table:

AY (1)	Cum. Paid & DCC (2)	Ultimate Loss & DCC (3)	Cum. Paid/Ultimate Losses Ratio (4)	Incr. Paid/Ultimate Losses Ratio (5)	Undisc. Percentage Unpaid (6)	Disc. Percentage Unpaid (7)	Discount Factor (8)
AY +15			100.00%	3.01%	0.00%	0.00%	
AY +14			96.99%	1.38%	3.01%	2.91%	96.67%
AY +13			95.61%	1.38%	4.39%	4.05%	92.34%
AY +12			94.23%	1.38%	5.77%	5.12%	88.78%
AY +11			92.85%	1.38%	7.15%	6.12%	85.62%
AY +10			91.47%	1.38%	8.53%	7.06%	82.71%
2000	50	55.5	90.09%	1.38%	9.91%	7.93%	80.00%
2001	55	62	88.71%	3.00%	11.29%	8.74%	77.44%
2002	60	70	85.71%	4.46%	14.29%	11.07%	77.47%
2003	65	80	81.25%	8.33%	18.75%	14.66%	78.18%
2004	70	96	72.92%	9.81%	27.08%	21.76%	80.33%
2005	65	103	63.11%	10.93%	36.89%	29.82%	80.82%
2006	60	115	52.17%	12.17%	47.83%	38.44%	80.36%
2007	50	125	40.00%	15.00%	60.00%	47.69%	79.48%
2008	35	140	25.00%	16.67%	75.00%	59.07%	78.76%
2009	15	180	8.33%	8.33%	91.67%	71.32%	77.80%

There are two **main things** to notice in the table:

- The payment pattern extends to year sixteen. Per IRS rules, the payment pattern is NOT allowed to go past year sixteen
- For years eleven through fifteen, the incremental paid percentage is 1.38%. This is due to the fact that the incremental paid percentage in year ten (i.e. AY 2000) is 1.38%. Per IRS rules, the incremental paid percentages in years beyond year ten must be capped at the year ten percentage EXCEPT for year sixteen. If the payment pattern is still incomplete by year sixteen, then the remainder is assumed to be paid (hence, the remaining 3.01% is paid in year sixteen)

Negative Payments in the Tenth Year

If negative incremental losses occur in the tenth year, then an adjustment is needed. Otherwise, we would be using a negative number as our cap when extending the loss payment pattern. When this occurs, we must **use the average of the incremental paid percentages in the oldest three accident years as our revised cap** for the eleventh and subsequent years. For example, assume that the incremental paid percentages for AYs 2002, 2001, and 2000 (i.e. years eight, nine, and ten) are 5.92%, 9.47%, and -3.64%, respectively. In this case, the percentage in the tenth year is negative. Thus, the revised cap for the eleventh year and beyond is 0.333(-3.64% + 9.47% + 5.92%) = 3.92%.

Negative Discount Factors

Negative loss payments at late maturities can occasionally cause negative discount factors. Since a negative discount factor does not make sense in terms of the time value of money (unless somehow, we had a negative interest rate), we need another adjustment. In this case, we simply interpolate linearly between the **nearest positive** discount factors on both sides. As an example, assume that the computed discount factors for three consecutive maturities are 80%, -35%, and 85%. We replace -35% with [80%(1-0.5) + 85%(0.5)] = 82.5%. If the computed discount factors for four consecutive maturities are 70%, -35%, -45%, and 85%, then we replace -35% with [70%(1-0.33) + 85%(0.33)] = 75% and -45% with [70%(1-0.67) + 85%(0.67)] = 80%.

Small Discount Factors

Most of the time, negative loss payments do not produce negative discount factors. Instead, they produce positive but small discount factors. This causes large tax liabilities in one year followed by tax refunds in the next year.

As an **example**, assume that the expected undiscounted loss reserves for AY 2011 at $50M, $45M, and $40M at 12/31/2017, 12/31/2018, and 12/31/2019, respectively. Further assume that paid losses equal $5M in each calendar year and that the IRS discount factors are 80%, 10%, and 85%. This gives us the following (all dollar figures in $M):

Calendar Year	Paid Loss	Change in Undiscounted Loss Reserve	Statutory Incurred Losses	Change in Discounted Loss Reserve	Tax-Basis Incurred Losses
2018	5	45 – 50 = -5	5 – 5 = 0	45(0.10) – 50(0.80) = -35.5	5 – 35.5 = -30.5
2019	5	40 – 45 = -5	5 – 5 =0	40(0.85) – 45(0.10) = 29.5	5 + 29.5 = 34.5

As shown in the table, the tax-basis incurred losses are significantly negative in calendar year 2018, which produces a tax liability. This is followed by significantly positive tax-basis incurred losses in calendar year 2019, which produces a tax refund.

Composite Discount Factors

Schedule P displays ten accident years and a "prior years" row. The "prior years" row consists of the unpaid losses for all accident years prior to the oldest of the ten individual years. Since discount factors are applied to individual accident year reserves, a **composite** or aggregated discount factor is needed for the "prior years" reserves. As we might expect, the IRS has a protocol for calculating the composite factor. It's best explained through an **example**.

Once again, assume that we are using an insurer's 2009 Schedule P to determine discount factors for AY 2011 at future valuations dates. As we showed earlier, the first ten discount factors apply to AY 2011 from 12/31/2011 to 12/31/2020. In the 2021 Schedule P, AY 2011 will no longer be an individual accident year. Instead, it will be part of the "prior years" row. Since the IRS discounting procedure assumes that all losses are paid by the sixteenth year, we assume that the "prior reserves" row shown in the 2021 Schedule P consists of five accident years, namely 2007-2011. The discount factor applied to this row is an average of the individual discount factors for 2007-2011. In particular, it's an average of the following discount factors:

- AY 2011 discount factor for a maturity of eleven years, which is computed from the 2009 Schedule P (recall the second example we looked earlier that showed an extended payment pattern; this is where the discount factor comes from)
- AY 2010 discount factor for a maturity of twelve years, which is computed from the 2008 Schedule P
- AY 2009 discount factor for a maturity of thirteen years, which is computed from the 2007 Schedule P

- AY 2008 discount factor for a maturity of fourteen years, which is computed from the 2006 Schedule P
- AY 2007 discount factor for a maturity of fifteen years, which is computed from the 2005 Schedule P

Here's an example of how the calculation actually works:

AY	Maturity (in Years)	Undiscounted Percentage Unpaid	Discounted Percentage Unpaid	Discount Factor
2007	15	2.98%	2.75%	92.35%
2008	14	4.18%	3.77%	90.12%
2009	13	6.23%	5.48%	87.98%
2010	12	7.64%	6.52%	85.32%
2011	11	8.53%	7.06%	82.71%
Total		**29.56%**	**25.58%**	**86.54%**

The total undiscounted percentage paid and total discounted percentage paid are found by summing all of the numbers in the column. The total discount factor is found by dividing the total discounted percentage paid by the total undiscounted percentage paid. The final composite factor for the "prior years" row in the 2021 Schedule P is 0.8654.

Industry Data vs. Company Data

The following summarizes the procedures for using industry loss payment patterns and company-specific loss payment patterns:

- Industry payment patterns
    - The Treasury determines loss payment patterns every five years (known as **determination years**) from aggregate Schedule P data. The determination years end in a 2 or 7
    - The payment patterns are based on aggregate Schedule P data for statement dates ending in a 0 or a 5
    - As an example, the 2007 determination year uses Schedule P data as of 12/31/2005

    - Industry loss payment patterns are only updated in determination years. However, the discount factors can change each year because the discount rate is recomputed each year
- Company-specific payment patters
    - In each determination year, insurers must elect to use industry discount factors developed by the Treasury or company-specific discount factors derived from their own Schedule P data
    - The election applies to the determination year and to the next four years
    - As an example, if an insurer elects to use its own data in the 2007 determination year, that election applies for years 2007-2011
    - An insurer must have data for all ten accident years in Schedule P to use its own data for a specific line of business
    - Company-specific payments patterns are updated each year

Loss Payment Lags

Certain lines of business have longer loss payment lags (ex. claims with more severe claims such as construction crews in workers' compensation). A longer loss payment lag **causes a lower reserve discount factor** since the time value of money has a larger impact. The lower discount factor reduces the tax-basis incurred losses, which increases the tax-basis underwriting income and produces a higher tax liability.

Reserve Margins

Insurers often include implicit reserve margins in their reserves as a type of "cushion" above the best estimate. Since these reserve margins increase reported losses and reduce taxable income, the IRS does not look favorably on them. The following things may suggest an insurer is including reserve margins in their Annual Statement figures:

- Reserve indications higher than the standard application of the reserving method
- Booked reserves higher than the actuarial reserve indications
- Consistent favorable development in Schedule P
- Average paid losses lower than the held reserves

Two-Year Lines of Business

In all of the prior examples, we examined Schedule P data with ten accident years and a "prior years" row. Several short-tailed lines of business (ex. Auto Physical Damage) only show two accident years and a "prior years" row. For these lines of business, the discounting procedure is identical to what we showed earlier with one exception. The losses remaining unpaid after two years are assumed to be **paid evenly over the next two years**.

V. Salvage and Subrogation

The tax-basis loss reserves must be net of anticipated salvage and subrogation (sal/sub). This is not quite as simple as it seems. The gross loss reserves (and by gross, we mean gross of sal/sub) and anticipated sal/sub must be discounted separately. Even if an insurer elects to use its own discount factors for the gross loss reserves, the anticipated sal/sub must be discounted using Treasury discount factors.

VI. Steps to Computing Tax-Basis Loss Reserves

In this section, we will the summarize the steps to computing the tax-basis loss reserves:

- Total net of sal/sub losses and expenses unpaid are obtained from Schedule P, Part 1
- Anticipated sal/sub is obtained from Schedule P, Part 1. These are added to the total net losses and expenses unpaid to produce unpaid losses and expenses **gross of all anticipated sal/sub**
- Any tabular discounts are added to the total gross losses and expenses unpaid to produce unpaid losses and expenses **gross of all discounts**
- Gross losses and expenses unpaid are discounted using either industry discount factors or company-specific discount factors
- Anticipated sal/sub is discounted using industry discount factors
- The discounted sal/sub is subtracted from the discounted gross unpaid losses and expenses to produce the final discounted reserves (i.e. the tax-basis loss reserves)

VII. Deconstructing Schedule P

Imagine we are computing discounted reserves for a long-tailed line of business for tax year 2017. Tax year 2017 is comprised of accident years 2017 and prior. Assuming the insurer is using its **own Schedule P data** to develop loss payment patterns, discount factors for each accident year are derived as follows:

- AY 2017 – Discount factor derived from the insurer's 2015 Schedule P at a maturity of one year
- AY 2016 – Discount factor derived from the insurer's 2014 Schedule P at a maturity of two years
- AY 2015 – Discount factor derived from the insurer's 2013 Schedule P at a maturity of three years
- …
- AY 2012 – Discount factor derived from the insurer's 2010 Schedule P at a maturity of six years
- AY 2011 – Discount factor derived from the insurer's 2009 Schedule P at a maturity of seven years
- …

Assuming the insurer is using **industry Schedule P data** to develop loss payment patterns, discount factors for each accident year are derived as follows:

- AY 2017 – Discount factor derived from the aggregate **2015** Schedule P at a maturity of one year
- AY 2016 – Discount factor derived from the aggregate **2010** Schedule P at a maturity of two years
- AY 2015 – Discount factor derived from the aggregate 2010 Schedule P at a maturity of three years
- …
- AY 2012 – Discount factor derived from the aggregate 2010 Schedule P at a maturity of six years

- AY 2011 – Discount factor derived from the aggregate **2005** Schedule P at a maturity of seven years

Note that for each accident year above, the discount rate is based on the 60-month moving average of federal mid-term rates in the five years preceding the accident year.

Original Mathematical Problems & Solutions

MP #1

A policy written on January 1, 2017 for a premium of $8,000 has one loss on 12/31/2017 that is paid for $9,261 on 12/31/2019. The term structure of interest rates is 5% per annum. In addition, the IRS discount rate is also 5%. Further assume that the IRS loss payment pattern is the same as the actual payment pattern.

a) Calculate the 2018 taxable income using statutory accounting.
b) Calculate the 2018 taxable income using tax accounting.
c) Calculate the 2019 taxable income using tax accounting.

Solution to part a:

The underwriting loss is zero since the full undiscounted loss does not change.

Investment income is ($8,000 + $8,000(0.05))(0.05) = $420.

The total taxable income is $0 + $420 = **$420**.

Solution to part b:

Due to the unwinding of the interest rate, the discounted reserves change from $\frac{\$9,261}{1.05^2} = \$8{,}400$ to $\frac{\$9,261}{1.05} = \$8{,}820$. Thus, the underwriting loss is $420 ($8,400 - $8,820).

Investment income is ($8,000 + $8,000(0.05))(0.05) = ($8,000 + $400)(0.05) = $420.

The total taxable income is -$420 + $420 = **$0**.

Solution to part c:

Since the loss is paid in 2019, the change in discounted reserves is ($0 - $8,820) = -$8,820.

The taxable incurred losses = paid loss + change in discounted reserves = $9,261 - $8,820 = $441.

Investment income is ($8,000 + $400 + $420)(0.05) = $441.

The total taxable income is -$441 + $441 = $0.

MP #2

A company's workers' compensation reserves for the "prior years" is $65M, which includes $25M of tabular discounts. The IRS discount factor for these reserves is 90%. Determine the tax-basis reserves.

Solution:

The full undiscounted reserves are ($65M + $20M) = $90M. The IRS discounted reserves are ($90M)(0.90) = $81.0M. Since the discounted reserves are greater than the statutory reserves of $65M, the **tax-basis reserves are capped at $65M**.

MP #3

Given the following from an insurer's 2015 Schedule P:

AY	Cum. Paid by 2014 ($000,000)	Cum. Paid by 2015 ($000,000)	Ultimate Losses & DCC ($000,000)
2006	630	650	680
2007	625	650	675
2008	595	615	685
2009	575	600	695
2010	540	580	660
2011	500	535	700
2012	450	495	705
2013	390	465	695
2014	150	370	710
2015		135	715

a) Determine the payment pattern for the first ten years based on a standard actuarial approach using the CY 2015 data above.

b) Determine the payment pattern for the first ten years based on the IRS approach using the CY 2015 data above.

Solution to part a:

The standard actuarial approach is as follows:

AY	Cum. Paid by 2014 ($000,000)	Cum. Paid by 2015 ($000,000)	Ultimate Losses & DCC ($000,000)	Percentage Paid
2006	630	650	680	**2.94% = (650-630)/680**
2007	625	650	675	**3.70%**
2008	595	615	685	**2.92%**
2009	575	600	695	**3.60%**
2010	540	580	660	**6.06%**
2011	500	535	700	**5.00%**
2012	450	495	705	**6.38%**
2013	390	465	695	**10.79%**
2014	150	370	710	**30.99%**
2015		135	715	**18.88%**

Solution to part b:

The IRS approach is as follows:

AY	Cum. Paid by 2015 ($000,000)	Ultimate Losses & DCC ($000,000)	Cum. Paid/Ultimate Losses Ratio	Incr. Paid/Ultimate Losses Ratio
2006	650	680	95.59% = 650/680	**-0.71%**
2007	650	675	96.30%	**6.52%**
2008	615	685	89.78%	**3.45%**
2009	600	695	86.33%	**-1.55%**
2010	580	660	87.88%	**11.45%**
2011	535	700	76.43%	**6.22%**
2012	495	705	70.21%	**3.30%**
2013	465	695	66.91%	**14.80%**
2014	370	710	52.11%	**33.23%**
2015	135	715	18.88%	**18.88%**

MP #4

An insurer is using the following 2015 Schedule P to produce discount factors for AY 2017:

AY	Cum. Paid by 2014 ($000,000)	Cum. Paid by 2015 ($000,000)	Ultimate Losses & DCC ($000,000)
2006	630	650	680
2007	625	650	675
2008	595	615	685
2009	575	600	695
2010	540	580	660
2011	500	535	700
2012	450	495	705
2013	390	465	695
2014	150	370	710
2015		135	715

The following table provides federal mid-term average rates over various timespans:

Timespan	Average Mid-Term Rate
January 1, 2011 – December 1, 2016	5%
January 1, 2012 – December 1, 2016	6%
January 1, 2013 – December 1, 2016	7%

a) Determine the full payment pattern using the IRS approach.

b) Use the iterative approach to determine the IRS discount factor that AY 2017 will use in tax year 2025.

c) Use the formulaic approach to determine the IRS discount factor that AY 2017 will use tax year 2025.

d) On December 31, 2025, the AY 2017 undiscounted reserves are $20,000,000. Determine the discounted reserves at the same point in time.

Solution to part a:

This is the same data from MP #3. The full payment pattern is as follows:

AY	Cum. Paid/Ultimate Losses Ratio	Incr. Paid/Ultimate Losses Ratio
AY + 11	100.00%	**1.32%**
AY + 10	98.68%	**3.09% = (-0.71% + 6.52% + 3.45%)/3**
2006	95.59%	**-0.71%**
2007	96.30%	**6.52%**
2008	89.78%	**3.45%**
2009	86.33%	**-1.55%**
2010	87.88%	**11.45%**
2011	76.43%	**6.22%**
2012	70.21%	**3.30%**
2013	66.91%	**14.80%**
2014	52.11%	**33.23%**
2015	18.88%	**18.88%**

Since the tenth incremental paid percentage was negative (i.e. -0.71%), we cannot use it as our cap. Instead, we take the average of the oldest three years. This becomes our new cap.

Solution to part b:

In 2025, AY 2017 will be eight years old. Thus, we need to use the AY 2007 discount factor from the 2015 Schedule P data. The appropriate discount rate is based on the 60-month average federal mid-term rate. This is based on the timespan from January 1, 2012 – December 1, 2016. Thus, it is 6%.

To use the iterative method, we start with AY + 11 and work backwards:

- AY + 11 – Discounted percentage unpaid = $\frac{1.32\%}{1.06^{0.5}} = 1.28\%$
- AY + 10 – Discounted percentage unpaid = $\frac{3.09\%}{1.06^{0.5}} + \frac{1.28\%}{1.06} = 4.21\%$
- AY 2006 – Discounted percentage unpaid = $\frac{-0.71\%}{1.06^{0.5}} + \frac{4.21\%}{1.06} = 3.28\%$

The AY 2007 undiscounted percentage unpaid is (1 – 0.963) = 3.7%. Thus, the discount factor is 3.28/3.7 = **0.8865**

Solution to part c:

The discounted unpaid percentage is $\frac{-0.71\%}{1.06^{0.5}} + \frac{3.09\%}{1.06^{1.5}} + \frac{1.32\%}{1.06^{2.5}} = 3.28\%$. Once again, the discount factor is 3.28/3.7 = **0.8865**

Solution to part d:

The discounted reserves are \$20,000,000(0.8865) = **\$17,730,000**

MP #5

Given the following discount factors for five consecutive maturities:

- 75%
- -40%
- -20%
- -30%
- 95%

Determine the final discount factors for the five maturities.

Solution:

- 75%
- Replace -40% with [75%(1-0.25) + 95%(0.25)] = 80%
- Replace -20% with [75%(1-0.5) + 95%(0.50)] = 85%
- Replace -30% with [75%(1-0.75) + 95%(0.75)] = 90%
- 95%

MP #6

An insurer is calculating the discounted reserves for "prior years" for tax year 2017 for a long-tailed line of business. The insurer is using company payment patterns. Given the following company Schedule P data:

AY	Undiscounted Percentage Unpaid	Discounted Percentage Unpaid
2002	3.0%	2.5%
2003	4.0%	3.7%
2004	6.0%	5.5%
2005	8.5%	6.5%
2006	10.0%	7.9%
2007	15.0%	11.9%
2008	20.0%	15.5%
2009	27.5%	20.8%

a) Identify the accident years that comprise the composite discount factor needed to discount the "prior years" reserves for tax year 2017.

b) For each prior accident year, identify the year of the Schedule P informing the discount factor for that accident year under the following scenarios:

- Company payment patterns used to produce discounted reserves
- Industry payment patterns used to produce discounted reserves

c) Calculate the composite discount factor for the "prior years" row for tax year 2017.

Solution to part a:

Accident years 2003 – 2007

Solution to part b:

- 2007 – Uses 2005 company Schedule P when based on company payment patterns; uses 2005 industry Schedule P when based on industry payment patterns
- 2006 – Uses 2004 company Schedule P when based on company payment patterns; uses 2000 industry Schedule P when based on industry payment patterns
- 2005 – Uses 2003 company Schedule P when based on company payment patterns; uses 2000 industry Schedule P when based on industry payment patterns
- 2004 – Uses 2002 company Schedule P when based on company payment patterns; uses 2000 industry Schedule P when based on industry payment patterns
- 2003 – Uses 2001 company Schedule P when based on company payment patterns; uses 2000 industry Schedule P when based on industry payment patterns

Solution to part c:

AY	Undiscounted Percentage Unpaid	Discounted Percentage Unpaid
2003	4.0%	3.7%
2004	6.0%	5.5%
2005	8.5%	6.5%
2006	10.0%	7.9%
2007	15.0%	11.9%
Total	43.5%	35.5%

The final composite discount factor is 35.5/43.5 = 81.61%.

MP #7

An insurer is developing discount factors for a short-tailed line of business that only requires two individual accident years and a prior years row in its Schedule P. Given the following from the insurer's 2015 Schedule P:

AY	Cum. Paid by 2014 ($000,000)	Cum. Paid by 2015 ($000,000)	Ultimate Losses & DCC ($000,000)
2014	150	370	390
2015		135	380

- The 60-month average federal mid-term rate is 6%
- The AY 2015 Treasury discount factor for anticipated salvage and subrogation is 98%

a) Determine the full payment pattern using the IRS approach.

b) Determine the IRS discount factor that AY 2017 will use in tax year 2017.

c) The AY 2017 net reserves are $250,000,000, which includes $20,000,000 of anticipated salvage and subrogation. Determine the AY 2017 discounted net reserves for tax year 2017.

Solution to part a:

AY	Cum. Paid/Ultimate Losses Ratio	Incr. Paid/Ultimate Losses Ratio
AY + 3	100.00%	**2.57% = (1 - 0.9487)/2**
AY + 2	97.44%	**2.57% = (1 - 0.9487)/2**
2014	94.87%	**59.34%**
2015	35.53% = 135/380	**35.53%**

Solution to part b:

We must base AY 2017 on the AY 2015 data above.

The discounted unpaid percentage is $\frac{59.34\%}{1.06^{0.5}} + \frac{2.57\%}{1.06^{1.5}} + \frac{2.57\%}{1.06^{2.5}} = 62.21\%$. The discount factor is 62.21/(2.57 + 2.57 + 59.34) = **0.9648**

Solution to part c:

The gross discounted reserves are (250,000,000 + 20,000,000)(0.9648) = 260,496,000

The discounted anticipated sal/sub is (20,000,000)(0.98) = 19,600,000

The discounted net reserves are 260,496,000 – 19,600,000 = **$240,896,000**

Original Essay Problems

EP #1

Explain why tax-basis underwriting income was modified in the Tax Reform Act of 1986.

EP #2

Briefly explain why tabular discounts on indemnity reserves for lifetime pensions cases are typically greater than the discounts underlying the IRS discounted reserves.

EP #3

a) Identify the types of securities the IRS assumes insurers are purchasing when developing the discount rates for loss reserve discounting.
b) Explain why the discount rate used for investment grade bonds is the rate when the bond was purchased and not the current rate.
c) Explain why the loss reserve discount is fixed for an accident year.
d) Explain why a moving average of the federal mid-term rates is used for discounting rather than the latest available rate.
e) Briefly describe the federal mid-term rate.

EP #4

Construct an example showing how small discount factors could cause large tax liabilities in one year followed by large tax refunds in the next year.

EP #5

a) Identify any determination years that exist between 2010 and 2020.
b) Briefly describe the actions taken by the Treasury during a determination year.
c) Briefly describe the actions taken by an insurer during a determination year.
d) An insurer elects to use its own data to develop payment patterns. Identify the number of years that election remains in place.
e) Identify any requirements for an insurer to use its own data to develop payment patterns.

f) Explain why a company might elect not to use its own payment pattern (even when it meets all of the requirements).

EP #6

Identify four red flags that an insurer is including an implicit risk margin in its reserves.

Original Essay Solutions

ES #1

Prior to the Tax Reform Act of 1986, tax-basis underwriting come equaled statutory income. This essentially gave insurers interest free loans equal to the tax rate times the present value of the interest discount in the full value loss reserves.

ES #2

These tabular discounts generally assume expected lifetimes of 10 to 20 years whereas the IRS discount factors only assume three more years of payments. This produces tabular discounts greater than the IRS discounts.

ES #3

a) Investment grade Treasury securities
b) Since investment grade bonds are recorded at amortized values, the discount rate should be based on the rate when the bond was purchased
c) The discount is fixed to match the unwinding of the interest discount on the loss reserves with the investment income on the supporting assets
d) A moving average is used to ensure that the loss reserve discount represents the best estimate of interest rates over the life of the claims
e) The federal mid-term rate is the average rate on Treasury securities with 3 to 9-year remaining maturities

ES #4

Assume that the expected undiscounted loss reserves for AY 2011 at $40M, $32M, and $26M at 12/31/2017, 12/31/2018, and 12/31/2019, respectively. Further assume that paid losses equal $4M in each calendar year and that the IRS discount factors are 75%, 12%, and 82%. This gives us the following (all dollar figures in $M):

Calendar Year	Paid Loss	Change in Discounted Loss Reserve	Tax-Basis Incurred Losses
2018	4	32(0.12) – 40(0.75) = -26.16	4 – 26.16 = -22.16
2019	4	26(0.82) – 32(0.12) = 17.48	4 + 17.48 = 21.48

As we see above, the CY 2018 tax-basis incurred losses are highly negative, which could result in a tax liability due to the increase in profit. This is a followed by a highly positive tax-basis incurred loss, which might produce a tax refund.

ES #5

a) 2012 and 2017
b) In each determination year, the treasury updates its payment pattern
c) In each determination year, insurers must elect to use industry discount factors developed by the Treasury or company-specific discount factors derived from their own Schedule P data
d) Five years
e) An insurer must have data for all ten accident years in Schedule P to use its own data for a specific line of business
f) If the discount factor for an accident year based on a company's own data is less than the industry discount factor for the same accident year, the company might choose to use the industry factor. A higher factor would produce higher liabilities which would reduce net income and lower taxes

ES #6

Four red flags are as follows:

- Reserve indications higher than the standard application of the reserving method
- Booked reserves higher than the actuarial reserve indications
- Consistent favorable development in Schedule P
- Average paid losses lower than the held reserves