# Patrik

## Outline

### I. Reinsurance Loss Reserving Problems

- ◇ **Problem 1: Claim report lags to reinsurers are generally longer, especially for casualty excess losses**
  - The claim report lag (the time from date of accident until first report to the reinsurer) is exacerbated by the lengthy reporting pipeline:
    - ◇ Claim is reported to cedant
    - ◇ Claim filters through cedant's report system to its reinsurance department
    - ◇ Claim travels through an intermediary before finding its way to the reinsurer
    - ◇ Claim appears in reinsurer's claim system
  - Serious claims tend to be under-reserved (i.e. modal reserving practices). This extends the reporting timeline since it takes a while for the claims to exceed the reinsurance threshold
  - Mass tort claims (i.e. asbestosis-related injuries) may have extreme delays in discovery or in reporting to the cedant
- ◇ **Problem 2: There is a persistent upward development of most claim reserves**
  - Caused by three things:
    - ◇ Economic and social inflation
    - ◇ Tendency of claims adjusters to reserve at modal values
    - ◇ Tendency to under-reserve ALAE
- ◇ **Problem 3: Claims reporting patterns differ greatly by reinsurance line, by type of contract, by specific contract terms, by cedant and possibly by intermediary**
  - Exposures assumed by reinsurers tend to be heterogeneous
  - This makes reserving difficult since traditional reserving methods require large volumes of homogeneous data
  - Even when reinsurers have large amounts of similar exposure, low frequency and lengthy report lags may cause extreme fluctuation in historical loss data

◇ **Problem 4: Because of the heterogeneity stated in Problem 3, industry statistics are not very useful**

- Every two years, the Reinsurance Association of America (RAA) publishes a summary of casualty excess reinsurance loss development statistics
- The heterogeneity of the exposure and reporting differences by company must be considered when using these statistics
- No two reinsurers have comparable Schedule P's because the Annual Statement does not properly categorize reinsurance exposures into homogeneous groups
- Most reinsurers' loss reserves are aggregated into one LOB (excess casualty)
- ISO loss development statistics by line are not applicable to reinsurance reserving without significant adjustments to the data. These adjustments may increase the indicated growth
    - ◇ For excess coverage, the lag in reserving or reporting claims grows with the attachment point
    - ◇ Primary company direct statistics do not reflect the additional delays noted in Problem 1

◇ **Problem 5: The reports the reinsurer receives may be lacking important information**

- Most proportional covers require only summary claims information
- Often data are reported by calendar or underwriting year instead of by accident year
- Even when there is individual claims reporting, information tends to be insufficient, requiring reinsurers to pursue more info from the cedant
- It's desirable to have a professional reinsurance claims staff (even when cedant is handling claims) to advise cedant's staff and possibly reduce ultimate payments
- In loss reserving, it's useful to have an exposure measure to compare loss estimates against (such as reinsurance premium by primary LOB)
    - ◇ On most contracts, losses are coded correctly by primary line
    - ◇ Reinsurance premium is assigned to LOB according to the percentage breakdown estimate made at the beginning of the contract. If percentages do not properly reflect loss exposure by primary LOB, comparisons between premiums and losses might be invalid

- For most treaties, there tends to be an added IBNR exposure for both premiums and losses

◇ **Problem 6: Because of the heterogeneity in coverage and reporting requirements, reinsurers often have data coding and IT systems problems**

- Business grows faster than the ability of reinsurers' data systems to handle and produce reports requested by marketing, underwriting, claims, accounting and actuarial staffs

◇ **Problem 7: The size of an adequate loss reserve compared to surplus is greater for a reinsurer**

- More of a management problem (rather than technical)
- Due to the issues described in Problems 1-6, many managers refuse to believe the magnitude of loss liabilities coming from the actuary (especially when IBNR has such a long tail)

◇ **U.S. Tax Reform Act of 1986**

- Requires the discounting of loss reserves for income tax purposes
- Now that insurers must discount loss reserves, they no longer have an implicit risk margin built into their loss reserve estimates
- This buffer flows into profits and is taxed sooner, decreasing assets and increasing companies' risk level

## II. Components of a Reinsurer's Loss Reserve

◇ **Component 1: Case reserves reported by the ceding companies**

- Reported on an individual claim basis (excess contracts) or in bulk summary form (proportional contracts)

◇ **Component 2: Reinsurer additional reserves on individual claims**

- Reinsurer reviews individual claims and specifies additional case reserves (ACR) if necessary

◇ **Component 3: Actuarial estimate of future development on components 1 and 2**

- Known as IBNER (Incurred but not enough reserved)

◇ **Component 4: Actuarial estimate of pure IBNR**

- Usually combined with component 3 due to limitations in data systems. Together, components 3 and 4 are known as IBNR

◇ **Component 5: Discount for future investment income**

- Companies can take credit for future investment income on assets supporting certain types of claims, such as WC permanent total cases, auto PIP annuity claims and medical professional liability claims

◇ **Component 6: Risk load**

- Adverse deviation loading is used to keep reserves at a conservative level
- Some actuaries load this in implicitly through conservative assumptions, while others account for it explicitly
- This component is more important for reinsurers due to the long-tailed nature of their exposure

## III. A General Procedure

◇ **Step 1: Partition the reinsurance portfolio into reasonably homogeneous exposure groups that are relatively consistent over time with respect to mix of business**

- Segregate contracts and loss exposure into categories of business (listed below in priority order) on the basis of loss development potential
  - ◇ LOB: property, casualty, etc.
  - ◇ Type of contract: facultative, treaty, finite
  - ◇ Type of reinsurance cover: quote share, surplus share, excess per-risk, excess per-occurrence, aggregate excess, cat, etc.
  - ◇ Primary LOB - for casualty
  - ◇ Attachment point - for casualty
  - ◇ Contract terms: flat-rated, retro-rated, sunset clause, share of loss adjustment expense, claims-made vs. occurrence coverage, etc.
  - ◇ Type of cedant: small, large or E&S (excess & surplus) company
  - ◇ Intermediary
- Not necessary to partition data into all eight categories mentioned above (credibility issue)

- Other notes on data partitioning:
  - ◇ Within each category above, the exposure should be further refined by contract type (treaty vs. facultative) and retention type (per-occurrence excess vs. aggregate excess)
  - ◇ Unique claim types (asbestos, pollution, etc.) should be separate
  - ◇ Treaty casualty excess exposure should be segregated by attachment point range and by primary LOB (since they have different report lags)
  - ◇ Treaty casualty proportional exposure should be similarly segregated (is the treaty share of ground-up exposure or share of excess?)
  - ◇ Facultative casualty exposure should be split between primary programs (ground-up exposure) and nonprimary programs (excess exposure)
- It's important to rely on the knowledge of underwriters and other staff members when determining the proper data partition

◇ **Step 2: Analyze the historical development patterns. If possible, consider individual case reserve development and the emergence of IBNR claims separately**

◇ **Step 3: Estimate the future development. If possible, estimate the bulk reserves for IBNER and pure IBNR separately**

- Due to the extreme variability in year-to-year reinsurance data, claim development patterns should be studied over long time periods, as long as the *expected* patterns are reasonably stable from year-to-year
- Since claim development studies are time-consuming, it's best to perform the analysis in the third or fourth quarter of the year (to construct models before the year-end time crunch)
- Once models are created, they can be applied to year-end and quarter-end claims and exposures to estimate IBNR

## IV. Claim Report and Payment Lags

◇ When analyzing reinsurance development patterns, it's useful to consider the inverse of the usual chain-ladder development factors. These are known as lags

◇ Lags can then be used to create a graph with time in years on the x-axis and the lag percentage on the y-axis

◇ This graph resembles a probability cdf and can be interpreted as the probability that any particular claims dollar will be reported to the reinsurer by time $t$

◇ Statistics can be calculated from this curve (such as expected value and standard deviation) to compare one claim pattern to another

## V. Methods for Short-Tailed Exposure Categories

◇ Any exposure for which losses are reported and settled quickly

◇ Consists of:

- Treaty property proportional
- Treaty property catastrophe
- Treaty property excess
- Facultative property

◇ Method 1: Set IBNR equal to some percentage of the latest-year EP

◇ Method 2: Reserve up to a selected loss ratio (especially for new LOBs), where the selected loss ratio is larger than the one computed from reported non-cat claims

◇ If losses are summarized by underwriting year, then percentage estimates should be used to allocate losses to true accident years to avoid overstating accident year loss development

## VI. Methods for Medium-Tailed Exposure Categories

◇ Any exposure for which claims are almost completely settled within five years and with average aggregate claims dollar report lag of one to two years

◇ Consists of:

- Treaty property excess higher layers (takes a long time to penetrate the layer)
- Construction risks (discovery period can be long)
- Surety (salvage recoveries tend to have long tail)

◇ Method 1: Standard chain-ladder (CL) method

- Advantage is that it strongly correlates future development with an overall lag pattern and with the claims reported for each accident year
- Disadvantage is that IBNR is so correlated with reported claims that estimates are not very credible for recent, immature years
- Possible to use paid losses rather than reported losses to increase stability, but that could backfire for immature years where very few losses have been paid

## VII. Methods for Long-Tailed Exposure Categories

◇ Any exposure for which the average aggregate claims dollar report lag is over two years and whose claims are not settled for many years

◇ Consists of:

- Treaty casualty excess (longest lags excluding asbestos, pollution, etc.)
- Treaty casualty proportional
- Asbestos, pollution, etc.

◇ First step is to separate these exposures into more homogeneous groups based on guidance from marketing, underwriting, claims and accounting personnel

◇ **Asbestos, pollution, other health hazard and other mass tort**

- Must be analyzed separately
- No claims for long time periods followed by gigantic claims
- Cannot use traditional reserving methods
- Must rely on complex reserving models

◇ Method 1: Standard chain-ladder method (not great for immature years)

◇ Method 2: Bornhuetter/Ferguson (BF) method

- Advantage is that it correlates future development for each year with an exposure measure (the reinsurance premium multiplied by a selected loss ratio)
- Disadvantages with the BF IBNR estimate include that it is dependent upon the selected loss ratio and that the estimate ignores reported claims for each accident year

◇ **Method 3: Stanard-Bühlmann (Cape Cod) method**

- **Key innovation of the SB method is that the ultimate expected loss ratio for all years combined is estimated from the overall reported claims experience, instead of being selected judgmentally, as in the BF method**
- A **disadvantage** of the SB method is that the IBNR by year is dependent upon rate-level adjusted premium
- Before moving on to the formulas, let's define a few terms:
  - ◇ $SBELR$ = SB estimate of the ELR
  - ◇ $SBIBNR(k)$ = SB IBNR estimate, year $k$
  - ◇ $RRL(k)$ = reported reinsurance loss, year $k$

- ◇ $ARPP(k)$ = adjusted risk pure premium, year $k$
- ◇ $Rlag(k)$ = aggregate claim dollar report lag, year $k$

- Using the terms above:

$$\boxed{\begin{aligned} SBELR &= \frac{\sum RRL(k)}{\sum[ARPP(k) \cdot Rlag(k)]} \\ SBIBNR(k) &= SBELR \cdot ARPP(k) \cdot (1 - Rlag(k)) \end{aligned}}$$

- The term $ARPP(k) \cdot Rlag(k)$ is also known as the "used-up premium" for year $k$
- Let's look at an example. Given the following as of December 31, 2014:

| AY | Earned Risk Pure Premium | Adjusted Premium | Aggregated Reported Loss | Aggregate Loss Report Lag |
|---|---|---|---|---|
| 2012 | 1000 | 1200 | 800 | 0.70 |
| 2013 | 1500 | 1800 | 500 | 0.40 |
| 2014 | 2000 | 2000 | 400 | 0.30 |

- First, calculate the used-up premium:

| AY | Adjusted Premium | Aggregate Loss Report Lag | Used-Up Premium |
|---|---|---|---|
| 2012 | 1200 | 0.70 | $840 = 1200(0.70)$ |
| 2013 | 1800 | 0.40 | 720 |
| 2014 | 2000 | 0.30 | 600 |

- Next, we calculate the SB ELR as follows:
  - ◇ SB ELR = reported losses / used-up premium $= (400 + 500 + 800)/(600 + 720 + 840) = 0.787$
- Calculate the SB IBNR:

| AY | Adjusted Premium | Aggregate Loss Report Lag | SB IBNR |
|---|---|---|---|
| 2012 | 1200 | 0.70 | $283.32 = 1200(0.787)(1-0.70)$ |
| 2013 | 1800 | 0.40 | 849.96 |
| 2014 | 2000 | 0.30 | 1101.80 |
| Total | | | **2235.08** |

◇ It's also worth mentioning that the SB ultimate losses for an AY are found by adding the SB IBNR to the reported losses to date. Then, we can divide the SB ultimate loss by the **earned risk pure premium** to calculate the final SB ultimate loss ratio

◇ **Method 4: Simple credibility IBNR estimate**

- When we don't have complete confidence in rate-level premium adjustments, we can weight the CL and SB methods together using a credibility factor
- Gives more weight to the SB estimate for immature years
- Gives more weight to the CL estimate for older years where the cumulative rate-level adjustments are less reliable
- Before moving on the formula, let's define a few terms:
  - ◇ Cred$IBNR(k)$ = credibility IBNR for year $k$
  - ◇ $CLIBNR(k) = CL$ IBNR for year $k$
  - ◇ $CF$ = credibility factor (between 0 and 1)
  - ◇ $Z(k) = CF \cdot Rlag(k)$
- Using the terms above:

$$\boxed{\text{Cred}IBNR(k) = Z(k) \cdot CLIBNR(k) + (1 - Z(k)) \cdot SBIBNR(k)}$$

- Given a credibility factor of 0.6, let's revisit our example from earlier:

| AY | Reported Losses | Aggregate Loss Report Lag | SB IBNR | CL IBNR | Cred IBNR |
|---|---|---|---|---|---|
| 2012 | 800 | 0.70 | 283.32 | 342.86 | 308.33 |
| 2013 | 500 | 0.40 | 849.96 | 750.00 | 825.97 |
| 2014 | 400 | 0.30 | 1101.80 | 933.33 | 1071.48 |
| Total | | | 2235.08 | 2026.19 | **2205.78** |

- Here are the calculations for AY 2012:
  - ◇ CL IBNR = $342.86 = \frac{800}{0.70} - 800$
  - ◇ Cred IBNR = $308.33 = 0.60(0.70)(342.86) + (1 - 0.60(0.70))(283.32)$

◇ Method 5: Other credibility procedures

- Weight together IBNR estimates based on reported claims and paid claims
  - ◇ Reported claims include case reserves that vary over time depending on the claims adjuster setting the reserve
  - ◇ Paid claims tend to be more stable, assuming you have sufficient data and believe the data to have a consistent expected payment pattern
  - ◇ Weights could be based on relative claim report and payment lags for each year

- Use the ELR inherent in the underlying pricing of the exposure in lieu of or in conjunction with the SB ELR
    - ◇ We call these *a priori* ELR estimates and can use them as our BF ELR estimates. These can then be used to calculate BF IBNR
    - ◇ Weight this *a priori* IBNR against the CL IBNR (Benktander Method)

◇ Method 6: Alternative estimation methodologies

- Stochastic reserving models
    - ◇ An advantage is that they give us more information and provide insight not available with traditional methods
    - ◇ A disadvantage is that they tend to be complicated and black boxish, making them difficult to interpret and explain to management
- Claim count/claim severity model
    - ◇ An advantage is that we can build models for various lag distributions, and then connect them with models for the dollar reserving and the payments on individual claims

## VIII. Monitoring and Testing Predictions

◇ Monitoring and testing quarterly claims run-off against predictions provides early warning of problems

◇ For short and medium-tailed lines, past AY run-off can be compared with previous year-end reported open reserves and IBNR reserves

◇ More sophistication required for long-tailed lines

◇ If more claims emerge than what was expected, what does it mean?

- Is it purely random?
- Does it indicate that the beginning IBNR was too small (or lags too short)? If our lags are too short (i.e. our reporting pattern is not long enough), then our beginning IBNR estimate will be too small (assuming we are running a chain-ladder method or any other method that relies on a reporting pattern to calculate IBNR)

◇ Continue to monitor claims each quarter to see if pattern persists. If so, we may need to lengthen the lags

## IX. Final Comments

◇ Differences between primary company loss reserving and reinsurance reserving:

- Less information
- Longer report and settlement timing delays
- Low frequency and high severity claims