# THE ESTIMATION OF LOSS DEVELOPMENT TAIL FACTORS: A SUMMARY REPORT

CAS Tail Factor Working Party

# Antitrust Notice

- The Casualty Actuarial Society is committed to adhering strictly to the letter and spirit of the antitrust laws. Seminars conducted under the auspices of the CAS are designed solely to provide a forum for the expression of various points of view on topics described in the programs or agendas for such meetings.
- Under no circumstances shall CAS seminars be used as a means for competing companies or firms to reach any understanding – expressed or implied – that restricts competition or in any way impairs the ability of members to exercise independent business judgment regarding matters affecting competition.
- It is the responsibility of all seminar participants to be aware of antitrust regulations, to prevent any written or verbal discussions that appear to violate these laws, and to adhere in every respect to the CAS antitrust compliance policy.

# Disclaimer

- While this paper is the product of a CAS Working Party, its findings do not represent the official view of the Casualty Actuarial Society. Moreover, while we believe the approaches we describe are very good examples of how to estimate tail development in reserving, ratemaking and selecting the best method for a given circumstance, we do not claim they are the only acceptable ones or that we have ultimately addressed all of the issues that must be considered in selecting a tail factor or tail factor methodology.

# Tail Factor Working Party

- Commissioned in 2004
- Bulk of the work appears to have been completed between 2005-2007…
- Paper presented to CASCOR for review in Fall of 2011
- Final review assigned in Fall of 2012
- Submitted for Publication Fall 2013

# Tail Factor Working Party Members (Past and Present)

- Steven C. Herman, co-chair
- Mark R. Shapland, co-chair
- Mohammed Q. Ashab
- Joseph A. Boor
- Anthony R. Bustillo
- David A. Clark
- Robert J. Foskey
- Ryan Royce

Aaron Halpert
Sejal Haria
Bertram A. Horowitz
Gloria A. Huberman
Richard Kollmar
Joshua Merck
Rasa V. McKean

Michael R. Murray
Bernard A. Pelletier
Susan R. Pino
Anthony J. Pipia
F. Douglas Ryan
Scott G. Sobel
Nancy Arico

# Tail Factor Working Party – Original Goals

- *The product* for this Working Party will be a paper which will
  - Survey existing literature
  - Identify additional methods in use
  - If needed, identify further areas that may need to be researched.
  - Product may provide examples of results using identified methods on industry data.
- *The purpose* is both to educate students and to help practitioners. It may become part of the syllabus and/or be included in a reserving textbook.

# Motivation

- Tail factors used to estimate additional development occurring
  - after the eldest maturity in a given loss development triangle, or
  - after the eldest credible link ratio.
- Over the years, many valuable contributions have been made to the CAS literature describing methods for calculating tail factors.
- However no overall paper compiling these contributions existed.

# Approach

- An extensive survey of existing CAS literature;
- Surveys of methods currently in use by various rating bureaus, insurers, and consulting organizations.

# Methods Presented

The methods identified by the Working Party are grouped into six basic categories:

- Bondy-Type Methods;
- Algebraic methods that focus on relationships between paid and incurred loss;
- Methods based on use of benchmark data;
- Curve Fitting methods;
- Methods Based on Remaining Open Counts;
- Methods Based on Peculiarities of the Remaining Open Claims; and
- Other Methods.

# Organization of the Paper

- Within each category:
  - General Introduction on types of methods in the category
  - Description of each Method
  - Examples
  - Advantages and Disadvantages
  - Users
  - Summary

# Formulae

- Standard Notation:
  - Consistency
  - Started with Notation from Reserve Variability Working Party
  - Added new notation where lacking
- Maybe different notation than found in the original literature

# Examples

- Obtained data from a number of different sources
  - Provide a comparison of results
  - Enhance discussion of each methods value and validity
- To the extent possible used a common set of data used throughout paper, examples and spreadsheet with some exceptions:
    - Methods previously detailed in CAS literature
    - Not appropriate for method
- Consistent actuarial judgment and assumptions
- Spreadsheet link will be available in the paper

# Bondy-Type Methods

- Bondy Method
  - Use last link ratio
- Modified Bondy Method
  - Double or square
- Generalized Bondy Method (Weller)
  - For $0<B<1$
- Fully Generalized Bondy Method (Gile)
  - Let Vary by Accident Year

# Bondy-Type Methods

- Advantages
  - Simple to implement
  - Pattern described with one factor
  - Uses both paid and incurred data
- Disadvantages
  - Not always useful for incurred data
  - Will fail with increasing development
  - May fail with “more complicated” patterns

# Algebraic Methods

- Equalizing Paid & Incurred Loss Estimates
  - Use cumulative incurred / cumulative paid
- Sherman-Boor Method
  - Adjust case reserves
- NCCI Method

# Algebraic Methods

- Advantages
  - Simple to implement
  - Only requires cumulative data
  - Statistically unbiased
- Disadvantages
  - May not be sophisticated enough
  - Subject to case reserve distortions
  - Some methods not generally well known

# Benchmark Methods

- Benchmark Tail Factors
- Adjusted Benchmark Development to Match Pre-Tail Link Ratios
- Benchmark Average Ultimate Severity
- Industry Booked Method
- Benchmark Adjusted for Company-Specific Case Reserving

# Benchmark Methods

- Advantages:
  - Supplement when data is sparse
  - Adds credibility
  - Various degrees of sophistication
- Disadvantages:
  - Assumes similar data
  - Claim handling procedures
  - Relative case reserve strength

# Curve Fitting Methods

- Exponential Decay
  - Constant Rate of Factor Decay
- McClenahan's Method
  - Constant Monthly Incremental Paid Decay
- Skurnick's Method
  - Simplify Using Annual Decay
- Sherman's Method
  - Uses "Inverse Power" Curves
- Pipia's Method
  - Uses Weibull curve
- England-Verrall Method
  - Smooth & Extrapolate Incremental Data

# Curve Fitting Methods

- Advantages:
  - Straightforward & intuitive
  - Extrapolate beyond end of data
  - Various levels of sophistication
- Disadvantages:
  - May underestimate tail for long-tail lines
  - Sub-optimal if pattern not consistent
  - Sometimes no closed form solution

# Methods Based on Remaining Open Claims

- Static Mortality Method
- Trended Mortality Method

# Methods Based on Remaining Open Claims

- Advantages:
  - Extrapolate "very-long" tail
  - Can include "increasing" factors
  - Detailed assumptions/some non-subjective
- Disadvantages:
  - More complex
  - Need "very old" data to parameterize
  - Need specific mortality rates

# Methods Based on Peculiarities of Remaining Open Claims

- Maximum Possible Loss
- Judgment Estimate Method

# Methods Based on Peculiarities of Remaining Open Claims

- Advantages:
  - Incorporates particulars of open claims
  - Uses knowledge of claim staff
  - Can provide bounds
- Disadvantages:
  - Requires access to individual claims
  - Subject to judgment/availability of auditors
  - May underestimate severe or IBNR/reopened claims

# Other Methods

- Restating Historical Experience Method
  - Adjust for Changes
- Mueller Incremental Tail Method
- Corro's Method
- Sherman-Diss Method

# RESULTS

Ten-period to ultimate (120 months) paid loss development tail for the methods using the common 10 year loss history shown in the appendix.

| Method | Indicated Paid Tail |
|---|---|
| Generalized Bondy Method | 1.025 |
| Fully Generalized Bondy Method | 1.043 |
| Sherman-Boor | 1.096 |
| Exponential Fit | |
| Using all Points | 1.032 |
| Using last 6 Points | 1.044 |
| McClenahan's Method | 1.055 |
| McClenahan's Adjusted Method | 1.040 |
| Sherman's Method | 1.137 |
| Sherman's Method with Lag Adjustment | 1.135 |
| Pipia's Method (Weibull Fit) Using all Factors | |
| Using all historical factors | 1.098 |
| Using selected development factors | 1.049 |

# Further Research

- Using simulated data wherein the ultimate values of the simulated data are also known.
  - Would provide a clearer sense of which methods work best based on the different types of data aberrations built into the simulations.
  - One key point is to create as many varying simulations as possible to properly test all methods.

# Tail Factor Working Party – Original Goals

- *The product* for this Working Party will be a paper which will
  - Survey existing literature
  - Identify additional methods in use
  - If needed, identify further areas that may need to be researched.
  - Product may provide examples of results using identified methods on industry data.
- *The purpose* is both to educate students and to help practitioners. It may become part of the syllabus and/or be included in a reserving textbook.