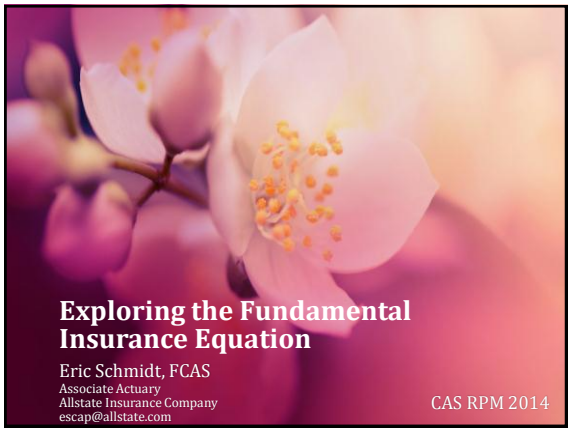

Exploring the Fundamental Insurance Equation

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CAS RPM 2014

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Fundamental Insurance Equation

- CAS Statement of Principle: "A rate provides for **all costs** associated with the transfer of risk."
- **Premium= Losses + LAE + UW Expenses + UW Profit**
- Key is to find appropriate balance
  - Ratemaking is prospective
  - Balance should be attained at the **aggregate** and individual levels

Two Methods to Determine Rate Level Adequacy

- Pure Premium Method

$$\text{Indicated Avg Rate} = \frac{\text{Pure Prem (including LAE)} + \text{Fixed UW Expense Per Exposure}}{1.0 - \text{Variable Expense \%} - \text{Target UW Profit \%}}$$

$$\text{Indicated Change} = \frac{\text{Indicated Avg Rate}}{\text{Projected Avg Premium @ Current Rate Level}}$$

- Loss Ratio Method

$$\text{Indicated Change} = \frac{\text{Loss\&LAE Ratio} + \text{Fixed Expense Ratio}}{1.0 - \text{Variable Expense \%} - \text{Target UW Profit \%}}$$

Pure Premium Vs. Loss Ratio

- When to use Pure Premium
  - Historical premium data is unreliable
  - New company
- When to use Loss Ratio
  - Historical exposure data is unreliable
  - Exposures are not well defined

Exposures

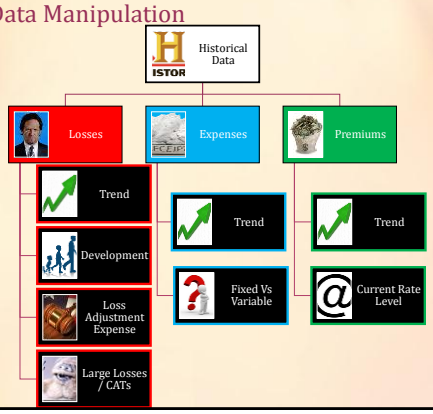
- Must be **P**roportional
  - Losses should be highly correlated with exposures
- Must be **P**ractical
  - Easy, Objective, and Inexpensive
- Must consider historical **P**recedence
  - Regulators and Transition Costs

Data Aggregation for Losses

- **Calendar Year**
  - Transactional
  - Fixed at year end
- **Accident Year**
  - Tied back to when accident occurs
  - Will develop over time
- **Policy Year**
  - Tied back to when policy was written
  - Will develop over time
- **Report Year**
  - Tied back to when accident was reported
  - Will develop over time

- Example
  - Policy written 11/1/10
  - Accident occurs 10/1/11
  - Accident reported 1/15/12
  - Payment of 10k on 2/1/12
  - Payment of 5k on 5/1/13

Data Manipulation



Trend

- Why?
  - To estimate future values in order to account for expected differences between the historical period and the period for which rates are being set
- How?
  - Identify trend amount
  - Identify trend period

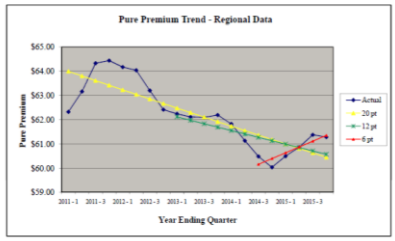
Trend Amount

Trend

Trend

Trend

State XX
Wicked Good Insurance Company
Private Passenger Auto: Property Damage Liability
Pure Premium Trend - Regional Data



Exponential Trend	
20 pt	-1.2%
12 pt	-0.9%
6 pt	1.6%

Selections*	
Current	0.5%
Projected	0.5%

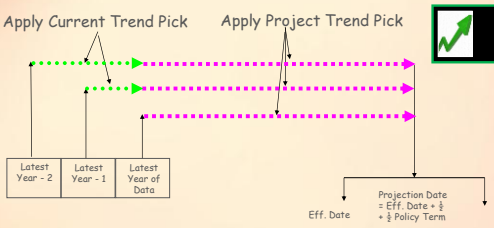
* Calculated Using Frequency and Severity Trend Selections

Trend Period

Trend

Trend

Trend



Development

Loss Development

- Why?
  - When using accident year data, ultimate losses are not known when evaluating historical losses. This must be accounted for or the rate level indication will be understated.
- How?
  - Construct a loss triangle
  - Select a method

Loss Triangles

Development

State XX
Wicked Good Insurance Company
Private Passenger Auto: Property Damage Liability
Loss Development

Reported Losses and Paid ALAE Evaluated As Of

Accident Year	15 Months	27 Months	39 Months	51 Months	63 Months
2009	705,088	725,592	738,686	753,027	752,239
2010	712,475	753,295	782,248	800,258	813,949
2011	714,196	763,913	835,150	874,106	856,495
2012	764,101	861,114	884,498	867,184	
2013	774,384	846,167	835,120		
2014	785,068	821,509			
2015	797,866				

Age-to-Age Factors	15-27	27-39	39-51	51-63	63-Ult
2009	1.0291	1.0180	1.0194	0.9724	
2010	1.0573	1.0384	1.0230	1.0171	
2011	1.0696	1.1194	1.0222	0.9799	
2012	1.1270	1.0272	0.9804		
2013	1.0927	0.9869			
2014	1.0464				
(1) All-Year Average	1.0704	1.0380	1.0113	0.9898	
(2) 3-Year Average	1.0887	1.0445	1.0085	0.9898	
(3) 4-Year Average	1.0839	1.0430	1.0113		
(4) Average Excluding Hi-Lo	1.0665	1.0379	1.0208	0.9799	
(5) Geometric Average	1.0699	1.0371	1.0111	0.9896	
(6) Selected Age-to-Age	1.0665	1.0379	1.0208	0.9799	1.0000
(7) Age-to-Ultimate	1.0966	1.0282	1.0003	0.9799	1.0000

(1) Straight Average
(2) Straight Average
(3) Straight Average
(4) Straight Average Excluding Highest and Lowest Values
(5) = (Product of Age-to-Age Factors) ^ (1.0 / Number of Age-to-Age Factors)
(7) = Cumulative Product of (6)

Development

Loss Development Methods

- Each method makes assumptions about the nature of loss development.
- Each method makes assumptions about future loss development based on past loss development.
- The appropriateness of those assumptions influences the accuracy of the method. Therefore, the best method depends on the situation at hand.
- Common Methods include:
  - Chain Ladder Method
  - Bornhuetter-Ferguson
  - Berquist-Sherman
  - Regression

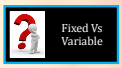
Loss Adjustment Expense

Loss Adjustment Expenses

- Costs incurred by a company during the claim settlement process.
- Two types
  - Allocated Loss Adjustment Expense (ALAE)
    - Costs that can easily be related to individual claims
    - Typically included with loss
  - Unallocated Loss Adjustment Expense (ULAE)
    - Costs that are more difficult to assign to particular claims
    - Must determine proper allocation method for ratemaking

Large Losses / Catastrophes

- Large individual losses and catastrophes can add unwanted volatility
- General approach to ratemaking:
  - 1) Remove either a portion, or all large loss and/or catastrophes
  - 2) Replace with a more stable alternative, typically:
    - A) Average over a longer time period
    - B) In case of some types of catastrophes, a model
- We do this to optimize the credibility and relevancy of the data

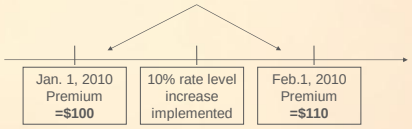


Expense Types

- 4 Expense Types
  - Commissions and Brokerage
  - Taxes, Licenses, and Fees
  - Other Acquisitions
  - General Expense
- General approach to ratemaking
  - 1) Calculate ratios of expenses to premium using historical data
  - 2) Determine what % of each expense type is fixed and variable
  - 3) Apply total fixed and variable expenses appropriately

Current Rate Level Adjustment

- Why bring premiums to current rate level?
  - To measure the adequacy of current premiums projected to the period for which rates will be in effect.



- Without this adjustment, premium trends could be severely distorted.

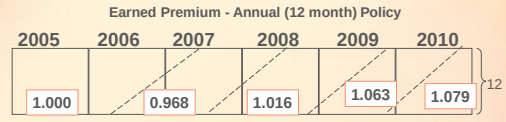
Current Rate Level

Current Rate Level Methods

- 2 Methods to choose from
  - Extension of Exposures
    - Re-rate all historical policies using current rating structure
    - The most accurate method
  - Parallelogram Method
    - Assumes policies are written uniformly across time
    - Applies an average factor to historical periods
- Choice of method will depend on data restraints and accuracy thresholds

Current Rate Level

Parallelogram Method



Renewal Process	4/15/06	7/16/07	11/15/08	12/02/09
Renewal Effective	5/15/06	8/15/07	12/15/08	1/1/10

Rate Change History

Renewal Process	Percent Change	Renewal Effective	Rate Level
4/15/06	-3.2	5/15/06	0.968
7/16/07	5.0	8/15/07	1.016
11/15/08	4.6	12/15/08	1.063
12/02/09	1.5	1/1/10	1.079

Profit Provision

- 2 sources of profit
  - Investment Income (Capital + Policyholder Supplied Funds)
  - Underwriting Profit
- Calculate Underwriting Profit that achieves a target Rate of Return on Equity
- For some long-tailed lines, investment income is large enough to accept an underwriting loss!

Credibility

- Where can credibility be used?
  - Overall indication
  - An individual loss estimate
  - Loss trends
  - Large Loss / CAT provisions
- How?
  - Choose a method
  - Choose a complement of credibility

Credibility Methods

- **Classical Credibility** (a.k.a Limited Fluctuation) – goal is to limit the effects that random fluctuations in the data can have on an estimate
- **Buhlmann Credibility** (a.k.a. Least Squares Credibility) – goal is to make estimation errors as small as possible (minimize the squared error)
- Credibility weighted estimate is calculated as

  Z * (Observed Estimate) + (1-Z) * (Complement)

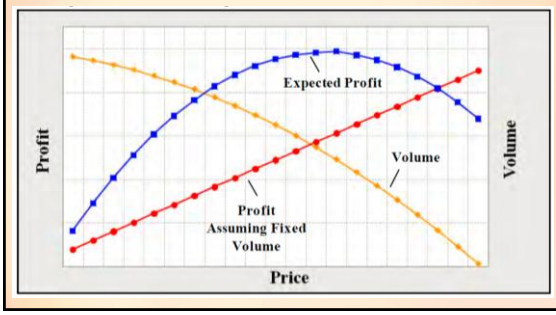
Compliment of Credibility

- Desired traits
  - 1) Accurate
  - 2) Unbiased
  - 3) Statistically independent from the base statistic
  - 4) Available
  - 5) Easy to compute
  - 6) Logical relationship to base statistic
- Examples include other lines of business, countrywide data, industry data, or other competitor information to name a few.

Acting on Rate Indications

- Considerations
  - Regulatory
    - Some states impose certain methodologies and restrictions that need to be considered
    - Profit provisions are also capped in certain states
  - Operational
    - A small rate increase in a small book of business may not be efficient to pursue
  - Marketing
    - Acting on rate indications has desired and undesired consequences that must be balanced

Acting on Rate Indications



Questions

- ???