Educational Workshop – Pricing
ASTIN Panama 2017

Christopher Cooksey, FCAS, MAAA
Head Actuary, Data & Analytics

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Determining Premiums

How might you determine a fair price for a given risk?

1. *Wisdom and judgment*

2. *Examine that risk’s experience over time*

3. *Examine the experience of similar risks*
Determining Premiums

The task of determining premiums for our customers is typically broken into two pieces –

**Overall rate adequacy and Rate relativities**

Finding the overall rate level separately allows for:

1. Using all of your experience
2. Using overall trends and loss development

Building relativity models to assign different rate levels allows for:

1. Dealing with the multivariate nature of the problem
2. Ignoring trends and loss development (?!?)
Determining “Premiums”

The rules that determine premiums...

Rates
Tariffs
Price list
Rate book
Rating plan

Context is everything.

Understand the ideas and you can figure out what your equivalent words are.
Agenda

Data

Data Sources
- Exposures
- Time Periods

Metrics
- Reasonability
- Verification

Rate Adequacy

Basic Premium Equation
- Current Leveling

Development
- Trending

Model Design – Axel Wolfstein
Special Thanks

While many of these slides are original, many are based off of Axel’s initial draft.

Also, many of the slides on Rate Adequacy were adapted from Patrick Stapleton’s slides for the Casualty Actuarial Society’s Basic Ratemaking Webinar.

(All errors are mine!)
Data Sources

Understanding the source of the data is critical.

• What does a single row represent?

• Is there metadata to describe the meaning of the information in each column?

• How is the data collected? Where does it come from?

• For what purpose was the data collected?

• What is the cost of the data?

• How recent is the data? How is it structured to represent time?
Data Sources

Internal data sources

• Policy administration systems, claims systems, billing systems

• Raw data, or has an extract already been created?

• “Level” of the data? Policy, vehicle, unit, location, risk…

• Remember the cost. You don’t explicitly purchase this data, but it requires resources to collect, maintain, store, etc.

• Often includes customer data, policy data, billing data, insured risk information, claims data, and renewal information.
Data Sources

External data sources

• Collected and compiled by someone else. Why?
  o For the purpose of selling to insurers for them to use?
  o For some unrelated purpose, but there may be value to insurers?

• How will this data connect to your internal data?

• Often an explicit cost to purchase. However “free” data still has a cost to collect, transform, maintain and store.

• Can include pooled insurance data, governmental data, customer behavior data (Internet!), etc.
Exposures

How do we count how much data we have? Number of records?

The problem with number of records is that insurance has transactions...

• One policy insured for a year, with no changes, may generate one record.
• One policy insured for a year, with two changes, may generate three records.
• One policy insured for half a year because the customer canceled may generate only one record.
We define the concept of “exposure” to give a weight to the extent to which the insurer is exposed to risk.

Exposures can be defined many ways and depends on the line of business and the coverage being offered.

• Time insured
  o one policy insured for one year is one earned policy year;
  o one vehicle insured for one year is one earned vehicle year; etc.

• Insured amount – sum the limits chosen; sometimes used when a single policy encompasses multiple properties or multiple coverages (i.e. building and contents).

• Commercial insurance can be quite varied – insured amount, payroll, number of seats in the restaurant, etc.
Exposures

A good exposure metric does two things:

1. Captures the amount of time the insurer is exposed to the risk

2. Scales with the level of the risks

Note that goal 2 is somewhat redundant with the rest of the calculation of the premium.

For example, if insured amount is your exposure basis, you need to think carefully about having a Limit relativity.
Portfolio size

Quantifying the size of your book of business can be done in several different ways.

• Total earned or written exposures
• Total earned or written premium
• Policy count

Note the difference between earned metrics and point-in-time metrics...
Portfolio size

Be wary of the subtleties

• Premium is written or earned?
• Net of reinsurance? Ceded? Retained?
• Excluding company cancels?
• Do different parts of the book use different exposure bases?
• Level of the data?
• Inter-country, country, intra-country? Companies? Coverages? Lines?

What you want to look at depends on what you are trying to do.
Time Periods – mapping policies and claims

And speaking of subtleties, we need to pay attention to how we account for time.

- Calendar Year
- Accident Year
- Reported Year
- Policy Year

To understand the differences, consider how each treats the accumulation of premiums/exposures and losses.
Time Periods – mapping policies and claims

And speaking of subtleties, we need to pay attention to how we account for time.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cal Year Earn Prem</th>
<th>Cal Year Paid Loss</th>
<th>Acc Year Earn Prem</th>
<th>Acc Year Paid Loss</th>
<th>Rep Year Earn Prem</th>
<th>Rep Year Paid Loss</th>
<th>Pol Year Earn Prem</th>
<th>Pol Year Paid Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>€167</td>
<td>€167</td>
<td></td>
<td></td>
<td>€167</td>
<td></td>
<td>€1000</td>
<td>€15000</td>
</tr>
<tr>
<td>2015</td>
<td>€833</td>
<td>€833</td>
<td>€15000</td>
<td></td>
<td>€833</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>€10000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>€15000</td>
</tr>
<tr>
<td>2017</td>
<td>€5000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Time Periods – mapping policies and claims

Who uses Calendar Year?

Accounting, Executives – it simply shows what happened and when it actually happened.

Calendar Year is not useful for most actuarial purposes.

You could assume losses from prior policies are the same as current, but...

- Doesn’t work for growing or shrinking books
- Assumes IBNR at end of each year is constant
- Ignores real changes in risk levels
- Ignores inflation of claim costs
- Ignores changes in claims handling practices
- Ignores changes in the rate levels
- Obscures any patterns in claims development
- Ignores changes in the regulatory environment
- Ignores shifts in the mix of business
- Ignores changes
- Ignores rate levels
- Ignores shifts in the mix of business
Who uses Accident Year?

Actuaries, mostly – reasonably ties losses to policies

Using Accident Year you can calculate loss ratios for the year to measure rate adequacy. (This assumes *premiums* earned from prior policies are the same as current, but this is much more regular than losses.)

Accident Year also allows you to identify regular patterns in how losses develop over time. We’ll use this to predict the future.
Metrics

From the basic metrics of exposures, premium, claim counts and claim amounts we derive other metrics.

- Frequency = claim counts / earned exposure
- Severity = claim amounts / claim counts
- Burning Cost = claim amounts / earned exposure
- Loss Ratio = claim amounts / earned premium
- Average Premium = earned premium / earned exposure
A bit more on Burning Cost...

Burning Cost  = claim amounts / earned exposure

It is also called Loss Cost. This formulation looks at the average losses generated by an insured risk (exposure).

Pure Premium is the same thing. The name highlights that we are talking about the portion of premium that covers losses.

Burning Cost, Loss Cost, and Pure Premium are often used somewhat interchangeably.
Reasonability

Information that we collect as data needs to be useful, reasonable, and cost-efficient.

- **Expense** – collecting, storing and using data costs resources. Lower cost is better.
- **Constancy** – data collected shouldn’t be too changeable.
- **Manipulation** – data should be objective and not manipulated by customers or agents.
- **Measurability** – data should be conveniently and reliably measured.
- **Public Acceptability** – sometimes society decides data can’t be used.
- **Representative** – data should be relevant to the insured risk.
- **Completeness** – need to have values on sufficient records.
Reasonability

Information that we collect as data needs to be useful, reasonable, and cost-efficient.

- **Expense** – model year *versus* black-box mileage.
- **Constancy** – property location *versus* credit score.
- **Manipulation** – black-box mileage *versus* self-declared mileage.
- **Measurability** – age of roof *versus* color of property.
- **Public Acceptability** – insured age *versus* insured religion.
- **Representative** – age of roof *versus* color of property.
- **Completeness** – credit *versus* social media usage.
Verification

Data should be checked, should be verified that it is correct, before being used.

- Data sources, the labeling and meaning of fields, transformations used...all this should be documented. (Example – does the multi-vehicle discount indicated match the vehicle count?)

- How the data was checked, changes over time, incompleteness or inconsistency...all this should be documented as well.
Verification

Checks on data can include, but are not limited to:

• Examine extreme values. Are the lows and high reasonable?
• Are the attribute values expected/allowed?
• Histograms or box-plots to check value distributions.
• Consistency in the distributions with prior years.
• Q-Q plots to check against theoretical distributions.
• Investigation and possible removal of outliers.
• Appropriate classification of categorical and numerical fields.
Verification

Checks on data can include, but are not limited to:

• Completeness of data. How many zero values? How many missing values? Do missing values mean anything?

• Identification of fields not used during the entire experience period.

• Do total premium, exposure, loss and claim count values look reasonable?

• Are frequency, severity and other metrics reasonable?

This takes time, but is better than making decisions on bad data.
Rate Adequacy
Purpose of an Indication

An indicated rate (or indication) is calculated to be the rate level needed such that expected future premiums cover expected future losses and expenses, while allowing for a targeted underwriting profit.

The key word here is “future”.

Note that the purpose is NOT to recoup losses paid out in the past.
Fundamental Insurance Equation

CAS Statement of Principle: “A rate provides for all costs associated with the transfer of risk.”

Premium = Losses

\[
\text{Loss Adjustment Expenses (LAE)}
\]

\[
\text{UW Expenses}
\]

\[
\text{UW Profit}
\]
Fundamental Insurance Equation

Pure Premium Method

Indicated Premium Per Exposure = \( \frac{\text{Loss}&\text{LAE per Exp} + \text{Fixed UW Expense per Exp}}{1 - \text{Variable Expense} \% - \text{Target UW Profit} \%} \)

Indicated Rate Change = \( \frac{\text{Indicated Premium Per Exposure}}{\text{Projected Average Premium}} \)

In this method, find the required premium that would be adequate to cover all expenses and then compare to premium that would be collected if no change were made.
Fundamental Insurance Equation

Loss Ratio Method

\[
\text{Indicated Rate Change} = \frac{\text{Loss (\& LAE) Ratio} + \text{Fixed UW Expense per Premium}}{1 - \text{Variable Expense \%} - \text{Target UW Profit \%}}
\]

In this method, we don’t calculate the required premium but calculate the required change directly.

All these calculations are done for the future period during which the rates will be in effect.
Fundamental Insurance Equation

Pure Premium & Loss Ratio Methods – Equivalency

\[
\text{Indicated Premium Per Exposure} = \frac{\text{Loss}&\text{LAE per Exp} + \text{Fixed UW Expense per Exp}}{1 - \text{Variable Expense} \% - \text{Target UW Profit} \%}
\]

\[
\text{Indicated Premium} = \frac{\text{Loss}&\text{LAE} + \text{Fixed UW Expense}}{1 - \text{Variable Expense} \% - \text{Target UW Profit} \%}
\]

\[
\text{Indicated Rate Change} = \frac{\text{Indicated Premium}}{\text{Projected Premium}}
\]

\[
\text{Indicated Rate Change} = \frac{\text{Loss (}&\text{LAE) Ratio} + \text{Fixed UW Expense per Premium}}{1 - \text{Variable Expense} \% - \text{Target UW Profit} \%}
\]
Determining Rate Level Adequacy

Pure Premium & Loss Ratio Methods

Pure Premium is a good method when...

- Historical premium data is unreliable
- Finding a rate for a new product, new company, etc.

Loss Ratio is a good method when...

- Historical exposure data is unreliable
- Exposures are not consistently or well defined

If we expect no other rate changes for one year, what is the full length of time these rates will be in effect?

Remembering that the data we have to analyze is historical, it needs to be adjusted for this future time period.
Adjusting the Data

Trends apply to each piece of our indication.

But losses, expenses and premiums require different adjustments according to their nature.
Adjusting the Data

Note what is not included in the adjustments – any projection of what customers we will actually write in the future.

From our historical data we know what our customers were actually charged and the losses they actually generated.

The question is then, what if those customers were written in the future period? What losses and expenses would they generate, and what would be an adequate premium?

(This is a good question to ask, but it is a separate question that will be addressed separately.)
Pure Premium Indication - Example

The math is simple; the work is in the adjustments and the accumulation of each necessary piece of information.

<table>
<thead>
<tr>
<th></th>
<th>Indicated Provision for Loss and Loss Adjustment Expense</th>
<th>$117.48</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Indicated Provision for Fixed Expense</td>
<td>$15.46</td>
</tr>
<tr>
<td>3</td>
<td>Variable Expense and Profit Ratio</td>
<td>28.7%</td>
</tr>
<tr>
<td>4</td>
<td>Indicated Average Premium: [(1) + (2)] / [1 – (3)]</td>
<td>$186.45</td>
</tr>
<tr>
<td>5</td>
<td>Projected Average Premium (current rates)</td>
<td>$160.51</td>
</tr>
<tr>
<td>6</td>
<td>Indicated Rate Change: [(4) / (5) – 1]</td>
<td>16.2%</td>
</tr>
</tbody>
</table>

“In order to cover our future losses and expenses, and achieve our desired profit, we need to increase our current premium 16.2%”
Pure Premium Indication – Future Loss & LAE

How much do we expect to pay for future losses?

|   | Indicated Provision for Loss and Loss Adjustment Expense | $117.48 |

Expenses that are a result of handling claims are sometimes included with losses – Loss Adjustment Expenses (LAE).

- Allocated Loss Adjustments Expenses (ALAE) – expenses that can be tied to a particular claim.
- Unallocated Loss Adjustment Expenses (ULAE) – claims handling expenses not tied to a particular claim.
Pure Premium Indication – Future Loss & LAE

How much do we expect to pay for future losses?

<table>
<thead>
<tr>
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<th>Indicated Provision for Loss and Loss Adjustment Expense</th>
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The historical losses generated by our customers will differ in the future for two reasons:

1. **Development**: Historical losses are not necessarily fully developed and don’t yet represent the full losses those customers will generate.

2. **Trend**: Historical losses took place in the past where costs for materials, services, medical care, etc. were different.
The goal with Loss Development is to estimate the ultimate value of the claims.

Losses develop for two reasons:

1. Until a claim is closed we have incomplete information.
   - Relying on paid amounts is clearly incomplete as more payments may be made.
   - Incurred loss (Paid + Reserves) is a metric which attempts to represent the ultimate value of the claim, but as we gain more information, things can change.

2. Even if all our claims were closed, things can still change.
   - IBNR – Incurred but not reported claims are real
   - Even closed claims can re-open
There are two broad approaches for estimating ultimate losses, each with a variety of methods and techniques. The appropriateness of the methods depend on the situation.

One approach uses historical payment patterns to project the losses to ultimate.

<table>
<thead>
<tr>
<th>Chain ladder method</th>
<th>Expected Loss Ratio (ELR) method – a priori Loss Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression – linear or exponential (curve fitting)</td>
<td>Berquist-Sherman – adjustments for reserving/payment patterns</td>
</tr>
<tr>
<td>Stochastic methods</td>
<td>Bornhuetter-Ferguson – a blending of actual and expected</td>
</tr>
</tbody>
</table>

Another approach uses claim and policy characteristics to predict ultimate loss.
The estimated ultimate loss for accident year 2015 is 3,833,388.

3,612,634 * 1.03 * 1.02 * 1.01 * 1.00 * 1.00 * 1.00
Many factors, internal and external, impact loss development:

• Type of coverage/claim – injury claims take much longer to develop than property claims; IBNR differs by claim type.

• Books that are growing or shrinking impact the development.

• Regulatory, competitive and/or environmental changes can mean the future will develop differently than the past.

• Changes in your mix of business impacts your mix of claims.

• Changes in claims settlement or reserving practices.

• Changes in technology can impact claims handling and experience.
Adjusting Losses – Loss Development

Different claim types, different development patterns
Adjusting Losses – Trend

Applying trend factors to losses is the easy part. Just keep the timeline in mind.

We could just trend losses to the future directly...
Adjusting Losses – Trend

It is more common to divide the trend period into what has already happened (retrospective) and what is yet to happen (prospective).
Adjusting Losses – Trend

Retrospective trends are much easier to select; prospective trends are much more uncertain.

Retrospectively, there’s clearly been a downward trend.

What will happen in the future?
Adjusting Losses – Trend

Your perspective depends on the timeframe you focus on. Fitting an exponential, the 20-point trend is clearly downward, but the 6-point trend is upward.

20-point Trend:  -1.2%
6-point Trend:  +1.6%

Much of trend selection depends on judgment.
Adjusting Losses – Trend

To reduce the amount of guesswork in trend selections...

• Break it up into components that are easier to think about and explain. Always look at frequency and severity trends.

• Identify mix of business changes which will drive future trends.

• Combine multiple sources of data – country, regional, etc. Agreement in the general trends provides context for the selections.

• Changes in the legal, regulatory, and competitive environments can justify trend selections that do not reflect the history.

• Changes in technology can also change future trends.
Adjusting Losses – Large Losses/Catastrophes

Loss development relies on consistent patterns, and trending assumes that applying the trend factor is appropriate.

• **Large Losses** – Individual claims which are unlike the vast majority of other claims.
  - Claims that have been open for many years (or decades), or
  - Claims that have already exceeded policy limits.

• **Catastrophes** – Individual events which are infrequent, but which cause high total losses and are often very local in their impact. Hail storms, earthquakes, etc.
Adjusting Losses – Large Losses

Losses have a distribution, and large losses don’t “fit”.

Are these losses really part of this distribution of losses, or are they exceptions?
### Adjusting Losses – Large Losses

Large losses are often capped rather than removed.

<table>
<thead>
<tr>
<th>Capping Amount</th>
<th>Excess Losses</th>
<th>Loss Elimination Ratio (LER)</th>
<th>% of Capped Claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncapped</td>
<td>€ 0</td>
<td>0,0%</td>
<td>0,0%</td>
</tr>
<tr>
<td>€ 1.000.000</td>
<td>€ 42.328.956</td>
<td>5,7%</td>
<td>0,2%</td>
</tr>
<tr>
<td>€ 750.000</td>
<td>€ 56.764.448</td>
<td>7,6%</td>
<td>0,3%</td>
</tr>
<tr>
<td>€ 500.000</td>
<td>€ 82.589.791</td>
<td>11,1%</td>
<td>0,6%</td>
</tr>
<tr>
<td>€ 400.000</td>
<td>€ 101.245.912</td>
<td>13,6%</td>
<td>1,0%</td>
</tr>
<tr>
<td>€ 300.000</td>
<td>€ 132.585.577</td>
<td>17,8%</td>
<td>1,6%</td>
</tr>
<tr>
<td>€ 200.000</td>
<td>€ 189.585.577</td>
<td>25,4%</td>
<td>3,2%</td>
</tr>
</tbody>
</table>

Correct cap amount? We are just trying to remove volatility in losses.

Tschebychev inequality, coefficient of variation, distribution fits, etc.
Adjusting Losses – Large Losses

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<td>25,4%</td>
<td>3,2%</td>
</tr>
</tbody>
</table>

Tschebychev inequality: \[ P(|X - \mu| \geq k\sigma) \leq \frac{1}{k^2} \]

(Rough, but robust – Wolfstein)
Adjusting Losses – Catastrophes

Catastrophe claims are generally removed and replaced with a modeled estimate or a long term average.

<table>
<thead>
<tr>
<th>Calendar year</th>
<th>Total incurred losses</th>
<th>Catastrophe losses</th>
<th>Incurred losses ex- catastrophes</th>
<th>Catastrophe losses Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>$2,062,835</td>
<td>$283,155</td>
<td>$1,779,680</td>
<td>15.9%</td>
</tr>
<tr>
<td>1992</td>
<td>1,967,170</td>
<td>50,023</td>
<td>1,917,147</td>
<td>2.6%</td>
</tr>
<tr>
<td>1993</td>
<td>2,084,698</td>
<td>14,710</td>
<td>2,069,988</td>
<td>0.7%</td>
</tr>
<tr>
<td>1994</td>
<td>3,179,286</td>
<td>932,774</td>
<td>2,246,512</td>
<td>41.5%</td>
</tr>
<tr>
<td>1995</td>
<td>2,737,399</td>
<td>169,844</td>
<td>2,567,555</td>
<td>6.6%</td>
</tr>
<tr>
<td>1996</td>
<td>3,320,365</td>
<td>82,416</td>
<td>3,237,949</td>
<td>2.5%</td>
</tr>
<tr>
<td>2013</td>
<td>13,064,311</td>
<td>6,233,048</td>
<td>6,831,263</td>
<td>91.2%</td>
</tr>
<tr>
<td>2014</td>
<td>7,583,256</td>
<td>1,216,266</td>
<td>6,366,990</td>
<td>19.1%</td>
</tr>
<tr>
<td>2015</td>
<td>8,468,534</td>
<td>1,157,517</td>
<td>7,311,017</td>
<td>15.8%</td>
</tr>
<tr>
<td>25-year aggregate average</td>
<td>$21,391,353</td>
<td>$120,831,928</td>
<td>17.7%</td>
<td></td>
</tr>
</tbody>
</table>

Note that large losses and Cats often need different treatments for different segments.
## Pure Premium Indication – Future Loss & LAE

### How much do we expect to pay for future losses?

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>Earned Exposures</th>
<th>Accident Year non-catastrophe ultimate loss</th>
<th>Average catastrophe factor</th>
<th>Accident year ultimate loss</th>
<th>Ultimate Loss and LAE</th>
<th>Loss Trend Factor</th>
<th>Projected ultimate loss and LAE</th>
<th>Projected average loss and LAE</th>
<th>Year weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>31,619</td>
<td>$3,020,592</td>
<td>0.177</td>
<td>$3,555,237</td>
<td>$4,099,188</td>
<td>1.040</td>
<td>$4,263,156</td>
<td>$134.83</td>
<td>14%</td>
</tr>
<tr>
<td>2014</td>
<td>37,813</td>
<td>2,594,664</td>
<td>0.177</td>
<td>3,053,920</td>
<td>3,521,170</td>
<td>1.040</td>
<td>3,662,017</td>
<td>96.85</td>
<td>43%</td>
</tr>
<tr>
<td>2015</td>
<td>40,847</td>
<td>3,833,388</td>
<td>0.177</td>
<td>4,511,898</td>
<td>5,202,218</td>
<td>1.040</td>
<td>5,410,307</td>
<td>132.45</td>
<td>43%</td>
</tr>
</tbody>
</table>

Indicated Provision for Loss & LAE | $117.48

This is just an example. There are many variations and refinements.
Premiums must be large enough to pay for more than losses. It costs money to run an insurance company (expenses).

Expenses include: commissions & brokerage; taxes, licenses & fees; other acquisition costs; and general expenses.

Fixed & variable are with respect to the premium on a given policy.

- Acquisition costs (e.g. marketing) are the same for all policies.
- Commission expenses are larger for larger policies.

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Indicated Provision for Fixed Expense</td>
<td>$15.46</td>
</tr>
<tr>
<td>3</td>
<td>Variable Expense and Profit Ratio</td>
<td>28.7%</td>
</tr>
</tbody>
</table>
Pure Premium Indication – Expenses and Profit

Premiums must be large enough to pay for more than losses. Investors expect a return on their investment.

<table>
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Actual profit includes two components which must combine for the targeted return on investment.

- Underwriting Profit is the money left after all losses and expenses have been paid on a policy. *The Profit Ratio here is UW Profit.*
- Investment Income comes from the time delay between receiving premium and paying losses.
Pure Premium Indication – Required Premium

With the components determined for the future state, we find the premium required to cover losses and expenses, while still providing an adequate return.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>Indicated Provision for Loss and Loss Adjustment Expense</th>
<th>$117.48</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>Indicated Provision for Fixed Expense</td>
<td>$15.46</td>
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<tr>
<td></td>
<td>3</td>
<td>Variable Expense and Profit Ratio</td>
<td>28.7%</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Indicated Average Premium: ( \frac{(1) + (2)}{1 - (3)} )</td>
<td>$186.45</td>
</tr>
</tbody>
</table>

\[
Indicated \ Rate \ Per \ Exposure = \frac{Loss&LAE \ per \ Exp + Fixed \ UW \ Expense \ per \ Exp}{1 - Variable \ Expense \% - Target \ UW \ Profit \%}
\]
Pure Premium Indication – Projected Premium

What premium per exposure would be achieved if no change in rate level is made?

| 5 | Projected Average Premium (current rates) | $160.51 |

The historical premiums generated by our customers will differ in the future for two reasons:

1. **Prior Rate Changes**: Since our experience period spans several older years, rates have likely changed.

2. **Trend**: Similar to losses, premiums can trend over time. The trending is typically due to natural changes in the mix of business.
Historical premiums need to be brought to current levels for two reasons:

- We don’t want to project into the future prior rate inadequacies that have already been addressed.
- We want premium trends to reflect drifts in premium, not taken rate changes.

There are two basic approaches for current leveling, an aggregate approach (parallelogram method) and a record-by-record approach (extension of exposures, or rerating).
Adjusting Premium – Rerated Premium

With extension of exposures, also called rerating, premiums for the records from the historical period are literally recalculated using the current rating algorithm.

This method is the most exact, but it is expensive – both computationally and in setting up a system capable of this.

However, being able to rate premiums at any chosen rate level has many applications.
Adjusting Premium – Current Level Factors

Parallelogram Method

<table>
<thead>
<tr>
<th>Year</th>
<th>Rate Level</th>
<th>Portion</th>
<th>Average Rate Level</th>
<th>Current Level Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>1.000</td>
<td>75.00%</td>
<td>1.005</td>
<td>1.012</td>
</tr>
<tr>
<td></td>
<td>1.021</td>
<td>25.00%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>1.021</td>
<td>93.75%</td>
<td>1.022</td>
<td>0.995</td>
</tr>
<tr>
<td></td>
<td>1.037</td>
<td>6.25%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>1.021</td>
<td>6.25%</td>
<td>1.036</td>
<td>0.982</td>
</tr>
<tr>
<td></td>
<td>1.037</td>
<td>93.75%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>1.017</td>
<td>na</td>
<td>1.017</td>
<td>Na</td>
</tr>
</tbody>
</table>

Obviously, this method is approximate. It relies heavily on an assumption of even writings over time. It does provide a good, high level check for rerating.
The math is simple; the work is in the adjustments and the accumulation of each necessary piece of information.

"In order to cover our future losses and expenses, and achieve our desired profit, we need to increase our current premium 16.2%"
Acting on Indications

The indication tells us what the data says about adequate rates. What we actually do can be different for various reasons.

- **Regulatory/Legal** – some environments provide limitations on trends, profit provisions, etc., which can alter what is implemented.
- **Operational consistency** – some companies prefer regular small changes to occasional large changes.
- **Underwriting/Marketing** – companies often distinguish between the technical rate and the market rate, or retail rate. Charging what you “should” at the cost of losing business might be a bad trade.
Rate Adequacy and Allocating Rate

This whole time we’ve been talking averages. Making sure the total premium generated is enough to cover losses and expenses is extremely important.

But we can’t just charge everyone an average rate. Some risks deserve a higher rate, and some deserve lower. This requires more sophisticated predictive approaches.
Questions?

Christopher Cooksey, FCAS, MAAA
Head Actuary, Data and Analytics

Guidewire Software

ccooksey@guidewire.com