P&L Attribution
Edward Toman, Travelers

Agenda

• Recap of P&L Attribution

• Performing the exercises

• Something to think about – a new use?
  – Developing ‘P&L Attribution’ into ‘Probabilistic Plan Evaluation’
04 November 2014

Recap of P&L Attribution

- Hypothetical pdf of insurance company operating results showing the following percentiles in blue…
  - 0.5th (i.e. 99.5th loss), 10th, 50th, 75th
- … and the mean in gold
- What proportion of our time do we spend at each of the points?
- What are we likely to see on a year-to-year basis?
- Which portion of the distribution gives us our (non-external) future capital resources?

Recap of P&L Attribution

- P&L attribution is about ensuring all risk drivers:
  - are captured
  - at a 'useful' level of detail
  - are moving in the right way (individually and jointly)
  - are being thought of in the right way ("categorisation of risk")
  - are consistent between the model and the way the firm is run ("risk management")
  - are regularly reviewed
- It’s a key component in changing thinking from a "capital model" (99.5th) to an "internal model"
Because fundamentally...

P&L Attribution exercises

• Two main components:
  1. Checking the model has the right risk drivers
     • At the right/useful level of detail
     • Categorised correctly
  2. Checking the model is capturing the risk drivers in the right way
     • Backtesting
     • Check of management reports of P&L vs model output
1. Checking model has right risk drivers

- We reviewed 5 years of history for our syndicate:
  - Review of internal reserving reports & examine narrative
  - Review of syndicate P&L accounts vs Plan
  - Discussions with actuaries, finance etc.

- Check if profit/loss explicitly modelled
  - E.g. “Unreported Large Loss from 2011 AY reported in 2013 from Liability line in USD”
  - If not, is it modelled in an aggregate distribution and will this give limitations?
  - If not, is this a problem?

- Check correct categorisation
  - E.g. Reserve risk

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1. Findings

- Vendor model should cover vast majority of P&L sources for SCR Use

- Potential gaps/differences
  - Premium volume / exposure changes / Loss of UW team
  - RI programme changes
  - Change in mix of LoBs / Aggregate modelling of LoBs
  - Aggregate modelling of reserve risk, in particular modelling of prior RI
  - Non-modelled cats (assumed to be in attritional)
  - Multiple large losses with a single cause (“clash”)

- (Lloyd’s only) Events between Final SCR submission & model start date
  - Op risk explicit in model but not in accounts
  - FX modelling for RI contracts
  - Unrealised capital gains/losses

- Some risks (e.g. Op Risk, RI dispute) can be quite hard to find in narrative

- Deal with some gaps through model governance (i.e. trigger + re-run)

- First time will highlight the majority of gaps

- Better to do this before building the model!
2. Checking risk drivers modelled in right way

- Backtesting: Testing model output against actual experience
- Two main types/methods
  - Retrospective
    - Plot (adjusted) historical data against output distributions
    - Should be done as part of parameterisation for risk drivers
    - Vulnerable to changes in business (real or perceived)
  - Prospective
    - Run model & wait for data to emerge.
    - Plot against original distributions generated to get percentile value ("pct-value")
    - Have to wait the model time-step (e.g. 1yr) to perform without approximations
    - Advantage is that assumptions and data should align
- Prospective is the more useful form for P&L Attribution

2. Prospective Backtesting – simplified example

<table>
<thead>
<tr>
<th>Item</th>
<th>Plan 2013AY completed @ 30 Sept 12</th>
<th>Actual 2013 AY @ 31 Dec 13</th>
<th>Pct-value @ 31 Dec 13 from model run @ 31 Dec 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross</td>
<td>500</td>
<td>450</td>
<td>10%</td>
</tr>
<tr>
<td>RI</td>
<td>50</td>
<td>48</td>
<td>20%</td>
</tr>
<tr>
<td>Net</td>
<td>450</td>
<td>402</td>
<td>8%</td>
</tr>
<tr>
<td>Plan Year Loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross</td>
<td>250</td>
<td>216</td>
<td>9%</td>
</tr>
<tr>
<td>RI</td>
<td>15</td>
<td>10</td>
<td>15%</td>
</tr>
<tr>
<td>Net</td>
<td>235</td>
<td>206</td>
<td>12%</td>
</tr>
<tr>
<td>Prior Year Loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net</td>
<td>0</td>
<td>10</td>
<td>75%</td>
</tr>
<tr>
<td>Commission</td>
<td>150</td>
<td>113</td>
<td>10%</td>
</tr>
<tr>
<td>OIE</td>
<td>68</td>
<td>68</td>
<td>50%</td>
</tr>
<tr>
<td>Investments</td>
<td>15</td>
<td>17</td>
<td>60%</td>
</tr>
<tr>
<td>UW Result</td>
<td>23</td>
<td>6</td>
<td>20%</td>
</tr>
<tr>
<td>Operating Result</td>
<td>38</td>
<td>23</td>
<td>25%</td>
</tr>
<tr>
<td>NCR</td>
<td>95%</td>
<td>99%</td>
<td>85%</td>
</tr>
</tbody>
</table>

- In this example:
  1. Gross premium & exposure is 10% below plan
  2. There’s a prior year loss
  3. Fixed expense is about the same

- Challenges
  - Conditionality within an exercise
  - Cross-terms
  - What to measure
  - Statistics
  - Practicalities
2. Conditionality – Within an exercise

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<td>99%</td>
<td>85%</td>
</tr>
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- Many items in the P&L Account are dependent on items higher up
- Potential solutions
  1. Don’t adjust but investigate & explain differences
  2. Examine deviation from expectation
  3. Use ratio approach
  4. Use model output and derive conditional pct-values*
  5. Recalibrate model and re-run*
  6. Combination recommended

\* - I’m planning to look at these for our next exercise

2. Cross-terms

- Some modelled variables affect multiple risk types:
  - Exchange rates, Inflation, Yield curves
- Recommendation: be pragmatic...
  - Remove these effects as early as possible:
    - Recalculate opening balance sheet and business plan on closing/average rates to examine the impact of FX
    - Examine model output using by currency / fixed rates
    - Build a process that’s repeatable, consistent & easily reconcilable (i.e. follow the actual Y.E. reports’ rates)
    - Avoid allocations – likely to be unstable over time
- … but don’t miss potential model weaknesses
  - E.g. mean reversion in ESGs
  - Potentially consider running model with only economic variables as stochastic
- Materiality will depend on hedging & model granularity
  - Material issues indication model not granular enough
2. What to measure

- The items above but…ultimates may take some time to reach their true ultimate (reserving cycle)
  - pct-values potentially understated after one year of data
- If practicable use data to gain leading-indicators:
  - Premiums in
  - Paid claims out
  - Attritional: Incurred movements
  - Large loss or Catastrophe: Claim frequency & average incurred severity
- Area for model improvement: Greater focus on incremental modelling?
- Granularity: Two layers of analysis (e.g. Business Unit, Total) will allow some analysis of dependencies

04 November 2014


2. Statistics

- Aggregate means can be deceptive:

<table>
<thead>
<tr>
<th>Gross Loss £m</th>
<th>Total</th>
<th>Line A</th>
<th>Line B</th>
<th>Line C</th>
<th>Line D</th>
<th>Line E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
<td>53</td>
<td>20</td>
<td>10</td>
<td>15</td>
<td>5</td>
<td>3</td>
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<tr>
<td>Actual</td>
<td>52</td>
<td>5</td>
<td>13</td>
<td>21</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>pct-value</td>
<td>50%</td>
<td>3%</td>
<td>80%</td>
<td>95%</td>
<td>93%</td>
<td>99%</td>
</tr>
</tbody>
</table>

- pct-values: 10 (independent) cells and a threshold of 90% means a 64% chance of at least one triggering just by random…
  - … and they’re probably not independent
- Consider using Binomial-based tests measured using inverse distributions from the internal model output to capture correlation
2. Other considerations

- First time:
  - Concentrate on value-add
  - Concentrate on first-order effects
  - Start simple

- Use to improve:
  - Internal reporting
  - Operational risk monitoring

- Form a narrative – easy to get lost in details

- Basis: GAAP or SII?

- Length of time between parameterisation & exercise

- pct-values
  - Keep pct-values consistent?
  - Do you want to set extreme pct-values?

- Beware of non-continuous distributions

- Conditionality between exercises

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A new model use?

- Despite challenges, pct-value information could be very useful in quarterly reserving / financial reporting:

<table>
<thead>
<tr>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserve increase</td>
<td>+5</td>
<td>+5</td>
<td>+8</td>
</tr>
<tr>
<td>Qtrly pct-value</td>
<td>60%</td>
<td>60%</td>
<td>70%</td>
</tr>
<tr>
<td>YTD pct-value</td>
<td>60%</td>
<td>80%</td>
<td>90%</td>
</tr>
</tbody>
</table>

- As well as engaging underwriters with the parameterisation of the internal model
  - Underwriting freedom tied to consistent pct-value history
  - Natural balance between wanting more downside variability (and better implied pct-values) and resulting capital allocated
  - Use of pct-values in setting bonuses