BRIDGING RESERVING AND BUSINESS STEERING USING AI ASSISTANCE

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Recent developments in the actuarial reserving field and regulation ... has increased the complexity to translate the model results into concrete actions ... eventually resulting in poor planning and performance management!

The main purpose of this presentation is to present a pragmatic approach to implement a simple but efficient reserving framework which can also be easily automatised with AI / ML
THE JOURNEY: RESERVING WITH AI ASSISTANCE

Finally, bring AI into the reserving world, to allow actuaries to relieve resources on reporting efforts and assist them to improve their reserving insights even further.

The next level leads to the day to day usage of the reserving insights, to operationalize strategic and planning decisions.

Ensure that the basics actuarial concepts and KPIs are well understood and defined univocally (i.e., one source of truth).

COLLABORATIVE CURRENT ACCIDENT YEAR PLANNING AND STEERING

STANDARD PRIOR YEAR ANALYSIS

AUTOMATISATION WITH AI ASSISTANCE

IMPACT

TIME

3
01 PRIOR YEAR / RUNOFF

02 CURRENT ACCIDENT YEAR

03 AUTOMATISATION WITH AI ASSISTANCE
The actuarial function (AF) is the owner of the reserves

THE AF HOLDER SHOULD ...

- ... be responsible for the runoff (gross and net) booked in the P&L

- ... be able to explain how much of the runoff is driven by *update in data* and how much by *change in assumptions*

- ... have an understanding of the **uncertainty of the results**, where:
  - **LOW** is the minimum he/she would sign
  - **MID** is the recommendation
  - **HIGH** is the maximum he/she would sign
RUNOFF – CHANGE IN DATA vs ASSUMPTIONS

Loss ratio by Development Year, grouped by Accident Year

Loss Ratio

Development

XM 12M 12M2019 (PYE) XM2020 (YTD) Ultimates

AY 2018 AY 2019

Actual vs. Expected

Run-off
## Prior Years

<table>
<thead>
<tr>
<th>AY</th>
<th>06M</th>
<th>12M</th>
<th>PYE</th>
<th>YTD</th>
<th>Actual</th>
<th>Expected</th>
<th>A vs E</th>
<th>06M</th>
<th>12M</th>
<th>PYE</th>
<th>YTD</th>
<th>Actual</th>
<th>Expected</th>
<th>A vs E</th>
<th>PYE</th>
<th>YTD</th>
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<th>IFRS</th>
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### Loss Ratios (Raw data) vs. Loss Ratios (Booked)

- **AvE** can approximate **update in data**. Difference between **runoff and AvE** approximates **change in assumptions**
- **Quick (pragmatic) back testing for uncertainty.** For example, if PYE booking was:
  - LOW (1in2 years negative runoff return period) ~ a red AvE every 2 years
  - MID (1in3 years negative runoff return period) ~ a red AvE every 3 years
  - HIGH (1in5 years negative runoff return period) ~ a red AvE every 5 years
- **Possibility to dig into details as much as needed**

### Consistency Check

- **(1) = (4)-(3)**
- **(2) = (5)-(6)**
- **(3) = (11)-(10)**
- **(4) = (12)-(11)**
- **(5) = (17)-(16)**
- **(6) = (18)-(17)**
- **(7) = (14)-(13)**

### Example

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### Loss Ratios

- **Loss Ratios (Raw data)**
- **Loss Ratios (Booked)**

### Runoff IFRS vs 12M Incurred

- **AY 06M 12M PYE YTD Actual Expected A vs E PYE YTD Incurred IFRS**

### Example

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### Legend:

- **Positive** values are loss, **negative** are profit
- **XM**: X months development
- **12M**: 12 months development
- **YTD**: year-to-date development
- **PYE**: previous year end development

### Note

- **(1) = (4)-(3)**
- **(2) = (5)-(6)**
- **(3) = (11)-(10)**
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### Calculation

- **Runoff IFRS vs 12M Incurred**

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## RUNOFF - RANGE

### Range of Total Net PY Run-off as at 6M2019

<table>
<thead>
<tr>
<th>Lower Range</th>
<th>Upper Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>-3</td>
</tr>
</tbody>
</table>

117Mn

### Range of Total Gross PY Run-off as at 6M2019

<table>
<thead>
<tr>
<th>Lower Range</th>
<th>Upper Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>-6</td>
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</tbody>
</table>

125Mn

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**Net** Run-Off figures with ULAE in EUR mn, by LoB

<table>
<thead>
<tr>
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<th>LOW</th>
<th>MID</th>
<th>HIGH</th>
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<tbody>
<tr>
<td>LoB1</td>
<td>5</td>
<td>-0.2</td>
<td>-1</td>
</tr>
<tr>
<td>LoB2</td>
<td>1</td>
<td>-1</td>
<td>-3</td>
</tr>
<tr>
<td>LoB3</td>
<td>-3</td>
<td>1.2</td>
<td>1</td>
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<tr>
<td>...</td>
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<tr>
<td>Total</td>
<td>3</td>
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<td>-3</td>
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</tbody>
</table>

**Gross** Run-Off figures with ULAE in EUR mn, by LoB

<table>
<thead>
<tr>
<th>LoB</th>
<th>LOW</th>
<th>MID</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>LoB1</td>
<td>1</td>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>LoB2</td>
<td>0.5</td>
<td>-0.5</td>
<td>-2</td>
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<tr>
<td>LoB3</td>
<td>2.5</td>
<td>-0.5</td>
<td>-3</td>
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</tr>
<tr>
<td>Total</td>
<td>4</td>
<td>-1</td>
<td>-6</td>
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</tbody>
</table>
Content

Topics

01 PRIOR YEAR / RUNOFF

02 CURRENT ACCIDENT YEAR

03 AUTOMATISATION WITH AI ASSISTANCE
THE AF HOLDER SHOULD ...

➢ ... be responsible for the **loss ratio** (gross and net) booked in the P&L

➢ ... **be able to explain** how much of the deviation vs Plan is due to the **business areas** (over/under achieving their targets) and **actuarial** (changing their assumptions)

➢ ... have an understanding of the **uncertainty of the results**, where:
  - **LOW** is the minimum he/she would sign
  - **MID** is the recommendation
  - **HIGH** is the maximum he/she would sign

**CAY LOSS RATIO – KEY PRINCIPLES**

The **actuarial function (AF)** is the **owner** of the **ultimate loss ratio**
There is a lack of actuarial literature (can we say there is basically nothing at all?) on the current accident year for quarterly closings.

Different approaches and definitions across the market: “year-to-date” or a “full-year” ultimate loss ratio?

Roles & Responsibilities (between actuarial/pricing/claims/underwriting/etc) usually not clearly defined.
### CAY LOSS RATIO – TWO COMMON MARKET APPROACHES

<table>
<thead>
<tr>
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<th>3m</th>
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<th>9m</th>
<th>12m</th>
<th>15m</th>
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<td>2019 Q2</td>
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<td>2020 Q1</td>
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<tr>
<td>2020 Q2</td>
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</table>

**Quarter on Quarter (QoQ) Triangle**

**Quarter on Years (QoY) Triangle**

### “Year-to-date” approach

We assume the company in “runoff”, ie. what is the ultimate loss ratio if the unearned exposure won’t happen

- Premium reserves (S2 / IFRS17) should reflect the profitability of the unearned part
- Doesn’t naturally reflect annual business exposure (eg. pricing, BF, etc.)
- Erratic projections (as relies on quarterly data)

### “Full year” approach

We consider also the future claims/exposure that will happen in the year

+ Premium reserves (S2 / IFRS17) can use the same loss ratio of the CAY
+ Easy to interpret, as gives a feeling of (yearly) normalised loss ratio (eg. pricing, BF, etc.)
+ Stable projections with possibility to spot change in trends (quarter or month development)
+ Immediate reconciliation with Technical KPIs
Another advantage is that in a “full year” approach, the **Ultimate Loss Ratio (ULR)** does not have a seasonality, whilst the **Incurred Loss Ratio (ILR)** does.

Example from chart:

1. If in March we observe a **67.9% incurred**, and we know that the business is fully developed after 12 months (i.e. No IBNER/IBNYR), how much IBNR would you book? **Answer: ~10%-p**

2. And if in June we still observe something in line with the past, i.e. ~75%, how much IBNR should we book? **Answer: ~3%-p**

3. And towards the end of the year you will have an **IBNR more accurate** thanks to the emerging experience (*)…

In other words, the ULR in the example is always **around 78%** (“normalized” loss ratio), and the volatility around it depends on the **emerging loss experience**: it is **random**, not **seasonal**.

(*) NOTE: the above is true also if the incurred is higher than the ultimate – of course, in this case, booking a negative IBNR the analyst should pay even more attention …
ULTIMATE LOSS RATIO – INCURRED AND IBNR

For this reason, we need to ensure that observed data (Technical KPIs) are reported separately from actuarial adjustments (IBNR and large/natcat(*)), to ensure a clear performance tracking:

Ultimate Loss Ratio (ULR) = Incurred Loss Ratio (ILR) + IBNR

Incurred Loss Ratio (ILR): Represent the total cost of the claim w/o IBNR
☑ Basis for discussion with the business areas (claims/pricing/underwriting..) on a recurrent basis.

Technical KPIs must reconcile to the incurred loss ratio

IBNR: it is the sum of IBNER (Incurred But Not Enough Reserved) + IBNYR (Incurred But Not Yet Reported)
☑ Main discussion with the actuarial function, to be validated against prior year analysis

(*) Note: large/natcat losses are modeled via EVT (eg. Pareto/Poisson model or exposure based) and excluded from this presentation
First we need to project from XM to 12M (ie. 12M Incurred Rolling Projection):
- This is done comparing the XM with the incurred plan as of XM (prospective view)
- Retail LoBs could be done by Technical KPI
- Commercial LoBs by Total Incurred LR

This is the key link between actuarial and business areas

Second we need to project from 12M to Ultimate
- This is based on the historical ratios 12M to Ultimate
- They depend on PY, thus linked to AvE
- For this reason it is important to show the historical pattern
- Usually the ratios should not show patterns – if patterns are shown, it means something is changing in the claims area and needs to be discussed!
CAY – ACTUAL vs monthly PLAN

12M ILR Rolling Projection
to be discussed in the Smart Circle and its owned by the business

Actual vs Plan

3M

12M

Actual vs Plan

Incurred Loss Ratio

Development

Incurred Monthly Plan
- Retail by Technical KPIs
- Commercial overall incurred

12M PLAN IBNR

• The accounting IBNR depends on the point in time we are, and it is always defined by Ultimate - Incurred
• To make the IBNR comparable in time, we analyse the IBNR always at 12M. For this reason we need (1) a Rolling Projection to 12M and then (2) a 12M Incurred to Ultimate factor

IFRS LR @ 3M
The IBNR is to be discussed in the LoRC and its owned by the actuarial function

Plan Ultimate Loss Ratio
Business areas
Key comments to explain the differences with the business

Actuarial
Key comments on IBNR change

Other
Any other comments (large losses/ULAE/etc)

+ Company year-end target always under control
+ Clear understanding of the movements, business vs actuarial to enable quick reactions
+ Possibility to dig into details as much as needed
## 1. OE – ACTUAL VS PLAN

Current Accident Year

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- Comparison vs the plan (incurred only), vs past for reference
- Automatic RP as of year-end (credibility approach)

Reconciled with the walk
FOCUS LOB 1 – TECHNICAL KPIS

Current Accident Year

- Technical KPIs reconciled with LR (see appendix)
- Possibility to dig down at detailed level
- Quick overview of actuals, plan and rolling projection
OE – 12M INCURRED TO ULTIMATE RATIO

Current Accident Year

- ** Same detail level of Technical KPIs
- They represent the ratio between ultimate and case reserves as year-end from PY analysis:
  - **Flat trend** – no significant changes in case reserve policy
  - **Increasing trend** – case reserves tend to have “less money” over time to pay for claims
  - **Decreasing trend** – case reserves tend to have “more money” over time to pay for claims
- Comparison of booking vs Plan and PY ranges

Reconciled with the walk
PRIOR YEAR / RUNOFF

CURRENT ACCIDENT YEAR

AUTOMATISATION WITH AI ASSISTANCE
**BRIDGING ACTUARIAL AND DATA SCIENCE WORLD**

<table>
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<th>TRADITIONAL ACTUARIAL APPROACH</th>
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<td>Individual claims reserving with <strong>ML Algorithms</strong> (i.e. Gradient Boosting, NN etc.)</td>
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<td>Assume to work on grouped data</td>
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1. After its occurrence, a claim is reported and a case reserve is allocated.

2. Subsequently, a certain amount is paid and the case reserve decreases accordingly.

3. The claim continues its developing until is definitively closed (Ultimate Cost).
With clustering techniques, we are able to identify and aggregate claims with similar trajectories up to a fixed development period.

Two linear regression models are fit on historical claims data to develop the paid amount (1) and the reserved amounts (2). Therefore, the projected point has coordinates defined by (1) and (2).
Before moving to full AI implementation, we need to ensure that (1) we are able to replicate most of the existing processes with an automatic process and (2) that we have “one single source of truth”
In Conclusion – One Platform for All

Current Year analysis:
- Actual vs Plan for Technical KPIs
- 12M Incurred to Ultimate for IBNR

Prior Year analysis:
Actual vs Expected analysis at any granularity

Planning cycle:
Clearly define business targets vs actuarial assumptions

Monitoring:
All monitoring should come from the same system / one source of truth and run on regular basis
MANY THANKS FOR YOUR ATTENTION
APPENDIX - FORMULAE

TECHNICAL KPIs DEFINITION

\[
\text{Inurred LR} = \frac{\text{Incurred Claims}}{\text{Earned Premiums}} = \frac{\text{Incurred Claims}}{\text{Reported (non nil) Claims} \times \text{Reported (non nil) Claims}} \times \text{Risk years}
\]

\[
= \frac{\text{severity} \times \text{frequency}}{\text{avg premium}}
\]

\[
\text{Severity} = \frac{\text{Incurred Claims}}{\text{Reported (non nil) Claims}} \quad \text{Frequency} = \frac{\text{Reported (non nil) Claims}}{\text{Risk years}} \quad \text{Avg. Premium} = \frac{\text{Earned Premiums}}{\text{Risk years}}
\]

ACTUAL VS EXPECTED DEFINITION

\[
\text{Actual} = \text{Triangle Latest}_t \times t + x - \text{Triangle Latest}_t
\]

\[
\text{Expected} = (\text{Ultimate}_t - \text{Triangle Latest}_t) \times \frac{(\text{Pattern}_t \times t + x) - \text{Pattern}_t}{1 - \text{Pattern}_t}
\]

Where:

\begin{itemize}
  \item Previous Year End = t
  \item Year To Date = t + x
  \item And Pattern\text{t}+x and Pattern\text{t} stand for the percentage developed YTD (ie. t+x) and for the percentage developed as at PYE Date (t), respectively.
\end{itemize}
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