Institute
and Faculty
of Actuaries

ROC Working Party: Towards the Optimal Reserving Process

Actual vs. Expected Techniques

by Neil Bruce (Chair) , Alastair Lauder, Alexander Crosby, Anthony Wright, Cameron Heath, Camilla Bennett, Gregory Overton, Jinita Shah, Joe Ryan, Katherine Laidlar, Keith Taylor, Marios Argyrou, Sylvie LeDelliou and Tim Jenkins

GIRO 2013

September 2013

Abstract

Our principle focus in this paper is on ways that actual vs. expected analyses can assist in saving time, and focussing resource more efficiently, as an example of the work we intend to carry out in the future. This paper begins by setting out the potential future scope for the working party, being the reserving process and wider related analyses. It highlights our views on the features of the "optimal" reserving process, noting that achieving such a state will always be aspirational. We highlight the most common issues we believe reserving processes currently face, and set out thoughts about how they may be addressed. Finally we suggest areas for future development and ask for feedback on where to concentrate next.

1. Background

This paper is part of the follow-up work from the GRIT working party by the IFoA GI Reserving Oversight Committee. That work is split into three workstreams: "Towards the Optimal Reserving Process ("TORP"), Research, and Education.

The stated aim of TORP is set out in three parts:

- Governance and design of reserving processes
    - governance issues including controls and risks including interaction of various reporting bases
    - identifying key aims and pitfalls of the reserving process and function
    - links to other departments/processes within the company (Claims, Risk, Finance; Planning, Pricing, Capital)
- Reserving methods available and their strengths and weaknesses
    - including how methods can assist in populating various reporting bases (and where they do not)
    - ways to apply methods to achieve outputs required for certain reporting bases
    - possible high-level review techniques
- Best practice in documentation and housekeeping
    - identifying alternative ways of approaching reporting
    - setting and monitoring operating standards

As the potential scope of the work involved in meeting the above aims is immense, we will not attempt to address all aspects of the process in the same level of detail, or at the same time. This is intended to make the work more user-friendly and allow current topics to be addressed in a timely manner.

In particular we note that the philosophy and culture within each organisation is unique, and hence the ideas presented here will not be appropriate in all instances. We do note that having a clear philosophy and culture relating to reserving (including ownership) is critical, but what that "should" be is for each individual organisation to decide, and will not be considered in this paper.

2. Introduction

To reflect this approach TORP is intending to set out its findings in a structure that will develop over a number of years and papers. The current paper is the core of this structure and has three distinct sections.

The first section relates to the scope of the reserving process. This has such a potentially wide range of definitions it is important for us to set out what this paper considers in scope and out of scope. This does not mean that we think anything excluded from the paper should be excluded by the reserving function, simply that we will not be considering it in our work.

The second section relates to the features of the "optimal" reserving process. These are the characteristics we feel a reserving process should aim to incorporate as far as possible, although there will be various practical constraints in each real situation that may limit the extent this is possible.

The main body of the current paper describes at a very high-level the areas within the reserving process and function to put our detailed work into context. This section aims to indicate the areas we believe require careful consideration when developing a new or refining an existing reserving process, as well as highlighting some potential hints on ways to approach some of these issues. It is this section that will form the detailed framework of future work and generate ideas for more detailed investigations.

We will then add separate chapters to this paper that will address particular aspects of that process in more detail. The topic included in this paper is "Actual vs. Expected techniques".

This detailed chapter looks at the use of this particular technique across the whole reserving process and so aims to raise awareness of its benefits and potential pitfalls. We expect not all detailed chapters will relate to calculation techniques; they may address governance or documentation for example.

The current paper is the first output of this working party.

In addition to the overall structure of the reserving process and in-depth reviews of particular aspects within it, we will also note practical tips that we have found to be useful in implementing certain facets of the process. These are indicated within the wider process section.

Finally our conclusion is a list of the areas that we believe are most topical in respect of needing further discussion. We welcome feedback both in seminars and directly on which the wider community would like us to tackle next, as well as any improvements to the current paper.

3. Scope of the reserving process

The purpose of this section is to set out the extent of the reserving process for the purposes of this paper. It is aimed to be as inclusive as possible, but excludes elements that are usually owned by other departments outside the actuarial function.

The primary focus is on the regular internal reserving process, although parts of the work presented could apply to external reserving processes, or one-off reserving exercises for regulatory purposes or to support a transaction.

The core of the process is the derivation of the reserves under whatever reporting bases (internal and external) are required, including any conversions between various reporting bases (including Solvency II). Any ancillary reporting based on the reserves are also included, such as unexpired risk provision, reinsurance bad debt provisions, unallocated loss adjustment expenses and reporting for premium trust funds.

Further analyses that assist the understanding of the reserves, such as estimating uncertainty (both in the best estimate and based on the range of possible outcomes) are included as are setting reserving related assumptions for the capital model (including projected opening balance sheets, correlations, risk margin and reserve uncertainty estimates).

The wider process can include additional analyses that integrate the results of reserving analyses, such as portfolio reviews, production of MI, derivation of planning assumptions and development patterns etc. These analyses are considered in scope of this working party, although as they can be very specific to individual companies, may not be dealt with in as much depth.

Developing alternative methodologies (e.g. re-reserving within the estimation of the Solvency II capital on a one-year basis) is part of the role of the reserving function, but is not explicitly addressed here as this will fall more within the remit of the research workstream. That said, “standard” methods in use for calculating risk margins and other elements of the reserves are included in the scope of the current workstream to the extent we can help ensure they are applied effectively.

Finally, we also consider stages from the identification and extraction of data from core sources, through to the interpretation and presentation of the results to various stakeholders: from peer review within the function, through the reserving/finance committee to Board presentations and external reporting to regulators. Not forgetting other stakeholders in the reserving process: e.g. underwriters, wider finance function, outwards reinsurance and claims.

4. Features of the Optimal Reserving Process

This section looks at the utopian world of the perfect reserving process. It aims to set the level we are aiming to achieve, although accepting that we will never fully achieve this in practice. In this way we can look at the way the reserving process

currently compares to this benchmark to see where to concentrate our resources in developing the process further (using the 80/20 rule – where 80% of the benefit can be achieved with 20% of the effort).

What "optimal" means will actually vary depending on who you are and what you are looking for in the reserve setting process. This may vary from board members, who need to post results within a certain deadline, and would prefer lower volatility, to the portfolio manager who will want the results to show a true best estimate of the profitability of each of their lines of business.

We have taken a wide view of what the various stakeholders may want out of a process. It is up to each reserving function to understand their own stakeholders' views as well as their own principles in selecting what elements are required, and how to avoid or remove inconsistencies in those aims.

We have grouped the optimal features roughly by the three parts referred to in the TORP aims, although this is largely artificial:

Governance:

- There is a consistent understanding of the reserving philosophy and policy across the organisation, including risk appetite, materiality levels, frequency (and depth) of review and reporting deadlines, that is supported by the culture of the organisation.
- Ownership of the reserve setting process is clear, with specific individuals/committees' responsibilities within the reserve setting process widely known and understood. This should include escalation procedures, particularly where conflicts of views reserving strength or purpose are possible.
- Similarly, the process is well documented with data flow diagrams, controls well defined and embedded in a workflow system, with clear hand-off and approval stages.
- Levels of security are set within the process that restrict access for different levels of user at different stages of the process, and in particular stops any changes after sign-off.
- The overall process is robust and embedded within the disaster recovery systems.
- All calculations and summaries contain appropriate checks as to the integrity of the calculations and data, and hence fulfil all TAS D and M requirements.
- All data items used in standard reserving methods and required for diagnostics and additional analyses are available.
- Data is automatically populated into the reserving tools used.
- All data is automatically reconciled to the core systems with appropriate reports generated e.g. for Sarbanes-Oxley evidence.
- Data flows to other departments and processes are defined and automatic, triggered by centralised workflow sign-offs.

Methods:

- Applied at the appropriate level of detail given materiality, but results allocated/ aggregated to a consistent granular level of detail across all reserving classes.
- Tools run automatic updates on new data to provide initial selections ready for review.
- Diagnostics flag areas of concern on an exception basis, including where past assumptions are not being met.
- Any methods that do not have their base assumptions fulfilled are highlighted for each data set.
- The process calculates all required outputs (i.e. all quantities in all required bases) from the core selections by applying well defined rules, and provides diagnostics to indicate the effects of each stage in the calculation (e.g. waterfall diagrams).

Documentation and housekeeping:

- Data is accurate, complete and timely in both entry to and extraction from the core systems.
- Data has a level of detail that allows drill-down and analysis across all material characteristics.
- Process automatically flexes to include new lines.
- Analysis of surplus is produced automatically showing main drivers of change.
- Diagnostics for sense checking derived elements on different bases are produced, flagging potential concerns on an exception basis together with high-level summaries and reconciliations.
- Detailed documentation (including rationale and validation) is produced directly from working papers. This concentrates on deviations away from agreed procedures, ensuring non-standard decisions or areas requiring more complex analyses are easily identified.
- Summary documents are populated with standard exhibits automatically both for internal actuarial review, but also alternative packs for dissemination to senior management, underwriters, finance etc. These are also TAS R compliant.

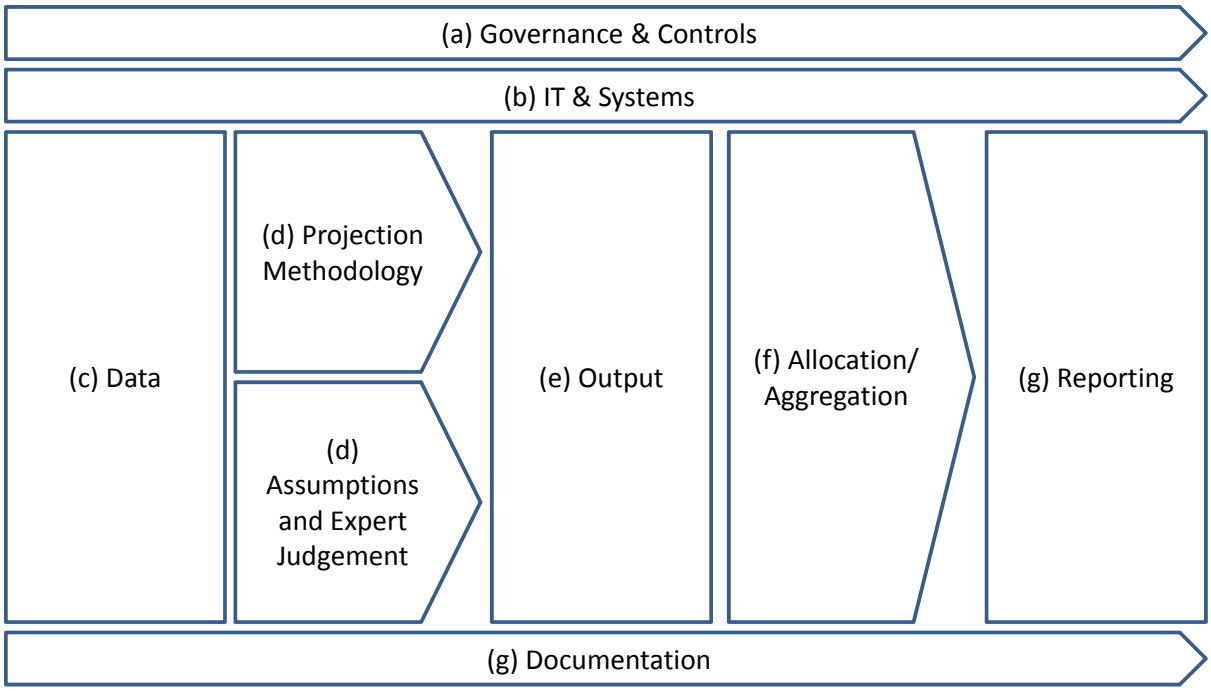
5. Description of the Reserving Process

The sections below attempt to describe the various aspects of the reserving process in a logical manner.

As the reserving process can be considered a cyclical process, which has many layers of complexity, there is no easy way of doing this. Additionally, as our working party has proven, most people have their own ideas as to the best way of grouping it.

To assist in navigating around our groupings, we include a rather simplistic diagram:

Figure 1 – The reserving process



The letters in each element refer to a section below, where the stage in the process is initially described as a brief series of bullet points to set the scene. We have then highlighted the areas where we see the most common need for improvement, together with an indication of the sort of solution that may help. This is to whet the appetite for what further research into these areas could investigate in more detail, potentially through this working group.

We do not anticipate that everyone will agree with, or even recognise all the difficulties we have noted. However, as mentioned in section 2, we would like to encourage feedback on areas that would benefit from further investigation by our working party. We have identified a small number in our conclusion, which we feel are most topical, and would appreciate thoughts on which (if any) we should tackle next.

This section sets out a "standard" reserving process, with the aim being to describe the process only. It does not cover either the resources needed to carry out the process or the structure of the reserving function, both of which are likely to be specific to the organisation in question, although it should be noted that both of these are very important aspects of designing the process.

a. Governance

- **Governance Framework** - Ensure all conditions of governance framework complied with, including review and sign-off requirements.
- **Control processes** – Complete all required evidential materials for Sarbanes-Oxley, Solvency II and/or other internal control processes.

- **TAS Compliance** - ensure TAS requirements are complied with, and that this is documented.

Common pitfalls and indicative solutions

- Finding the right balance between ensuring the reserving process is timely and that reserve figures are sufficiently up to date, without putting a strain on actuarial and other business resources that have conflicting requirements, is a significant challenge. Automated application of existing assumptions to the latest data position can help, but care needs to be taken that work performed to understand the resulting movements does not take as long as a full re-reserving exercise. This risk can be limited if clear expectations on the focus of the reserving process are agreed in advance, particularly with respect to materiality criteria around when further investigations are (not) required.
- At large companies with Group structure and multiple branches, quarterly reserving can be a particularly time consuming task due to both the sheer volume of data and the many levels of review that can exist. Clear materiality levels and standard simple exhibits identifying causes of movements can assist in making this process smoother.
- As Solvency II has introduced a refresh of the governance structure in many companies, there is less confusion around the ownership of the reserving process and output. It is now expected that a governance process and Reserving Committee structure would include the following principles:
    - Ensures reserves are appropriate for the use(s) to which they are being put.
    - Allows for all relevant information to be incorporated in a timely and effective manner.
    - Ensures that all relevant stakeholders are bought in to key decisions and understand the uncertainties and limitations of the analyses supporting these decisions.
    - Ensures each element of the sign-off chain is given the required level of information to provide informed challenge to the reserving estimates and process, whilst allowing sufficient time for feedback during the quarterly cycle.

b. IT and Systems

- **Ability to apply required projection methods in a robust framework** – Use of a reserving tool/framework that is robust and able to cope with the methods used within the reserving process.
- **Linkage between systems** – Feed of data from the output of the reserving framework to other data warehouses/departments automatically, without any manual intervention required.
- **Security access** – Ability to have lock-down of assumptions after review and/or access levels to approve sign-off for the next level of review.

- **Disaster recovery** – Ensuring any interruption in access to the primary systems will not restrict the reserving function's ability to carry out their tasks to an acceptable degree.
- **Note changes in available data and reports** – Confirm required reports and systems are available and have not changed basis. This may not be standard step and could be implicit in the IT development process. Note that this may include identification of new data types/sources.

Common pitfalls and indicative solutions

- The key area that causes companies the most trouble in our experience is the linkage between systems. Often companies have inherited reserving systems that are not easily compatible with central warehouses, which can be focussed on other processes (e.g. underwriting data). The potential advantage for reserving is that the tools and frameworks available have developed significantly over a relatively short period, and have been designed to be able to cope with a variety of data formats for input and output. The evolution of computing power allows simple manipulation of large data sets between formats, which can improve the linkages between the reserving system and core systems. The many challenges that exist in linking various core systems are, thankfully, out of scope of this paper.
- Whilst off-the-shelf reserving software can be used to carry out a wide range of reserving techniques in an automated fashion there are potential challenges:
    - Need to ensure all reserving actuaries fully understand the automated underlying models and potential deficiencies in automated models.
    - Methodology not always transparent.
    - Too many methods can encourage inconsistencies in selection between classes to get to a pre-conceived set of appropriate outcomes.
- These can generally be resolved by a strong governance framework, reserving philosophy and intelligent reporting. It is unlikely that any off-the-shelf product will fulfil all aspects of a reserving process
- In addition, care is required when implementing such a tool that the joins between it and other software, such as spreadsheets and core systems, are robust. Linking the output of the reserving tool directly to finance and planning systems can provide significant benefits. The alternative can cause delays in acknowledging the availability of information in times of high stress and time pressure.
- A special case of the above is when last minute changes in assumptions or selections can cause problems if systems are not able to automatically push changes through to the end of the process. Preferably the sign-off processes discussed under governance above, as well as prominent checks within the reporting phase will easily identify where inconsistencies arise.

- Spreadsheets must be used with care. Whilst their flexibility means they are likely to be required somewhere in the process that flexibility leads to risks that need to be controlled.

c. Data

- **Update of tables feeding data extraction** – Some inputs may be needed in the extraction of data, such as a list of specific claims that are dealt with separately. This process may be fully automatic, or require some expert judgement.
- **Data extraction** – Gather appropriate extracts of gross and reinsurance premiums/exposures, claims (numbers & amounts), expense and relevant other data from databases/other IT systems.
- **Data adjustment** – Apply any adjustments required (e.g. from underwriting to accident year basis or for late events not reflected in the data).
- **Data aggregation** – Aggregate extracted data to the appropriate level for the analysis to be carried out (if applicable).
- **Supplementing core data**
    - Soft information – Meet with other areas of the business (e.g. underwriters, claims, reinsurance team) to ensure factors such as changes in mix of business, adjustments to underwriting or claims handling approach etc. are understood as well as the latest view of emerging topics.
    - Benchmarks – Gather appropriate benchmarks from internal and external sources.
- **Checking data** – Check data for completeness, internal consistency, consistency over time and consistency with other sources.
- **Diagnostics** – Calculate diagnostics to inform interpretation of the data in advance of performing the analysis, e.g. paid/incurred ratios, movements in paid or incurred data above a threshold etc.
- **Data mining** - this may be a useful technique in extracting valuable data or identifying areas that need special attention, particularly for classes of business where large volumes of data are available or external data sets can be used to bring insight.

Common pitfalls and indicative solutions

- Data is the area where a lot of actuaries spend most of their time. It holds power over the rest of our processes and generally for companies over a few years old, can be held in systems that seem archaic and full of inconsistencies and/or errors. As such we can only scratch the surface of issues that most reserving actuaries face, but note that there are many areas that require attention.
- One specific area that is more tractable is the use and management of soft information. Not everything we use in reserving is held on a system. Incorporating views from throughout business in a timely manner is a key challenge. This requires engagement with all key stakeholders from the

outset, so that all relevant information and opinions can be incorporated in a timely and efficient manner. Good communication and business engagement is key to delivering successfully and to timetable. The ability to trace the timelines and audit trails of the various verbal updates on specific issues can be critical when reporting on the "latest view" of an issue.

- Finally the timing and granularity of data in relation to the deadlines for analysis can be a major issue, particularly if, for example, reinsurance data is not updated as frequently as gross or specific items are only available very late in the reporting schedule.

d. Projection Methodology

- **Automated projection** – Apply a range of standard projection techniques to the data to produce initial first cut estimates.
- **A vs. E** – Use results of automated Actual vs. Expected exercise to inform selections and highlight areas needing further investigation.
- **Review assumptions** – Update assumptions used in reserving methods as necessary, note and record application of expert judgement.
- **Statistical tests** – Apply tests to results and methods – for example, goodness-of-fit tests for fitted claims development patterns.
- **Special cases** – Apply alternative techniques to areas such as large/catastrophe losses, aggregate deductible policies, PPOs and APH reserves where standard techniques are less applicable. Ensure appropriate expert input is sought such that reserving models are appropriate.
- **Ancillary calculations** – Calculations such as ULAE, reinsurance bad debt and unexpired risk provisions need to be carried out often after the core analysis.
- **Selection of results** – Review estimates from each method, and compare and contrast outputs of different methods. Adjust assumptions as appropriate to reach selected results, both gross and net of reinsurance. Application of judgement is again documented and justified.
- **Analysis of surplus** – Consistent mechanical calculation of the components driving the movement of ultimate selections.
- **Reserve variability analysis** – Repeat the above steps in relation to methods for analysing the level of variability in the reserves and, where possible, quantify that uncertainty at the appropriate level(s) of granularity.

Common pitfalls and indicative solutions

- There are many areas of debate regarding the most appropriate methods to be used for reserving. We do not aim to replicate descriptions of standard methods, or remind the Profession to be aware of the underlying assumptions and whether they are valid when relying upon output, but refer the reader to various papers that consider the benefits and drawbacks of various methods under various circumstances.
- Our key concern in this section was highlighting the effective use of A vs. E. We expand on this in detail in section 6 below.

- Another area which we deemed worthy of note was in relation to reserve variability. Again we do not consider the comparative benefits of each common method, but here note that the review of the output of a number of such methods in terms of selecting the "right answer" is relatively undeveloped. We would encourage those needing to select such a view to ensure they have sufficient understanding of how well the data fits the assumptions of each method, and also the reasons why different methods give materially different results, in an analogous way to selecting a point best estimate. As normal the use of the selected results is important when deciding on the final selection. As this is an emerging area, we have highlighted this as a potential candidate for further research in the conclusion. This point applies to both the reserving actuary and the peer reviewer.
- When designing projection methodology there is a trade-off between automation and the flexibility to be able to carry out bespoke modelling for certain classes. We believe that potentially phasing detailed analyses "off cycle" is a way of coping with this need to balance speed and detail, as are A vs. E and other diagnostics, which can concentrate resources more effectively when time is short. This specific issue is one of those we suggest as a focus for the future, particularly in respect of "fast close" reserving processes.
- Having a reserving process that covers all required bases in one go is a particular challenge. Preparing a process whereby the core reserving outputs automatically feed all reporting requirements and reserving bases from one source, will minimise the risk of loss of integrity between different bases and duplication of effort. Diagnostics and comparisons over time can help identify outliers in results or areas for investigation in an efficient way. It is worth noting that in practice, reserving requirements are constantly evolving so any process will need to be flexible enough to adapt over time.
- A very well-known area for care to be exercised is whilst making assumptions when reviewing automated projections from roll-forward or other high-level methodologies, particularly for fast close or similar processes. The main defence here is a strong sense of materiality, but a well-structured series of standard exhibits can make the process smoother and more consistent, for example:
    - Graphical review of recent (and full) development against expectations or ultimate selections.
    - Tabular review of implied results noting A vs. E deviations, cases of negative IBNR etc.
    - Review of diagnostics such as movement statistics, including survival ratios, IBNR burn etc.
    - Review of results against different data sources (e.g. both paid and incurred claims development compared to claims ultimates).
    - Ensure rationale for selections and assumptions are documented.
- Supplementary data – As an extension to the Data point above, ensure the decisions made on the basis of "soft" information and benchmarks gathered are recorded.

e. Output from the analyses

- **Output creation** – Present the results of the reserving process in standard templates, including population of exhibits for documents. This will include any additional information required for other purposes, such as payment patterns, volatility assessments etc.
- **Documentation** – Where appropriate, add non-numerical descriptions to allow the reader to interpret the rationale for particular selections and/or the results of the process. This may take the form of projection notes, which will feed into the wider documentation process.
- **Ancillary analyses** – Where results are required on alternative bases, prepare and check the required information and perform the conversion(s) using "side analyses" (this may already be covered in the projection methodology section above depending on if any expert judgement is required in the process).
- **Specific assumptions** – These can be extracted from the core process to feed into other dependent calculations and analyses (estimates of losses relating to specific events).
- **Uncertainty** – Volatility estimates are extracted from the appropriate analyses. This will include comments on the level and key drivers of uncertainty.

Common pitfalls and indicative solutions

- There is huge potential for misunderstanding what outputs can be used for what purpose, particularly when there are multiple reserving bases (e.g. booked vs. best estimate etc.) being issued at slightly different times. Communication and education across the business is key, with very clear naming conventions and formats for exhibits relating to different uses assisting in avoiding confusion.
- Comparison of current results to previous analyses can be very useful, and being able to rationalise those movements gives important comfort around the new result. However, it is always important to consider the audience. Communicating key movements may be more readily digestible to the business and give a better idea of the primary areas of focus than detailed schedules. With the latter being much more appropriate as diagnostic checks for actuaries carrying out the reserve review.

f. Allocation/Aggregation

- Allocate results - various different reporting levels may be required, leading to the need to aggregate and/or allocate results. Adjustments may be necessary (e.g. for different reporting bases, if these are not allowed for earlier in the process).

Common pitfalls and indicative solutions

- Too often in the London Market each underwriter demands projections are performed for his or her own account in isolation leading to many more

classes being projected than strictly necessary. The Actuary needs to be given the freedom to decide an appropriate level of aggregation for homogeneous accounts to develop an efficient process. This does not mean to say that more detailed analyses can't be performed on a rolling basis away from the time critical periods.

- All allocation routines make some fairly broad brush assumptions. The main concern is that the ultimate users of the output of such processes are very rarely aware of the limitations of these routines. This is particularly important when such allocations could be used in portfolio analyses and further in the design of future strategy. It is vital that any such data always has an appropriate caveat around the output derived from it, and preferably an indication of the reliability (or not) that can be assigned to absolute or comparative analyses.

g. Reporting

- Prepare **internal reports**, including:
  - Explanation of movements
  - Peer review reports
  - Reports to underwriters
  - Board/management reports
  - Financial statements
  - Management information schedules
  - Business planning comparisons
- Prepare **regulatory reports**, including:
  - Regulatory returns
  - Dealing with auditors
  - Annual Actuarial Function reports
  - Adequacy and reliability of Solvency II Technical Provisions
  - Statement of Actuarial Opinions – Worldwide, Trust Fund
  - Tax opinions

Common pitfalls and indicative solutions

- As with all reporting, the challenge is to ensure the audience gets the information they need in as clear and concise manner possible, whilst understanding the limitations of the analyses. This requires very different reporting styles and content for each stakeholder, but that doesn't mean that the process needs to be unmanageable.
- Reserve committee packs could include just the key numbers required for sign-off along with high level commentary around key areas. Detailed schedules of numbers can divert attention from the key reserving decisions, but can be held as appendices or supplementary schedules that are only provided to those that request them.
- Use of presentations, carefully constructed executive summaries or "summary on a page" additional documents or dashboards can be invaluable in concentrating both the report writer's and reader's attention to the truly

important areas. This is particularly effective as the audience gets less technical, or has a much broader perspective.

- Documentation of reserving processes can quickly become out of date. A particular pitfall is ensuring that documentation is readily updated, particularly when a document covers a bespoke part of the reserving process in detail, which is then changed at future reviews due to change of personnel and / or changing business requirements.
- Additionally, repetition of background text quarter after quarter can disengage the reader and mean that important messages elsewhere in the document can be missed.
- A simple mechanism for ensuring less repetition of details is to “layer” documents, keeping standard descriptions and processes out of reporting documents, but ensuring regular review of these as separate exercises (at less time pressured meetings) and reference to them in the summary documents. This also sets the expectation that everything in the report is “non-standard” and so needs to be read.
- The art of report writing can also be very much the last in a long list of “to-do’s”, but we would encourage this to be promoted, even at the expense of preparing standard formats and wordings in advance to ensure a document is produced that clearly communicates the key aspects of the review.
- Embedding comprehensive reserving process notes into the reserving process at the point that reserving decisions are made can be difficult, given the very short timeframes in which reserving analyses can be prepared. A challenge is to factor in the time to enable these notes to be prepared, which will minimise the risk of error and should save time when it comes to preparing reserve committee papers and other reports. Use of standard methods of capturing such notes (e.g. in spreadsheets or embedded in reserving software) and strict guidelines on what they should (and shouldn’t) address can allow quick collation of the salient points for use as reference material when identifying the most important issues. This sort of documentation will pay dividends if a reserving actuary moves on and someone else needs to pick up from where they left off.
- Operating as a professional is about living up to expectations, which includes complying with professional standards. The TASs are important, not just because they set out a sensible way to operate as an actuary, but because, in the event that something does go wrong, you don't want to be sitting in the witness box having to say 'no' to the question 'did you perform your work in accordance with your profession's standards'. Done effectively compliance will ensure your stakeholders have clear, appropriate and timely information to support decision making and your process will be resilient to changes in personnel. Compliance, however, is often a matter of interpretation. It is critical for each organisation to set out their own interpretation of the standards and how they apply in their particular circumstances. This will include an explanation of how proportionality and materiality are assumed to apply.

6. Actual vs. Expected (AvE) analysis

a. Introduction

The background to choosing this topic was that the attendees of a workshop at GIRO 2012 were less than sure that AvE techniques were valuable in a reserving context. Six months later a presentation by this working party on AvE generated some robust discussion around how the discussion was a waste of time as everyone was using AvE techniques and we were not adding anything new (others disagreed).

This demonstrates why, as our remit is to provide a "baseline" of knowledge for the Profession, this seems to be a good topic to discuss.

In fact, beyond those already converted to the benefits of AvE, we believe that we can divide the Profession up into two main categories:

- Those who don't realise they are using AvE techniques every time they do a reserving exercise, and
- Those who don't realise the extent AvE techniques can be used in a reserving exercise.

There are always exceptions to such rules, but we are aiming for the majority in this case.

The purpose of this section is to highlight the range of applications for AvE techniques, and also provide illustrations of what such exhibits could include, together with our view of their strengths and weaknesses.

It is also intended to allow the actuary to be more comfortable (or at least willing) to share the results of such analyses to a wider audience. We understand that this will, at least initially, cause significant discomfort due to a much greater degree of questioning regarding the output of the reserving process itself, but we believe that this will eventually lead to better understanding of both actuarial principles, and the need for expert review of such mechanical diagnostics and so promote the use of actuarial techniques and judgement within the organisation.

Where we as a group have identified simple practical ideas that may help combat some of the difficulties, we have introduced those as "hints", formatted within text boxes to reduce the impact on the flow of the paper, such as it is.

b. Structure for the sub-paper

This sub-paper has 5 sections as follows:

- A summary of our conclusions and recommendations.
- A background section giving a generic definition of AvE, including the types of data that they are commonly applied to.
- A look at how AvE might be used through a typical reserving cycle and the stakeholders who are interested in it.

- What methods are commonly used and how AvE outputs are commonly displayed.
- Pros and cons of using AvE and suggestions for working through the challenges using specific examples.

We note that this sub-paper does not go into the detail of the underlying AvE IT systems or processes required to implement the methodologies discussed.

c. Summary of findings

We believe AvE has lots of benefits, the main one being to enable reserving actuaries to **spend more time on value-adding analysis** rather than turning the reserving process wheel. So whilst there may be an initial investment in setting up your integrated AvE system it will free up time for the team in the long-run.

This will be a **cultural shift** for some reserving actuaries, and indeed some organisations, who feel that every class of business needs a "full review" every quarter. However, given the intrinsic variability in claims development, actuaries should look to AvE techniques to support the null hypothesis that the previous quarter's ultimates are still appropriate for the current quarterly review for the less material and/or longer tail classes of business.

Depending on the appetite of the organisation amendments to this strict assumption may be required, for example, to avoid negative IBNR or reserves. The selling point could be more time to focus on emerging risks and issues, more recent origin periods, or even (dare we say it) time spent on more front-end tasks such as pricing or underwriting strategy depending on how the reserving function is designed and the philosophy of the organisation.

This efficiency benefit can best be achieved if **AvE in its many guises is used at all stages of the reserving cycle process** (e.g. scoping and monitoring between exercises) not just as either an initial diagnostic, or a way of calculating analysis of surplus.

Clear and effective communication is probably the key element in the success of implementing AvE, as it is for most actuarial work. Part of this is being brave in **putting the expectations out in advance** of knowing whether they are right or not! In addition, it's important that the AvE analysis is shared at a level of detail that is appropriate for the audience.

In particular, noting AvE **materiality thresholds** well in advance, and agreeing them with all stakeholders is vital to defend against "scope creep" in the level of analysis undertaken. This can be one of the most challenging parts of reducing the level of detail in a "Fast close" or similar exercise.

Perhaps even more than for a deep dive, **clear communication of the limitations** of AvE analysis and the uncertainty associated with any estimates is vital to ensure the stakeholders are able to interpret the information correctly.

d. What is AvE?

Our definition of AvE is a process (technique) comprising three core steps:

i. Develop one (or more) expectations (E) of the behaviour of an observable quantity over a period of time in the future based on assumptions at a particular point in time t_0;
ii. Compare observed experience (A) during that period $t_1 - t_0$ against those expectations, and
iii. Use the results to assist in completing a task and/or come to a conclusion (as part of the reserving process).

As can be seen from this generic definition, AvE techniques can really be used on any observable quantity. However, typical data to which these techniques are commonly applied are:

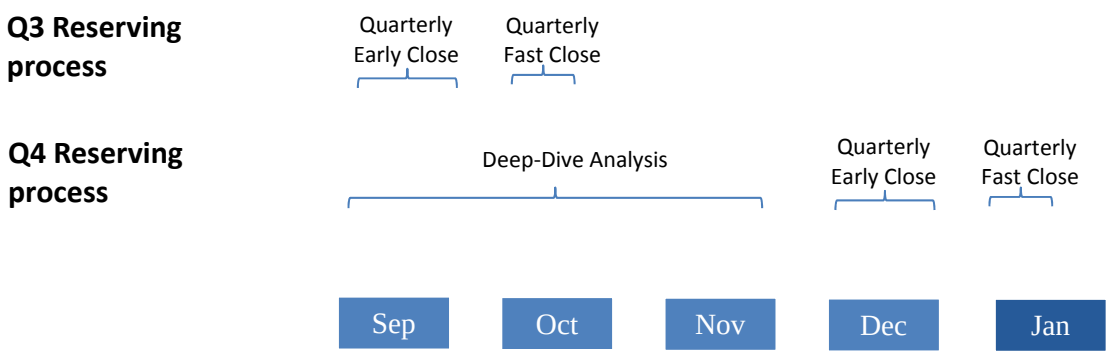
- Premium and claims
- Written and signed / earned
- Numbers and amounts (individual and aggregate)
- Paid and incurred (settled, open, closed)
- Other items like inflation (various types), interest rates (under S2) etc

Tip: Creating the expectation before the start of the time period is particularly important for AvE to become fully embedded, both from a system and cultural perspective.

e. Using AvE through a typical reserving cycle

As companies continue to want to publish their financial results closer and closer to the quarter end, reserving processes are more and more commonly moving to an early close and fast close process, as set out below.

Figure 2 – The early/fast close reserving process



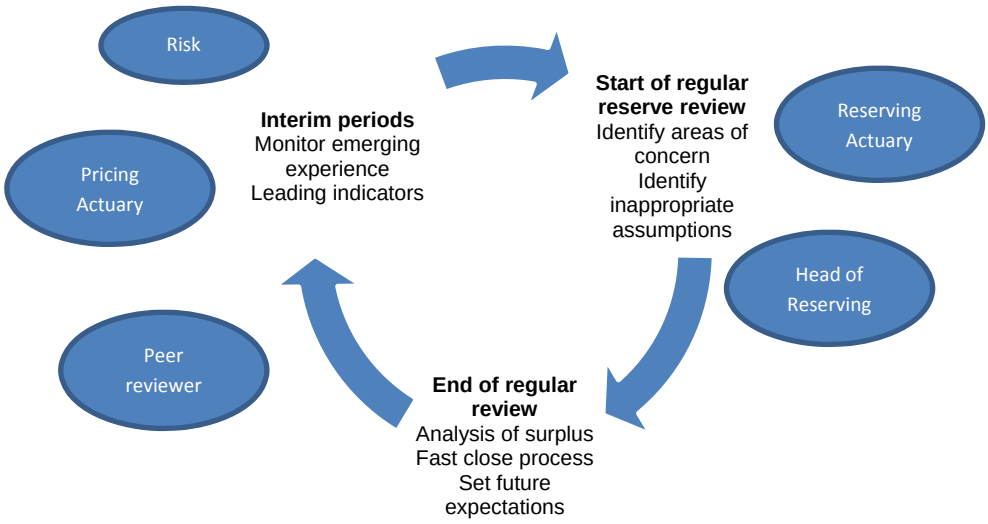
In this context AvE can be helpful:

- at the start of the Early Close reserve review;

- at the end of the Early Close reserve review including the Fast Close reserve review; and
- at interim periods in-between these Early & Fast Close reviews.

As shown in the diagram below.

Figure 3 – AvE in the reserving process



i. Early Close – working from data before the quarter-end

In particular, reserving actuaries commonly use AvE at the start of the Early Close reserve review process to:

i. identify where to concentrate the analyses, both for the immediate Early Close review and any future interim deep-dive analyses, and
ii. backtest assumptions to see if they are still appropriate.

Both of these areas can be very beneficial to a reserving actuary.

The first is probably the most important, and is one of the main recommendations from this paper: use AvE techniques to limit the amount of work done in areas where it is not required.

This can be a scary place for an actuary in that they will have to rely on their diagnostics rather than a full analysis, but this is vital if the limited resources are to be put to their most effective use.

We are not saying that any class that seems to follow predicted paths should never be reviewed, but we would say that the frequency of such reviews, and the timing (being during quarter-end or mid-quarter) could be altered to best suit the availability of resources.

The corollary of this is that the reserving actuary frees up resource to investigate those areas that are materially deviating from expectations, which we would expect to be a more valuable exercise during the quarterly close.

The second is almost second nature to all reserving actuaries, so much so that they may not even know they are doing it. This can take the form of checking the leading diagonal of a triangle against the previous selections, or simply looking at development graphs based on previous ultimates to spot anomalies. In any case, the testing of the previous selections will emerge from applying these previous assumptions to the new data and noting the size and direction of the resulting change in estimated ultimate.

The familiarity of such techniques should not be used as an excuse not to consider them in a wider context, or look for further uses that they can be put to. If such work is being undertaken already, then it should be used as much as possible and to provide as much information to the stakeholders of the process as possible. This may mean feeding the results of an initial roll-forward based on new data into an analysis of surplus, or providing a selection of graphs as part of the reporting pack indicating why such a movement in ultimates was necessary, as noted below.

At the end of the Early Close review process AvE can be used in a number of ways as follows:

i. to explain to governance & business stakeholders whether movements since the previous review are due to the experience being different to expected or changes in actuarial models/assumptions – an “Analysis of Surplus”
ii. this is particularly useful for Finance stakeholders who want an understanding of changing results during the financial year
iii. if one looks over not just the last review but a number of reviews / years then AvE can give an indication of ongoing over- or under-reserving, which high level financial governance stakeholders, e.g. CFO or Board, may be interested in
iv. to set expectations for future periods
v. to provide feedback to other stakeholders who provided assumptions, e.g. Pricing actuaries’ risk-mix trend assumptions

The key is to consider what analyses that are currently being undertaken can be extended in purpose with very little effort, but add significantly to the effectiveness of explaining the movements within the reserving process. Similarly, to consider whether small additional calculations or exhibits can again improve the usefulness of these core techniques both inside the core reserving function, but also across the wider stakeholders.

Note that all of the above is also true even if working from true quarter-end data, if there is a “reasonable” amount of time to perform the analyses.

ii. Fast Close – working from quarter-end data

The key distinction between the above analyses and a “fast close” review, is that in the latter the general anticipation is that there will be no changes to the selections made at the previous review. Any adjustments that are made will be few and specific to reflect material issues or deviations arising since that time.

AvE can have a very specific and significant use after the Early Close reserve review, as it is often the sole type of analysis involved in the Fast Close reserve review given that the analysis timescales for these reviews can commonly be just a few days. Given the significance of this use in its own right we have proposed this entire process as a focus area for later TORP sub-papers rather than focusing on the AvE element of it in detail here.

AvE is also an area that we feel has a lot to offer reserving actuaries from an efficiency perspective as data and IT systems continue to improve and hence we feel it should be more fully embedded into the reserving process rather than seen as an add-on. It is not without its pitfalls though so this sub-paper also looks to give reserving actuaries ideas for coping with these as well.

iii. Monitoring during the quarter

AvE can also be carried out at interim monthly periods as an important monitoring tool to give an initial view of emerging experience against expectations. All business stakeholders will be interested in this to some degree, as it gives an advance warning of what is happening to the profitability of their portfolios/business.

Tip: Ensure that AvE is communicated at the appropriate level of detail for the relevant different stakeholders. For example, for monitoring purposes for the Board this may be whole entity.

f. AvE Methods commonly used and how they are commonly displayed

Given the myriad of possible variables to display, and the multitude of levels of granularity at which the analysis can be undertaken, it is no wonder that such a wide variety of possible exhibits exist to display what is a fairly simple result.

This section sets out a very brief series of classification to assist in explaining the potential exhibits, but the exact combination that is most appropriate for any given purpose will be dependent on many other factors, such as the composition of the audience, whether it is part of a paper or presentation and what message is attempting to be put across.

i. Types of method

There are two main types of methodology:

1) Comparing movements in development data in a period:
- Calculating differences from an expected amount, e.g. expected paid in the period vs. actual paid in the period.
- Eyeballing graphically, such that no explicit expectation is considered, just whether the development “looks right”.

2) Comparing previous ultimate to a new ultimate:
- Re-apply previous models/assumptions to fresh data.

- Apply pre-selected models/assumptions to fresh data.

There are situations where each of these is appropriate, and in some cases they can tell the reserving actuary (or any given stakeholder) specific information: the flight path without expectation requires very little process and calculations around it and will provide broad directional information (ultimates now look too low/high) and comparative data (incurred looks at ultimate, but paid is tracking some way below – redundant outstandings?). The application of previous assumptions and selections to new data will provide a "first cut" reserving output, but also indicate how good those assumptions turned out to be.

We explore the potential uses of specific examples of these methods in the appendix.

The data types that can be applied within an AvE framework are varied and although the most common use relates to data types where development assumptions are used, such as claims payments, premium income or incurred claims. However other data can also be used, such as claim numbers, average costs or transition probabilities within multi-state models.

The frequency of the AvE exercise can vary, being monthly, quarterly or annual. The frequency does not affect the techniques used, but it does affect the level of materiality before which the deviation may be classed as significant.

The expectation against which the actual is measured can be more than a point estimate. The use of ranges can provide not only additional information about how significant a deviation is, but also assist in monitoring against percentile deviations.

Many methods are available to adjust ultimates to take into account deviations from expected development. Thus if there is a deviation that reaches the chosen materiality threshold, how do you decide how much (if any) of this deviation should be allowed to impact the selected ultimates? The answer will depend on the purpose of the analysis being performed, the reason for the deviation and any particular sensitivities of the organisation (at the time), e.g. "we want to fully recognise any implied deficiency in our asbestos reserves immediately".

This document notes this as an important consideration, but does not explore the variety of methods that are possible due to the large influence specific company reserving philosophy will have.

ii. How can AvE be displayed?

As with the presentation of any results, the key considerations when choosing a type of exhibit to present the results of an AvE exercise will depend on the audience, the media of presentation (document, presentation etc.) and the point of the analysis.

As with all presentations, different people get more information from different types of exhibit (figures vs. pictures). In addition, some exhibits will show the point of the

analysis better than others: a flight path without expected indicators would be less useful than one with if numerical deviations are needed.

To indicate the extent of the variety of the potential ways of displaying the information we have set out some examples in the appendix.

Below is a table of some of the key features of the specific methods/exhibit types in the appendix. Where there are other pros, cons or comments we have made these in the commentary under the example exhibit.

Figure 4 – Method/presentation features

Method	Table / Graph	Multiple years	Multiple actuals (e.g. paid, incurred)	Multiple ultimates	Separates large / cat losses	Path to ultimate	Scale (% or £)	
1	Tables by amount	Table	Y	Could	Could	Could	N	£
2	Percentages by year	Table	Y	Could	Could	Y	N	%
3	Graph by year	Graph	Y	N	N	Could	N	%
4	Single origin period	Graph	N	Could but cluttered	Y	Could	Y	£
5	Multiple origins	Graph	Y	Could but cluttered	Y	Could	N	%
6	Flight-path	Graph	Y	N	N	Could	Y	£
7	Combined data types	Graph	N	Y	Y	Could	Y	£
8	Range of outcomes	Graph	N	Y	Range	Could	Y	£
9	Banana chart	Graph	N	Y	Range	Could	Y	%

g. Benefits and difficulties of using AvE

Below we list a number of pros and cons we believe are important to consider when considering how and when to use AvE techniques, and also which presentation method to use. This list is by no means exhaustive, but we consider it a good way to consider the various situations where these methods may assist in moving your current process closer to the optimal.

– Benefits

i) Initial view of emerging experience against expectations – a very fast process, perhaps with limited detail and/or guidance. May involve numerical deviations or more broadbrush subjective assessments.

ii) Can usually be automated and hence quick to perform calculation – in some instances a great deal of thought and planning is required to get the most efficient and appropriate process, which may take some time to implement initially, but in the medium term could be very slick.

iii) Can be carried out at any level of granularity (portfolio, claim type etc) – potentially even more granularly than the assumptions were set at (depending on the allocation methodologies in place).
iv) Can be applied to any observable – in some cases monitoring nil claims, claim numbers or claim counts may be a better diagnostic than incurred claims due to greater stability, and may give insight into particular elements within the claims process.
v) Graphical and other presentation methods can allow very fast review of the results, particularly if selecting a "drill-down" approach if only a high-level check is required.
vi) Good for long tailed lines of business – particularly over an extended period of time trends away from expectations can be monitored and hence investigated.
vii) Helps communication – is an intuitive measure that is easily understood, although care will be needed to manage expectations of the eventual effects on the estimated ultimate.
viii) Cashflows will be required under Solvency II – and hence future expectations of paid claims will already be available.
ix) Useful feedback into actuarial / business planning process – is a backtesting mechanism that can highlight areas for further review.
x) Useful starting point for discussing potential reserve changes.
xi) Already done by most firms, albeit sometimes informally and hence at least some of the infrastructure is already in place.
xii) Adds discipline to the reserving process – due to formally recognising deviations from expectations, which will assist in highlighting where assumptions require review.
xiii) Helps to put movements into perspective – noting the size of the expectation can make explaining reserving movements easier over time as the stakeholders get used to the "normal" level of volatility around an expectation: a £5m deviation from a £70m expectation could be construed differently to that from a £20m expectation (even though both could be considered "normal" is different circumstances!).
xiv) Enables a fast close, particularly where ultimates aren't expected to change – possibly the most difficult process to communicate and manage expectations around.

– Difficulties

i) Answers may need interpretation (and hence can be misinterpreted) – absolutely key in all analyses, but particularly AvE.
ii) Will not give all the answers – especially where there is more than one offsetting trend/driver, e.g. frequency and severity effects. The AvE exercise will only look at the data being used; any competing trends embedded within that data will not be flagged separately unless the exercise is carried out on independent metrics, e.g. claims counts as well as total incurred.
iii) The more granular, the less reliable – as with reserving itself, the shorter the period of projection and the lower the granularity of the analysis, the more

volatile the actual data is likely to be, and hence harder to identify whether a deviation is significant or not.

iv) Lumpy experience such as cats can make the analysis irrelevant/ misleading – this is a specific case of the volatility in the previous point. Here techniques such as monitoring over longer time periods, or looking at cumulative rather than incremental data can assist in interpretation.

v) Bordereau: timing of data arrival is artificial, not tied to loss date – another specific example of granularity issues, where incremental data may have a natural frequency below which any AvE technique will fail.

vi) Volatile in early development periods (for long tailed classes) – the granularity/frequency issue again, but noting that in some cases very sparse expectations may cause fluctuations in the early development. Usually best handled via materiality expectations and potentially considering multiple years combined as well as individually.

vii) Analyses on different data (paid vs. incurred or ACPC, frequency vs. ultimate) may lead to conflicting indicators – this is the corollary to point (ii) above. In this case if random fluctuations in actual data are giving different messages, the granularity may not be appropriate, or there may actually be some fundamental issues arising in the data!

viii) Paid claims roll-forwards tend to understate cash flows – a common failing in the reserving process, where paid projections can become second class and less focussed on. It is always important to ensure these patterns are appropriate, and even more so as reserving bases become more and more cashflow based.

ix) Setting expectations when not applying a “pure” reserving method – this is more of a problem for “ultimate” AvE techniques, but can be addressed approximately by a number of techniques (interpolation, use of weightings between standard methods etc.) depending on how the results will be used.

x) Should the expectation be based on the actuarial best estimate or the booked ultimate? Important when the bases are materially different, and depending on the use of the output and how each basis is derived.

xi) Expectations of negative development – this may add confusion to the interpretation of the output.

xii) What if there are process changes that mean the expectation is no longer appropriate? This may render the exercise much less valuable, particularly if the effect of that change has not yet been enumerated.

xiii) Interpretation if the results where there is a zero prior expectation – perhaps if a new class has recently been written, this will need to be adjusted for in any interpretation of the results of AvE, or the process itself will need adjusting.

xiv) Doesn’t capture changes in underwriting / exposure very well – the interaction of premium and claims development expectations is complicated. However the fundamentals of testing previous assumptions still holds true, with the comparison of output of both exercises able to give a more complete picture, e.g. “we’ve had more claims development partially due to an increase in exposure in the period”.

xv) Communicating the mean vs. median – always a challenge in low frequency/high severity classes.

xvi) Only as good as the expected! Relies on sensible assumptions in the first place, but can also be used to highlight where they don't exist (i.e. Pros (ix))

h. Communication of AvE

Actual vs. Expected analysis is not a new idea and at a recent IoA Reserving Seminar plenary on this topic most attendees said they were using it in some way. We have decided to focus on it for this sub-paper though as it is an area where we feel that a lot of misunderstandings can arise due to the sheer variety of ways in which AvE can be used and communicated. In particular, given the increasing use of AvE within formal governance processes and the ever increasing interest in AvE from Executive and Board stakeholders these potential miscommunications can pose a real risk to organisations if not identified and resolved.

One of the most important factors in communicating AvE results, and one of the most important points in this paper, is that setting expectations of materiality is key. We do not want Board members asking over a £2k variance on an expectation of £50m. Unfortunately there is no magic formula for an appropriate level of deviation to be considered "within expectations". Various exhibit types as mentioned above and in the appendix may assist in steering the necessary conversation to an appropriate solution, but in the end it will be the personal and corporate sensitivities of those involved that will make that decision.

Unfortunately it does not end there. When development is close to expectations, stakeholders can have a tendency to dig into the biggest "remainder" to look for issues. This is a guaranteed way to lose any benefit gained by reducing the level of analysis in the first place – always be clear about the level of materiality of when a deviation needs to be investigated, and also when an adjustment may occur.

Our other focus regarding communication relates to ourselves: be brave in communicating your expectations. They are indeed a very public hook on which to hang your reputation, but they are also a fundamental part of your previous estimates, and hiding behind experience over a quarter does not do your reputation any good either!

7. Conclusion

Our conclusion to the paper as a whole is unusual in that it does not summarise the rest of the paper. It is primarily a tool to set out our stall for future work, and to encourage the reader to provide their personal opinion of the most pressing area within the reserving process as set out in this paper for further discussion.

This can be the topic they are particularly struggling with at the moment, or have yet to tackle themselves. Or it can be the "wise old actuary" view of what the youngsters never get right.

Our own thoughts on this matter can be summarised as follows:

- Timing of reserving exercises – In particular the “fast close”, where the reserving actuary has to produce an answer in advance of a seemingly impossible deadline. Specifically, this can be seen in reporting to stock markets or GAAP accounting. What is the best way to deal with the competing pressures of robust reserving and fast reserving?
- Transforming ultimates – The plethora of reporting bases can easily tangle innocent numbers into a web of forced interpretations, which can cause inordinate amounts of work to explain comparisons. What processes and calculations can help in making this less painful, and what limitations do they have?
- Interpretation and comparison of reserve uncertainties – An emerging sphere: how can you compare outputs of reserve uncertainty techniques in a sensible way, and justify your decision to both technical and non-technical audiences?

Please do let us know if one of the above resonates particularly with you, or indeed if another topic seems more appropriate for our attention.

APPENDIX: Types of presentation of AvE

1. Tables by Amount

Reserving class	Origin year	Actual incurred move	Expected incurred move	Delta Inc'd	Previous ultimate	Updated mechanical ultimate	Delta Calc Ult	Selected movement
Class 1	2011	1,032	965	67	14,692	13,347	(1,345)	0
…	…							
Class 2	2013	7,963	8,100	(137)	25,693	21,325	(4,368)	6,500
…	…							
Class n	2012	10,586	8,400	2,186	38,200	40,346	2,146	2,000
Total	All	32,500	30,100	2,400	n/a	n/a	(1,596)	10,000

Description:

- Rows represent reserving groups and are commonly combinations of class, head of damage and origin year. There are likely to be substantially more rows than shown here.
- Columns represent data movements, e.g. payments, settled clams, frequency, claims numbers, average cost per claim and more. There are also columns for impact of data movements on projected ultimates which can be increased to show different bases of adjustment. In practice there are likely to be columns than shown here.
- As with any reserving work resulting in ultimate costs there is still a selection process required and a requirement for judgement based on strong knowledge of what is happening within the claims portfolio, e.g. the impact of large claims, weather events, catastrophes, etc.

Uses:

- Primarily for practitioners to review numerical deviations from expectations and capture assessments of the impact to selected ultimates. Can also be used as a direct output of the process (at an appropriate granularity) for explaining selections to stakeholders.
- Use of "selection" columns can be used to show how much of any deviation is being allowed to flow into the results – a comments field, or an accompanying document will need to give explanations of such selections referencing the materiality and objective of the exercise as normal.

Pros/cons:

– Can be very detailed as an exhibit.
\+ Captures rationale directly and aids in audit trail

+ Can be used on multiple bases (gross/net) and various granularities as appropriate. Can also be used to determine gross deviation with reference to the data, and then infer the RI impact by considering each of the gross issues separately, hence avoiding the need to repeat the exercise on RI data.

2. Table: Percentages by Acc Year

Attritional	2008	2009	2010	2011	2012	2013	Total
Actual	62.6%	35.0%	26.8%	52.0%	39.0%	46.9%	42.0%
IELR Budget	53.5%	54.0%	49.8%	48.7%	51.2%	46.9%	49.9%
AminusE	**9.1%**	**-19.0%**	**-23.0%**	**3.3%**	**-12.3%**	**0.0%**	**-7.8%**

Catastrophe/LL	2008	2009	2010	2011	2012	2013	Total
Actual	40.0%	32.4%	83.4%	15.5%	65.0%	21.6%	42.3%
IELR Budget	22.6%	23.2%	21.6%	18.2%	17.3%	21.6%	20.2%
AminusE	**17.4%**	**9.2%**	**61.8%**	**-2.7%**	**47.7%**	**0.0%**	**22.1%**

Total	2008	2009	2010	2011	2012	2013	Total
Actual	102.6%	67.4%	110.1%	67.5%	104.0%	68.5%	84.4%
IELR Budget	76.1%	77.2%	71.4%	66.9%	68.5%	68.5%	70.1%
AminusE	**26.5%**	**-9.8%**	**38.8%**	**0.6%**	**35.5%**	**0.0%**	**14.3%**

Description:

+ Proportion of development (as a percentage of reserves, IBNR or other metric) in the period compared to the expectation ("budget").
+ In this case split by claim type and origin period, as well as totals.

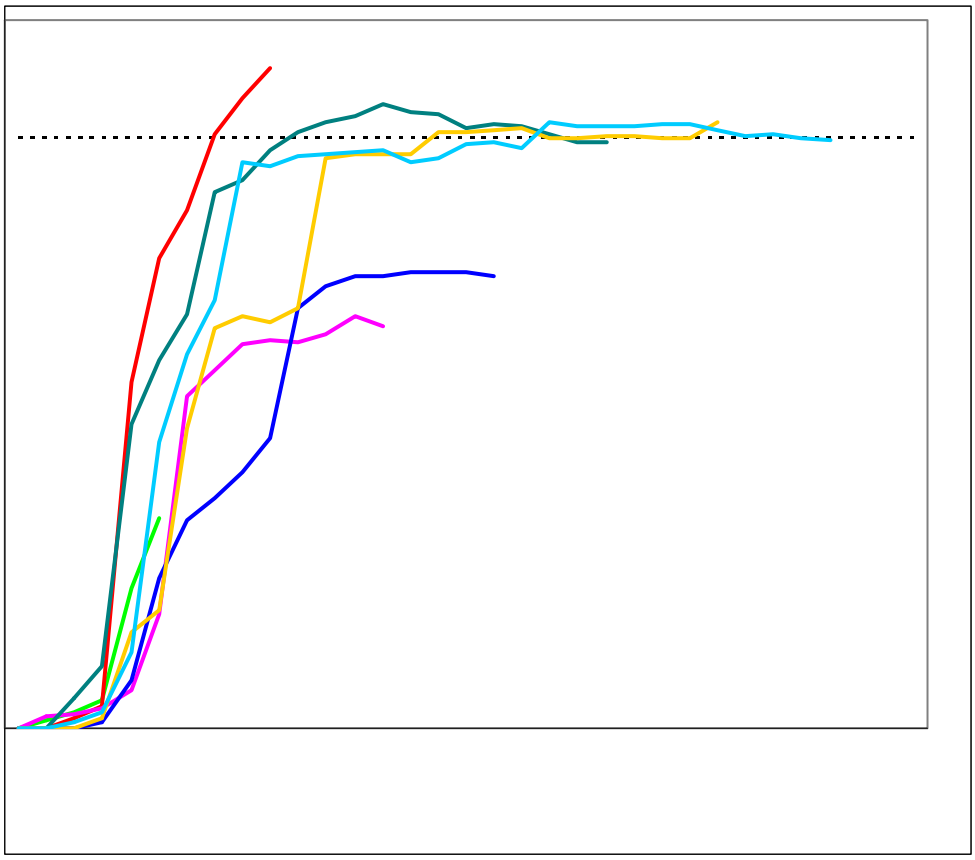
Uses:

+ As a volume independent reference to identify areas that are significantly away from expectations.

Pros/cons:

+ Shows expectations and deviations together to give an indication of relativities.
+ Conditional formatting on the AvE can aid quick identification of material deviations
+ Splits out attritional vs. more volatile experience.
+ Use of ratios assists in comparing widely different amounts on the same schedule.
– Counter to the above, does not give an indication of relative materiality.
– There is no absolute deviation presented, hence summing results over multiple classes etc. will be difficult unless additional information is provided.

3. Simple Graph by Origin Period



Description:

- Flight path graph showing multiple origin years development of a development statistic (paid, incurred claims, signed premium, claims numbers) over time against the prior selected ultimate (or other measure such as ultimate premium).

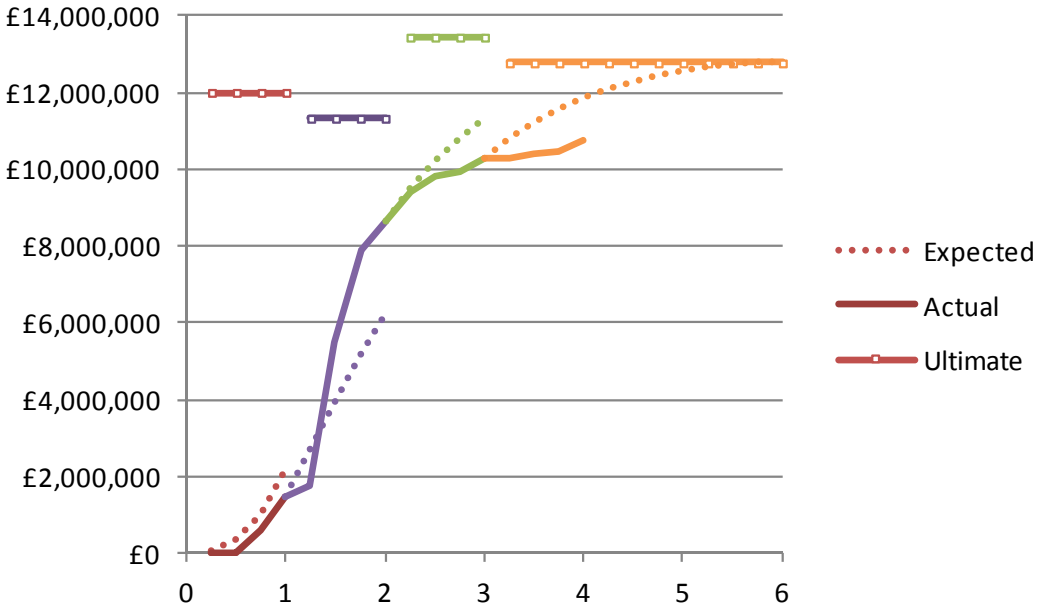
Uses:

- High-level diagnostic of varying development characteristics between origin years.
- View of last data points) can indicate whether movement is approximately as expected.
- Alternative can show multiple statistics for a given origin period, which can assist in identifying inconsistent assumptions (see next example).

Pros/cons

+ Graphical format makes for easy review.
+ Scale can make most recent development difficult to see.
– Can get crowded if too many years are presented at once.
– No view of expected development.
– No numerical output to quantify deviation from expectations.

4. Single Origin Period Graph



Description:

- Shows historical view of ultimate selections as well as change in expectation over a series of reserving exercises.

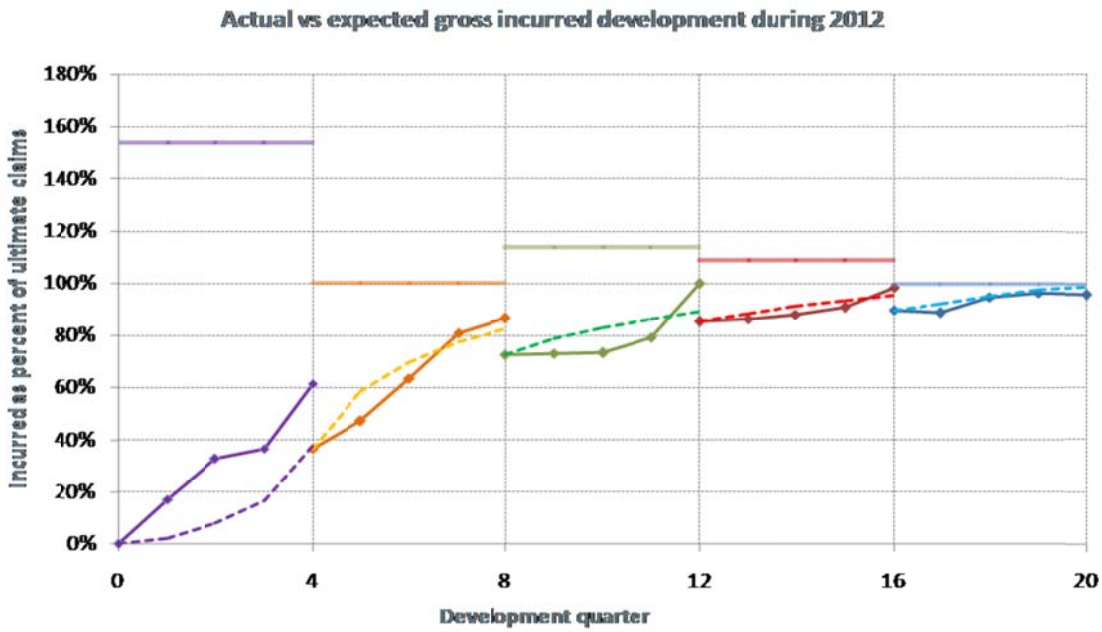
Uses:

- Actuarial diagnostic for providing feedback on previous (more than one set of) reserve review assumptions.
- Indicates volatility of selection of ultimate.

Pros/cons:

+ Highlights changes in expectations over time, in particular over multiple reserve exercises.
+ Shows how actual has deviated from expectations at previous reviews to indicate consistent under/over reserving.
– Divorced from e.g. any change in exposure measure, hence will not give the full story.
– Complicated to explain to non-actuaries.

5. Graph of Multiple origin Periods



Description:

- Shows latest development on multiple origin periods on one graph. Horizontal bars showing actual as a proportion of expected development in the period.

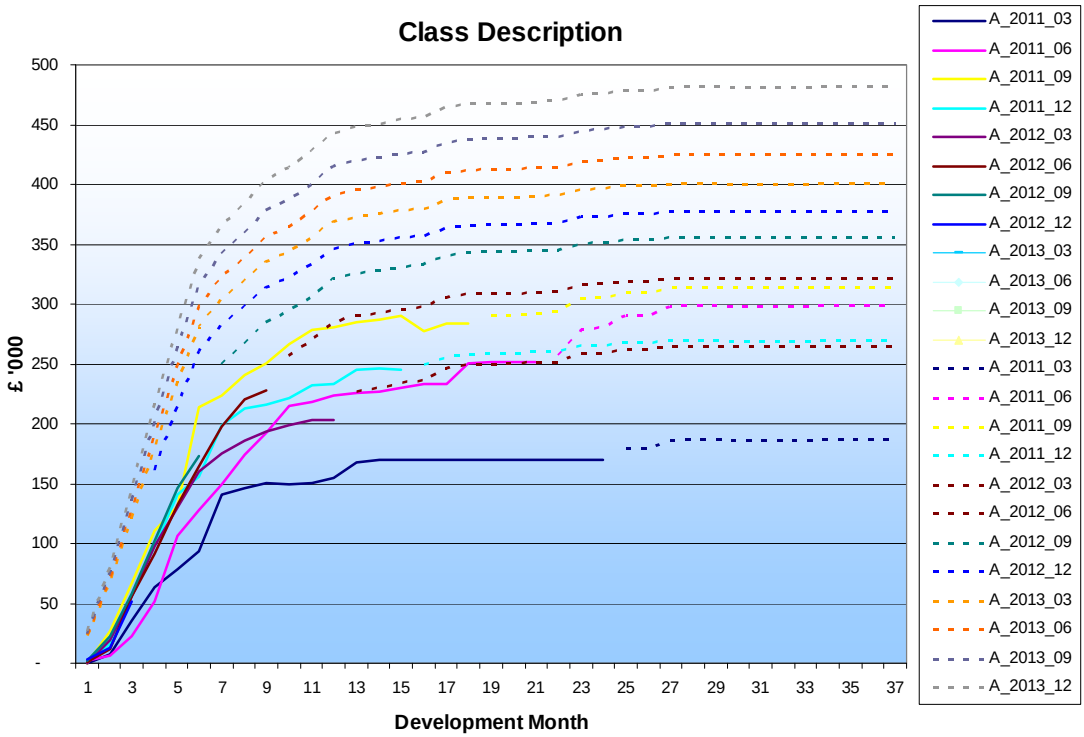
Uses:

- Summary diagnostic showing how development has compared to expectations for multiple origin periods at once.

Pros/cons:

+ Allows quick identification of significant deviations through horizontal bars.
+ Very compact exhibit (compared to showing all development of all years).
+ Expectations set out.
+ Could extent to paid and incurred claims (although may need to balance clarity).
– No indication of materiality.
– Does not show historical information.
– Cannot easily combine different classes without computation.

6. Graph showing flightpath



Description:

- Actual development shown with expected future flightpath for multiple origin periods.

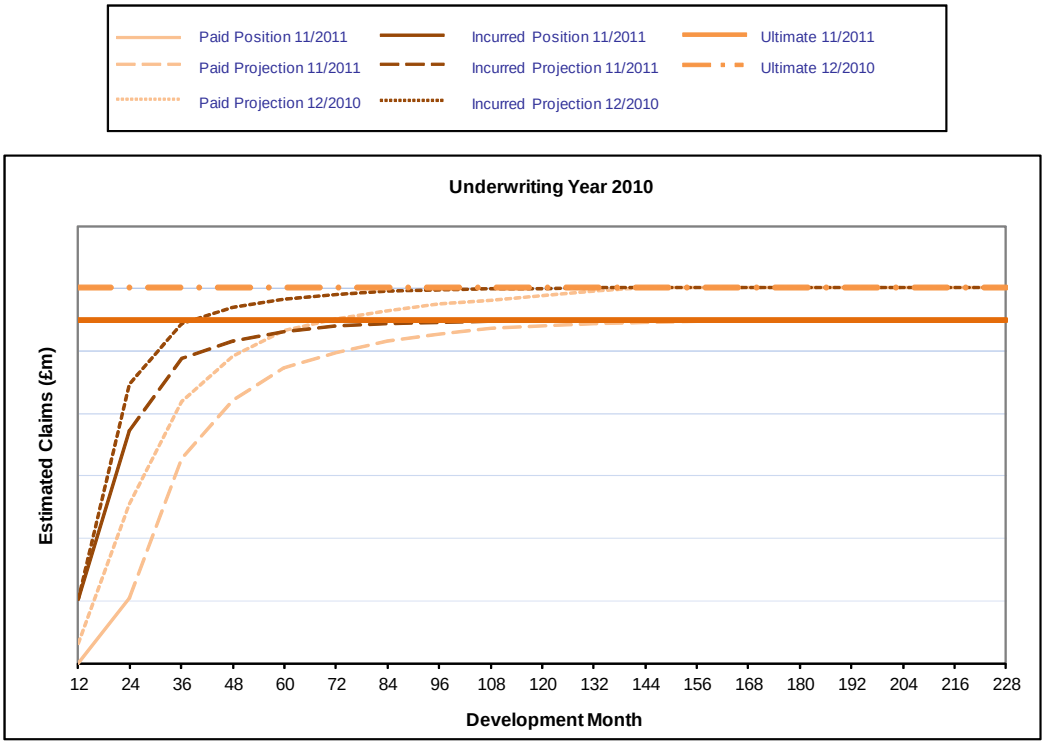
Uses:

- Shows expected development for multiple origin periods.

Pros/cons:

+ Gives absolute amounts for measuring deviations.
– Can get busy with many origin periods displayed at once.
– Does not show actual compared with expected.

7. Graph combining data types



Description:

- Showing change in projection due to review for both paid and incurred claims.

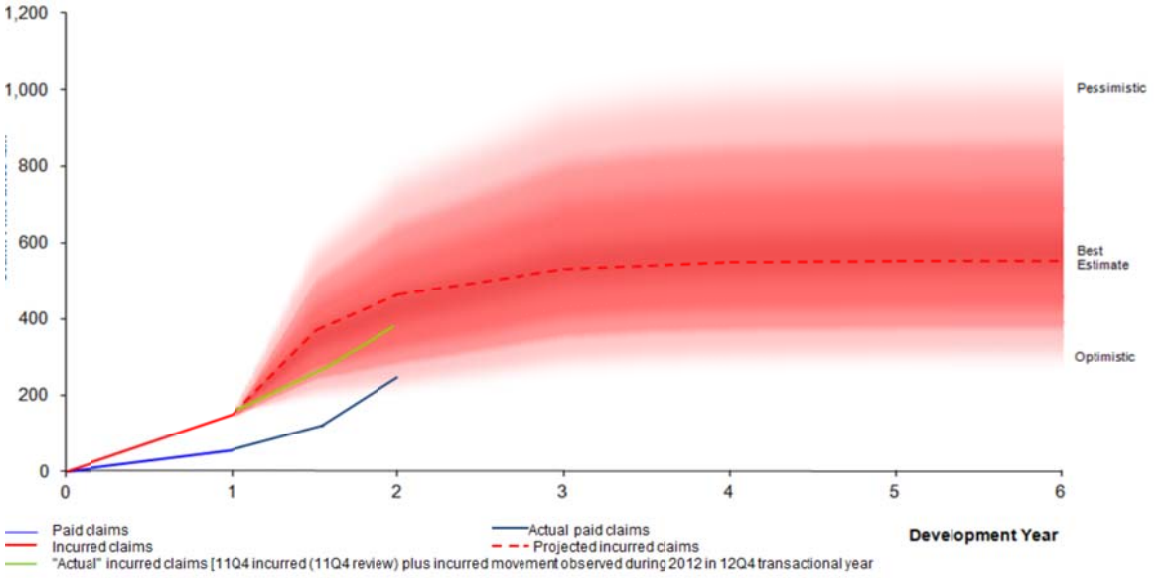
Uses:

- Reserving diagnostic showing movement in ultimate selections. Also can be used if applying previous assumptions to current data to identify effect on ultimates.
- Indication of consistency of paid and incurred projection results.
- Determine expected flightpath of future claims statistics.

Pros/cons:

+ Shows comparative curves with different data statistics.
+ Shows change in indicated ultimate selection.
+ Can identify magnitude of deviation.
– No indication of actual against expectation for each statistic.

8. Graph indicating range of outcomes



Description:

- Graphical indication of range of potential future paths, with indication of path to best estimate selection. Also shows actual development in comparison as well as paid data for reference (without expectation).

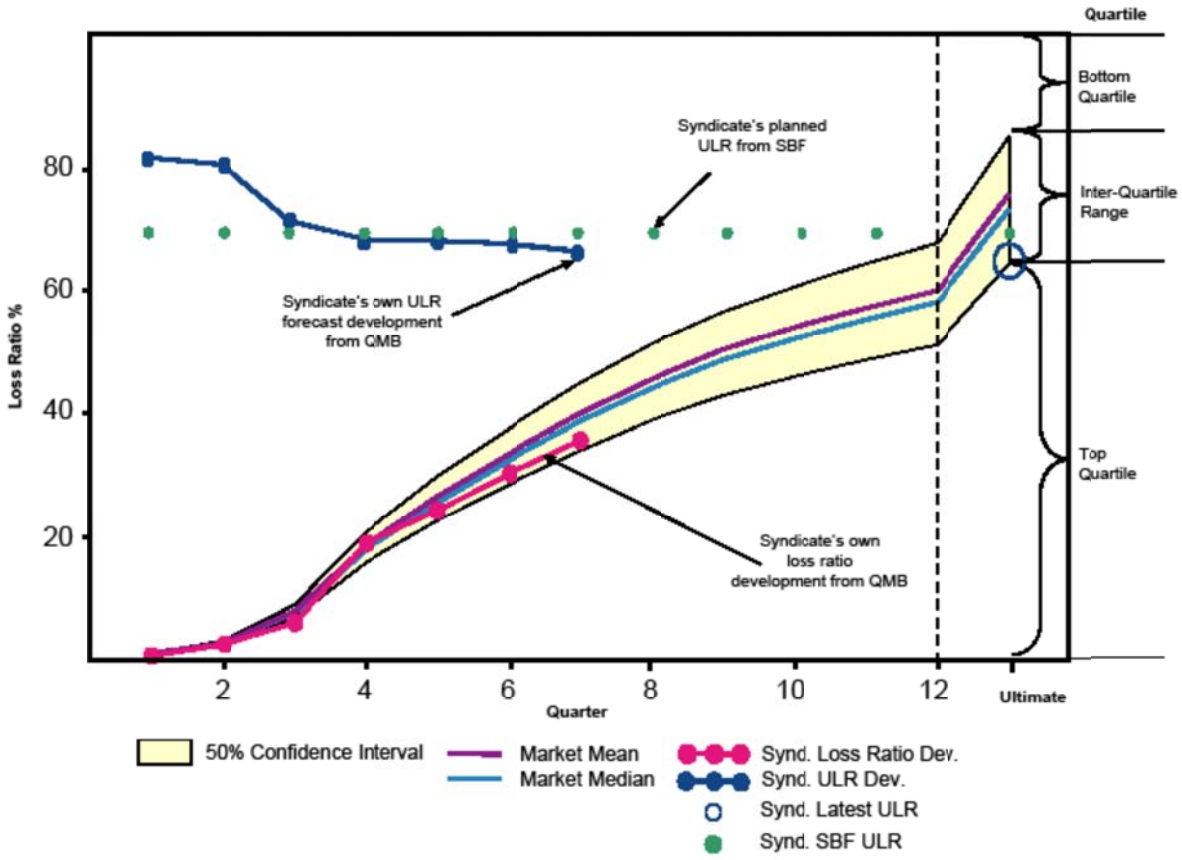
Uses:

- Provides graphic indicating “return period” of deviation of statistic from expectations.
- For high-level presentations can illustrate deviation in context without requiring strong mathematics, particularly for either total portfolio level, or to illustrate “problem” accounts.

Pros/cons:

+ Provides context of expected probabilities for equivalent deviation.
+ Magnitudes included to assist in putting materiality into context.
+ Can provide sense check on reserve variability output.
+ Paid claims reference useful, but is slightly out of context as no expectations indicated.
– Combining such probabilistic results very difficult conceptionally and if explaining multiple such graphs in aggregate.

9. Lloyd's of London 'Banana Chart'



Description:

- Shows development of ultimate loss ratio compared to original plan.
- Also sets out development if statistic (usually incurred) against initial expected inter-quartile range of development, including indications of mean and median.
- Development after 12 months condensed into one quarter for ease of presentation.

Uses:

- Officially as an indicator of development against original (plan) expectations and notional portfolio.
- Also as a comparison of historical reserving accuracy and profitability compared to original expectations.

Pros/cons:

+ Shows the history of AvE not just the latest point, which should help build up a picture and avoid focussing on a single development period.
+ Provides comparative to original plan.
+ Gives an indication of expected volatility.

- There is a lot going on in just one chart and there needs to be one for each class and origin year.
- Does not provide detail on older origin periods (although scales could be changed for those years).
- Expectation does not change over time.