Quantification and Reporting of Uncertainty for GI Reserving

A paper produced by the Reserving Oversight Committee of the Actuarial Profession

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Introduction

This paper has been produced by ROC (the Reserving Oversight Committee, a subcommittee of the General Insurance Board of the Actuarial Profession).

The GRIT Report (A change Agenda for Reserving, presented to the Institute of Actuaries on 27 March 2006) recommended that 'an actuary should be required to show a numerical estimate of uncertainty in any formal report wherever a point estimate of reserves is supplied' (para 1.5.2). The purpose of this paper is to set out the views of the members of ROC on how this recommendation should be implemented in practice. We welcome comments on this paper.

This paper represents only the views of the members of ROC. It does not constitute formal guidance for actuaries, it does not form part of the Manual of Actuarial Practice and is not an 'AP Standard' as defined by the Professional Conduct Standards. There is no mandatory requirement on members to use any information or follow any advice given in this note.

In this paper personal pronouns have been used in both genders, randomly, in approximately the same proportions as the gender mix in ROC.

1. Existing guidelines

1.1 Section 8.1 of GN12 states that:

The report *should normally* indicate the nature, degree and sources of uncertainty surrounding the results and sensitivities to key assumptions. Uncertainty *should normally* be quantified where practicable, but otherwise *should normally* be reported using an appropriate descriptive summary.

1.2 "Should Normally" is defined in the PCS:

"*members* must comply with a particular requirement or prohibition, unless the circumstances are such that the requirement or prohibition is inappropriate and non- compliance is consistent with the standards of behaviour, integrity, competence and professional judgement which other *members* or the public might reasonably expect of a *member*"

2. ROC's Interpretation of GN12

2.1 The current version of GN12 was drafted during the consultation process on the GRIT paper and had regard to the GRIT recommendations. GN12 requires that actuaries should normally quantify uncertainty where this is practicable, and leaves the actuary to make the judgement of when it is practicable to do this. The following sets out ROC's views on how this should be interpreted in practice:

a) Where GN12 applies the actuary should, in nearly all cases, illustrate the uncertainty in the eventual outcome of the ultimate claims with a numerical quantification (the 'Quantitative Illustration') which the actuary considers appropriate. The actuary should also provide a qualitative description of uncertainty.

b) There should only be a small number of exceptional instances where a Quantitative Illustration of uncertainty is not supplied, and this should be where there are specific reasons for deeming it inappropriate to supply an illustration. If a Quantitative Illustration is not provided the actuary should explain why he has decided not to supply it.

c) As actuarial judgement is involved, to a certain degree, in all methods used for quantifying uncertainty, there is necessarily going to be an element of inconsistency between the Quantitative Illustrations produced by different actuaries. This is not sufficient reason for not providing a Quantitative Illustration of uncertainty.

d) The actuary should normally state how she has calculated her Quantitative Illustration.

e) The actuary should normally explain in a clear vocabulary what the Quantitative Illustration of uncertainty is intended to cover. For example it may exclude the emergence of significant new latent claims, or be based on the assumption of a stable inflation environment, or be based on the assumption of a stable legislative environment for personal injury claims for motor claims.

f) At least one Quantitative Illustration should normally be given which allows for uncertainty in outcome – i.e. in technical terms allows for all three of model, parameter and process uncertainty. The actuary should consider whether there is a need to discuss in the actuarial report the difference between these three causes of uncertainty, and if so this

should be in a form appropriate for the intended audience (in particular intelligible to non-experts.)

Model uncertainty stems from using the wrong model. Parameter uncertainty stems from the parameters not being what they are estimated to be, even if the model is correct. Taken together, parameter and model uncertainty is the statistical risk that the correct application of sensible methods and calculations will not accurately reflect the underlying distribution of possible ultimate claims outcomes, as a result of a combination of data errors, sample errors and an inappropriate fit of models. Process uncertainty is also referred to as stochastic uncertainty and stems from actual out-turn being random. Even if the model and parameter uncertainty were zero, there would still be a range of possible outcomes, exactly defined by the actuary's model. As such the actuary could make statements about percentile events by reading off the distribution implied by his model.

A more detailed discussion of parameter and process uncertainty can be found in section 6.3.2 of the GRIT Report: A change Agenda for Reserving, presented to the Institute of Actuaries on 27 March 2006. (Although it should be noted that in that paper – as is explained therein – parameter and model uncertainty are collectively described as 'parameter' uncertainty.)

g) If the actuary describes the Quantitative Illustration using the phrases model, parameter and/or process uncertainty, then the actuary must explain these terms clearly.

h) In this note we have focused mainly on the causes and quantum of uncertainty. We have not considered the timing of the emergence of uncertainty – i.e. how long before outcome could start differing materially from the estimate, or by when will all the uncertainty have manifested itself.

2.2 The Quantitative Illustration of uncertainty should be in a form that the actuary considers most appropriate in the context of the scope and purpose of the work to demonstrate the potential for material adverse (or favourable) deviation. Some examples might be:

a) A range of outcomes for aggregate ultimate claims. As discussed in Section 5 below this would typically have a 'likelihood' and 'severity' element.

b) Scenario based illustrations of uncertainty – ie a quantification of the effect on ultimate claims corresponding to specific scenarios described by the actuary. These would typically have a 'severity' element, but a 'likelihood' component might not be required.

c) Separate illustrations of outcomes for different parts of the reserves, or corresponding to different causes of volatility. Each could be described by either range or scenario approach, with the possibility that a combination is used.

d) Some other way of illustrating uncertainty in a quantitative way which the actuary considers appropriate.

2.3 As noted above the Quantitative Illustration should be of the eventual outcome of ultimate claims. The actuary may of course also provide an illustration of the range of reasonable best estimates, or some other measure, if she feels it is appropriate. If she does so it is important that the actuary describes the distinction clearly.

3. Describing the causes of Uncertainty

3.1 Communicating uncertainty should enable users of actuarial reports to understand the nature as well as the size of this uncertainty. A quantitative illustration of uncertainty is useful only if it helps users understand what it means in terms of the results presented to them. As such, helping the user of the report to understand the context and implications of this numerical measure is as important as the quantitative assessment itself.

3.2 In order to do this, actuarial reports should disclose sufficient information on the key drivers of uncertainty. To this end, the actuary should normally accompany the Quantitative Illustration with a description of the sort of event, events or trends that would need to occur for the lower and upper limits of any ranges, specific points on a distribution, scenarios or illustrations produced by the actuary to be reached.

3.3 Producing an overall measure of uncertainty at an aggregate level (by combining results from sub-level – eg individual classes of business) will require some adjustment for diversification, and so will require assumptions about correlations. This will contribute to the uncertainty in the overall aggregate estimate and should be included in the communication of uncertainty. It may be included in the Quantitative Illustration of uncertainty in a way that the actuary considers appropriate.

4. Methods used to quantify uncertainty

4.1 There are, as yet, no universally accepted definitive methods for quantifying uncertainty in outcomes, so the actuary will need to use a degree of judgement when selecting the most appropriate approach for estimating uncertainty.

4.2 GN12 is not prescriptive about the methods that should be employed by the actuary when quantifying uncertainty, however in one or some combination of the following approaches should normally be used:

- Judgemental/Indicative Volatility
- Scenario/Stress Testing
- Statistical Methods

4.3 A statistical methodology is not always appropriate and a judgemental approach based on the actuary's knowledge of the account and experience of the relevant wider market issues may be the most practical approach.

4.4 In choosing the approach to quantifying uncertainty the actuary may also have regard to the costs and benefits involved. For example an approximate judgemental method may in some circumstances be preferable to a complex sophisticated and time consuming statistical approach, whereas in other cases the latter may be more appropriate.

5. Practical Approach to Communicating Uncertainty

5.1 This section discusses how the quantification of uncertainty in the overall result can be communicated. The numerical quantification of uncertainty will generally need two components corresponding broadly to size and likelihood. The size component is usually stated explicitly, and the likelihood component can generally be communicated in two ways:

1 Everyday English

2 Percentiles

5.2 It may be helpful to note that Percentiles is a method of communicating uncertainty rather than a method of estimation i.e. the actuary could use a judgemental approach to quantify the reserve uncertainty and then communicate this uncertainty using percentiles.

5.3 If the actuary chooses to use percentiles to communicate uncertainty, he should be aware that the precise nature of this form of communication could be interpreted as implying that uncertainty has been quantified very accurately. If in fact the quantification is uncertain, then the actuary should be careful to counter any such mis-interpretation. It may be that Everyday English is a preferable way to communicate uncertainty when the quantification is based on significant areas of judgement. However, Everyday English runs a greater risk of ambiguity, and in some cases a combination of methods could be appropriate.

5.4 Overall therefore, the actuary should consider the appropriate choice between Everyday English, percentiles, or a combination when communicating uncertainty.

5.5 When giving a range of outcomes the use of the terms ‘high’ and ‘low’ without explaining the meaning of these should be avoided, as the reader may draw erroneous conclusions regarding the degree of extremity of these points within the complete distribution of outcomes.

5.6 In some circumstances the actuary may wish to communicate outcomes in the tail of the distribution. In these cases, we believe that consistency in how we as a profession communicate with our stakeholders is important. With this in mind we suggest that the following standard vocabulary from Table 1 below should normally be used, in the context indicated. However this does not preclude the actuary using additional alternative phraseology if it would assist the audience understand uncertainty better.

Table 1: Suggested Standard Vocabulary for communicating Uncertainty in GI reserving

Indicative percentile	75%	90 %	95 %	99%
Wording 'below' percentile	Fairly likely that the outcome will lie below this estimate	Likely that the outcome will lie below this estimate	Very likely that the outcome will lie below this estimate	Extremely likely that the outcome will lie below this estimate
Wording 'above' percentile	Reasonable chance that the outcome could lie above this estimate	Possible but unlikely that the outcome will lie above this estimate	Possible but very unlikely that the outcome will lie above this estimate	There is a possibility, albeit remote, that the outcome will lie above this estimate

5.7 The rationale for the wording in line 1 is that the dictionary definition of 'likely' is: 'probable, such as might well happen'. This has been applied to the 90 percentile, and the other percentiles graduated accordingly. For line 2 the dictionary definition of 'possible' is: 'that can happen'.

5.8 If the actuary wishes to communicate ranges with a different definition than suggested above then he will need to adapt the wordings suggested above as he sees appropriate. E.g. if the actuary wanted to communicate say a 5% to 95% confidence interval then the phrase 'likely that the outcome will lie within this range' could be used.

5.9 In some circumstances the actuary may wish to communicate a narrower range, say for example a range which the actual outturn could well fall outside. In these circumstances wording of the form below could be used:

> "The outcome is as likely to be inside the range as outside it, and is as likely to be above as below."

5.10 The actuary may want to combine the wordings for 'Below' and 'Above' and a Percentile communication approach, for example:

> 'Whilst it is fairly likely that the outcome will lie below this value, there is a reasonable chance that it could lie above. In statistical terms this equates to the 75^{th} percentile, meaning that in my judgement there is a 75% chance that the outcome will lie below this value and a 25% chance that it will lie above."

5.11 Finally there may be circumstances where the actuary wants to communicate only the severity component of uncertainty. This would typically be because the actuary was unable or unwilling to take a view on the likelihood component. An example would be communicating the potential impact of a specific scenario – eg the outcome of a material legal dispute. In this

case the uncertainty would be communicated in the obvious way - if lost then the financial impact would be £xm, and if won it would be £ym.

5.12 It should be noted that if the scenario approach is used in the quantification of overall uncertainty (as opposed to illustrating the causes of uncertainty as described in section 1.2 above) then the actuary should consider carefully how the scenario has been incorporated in her best estimate. The potential issue is that if the actuary feels

- unable to quantify the likelihood component then she should be clear how this has been incorporated into the calculation of the best estimate (which might for example involve calculating, at least conceptually the mean of the distribution of outcomes.)

- able to quantify the likelihood component, then arguably the scenario should not be treated separately, but incorporated into the overall likelihood/severity communication described at the start of this section 1.4

5.13 The actuary may also wish to have regard to the wordings suggested for communicating the impact of large losses, as set out in the advisory note on wordings for actuarial opinions and reserving reports - large losses (27 January 2006).

6. Examples

Two examples of the wordings that could be used are given below:

Example 1 – Combination of judgemental and statistical estimation methods combined with Everyday English for communicating uncertainty. In order to clarify the link between the words in this example to the table above the confidence interval being referred to on each occasion is described in square brackets. In practice these words in brackets could be omitted, or the actuary could include a quantitative explanation of his plain English words, as he feels appropriate. Also, in practice the actuary may not want to describe as many components of uncertainty, but they are included here to illustrate possible wordings based on the table above.

The best estimate reserve is my estimate of the expected value of future claims. However, there is considerable uncertainty in the eventual outcome of claim payments, and future claim payments could be more or less, possibly significantly so, than the best estimate. Estimating this uncertainty is a judgemental process, but in my view there is a reasonable chance that claim payments will exceed £Am, but unlikely that the outcome will exceed £Bm. [A and B are estimated 75% and 90% percentiles respectively]

Some of the key features which contribute to this uncertainty are:

(1) the XYZ legal dispute, which could cost up to £C1 million or produce savings of £C2 million;

(2) normal volatility in payments experienced in the past. If this repeats in the future, it is possible (but unlikely) that claims will be greater by £Dm or more; [90 percentile for this component of volatility]
and

(3) uncertainty on the impact on reserves of the change in underwriting strategy in 2004 and 2005. This could increase reserves by £E million or reduce them by £F million.

Overall I believe it likely that the outturn for total claim payments will lie in the range £Gm to £ Hm. [90% confidence interval]

Example 2 – Statistical estimation method combined with a percentile approach to communicating uncertainty.

The best estimate reserve is based on my assessment of the mean or expected value of the range of potential outcomes for the ultimate claims settlements, undiscounted for future investment income, excluding those contingent circumstances surrounding the potential, but remote, unfavourable outcome of `Dispute X'.

This reserve has been estimated for the purposes of providing an independent best estimate to the board for their consideration, along with other information and views at their disposal, in forming their view of the reserves to carry in their published accounts.

In order to comment on the uncertainty in deriving a suitable outcome, I have carried out a statistical analysis and estimated a range of likely outcomes. I believe that there is approximately a 90% chance that the eventual outcome will lie in the range quoted, with approximately a 5% probability that it will fall below and 5% above.