Philosophy of Reserving

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Philosophy of Reserving

- *Context and Aim of Paper*
- *Conflict of Cultures*
- *Nature of Provisions*
- *Estimation*

There are four sections to this presentation.

The first two set the scene for the substantive discussion which follows in the last two.

Context and Aim of Paper

- **Context**
  - **Outstanding Claims**
  - **Published Accounts**
  - **Highly Uncertain**
    - **Long-Tail Business**
    - **Reinsurance**
- **Aim**

The paper is about the presentation of outstanding claim provisions in an insurer's published accounts. The concepts presented are also applicable wherever there is a high degree of uncertainty in liabilities or assets. Conventional accounting practice is based on a deterministic world-view, while uncertainty needs a stochastic approach.

In insurance, the greatest uncertainties are found in long-tail business and reinsurance.

Context and Aim of Paper

- **Context**
- **Aim**
  - **What are we trying to do in Reserving?**
    - Valuation   Understanding
    - Reserving   Presentation in Accounts
  - **How do we do it?**
    - Utility Estimation
    - Time Series Approach

The main concern of the paper is the philosophy of reserving - what we are trying to do. It also looks at some aspects of how we do it.

Context and Aim of Paper

- **Context**
- **Aim**
  - **What are we trying to do in Reserving?**
    - Valuation   Understanding
    - Reserving   Presentation in Accounts
  - **How do we do it?**
    - Utility Estimation
    - Time Series Approach

There are two main stages:

Valuation, in which the actuary seeks an understanding of the value of outstanding claims, which includes an understanding of their uncertainty.

Reserving, in which that understanding must be distilled for presentation in the published accounts.

We then look at some aspects of how provisions are calculated.

Context and Aim of Paper

- *Context*
- *Aim*
  - *What are we trying to do in Reserving?*
    - *Valuation*   *Understanding*
    - *Reserving*   *Presentation in Accounts*
  - *How do we do it?*
    - *Utility Estimation*
    - *Time Series Approach*
    - *Discount Rates*

Philosophy of Reserving

- *Context and Aim of Paper*
- *Conflict of Cultures*
  - *Accountancy*
  - *Actuarial Science*
- *Nature of Provisions*
- *Estimation*

This paper is an attempt to bridge the gap between two different cultures.

Conflict of Cultures

- *Accountancy*
  - *Deterministic*
  - *Measurement*
    - *of Past Reults*
- *Actuarial Science*
  - *Stochastic*
  - *Estimation*

Accountancy has largely developed in a deterministic context. It is about the measurement of past results.

Conflict of Cultures

- *Accountancy*
  - *Deterministic*
  - *Measurement*
- *Actuarial Science*
  - *Stochastic*
  - *Estimation*
    - *of Future Outcomes*

Actuarial science is primarily concerned with the estimation of future outcomes. It is inherently stochastic.

The clash arises when past results can only be measured in terms of estimates of uncertain future outcomes.

Philosophy of Reserving

- *Context and Aim of Paper*
- *Conflict of Cultures*
- *Nature of Provisions*
  - *What are we trying to do?*
- *Estimation*

That is the background.

The bulk of the paper is concerned with what we are trying to do in setting provisions.

Nature of Provisions

- **Estimation**
  - *Central Estimates*
  - *Estimate of What?*
- **Accounting Concepts**
- **Understanding Liabilities**
- **Setting Provisions**

In order to understand what we are doing, we need to consider the idea of estimation.

Estimation

- *Central Estimates*
  - *Mode*
  - *Median*
  - *Mean*
  - *etc.*
- *Estimate of What?*

A central estimate is an indication of location. The three most common are the mode, the median and the mean. Others are possible.

Central Estimates

- *Mode*
  - *Easiest to Visualise*
  - *Depends on Scale*
- *Median*
  - *Easiest to Explain*
- *Mean*
  - *Best for Financial Reporting*

The mode is the most popular value. This can depend on how we look at things. For a continuous skew distribution, the mode can be quite different according to whether we use a linear, logarithmic or some other transformation of the scale.

Subjective estimation will probably favour the mode.

Central Estimates

- **Mode**
  - **Easiest to Visualise**
  - **Depends on Scale**
- **Median**
  - **Easiest to Explain**
- **Mean**
  - **Best for Financial Reporting**

The median is the half-way point of a probability distribution.

Central Estimates

- **Mode**
  - **Easiest to Visualise**
  - **Depends on Scale**
- **Median**
  - **Easiest to Explain**
- **Mean**
  - **Best for Financial Reporting**

The mean is the probability weighted average.

As such it is the most appropriate for financial reporting.

For positive skewed distributions, such as are found in most forms of insurance

$$\text{Mode} < \text{Median} < \text{Mean}$$

If the uncertainty is high, these differences increase, but it becomes harder to be sure which a particular estimate is.

Estimation

- **Central Estimates**
- **Estimate of What?**
  - Inflation
  - Development
  - Discounting
  - Expenses
  - Uncertainty
  - **Depends on what the estimate is for**

This is the key question.

What do you include?

What do you leave out?

The provision for outstanding claims should be a central estimate of something, preferably its mean or expected value. But of what?

The answer to this lies in the accounting concepts underlying the standards which published accounts must comply with.

Nature of Provisions

- *Estimation*
- **Accounting Concepts**
  - *Purpose*
  - *Reliability*
  - *Uncertainty*
  - *Recognition*
  - *Measurement*
- *Understanding Liabilities*

The accounting concepts quoted here are Australian, but should not differ in principle from those anywhere else.

Accounting Concepts

- **Purpose**
  - *General purpose financial reports shall provide information useful ... for making ... decisions about the allocation of scarce resources (SAC 2)*
- *Reliability*
- *Uncertainty*
- *Recognition*

Published accounts are provided to provide the general public with information on which to base financial decisions involving the reporting entity.

Should I buy / sell / hold its shares?

Should I buy insurance from it?

If I have a disputed claim, should I compromise?

The purpose of standards is to allow the general public to make decisions which serve their own interests, rather than those of the reporting entity.

Accounting Concepts

- *Purpose*
- *Reliability*
  - *Reliable information will ... faithfully represent ... transactions (SAC 3)*
- *Uncertainty*
- *Recognition*
- *Measurement*

This is an expression of the deterministic measurement approach, which needs to be interpreted when we must base what we are doing on stochastic estimation.

Accounting Concepts

- *Purpose*
- *Reliability*
- *Uncertainty*
  - *... faithful representation of information, including the uncertainties surrounding it, ... may be ... reliable (SAC 3)*
- *Recognition*

This recognition of uncertainty is important, but not very helpful. The structure of published accounts inevitably relegates such discussion to the notes. This is not enough when there is great uncertainty.

Accounting Concepts

- *Purpose*
- *Reliability*
- *Uncertainty*
- *Recognition*
  - *A liability shall be recognised ... when*
    - *it is probable that the sacrifice ... of ... future economic benefits will be required*
    - *the amount ... measured reliably (SAC 4)*

This is a real problem in relation to insurance.

Most insurance contingencies are highly improbable when taken individually. (Otherwise why insure?)

In extreme cases, such as high layer reinsurance, they remain improbable even in aggregate

Outcomes are often highly uncertain.

Accounting Concepts

- *Purpose*
- *Reliability*
- *Uncertainty*
- *Recognition*
- *Measurement*
  - *Single value recognised*
  - *Uncertainty requires at least two*

This is the crux of the problem. There is only room in the accounts for one answer. This is all that most users can usefully absorb.

Understanding Liabilities

- **Valuation**
  - *Analysis*
  - *Model Building*
  - *Projection*
- **Realistic Assumptions**
- **Inflation and Discounting**

The aim of the valuation process is to form an understanding of the liabilities. The three steps in this process are well known to actuaries.

For sound results, we need a sound model. It need not model the insurance process closely, although such models are easier to relate causal considerations, but must be complete and must not include any deliberate distortions.

Realistic Assumptions

- *Necessary for Understanding*
- *Desirable for Presentation*
  - *Distorted Results can lead to Incorrect Conclusions, especially if the extent of the distortion is not known*
  - *If distorted results are used, the extent of the distortion must be known, even if it is not disclosed*

For presentation purposes, it may be helpful to simplify things. If so, it is essential to understand the impact of the simplification.

If a deliberate distortion is not quantified, it is likely that its impact will be substantially different from what was assumed. With offsetting distortions, it is easy to get even the direction of the net distortion wrong.

Understanding Liabilities

- *Valuation*
- *Realistic Assumptions*
- *Inflation and Discounting*
  - *Safety Margin?*
  - *Offset?*
  - *Explicit Margins Better*

While the preceding discussion says it all, the issue of inflation and discounting deserves comment.

Inflation and Discounting

- **Safety Margin?**
  - **Is it enough?**
  - **Too much?**
  - **Interest rates vary independently of risk**
- **Offset?**
- **Explicit Margins Better**

A standard argument for not discounting is that this provides a safety margin.

But is it an appropriate safety margin? There is no good reason why it should be.

A safety margin should be related to risk, not to some extraneous variable. Interest rates vary widely for reasons which are largely unrelated to the sorts of risk inherent in outstanding claim provisions.

Inflation and Discounting

- *Safety Margin?*
- *Offset?*
  - *Gap Theory*
  - *Claim Escalation can invert gap*
- *Explicit Margins Better*

Interest earnings have also been said to offset various things at various times.

       Expenses

       Inflation

Again, we must ask: Is the offset appropriate?

       For expenses, it could only be so by coincidence.

       For inflation, we are on slightly firmer ground, but the gap has varied substantially. Negative gaps between interest and wage inflation are not unknown. If social inflation is included, negative gaps are common.

Inflation and Discounting

- *Safety Margin?*
- *Offset?*
- *Explicit Margins Better*
  - *Value of Uncertainty*
  - *Probability of Adequacy*
  - *Market Practice*

It is far better to make explicit allowance for known factors and to include an explicit margin over the central estimate of the actuarial central estimate. This margin should relate to the perceived risk, rather than to extraneous factors.

The characterisation and determination of this margin is the basis of the transition from valuation to reserving: from understanding liabilities to setting provisions.

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Nature of Provisions

- *Estimation*
- *Accounting Concepts*
- *Understanding Liabilities*
- *Setting Provisions*
  - *Solvency*
  - *Profitability*
  - *Utility Estimation*

Provisions are the basis for determining both the solvency and profitability of an insurer.

Setting Provisions

- *Solvency*
- *Profitability*
- *Utility Estimation*
- *Continuity*

Conventional accounting practice emphasises solvency and assumes that successive solvency estimates will give a good measure of profitability. Unfortunately, this is not always the case when there is a high degree of uncertainty.

If we minimise the potential errors in successive solvency estimates, this can lead to large potential errors in the estimated profit. Conversely, if we minimise the potential errors in the estimated profit, this can lead to large potential errors in at least one of the opening and closing solvency estimates.

Measurement of Solvency

- **Solvency Provision**
  - *Can be a point estimate*
  - *Based on central estimate*
  - *Should include value of uncertainty*
  - *80% commonly accepted*
  - *Margin is NOT conservatism but recognition of uncertainty*

Solvency is about the situation at a point of time - the balance date.

Because uncertainty has a value, the solvency estimate is not simply the central estimate of the present value of projected future payments.

In Australia, it is generally accepted that a probability of adequacy around 80% (60% to 95%) gives a reasonable allowance for uncertainty.

Depending on interest rates, the undiscounted central estimate may be lower or higher than the proper value of uncertainty for accounting purposes.

(Taxation provisions are based on legislation).

Measurement of Profit

- **Profit**
  - **Measured as Difference**
    - **Opening and closing provisions must be consistent for meaningful measurement**
    - **Should use time series estimate**
  - **Reward for Risk (and other services)**

Profit is about what happened over a period - the accounting year.

The difference between the opening and closing provisions is the result of

+ estimates for new incurred claims

− payments in respect of claims

+ assumed interest

± changes in economic assumptions

± changes in future experience

± changes in actuarial perception

The last two can only be distinguished with the aid of hindsight.

With high uncertainty, the last component can totally swamp the true profitability of long-tail business.

Reward for Risk

- *Expected profit spread in proportion to risk*
- *Profit loadings should be retained until earned*
- *Experience profit is earned as differences between the actual the and the expected experience emerges*

Insurers earn profit by accepting risks.

> Occurrence risk - spread over policy term
> Run-off risk - continues until last claim is settled
> Investment risk - as and when taken

Profit should be accounted for as earned

> Expected profit
> Occurrence - Unearned premium
> Run-off - value of uncertainty
> Investment - "risk-free" discount rate

Experience variations

> Ideal - as they arise
> Practice - as they are recognised
> Not - according to the actuary's mood

Setting Provisions

- *Solvency*
- *Profitability*
- *Utility Estimation*
  - *for Solvency and Profitability*
- *Continuity*

Both solvency and profitability considerations lead to the concept of utility estimation, but not necessarily the same utility functions or parameters.

Setting Provisions

- *Solvency*
- *Profitability*
- *Utility Estimation*
- *Continuity*
  - *Time Series*

The need for continuity in the measurement of profitability leads to the time series approach.

Estimation

- *Utility Estimation*
- *Time Series Approach*
- *Discount Rates*

We now turn from philosophy to implementation.

Utility Estimation

- *The provision must be a single figure*
- *The liabilities are uncertain*
- *For a full understanding, more than one figure is required*

Utility estimation derives from the need to record a single figure in the accounts, for the liability.
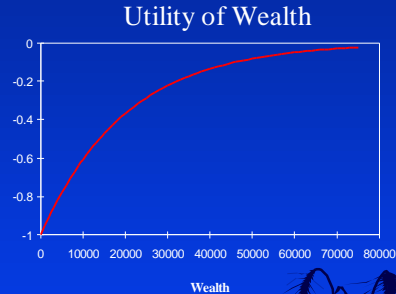
Utility Estimation

- *The provision should lead to the same decisions about the allocation of scarce resources as a full understanding of the nature and uncertainty of the liabilities*

This may be found in the "certainty equivalent" concept of utility theory.

For a given individual, at a particular time, there is a fixed amount such that that individual is indifferent between that fixed amount and the uncertain outcome.
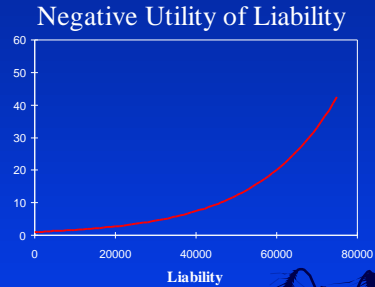
Utility Estimation

- **Utility of Wealth**
- **Utility of Liability**
- **Probability**
- **Utility Value**

Utility of Wealth

It is generally thought that most individuals are risk averse. That is, gaining $1,000 is more attractive if you have nothing than if you have $1 million.
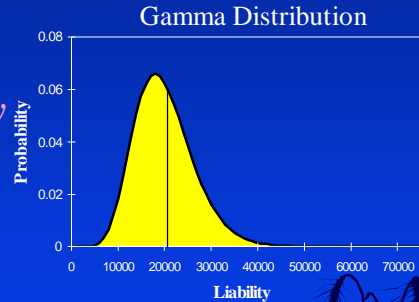
Utility Estimation

- *Utility of Wealth*
- *Utility of Liability*
- *Probability*
- *Utility Value*

Negative Utility of Liability

Conversely, it is worse to lose your last dollar than one dollar out of a fortune.
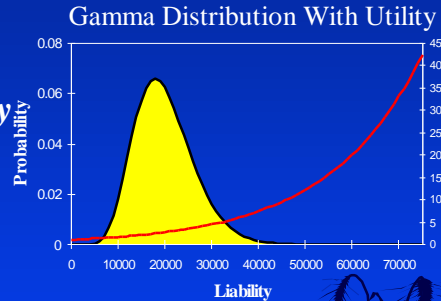
Utility Estimation

- *Utility of Wealth*
- *Utility of Liability*
- *Probability*
- *Utility Value*

Gamma Distribution

The uncertain outcome has an associated probability distribution.

Utility Estimation
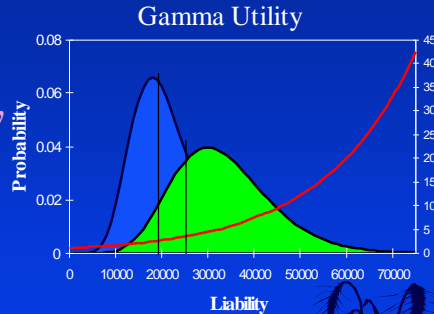
Gamma Distribution With Utility

- *Utility of Wealth*
- *Utility of Liability*
- *Probability*
- *Utility Value*

Combining utility with probability.

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Utility Estimation

- *Utility of Wealth*
- *Utility of Liability*
- *Probability*
- *Utility Value*

Gamma Utility

Gives the subjective impact of each possible outcome.

The mean of this transformed distribution is the utility estimate. In theory, this solves the problem of setting provisions.

In practice,

> the probability distribution is not well understood.

> the utility function for each individual is poorly understood.

> different individuals have different utility functions, which also change from time to time.

Estimation

- *Utility Estimation*
- *Time Series Approach*
  - *Point Estimation*
  - *Time Series Estimation*
- *Discount Rates*

If the underlying liabilities are highly uncertain then any estimates of those liabilities vary according to random variation in the past data on which those estimates are based. Further variation comes from the need for subjective input about future conditions.

Time Series Approach

- **Point Estimation**
  - *Ignores previous estimates*
  - *Both variable and uncertain*
- **Time Series Estimation**
  - *Only departs from previous estimates to the extent demanded by the data*
  - *Equally uncertain but less variable*

If only an estimate at a point of time is needed, this can be assessed in isolation. Such an estimate should fully reflect what is known and thought at that moment.

Time Series Approach

- *Point Estimation*
  - *Ignores previous estimates*
  - *Both variable and uncertain*
- *Time Series Estimation*
  - *Only departs from previous estimates to the extent demanded by the data*
  - *Equally uncertain but less variable*

If the real interest lies in the difference between successive estimates, isolated estimates can lead to a very poor estimate of the difference.

One approach is to use the same basis for the starting and ending estimates. For accounts, this fails because the starting estimate must be the ending estimate from the previous period. It is possible to get around this by revising the starting estimate each year and reporting the change as an "extraordinary item". It looks distinctly odd, however, if the accounts consistently include the same extraordinary item.

The alternative is to have regard to the previous valuation basis and only change it to the extent justified in the light of the variability of the new data.

Time Series Estimation

- **Bayesian Estimation**
  - **Kalman Filter**
- **Bornheutter-Ferguson**
  - **Flow of Liabilities**

The theoretical response to such a situation is known variously as Bayesian estimation or the Kalman filter. These come from different perspectives, but lead to essentially the same formula. They result in estimates using a weighted average derived from successive data points. These are weighted in inverse proportion to their uncertainties.

Time Series Estimation

- *Bayesian Estimation*
  - *Kalman Filter*
- *Bornheutter-Ferguson*
  - *Flow of Liabilities*

The Bornheutter-Ferguson technique achieves a similar effect by considering the flow of information and how the unknown becomes known over time.

Flow of Liabilities

PREMIUM
IBNR   Unexpired
IBNER   Risk

Case Estimates

Payments

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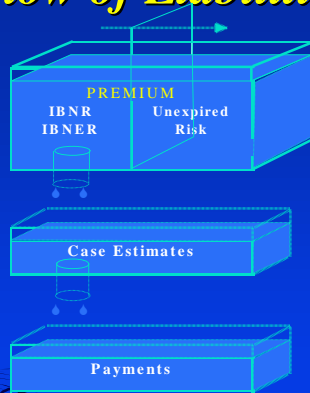
Estimation

- *Utility Estimation*
- *Time Series Approach*
- *Discount Rates*
  - *"Risk-Free" Rates*
  - *Portfolio Based Rates*
  - *"Risk-Adjusted" Rates*

A number of approaches can be used in selecting the discount rate to be used in a present value calculation.

Discount Rates

- **"Risk-Free" Rates**
  - *Yield Curve*
  - *Treasury Bonds*
- **Portfolio Based Rates**
- **"Risk-Adjusted" Rates**

The "risk-free" approach uses the yield curve for Treasury Bonds at the valuation date. The calculation is straightforward in principle.

> The rate for period 1 is simply the yield on a 1 period bond.

> For period 2, the forward rate is the rate which, when compounded with the period 1 rate, gives the yield on a 2 period bond.

> etc.

Practical problems arise because the actual maturity dates seldom match the dates required for the valuation projection.

This approach is based on Jim Anderson's separation into insurance and investment profit. Investment profit is the difference between actual investment results and results from a notional "risk-free" portfolio.

Discount Rates

- *"Risk-Free" Rates*
  - *Yield Curve*
  - *Treasury Bonds*
- *Portfolio Based Rates*
- *"Risk-Adjusted" Rates*

Portfolio based rates allow for the difference between actual investments and this notional portfolio.

This difference can be assessed on the basis of historical differences in performance. Alternatively, if the actual investments have known payments with negligible risk, an average yield curve can be constructed from first principles.

This approach capitalises future investment profits.

Discount Rates

- *"Risk-Free" Rates*
  - *Yield Curve*
  - *Treasury Bonds*
- *Portfolio Based Rates*
- *"Risk-Adjusted" Rates*

Another approach is that the "risk-free" rate should be reduced on account of uncertainty.

This has the effect of incorporating a value for uncertainty in the provisions. In my opinion, it is better to assess the value of uncertainty directly. Otherwise, how can one know that a particular reduction in the discount rate is appropriate?

Philosophy of Reserving

- *Valuation assumptions should be realistic and complete*
- *Provisions should include the value of uncertainty (this is not conservatism)*
- *A time series approach to estimation should be adopted for published accounts*