INSTITUTE OF ACTUARIAL & QUANTITATIVE STUDIES

Class: M.Sc Sem 3

Subject : Actuarial Practice 1

Chapter: Unit 4 Chapter 16

Chapter Name: Assumptions for a Model - I

Today's Agenda

1. Introduction to assumptions
2. Understanding demographic and economic assumption
3. What is information and sources of information
4. Extent to which information is useful
5. Factors to consider when determining assumptions
6. Assumptions used in pricing contracts

1 Introduction

As in all actuarial work, when setting assumptions it is important to:

- consider the use to which the assumptions will be put. Assumptions may be used in modelling future profits, for reserving, for estimating premium rates etc.
- take care over the choice of the assumptions that will have the most financial significance. Some assumptions have a greater impact than others such as mortality assumptions are more significant than taxation assumptions
- achieve consistency between the various assumptions. When there are several assumptions to be made, they should all be in sync with each other and one assumptions should not counter the other
- consider any legislative or regulatory constraints
- consider the needs of the client.

2 Demographic vs Economic Assumptions

Demographic assumptions such as the male to female ratio, morbidity and mortality rates, the average age of policyholders usually affect the timing and number of cashflows. Say if mortality is high then more claims will need to be paid, or if the average population age is around the retirement age, then pension will be paid earlier

Economic assumptions such inflation rates, interest rates, returns on investment etc affect the level of cashflows. Higher interest rates will make policyholders expect a high claim amount for the premium they are paying.

An actuary is modelling a term insurance product that extends its cover to the spouse of the policyholder after a specific number of years within the term of the policy.
List the assumptions needed to be made and categorise them as demographic or economic assumptions.

3 Information

Historical Data

- Historical data is likely to be a primary source of data used in determining assumptions about future experience. However care needs to be taken to not completely rely on historical data, as events of the past may not necessarily occur in the future. Historical data can only be used as a guide along with recent
- Historical data can be helpful when choosing demographic assumptions.
- For example, historical levels of mortality in a country, industry or company may help with the choice of assumptions for the number of individuals who will survive to receive pensions, or for the extent to which contingent benefits will be payable. In many countries this data will have been analysed and used to produce a graduated decrement table. Past data can also be used to help project future improvements in mortality.
- Similarly, past data can be used when determining the probability of individuals leaving employment, becoming ill, retiring, being married or other significant life events.

3 Information

The use of historical data when setting demographic assumptions:

- In determining an assumption for future investment returns, past data on dividend yields on equities and on the total returns on relevant classes of investment may be useful. Where dividends are linked to an inflation index, past data on that index may be useful.
- Past data on salary levels in a particular country, industry or company may be useful when making an assumption about future levels of salary growth.
- The history of an inflation index may also be useful in determining an assumption for future benefit growth that is linked either fully or partially to that inflation index.

3 Information

Current Data and Forecasts

- Current data may also be of use when determining assumptions. The relationship between current yields for fixed-interest and index-linked bonds may provide some indication of the market's view of future levels of the inflation index to which the bonds are related. It is also a greater reliable source over past data.
- Policy statements by governments such as the financial budget, tax slabs etc or by controlling banks such as the repo rates may also be useful when making assumptions about economic factors.
- A scheme sponsor may be able to provide information on planned future salary increases or likely future rates of withdrawal.
- In some instances, assumptions may be defined in regulations or legislation.

4 Usefulness of the Information

Relevance and Credibility of Past Data

- It is unlikely to be sensible to take an average rate from past data and assume that it will be appropriate for projecting future experience. Past data does not provide the answer as to what will happen in the future, but simply provides information that can be considered when determining the most likely future experience. For example past data on the number of dengue cases during the rains is useful for future projections as it is a common scenario, however past data on a pandemic will not be useful as the probability of another pandemic is low
- The social and economic conditions are likely to have changed over any period of history. The actuary therefore needs to consider the conditions that will apply in the future period to which the projections will relate and how those conditions will lead to differences from the past data that is being used.
- Past data for benefit schemes is also affected by changes in benefit. For example if early retirement benefits become more lucrative, then the number of people retiring early will increase. When considering any historical data, any changes in benefits needs to be accounted for.
- The relevance of past data to future projections must also be balanced against the need for sufficient data for its analysis to be statistically credible. In making a judgement about future experience, this conflict between credibility and relevance must be managed.

4 Usefulness of the Information

In case of demographic assumptions, the size of the exposure to risk is important to make the data more credible. For example the suitability of particular mortality statistics depends on how large its past data is.

When using past data, it is necessary to consider how to deal with:

- abnormal fluctuations such extreme events like the great depression or the plague
- changes in the experience with time such as medical advancements that increases life expectancy
- random fluctuations
- changes in the way in which the data was recorded
- potential errors in the data
- changes in the mix of homogeneous groups within the past data
- changes in the mix of homogenous groups to which the assumptions apply.

4 Usefulness of the Information

- Fluctuations and Changes Over Time

1. Changes Affecting Economic Data

Economic data fluctuates with changes in economic and fiscal policy as well as with the general economic cycle. Past data for investment returns, salary levels and dividend yields in most countries fluctuates significantly over an extended time-frame.
It could be thought that economic and fiscal changes mean that most past data are irrelevant and so only data that relate to a period after any recent significant change can be used. However, this would reduce the credibility of the data and increase the effect of any random fluctuation.
It is necessary to use the earlier data and to try to strip out the fluctuations that relate to economic and fiscal conditions that differ from those that currently exist.

4 Usefulness of the Information

2. Price Inflation

Past levels of an index to measure price inflation usually fluctuate significantly and are often a useful indicator of the economic conditions that existed. They are therefore unlikely to be very useful in determining an assumption for future levels of inflation.
Consequently, current index values may be a better guide to future levels of inflation. For example, government projections and the 'risk-free' real returns indicated by the current yields on long-term index-linked bonds could be used.

3. Use of Real Values

Past data for price inflation can be very useful in determining other economic assumptions, as conversion of past economic data into real terms will often remove much of the fluctuation.
Actuaries often also set their assumptions in real terms, and factors affecting future cashflows can be determined relative to price inflation.

4 Usefulness of the Information

4. Other Economic Adjustments

Making any further adjustment for economic or fiscal changes is difficult to do other than subjectively. Dividend levels could be adjusted to allow for changes in taxation applying to those dividends. However, an explicit adjustment may be spurious, as there may be changes to the taxation of companies or individuals that have a more significant effect.
At the start of 1990's tax paid on UK dividends could be reclaimed by the UK pension schemes. However, the government later reduced the amount of tax that could be reclaimed and then removed the preferential treatment altogether. As a result, actuaries working in pensions changed their long-term assumptions by reducing the assumed dividend yields and total investment returns.

5. One-off Impacts

One-off impacts in the past data will also need to be considered to ensure that the assumptions are valid. For example, significant returns in one year on a specific asset could be because of government intervention. High numbers of deaths could be due to an epidemic, meaning that mortality experience for that year is unusually high. One-off events must either be excluded from historical data or the data for that period could be adjusted to a more normal value

4 Usefulness of the Information

- Data Recording

1. Changes in Statistics Recorded

Over time, statistics produced by the State or data recorded by companies may change. Such changes distort the past data and could lead to inappropriate assumptions unless these changes are recognised. For instance if there is a change in the occupation or financial status of people from their previous ones, and they are grouped into various classes to determine mortality rates. This can lead to an increase or decrease in mortality for a particular class from one study to the next.

2. Errors in Data Recorded

Data errors will also cause distortions but may not be as easy to recognise as changes in the ways of recording the data. Generally, the management and verification of data recorded by companies has improved significantly as the capability of computers has improved. Older data may carry a greater risk of data error, perhaps to an extent that outweighs the usefulness of having more data.

4 Usefulness of the Information

- Heterogeneity

1. Changes in the Constituents of the Population

In adjusting past data, it is important to recognize that the past data may give false results due to changes in the balance of homogeneous groups over time.
For example, past levels of salary growth may reflect a change in the overall composition of a workforce (for example production line workers being replaced by mechanization) rather than just the changes in real salary levels for individuals.

2. Splitting the Population into Homogeneous Groups

It is important that the past data used is relevant to the group of individuals about whom assumptions are to be made. Levels of salary growth and mortality, for example, usually differ by type of employment or social class. Ideally, the past data would be split into homogeneous groups to reflect such differences.

4 Usefulness of the Information

In practice the information necessary to split the data reliably is unlikely to be available, and splitting the data would result in a significant reduction in credibility. Therefore, past data will usually need to be adjusted in a subjective manner to allow for differences in the characteristics of the individuals concerned.

When considering a group life insurance policy for a company, its employees may include manual labourers, peons and management staff. These groups will differ in terms of mortality rates, staff turnover, salary growth, standard of living, etc.
The company as a whole will provide sufficient data with reasonable credibility. However, splitting the workforce into homogeneous groups will decrease the size of each group and hence reduce the data's credibility.

- Standard Tables

In some countries past data has been analysed on a national or industry level. The most common data for such analyses relates to mortality and morbidity.

4 Usefulness of the Information

Countries may analyse the whole population's experience based on censuses. One disadvantage of census data is that it includes all lives, and not just the restricted population that effect insurance contracts. Thus census data generally includes lower socio-economic groups that distort the experience of lives effecting insurance contracts.

Also the risk of the data becoming irrelevant exists if a lot of time has passed from the date of data being published to the date of its usage

As an example, in the UK the Institute and Faculty of Actuaries has established the Continuous Mortality Investigation Bureau (CMI), which produces mortality tables based on experience provided by participating insurance companies. The CMI Bureau conducts statistical analysis of the data including, for example, projecting mortality improvements for the experience of annuitants.

When using standard tables, the same considerations are needed as when using the company's own past experience data:

- whether the data is relevant to the intended population at which the product is marketed
- whether adjustments need to be made to the data to reflect continuation of past historical trends.

5 Factors to Consider when Determining Assumptions

- The Need for Accuracy and Prudence

1. Purpose of the Valuation

When considering the assumptions to use to project future experience, the actuary needs to consider the purpose for which the assumptions are to be used and the significance of each assumption in the overall result. This helps assess the degree of accuracy required and hence the extent to which it is necessary to try to remove distortions from data.

It also helps judge whether the assumption should reflect the best estimate of the future experience or whether it is appropriate to reflect any uncertainty about future experience by an overstatement or an understatement within the assumption.

2. Accuracy of Assumptions

Where assumptions are used to place a capital value on future cashflows, it is usually unnecessary to make a judgement about the accuracy of each assumption. Instead it is necessary to determine that the overall value resulting from the combination of assumptions is appropriate. However, where the individual cashflows are important, it may be necessary for the accuracy of each assumption to be assessed.

5 Factors to Consider when Determining Assumptions

For example, an asset-liability modelling study requires detailed assumptions relating to the incidence of future cashflows, whereas a model to determine the approximate cost of a proposed benefit improvement may only need very broad assumptions.

3. Significance of Errors

Consideration of the potential financial significance of errors in the assumptions also helps assess the degree of accuracy required, the extent of margins necessary or the level of risk being taken.

The significance will depend on the potential effect on the decisions that will be made based on the results of the modelling exercise.

Deviation in actual experience compared with the assumptions is inevitable. The actuary needs to be aware of which assumptions have a material effect on the results.

5 Factors to Consider when Determining Assumptions

- Effects of Assumptions on Cash Transactions

It is important to distinguish between one-off payments and regular payments, as one-off payments cannot be adjusted in future payments.
For example, when acting as expert witness to determine a fair compensation settlement between two parties, it is important that the assumptions used are the actuary's best estimate of the future experience. Under- or over-statement will give one party a direct financial advantage at the expense of the other. Consequently each party will have a preference for which side of 'best estimate' they would like to see each assumption.

Consider an employer who can no longer sponsor an ongoing pension scheme, and has decided to transfer his pension liabilities to an insurance company. The insurance company charges the employer an X amount that should be sufficient to cover any future pension liabilities. If the insurer underestimates the X value, he will make a loss and if he overestimates it then he may lose on his business.

5 Factors to Consider when Determining Assumptions

- Implicit Assumptions

It is necessary to be aware of implicit assumptions within a model and consider the effects of these. For example, the funding method for an occupational pension scheme may assume that:
new members continue to join or new policies continue to be written and therefore the age / sex distribution of a population will be maintained
no new entrants will join or no new policies will be written and so the existing population should be treated as a closed group.
Not assumptions need to be parameterized or should result in a change in values. They tend to be implicit in nature, working in the background yet having significant impact on the credibility of the results.
For an insurance company, the assumption of the company being open or closed to new business though an implicit one, is critical, because it will affect the contribution that each policy must make to the fixed overheads of the business, as well as affecting the nature and term of the investments

6 Assumptions Used in Pricing Contracts

- Margins

The assumptions will be estimates of the expected values for the parameters.
Where a cashflow model is being used to price a product, the risk to the provider from adverse future experience could be allowed for by:

- adjusting the risk element of the risk discount rate thereby allowing for a higher risk discount rate as a matter of prudence
- using a stochastic discount rate instead of a fixed discount so that all variability can be captured
- applying margins to the expected values to have sufficient funds incase of worsening of scenarios

6 Assumptions Used in Pricing Contracts

❑ Profit Margins

In pricing a product, a profit requirement will need to be incorporated. This is because it is reasonable to suppose that the owners of the provider decide where to invest by comparing the returns offered by different projects, relative to the risks that are run.

For any company, the owners are the shareholders who have invested in the company with the expectation of earning returns which will be a product of the company's profits, hence pricing assumptions should allow for a profit margin.

❑ Risk Discount Rates

The discounting rate consists of the risk free rate of return and a risk margin which reflects the investment's inherent risk.

Not all products are equally risky. The provider should view itself as an investor like any other when it considers the risks of a new product, as in the long run the profits emerging from the company are the profits emerging from the products that it sells. A change in the mix of business, for example away from old and safe contracts towards new and innovative contracts, would change the market's evaluation of the provider's risks.

6 Assumptions Used in Pricing Contracts

The following features can increase the risks in a product design:

- lack of historical data
- high guarantees
- policyholder options
- overhead costs
- complexity of design
- untested market.

It is not easy to assess these risks, and it is even harder to say what effect they should have on the risk discount rate.