

LIFE INSURANCE AND RETIREMENT VALUATION

MODULE 8: VALUATION ASSUMPTIONS





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8. Valuation assumptions

This module addresses the following learning objectives:

Item	Unit/Key Performance Objective/Learning Objective
3.3	Suggest and evaluate an appropriate valuation method, model and actuarial basis for major insurance product lines and retirement products.
3.3.6	Explain the need for valuation assumptions
3.3.7	Consider the various purposes for which actuarial assumptions are used
3.3.8	Assess sources of information in setting assumptions
3.3.9	Distinguish between the different categories of assumptions
3.7	Determine the impact of, and justification for, valuation assumption changes
3.7.1	Assess the impact of assumption changes
3.7.2	Apply and explain the use of alternative methodologies for incorporating assumption changes

In this module, students will learn how to take the context for the valuation into account when deciding on a set of appropriate assumptions. Students should understand the process of selecting assumptions under a given valuation method, the different categories of assumptions, their purpose and how to apply these assumptions in a valuation.

The focus of this module is on the types of assumptions that need to be set and the high-level considerations required in selecting appropriate assumptions **for life insurers**. Many of the issues discussed in this module also have relevance for the valuation of retirement fund liabilities. The assumptions required for the valuation of retirement fund liabilities and determination of funding rates are covered in Module 9 (Retirement valuation).

This module provides an introduction to the more detailed discussion on assumption selection that will occur in the LI&R Product Development subject. That subject will cover methodologies for conducting experience analyses and using these analyses to derive detailed assumptions.



8.1. The need for valuation assumptions

To estimate life insurance and retirement fund liabilities, assumptions must be made about the future costs and income streams related to the risks accepted and benefits to be provided. We note that, like other aspects of a liability valuation, assumptions can only ever be an estimate of what the future experience holds. The assumptions selected have an impact on the current liability calculation but they do not actually impact future experience.

We often derive assumptions based on past experience but then use professional judgment to make sure the assumptions are relevant to the future period under consideration. This application of judgment will be explored in the LI&R Product Development and Applications subjects.

Assumptions cover all matters that impact expected future cash flows. For life insurance policies, this includes expected rates of claims, cover levels, servicing and management costs, rates of policy lapse or continuance, expected investment returns and rates of exercise of policy options. For retirement funds, the assumptions required include rates of retirement, voluntary withdrawal, death, disablement, salary growth and investment returns.

As previously defined in Module 5 (Life valuation), the set of assumptions used in valuing liabilities is referred to as the *valuation basis*.

Key assumption categories for life insurance liabilities are as follows:

- Economic assumptions
 - investment earnings
 - discount rates
 - inflation
 - taxation
- Demographic and other assumptions
 - mortality and morbidity
 - expenses
 - policy discontinuance



Each of these assumptions is discussed in Section 8.4. Given the importance of choosing an appropriate discount rate for liability valuations, embedded values and appraisal values (Module 15), a reasonable amount of detail is included in Section 8.4 on different types of discount rates that can be adopted. Other valuation assumptions covered in this module are discussed at a higher level and are covered in more detail in the LI&R Product Development subject.

8.2. Assumption considerations

As discussed in Module 5 (Life valuation), the assumptions selected should be suitable for the valuation method used. For example, under some valuation methods, explicit assumptions are required about the level of future expenses. However, under a net premium or loss ratio method, this may not be required.

The setting of valuation assumptions requires judgement. Consideration is given to the types of policies being valued, the importance or materiality of each assumption, the reliability of its determination, and its impact on the results. For example, future mortality rates have a material impact on the expected cost of lifetime annuities but may have little impact on the cost of unit linked benefits if they only provide the accumulated unit balance on death. To aid in assessing materiality, an actuary may want to model the financial impact of sensitivities to assumptions.

Depending on the jurisdiction, legislative requirements, accounting rules and actuarial professional standards may also place constraints on the selection and setting of assumptions for a valuation.

The following sections set out other considerations which need to be made when selecting assumptions for a liability valuation.



8.2.1. Consistency

Actuarial models are required for a range of different purposes including pricing, valuation of liabilities, appraisal values, capital management, monthly reporting, business planning, and financial condition reporting. Assumptions should be internally consistent within a given model (e.g. consistency in the inflation assumptions adopted for assets and liabilities). However, because different models have different purposes, it doesn't follow that they should necessarily be consistent with each other. In particular, the assumptions adopted for each of the above purposes may not be the same.

For example, mortality assumptions for funeral cover insurance could be quite different to those for term insurance and different again to those for retirement annuities, based on the different mortality risks appropriate for the types of customers protected under each of these products. As another example, valuation assumptions for some purposes may be deliberately conservative, providing implicit margins for adversity. For pricing purposes, best estimate assumptions may be appropriate with explicit allowance for the cost of holding any additional margins for adversity. Also, assumptions for a valuation are more likely to reflect the average experience expected over an entire portfolio. For example, benefits under different groups of trauma policies may have different assumed costs, based on differences in benefit definitions. While pricing bases may make explicit allowance for these differences, valuation bases may combine policy groups and use assumptions based on average costs.

Some assumptions, such as rates of interest and inflation, have logical relationships and dependencies, which again need consistency in their selection.

Exercise 8.1

Why might mortality assumptions for funeral cover insurance, term insurance and retirement annuities be different? How will they be different?



8.2.2. Ongoing concern versus winding down basis

Valuations are usually performed on an ongoing basis, whereby the business is expected to continue to operate in the same manner as it has in the past.

Where a company or fund is winding down (ceasing to write new business), the valuation approach and assumptions will need to reflect this. This is because in this context, past experience may not give a true indication of expected future experience. For example, policy lapse rates may trend downwards as longer duration policies start to dominate. Alternatively, depending on the disincentives or penalties for terminating policies, significant numbers of policy owners may change insurers. Also, investment strategies for a closed product or fund may be more conservative and include greater matching of assets and liabilities. For a closed and reducing product or fund, expenses per policy or member will likely increase as economies of scale are lost and overhead costs are spread over a smaller base.

8.2.3. Implicit assumptions

Some assumptions may be explicit, whereas others are implicit. For example, claims rates under yearly renewable term policies are likely to be subject to opposing forces:

- claims rates tend to worsen with duration due to the anti-selective effect of lapses. Unhealthy lives are less likely to lapse their term cover (as they have a higher expectation of needing their policy), resulting in the portfolio of policy owners gradually becoming less healthy over time as healthier lives lapse their policies and unhealthy lives retain their insurance cover;
- mortality rates generally improve over time, reflecting improvements in modern medicine and standards of living; and
- new business flows refresh the portfolio with shorter-duration underwritten policies.

Under the above example, the two opposing forces could be reflected in explicit assumptions, both impacting (in opposite directions) on claims rates. Alternatively, assumption selection may be simplified by assuming these two impacts will offset each other.



There is often a link between the valuation method used and the assumptions selected. For example, gross premium methods use explicit assumptions about future expenses, whereas expenses are often modelled implicitly under net premium methods.

While implicit assumptions and offsets may simplify modelling, they need to be used with caution. The simplification may hold at a point in time, based on the then current business mix, but the relationship may change over time. For example, a policy benefit may include a premium waiver in the event of unemployment. This benefit may have a low cost over the entire mix of ages in a portfolio. However, the cost may be much more significant for those at higher ages. Closure of the option for new policies may result in an increase to cost that is not reflected in the assumptions adopted.

8.2.4. Grouping

Assumptions are usually set with reference to past experience. For assumption-setting purposes, experience data to be analysed needs to be statistically credible and relevant. For this reason, policies with similar benefits and payment terms are likely to be grouped together, with assumptions set at the level of policy groups or series. *Series* refers to policies that are similar in terms of conditions and pricing. This grouping helps to ensure an adequate volume of data is available, therefore making the results of analysis more credible.

The extent of grouping of policies will depend on various factors. It is important to consider the types and mix of policies contributing to any past experience and how these differ to those at the valuation date. This helps to ensure any analysis conducted is relevant in setting assumptions for the future.

Another consideration for the extent of grouping is the practicality of determining and using numerous sets of assumptions versus the gains in accuracy of doing so, as discussed in Section 8.2.1.



8.2.5. Documentation

Documentation of assumptions, their application and the rationale for their selection is very important. Good documentation will guide team members in the correct coding, input and use of assumptions in valuation models. It provides a reference point and guide for subsequent valuations and may assist in the preparation of reporting, auditing and disclosures. Where an assumption includes deliberate bias, such as the use of margins for conservatism, the rationale for applying this basis should be documented. Some reporting requires a margin, so the rationale for the use of the margin would not be documented but the level of the margin would be.

8.3. Sources of information

Companies rely on a range of data sources in developing their valuation basis. These include internal data relating to the company's own experience and external data reflecting the experience of the entire industry.

In setting assumptions, the quality of a company's own data and experience analyses will impact the extent to which the company can rely on these, rather than other sources such as industry experience. In addition to quality, there needs to be a sufficient amount of experience for results to be statistically reliable. For these reasons, published information on industry experience and emerging trends (both locally and, where relevant, overseas) are often also considered. Unpublished information may be available via reinsurance companies.

A starting point in setting assumptions is often the valuation basis used in the previous valuation. These assumptions are reviewed against the company's own experience since the previous valuation and any recent changes in its management practices. Life insurance companies develop sophisticated systems for analysis of their business experience. A key consideration is the extent to which emerging experience and observed trends are likely to be indicative of future experience. The mechanics of this process is discussed in Module 12 (Analysis of surplus).



Reconciliations of alternative sources of experience data are important in forming a view on their integrity. For example, data from claims systems is reconciled to that from accounting ledger systems to check that a class of claims payments has not been missed. Explanations of reconciliation differences are important, both for auditing purposes and to avoid reinventing the wheel for future analyses. Where doubts exist over the quality or relevance of experience analysed, these need to be reflected in the selection of assumptions to be used. Also, additional reserves may be held for uncertainty caused by lack of adequate supporting experience data.

In setting assumptions for benefits where little or no relevant experience is available, wider sources of information need to be considered, such as relevant population or hospital statistics. Valuation teams often also draw on research and assumptions developed by product pricing and development teams. For instance, valuation teams may adopt claims or expense assumptions developed by the pricing team for new benefit types such as new trauma conditions or credit-related insurance (covering repayments during periods of illness). When this occurs, specific care should be taken to include the new benefit types in the subsequent analysis of profits [Module 12 (Analysis of surplus)].

Specific sources of information available for analysing past experience and setting assumptions about the future are discussed in greater detail in the LI&R Product Development subject. Considerations for defined benefit funds are covered in the Superannuation and Retirement Applications subject.

8.4. Types of valuation assumptions

Assumptions for life insurance valuations can be divided into two broad categories: economic (e.g. investment earnings, discount rates and inflation rates) and non-economic (such as expenses and claims rates). These will each be discussed in the sections below.



8.4.1. Economic assumptions

Investment returns

The investment performance of a life company or retirement fund is one of the key variables that affects its financial performance. Expected investment returns are an essential input for business planning, profit-testing, calculation of a life insurer's business values, embedded values and appraisal values, and the projection of retirement benefits.

Projections of expected investment returns are more material for some classes of business than others. A key factor is the size of the liabilities. For example, investment return is a key assumption for savings contracts but is less important for risk business, e.g. term insurance.

Exercise 8.2

Why are term insurance reserves relatively low [on which comparative?] compared with a participating endowment assurance contract?

An actuary, therefore, needs to be able to analyse actual investment returns and to formulate assumptions about future investment returns.

In setting appropriate investment return assumptions, consideration is given to:

- the current and expected future mix of assets backing the liabilities for the company or fund;
- risk-free, market risk premium, risk tolerance / appetite;
- past rates of investment return for each asset class;
- target rates of investment return set as part of the investment strategy; and
- financial analysts' forecasts for individual asset types and the economy as a whole.

A deduction for investment management expenses is usually made from expected investment returns, unless these expenses are projected separately as part of the projected cash flows.



Tax on income earnings may also be allowed for when considering past actual returns and setting assumptions about future returns.

Expected investment returns can vary depending on the time horizon of the forecast. For some purposes, such as calculating an appraisal value or projecting retirement benefits under a defined contribution fund, long-term forecasts are appropriate. For other purposes, such as calculating smoothed investment returns for an investment account, a short-term forecast is needed.

Discount rates

Discount rates are key inputs to discounted cash flow valuations. As discussed in Section 8.2.1, it is important that there is consistency between the economic assumptions used in valuing assets and the implied future returns used in valuing liabilities.

Often, assets are valued at market value, so the economic assumptions in their valuations are implicit. Some assets, where markets are thin (low volumes of trade), may be valued on a discounted cash flow basis with explicit assumptions. Whether assumptions are explicit or implicit, the actuary still needs to consider consistency between asset and liability valuations. For instance, property values will include, implicitly or explicitly, appreciation of rental income, which can be compared with assumed inflation rates used in the valuation of liabilities.

Economic assumptions should reflect the forecast economic outlook over the expected duration of the liabilities. The discount rate should be set with reference to the nature, structure and term of the future liability cash flows to be valued, although a practical difficulty is that the duration of liabilities may exceed the duration of assets.

It is important to understand the different types of discount rates that are used, how they may vary over time and their relationship to investment returns. The most appropriate discount rate assumption will depend on the purpose of the valuation.

Possible discount rates include:

- a risk-free rate of return;
- the risk discount rate that life company shareholders or retirement fund members expect to earn on their capital/accumulated funds;



- the discount rate used to determine the fair value (or market value) of the liability;
- the expected rate of investment return; and
- a conservative discount rate.

Risk-free discount rates

A risk-free discount rate is the rate of return from a theoretical fixed interest investment where there is no risk that the issuer will default on repayments of interest or the maturity value. In practice, such an investment does not exist, as all investments have some risk of default. There are also other risks associated with such an investment. If interest rates rise, the value of an existing fixed interest investment will fall. Even if the investment is held until maturity, it is possible to make a loss in real terms if inflation over the period of the investment exceeds the rate of return at the time the investment was made.

The use of a risk-free discount rate for profit reporting has the following implications:

- A company that is able to match its liabilities exactly with a portfolio of risk-free assets will have no investment risk. In this situation, a risk-free discount rate is clearly appropriate as it is certain to be the same as the investment return. Technically, no such portfolio can exist, but yields on governments bonds are often assumed to be a proxy for risk-free rates.
- If a company invests in risky non-replicating assets, it expects to earn additional profit but it is also exposed to investment risk. The use of a risk-free discount rate means that any additional uncertain investment profits will only be recognised as they are earned. If a risk-adjusted discount rate that reflects expected investment returns was instead used, any additional expected returns would be capitalised and recognised in profit immediately
- Two companies issuing policies with the same expected cash flows will place a similar value on their liabilities. However, as judgement is required in determining risk-free discount rates, the discount rates used by the two companies may not be identical.

In some countries, such as Australia, prudential and/or accounting standards require a risk-free rate of return to be used in certain circumstances, such as when valuing policy liabilities for insurance contracts where the benefits are not dependent on the performance of the assets backing the liabilities.



Risk free rates can be derived from a number of sources, such as:

- government bond yields;
- interest rate swaps;
- local (e.g. state) government securities; and
- high-quality corporate bonds.

In economically stable countries, government securities are regarded as being extremely close to risk-free because the government has the ability to raise additional taxation revenue if it ever runs short of cash to meet its debt obligations. It also has the ability (through its central bank) to issue additional currency in order to meet its obligations.

There is some debate about which of the remaining three data sources are more appropriate as a measure of risk-free rates and it is important to document the rationale adopted. A narrower definition of the risk-free rate, based on government bonds only, is applied in some circumstances and under some jurisdictions.

If basing risk-free rates on one of the other three asset types listed above, a deduction will often be made to remove any margins for credit risk implicit in the yields. The margin for credit risk allows for the cost of expected defaults by the counterparties that issued the assets, together with a margin for unexpected defaults.

A margin for unexpected defaults is implicitly included in the yields of all risky assets. Investors need to hold capital against the risk of unexpected defaults if they are to be reasonably certain of being able to meet their own liabilities. Investors expect to earn a margin above the risk-free rate of return on this capital.



Liquidity refers to the ease with which an asset can be traded. If an asset is more difficult to trade, then its price will reflect this difficulty and be lower than that of a similar asset that is more easily traded. When considering the return on an asset, a less liquid asset will have a higher yield than a comparable more liquid asset, because of the inverse relationship between prices and yields. The additional yield covering the liquidity risk is known as the *liquidity premium*. ¹The liquidity premium compensates investors for investing in assets with low liquidity. That is, they get a higher return.

The main reason why risk-free rates can vary, depending on which reference assets are used, is that interest rates on assets include an implicit liquidity premium as well as a margin for credit risk. Government bonds are generally regarded as being the most liquid type of fixed-interest asset and, therefore, have a liquidity premium of zero. The liquidity premium allows for the risk that the market for an asset may become illiquid at times, resulting in a loss to the owner if they are forced to sell the asset before it reaches maturity. If the owner is certain that they will not have to sell the asset prior to maturity, the liquidity premium is effectively an additional risk-free return.

It is important to note that risk-free interest rates have a term structure. The yield for bonds maturing in ten years is usually higher than the yield for bonds maturing in one year or for cash deposits (this is called a *normal yield curve*). The yield for a long-term bond should, in theory, reflect the expected progress of cash rates over the term of the bond. This is because an alternative to investing in a long-term fixed-interest bond is to invest in a cash deposit with a variable (or floating) interest rate.

¹ There are a range of terms by the industry used in relation to liquidity pricing, premiums and discounts. We will use Liquidity Premium to refer to the higher yield expected from a less liquid asset.

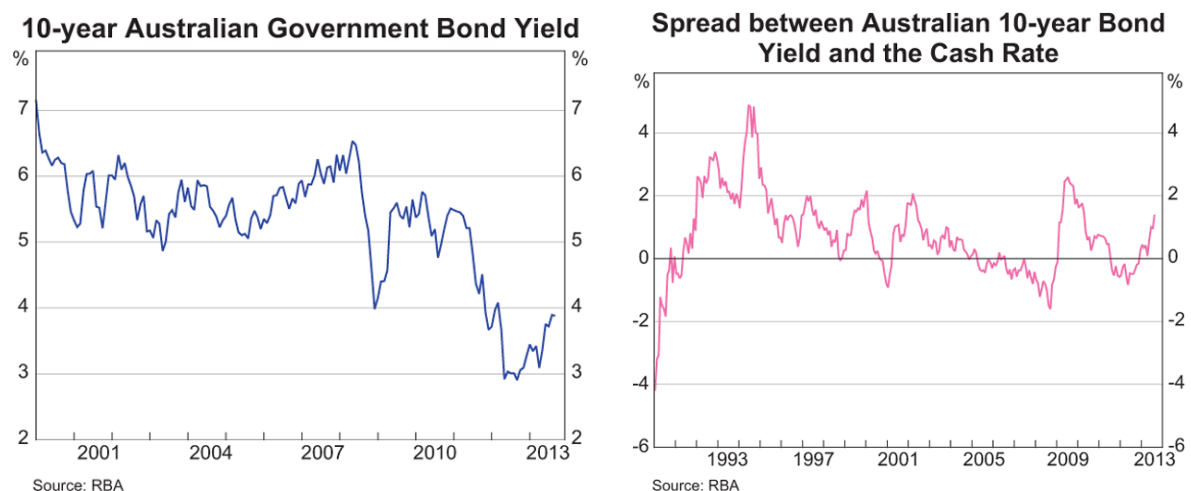


The shape of the yield curve also reflects investor preferences. Future inflation is a risk for many investors as their liability cash flows are affected by inflation. If inflation is greater than expected, the real value of a long-term bond will reduce. Short-term deposits give greater protection against inflation as when inflation increases, the central bank's normal response is to increase the cash rate. Many investors are also exposed to liquidity risk (the risk that they will have to sell a long-term bond to pay their creditors). If interest rates have risen in the period since they purchased the bond, the value of a long-term bond will fall and the investor may incur a loss.

The yield on long-term bonds therefore includes a margin on top of expected cash rates to allow for inflation and liquidity risks. If cash rates are expected to remain flat, the yield for a long-term bond will be higher than for a short-term bond due to this risk margin. An *inverse yield curve*, where long-term rates are lower than short-term rates can, however, occur when cash rates are expected to decrease over time.

Figure 8.1 contains two graphs which illustrate how the yield curve can vary over time. The first graph is of the 10-year Australian (Commonwealth) government bond yield. The second graph looks at the difference (spread) between the 10-year bond yield and the cash rate. Normally this difference is positive (i.e. 10-year rates are higher than cash rates) but, occasionally, the cash rate is higher.

Figure 8.1: Bond yields over time





For actuarial modelling purposes, it is usually most convenient to express risk-free rates as a time series of “forward rates”. In simple terms, the forward rate for year n is the risk-free rate we expect to earn in year n , based on current long-term yields. Note that the forward rate for year n is not a best estimate of the actual short-term rate in year n , as the forward rate includes a risk margin. There are standard methods for transforming a series of bond yields derived from market data for bonds with a range of coupons and maturities into a *zero coupon yield curve* and then into a series of forward rates.

A zero coupon bond is a bond that has a maturity payment but no interest payments. The yield on a zero coupon bond is sometimes known as a *spot rate*. The formula linking the spot rate (z_n) for a zero coupon bond maturing in n years with the forward rates (f_1, f_2, \dots, f_n) for each of those years is:

$$(1 + z_n)^n = (1 + f_1)(1 + f_2) \dots (1 + f_n)$$

The forward rate for Year 1 is the same as the spot rate for Year 1. The forward rate for each subsequent year can then be calculated using the spot rate for a zero coupon bond maturing at the end of that year and the forward rates for the previous years.

In attempting to match the term of liabilities with the maturity date of government bonds, the range of actual maturities is limited by the range of bonds currently on issue; hence, difficulties arise with regard to interpolation and extrapolation of the yield curve beyond the available data points. Extrapolation is the more difficult of these two issues. These issues and methods to deal with them are discussed in the LI&R Product Development subject².

As an approximation, it can be reasonable to use a single interest rate appropriate for the duration of the projected cash flows instead of a yield curve of rates that vary by time period. However, care is needed in choosing a single rate that gives approximately the same results as the yield curve. It is, therefore, better practice to use a yield curve than a single rate in actuarial calculations.

² Those interested can also refer to Mulquiney and Miller’s 2014 paper “A Topic of Interest – How to Extrapolate the Yield Curve in Australia”.



Where backing assets are not well matched to guaranteed liabilities, a notional backing portfolio may be more important in setting assumptions than the actual investment portfolio. Consider a company backing term insurance liabilities with high-risk equities. These should not be valued using a higher discount rate (thereby placing a lower value on its liabilities) than the same liabilities backed by term-matched risk-free securities. In fact, where there is such a mismatch, liability values may need to be increased by adding mismatch margins to allow for the risk that asset returns may prove inadequate.

Risk discount rates

In life insurance, for profit-testing and appraisal value calculations, a risk discount rate is used to value the future transfers to shareholders (also known as *distributable profits*). The risk discount rate is the minimum rate of return (or *hurdle rate*) that shareholders require on their invested capital. This rate depends on the type and level of risks to which shareholders are exposed. Higher levels of risk are reflected in higher discount rates and lower values being placed on future profit streams. For an investor purchasing an asset (i.e. the right to the future profit stream), higher risk therefore results in a lower price for that profit stream.

If the risks to life company shareholders are regarded as similar to the risks of investing in equity markets as a whole, the hurdle rate should be similar to the expected rate of investment return on equities. This will not, however, necessarily be true.

A widely used method for setting risk discount rates for life insurers and other types of businesses is the capital asset pricing model (CAPM). It should be recognised, however, that whilst the CAPM is widely used, there are important assumptions underlying it which need to be understood. There are also disagreements on the validity of the CAPM. However, it is outside the scope of this module to discuss these issues.



According to the CAPM, the expected return to shareholders (i.e. the risk discount rate) is the risk-free rate of return plus β (beta) times the equity risk premium for the market as a whole. The parameter beta is a measure of the correlation of movements in the company share price to movements in the market. For the equity market as a whole, beta is one. For an individual company, beta can be higher or lower than 1. If a company has a beta of one, its price tends to move in the same direction and by the same amount as the market as a whole. If a company has a beta of zero, its share price movements are uncorrelated with the market.

The value of beta reflects the extent of a company's exposure to systematic risks. Investors in shares prefer to have exposure to non-systematic (or diversifiable) risks rather than exposure to systematic risks. They therefore set a higher hurdle rate for capital exposed to systematic risks. Systematic risks affect equity markets as a whole and are, therefore, not able to be reduced through diversification. On the other hand, the impact of non-systematic risks on a share portfolio can be reduced by diversifying the portfolio.

Mortality risk is regarded as being largely non-systematic (i.e. unique to retirement funds and life insurance companies). Risks related to property markets, morbidity, lapses, expenses and new business volumes/membership movements are partly systematic, as these risks depend to some degree on the health of the overall economy. There is, therefore, a partial correlation between these risks and movements in equity markets. For example, an economic recession is likely to result in falling equity and property values and higher unemployment. For life companies, this may result in higher morbidity rates, higher lapse rates and lower new business volumes. For retirement funds, this may result in lower rates of both voluntary contributions (as individuals may have less discretionary income) and compulsory contributions (when individuals are unemployed).



An investor with an existing share portfolio who has no investments in life companies is able to diversify their portfolio and reduce their overall level of risk by purchasing shares in a life company exposed only to insurance risks (e.g. the life company only sells risk business and matches its assets and liabilities). However, if the life company is mainly exposed to investment risks (e.g. it only issues term annuities and mismatches its assets and liabilities), the investor would not be diversifying the risks in their portfolio. The investor would, therefore, want to earn a higher return if they invested in the shares of the life company mainly exposed to investment risks (i.e. this company would have a higher beta than a life company exposed only to insurance risks).

The calculation of beta for life companies poses some problems. For a listed life company, beta could be observed by finding the historical correlation between movements in the share price of the company and movements in the equity market as a whole. For an unlisted life company, the beta of listed companies with similar risk profiles might be used. For example, reference may be made to listed holding companies whose major subsidiaries are life companies. Alternatively, reference can be made to foreign listed life companies and foreign equity markets.

Another potential source of information that can be used in determining a suitable risk discount rate is reports by market analysts on listed life companies or listed holding companies that have substantial life insurance subsidiaries. Analysts often use an explicit risk discount rate in determining a target price for listed companies. The reports of several analysts should be compared as the discount rates they use will vary.

Another method of estimating beta is to consider the degree to which the life company is exposed to systematic risks. One could, for example, calculate the sensitivity of the embedded value or appraisal value of a life insurer to systematic risks such as movements in interest rates, equity and property markets.

A significant degree of judgement is necessary in selecting the risk discount rate, whichever method is used.



For companies that have issued debt capital (i.e. subordinated debt that ranks in priority of payment behind policy owners but ahead of shareholders) as well as shareholders' capital, the risk discount rate should be calculated as a weighted average of the cost of the two types of capital. The cost of the debt capital will reflect current market interest rates and the credit rating of the life company.

Once a risk discount rate suitable for the entity as a whole has been determined, further adjustments can be made for valuing specific products. A lower risk discount rate might be used for risk products than for investment products that are highly exposed to systematic risks.

For the purpose of profit-testing new business, an additional margin is often added to the risk discount rate (e.g. new business may be required to earn a return on capital of at least 12% p.a. even though the risk discount rate used in calculating the embedded value is 8%). In committing capital to the selling of new business, the return on capital should exceed the risk discount rate so that value is created for shareholders. There are also additional risks and uncertainties in relation to future sales of new business.

For the purpose of calculating an appraisal value, the risk discount rate used to value future new business may include an additional margin to allow for the systematic risks associated with future sales. This is because sales volumes are, in part, dependent on the state of the broader economy.

Risk discount rates are normally not duration-dependent. The risk-free rate from which they are derived will be a long-term bond yield. Life companies are long-term undertakings; hence, shareholders should be expected to set a long-term hurdle rate.

Fair value discount rates

Sometimes accounting, prudential and/or professional standards require liabilities to be valued at their fair value. For example, in Australia, this applies to liabilities for term annuities and some other types of investment contracts. The *fair value* of a liability is the amount for which the liability could be transferred between knowledgeable, willing parties in an arm's-length transaction. In other words, it is the amount that Company A would need to pay Company B if Company B agreed to take over the liability for a contract from Company A.



A fair-value discount rate may differ from the risk-free discount rate in order to reflect the uncertainty in the amount and timing of the liability cash flows. In this case, a deduction from the risk-free rate would be made, leading to an increase in the fair value of the liabilities. Note, however, that a preferable approach to reflecting the uncertainty is to probability-adjust the cash flows rather than adjust the discount rate.

No allowance for "own credit risk" should be made. "Own credit risk" refers to a policy owner's view of the risk that a life company will be unable to meet its obligations to policy owners.

In the case of term annuities, the amount and timing of the annuity payments are fixed and certain; hence, the only adjustment required is for credit risk and the fair value discount rate will exceed the risk-free rate. A discount rate derived from yields on very highly rated corporate bonds or state government securities may be appropriate.

Expected investment returns

The expected rate of investment return can be used as the discount rate in some circumstances. For example, in Australia, accounting and prudential standards require an expected investment return to be used in valuing the best estimate liabilities for insurance contracts where the benefits are dependent on the performance of the assets backing the liabilities.

Conservative discount rates

Some valuation methodologies deliberately apply more conservative assumptions. This may require a discount rate lower than the expected return on assets. The subsequent earning of a higher rate of earnings on assets would result in investment experience profits. These profits could be distributed as bonuses. This approach is sometimes used along with a conservative net premium valuation method for participating business.



Inflation

Inflation assumptions are required to reflect inflationary growth in future claims and expenses. Under certain types of policy, premiums and/or benefits may automatically increase on a regular basis, which needs to be allowed for. Where increases are linked to the consumer price index (CPI), the rates assumed should be set in a consistent manner with the inflation assumption for expenses. This may mean identical assumptions or, depending on the outlook, an identical base assumption, adjusted appropriately. For instance, assumed expense inflation rates may include an additional component for future salary increases over and above CPI.

Inflation and interest rate historical series are routinely produced by central banks or their affiliates in most jurisdictions. The inflation rate assumption can be selected with reference to a published central bank target. Inflation rate assumptions may also be implied from market yields on fixed-interest securities, where the nominal yields comprise a real interest rate plus a component relating to the expected inflation rate over the term (e.g. index-linked bonds).

Taxation

Life companies and retirement funds are liable to pay tax according to the relevant tax rules. Depending on the purpose of the valuation and the nature of the tax impost, valuations may need to reflect tax liabilities.

It is important to distinguish between tax applying to a company or fund and tax applying to policy owners or members. The company or fund may be required to collect and pay tax on behalf of policy owners or members. For example, some taxes, such as stamp duties or income tax on disability income benefits, may be deducted by the company or fund and paid directly to the government on behalf of the policy owner or member. However, this distinction may not always be explicit. For instance, tax on investment income may be applied at the company or fund level but impacts in the same manner as a direct tax on policy owner or member benefits.



In many jurisdictions, proprietary life companies are taxed on profits. The amount of tax payable will depend on the definition of profit in a given period, which will generally include a component reflecting changes in the value of liabilities over the period. Where tax is charged on profit, the value of liabilities on a gross basis can generally be obtained first and then adjusted to obtain net of tax results. The exception to this is where the permitted valuation method or basis for tax purposes is different to that used for accounting or other purposes. In this case, tax impacts may need to be modelled explicitly when calculating appraisal values.

Tax rules can vary considerably between jurisdictions and over time. Tax may apply to other business measures as a simplifying proxy for tax on profit. An example might be tax on investment income only. Such a tax needs to be reflected in valuation formulae or models. Care needs to be taken that the tax is reflected consistently in setting other assumptions, such as fund investment earning and discount rates. Where tax is applied to investment income, the discount rate should reflect expected returns net of tax. Gross cash flows discounted at a gross rate will not produce the same values as net cash flows discounted at a net rate.

Allowing for the cost of future tax on profits also means allowing for the benefit of the tax deductibility of future losses. Future tax losses are likely to be of value only to the extent they can be offset against future profits elsewhere in the company. Care needs to be taken to ensure that any value attributed to future tax losses is supportable, based on reasonable expectations when calculating appraisal values.

Retirement funds are also subject to different tax rules in different jurisdictions. These taxes are generally applied to one or more of contributions, investment earnings and benefit payments. For defined contribution funds, taxes are generally charged to the individual member's account as they are incurred and/or deducted at the point of paying a benefit. For defined benefit funds, where member benefits are fixed according to a formula, the taxes are charged to the fund as a whole and the cost of taxes may need to be reflected in higher employer funding rates.

Specific tax rules relevant in Australia will be taught in the Applications subjects.



8.4.2. Non-economic assumptions

Mortality and morbidity

Mortality and morbidity assumptions may be updated less frequently than others, as experience is often assessed over a number of years. As for other assumptions, analysis and interpretation of emerging experience and trends both at a company level and industry level is important to increase the probability that assumptions reflect future experience.

The main determinants of mortality and morbidity experience include age, policy duration, selection, anti-selection, gender, habits (e.g. smoking) and occupation. Mortality and morbidity assumptions should be set taking into account the specific types of policies and benefits under consideration. For example, assumed mortality rates for direct marketed life, individual term cover, annuity business and group life will be different, due to the different insured populations under each of these types of products.

Policy provisions, criteria for eligibility to claim and underwriting/claim standards may vary considerably between different policy series, particularly for “living” benefits such as trauma or income protection. Morbidity rates adopted for otherwise similar types of benefits may, therefore, differ. These differences often have a material impact on expected claims rates.

Claim rates under income protection and TPD cover can also be affected by economic cycles. In the past, claim rates for these covers have trended upwards during recessionary economic conditions, when unemployment has been higher.

As discussed in Module 2 (Cash flows), changing societal expectations may have a large impact on morbidity claims. The actuary should consider if there are latent claims in the underlying data and attempt to pick up on sources of claim that are changing faster than anticipated. The difficulty relates to the credibility of data at the level required to monitor signals. This theme is developed in the LI&R Product Development subject.

Other important claim assumption matters include:

- historical vs future;
- policy owner behaviour, propensity to claim;



- underwriting (selection);
- anti-selection;
- buybacks/multi-variate claims; and
- collecting and analysing data.

Expenses

There are various types of expenses that may need to be modelled separately in a liability valuation. These include:

- premium-related expenses such as **commission**, which are modelled according to the policy terms;
- **administrative expenses**: assumptions for these may be set as dollars per policy, a percentage of premiums or sums insured, or a percentage of commissions; and
- **investment expenses**, which may be modelled as a percentage of projected assets or funds under management.

An actuary aims to achieve a practical approach to modelling expenses that captures all the material future expenses likely to be incurred in managing the business.

The starting point in setting expense assumptions is often a review of the company's budget. For most companies, expense budgets for the following year are set as part of the business planning process. Actuaries often provide significant input to these processes, which usually include allocation of expenses to business groups, functions and product lines. Expenses are usually also allocated between acquisition and maintenance activities. The expenses allocated to participating business will affect the amount of profit paid to participating policy owners.



Although acquisition expenses have already been spent for the existing business being valued, they are still an important consideration for a number of reasons. Liability values may require adjustment for recovery of historical acquisition costs. Also, where policy liabilities include margins to manage the release of planned profit, the profitability of new business, which is impacted by acquisition expenses, is a key component in setting these margins. Further, annual budgeting generally includes an allocation of budget expenses between acquisition and maintenance functions as well as to product lines. The higher the allocation of expenses to the acquisition category, the lower the level assumed for maintenance expenses and vice versa. This allocation process, therefore, impacts the level of ongoing expenses assumed in a valuation. Local accounting standards may specify whether an acquisition expense can be amortised.

Some expense items identified as “one-off” expenses may be excluded when deriving unit expense assumptions for modelling. An example may be a one-off systems development project to address changes in legislation. However, such exclusion of expenses requires careful consideration. For instance, costs associated with changes in legislation and related systems updates may be a recurrent theme in managing the business. Even if the particular change under consideration is one-off, it may be more realistic to assume appropriate recurrent expenses of this nature.

It is important that modelled expenses, in aggregate, are reconciled to the total actual or budgeted expenses, and any differences, such as exclusions of one-off expenses, are explained and understood.

In setting expense assumptions, consideration should also be given to the business direction and how this will impact future costs. Significant growth in business volumes may lead to reductions in unit costs. A portfolio closure and run-off has the opposite impact, as some fixed expenses will need to be spread over a decreasing number of in-force policies.

Assumptions will also include allowance for expected future inflationary impacts. The adequacy of assumptions in relation to historical expenses, including any historical expense overruns, will influence the assumptions made.



Lapse rates

Lapse assumptions relate to the likelihood of policy owners renewing their policy at each payment date. In selecting appropriate discontinuance (or lapse) assumptions, an actuary will consider the influence of features such as product design (e.g. surrender values and premium structures), age of policy owners, mode of premium payment and duration of policies.

Lapse assumptions may be averaged over groups of policies with similar policy types and designs, policy owner ages and durations. However, it is important to check that the use of average rates does not materially affect the valuation results. It is also important to assess the effect of changes in the business and policy owner mix over time.

Expectations as to lapse rates in a portfolio impact the value of policy liabilities. A key driver is the amount payable, if any, under a policy on termination. This is also referred to as the *surrender value*, which may be zero. Of particular importance is how the surrender value compares to the liability value ignoring lapses.

If the surrender value of a policy is lower than the value placed on future liabilities ignoring lapses, then anticipating surrenders lowers the value of liabilities. If surrender values are higher, anticipation of surrenders raises the value of liabilities. Consider, for example, a level premium term policy. Premiums are higher than expected claims in the early years, which may drive higher lapse rates than those under a stepped premium policy in the early duration of a policy. If no surrender values are paid, lapses will contribute to profit (at least in the short term³) as the liabilities held for these policies will be released. Assuming higher lapse rates within the valuation basis therefore lowers liability values.

Note that if surrender values are greater than the calculated policy liability for a major policy series, higher surrenders than anticipated may threaten the solvency of the company. For this reason, regulators generally require policy liabilities calculated for solvency purposes to be at least as high as values payable on immediate surrender.

³ In the longer term, dissatisfied customers lapsing their policies may lead to lower new business sales and may ultimately reduce the profits of the company.



Benefit increase rates

Under certain types of policy, premiums or benefits are automatically increased with inflation. Where these increases are not automatic or may be rejected, assumptions about take-up rates for indexation increases are required. These should be based on the company's experience, supplemented if necessary by available industry experience in relation to similar policies.

An actuary should also allow for the actual frequency of premium payment and any experience of premium dormancy under the class of business, where relevant and material, when projecting future premiums and the corresponding benefits.

As stated at the start of the module, the above sections provide a high-level overview of the various economic and other assumptions required for a life insurance liability valuation. Further detail on how to select these assumptions is covered in the LI&R Product Development subject.



8.5. Assumption changes

8.5.1. Impact of assumptions changes

Under Australian and many other reporting requirements, valuation assumptions are on a best estimate basis and must be reviewed and updated regularly as new experience emerges. Changes to valuation assumptions affect the value placed on liabilities. This will have flow-on impacts to profit, taxation, solvency and capital requirements, and may trigger a review of pricing terms for new business. Disclosure of assumptions or changes may be necessary under reporting requirements. Changes to assumptions may signal information to the regulator, the market or to management about the strength of the business.

The actuary needs to apply judgement to the results of analyses of emerging experience in assessing the need for assumption changes. Such judgement may apply to the sources of experience analysis, their statistical reliability and relevance to the business under consideration. The objective is to derive assumptions relevant to future experience.

A view must also be taken as to the extent to which emerging experience reflects a "trend" which is indicative of future experience (compared to the experience being a one-off "shock"). This requires assessment of whether departures from a historical or expected mean are random statistical variations, or indicative of permanent shifts. In practice, this can lead to actuaries analysing emerging experience over a period of time (sometimes a few years) before deciding the trend is permanent and needs to be reflected in a changed set of assumptions. Considerable judgment can be required in knowing when and how to respond to an unexpected emerging "trend".

Valuation models are often run on a range of scenarios of selected assumptions to assess the sensitivity of the results to various assumptions. These can also be used to communicate the impact and materiality of variations to different assumptions.

Judgement is required to set sensitivity tests that relate to the volatility of each assumption rather than just stressing each assumption by the same percentage amount.



The flow-on impacts of assumption changes mean that changes must be carefully considered. This subject is focused primarily on the theory of the relevant valuation techniques. The Applications subjects cover professional and ethical considerations in balancing the interests of multiple stakeholders in applying professional standards and judgement.

It may be desirable to spread the impact of assumption changes, derived via judgement, over time. This can be achieved by making the changes gradually over a number of years. For example, a 6% increase in mortality may be made by 2% increases over three successive years. This approach provides more time for monitoring of any emerging trends before a final decision about their permanence is made.

Reporting standards in some overseas jurisdictions also permit spreading the impact of assumption changes over time, such as by changing assumptions immediately and using a valuation methodology to spread their flow-on impact over time. The remainder of this module will discuss this approach in more detail.

8.5.2. Incorporating assumption changes immediately

In Section 8.5.1, the use of gradual changes to assumptions over time was raised as one method for spreading the impact of changes on valuation results. This provides more time for monitoring of trends; however, it can lead to inappropriate deferment of assumption changes.

It may be desirable to allow certain economic assumption changes to immediately flow through to profit. This would produce consistency in approach, where assets are valued on a fair-value or market-value basis. An example is a portfolio of non-participating endowment or level term policies with benefits fully guaranteed and backed by a matching asset portfolio of fixed-interest securities. An appropriate discount rate in this case would be the risk-free rate, as this is reflective of the nature and term of the liability. A decrease in market observed risk-free rates would lower the discount rate and increase the value of liabilities. However, the change in market rates would produce an offsetting increase to the value of a matching asset portfolio, so the total profit impact would be negligible.



Another example where it may be desirable to allow assumption changes to immediately flow through to profit is for certain provisions for claims incurred, such as disabled lives reserves (DLRs). It can be argued that disabled lives reserves are for claims that have already occurred, so spreading the impact of an adverse assumption change is equivalent to using future profits to pay for current claims, which is not appropriate.

Relevant valuation standards generally provide guidance or include a prescribed approach in relation to assumption changes, and these need to be considered in deciding on a suitable approach.

8.5.3. Spreading assumption changes through profit margins

In Module 6 (Profit), methodologies were examined for achieving the orderly release of planned profit by adding a profit margin to the value of liabilities. As an alternative approach to incorporating assumption changes, if the valuation basis includes a margin for the orderly release of profit, this margin can be adjusted so that the profit impacts of assumption or other changes, such as product repricing, are also spread in an orderly and consistent way. In this way, assumption changes can be made immediately, but the impact of assumption changes is spread over future years, rather than being released as profit (or loss) in the year the change is made.

One methodology for spreading the impact of an assumption change is to equate the total liability value before and after the assumption change with the value of the profit margin used as a balancing item. This is articulated mathematically in the following equation:

$$BEL_{Old} + PM\%_{Old} \times VDriver_{Old} = BEL_{New} + PM\%_{New} \times VDriver_{New}$$

where

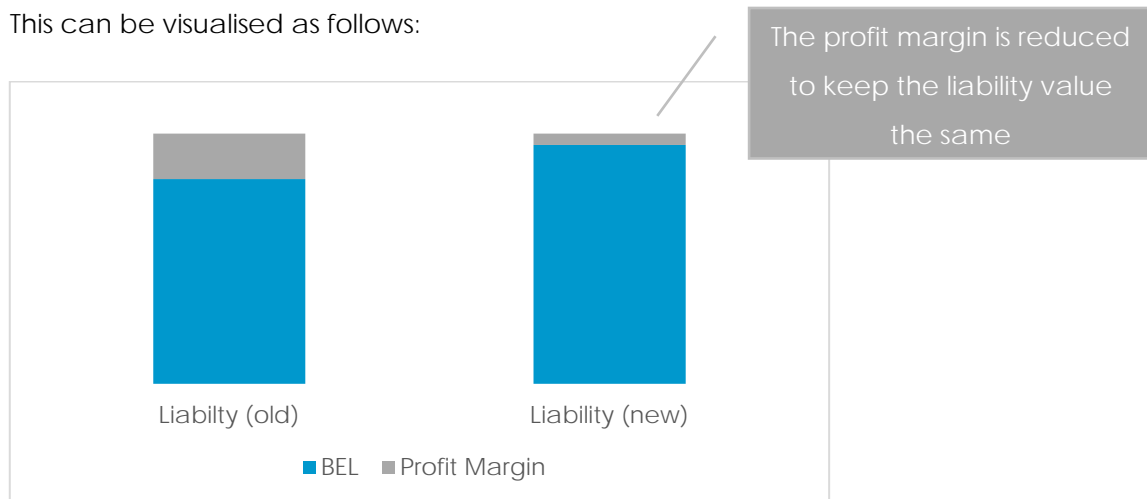
BEL_{Old} is the best estimate liability under the old basis

$PM\%_{Old} \times VDriver_{Old}$ are the profit margin and value of profit driver under the old basis, respectively; and similarly for the items under the new basis.



The total liability (i.e. the left and right sides of the above equation) remains the same before and after the assumption change.

This can be visualised as follows:



The best estimate liability and value of drivers are modelled directly and used to solve for the new profit margin as follows:

$$PM\%_{New} = (BEL_{Old} + PM\%_{Old} \times VDriver_{Old} - BEL_{New}) / VDriver_{New}$$

Table 8.1 and Table 8.2 show the impact of an assumption change made at the end of Year 5 for a level premium term policy which was considered in Module 6 (Profit), Table 6.9.

Table 8.1: Future profits BEFORE assumption change

Year	Commission	Expenses	Net Cash Flow	PV Carrier	BEL	PV S/h profits	Policy liability	Profit	Profit / Premiums
5				2087	281	209	489		
6	-215.4	-85.0	1.2	1,594	302	159	461	55.5	10.00%
7	-193.5	-77.9	-39.1	1,144	282	114	397	49.8	10.00%
8	-173.8	-71.4	-75.8	731	224	73	297	44.8	10.00%
9	-156.1	-65.4	-110.2	350	129	35	164	40.2	10.00%
10	-140.2	-59.9	-140.5	0	0	0	0	36.1	10.00%

Table 8.1 shows the expected value of profits for this product under the original assumptions used when the policies were issued.

Table 8.2 shows the impact of increasing the best estimate of expenses for Years 6 to 10 by 50%.



Table 8.2: Future profits AFTER an assumption change

Year	Commission	Expenses	Net Cash Flow	PV Carrier	BEL	PV S/h profits	Policy liability	Profit	Profit / Premiums
5				2087	366	123	489		
6	-215.4	-128	-20.1	1,594	368	94	462	32.8	5.92%
7	-193.5	-117	-58.6	1,144	330	68	398	29.5	5.92%
8	-173.8	-107	-93.7	731	255	43	298	26.5	5.92%
9	-156.1	-98	-126.6	350	144	21	165	23.8	5.92%
10	-140.2	-90	-155.5	0	0	0	0	21.4	5.92%

The policy liability at the end of Year 5 is \$489.3. Under the old assumptions, the best estimate liability was \$280.6. Under the new assumptions, the best estimate liability increases to \$365.8. In order to preserve the value of the policy liability at \$489.3, the present value of shareholder profits must be reduced from \$208.7 ($\$489.3 - \280.6) under the old assumptions reflected in Table 8.1 to \$123.5 ($\$489.3 - \365.8) under the new assumptions reflected in Table 8.2. The shareholder profits are the balancing item.

The present value of the profit driver (premiums, in this example) as at the end of Year 5 is \$2,086.5 and is unaffected by the assumption change. However, the profit margin changes from 10% ($\$208.7 / \$2,086.5$) under the old basis to 5.9% ($\$123.5 / \$2,086.5$) under the new basis.

As a result of these changes, the profit is unchanged in Year 5, but decreases in each year from Year 6 onwards.

The above methodology can be used when liability values include explicit profit margins. However, this may not always be the case. For example, the valuation of disabled lives reserves may not include a margin for release of future profit. Where companies value disability income policies by combining active and disabled lives together as one portfolio, profit margins on active life policies could be used to spread the impact of assumption changes affecting either active or disabled lives (or both).



Exercise 8.3

If the impact of a change in assumptions is large enough, the profit margin becomes negative. What are the benefits and problems with spreading the impact of assumption changes that have caused a profit margin to become negative?

8.5.4. Capitalising expected future losses

The use of profit margins to spread the impact of assumption changes for a specified portfolio should not extend to situations where margins would become negative by doing so. Otherwise, the liability value on which a reserve is based will not be sufficient to cover the future losses expected from the assumption change. Instead, losses should be realised immediately (referred to as *capitalising* or *recognising expected future losses*).

The concept of ensuring that liability values are adequate extends beyond situations where explicit assumptions have changed. Changes to the business mix or the exercise of options under policies may cause a marginally profitable portfolio to project future losses. Where policies are valued on an accumulation basis, it may be necessary to project cash flows to ensure that reserves are expected to be adequate at all times in the future. This may be obvious without a projection if fees and expenses are well matched. It may be less obvious for more complex structures or where future contracted bonuses or guarantees apply.



8.5.5. Grouping and the impact on margins

The techniques discussed above for the spreading of assumption-change impacts are applied to groups or portfolios of policies. It may be appropriate to use the same level of grouping used in setting assumptions. However, for reporting purposes, larger groups or smaller sub-groups may be required. Reporting standards may allow or restrict adjustments to policy groupings for the purpose of spreading the impact of assumption changes. Subject to any legislative or other restrictions, a company may adjust its groupings to combine more and less profitable portfolios. This may have the effect of creating a larger, profitable group from smaller groups, some of which are profitable while others show expected losses. The grouping of policies for valuation is discussed further in Module 10 (Process).

Exercise 8.4

What are the advantages and disadvantages of grouping portfolios?

Exercise 8.5

As a result of assumption changes, a company will report expected losses on its annuity portfolio. The finance manager has suggested combining the term and annuity portfolios to avoid these losses being obvious in reported results.

Comment on this suggestion.

	Before change	After change
Annuity portfolio		
BEL \$m	300	305
Value of driver \$m	295	300
Profit margin %	0.50%	
Term portfolio		



BEL \$m	-30
Value of driver \$m	95
Profit margin%	3%

8.6. Key learning points

- To value liabilities, assumptions must be made about factors affecting future costs and income streams. Assumptions have an impact on the calculation of liability values, but they do not impact actual future experience.
- In setting assumptions, actuaries need to consider items such as the valuation method used, the purpose of the valuation, consistency between assumptions and available sources of information.
- Companies rely on a range of internal and external data sources and investigations. The quality of a company's own data and analyses will affect the extent to which it relies on these.
- Documentation of assumptions, their application and the rationale for their selection is very important.
- Assumptions for life insurance valuations can be divided into two broad categories: *economic* (e.g. investment earnings, discount rates and inflation rates) and *non-economic* (e.g. mortality, morbidity, lapse rates and expenses).
- Investment earning assumptions should take into account the asset mix, past and target rates of investment return and financial analysts' forecasts.
- Discount rates should be set with reference to the nature, structure and term of the future liability cash flows. This, along with the purpose for the valuation, will help determine whether a risk-free or risk discount rate should be used.
- Tax assumptions take into account relevant tax rules.
- Mortality and morbidity assumptions should be set with regard to the specific types of policies and benefits under consideration.
- There are various types of expenses that may need to be modelled, including acquisition and maintenance expenses.
- The impact of lapse assumptions depends on the amount payable on lapse compared to the liability held at the time of lapse.



- It may be desirable to spread the impact of assumption changes over time. This can be achieved by adjusting liability profit margins. However, where assumption changes would cause margins to become negative, such losses should be recognised immediately.
- Scenario and sensitivity testing can be performed by varying assumptions to assess the effect on valuation results.

8.7. Answers to exercises

Exercise 8.1:

Why might mortality assumptions for funeral cover insurance, term insurance and retirement annuities be different? How will they be different?

Answer:

Expected claims are likely to differ across these three product types necessitating different mortality assumptions.

Underwriting is the process by which a life company assesses risks and decides the terms on which proposals are acceptable. An underwriting decision may involve accepting, loading, excluding or declining a risk. Underwriting also serves to protect the insurer from information asymmetry, which could occur if there are conditions effecting the cost of insurance that the insured is aware of, but the insurer is not aware. This is referred to as anti-selection.

Term insurance will be subject to a more extensive underwriting process than funeral cover as the cover amounts under term are significantly higher with more variation. Funeral cover would likely have higher assumed mortality than term insurance. Annuities are generally not underwritten although there are 'impaired lives' annuities, where the annuitants have lower than average life expectancy and these contracts are underwritten to check that the annuitant is a higher risk than standard annuities.



Exercise 8.2:

Why are term insurance reserves relatively low compared with a participating endowment assurance contract?

Answer:

The reserves under a participating endowment contract will reflect a substantial savings component. The benefit includes a guaranteed sum insured plus declared bonus. Also, term insurance is payable only on death, whereas endowment policies is payable either on death as with term, or otherwise on surrender or survival to the maturity age.

Exercise 8.3:

If the impact of a change in assumptions is large enough, the profit margin becomes negative. What are the benefits and problems with spreading the impact of assumption changes that have caused a profit margin to become negative?

Answer:

A negative profit margin means that reserves plus future income is expected to be exceeded by outgo. The deficit needs to be funded immediately. To spread the negative margin is to assume that future shortfalls can be made up as they fall due. It is a principle of reserving, and fundamental to the solvency of the company, that you should not rely on discretionary funding to meet future payment obligations.

Exercise 8.4:

What are the advantages and disadvantages of grouping portfolios?

Answer:

Advantages

- More stable results. A small marginal portfolio may have a large and volatile impact on total results in isolation as it moves between being profitable and unprofitable
- A loss leader could be grouped with more profitable series to provide a more meaningful overall picture.



- The allocation of overhead expenses can be subjective, and have a significant impact on reported profitability, particularly for smaller series. By combining smaller and larger series of otherwise similar policies, overall results may be more meaningful.
- More streamlined valuation process. Some product groups may not be material. Grouping together similar series can reduce the number of calculations and simplify the process and analysis of results.

Disadvantages

- There may be pressure to combine more and less profitable groups to hide losses.
- Grouping may lead to important information being missed about the underlying policy series being grouped.

Exercise 8.5:

As a result of assumption changes, a company will report expected losses on its annuity portfolio. The finance manager has suggested combining the term and annuity portfolios to avoid these losses being obvious in reported results.

Comment on this suggestion. Data is supplied in the table below.

Answer:

The following table provides the backing data for the question.

	Before change	After change
Annuity portfolio		
BEL \$m	300	305
Value of driver \$m	295	300
Profit margin %	0.50%	
Term portfolio		
BEL \$m	-30	
Value of driver \$m	95	
Profit margin%	3%	



See the spreadsheet 'LI&R Val S1 2020 M08 Exercise 8.5' that generates the following tables:

	Before change \$m	After change \$m
Annuity		
BEL	300	305
Profit margin \$m	1.475	0
Liab	301.475	305
Loss recognised		-3.525
Value of driver	295	300
Profit margin %	0.50%	

Term		
BEL	-30	-30
Profit margin \$m	2.85	2.85
Liab	-27.15	-27.15
Value of driver	95	95
Profit margin %	3%	3%

Total position if not combined		
BEL	270	275
Profit margin	4.325	2.85
Liab	274.325	277.85
Loss recognised		-3.525

Total position if combined		
BEL	270	275
Profit	4.325	0
Liab	274.325	275
Loss recognised		-0.675
Still an overall loss even when combined		



The two are not similar types of policies so combining in a portfolio does not have sound justification.

The combination will not remove the problem but instead mask it, making it harder to manage. The results for the combined portfolio will be difficult to explain as they are not meaningful.

A subsequent adverse change to risk assumptions would have a capitalised impact on the combined portfolio.



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