

Institute of Actuaries of India

Subject ST2 – Life Insurance

October/November 2007 Examination

INDICATIVE SOLUTION

Introduction

The indicative solution has been written by the Examiners with the aim of helping candidates. The solutions given are only indicative. It is realized that there could be other points as valid answers and examiner have given credit for any alternative approach or interpretation which they consider to be reasonable.

Question 1**a) Returns Required by Investors**

- Owners of a life insurance company can decide where to invest by comparing the returns offered by different companies, relative to the risks which are run
- Can move capital from one company to another if they wish.
- Concept exists of a “risk-free” asset - an asset which offers a certain return free from all risk of default.
- Investors will demand a higher expected rate of return from a risky investment than from a safe investment - a “risk premium” over and above the expected returns on safer investments.
- Investing in a life insurance company is not the same as investing in a risk-free asset. Investors will demand an expected rate of return equal to the risk-free rate plus a risk premium.
- Such a rate of return is called a “risk discount rate”.
- The Capital Asset Pricing Model (CAPM) has been widely used by stock market investors to try and determine an appropriate risk premium to compensate for the risks of investing in companies generally
- The CAPM is just one example of how the market might assess the shares of a company.
- Not up to the actuary alone to decide what is an appropriate rate of return for shareholders. The actuary will need to make some assumptions, but the market is the final judge.
- Company should view itself as an investor when it considers the riskiness of a new product, as in the long run the profits emerging from the whole company are the profits emerging from the products that it sells.
- A change in the mix of business, eg away from old and safe contracts towards new and innovative contracts, would change the market’s evaluation of the company’s riskiness.
- The following can make a product design riskier, viewed as an investment:
 - lack of historical data
 - high guarantees
 - market risk
 - insurance risk
 - persistency risk
 - speed of repayment of capital
 - policyholder options
 - overhead costs
 - untested market.
- The level of risk could be assessed using one of the following methods:
 - Analytically, by considering the potential variances of the individual parameter values used.
 - Using sensitivity analyses with deterministically assessed variations in the parameter values.
 - Testing scenarios to assess the impact of the correlated impact of adverse changes in parameters
 - Using stochastic models for some, or all, of the parameter values and simulation.
 - By comparison with any available market data.

b) Expression of Net Present Values:

- Reflect the effort that would be expended on selling a policy.
- Express as a proportion of initial commission that rewards the salesperson.
- Can align the financial interests of sales people and the company
- Size of market in terms of the premium income of insurance companies, among other things.
- Express as a percentage of the present value of the premiums that will be paid under the policy.
- If a company can sell the same volume of premiums, ie capture the same market share, for a higher net present value it should aim to do so.
- Aligns financial performance of company with a frequently used external measure of success

c) Risks Faced by Policyholders

Conventional without profits contracts	<p>Benefit provided – being fixed and guaranteed – turns out to be insufficient</p> <p>For a long-term contract, this risk is exacerbated by the effects of inflation over time</p> <p>Insurer becomes insolvent and unable to meet the guaranteed benefits in full</p> <p>Inflexibility of the product to keep pace with the changing disposable income of the policyholder</p> <p>Inflexibility to cope with changing amounts of benefit needed throughout the financial life cycle</p> <p>Risk of being unable to maintain premiums due to accident, sickness, redundancy, or other loss of income unless contract incorporates cover against these eventualities</p> <p>Risk that a term assurance policy expires before the client makes a claim</p> <p>Risk that policyholder's claim is not covered by the policy eg wrong illness or pre-existing condition</p>
With profits contracts	<p>Similar to conventional without profit contracts</p> <p>Some protection against the ultimate benefits being eroded by inflation</p> <p>But only to the extent that the policyholder does not also choose to reduce the guaranteed level of benefit in anticipation of future bonuses</p> <p>Risk of insurer insolvency may be lower because reduced guaranteed being provided</p>
Unit linked contracts	<p>Some protection against the ultimate benefits being eroded by inflation</p> <p>Any minimum guaranteed death benefit will tend to be expressed in monetary terms and hence be subject to being eroded by inflation.</p> <p>Poor investment performance</p> <p>Risk of pricing basis switching from offer to bid</p> <p>Particular risk of reduced unit values at the point of benefit payment.</p> <p>Some risk of insurer insolvency.</p>

	<p>Lower risk misaligned needs and benefits as contracts can be designed in a flexible manner so as to allow the policyholder to vary premiums and benefits over his or her lifetime.</p> <p>Contracts can allow premiums to be missed for ad hoc periods of time.</p> <p>Increases in minimum guaranteed death benefits are likely to be made subject to satisfactory evidence of health unless contract incorporates some form of option.</p>
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d) Reserving Assumptions

<ul style="list-style-type: none"> Published Accounts 	<p>Assumptions should have regard to the legislation and accounting principles governing the preparation of those accounts in the country concerned.</p> <p>Accounts prepared on a going concern basis?</p> <p>Accounts required to show a true and fair view?</p> <p>Reserves required to be assessed as best estimates or on some other basis?</p> <p>Precisely how the terms used are to be interpreted.</p>
<ul style="list-style-type: none"> Accounts provided to the Supervisor 	<p>Rules governing the preparation of these separate accounts may or may not be the same as those that apply to the published accounts.</p> <p>More prudent basis than for accounts as testing solvency</p> <p>May be required on a going concern basis or on a break-up basis.</p> <p>Reference should be made to those rules and any guidance that may have been issued as to their interpretation.</p>
<ul style="list-style-type: none"> Internal Management Accounts 	<p>Principles to be followed are matters to be discussed and agreed with the insurer.</p> <p>Aim is likely to be to produce expected values of the future experience, based on realistic assumptions.</p> <p>Assumptions likely to be stripped of margins.</p> <p>The basis derived will be closer to that used for new business pricing.</p> <p>All items will be included explicitly (expenses, withdrawals, investment return).</p> <p>Cashflow method would estimate the amounts that needed to meet future claims (including options), expense and tax outgo against the expected premium and investment revenue inflow.</p> <p>No elimination of negative values.</p> <p>Generally used when management wishes to have a best estimate of the company's financial performance.</p> <p>Might arise in circumstances where the insurer is to be sold</p> <p>Might arise where company wishes to reward key staff for their contributions to the overall growth of the company.</p>

<ul style="list-style-type: none"> Valuation for Sale or Purchase 	<p>Starting point in valuing a life insurance company purpose will be to place a value on the existing business - embedded value</p> <p>Liabilities for a sale value based on realistic assumptions without margins</p> <p>Liabilities for a purchase value being based on cautious assumptions that include margins.</p> <p>Value would be placed on future new business to assess goodwill</p>
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[maximum 11]

Question 2**a) Taxation of life insurance:**

- Tax on the annual profits of the business
- Tax on investment income less some or all of the operating expenses of the company
- Tax on realized and unrealized investment gains
- Tax on premium income
- Within a particular country, different types of life insurance business may be taxed on different methods
- This can mean lower cost for the consumer and/or more profit for the company if certain forms of benefit can be offered as one type of business rather than another.
- Taxation treatment of life insurance business may make life insurance more or less attractive as a savings medium than contracts offered by other savings institutions
- Tax concessions available to individuals may make the sale of certain types of contract easier
- Tax treatment in the hands of policyholders of policy proceeds can distort buying habits.
- Product design should make the best use of any opportunities to reduce the tax burden on the company
- Need to take advantage of favourable taxation treatment may force constraints on product design.
- Taxation can change over time - important to bear when benefits are guaranteed over the long term.[in reality one wouldn't specifically allow for this - covered by general margin for risk]

b) Immediate annuities – product types

- Regular amounts of benefit provided life insured alive at time of payment.
- Payments start immediately
- Payments made in advance or in arrears
- Maximum period until first payment is frequency period of payment
- Purchased in advance by a single premium
- Premium may be proceeds of another contract
- Main purpose to convert capital into lifetime income

- Removes uncertainty of how quickly capital should be spent to provide income over remaining lifetime.
- Immediate annuities may be
 - Single life
 - Joint lives ceasing on first death
 - Joint lives ceasing on survivor's death
 - Payable for temporary periods only
- Last survivor annuity can be used to provide for dependants' income following the death of main life.
- Temporary annuities may be suitable, for example, to pay school fees
- Benefit payments may be level or variable
- Most common variable fixed or inflation linked increase
- With-profits annuities have income paid of a guaranteed amount plus a bonus added by the insurer.
- Unit linked annuities have income expressed as a number of units and monetary benefit is number of units multiplied by the unit price.
- Payments may be made for an initial number of years irrespective of whether the life insured survives the initial period.
- May be a guarantee that on death any shortfall between the initial premium paid and the amounts of annuity received to the date of death will become payable.
- Surrender values not normally available.
- Applicants whose health is impaired can be given higher levels of annuity benefit

c) Immediate Annuities – Mortality Related Risks

- Longevity risk
- Rates of improvement of life expectancy
- Anti-selection risk
- Underwriting of impaired lives
- Extent of free choice available to the policyholder regarding the purchase of the contract.
- These factors are important because for most annuities there is no option to change the benefits in future if annuitants live longer than expected
- If mortality is over-estimated the company could sustain significant losses in the future

d) Immediate Annuities – Investment Issues

<ul style="list-style-type: none"> • Guaranteed in money terms – annuity payments in fixed monetary terms 	<p>Ideally invest so as to ensure guarantees can be met</p> <p>Investing in assets which produce a flow of asset proceeds to match the liability outgo.</p> <p>Fixed interest investments</p> <p>Government bonds are risk free but may consider corporate bonds or other fixed interest investment for a higher yield</p> <p>Then need to take into account the additional (credit</p>
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	<p>and possibly liquidity) risk with such investments</p> <p>Take into account term of the liability outgo</p> <p>Take into account probability of the payments being made</p> <p>Probably impossible in practice to find assets whose proceeds exactly match the expected liability outgo.</p> <p>Terms of available fixed-interest securities are often much shorter than the corresponding liabilities.</p> <p>Technique of immunization may be used but is subject to theoretical and practical problems.</p> <p>Reinvestment risk is significant</p> <p>Equities may be considered for long term element of liabilities but need to take into account the additional capital needed for the additional risk involved</p> <p>Liabilities denominated in a particular currency should be matched by assets in the same currency, so as to reduce any currency risk.</p>
<ul style="list-style-type: none"> Guaranteed in terms of an index – annuity payments linked to inflation payments 	<p>Ideally index-linked securities</p> <p>But these may not be for the index the benefits are linked to – so may need to consider purchasing financial options</p> <p>Match expected term of the liability outgo.</p> <p>A substitute would be assets expected to provide a “real” return.</p>
<ul style="list-style-type: none"> Discretionary – with profits annuities with annuity payments a guaranteed amount plus some form of bonus 	<p>As for guaranteed payment annuities in respect of the guaranteed portion of the benefit</p> <p>Aim would normally be to maximize discretionary benefits</p> <p>Invest in assets that will produce the highest expected return.</p> <p>Annuitants may expect the annuity payments to maintain their value in “real” terms.</p> <p>Invest in assets recommended that are expected to provide a “real” return.</p>
<ul style="list-style-type: none"> Investment linked – annuity payments in expressed as units 	<p>Benefits are guaranteed in the sense that their value can be determined at any time in accordance with a definite formula based on the value of a specified fund of assets</p> <p>Avoid any investment matching problems by investing in the same assets as used to determine the benefits.</p>
<ul style="list-style-type: none"> Allowance for expenses 	<p>Insurer’s future expenses are similar in liability terms to a benefit payment</p> <p>Continue as long as the annuity payments continue</p> <p>Expense payments tend to increase similar to the rate of change in a price index,</p> <p>Can be viewed as benefit payments guaranteed in terms of an index of prices or similar.</p>

[maximum 11]

Question 3**a) Expense Assumption as a Proportion of Premium**

- Although aggregate ratio is stable, underlying expenses could differ by product type
- Differences should be reflected in product pricing on grounds of fairness and to minimise risks if business mix changes
- Generally accepted that initial expenses for life insurance are higher than for renewal and this pattern needs to be reflected in pricing especially where product terms vary
- Expense rate is a function of level of new business and so could increase if new business increases or vice versa
- Some overhead expenses are fixed and do not vary with premium volumes
- A large proportion of renewal expenses will increase with inflation whereas renewal premiums will often be level
- Renewal commission is often a proportion of premium
- Pricing includes bonus determinations for with profit policies
- Surrender values should also reflect both the level and incidence of expenses attributable to the policy concerned.

b) Expense Analysis

- Exclude commission which can be added in later by a formula approach.
- Need to identify the expenses attributable to the four separate product lines
- Split non-commission expenses into:
 - initial expenses
 - renewal expenses
 - termination expenses
 - investment expenses
 - development expenses
- First three items further split according to whether the expense is fixed or is proportional to:
 - the number of contracts written or in-force
 - the amount of premium written or in-force
 - the amount of benefit written or in-force.
- Fixed expenses need to be apportioned between initial and renewal and between products – possibly as an uplift to the promotional expenses
- Most other expenses are proportional to the number of contracts written or in-force except:
 - marketing expenses – typically related to the amount of initial commission paid;
 - underwriting expenses – mainly related to size of benefit.
- Investment expenses expressed as a percentage of funds under management
- Main items of expense are:
 - salaries and salary-related expenses
 - property costs

- computer costs
- investment costs
- Staff can be split into three groups:
 - staff whose work comes entirely within a particular product line
 - staff whose work comes within more than one product line
 - other staff.
- Salaries etc of staff in first group can be directly allocated to the appropriate product line.
- Salaries of staff in second group between the appropriate product lines based on timesheets
- Salaries of staff in third group are likely to be split pragmatically.
- If the company owns any of the buildings it occupies, a notional rent needs to be charged to the relevant departments.
- Property costs be split by floor space occupied, between departments and then allocated in accordance to salaries.
- Ongoing computer costs can be allocated according to systems usage
- Large one-off capital costs need to be amortised over the expected useful lifetime of the item purchased and cost allocated based on usage

c) Incorporating into charging structure expenses which do not vary by size of contract:

- Individual calculation of premium rates or charges.
- Policy fee addition to the premium
- Deduction from regular benefit payments
- Charges that match the per-policy expenses for unit-linked contracts. This approach may need to be modified if the policy fee or charges would be uncompetitive. However such modifications would lead to increased risk for the company.
- Premium rates are charged according to which band the benefit falls.
- Different charges, for example allocation rates, are applied according to which band the premium payable falls into.

[max 3]

Question 4**a) Reasons for underwriting:**

- These products have a large sum at risk compared with the premium paid so it is important that the company controls the risk it is taking on
- Protect company from anti-selection .This includes from seriously impaired lives that the company would want to decline and by identifying lives for whom special terms should be quoted.
- Identify the best approach and level of charges where special terms apply.
- Classify risks to ensure that standard and impaired lives are treated fairly.
- Help ensure that morbidity and mortality experience does not depart far from pricing assumption.
- Make it easier or cheaper to get reinsurance
- Reduce risks arising from over-insurance on large proposals.

b) Factors to take into account when setting medical limits

- Insurance intermediaries will want the underwriting process to be as quick as possible.
 - Getting doctors reports will generally slow the process.
 - Company will not want to set its limits too low relative to the market as it may find that intermediaries place business elsewhere.
 - Conversely, if the company sets its limit too high then it may risk anti-selection.
- Setting a higher medical limit will reduce the number of reports requested and reduce underwriting expenses. However:
 - Limits must be consistent with the morbidity assumed in the pricing basis.
 - If a high limit is chosen, then the underlying morbidity should be assumed to be heavier than if a lower limit is used.
- Company may seek guidance from reinsurers in setting the new limits
- To evaluate the impact of choosing a higher limit, take a sample of existing cases with sum assured above the old limit but below the proposed limit.
 - Compare the present value of any additional loadings with the expenses incurred – including the value of any exclusions and liens
 - If the savings are more than the value of the loadings then the increase is sensible. If not, then the company could either reduce proposed level until equivalence is reached or increase premiums to reflect the likelier heavier morbidity

c) Special Terms

- An addition to the premium charged for the risk:
 - An addition to the decrement rate of a flat rate (usually expressed as a rate per thousand sum assured).
 - Underlying decrement rate may be loaded by an additional percentage.
- A debt or lien on the sum assured where benefit paid in the event of a claim is reduced.
 - Extent of the reduction may be fixed or reduce over time if the additional risk is thought to have a select effect.

- Reduction may apply for a temporary period.
- An exclusion clause :
 - Claims that arise due to specified causes or pre-existing conditions are not paid.
 - This may be throughout the policy term or temporary

- d) Analysis of Experience:**
 - Split the data into homogeneous groups whilst keeping the volume of data within each group credible.
 - The investigation may be carried out on
 - amounts as well as a lives basis
 - net and gross of reinsurance.
 - Only business accepted at standard rates (and with no debts or exclusions) included. – although if a significant volume of these cases the experience of these may be analysed separately
 - Claim data and the exposed to risk data must correspond.
 - The exposed to risk will normally be the average of the in-force policies at the year start and the year-end (but more accurately if the data are available), except that critical illness claims will be given a full year's exposure (rather than a half) in the year of claim.
 - Analysis would be performed to cover the experience for each year since commencement, but as significant volumes have only been sold for the last 3 years, it may be necessary to group the experience for some calendar years together.

 - As there may be a delay between the date of claim and when it is admitted, care needs to be taken to include the claim within the calendar year and duration to which it relates.
 - Allowance should also be made for any incurred but not reported (IBNR) claims in the more recent years.
 - The most important levels at which to carry out the investigation are:
 - Sex
 - Age (grouped as required)
 - Smoker Status
 - Duration since outset
 - (Experience will be lighter at early durations due to underwriting)
 - Sales Channel (this is an indicator of target market)
 - Type of illness
 - If enough data exists then the investigation could also be split by:
 - Medical / non-medical cases
 - Occupation
 - Premium size
 - Premium payment method

- e) Use of the analysis in setting assumptions**
 - Assumptions are required for both the current level of critical illness experience and the expected future changes
 - More recent years' experience would be used to help make an assumption about current experience.
 - Express results as a percentage of reinsurer's rates, of a standard table if

one exists, or of the pricing basis if different.

- Trend in experience for recent years would be used to help make an assumption about the expected future trend in critical illness experience.
- If the volume of data were sufficient this trend would be considered separately for each type of illness
- Care needs to be taken to allow for any features that may have impacted on the experience over the period of the investigation that may make it an unreliable guide for future experience.
- Impact of very large cases would be excluded

f) Results not indicative of future experience

[Total 25]

- Underwriting standards may have changed over the period of the investigation.
- Experience for durations greater than three is based on small volumes of data so may not be credible. Similarly the trend in experience is only based on significant volumes of data for the last 3 years. This is unlikely to be sufficient to give an indication of likely future trends.
- Changes in the sales process or the target market over the period of the investigation may affect experience.
- Changes in the medical or reinsurance limits may have impacted the experience
- The average premium size may have changed over the period of the investigation. This will affect the results if the analysis is not split by premium size.
- Reductions in market premium rates over the period of investigation may have led to selective lapses and worse experience. If this will not be a feature of the marketplace in future then the results will not give an appropriate assumption.
- Changes in the definition of a critical illness or the critical illness covered over the period of the investigation will distort results, as will changes in claims admittance standards.
- Consumerist pressure may lead to more pressure in future to admit claims that do not meet the strict definition
- Future medical advances may lead to earlier detections of critical illnesses or more routine operations in future such that past trends are not indicative of the future.
- Particular medical advances that are not expected to continue in future may have caused past trends in experience
