# Institute of Actuaries of India

# Subject CA1 – Paper I
# Core Applications Concepts

## 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.

1) A life insurance company that sells without profit term assurance product through its own sales force now wishes to sell via the Internet.
Outline why the existing product premium and terms cannot be offered for sale through this new channel.

Major factors affecting price will be -

Mortality- which will depend on

1. Target market, distribution channel-The 2 channels cater to different market segments. Own sales force more a "push sale" than internet channel where the sale would be based on need
2. Underwriting and Claims process – Internet sale requires simplified UW and issuance process which will result in different claims experience.

Expenses including sales incentives- - Nature of expenses not the same as own sales force will involve salary /commission. Internet sale will not involve huge people costs but expenses in terms of advertising, propagation of internet sales etc may be different,

Persistency – will not be same due to the differing nature of sales channel and target market. Internet sales can also propagate issues like bank account debit of premium payments which might improve persistency and have different cost implications as well

Average case size will be different- due to simplified UW process in internet it might not be possible to offer large SA which will impact expense allowance emergence

2(a) Explain why supervisory authorities require financial providers to maintain a specified level of solvency capital.

(b) Discuss the relationship between the strength of the supervisory provisions for individual contracts and the level of solvency capital required.

The solvency capital provides an additional level of protection to the customer over and above that provided by the individual provisions alone.

If the provider is unable to meet the solvency capital requirements of the supervisory authority, this may trigger intervention by the authority and a subsequent examination of how the practices of the provider can be changed to ensure more prudent financial management and to safeguard the benefits of the customers. This will enable the regulator to identify trouble areas faster.

(ii) Relationship between provisions for individual contracts and solvency capital
When considering the adequacy of the provisions that have been set up for individual contracts, it is important to do this in the context of the solvency capital requirements and vice versa.

In some territories the basis for assessing provisions for individual contracts takes a best estimate of future experience, with few margins. This type of basis is normally coupled with a requirement for the financial provider to maintain significant capital to demonstrate solvency. In other territories the individual contract basis is very prudent, with significant margins, but the financial provider is required to hold little or no solvency capital in excess of the individual contract provisions.

[Total 3]

3 A general insurance company that writes commercial property insurance business wants to purchase excess of loss reinsurance protection to reduce the overall variability of its claims experience. You have been asked to recommend an appropriate reinsurance structure (limit, deductible etc). For accomplishing this job you decide to build a liability model.

State the major requirements from the model which would enable you to decide on the appropriate reinsurance strategy.

State the other factors that the insurance company needs to consider before deciding to purchase the reinsurance.

[Total 8]

The model must be capable of producing claim distributions both gross and net of a specified reinsurance structure. It should enable the user to test various reinsurance structures.

It must accurately describe the insurer's current portfolio, present and prospective.

The model should run quickly and reliably with communicable answers, encompasing key deterministic variables.

(ii) Cost and availability of the various reinsurance structures vs their likely benefit.
Size of the portfolio relative to the total portfolio
Any large exposures which skew the company's portfolio
Security Status of the available reinsurers- credit rating, financial strength
Size of free reserves of the company and company's risk appetite
Any local regulations which govern reinsurance
Impact on solvency requirements from regulators.- for eg. The regulations might require a credit risk capital based on reinsurance ceded
How does the chosen reinsurance structure compare with competitors?
Alternatives to XOL reinsurance
Services available from reinsurers.
Service standards available from reinsurers
Extreme risk, catastrophe
Experience

[maximum 5]

4 (a) What is meant by the real yield gap? Develop a relationship to explain the circumstances under which the level of the real yield gap may be larger than usual and list those circumstances.

(b) Consider an investor with the following views:

- equity risk premium = 3.5%
- real future dividend growth = 1.5%
- gross dividend yield = 4.5%
- real yield on index-linked government bonds = 3%
- real yield on index-linked corporate bonds = 4%
- default risk premium on index-linked corporate bonds = 1.5%
- expected future inflation = 2.5%

Which investment class will the investor choose to purchase – equities or index-linked bonds?

a) The real yield gap is equal to the excess of the equity dividend yield over the real yield on index-linked bonds.

It is normally defined with respect to index-linked government bonds rather than index-linked corporate bonds, as there are very few of the latter.

Assuming that both equities and index-linked government bonds are fairly priced, then the risk-adjusted real expected returns should be the same on both asset classes.

For index-linked government bonds, the risk-adjusted real expected return is simply the risk-free real yield, rf.
For equities, the risk-adjusted real expected return is given by:
dividend yield (d) + expected real capital gain (g) + expected inflation (infl)
– equity risk premium (ERP) – expected inflation (infl).
Equating these gives:
rf = d + g – ERP
ie d – rf = ERP – g
ie real yield gap = ERP – g

Thus, the real yield gap will be larger than usual if:
• equities are perceived to be riskier than usual, and/or
• the expected real growth of dividends is lower than usual and/or
• equities are under priced relative to index-linked government bonds.

[Maximum 4]

(b) Which will she purchase?
Risk-adjusted real returns
Using the relationship in (a), the risk-adjusted real expected return on equities is:
4½ + 1 ½- 3 1/2 = 2%
Whilst for government index-linked bonds it is 3%
And for corporate index-linked bonds it is:

$4 - 1.5 = 2.5\%$
Based upon these figures alone, she will choose to invest in index-linked bonds

[Total 2]

5a) Describe the generalized dividend discount model used to derive the value of an equity share. Derive a simplified model from the generalized model. Explain all symbols that you use.

b)State the factors that you will consider while assessing the value of shares of a new consumer goods retailer which is yet to declare dividends?

[Total 7]

The dividend discount model derives the value of a share as the discounted value of the estimated future dividend stream.

The general model can be expressed as:

$$V = \sum_{t=1}^{\infty} D_t \, v(t)$$

where: V is the value of the share,
Dt is the gross amount of the tth dividend payment,
v(t) is the discount factor applied between time 0 and the time of the tth dividend payment.
Note that this assumes that the share is held in perpetuity.

Simplified model
A simplified equation can be obtained by assuming:

- that dividends are payable annually, with the next payment in one year's time
- that dividends grow at a constant rate, g, per annum
- and that the required rate of return, i, is independent of the time at which payments are received.

With these assumptions the equation becomes:

D/(1+i)+D*(1+g)/(1+i)^2+ D*(1+g)^2/(1+i)^3+……..

D/(1+i)[1+(1+g)/(1+i)+(1+g)^2/(1+i)^2+……..]

D/(1+i)[1/(1-[(1+g)/(1+i)]

D/i-g

where D is the dividend to be paid one year from now.

b) Dividend discount model cannot be used as the company does not have a dividend record. We have to determine a relevant and measurable key factor for the company's business. The relationship between this factor and the market price of other quoted companies is then used as a basis for valuation. The factor used will depend on the particular business of the company.

Food retailers typically operate with high volumes of sales
and low profit margins
Efficiency of sales and turnover is therefore likely to be a crucial determinant of success
Investigate such factors as:
• turnover per square meter of selling space or per member of staff
Determine similar ratios for listed retail companies and relationship between market value of the listed and these ratios. Use this relationship to determine the value of the listed company.

We can also investigate other factors like -
• the stock turnover ratio (stock ⎜turnover)
• creditors ⎜turnover (the company may be able to increase profitability by delaying payments to suppliers as long as possible).
Market share and quality of management might also be of interest.

[max 4]

6) The marketing head of your pension products sees potential in the unit linked deferred annuity market space in terms of providing professional investment advice. He believes many customers lack the knowledge and expertise to choose the best funds to be invested in during the deferment phase prior to retirement. He recommends that the company consider offering a .lifestyle investment option which is to be marketed as being broadly suitable for a wide range of customers. The investments under the lifestyle option will change during the life of the policy, ie as the customer moves towards retirement.

Describe the considerations that you think need to be taken into account in determining the investments that will make up the lifestyle option.

Profile of the liabilities: There is a fundamental requirement that the investments offered are a suitable match for the liabilities in terms of nature, term and currency.

For much of the pre-retirement period the liabilities are real and are best matched with asset classes that might offer returns in line with salary growth or some other measure inflation, eg equity and property investments.

Closer to retirement, eg last 10 years, the desire to match the liabilities may result in a gradual move into asset classes that match the movements in annuity rates, eg bond investments.

If a proportion of the retirement fund is typically taken as a cash sum rather than as annuity, the funds in respect of this portion could be switched into cash as retirement approaches rather than into bonds.

Profile of target market -Consider the financial sophistication of the company's customers in making investment decisions. As the research suggests a lack of understanding of and interest in certain investment decisions, the lifestyle option should reflect a decision applicable to the mainstream rather than a narrow target group.

The risk aversion of the target market is critical, as it will determine the extent to which risk (including mismatching risk) may be taken in pursuit if higher returns. Again, given the reasons for introducing this option, a relatively cautious approach is likely to be the most appropriate choice.

Legislation and tax – the investment options offered must take account of any restrictions and the tax treatment of the different asset classes.

Practical issues -The size of the funds under management might limit the range of available asset classes. Some asset classes (eg direct property) incur high expenses and may be unsuitable.

Competition- Consider the investment options offered by competitors offering comparable products and options.

Ease of valuation – the ease with which different investments can be valued (to show customers the value of their funds) should be considered.

[Total 9]

7) What are the main economic and other factors affecting the overall supply of:
(a) industrial property
(b) index-linked government bonds
(c) equities
(d) futures

[Total 8]

***Industrial property***

• Real economic growth, which will stimulate occupational demand, particularly growth in the manufacturing and capital goods sectors

● The level of interest rates, which will influence the effective cost of building new property and hence the profitability of investment in new property

● The length of development lags

(ii) ***Index-linked government bonds***

• The overall size of the government's fiscal deficit

● The government's funding policy and in particular, the split between issuing conventional and index-linked bonds, treasury bills and printing new money which will reflect possible conflicts between the government's economic objectives and its desire to fund its borrowing as cheaply as possible

• pricing – real return demanded vis a vis alternatives

(iii) ***Equities***

• The overall demand for new finance from existing private sector companies.

● This will reflect general economic conditions (eg finance may be required to finance new projects when conditions are good, or conversely to safeguard the financial position of the company when times are bad)

● The relative costs of raising finance via new issues of debt and equities which will reflect the relative levels of the equity and bond markets

● A buoyant equity market together with a depressed bond market (and hence high bond yields) will tend to produce a higher proportion of new equity issues and vice versa

● A programme of privatization of nationalized industries (or indeed nationalization of private industries)

New IPOs, GDP growth, inflation and interest rates (reverse yield gap) as points

(iv) Futures

● The overall level of trading activity in the derivatives markets, which in turn will tend to reflect the level of activity in the markets for the underlying securities or commodities and investor understanding of the derivatives

● Derivatives trading might be higher in times of investment market uncertainty.

8)Explain the importance of relevant, accurate data for a general insurance company underwriting private motor insurance.

- Policy, claims, investment returns and expense data are essential for reserving -to ensure sufficient funds are retained to pay future claims and to highlight any concerning trends.
- This is also likely to be required for insurance Regulatory purposes, accounts or otherwise both to satisfy reserving requirements and to demonstrate that the company is run in a sound manner, e.g. with regards to investment strategy, capital use and planning.
- Similar data is also required for pricing to ensure that there is no adverse selection and to aim to maximize profits. More accurate / complete data enables better pursuit of these goals
- Relevant, accurate data is required both for assessing appropriate levels of reinsurance and to provide to reinsurers in order to maximize the chance of obtaining the desired cover for an appropriate premium.
- Such data is also required for persistency, portfolio movements and quote strike rate management information to assess the business you have on your books at any particular time.
- In a competitive market such as motor, improved data can give the edge in terms of more accurately pricing risks to win more profitable business and help avoid the less profitable categories. Without relevant accurate data, poor underwriting decisions become more likely
- Customers will not appreciate providing irrelevant information and will not want to take the time. So the company must restrict info requested to just the minimum to enable underwriting, in order to ensure volumes of business are optimized.
- Exclusions / Excesses must be recorded correctly to ensure that the correct policy cover information is applied in the event of a claim. This information underpins management decisions. Poor data may result in poor decisions being made
- Relevant, accurate information may help to prevent fraudulent behavior

[maximum 8]

9 a) A large UK institutional investor has for some years directly invested a proportion of its money in developed markets. One of the company directors has said that the money would be better invested in emerging markets.

Discuss the major issues arising from this proposal.

b) Another company director opines that investment in domestic companies with exposures to overseas developing markets will provide similar benefits as investing directly in the developing markets. Comment on this statement.

[Total 10]

Positive issues arising from investing in emerging markets-
With the prospects of high growth rates, and possible market inefficiencies, opportunities exist for profitable investment, but with a correspondingly higher level of risk than for investment in developed markets.

The economies and markets of many smaller countries are less interdependent than those of the major economic powers. Therefore, investment in emerging markets may provide a good means of diversification.

Negative issues arising from investing in emerging markets
If the money is transferred from developed markets equities after .recent returns. that have disappointed it may be that we will be selling equities at a low point in the market.

Markets in small economies can be highly affected by the enormous flows of money generated by changes in sentiment of international investors. This means that returns may be more volatile.

Emerging markets tend to have less stable currencies and so more volatile returns.

Practical issues arising from implementing the proposal

Marketability may be poorer in emerging markets.

Whether the existing fund managers are the best people to invest in emerging markets is an important issue. It is possible that the mandate should be given to other managers with greater expertise and/or a better track record in these specialist markets.

Settlement and administration of emerging market deals is more complex. This leads to the issue of whether or not indirect investment would be better for these markets.

A key issue will be which countries to invest in. This will depend upon:

- current market valuation and possibility of high economic growth
- currency stability and strength
- level of marketability
- degree of political stability
- market regulation
- restrictions on foreign investment
- tax
- information problems (eg availability and quality of information).

[Maximum 6]

Advantages: of investing in domestic companies which have large exposure to developing overseas markets -

- It is easy to deal in the familiar home market
- The companies will have expertise and tend to conduct their business in the most profitable areas overseas, including areas where direct investment may be difficult.

- Costs will be lower as you are investing cos on which lot of information will be readily available

- Even exposure to countries which might not allow direct investment in equity markets

- It is likely that the domestic company will be hedge currency risks better than the institutional investor if their volumes of business are higher

- If it is a small fund it can be particularly advantageous

The disadvantages are that:

- such a company' earnings will be diluted by domestic earnings

- the company may not be able to offset all withholding taxes

- it will be difficult to direct the investment towards specific areas overseas, which might be of interest to the company

- the company' share price movement will not be divorced from movements in the home equity market

[max 4]

10 ) Outline the issues you would need to consider in developing an investment strategy for each of the following investors:
(a) Contributions to a personal pension plan fund
(b) The reserves of a general insurance company which specializes in all types of liability insurance.
(c) The free assets of a rapidly growing life insurance company that has just raised a large sum through a rights issue
(d) Rs 50 lac received as lump sum by a recently retired person who does not have any other savings other than the house he lives in.
(e) A charity

(a) The investment objective is to create as large a fund or pension as possible on retirement. As retirement approaches some defense against the possibility of falling interest rates is also desirable. The likely strategy would involve investment in equities and possibly bonds as well for diversification, transferring more into bonds as
retirement approaches.

The key issues should centre around finding the optimum time to begin transferring which, may be linked to the contributor's age, and how regularly to transfer and in what proportions of the fund.

(b) The first priority must be to ensure that all liabilities can be met, allowing for the length of time it might take to achieve settlement and uncertainty over amounts and timings of payments. Competitive premiums may require the highest investment return using asset types permitted by regulations. It may be important to stabilize profits. Investment policy depends on size of free reserves, and reinsurance arrangements.

c) Working capital is required to meet expansion plans. Hence it is necessary to invest the money over the short term (in liquid and MM assets) which can be used to meet cash requirements as and when in arise.

Since it is rapidly growing its regulatory capital requirement will also increase over the future in which case a portion of the assets can be invested long term in line with regulatory capital requirements- long term bonds and equities mimicking the investment strategy for policyholder funds.

d) The lump sum can be used to meet income needs during retirement. He can use it to purchase immediate annuity which will provide him life long income. He will also need to purchase medical/health insurance (may be even long term care) which will enable him to meet medical expenses. He can also look at using his existing property to increase his income during retirement (reverse mortgage)

If he has a dependent spouse a joint whole life annuity (reducing to 50%) on death of the spouse will be better than a stand alone annuity.

(e) Investment policy may impact on the reputation of the charity, which will have broad objectives and constraints. The attitude to risk of trustees/management and contributors should be considered. It will also be necessary to consider the specific purpose of charity, its operating considerations, need for investment income and capital. Impact of the tax status on expected returns. The amount and timing of contribution income will be relevant.

11) The Government of a developing country (with a population of 50 million) wants to encourage life insurance amongst the socially and economically backward groups.
It is examining 2 proposals which are -

Proposal AProviding a fixed amount on the death of the bread winner in the family. The cost of the same shall be borne by imposing a special tax on income which shall be reviewed once every 5 years. The scheme shall be administered by the State.

Proposal BMandate Private Life Insurance companies to sell life cover to the economically and socially backward groups by requiring them to sell 10% of the total polices (by number) in a year to this section of the population. The premium rate per mille shall be fixed by State (independent of age) and shall be paid by the State. The rate per mille shall be reviewed by the State once every 5 years.

a) (i)Outline why the State would consider providing insurance benefit to this group.
(ii) Outline what factors should be considered in determining the level of benefits that the State should consider providing.

b) Outline what the main areas of risk that Arise from Proposal A.

c) Explain the major advantages and disadvantages of Proposal B compared to Proposal A as far as the State is concerned.

d) Outline the main areas of risk in Proposal B for the private life insurance companies.

e) Suggest modifications to Proposal B which would reduce the risk for the life insurance companies.

[21]

a) State will consider providing benefits for-
This group may not have the means to purchase even minimum life cover and the mortality might be particularly high in such groups
Paternalistic/Socialist attitude- provide minimum security to its citizens
Political reasons – to increase its popularity among the masses
This might also be considered a cheaper benefit to provide than say health or pension benefits

[max 2 ]

Factors to consider in fixing amount of benefit-

Cost of providing benefit –costs involved in providing the benefit and the income that can be expected from the special tax

Must not be so small as to have no value for the family but also should not be very large which might increase “moral hazard”

Ideally benefit should enable family to pay off creditors/provide benefit during period before alternative earnings arrangements can be made

[2]

b) Main areas of risk or State

Scheme to be funded by special tax- main risk is benefit [about plus administrative costs ] exceed the amount of tax collected . May lead to macro economic problems

It might not be easy to estimate costs of the scheme- no of people to be covered, mortality rate, expenses etc need to be estimated and past/historical data might not be available.

Tax rate is fixed for 5 years – the growth in income levels may not be in line with expectations which will result in lower tax collection

Costs of administration may turn out be high than expected. Administering such a scheme may be expensive- establishing claim eligibility, ensuring payout reaches family etc

Risk of scheme being abused- bogus claims, moral hazard

Catastrophic risks (deaths from floods, famines/epidemics such similar catastrophic events) – at such times it is likely that tax collection may also drop

Earning individuals/corporate might not be happy with the new tax and might lead to tax evasion which could to lower collection than anticipated

c) Major advantages to State compared to first proposal

Rate per mille is fixed by State and reviewed once in 5 years. It is easier for the State to estimate the out go as now it only has to estimate – no of lives to be covered over the next 5 years by insurance companies and the expected no of social/economically back ward lives to be insured

Administration is now passed to the insurance companies which have the expertise to manage such portfolios

All risks mentioned above- catastrophic risks, risk of mis-estimation of premium rates etc is passed to insurance companies who are more knowledgeable about risk mitigation and management than the State

Disadvantages

Only 10% of total polices sold by insurance companies need to be to this section of population which might not meet the State's requirement of covering the entire section in the population.

If companies demonstrate poor risk management initiatives it might lead to an impact on their solvency and Profits and in the end the State might be forced to make good any failure on the part of life cos to pay claims

If the actual costs of providing benefits for the life insurance cos are higher than the premium rate per mille fixed by State they may not be very keen to do the business and might indulge in practices like time lags in payment, denial of claim payment on flimsy grounds, poor administration etc. In the end the State might not be able to achieve its objectives.

d) Major areas of risk in the 2nd proposal for life insurance companies

Premium rate per mille fixed by State- The rate might be lower than the costs (claims costs and expenses) incurred by cos. The rate is reviewable only once in 5 years – might not even allow for inflation of administration of expenses.

Flat rate per mille not based on age –which case if the business mix is different from the basis underlying the rate per mille fixed by State exposes the life companies to risk of low premiums than required to meet claims

Issues of moral hazard, bogus claims which might lead to higher claims coasts than expected

Costs of administering might be high and the rates fixed by the State might be uneconomical

Catastrophic risk- floods, epidemics etc. and the rate per mille might not allow for that

The Life cos might have to maintain capital to back these liabilities (as per regulatory requirements) and the return on capital might be low

Distribution infrastructure have to be created to sell these polices to these groups which might not be covered by the premium rates

The 10% of sales may be too great vis a vis other sales.

[max 4]

e)Modification to 2nd proposal –

- Premiums are reviewed every year rather than once in 5 years . Premium rates are also set in consultation with life cos.

- Age band rates, male/female rates rather than flat rate per mille

- Some sort of an excess of loss insurance by State to protect cos from Catastrophic risks

- Centralized administration infrastructure can be set up jointly by State/insurance companies –which will mean that administration infrastructure is not set up by all companies

| Syllabus objective | Knowledge | Application | Higher skills | Total | Cumulative total |
|---|---|---|---|---|---|
| **1** | | 5 | | 5 | 5 |
| 2 | 4 | | | 4 | 9 |
| **3** | 3 | 5 | | 8 | 17 |
| **4** | 4 | 2 | | 6 | 23 |
| **5** | 3 | 4 | | 7 | 30 |
| **6** | | 8 | | 8 | 38 |
| **7** | 8 | | | 8 | 46 |
| **8** | | 8 | | 8 | 54 |
| **9** | | 10 | | 10 | 64 |
| **10** | | 10 | 5 | 15 | 79 |
| **11** | | | 21 | 21 | 100 |
| **12** | 22 | 52 | 26 | 100 | |
| | | | | | |

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