

# **Institute of Actuaries of India**

## **Subject ST1 – Health & Care Insurance**

**May 2008 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.

## Solution 1.

(i)

- Use of existing pricing and reserving methodologies
- Not too overly risky:
  - are the guarantees and options too onerous?
  - are claims definitions watertight?
- Extent of cross-subsidies involved – do they represent acceptable level of risk (e.g. unexpected changes in the mix of business)?
- Sufficiency of charges and premiums to ensure adequate profitability and return on capital
- Profit to be not too sensitive to changes in conditions (e.g. reviewability of charges and premiums)
- Minimal new business strain and enough capital to cover possible future new business volumes
- Speedy return on initial capital
- Adequate underwriting standards
- Adequate claims control
- Ease of record keeping and reporting – including supervisory reporting
- Effect on other business – both existing (e.g. lapses) and on sale of other new business
- Fully established administrative and computer systems.

(ii)

- Reinsurance has a net cost to the insurer and thereby will reduce the profitability of the contract.
- Therefore the product price may have to be increased to reflect this cost.
- Due to arbitrage opportunities (e.g. tax) it may be that reinsurance can lead to increased profit for the insurer.
- In such circumstances it can lead to a reduction in product price.
- Reinsurance generally reduces risk.
- This means that the product can be priced with more certainty and so the margins in the basis to cover risk (e.g. in the risk discount rate) can be lower.
- This will reduce the product price.
- Reinsurance can reduce the company's financing requirement.
- This may reduce the cost of capital and also the product price. However, you are effectively paying for the reinsurer's cost of capital via their rates, so overall there can only be a reduction in price if the total capital that has to be held is lower than before.
- It will also allow more business to be written which can result in total higher profits.
- The reinsurance agreement may specify the price that the insurer has to charge for a product (e.g. when a high quota share is used)
- Any profit sharing agreements may affect the expected profit and hence the price that can be charged.

## Solution 2.

(i)

- The main influence is that companies have to design products which are capital efficient.
- E.g. unit linked contracts rather than conventional contracts, which can be designed to operate in capital efficient ways (such as low allocation at the start of the contract)
- Try and reduce the extent of guarantees offered as guarantees will require larger reserves.
- This will take the form of offering contracts with reviewable premiums and /or charging rates.
- Limit the availability of policyholder options – which will require additional reserves because of additional contingency.
- Try and improve the matching of expense charges and expense outgo.
- For example, using level commission for regular premium contracts, short term or single premium contracts or directly using a unit linked structure.
- Limit the extent of benefit uncertainty by choosing appropriate benefit terms and restrictions.
- For example, putting a ceiling on the periodic benefits payable under LTCI or IP contracts or by having strict definitions of diseases under CI conditions.
- Try and use the best possible data for determining the assumptions for pricing and reserving; thereby reduce the parameter uncertainty and hence reduce the need for margins in reserves.
- Try and avoid issuing novel and innovative products which regulators might regard as high risk on which stringent reserving requirements might be imposed.

(ii)

- Insurers will no longer be able to use age or sex as rating factors in pricing.
- The impact of this depends on the extent to which age and sex are currently used as rating factors, if at all.
- This may depend on the level of competition in the market, the insurer's culture and the product being sold.
- For example, in some territories, age and not sex is used for rating private medical insurance;
- In more competitive markets, some insurers have started using a number of rating factors including age and sex.
- And often, neither factor is used for rating hospital cash plans.
- Insurers who made best use of age and sex as rating factors will be most affected; they will no longer be able to use them to their advantage.
- There will be cross subsidies in those insurance products where the risk depends on age and or sex.
- For example, under PMI, younger policyholders will subsidize older ones (older policyholders will generally claim more)
- This will result in reduced profits from the riskier (e.g. old) customers but higher profits from the less risky (younger) segments.
- The resulting price increase will be imposed on the better risks forcing these customers not to renew their policies; the policies will now be more attractive to riskier groups.
- This will result in anti-selection and higher overall expected claims.
- The level of lapses will depend on how important individuals feel it is to have coverage against a particular risk.
- One factor here will be the current health of the customer – those in poorer

health will be more likely to stay, thus increasing the anti-selection effect further.

- The changes are not likely to impose great anti-selection problems to one particular health insurer, because the whole market is selected.
- It will be difficult for better risks to get cheaper cover from another insurer, except to the extent that customers are able to buy cover from insurers based in another country not affected by the new legislation.
- As well as offering same premium, all insurers will have to offer the same benefits to all customers regardless of age and sex. For example, they would not be allowed to offer different levels of cover or excess levels to different age groups.
- Insurers will not be allowed to restrict coverage to one sex or the other or place minimum or maximum age limits on cover.
- Insurer may need to take on risks previously deemed to be unacceptable.
- Insurer will not be explicitly allowed to explicitly sell products to a target sex or age bracket – for example by solely emphasizing the benefits of health insurance, say, to young people, in the marketing literature, without mentioning other sectors of the population.
- Certain specialist insurers will no longer be able to sell to a particular niche market.
- This may result in loss of business since customers no longer feel that the insurer is treating them as being “special”.

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### **Solution 3.**

(i)

For each policy in force the following will be the data to be recorded:

- Claim status (currently claiming or not claiming)
- sex
- date of birth
- smoker status
- occupational group
- date of policy entry
- date of most recent claim inception (if claiming)
- reason for claim
- dates of inception and completion of past completed bouts of claiming
- policy termination date
- current benefit level (including full indexation increases from date of policy entry)
- benefit payment frequency
- current premium level (including full indexation increases from date of policy entry)
- premium payment frequency
- any special rating information (e.g. health impairment)

(ii) The appropriate transition model will be

- Transition from Healthy to Sick
- Transition from Sick to Healthy
- Transition from Healthy to Lapsed

- Transition from Healthy to Dead
- Transition from Sick to Dead

Would need to assume probabilities of the forms, with  $x$  the entry age

Probability of healthy life aged  $x$  being healthy at age  $x+t = tP_x^{hh}$

Probability of healthy life aged  $x$ , being sick at age  $x+t$ , with sickness duration between  $(r, r+1)$  at time  $t = tP_x^{hs(r)}$

The probabilities would be obtained from the above multi-state model, which allows for lapses, deaths, recoveries and sickness inceptions.

Probabilities of receiving benefits at future time  $t$ , can then be obtained by summing up the relevant probabilities for sickness durations greater than the deferred period  $d$ :

$$tP_x^{hs} = \text{Sum of } tP_x^{hs(r)} \text{ from } r=d \text{ to } (t-1)$$

The expected total claim cost for year  $(t, t+1)$ , assumed incurred mid-year on average would then be calculated as :

$$B_t * \frac{1}{2} * (tP_x^{hs} + (t+1)P_x^{hs})$$

Where  $B_t$  is the average annual amount of claim payable to sick lives during policy year  $(t, t+1)$

Discounting from mid-year  $t$  and summing over all  $t$  gives the total expected future claims cost

(iii)

- The method will show realistically how sensitive the reserve values are to variations in the parameter assumptions
- This will be of great assistance when assessing the size of margins the company needs to include in each assumption
- to obtain the required degree of prudence in the reserves
- It will also enable the actuary to experiment and decide which cells can be combined into larger groups without causing significant loss of accuracy
- it can test the robustness of the model

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## Solution 4.

(i) Lives aged 40 last so require independent rate for age 40.5 exact.

For stand alone critical illness contracts the claim rate is  $ix * \text{probability to survive 30 days}$  (stand alone contracts require a survival period, typically 30 days).

Age 40: Dependent rate =  $2.6 * 0.9$   
Independent rate =  $2.6 * 0.9 * (1-0.1*0.5)$

Age 41: Dependent rate =  $2.9 * .9$   
Independent rate =  $2.9 * .9 * (1-0.1*0.5)$

$$\text{Age 40 last rate} = 2.75 * .9 * (1 - 0.1 * 0.5) = 2.3513$$

$$\text{Expected claim cost} = (2.223 + 2.4795) / 2 * \text{Rs } 425,000 = \text{Rs } 999,281.25$$

(ii) Need to include claims where the critical illness occurred within 2007 and where the insured survived a minimum period of 30 days immediately following the (diagnosis of the) critical illness.

Date of notification and date of settlement are irrelevant.

$$\text{Hence claims amount} = \text{Rs } 200,000 + \text{Rs } 575,000 = \text{Rs } 775,000$$

$$\text{Actual/expected} = 775,000 / 999,281.25 = 77.6\%$$

(iii) Would need to allow for claims which have been incurred but not reported.

(iv) For an acceleration-type critical illness contracts the total claim rate is  $ix - (1 - kx) * qx$

$$\begin{aligned} \text{Age 40: Dependent rate} &= 2.6 + (1 - 0.35) * 2.0 = 3.9 \\ \text{Independent rate} &= 3.9 * (1 - 0.1 * 0.5) = 3.705 \end{aligned}$$

$$\begin{aligned} \text{Age 41: Dependent rate} &= 2.9 + (1 - 0.38) * 2.2 = 4.264 \\ \text{Independent rate} &= 4.264 * (1 - 0.1 * 0.5) = 4.0508 \end{aligned}$$

$$\text{Expected claim cost} = (3.705 + 4.0508) / 2 * \text{Rs } 425,000 = \text{Rs } 1,648,107.50$$

$$\text{Actual claims to include} = \text{Rs } 1,345,000$$

$$\text{Actual/Expected} = 81.6\%$$

So result would be slightly worse if all of the plans were typical acceleration CI contracts.

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## Solution 5.

(i)

- offer higher (loaded) premiums
- defer (if the period of higher risk is deemed temporary)
- decline (if the additional risk is thought to be too high)
- offer a different (less risk intensive) type of policy
- offer the risk to a reinsurer facultatively with zero retention
- offer the policy with a certain specific additional exclusion

(ii)

- Underwriting is about assessing the risk to the insurer in terms of the probability and size of claim.
- Probability of dying is relatively simple to assess as it is mainly affected by age and sex.
- Probability of being unable to follow your normal occupation as a result of illness or accident is affected by many more factors (e.g. lifestyle factors), and

- the “hurdle” that must be jumped to establish a valid claim will depend on the nature of the occupation. For example, even minor illnesses and injuries may prevent a manual worker from doing his job, whereas the same illnesses and injuries would not prevent an office worker from earning a living.
- So in addition to assessing the proposer’s health the underwriter needs to assess the demands of their normal occupation.
- The total cost of claims depends on how frequently the insured makes claims and
- also the length of the period for which he claims. The length of a period of sickness is influenced by lots of health factors (eg the kinds of illness that are most likely to result in the life being unable to work). The cost of a claim for a term insurance policy is fixed (i.e. the sum assured).

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## Solution 6.

### Advantages

- If benefits are available on a sliding scale beginning when there is only modest impairment then care is provided at an early stage. Provision at this early stage may slow down the rate of deterioration of the insured’s health, thus providing a better quality of life with a reduced overall cost of care during their future lifetime.
- The insurer would be in a position to manage the claim at an earlier stage where modest impairment is covered and support the rehabilitation process.
- The benefits may be a better match for many customers’ needs. If the product is more likely to match need then it is more likely to sell well.
- Customers may see the product as better value, as it seems more likely that they will receive some benefits.
- If this feature is novel, it may attract more interest from intermediaries.

### Disadvantages

- Increased administrative costs for the insurer.
- If premiums are waived when partial benefits are payable, then this may increase the cost of premium waiver.
- Pricing will be more difficult.
- The design is more complex. This means more detailed sales literature is required and more effort is required by intermediaries to explain the product to clients.
- Claims management is more complex where modest impairment is covered.

[8]

## Solution 7.

(i) There are three (to four) characteristics of an illness or condition that make it appropriate for inclusion in a critical illness product:

- it should be a condition perceived by the public to be serious and to occur frequently
- each condition covered can be defined clearly so that there is no ambiguity at time of claim

- sufficient data are available to price the benefit
  - ability to avoid anti-selection.
- (ii)
- Malaria is a condition perceived by the public to be serious and to occur frequently, however, regional differences exist and the disease is more widespread in poorer and rural areas. Since it is an infectious disease, a sudden outbreak of malaria could significantly influence the experience and thus add volatility to this product (similar to a screen programme).
  - It is most probably possible to define the condition clearly enough, however, only infections with a severe outcome could be covered. A minimum severity would be required as otherwise individuals may expose themselves to this infection to benefit from the policy.
  - Malaria mapping is available for India offering reasonable data for pricing.
  - Although it fulfils some important characteristics for an illness that make it appropriate for the inclusion as a CI, it is not recommended to include Malaria as it is an infectious disease with very different incidence rates amongst population groups and territories in India. Furthermore, the fact that an individual could infect him/herself poses a great challenge.
- (iii)
- An agreed definition will draw upon the experience of lots of insurers and therefore likely to be free from ambiguity
  - Agreed definitions will help insurers to be able to settle claims quickly with few disputes
    - less possibility of claimants producing from other insurers to support their disputed claim
    - reduce the expense and threat to reputation that a disputed claim settlement produces
  - There will be sharing of current and future expertise in the interpretation of current medical conditions and future advances
    - the cost of developing and maintaining policy conditions will be shared
    - resulting in reduced costs for each insurer
  - With standardized claim conditions, policies are likely to be easier for
    - prospective policyholders to understand
    - sales staff to explain and
    - for comparisons to be made between products from different insurers
  - Industry-wide information and education may make the definitions better understood.
  - The result will be more sales in generally leading to increased business for all insurers and bigger increases for those who offer better customer service etc.
  - With standardized definitions it will be easier to collect compatible industry-wide data.
  - This will mean better information on which insurers can assess risks.
  - This increased information may result in lower risk loadings and lower premiums, thus further increasing the potential size of the market.
  - Reinsurers will enjoy similar benefits, as their fortunes are likely to follow those of the insurers.



- (iv)
- Terminal cover does not relate to a specific disease; its definition involves the severity of a condition and its effect on life expectancy.
  - Terminal illness cover ensures that all conditions that significantly reduce life expectancy are covered, although at a late stage.
  - An equitable benefit – a policyholder could otherwise suffer a severe illness that reduces life expectancy significantly but does not qualify for benefit
  - The addition of a terminal illness benefit will have a different impact in each of these cases.
  - For term products (i.e. an acceleration product with a fixed policy term) there may be a few additional claims towards the end of the policy that will impact cost more significantly.
  - If terminal illness benefit ceases 12 (or 24) months prior to the end of the term, these additional claims can be avoided.
  - Terminal illness benefit does not fit as naturally into a stand alone critical illness plan where a death benefit is not payable.
  - In this case it is a genuine extra cost, because a new benefit is being provided and the incidence of the various causes of terminal illness will need to be established.

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## Solution 8.

### (i) Twenty year CI

- The extent of margins will depend on the degree to which premiums might be reviewable during the policy term.
- The more frequently they can be reviewed, the lower the margins need to be, provided there is no restriction (say, from marketing requirements) on the amount to which premiums can be increased.
- An increase in premiums in excess of what policyholders are prepared to pay will lead to selective lapsing and even worse experience will follow.
- Margins are required to cover poor claims experience because of :
  - Poor assumption setting as a result of poor or inappropriate data
  - Disease diagnosis rates accelerating more quickly than expected, due to unforeseen medical advances
  - New diseases occurring which, perhaps due to loose claim definitions in the policy wording, lead to more claims being made
  - A higher rate of disease incidence in the population than expected
  - A greater extent of selective withdrawal than expected
  - A different mix of business sold than expected, where cross subsidies in the claim experience have been allowed for – e.g. by distribution channel, policy size
- The margin would take the form of an increase to the assumed claim incidence rate in the basis.
- May be, also assume a high lapse rate early on when the earned asset share is negative, possibly lower lapse rates later in the term when a profit would be made on lapse.
- There is little point in assuming a margin in the interest rate assumption for regular premium critical illness insurance. It would make little difference to the premium rate, because the reserves are relatively small and the investment contribution to profit is small.
- Expenses could be higher than expected due to:

- Policy administration requiring more work than expected (this is particularly likely in the area of claims management)
- Fewer policies being issued than expected causing a greater per – policy cost of fixed expenses
- Inflation of expenses being higher than expected
- It would be sensible to include margins by increasing the expense assumption and increasing the inflation rate assumption.

(ii) Private Medical Insurance

- They are one year contracts so they are effectively one year renewable.
- Margins are therefore less needed than in the other contracts as the renewal premiums can be revised in the event of worsening claim and expense experience.
- Margins will still be necessary, in order to make a profit.
- Higher than expected claim incidence rates, expenses and average claim amounts could be used or an overall explicit margin could be used.
- A particular explicit margin might be needed for the rate of renewals assumed when spreading initial expenses.
- A lower than expected renewal rate can be used.
- Some claims, particularly the more expensive ones, may result in payments that continue for several years. In such cases medical inflation will be an important influence on claim costs. We should assume a higher rate than expected in order to provide the margin.
- Reserves will be small and so the investment return will not be a significant factor.
- Therefore little loading will be needed for this.

General

- Some or all the margins suggested above could alternatively be incorporated into the risk discount rate, if used by making it higher.
- In practice the scope for margins will be limited by competition.

[12]

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