

# The Institute of Actuaries of India

## Subject ST1 – Health & Care Insurance

**15th May 2007**

### **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.

Arpan Thanawala  
Chairperson, Examination Committee

**Q.1)****i) Deferred period**

Encountered in IP insurance

First few weeks of sickness during which insurer will not pay benefits

Applied throughout the policy term

Usual deferred periods, 4, 8, 13 etc. weeks or equivalent months (28 weeks common in group schemes)

Main reasons :integrate with employer supplied benefits, reduce cost of claims and of administration and therefore reduce premium, meet true customer needs

**ii) Antiselection**

Arises from asymmetry of information or its interpretation between the insurer and the insured.

Antiselection against the insurer arises when the customer has some knowledge about the insured risk which the insurer does not have. er information

People are more likely to take out insurance when they believe their risk is higher than allowed for in the insurer's premiums.

Examples:

In the context of CI cover, applicant has had chest pain, but takes out a policy without mentioning the chest pains; if it is revealed, later on medical consultation that the pains are due to heart disease, there is greater likelihood of a claim for benefit.

Insured may know his occupation exposes him to higher risk of some cancers or illness or accident which will result in an IP claim, but insurer's underwriting procedures may not pick this up.

Also recognized in renewal of policies or take up options for additional cover without evidence of health, by sick or sub standard lives.

Use of waiting period may eliminate or reduce effects of antiselection.

**iii) Individual rating**

At underwriting stage the insurer collects information about the insured individual about his age, sex, state of health etc.

This is then used to determine the premium rate the individual will pay.

**iv) Community rating**

Refers to the practice of charging all applicants / policyholders (or a significant subset of persons insured) the same premium rate irrespective of rating factors such as age, sex and medical history; does not use individual information

Will use only group or community level information, such as where a person lives or his occupation

No individual proposer who meets eligibility conditions will be refused insurance.

The common premium may increase from year to year as a result of increase in claims costs.

Also applies to the process of applying tabular rates to applicants irrespective of claims history

As all variations in claims between policyholders are not taken into account, some policyholders will pay premiums that exceed their expected claim costs plus expenses and others will pay premiums that are less than their costs.

**vi) Replacement ratio**

In the context of IP policy, this refers to the ratio of post claim income to preclaim income, net of taxes in both cases.

Value less than one desirable from insurer point of view, to provide a financial incentive to the claimant to return to work.

Given that expenses in disability may be less than in normal health.

Higher the replacement ratio, lower the incentive to return to work and poorer the morbidity experience.

Some evidence that people enjoy the social aspects of being in the workforce, but returning to work after a long term sickness is a difficult transition for many people.

[10]

**Q.2)**

(a) State system can provide care and treatment for both acute and chronic conditions

Insurer will find it difficult to cover chronic conditions – expected high claim costs

Particularly important for some commonly occurring chronic conditions – like mental illness

State system can allow cross subsidy between individuals – No need to have link between member's contributions and expected cost of his benefits

Insurer can allow only a limited cross subsidy – such as community rating

State system can make losses – provided can be funded by tax or other sources

Insurer can sell at a loss only in the short term

State can provide benefits for those not insurable (e.g. HIV patients, genetically related illness)

Insurer would refuse cover in such cases – expected high cost

State system can provide cover for those who have dangerous jobs, particularly in the public service (armed forces, fire services)

Insurer would quote special terms for such people.

**(b)** Inflation may erode the real value of the benefit under the health and care policy

So that it may not now fully meet the needs of the customer

Solutions:

Sell short term policies – benefits can be updated regularly

Sell indemnity policies – by definition must meet the needs

For long term contracts

- allow policyholders to increase benefits periodically
- include predetermined benefit and premium escalation
- have index linked benefit and premium escalation

[7]

### Q.3)

**(a)** Higher first year commission : A; level commission throughout : B

Agent puts in most efforts to sell new policy; less effort to get it renewed ; method A reflects more closely the Agent's efforts

Commission by method (A) 2 will encourage agents to sell and therefore will be popular with them

The lack of new business incentive will be a significant problem for method (B)

Method (B) will reward the agent according to the number of years for which premiums are paid – whether long term policy or short term policy renewed every year, thereby reflecting the total contribution to the profit from the policy

Method (A) will have to structure first year commission according to term – to make it fairer

Method (B) puts emphasis on renewal and therefore persistency

Method (A) has the risk of not recovering full cost of first year commission, in the case of early lapses;

Method (A) could cause significant losses to the insurer if persistency is poor and hence a major problem

Method (A) will worsen financial strain caused by new business;

due to high first year commission and the need to set up reserves on prudent basis.

**(b)** Health care insurance policies can help repay loans; provides comfort against inability to meet major financial outgoings

Under CI policy –level amount of outstanding loan can be repaid when CI is diagnosed.

IP policy can be used to meet interest and capital payments when disability sets in and policyholder unable to work

IP products can replace income. In order to provide an incentive to return to work, replacement is not full, usually 60 % to 75 % of gross salary.

PMI and Hospital Cash policies can finance medical treatment bills

Even where State provides medical treatment, insurance is a mechanism by which medical treatment affordable – where State scheme provides limited cover, or the customer needs faster access to treatment or higher level of treatment.

LTCI seeks to cover medical and domiciliary needs under more chronic conditions, usually at older ages. The benefit is couched in cash terms without directly meeting the needs of claimants in terms of care.

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**Q.4)** The items in the cashflow method:

investment return ii) premiums iii) benefit payments iv) inflation rates v) claim incidence rates vi) disability annuity rates / claim termination rates to calculate annuity values vii) mortality rates viii) expenses ix) expense inflation x) commission scale xi) tax xii) mix of new business (where there are cross subsidies e.g. by size) xiii) new business volumes (to determine expense loading) xiv) lapse rates xv) profit criterion xvi) risk discount rate xvii) reserving basis xviii) required solvency margin

Items which will not be there in the cashflow method: (xiv) to (xviii) (1)

[7]

**Q.5)**

(a) Need to estimate the future experience of those who will take out this policy

Normally, look at the past data then adjust for any changes to circumstances that are expected to alter the experience in the future (e.g. changes in underwriting, target market, distribution channel, policy claim definitions, medical advances)

Company has no data.

Certainly not much industry data for the country. Do reinsurers have any data ? Not certainly of the specific country.

Need to look at reinsurer's data relating to other countries bearing in mind the differences between that country and other countries for which data are available.

E.g. look at the relative population mortality and morbidity characteristics, underwriting differences and cultural differences

Different policy wordings will cause further differences in experience data compared with the new product

It will cause experience data to be heterogeneous, so that even trends will be misleading

There might be some national population statistics on the incidence of the various illnesses and conditions

Overall it will be difficult to get a good fix on the inception rates

This will not be too problematic because the product will be a unitized one and hence will have reviewable rates

Once a suitable basis for best estimate of future experience is decided, a margin will need to be added. This will have to be reasonably big because of the uncertainty.

Not a huge margin – because of the need to be competitiveness and the ability to vary rates.

Competitors will have same problems – products are new for all.

(b)

(i) **Critical illness**

Medical developments can increase the rate of diagnosis

This can make claims occur sooner- can make claims occur within the policy term, which previously would have occurred after the policy term

Both will increase the cost of claims – especially the second one

Some diseases will be diagnosed which would never have been diagnosed earlier

Medical advances may prevent claims from occurring thereby reducing claim costs

Some CI claims relate to the need for specific expensive treatments (like heart bypass surgery) – medical advances can mean some of these treatment no longer occur, so reducing claim

Alternatively, medical advances can enable many more people to receive this treatment, thereby increasing claim costs

### **(ii) Income Protection**

The effect depends on the type of disease or disability involved with the claim.

If the disease is chronic, so that the claimant is unlikely to ever return to work, medical advances may prolong life and hence increase the duration over which claim payments are made

If the disease is normally temporary, then medical advances should hasten recovery and so reduce total claim costs.

In some cases, recovery may now occur during the deferred period, thus eliminating these claim costs altogether.

Medical advances that reduce the incidence of disease will reduce claim costs.

### **(iii) Private Medical Insurance**

If medical advances make more expensive treatments available, then this will increase the claim costs

Previously more expensive treatments may become routine and so less expensive, thus reducing claim costs

Treatments may become more effective, reducing the duration of treatment and the associated costs, such as the cost of hospital stays

Some advances may remove the need for treatment altogether, again reducing claim costs

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### **Q.6)**

(a) In a particular PMI market, most insurance companies have been charging different premium rates to males and females. ABC Ltd., had noticed very little difference in its claims experience between the sexes in the past, and over the last year has been selling PMI policies on identical terms to males and females. During this time you have noticed a marked increase in sales, especially to female lives.

#### **Possible Reasons**

The removal of apparent discrimination may be popular with the public (especially, it seems, with females), managing the company's products easier to promote and easier to sell than those of competitors.

The rise in sales to females may be because this company's premium rates might now be substantially cheaper than those typically offered to females by the rest of the market.

The application procedure has been simplified, which might make it more attractive for intermediaries to sell this product rather than others.

*Possible implications*

Provided recent experience is consistent with previous years, then the rise in volume should increase profits, increase return on capital, and cover a bigger share of the company's overhead costs.

The increased volume, if continued, may possibly require the employment of extra staff, both for policy and for claims administration. Provided economies of scale can be achieved, this should ultimately improve returns for shareholders

There may be short-term administrative delays, which could damage the company's reputation with policyholders, intermediaries, or both

The increased volume, especially if it persists, may put a strain on the company's capital resources. This will only be a major issue if the company is short of free capital

Additional financing reinsurance may then be necessary

There is a concern that the claims experience of the new policyholders may differ from previously

There is a real possibility of anti-selection for a company that charges aggregate rates when the rest of the market charges differentially

The suggestion here is that the competition must be charging higher rates for females...

...and if this is a true reflection of future claims experience then this company could incur significantly higher claims costs but without an increase in premium rates.

This could occur despite the company's own past equality of experience between the sexes, for example because the new product design might appeal to a different sector of the market or a different class of life.....

...or because the company did not correctly identify the real differences between the sexes in the past due to inadequate grouping of data in its analyses

**(b)** A thorough expense investigation would be needed

The most recent year for which data are available would be chosen

Any one-off events would be allowed for when interpreting the results

This and several previous years' results would be considered together, in order to establish whether or not any trends were developing. This is important here, as the question suggests that the costs are getting worse over time.

The known expenses would be commissions, salaries, property, computing and investment costs.

Commissions and investment costs would be ignored for this purpose, as they form no part of the claims management costs.

It is necessary to determine which of the other costs relate to claims management. It would be necessary to look at all types of cost here, so that we can be sure that none of them has been overlooked

So we will need to break down each of the other known cost items by policy class, and according to whether it is an initial, renewal, termination or claim expense.

For IP it is also necessary to itemize the claim expenses that are incurred at and around claim inception, and those which relate to ongoing payments.

**(c) Possible actions**

It is always necessary to ensure that premiums are adequate to meet costs. Pricing assumptions may therefore need to be amended in order to cover revised expected future expense levels.

Reserving bases may also need to be changed, if the existing expense assumptions are no longer felt to be sufficiently prudent

The main other actions of control relate to making claims management operate in the most cost-effective way.

Actions that might be taken include:

- Introduce a rehabilitation service, which might decrease the overall cost of claims by much more than the increase in expenses involved.
- Improve the process for validating new claims, and for re-certifying the validity of existing claims.
- Ensure that the claims management staff have the necessary expertise for the job; this may involve change in personnel and/or improved training.
- Consider bringing in external claims administration services, if these could handle and manage claims more cost effectively for the company.
- Any over-capacity (unnecessary expense) should be reduced by suitable laying-off or redeployment of staff.
- Any under-capacity should be rectified by suitable new recruitment or redistribution of staff from other areas (with suitable training).
- Ensure that salaries are motivating but not excessive for the work required.
- Ensure that data handling and administrative systems are cost effective, which may mean increased automation where possible.
- If a lot of would-be claim applications are currently being turned down, expenses could be reduced by better educating policyholders of their claim entitlements; this may mean changes to the policy literature, and to information provided at the time of sale and policy renewal.

The claims management expenses should be monitored on a regular basis to ensure that these actions are having the desired effect

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**Q.7)**

- (a)** The rate will depend on the estimate of expected claim rate.

The expected claims rate would be estimated by looking at the experience with this type of cover with other companies.

Need to take into account the differences compared to the contracts offered by other companies ) e.g. are the critical illness definitions the same ?.

Also look at industry data available.

Make allowance for expected future trends in CI experience and consider any uncertainty around this.

If unsure about experience, offer rates reviewable every year rather than guaranteed rates.

This will be the case even if the insurer offers guaranteed rates to the policyholders.

Check the intended underwriting procedure of the company for this product.

Greater possibility of selection against the company, as the product is a stand alone contract.

The insurer should take steps to minimize such selection

Need to ask about the intended limits of cover for varying degrees of medical evidence- Are they satisfactory, given the reinsurer's experience of this contract ?

How will the contract be marketed and sold ? – Will this affect the expected claims experience.

If not satisfied with marketing / underwriting aspects, reinsurer's terms should be conditional on their being modified.

Perhaps offer cover on a proportion of risk above the retention limit of the insurer (i.e. 75 % instead of the normal 100 %), so that the insurer will have a stronger interest in underwriting quality

Set the limit upto which cession / sum assured will be accepted on obligatory basis; beyond which cover will be on facultative basis.

Mortality rates will also be relevant. Should be based on what you can expect on similar contracts.

Given the estimate of pure premium rates, add allowances for expenses ;

and profit in order to achieve target profitability on your risk discount rate.

(b) Plenty of diversification (by class or by territory) ii) no large risks accepted iii) massive free reserves iv) not listed; so stable results not required v) no need for technical or administrative assistance vi) financial support available from parent company vii) no possible to exposure to a catastrophe

It may be difficult to establish there will be no exposure to catastrophe.

[12]

### **Q.8) Claim transition probabilities**

The company is at risk of underestimating the rates at which people will start a claim....

... and also the rates at which they move to higher levels of need and therefore of benefit level.

These probabilities are particularly difficult to estimate if reliable data are scarce.

A further element of unpredictability is the independent assessment of need, in particular the interpretation of policy literature by the assessor and the policyholder

Expenses and inflation

The company is at risk of losing money if expenses are higher than expected,....

.... notably through higher-than-expected inflation.

Perhaps more significant is that benefits may increase more than expected because of high inflation.

Although premiums are also indexed, this would not be sufficient to cover the increased cost of benefits

This is because the whole of the benefit will be increased but not all the premiums would be

In particular, unexpectedly high inflation at long durations in force (ie shortly before a claims) might significantly increase the benefit with only a small effect on total premium income....

.....although this might be offset by higher nominal investment returns



Subject to the last point, the company is even more vulnerable to inflation after premiums have ceased, either for a claim or due to reaching age 75.

There may also be a marketing risk if care costs (which will be to some extent earnings-linked) inflate at rates in excess of price inflation.

The benefit might not then cover the care needed, leading to dissatisfied customers and bad publicity.

### ***Investment return***

Premiums may have to be invested over a very long period and substantial funds may build up in advance of a claim.

Investment return is therefore a significant risk

The indexed benefit means that the company will need to seek a return that at least matches inflation

Investment in index-linked securities would reduce the risk....

.....but the company may also choose to invest in equities, particularly if index-linked securities are not available

Equity investment represent a higher risk, but this may not be perceived as a serious problem for long-term investment.

### ***Withdrawals***

Whenever the asset share is negative there is a financial risk form withdrawal.

At other times, the extent of such a risk depends on how much any withdrawal benefit paid exceeds the asset share.

There is also a risk that selective withdrawals will lead to a less healthy insured population than was assumed.

### ***Capital strain***

Because this is a regular premium without-profits contract, with significant guarantees, this product will need high reserves and hence will cause capital strain at entry

So the company is at risk from new business strain.

[10]

### **Q.9)**

**(a) The problems that will then confront the actuary in achieving his or her aim are as follows:**

1. Policy data – Are the data provided by the company complete and accurate?
2. Product design- What contracts should the company offer and what benefits and design features should be included in them, given its risk profile and the resources available to it?
3. Pricing – What is the expected profit, and its variance, from selling a new contract at particular premium rates or with particular charges and will the company have the resources to sell the contract on those terms?
4. Return on capital – What return on capital will the company expect to make by investing its capital in the development and issue of a new insurance contract?
5. Profitability - What is the expected profit, and its variance, from the existing business?
6. Supervisory reserves – What assumptions should be used so that the reserves and level of solvency capital required provide adequate security for policyholders?
7. Investment – How should the company invest its assets so as to maximize expected return within the resources available to it?
8. Capital management – will the company be able to achieve its short, medium and long term plans given the resources available to it?

9. Risk management – How can underwriting and reinsurance be used to manage risk so that the company can increase profits, whilst keeping its risk profile within the resources available to it?
10. Claims – Are the claims procedures adequate? Are the claims functions being properly followed? Are there effective fraud control measures control measures in place?

(b)

- Increasing security by increasing reserves increases the capital needed to finance new policies, reducing the return on capital produced and thereby making the policies more expensive. Passing this cost to the policyholder by increasing premiums or charges could reduce marketability, causing further reduction in returns.
- Increasing reserves will cause a deferral of all remaining profit from existing business, thereby reducing its present value to the providers of capital.
- Unless a compensating capital injection is made, increasing reserves will reduce the free assets (working capital) available to the company, which may reduce investment freedom.
- Increasing reserves reduces the capital available. This can affect the company's ability to develop and sell business in the volumes it would like, or to follow a particular approach to smoothing profit distribution over time.

(c) Both activities cost money, and so the more carefully you underwrite policies, or the more reinsurance cover you take out, the less your *expected* profit will be, all other things being equal.

[10]

**Q.10)** Note that those that the option exhibit the special mortality only from the point at which they take the option. Up to the option date, they are assumed to experience the normal select claim incidence rate assumption. Those that take the option are subject to the higher claim rate for all their policy benefits (ie for Rs. 200000), not just for the additional benefit.

First we need to create the combined decrement table in which those lies choosing the option experience the special claim rates of 750% of AM92 Ultimate. We choose a radix of 100000 for normal lives at age 40.

Normal lives

$t$	$l'_{(40)+t}$	$q'_{(40)+t}$	$d'_{(40)+t}$	$w_{(40)+t}$
0	100000	0.003940	394.00	19921.20
1	79684.80	0.004810	383.28	15860.30
2	63441.22	0.005520	350.20	-

Lives choosing the options

$t$	$l''_{40+t}$	$q''_{40+t}$	$d''_{40+t}$
1	19921.20	0.007605	151.50
2	35630.00	0.008280	295.02

Where  $q'_{(40)+t} = 5 \times q_{[40]+t}$  }

$$d'_{(40)+t} = l'_{[40]+t} \times q'_{[40]+t}$$

$$w_{[40]+t} = (l'_{[40]+t} - d'_{[40]+t}) \times 0.2$$

$$d''_{40+t} = l''_{40+t} \times q''_{40+t}$$

$$l''_{40+1} = w_{[40]}$$

$$l''_{40+2} = l''_{40+1} - d''_{40+1} + w_{[40]+1}$$

The premiums charged for the additional sums will be:

- For the option at the end of year 1:

$$\begin{aligned} &= 100,000 \times \left[ q'_{[41]v} + (1 - q'_{[41]})q'_{[41]+1v^2} \right] \\ &= 100,000 \times \left[ \frac{0.004255}{1.055} + 0.995745 \times \frac{0.005245}{1.055^2} \right] = 872.55 \end{aligned}$$

- For the option at the end of year 2:

$$= 100,000q'_{[42]v} = \frac{100,000 \times 0.004610}{1.055} = 436.97$$

The premium for the normal policy is:

$$\begin{aligned} &= 100,000 \times \left[ q'_{[40]v} + (1 - q'_{[40]})q'_{[40]+1v^2} + (1 - q'_{[40]})q'_{[40]+1v^2} + (1 - q'_{[40]})q'_{[40]+1v^2} + (1 - q'_{[40]})q'_{[40]+1v^2} \right] \\ &= 100,000 \times \left[ \frac{0.003940}{1.055} + 0.996060 \times \frac{0.004810}{1.055^2} + 0.991269 \times \frac{0.005520}{1.055^3} \right] \\ &= 1,269.90 \end{aligned}$$

The expected present value of the premiums;

$$= 1,269.90 + \frac{19,921.20 \times 872.55v + 15,860.30 \times 436.97v^2}{100,000}$$

$$= 1,496.93$$

The expected present value of the claims:

$$= 100,000 \times \left[ \frac{394.00v + (383.28 + 2 \times 151.50)v^2 + (350.20 + 2 \times 295.02)v^3}{100,000} \right]$$

$$= 1,790.77$$

Therefore the option premium is:

$$1790.77 - 1496.93 = Rs.293.84$$

[10]

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