INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

19th September 2016

Subject ST8 - General Insurance: Pricing

Time allowed: Three hours (14.45* – 18.00 Hrs)

Total Marks: 100

INSTRUCTIONS TO THE CANDIDATES

1) *Please read the instructions inside the cover page of answer booklet and instructions to examinees sent along with hall ticket carefully and follow without exception*
2) ** You have 15 minutes at the start of the examination in which you are required to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have three hours to complete the paper.*
3) *You must not start writing your answers in the answer sheet until instructed to do so by the supervisor.*
4) *The answers are not expected to be any country or jurisdiction specific. However, if examples/illustrations are required for any answer, the country or jurisdiction from which they are drawn should be mentioned.*
5) *Attempt all questions, beginning your answer to each question on a separate sheet.*
6) *Mark allocations are shown in brackets.*
7) *Please check if you have received complete Question Paper and no page is missing. If so, kindly get new set of Question Paper from the Invigilator.*

AT THE END OF THE EXAMINATION

Please return your answer book and this question paper to the supervisor separately.

Q. 1)   **i)**   The full credibility standard for a company is set so that the total number of claims is to be within 2.5% of its expected number of claims with probability P. This full credibility standard for a certain book of business is calculated to be 5,000 claims. The standard is altered so that the total aggregate amount of claims is to be within 9% of its expected amount with probability P. The claim frequency has a Poisson distribution and the claim severity has the following distribution:

f(x) = .0008(50 - x), $0 < x < 50$

Calculate the expected number of claims necessary to obtain full credibility of the aggregate loss under the new standard.   (4)

ii) It is a common practice in rate-making to cap losses in order to increase the credibility assigned to the data – comment on the validity of this statement.

Also comment on the relevance of skewness of claims distribution in this context.   (4)
                                                                                                              [8]

Q. 2)   **i)**   For a certain book of business, assume N to be the random variable denoting number of claims which follows geometric distribution with parameter 'p' denoting the probability of success in each trial. Let X denote the random variable for the amount of any claim. Assume that claim sizes are independent of each other and are also independent on the number of claims. Let S denote the aggregate claim amount. Using Panjer's recursive formula show that:

$$P(S = 0) = p$$

$$P(S = s) = \sum_{x=1}^{s} (1 - p) * P(X = x) * P(S = s - x) \; ; s = 1,2,3, ...$$

                                                                                                              (3)

ii) A continuous distribution has been used to model the claim amounts. Outline the two main considerations to be made in determining the number of 'strips' the claim into which the continuous claim amount distribution to be divided into, while 'discretising' the distribution in order to be able to apply the Panjer 's recursive formula   (2)

iii) The number of claims arising from a particular group of policies follows a geometric distribution with parameters p = 0.01. The Individual claim amounts are independent of each other and follow the Pareto distribution with parameters α = 4 and λ=15. Using normal assumption to the aggregate claims distribution, calculate the probability of claim greater than 1500.   (4)
                                                                                                              [9]

Q. 3)   **i)**   Given the below ILF curve for 2016 accident year, calculate the loss cost for the layer 60m XS 240m for accident year 2017. Base loss cost for a limit of 100m is 5m in 2016 accident year and annual inflation is 20%. Assume inflation impacts the loss distribution uniformly.

Limit (in mn)	ILF
100	1.00
200	1.80
210	1.90
220	1.99
230	2.07
240	2.13
250	2.19
260	2.25
270	2.30
280	2.34
290	2.37
300	2.39

(2)

ii) In addition to the pure loss cost, state why the ILF curves might include a load for risk at each limit. State the other components that could be included in the ILF curve. (2)

iii) A reinsurer while deciding on providing XoL coverage to an insurance company for its professional indemnity business comes across a market ILF curve. Discuss the key considerations made by the reinsurer in using the market ILF curves to price the XoL contract. (5)

[9]

Q. 4) **i)** Your company has decided to insure a construction project. The project spans over a period of 3 years with 15%, 60% and 100% construction completed at end of each year. The frequency of total collapse during the 3 year period is 5%, 3% and 1% for year 1, 2 and 3 respectively.

Stating all assumptions, calculate the upfront premium that should be charged to cover 3 years of insuring total collapse.

Given:

- Total cost of the project: INR 1000 crores

- Assume a discount rate of 5% p.a. to arrive at present value

- Expenses of 10% of the written premium at the beginning of the contract towards acquisition cost.

- General administrative expenses of 10% of the written premium excluding acquisition cost.

- Assume no loss adjustment expenses apply

- Ignore profit margin and any other expenses. (5)

ii) The insurance company decides to have reinsurance protection for the engineering insurance portfolio. It has choice between two reinsurance treaties with same amount of expected recoveries: Individual XoL and Quota Share. Considering various features of these reinsurance arrangements, discuss which reinsurance arrangement is preferred with regards to:

- Solvency of the insurer
- Profitability to the insurer   (4)

[9]

Q. 5) You are the pricing Actuary in a large General Insurance company which provides different types of commercial insurance covers. In recent years, a number of organizations have suffered heavy loss due to cyber crime. Your company's Chief Underwriter wants to tap this market as she feels the demand for cyber risk insurance is genuinely very high. In order to do that, she has approached you to understand some nuances of such insurance.

i) Outline any three typical coverages of such product.   (3)

ii) List any eight key factors associated with the potential insured need to be analyzed before providing cyber risk insurance cover.   (4)

iii) List any six key exclusions which can be considered in designing such a product.   (3)

[10]

Q. 6) You work in the pricing department of a large insurer and currently analyzing the appropriate expense allocation method.

i) Define Allocated Loss Adjustment Expenses (ALAE) and Unallocated Loss Adjustment Expenses (ULAE).   (2)

ii) Write down one example each for both ALAE and ULAE in the context of personal motor insurance.   (2)

iii) Outline the main disadvantage faced by an insurer in pricing by loading general administration expense, excluding acquisition charges, as a proportion of the premium.   (2)

iv) Suggest an alternate way of allocating general administration expenses to overcome the disadvantage in part (iii).   (1)

v) Outline, by providing an example, how policyholder persistency could also be an important consideration to be made in allocation of general administration expenses.   (3)

[10]

Q. 7) In a highly competitive motor insurance market, a big insurance agent suggests to the insurer to let him provide insurance as per his pre-agreed rates for all private cars. The agent also has the freedom to deviate, within a specified range, from those agreed rates. The agent has suggested that he will maintain a profitable portfolio. Assume that this kind of arrangement is allowed in that market.

    i) The insurer aims to monitor on a regular and frequent basis the business being brought by the agent:

        a) Outline how the insurance company can assess the profitability of the business being provided by the agent. (2)

        b) Outline the three key challenges insurer is likely to face in estimating the profitability of the business being brought by the agent. (3)

    ii) The agent was broadly found, during those regular and frequent monitoring, to be bringing business that is expected to be profitable on an overall level as desired by the insurer. It has been one year since insurer has been accepting business brought by the agent.

        a) Comment on why the insurer might still intend to monitor the actual claims experience of the business brought by the insurance agent. (2)

        b) Outline the three key challenges faced in analyzing the actual one year claims experience of the portfolio to assess the profitability of the agent's business. (3)

[10]

Q. 8)   **i)** You have recently joined the reinsurance pricing team of a large reinsurer. During a treaty review meeting with underwriters and reinsurance broker, you have come across discussions around loss sensitive premium.

        a) State the meaning of loss sensitive premium. Also write down the other name of loss sensitive premium. (2)

        b) Outline the two forms of such loss sensitive premiums, in the above context. (3)

    ii) An occurrence of any catastrophe often generates multiple individual claims. An occurrence limit can easily be wiped out by large numbers of individual claims, leaving the ceding insurer without reinsurance coverage for those claims arising from the same occurrence after the occurrence limit is exhausted.

    You have the following information about a catastrophe excess-of-loss reinsurance treaty on a loss-occurring basis for the annual term encompassing the entire year 2017, where the treaty has a provision for one reinstatement subject to additional premium.

    Annual premium: INR 3,500,000
    Occurrence limit: INR 60,000,000
    Date of loss: September 30, 2017
    Loss amount: INR 42,000,000
    Reinstatement premium: 120% of premium after proration

a) Assuming that the reinstatement provision is pro rata as to amount, calculate the reinstatement premium after the loss.   (2)

b) Calculate the reinstatement premium after the loss if the reinstatement provision is pro rata as to amount and also pro rata as to time.   (2)

c) Out of the above two types of reinstatement premiums, comment on which one is more common for catastrophe excess-of-loss treaties.   (2)

[11]

Q. 9) You are the Pricing Actuary in XYZ Insurance Company writing both personal and commercial business. A property underwriter of your company has got a proposal to cover a large warehouse in a single location. There is an underwriting policy in place. The property falls within the company's target market. However, the market is softening. The underwriter has approached you to seek with respect to this deal and asked the following questions.

i) **a)** State the two possible exposure measures relating to this risk.   (2)

b) Also state three complications in using such exposure measures.   (3)

ii) State three circumstances under which the underwriter may modify the risk acceptance criteria in a soft market.   (3)

iii) In current scenario, the Company management is contemplating either withdrawing from the property line of business or reducing the exposure in this line. List any two merits and demerits for each of these strategies.   (4)

[12]

Q. 10) **i)** An initial GLM model fitted on 100 observations has 40 parameters with deviance of 249,719. Of this model, a factor sum insured band is removed which has 5 levels and the deviance increases to 261,981. Suggest which model is preferred.   (3)

ii) A domestic property multiplicative GLM model consists of two perils, namely Fire and Theft. For each of these, frequency and severity has been modeled separately based on claims occurring in 2015 without any IBNR loading. The base and relativities of the rating factors in each of these models is given below. Estimate the base and relativity of the total claims cost model for each of these perils for the business written in 2017. State any assumptions made apart from following:

8% annual claim cost inflation

2% annual decrease in frequency

10% loading for IBNR (as % of risk premium)

Sprinkler installed only affects the severity of loss due to Fire peril.

	Fire		Theft	
	Frequency	Severity	Frequency	Severity
Base values	1%	200,000	3%	15,000
Rating factors & Relativities				
Age of building				
<5	1	1	1	1
>=5	1.1	0.9	1.3	1.2
Sum Insured				
Low	1	1	1	1
Medium	0.8	1.6	0.9	1.2
High	0.7	2	0.8	1.5
Sprinklers Installed				
Yes		0.8		
No		1		

(4)

iii) Outline the pros and cons of constructing a total claims cost model for a given peril vis-à-vis constructing multiplicative frequency and severity model separately and then combining. (3)

iv) Without doing any further calculations, write down the steps involved in combining the total claims cost models for Fire and Theft perils into a single GLM model to give the combined risk premium. (2)

[12]

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