

INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

12th May, 2015

Subject SA3 – General Insurance

Time allowed: Three hours (14.45* - 18.00 Hours)

Total Marks: 100

INSTRUCTIONS TO THE CANDIDATES

1. *Please read the instructions on the front 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 expected to be India Specific application for the syllabus and corresponding core reading. However, substantially the core reading material is still taken from material supplied by Actuarial Education Company which is meant for UK Fellowship examination. The core reading also contains some material which is India Specific, mostly the IRDA regulation. In view of this, it should be noted that focal point of answers is expected to be India Specific application. However if application specific to any other country is quoted in the answer the candidate should answer the question with reference to Indian environment.*
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)** You are the senior actuary at Ecco Insurance Company, a general insurer. One analyst in your team has undertaken research on a potential new crop insurance product. He has researched on the correlation between crop failures and the El Nino effect. El Nino is a pervasive global weather phenomenon which has a high correlation with drought conditions. The El Nino effect typically lasts from five to seven years.

This analyst claims that Ecco should offer a product for crop insurance which uses predictions of El Nino as the major influence on premium rates. When El Nino is expected to be present, rates should be very high and conversely, rates can be lowered when El Nino is not expected to have an effect. Another possibility is for Ecco to offer very long-term crop insurance (say ten or twenty years) policies, so the El Nino effect is balanced over the period of the policy.

Ecco has decided to sell this product as a long term, 20 year policy.

- i)** What are the issues to consider when selecting the investments to (notionally) back this product? (3)
- ii)** What are the issues to consider in setting the reinsurance programme for this product? (3)
- iii)** One year later, premium volumes are significantly lower than budgeted. What are the consequences of this? What would you do to investigate the reasons behind the low premium volume? How should the consequences be disclosed in the Financial Condition Report? (4)
- iv)** Another analyst in the team has been reviewing the Commercial Motor Fleet experience rating system. She suggests that some form of experience rating be used for this new crop insurance product. Do you agree or disagree with her and why? (2)

It is five years later. At the end of the first underwriting year the CEO directed the product and underwriting team to cease underwriting. The one year of business written has been in run-off now for four years, with exposures being earned on a pro-rata basis over the term of each policy.

There have been no general weather-related events driving claims experience in the last five years. The CFO has been reviewing experience. He notes that the loss ratio has been climbing sharply for each accident year.

- v)** What are the possible causes of this? (3)

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- Q. 2)** Tuff Insurance is a general insurer that provides insurance products to small and medium sized businesses. It has been very successful in this segment, largely by providing excellent customer service and is keen to expand its offerings to its loyal client base. The marketing department has identified Accident and Sickness Insurance as a promising area for Tuff's expansion, and proposes to provide a standard policy to all possible policyholders.

The following figures have been produced by the research department in conjunction with the marketing department:

Volume	1,000 policies	10,000 policies
Expected claim frequency	2%	2%
Average claim size	\$8,000	\$8,000
Claims handling expenses	7% of claim size	7% of claim size
Other expenses	\$140,000	\$160,000
Required profit/solvency margin after claims and expenses	17% of premium	11% of premium

- i) Calculate a sound premium per policy under each of the volumes of 1,000 policies and 10,000 policies. (2)
- ii) Why do the two figures in (i) differ? You should give clear explanations of the underlying reasons rather than just describe the calculations in (i). (1)
- iii) The marketing department is "very confident" they can sell at least 10,000 policies, especially as Tuff's calculated premium rates for this volume are lower than their potential competitors. What other factors would you consider before recommending the initial premium that should be charged by Tuff? (3)
- iv) The managing director likes the idea of expanding into Accident and Sickness Insurance. She asks about exclusions which should apply to the product. Give three major exclusions which should apply with supporting reasons. (3)
- v) The CFO of Tuff is concerned about the capital requirements of the new product. He realises these have been reflected in the margins, but wonders if Tuff should take some reinsurance for protection. Give a brief description to the CFO of reinsurance policies which would be suitable for this specific policy type and situation. The options described should include the risks they are designed to protect and the impact on the profit/risk margins required. (4)
- vi) The management of Tuff decides to proceed with the writing of the new product. Give a brief description of how this decision should be reflected in Tuff's Financial Condition Report. (5)

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- Q. 3)** You are a company actuary working on your company's comprehensive motor insurance portfolio. You are in the process of completing a technical pricing analysis using GLMs.

For claim frequency you fit a model with a Poisson error and a log link. For claim size you fit a model to the log of claim size with a normal error and an identity link (i.e. a log-normal model). The following output is an extract for Sum Insured Band (SI) from your work.

Claim Frequency Model: (Poisson)		
Parameter	Estimate	Standard Error
Constant	-2.0321	0.0779
SI (less than Rs. 200,000)	0.0000	0.0000
SI (Rs 200,000 to Rs 500,000)	-0.3504	0.1108
SI (Rs 500,000 to Rs 1,000,000)	-0.0914	0.1020
SI (Rs 1,000,000 to Rs 2,000,000)	-0.0473	0.1000
SI (Rs 2,000,000 to Rs 5,000,000)	0.0417	0.0988
SI (above Rs 5,000,000)	-0.2761	0.1245
Scale Parameter	1.0000	

Claim Size Model: (Log Normal)		
Parameter	Estimate	Standard Error
Constant	5.7910	0.0965
SI (less than Rs. 200,000)	0.0000	0.0000
SI (Rs 200,000 to Rs 500,000)	0.4381	0.1373
SI (Rs 500,000 to Rs 1,000,000)	1.1837	0.1264
SI (Rs 1,000,000 to Rs 2,000,000)	2.0038	0.1239
SI (Rs 2,000,000 to Rs 5,000,000)	3.5600	0.1224
SI (above Rs 5,000,000)	4.8364	0.1542
Scale Parameter	1.2391	

Note that the scale parameter is an estimate of a (φ) and for the Poisson distribution $a(\varphi)=1$ and for the Normal distribution $a(\varphi)=\sigma^2$.

- i) Describe the model adequacy tests you would apply to check the adequacy of your final models. (3)
- ii) Sum Insured (SI) has been fitted as a categorical variable. What other modelling alternatives are there and would they produce a better model? (2)
- iii) You have not included no-claim-bonus or excess in your analysis. What are the reasons for excluding these variables from a GLM analysis? (2)

It is now three months since the rate review and the portfolio manager has drawn your attention to falling retention rates. He has provided you a summary of the retention analysis he has undertaken:

Month	Renewals invited	Lapses processed	Lapse rate (%)
August	49,010	9,034	18.4
September	49,790	11,363	22.8
October	32,760	10,566	32.3
November	28,990	6,243	21.5
December	22,100	6,105	27.6

You have obtained the following additional information relating to the number of lapses:

Processing Month	Renewal effective month				
	August	September	October	November	December
August	2,432				
September	4,139	1,994			
October	3,257	3,673	1,645		
November	656	1,913	1,661	1,397	
December	407	905	1,598	2,066	775

iv) Perform your analysis and prepare a draft response

(11)
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Q. 4) A two financial year old Indian general insurance has begun its annual reserving activity as at the end of second year 31st March X. Despite the lack of in-house experience the Chief Actuary has suggested the use of Basic Chain Ladder (BCL) method for estimating claim reserves. The Actuary has advised the team to draw up Accident Year (AY) cohorts and use the AY development factors based on industry experience.

The actuarial analyst having observed industry data has used a curve fitting method to estimate the age-to-ultimate development pattern. The following curve was fitted:

$$f(x) = a^{(b-x)} \text{ where } x \text{ denotes the year of development and is an integer; } x > 0 \text{ and } 0 \leq f(x) \leq 1$$

'a' and 'b' are parameters that signify the speed of development and ultimate length of development respectively.

The resultant development pattern using the above curve is expressed as a percentage of the ultimate claims cost. Therefore, if the value of $a^{(b-x)}$ is, say, 0.43 for a given value of x, the interpretation is that 43% of the expected ultimate claims cost are expected to develop within x years from the accident year.

- i) Briefly describe a curve-fitting method. Discuss the uses and possible situations where a curve-fitting method could be ineffective. (9)
- ii) Based on the information given above, by logical reasoning, deduce the lower and upper bounds for a, b and x. Explain the rationale. (5)

The actuarial analyst has drawn up the following development factors for Motor OD and Motor TP lines of business using the above curve on industry data:

Accident Year cohort	Motor OD (age to ultimate factor - ATUF)	Motor TP (age to ultimate factor - ATUF)
12 months	1.0307	7.6840
24 months	1.0152	5.9551
36 months	1.0000	4.6152
48 months		3.5768
60 months		2.7720
72 months		2.1483
84 months		1.6649
96 months		1.2903
108 months		1.0000

The insurer has the following in-house claim incurred information (Amounts in INR Million):

Motor OD	Development Cumulative Net claim incurred	
Accident Year	12 months	24 months
31 st Mar X	50	
31 st Mar X-1	10	12
Motor TP	Development Cumulative Net claim incurred	
Accident Year	12 months	24 months
31 st Mar X	12	
31 st Mar X-1	2	4

- iii) Estimate the Net IBNR for Motor OD and Motor TP as on 31st March X. (3)
- iv) Using the above given table of ATUF (age to ultimate factor):
- a) Draw up the development pattern (as per the curve) and estimate the values of parameters 'a' and 'b' for Motor OD and Motor TP. (8)
- b) Critically evaluate and comment on the results for this insurer in Indian context. (6)

Based on the information on the premiums and the pricing target loss ratios for the previous two years, the Chief Actuary opines that, the curve-fit method on an underwriting year (UWY) cohort may be used.

The available premium (INR million) and ULR information is given below:

FY X-1	NWP	Expected ULR	FY X	NWP	Expected ULR
Motor OD	15	65%	Motor OD	70	65%
Motor TP	12	145%	Motor TP	60	145%

- v) Why do you think the actuary opines to look at the UWY cohort? As such, what modification would you make for the above curve fit to represent an underwriting year development pattern? Also clearly explain the applicability and limitations of the proposed modification in general and specific to Indian context. (4)
- vi) Using the above premium and claim information as relevant:
- a) Estimate the Net IBNR as on 31st March X using the B-F method on underwriting year exposure, listing all assumptions. (6)
- b) By comparing these results with the results in Q4 above, explain possible reasons for observed differences if any. What further checks would you suggest? (3)
- vii) Cite the drawbacks of the above curve fit method mentioning alongside suggestions and recommendations to contain these drawbacks. (5)
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