INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

27th May, 2014

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 are 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.*

Q.1) As a consulting actuary you have been approached by Alternative Insurance to assist it in calculating its outstanding claims provisions as on 31st December 2013. Alternative Insurance has operated since the year 2000 writing Engineering Construction business to cover large construction projects which last between 3-8 years. Each policy covers a project's full construction period.

Two methods have been used by Alternative which you would like to investigate further:

- Paid Chain Ladder

  Which is similar to the standard incurred chain ladder method, however, the loss development factors are derived from paid to date data.

- Additive Chain Ladder

  Which is similar to the standard incurred chain ladder method, however, the triangle is based on incurred loss ratios rather than incurred amounts and the loss development factors measure the loss ratio increase (i.e. the increment or additive increase not the multiplicative increase) from one development period to the next.

  The following data has been provided by your actuarial assistant to assist you in your task.

General Information:

Underwriting years are calendar years. Development years are relative to the start of the underwriting year. For instance, Development Year 1 for the 2008 underwriting year relates to payments made in the 12 months ended 31/12/2008

Paid To Date (Rs000s)

Underwriting Year	Development Year					
	1	2	3	4	5	6
2008	5,066	10,616	11,628	12,583	13,226	13,746
2009	3,840	6,043	8,817	10,380	11,489	
2010	1,386	3,779	5,128	5,982		
2011	1,396	4,501	5,512			
2012	1,546	2,421				
2013	1,689					

Case estimates (Rs 000s)

Underwriting Year	Development Year					
	1	2	3	4	5	6
2008	4,359	1,408	1,621	1,672	1,551	1,321
2009	4,721	4,503	3,478	2,605	2,195	
2010	5,699	5,337	5,104	4,775		
2011	3,666	2,358	2,145			
2012	746	556				
2013	3,034					

Incurred to date (Rs 000s)

Underwriting Year	Development Year					
	1	2	3	4	5	6
2008	9,425	12,023	13,248	14,255	14,777	15,067
2009	8,561	10,546	12,295	12,985	13,684	
2010	7,085	9,116	10,232	10,756		
2011	5,063	6,859	7,658			
2012	2,292	2,977				
2013	4,723					

Information for Paid Chain Ladder Method

Paid chain ladder loss development factors

Underwriting Year	Development Year				
	1:2	2:3	3:4	4:5	5:6
2008	2.096	1.095	1.082	1.051	1.039
2009	1.574	1.459	1.177	1.107	
2010	2.726	1.357	1.166		
2011	3.224	1.225			
2012	1.566				
2013					
Weighted average	2.07	1.25	1.13	1.08	1.04

Information for Additive Chain Ladder Method

Incurred loss ratios

Written Premium (Rs 000s)	Underwriting Year	Development Year					
		1	2	3	4	5	6
15,328	2008	61%	78%	86%	93%	96%	98%
16,312	2009	52%	65%	75%	80%	84%	
16,332	2010	43%	56%	63%	66%		
22,838	2011	22%	30%	34%			
22,791	2012	10%	13%				
21,843	2013	22%					

Loss ratio increase

Written Premium (Rs 000s)	Underwriting Year	Development Year				
		1:2	2:3	3:4	4:5	5:6
15,328	2008	17%	8%	7%	3%	2%
16,312	2009	12%	11%	4%	4%	
16,332	2010	12%	7%	3%		
22,838	2011	8%	3%			
22,791	2012	3%				
21,843	2013					
	Weighted avg loss ratio increase	10%	7%	5%	4%	2%

i) What things would you consider and what information would you seek in quantifying the tail assumptions? (4)

ii) Derive the Ultimate Loss Ratio and the Projected Future Claim Payments for the following underwriting years: (Projected Future Claim Payments are defined here as the ultimate incurred cost estimate less the claim payments paid to date).

   a) The 2012 underwriting year, using the Paid Chain Ladder method. Use the weighted average Paid Chain Ladder factors calculated in the tables provided. Assume tail factors of 1.02 and 1.08 for development periods 6:7 and 7:8 respectively.   (3)

   b) The 2013 underwriting year, using the additive chain ladder method. Select the average Loss Ratio increase factors that you would use in calculating the ultimate incurred cost estimate, justifying your selections.

   Assume tail factors of 1% and 5% for development periods 6:7 and 7:8 respectively.   (3)

iii) Alternative's Underwriting Manager has indicated that the premium rates for the Engineering risks almost doubled from the beginning of the 2011 underwriting year.

   What issues would you consider when re-selecting your assumptions for the additive Model to allow for this change in rates?   (2)

iv)   a) In respect of the 2012 underwriting year, what could be an inherent weakness in the paid chain ladder approach?   (1)

      b) What is an inherent weakness in the additive chain ladder method?   (1)

v) List all the relevant additional issues you would need to consider if you were estimating the outstanding claims provision for the 2012 underwriting year.   (4)

[18]

Q. 2) National Fidelity Insurance ("NFI") Limited is a large insurer that specialises in long-tail lines of businesses. NFI has asked you, a consulting actuary, to talk to it about reserving methodology for professional indemnity. You meet with NFI's professional indemnity underwriter and claims manager and have gathered the following information:

After a period of rapid premium growth in early 2008, NFI has spent the last several years trying to reduce its book by being more selective with underwriting. It has reduced its exposure to some professions that are considered to be higher risk, while it has increased its exposure to what it considers to be lower risk professions.

All of its business is sourced via brokers. Most recently, with the collapse of one of its competitors and the consequent reduction in market capacity, NFI has decided to increase its business volume to take advantage of the hardening premium rates.
On the claims side, the claims manager says that there have been a number of changes in claims practices over the same period. Until 2003, all potential circumstances that were notified to NFI were entered on their computer system as claims with a nominal case estimate of Rs 1,000. There was an annual claims review, just before finalising the accounts and in this review. If a claim had not had any action for 3 years since notification, it would be finalised. i.e. settled and closed

This procedure was changed in 2004, when a system of continuous case review came into effect. This meant that all claims would be reviewed at least annually on a continuous basis, to remove the backlog of claims processing just before closing balance date. Now, if a claim has not had any action for 12 months since notification, it would be finalised.

Another change has been to the way case estimates were made. Previously cases were sent to an external legal panel with instructions to estimate on a most likely outcome basis. Now the instructions are to estimate on a worst-case scenario which equates roughly to an 80% chance of the claim being settled for the case estimate or lower.

i) What exposure information will you request from NFI and how will it help deal with the issues identified by the underwriter? (4)

ii) What claims data will you request from NFI and how will it help deal with the issues identified by both the underwriter and claims manager? (5)

iii) What outstanding claims estimation techniques do you propose to use to come to your best estimate, and how will you deal with the issues you identified in (i) and (ii) above? (8)

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Q. 3) An actuary at an insurance company wants to use Value at Risk (VaR) to allocate capital by line of business.

i) Discuss a process to do this including various issues which the actuary should consider in Selecting an appropriate risk horizon (4)

ii) Briefly describe three features of VaR that make it a popular statistic for measuring market risk (4)

iii) As per IRDA's circular on Asset Liability Management and Stress Testing, detail all the risk factors which an insurer should consider in projecting financial and capital adequacy positions over a three year time period (7)

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Q. 4) A leading general insurance company is planning to venture into writing rainfall index based crop insurance. As a part of its assessment exercise, the Company also evaluated the potential risk on hand to purchase reinsurance protection.

One of the reinsurers have offered a 'rainfall trigger and return period' based reinsurance protection instead of the traditional methods of reinsurance protection in crop insurance. Under this arrangement, the Company would set the exit level as equal to the trigger at a given return period. Once maximum rainfall in the insured period exceeds the exit, as per reinsurance terms, the reinsurance protection would set in that would pay up the entire losses over and above the first layer ground up retention of the Company.

The Company wants to independently evaluate the potential cost-benefit from this type of protection. The Chief Actuary has suggested the usage of extreme value theory (EVT) for evaluating the same for various return periods.

i) Explain the concept of EVT and its application in general insurance business.   (4)

ii) List at least three traditional methods of reinsurance in Indian market for crop insurance.   (2)

iii) Discuss the potential advantages and disadvantages of such an arrangement for both the insurer and the reinsurer.   (6)

The Company's actuarial team has gathered historical information on the maximum observed rainfall in centimetres for the last fifty years during the months July to September for the particular region. The fifty-year maximum was observed at 7.7 cms.

A GEV model with the following CDF was fitted to the data:

$$F(x) = \begin{cases} \exp\left(-(1 + \xi * (x-\mu)/\sigma)^{-1/\xi}\right) & \text{for } \xi \neq 0 \\ \exp\left(-\exp(-(x-\mu)/\sigma)\right) & \text{for } \xi = 0 \end{cases}$$

The log-likelihood method was used to fit the GEV distribution to estimate the values of the parameters μ, σ and ξ

iv) Mention at least three other methods that can be used for fitting the distribution   (2)

v) Specify, with reasons, what kind of diagnostic/exploratory analyses that you would carry out with the rainfall data while fitting a GEV model.   (8)

The pricing actuary's team carried out the fitting exercise and the following values were estimated for the three parameters:

Scale parameter estimate = 0.8635
Location parameter estimate = 6.0468
Shape parameter estimate = - 0.5728

vi) Explain the importance of each of the above parameters for the model. Map the above values to μ, ξ and σ.   (4)

vii) Using the above parameter estimates, calculate the trigger rainfall indices for the following return periods:

    a) One-in-ten-years
    b) One-in-twenty five-years
    c) One-in-fifty-years
    d) One-in-hundred-years
    e) Upper bound trigger   (11)

Given the data and having seen the results, the actuary comments, "Either the model fit is wrong or the reinsurance arrangement is not appropriate!"

viii) What do you think of the actuary's comment? Substantiate your argument.   (6)

ix) In wake of the above, describe what further factors you would consider and what next steps would you suggest from viewpoint of the model fit and the reinsurance strategy.   (7)

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