



Master in Actuarial Science
Loss Reserving
16-06-2015
Time allowed: 2 hours

Instructions:

1. This paper contains **5** questions and comprises **8** pages including the title page and **4** preprinted answer sheets.
2. Enter all requested details on the cover sheet.
3. You must not start writing your answers until instructed to do so.
4. Number the pages of the paper where you are going to write your answers.
5. Attempt all questions.
6. Begin your answer to each question on a new page.
7. Marks are shown in brackets. Total marks: 200.
8. Show calculations where appropriate.
9. An approved calculator may be used.
10. Mobile phones and smartphones may not be used during the examination.
11. Preprinted answer sheets are available for some of the tables required.

You are the actuary of the St. Thomas Mutual Assurance and have been asked to analyse the claim cost of its home and contents insurance portfolio. This is the data you receive from the company:

Accident year	Earned premium
2010	153
2011	167
2012	191
2013	206
2014	219

Cumulative paid claims

	Development year				
Accident year	0	1	2	3	4
2010	78	131	135	139	140
2011	85	144	154	159	
2012	80	143	152		
2013	86	140			
2014	93				
Sum	422	558	441	298	140

1. Give a brief definition of the following terms:

- a. Estimate [2 marks]
- b. Provision [2 marks]
- c. Premium provision [2 marks]
- d. Outstanding claim provision [2 marks]
- e. Reserve [2 marks]

2. Payment pattern

You may assume that all claims are settled after a delay of four years.

- a. Estimate the payment pattern using development factors. [15 marks]
- b. Would you characterize the portfolio as long-tailed or short-tailed? [5 marks]

Calculate your answers with three decimals.

3. Claim predictions

- a. Predict the outstanding claim cost and the ultimate claim cost of each accident year, using the chain ladder prediction method. [15 marks]
- b. Predict the timing of future payments of each accident year, using the estimated payment pattern. [20 marks]
- c. Predict the remaining outstanding claims at the start and the end of each future payment year. [15 marks]

Calculate your answers with three decimals.

4. Outstanding claim provision according to Solvency II

Assume an interest rate of 5%.

The “best estimate”

- a. Calculate the discounted value of the predicted outstanding claims.
You can assume that payments are made at the end of each payment year.
You do not need to specify the best estimate by accident year, just in total. [15 marks]

The “risk margin”

- b. Explain the cost-of-capital method for calculating a risk margin. [20 marks]
- c. Assume that on 1st January of 2015, 2016, 2017, 2018, the solvency capital requirement (SCR) is 50% of the outstanding claims that you predicted in exercise 3.c. The upfront cost of providing capital for one year is 6%. Calculate the risk margin as the total discounted cost of providing solvency capital for the years 2015-2018. You do not need to specify the risk margin by accident year. [20 marks]

The outstanding claim provision according to Solvency II is the sum of best estimate and risk margin.

Calculate your answers with three decimals.

5. Modelling by GLM

The predictions of the chain ladder method can be reproduced within a generalised linear model (GLM).

- a. Specify the GLM that will reproduce the predictions of the chain ladder method. A GLM is fully specified by its covariate structure, its link function and its probability distribution. [15 marks]

- b. What other probability distribution could you use for claim payments if you are not obliged to reproduce the predictions of the chain ladder method? Discuss why there could be better distributions for claim payments. [20 marks]

Now assume that instead of one portfolio, you have two portfolios to analyse.

The portfolios are closely related: Their payment patterns are identical; the year-to-year variation of the ultimate claim rates is driven by the same risk factors; however, the absolute size of the ultimate claim rates differs by a fixed relativity that you do not know.

You could think of the two portfolios as similar insurances of similar objects, where the only difference between the portfolios is in the size of the objects and/or the insurance cover and/or the premium rate.

Let us denote the earned premiums of the two portfolios by $p_j^{(1)}$ and $p_j^{(2)}$, and their claim payments by $X_{je}^{(1)}$ and $X_{je}^{(2)}$.

- c. Specify a GLM that will allow you to estimate the payment pattern, the year-to-year variation of the ultimate claim rates, and the fixed relativity between the ultimate claim rates, using all available data. [30 marks]

THE END

Name: _____

Answer sheet for Question 2a

	Specify formula	Development year e				
		0	1	2	3	4
Incremental development factors δ_e^*						
Cumulative development factors Δ_e^*						
Cumulative payment proportions $\pi_{\leq e}^*$						
Incremental payment proportions π_e^*						

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Answer sheet for Question 3a

Accident year j	Earned premium	Cumulative Payments to date	pi(cum.)	Theta (CL)	Outstanding payments (prediction)	Ultimate payments (prediction)
Specify formula	p_j	$X_{j, \leq 2014-j}$	$\pi_{\leq 2014-j}^*$	$\theta_j^* =$	$\bar{X}_{j, > 2014-j} =$	
2010						
2011						
2012						
2013						
2014						
Total						

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Answer sheet for Question 3b and 3c

	Payment year				
Accident year	2015	2016	2017	2018	Total
2010					
2011					
2012					
2013					
2014					
Total payments during payment year (prediction)					
Outstanding payments at start of payment year (prediction)					
Outstanding payments at end of payment year (prediction)				0	

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Answer sheet for Question 4a and 4c

	Payment year				Total
	2015	2016	2017	2018	
Predicted payments at 31 st December of the payment year					
Discount factor at 31st December 2014					
Discounted value of predicted payments at 31st December 2014					"Best estimate"
Outstanding payments on 1st January of the payment year					
Solvency capital required during the year					
Upfront cost of solvency capital provided during the year					
Discount factor at 31st December 2014					
Discounted value of cost of capital at 31st December 2014					"Risk margin"