

# EXAMINATION

11 October 2010 (pm)

## Subject ST8 — General Insurance: Pricing Specialist Technical

*Time allowed: Three hours*

### *INSTRUCTIONS TO THE CANDIDATE*

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*
2. *You have 15 minutes before the start of the examination in which 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 booklet until instructed to do so by the supervisor.*
4. *Mark allocations are shown in brackets.*
5. *Attempt all 10 questions, beginning your answer to each question on a separate sheet.*
6. *Candidates should show calculations where this is appropriate.*

### *AT THE END OF THE EXAMINATION*

*Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.*

*In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator from the approved list.*

- 1 A general insurance company is using a generalised linear model to set risk premium rates for a book of business. The rating factors available are as follows:

<i>Rating factor</i>	<i>Possible values</i>
Age attained	16 to 120
Gender	M or F
Employment type	A, B, C, D or E

The model uses a linear variate for age attained.

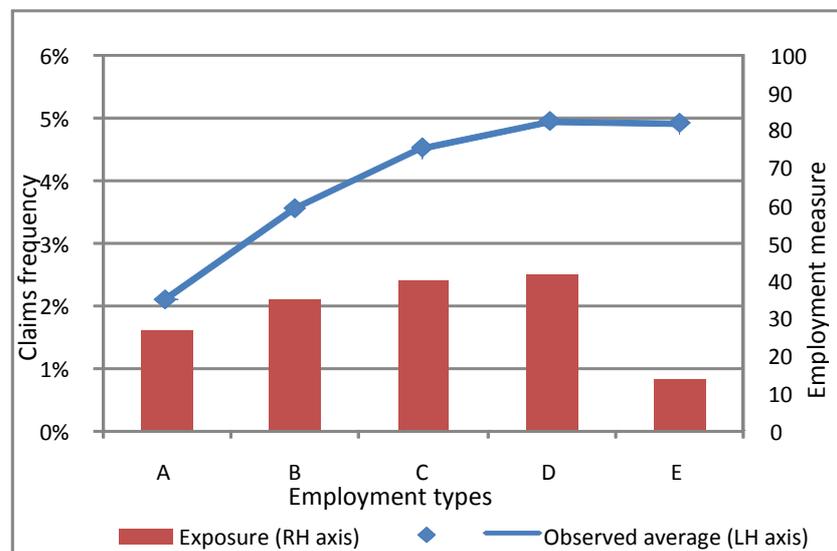
The following are three observations in the data:

<i>Observation</i>	<i>Age attained</i>	<i>Gender</i>	<i>Employment</i>
1	18	M	D
2	55	F	A
3	92	M	E

- (i) Construct for the model:
- a vector of parameters
  - a design matrix including a row for each of the three observations
  - a set of definitions for the columns of the design matrix

[3]

The modeller wishes to improve the model for claims frequency by reducing the number of parameters. The following chart illustrates the data relating to employment type.



- (ii) Describe suitable methods for reducing the number of parameters. [2]

The modeller is concerned that the linear fit of the age variate for very young and very old ages may be unreliable because the data is sparse in these ranges.

- (iii) Suggest a method of grouping the data that could improve the reliability of the model. [1]

[Total 6]

**2** A general insurance company is reviewing the expense loadings in its premium rates.

Discuss the difficulties that are likely to arise when subdividing expenses between new business and renewals. [4]

**3** (i) Describe the cover given under risk excess of loss reinsurance. [2]

(ii) Explain “reinstatement” in the context of risk excess of loss reinsurance. [4]  
[Total 6]

**4** A general insurance company is about to write commercial property insurance for the first time.

(i) State the reasons for the company to monitor business written. [3]

The Managing Director has requested a regular report on premium rate changes to assist with monitoring profitability and has suggested the following as possible definitions:

(a) change in average premium per unit of expected loss calculated considering each individual risk written

(b) change in average premium per unit of expected loss calculated considering a basket of risks representative of the portfolio

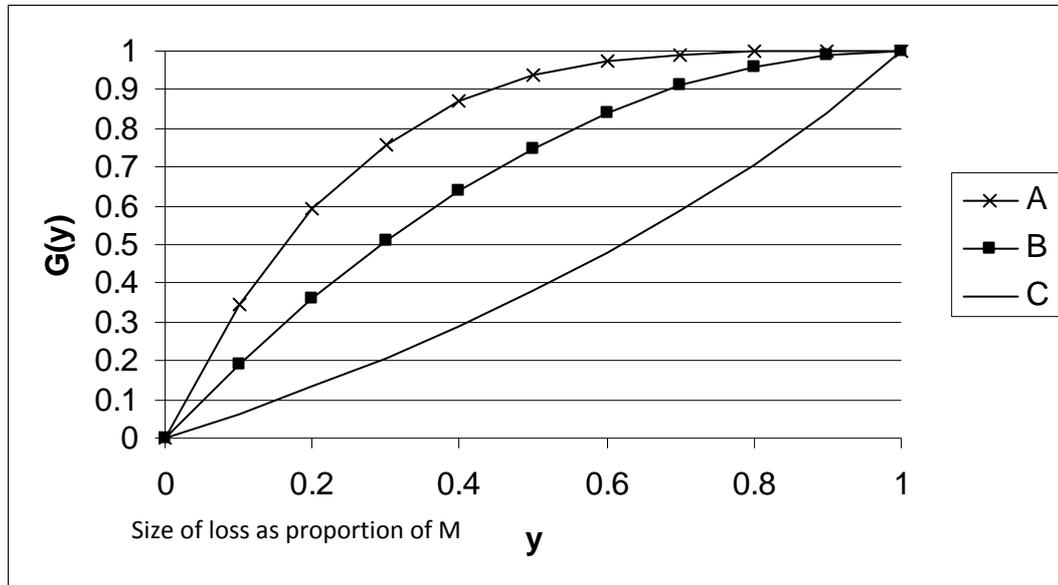
(c) the class underwriter’s overall view of premium-rate changes

(ii) Explain the relative merits of these three definitions. [6]  
[Total 9]

- 5 The chart below shows three exposure curves.  $Y$  is a random variable representing the size of loss as a proportion of the total sum insured ( $M$ ). The curves are used for losses only.

The exposure curve is defined as  $G(x) = \text{LEV}(x) / E[Y]$ , where  $\text{LEV}(x)$  is the limited expected value function:

$$\text{LEV}(x) = \int_0^x (1 - F(y)) dy, \text{ where } F(y) \text{ is the cumulative density function of } Y.$$



- (i) State the key assumption about the relationship between  $Y$  and  $M$ . [1]

Assume that you have calculated the ground-up premium for a property risk. You now want to use the curves above to calculate an appropriate premium rate for a layer between 0 and  $M/2$ .

- (ii) Explain the relationship that you would expect between premiums for this layer calculated using curves A and B, without doing any calculations. [1]
- (iii) Describe briefly how you would expect the distributions of claims size underlying curves A and B to differ. [1]
- (iv) Describe the approach to selecting the most appropriate curve for the rating exercise. [3]
- (v) Comment on whether or not curve C is likely to be appropriate for an exercise of this type by considering the shape of a curve in which only total losses were possible, or otherwise. [2]

[Total 8]

**6** An analyst at a general insurance company that writes personal lines business in the UK is modelling the cost of claims for the purpose of pricing.

(i) State the purpose of using spatial smoothing for the full postcode rating factor. [1]

(ii) Explain whether distance-based or adjacency-based methods would be more suitable for the following types of claim:

- (a) windstorm claims on household buildings
- (b) theft claims on motor

[3]

The analyst is considering using an adjusted distance-based method for flood claims that includes height above sea level and distance from the coast in addition to latitude and longitude.

(iii) Discuss the advantages and disadvantages of this proposal. [2]

The analyst has fitted a model that uses the spatially-smoothed postcode as a factor.

(iv) Suggest diagnostics that could be used to test whether the extent of smoothing is appropriate. [2]

[Total 8]

**7** An underwriter has been asked to quote a premium for the 2011 contract for professional indemnity insurance for an accountancy firm. The broker has provided data on claims on the policy originating from the last three underwriting years. In each of these years the policy had a per-claim deductible of 100,000. For the coming year this is being raised to 150,000.

The underwriter is proposing a premium of 1,450,000 for the coming year and has produced the following spreadsheet.

<i>Underwriting Year</i>	<i>Number of Claims</i>	<i>Aggregate Claims</i>	<i>Increase in Deductible</i>	<i>Claims under New Deductible</i>
2007	2	2,600,000	50,000	2,550,000
2008	3	1,500,000	50,000	1,450,000
2009	1	400,000	50,000	350,000
Total Claims				4,350,000
No. of Years				3
Average Claims per Year				1,450,000
Proposed Premium for Next Year				1,450,000

Discuss the underwriter's analysis and how it might be improved. [11]

- 8 An insurance company needs to price an insurance policy for the property portfolio of a large commercial enterprise. The coverage is \$5 million xs \$25,000 per loss. The company has insured the risk for many years, in which time the coverage has always remained the same.

The company has decided to price the layer based on the experience of this risk. Below is an extract of policy claims from the claims department for the \$5 million xs \$25,000 layer. The amounts have been restated using the current exchange rate.

<i>Claim Ref</i>	<i>Peril</i>	<i>Claim Status (Open/Closed)</i>	<i>Claim Amounts (\$) cumulative to date</i>		
			<i>Paid</i>	<i>Outstanding</i>	<i>Incurred</i>
675	Snow	Closed	35,000	–	35,000
676	Flooding	Closed	20,000	–	20,000
677	Wind	Closed	340,000	–	340,000
678	Fire	Closed	5,000,000	–	5,000,000
679	Wind	Closed	750,000	–	750,000
680	Theft	Closed	30,000	–	30,000
681	Tornado	Open	50,000	10,000	60,000
682	Flooding	Open	10,000	5,000	15,000
683	Fire	Open	–	25,000	25,000
684	Fire	Open	–	25,000	25,000
685	Flooding	Open	–	25,000	25,000

- (i) Comment upon the appropriateness of using the open and closed claims data for pricing the policy. [4]
- (ii) Suggest how the claims data might be adjusted for pricing the following policy options.
- (a) Increasing the excess to \$50,000
  - (b) Lowering the excess to \$10,000
  - (c) Excluding flood coverage
  - (d) Including terrorism coverage (this was not previously covered)
  - (e) Lowering the limit to \$1m
  - (f) Increasing the limit to \$10m

[7]

[Total 11]

- 9**
- (i) List the principal covers that would be included in comprehensive motor insurance. [2]
  - (ii) State, for each cover under part (i), whether or not it would normally be included in non-comprehensive motor insurance. [1]
  - (iii) Describe the main benefits and insured perils of each cover listed in part (i). [6]
  - (iv) Explain how inflation may be expected to affect the cost of claims of each of the cover listed in part(i) and the types of inflation index that may be useful in projecting claims. [6]
- [Total 15]

**10** A general insurance company markets and underwrites direct household and motor business. A marketing manager has proposed a change to the product whereby the compulsory policy excess will be waived for any claim caused by a third-party criminal act. The manager has also suggested that the change could be made to existing policies at their next renewal.

- (i) Explain the advantages to the company of the manager's proposals for new and renewing policies. [4]
  - (ii) Discuss the additional uncertainties involved with the pricing of this extra coverage. [8]
  - (iii) Suggest the measures that the company might implement to mitigate the uncertainties in part (ii). [10]
- [Total 22]

**END OF PAPER**