INSTITUTE AND FACULTY OF ACTUARIES

EXAMINATION

5 October 2012 (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 eight 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.

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1   A general insurance company writes employers' liability insurance, using risk-adjusted number of staff as the exposure measure.

Discuss the factors that should be considered when determining the exposure for the purpose of pricing. [4]

2   (i)   Describe the features of fronting arrangements. [2]

(ii)   State reasons why an insurer would use a fronting arrangement rather than underwriting a risk directly. [3]
[Total 5]

3   A general insurance company is building a stochastic model for the number of annual claims for a particular class of business. The following data is available:

Accident Year	No. of claims
2006	7
2007	6
2008	8
2009	5
2010	2
2011	1
Mean	4.8333
Variance	7.7667

(i)   Fit, using the method of moments, parameters for both the Poisson and the Negative Binomial distributions. [2]

(ii)   Explain which of the above two distributions is the more appropriate. [1]

(iii)   Discuss further investigations that could be conducted and additional information that may be required to improve the model. [6]
[Total 9]

4 (i) Define the term pooling. [1]

(ii) Compare pooling with conventional insurance contracts. [2]

A reinsurance company is considering renewal terms for a policy covering a yacht-owners' insurance pool.

A frequency model for the ground up claims to the pool needs to be built. Historical claim numbers and total insured values are provided.

Policy Year (beginning 1 Nov)	Number of Claims	Sum Insured (£m)
2007	203	25.1
2008	129	26.0
2009	179	29.8
2010	30	33.2
2011	50	25.6

The above claim numbers and sums insured are reported as at 1 August 2012.

All policy years offer coverage from 1 November to 31 October.

A marine expert states that annual sum insured inflation was 5% prior to 31 December 2009 and zero subsequently.

The table below gives development percentages for projecting claim numbers.

Months since Policy Inception	Number of Claims Reported as a % of Ultimate
60	95%
48	90%
36	70%
24	40%
12	20%

(iii) Estimate the expected number of claims for the 2012 policy year, justifying your estimate and stating any assumptions that you make. [11]

[Total 14]

PLEASE TURN OVER

5   A general insurance company specialises in underwriting property and liability risks for factories. The company is assessing the renewal premium for a large chemical factory that switched its main product from Chemical Y to Chemical X two years ago.

The insurer wishes to use the factory's loss history prior to the switch, so it proposes to adjust previous loss data and use a credibility approach to determine the new risk premium. The underwriter has a prior belief that the total cost of claims per unit turnover under Chemical X will be half of that under Chemical Y.

The table below gives the turnover of the factory, which is used as the overall exposure measure, and the actual and adjusted loss data. All amounts have been adjusted onto policy year 8 terms and monetary values.

| | | | Ultimate loss (£) per £000 turnover | |
| | | | Chemical X: | |
Policy Year	Turnover (£000)	Chemical Y: actual	prior (50% of Y)	Chemical X: actual
1	5,033	32	16	
2	5,234	34	17	
3	5,444	82	41	
4	6,123	38	19	
5	6,368	48	24	
6	6,623			35
7	6,888			38
8 (estimate)	9,000			

Let:

- "*X*: prior" and "*X*: actual" be denoted Risk 1 and Risk 2 respectively.
- the turnover in £000 for Risk i in year k be V_{ik}.
- the loss per £000 turnover for Risk i in year k be X_{ik}.

(i)   Specify the Bühlmann-Straub model that could be used to estimate the year 8 loss experience for the factory, stating the underlying assumptions.   [5]

In the Bühlmann-Straub model:

- the long-run (hypothetical) losses per £000 turnover can be estimated as the mean of all losses per £000 turnover, $\overline{X}$

- the expected variance of losses per £000 turnover can be estimated as

$$\hat{\varphi} = \frac{\sum_{i=1}^{R} \sum_{k=1}^{N_i} V_{ik} \left(X_{ik} - \overline{X}_i \right)^2}{\sum_{i=1}^{R} (N_i - 1)}$$

- the variance of the hypothetical mean losses per £000 turnover can be estimated as

$$\frac{\sum_{i=1}^{R} V_i \left(\bar{X}_i - \bar{X} \right)^2 - (R-1)\hat{\varphi}}{V - \left(\frac{1}{V} \right) \sum_{i=1}^{R} V_i^2}$$

where

- N_i is the number of years of data for Risk i

- R is the number of risks

- $V = \sum_{i=1}^{R} V_i = \sum_{i=1}^{R} \sum_{k=1}^{N_i} V_{ik}$

- $\bar{X}_i = \frac{1}{V_i} \sum_{k=1}^{N_i} V_{ik} X_{ik}$

- $\bar{X} = \frac{1}{V} \sum_{i=1}^{R} \sum_{k=1}^{N_i} V_{ik} X_{ik}$

The following calculations are available.

	Risk 1	Risk 2	Both risks
$\bar{X}_i$	23.4692	36.5294	
$\bar{X}$			27.6994
$\sum_{k=1}^{N_i} V_{ik} \left(X_{ik} - \bar{X}_i \right)^2$	2,297,024	30,388	

(ii)   Derive the estimated losses from policy year 8.   [7]
[Total 12]

PLEASE TURN OVER

6 A general insurance company writes large commercial property insurance. The underwriter currently determines the premium by selecting an appropriate base rate for the building occupancy (for example, office or restaurant). This rate is then adjusted depending on a number of other rating factors. The base rate and adjustment factors are documented and must be followed.

    (i) List the possible rating factors for commercial property, apart from building occupancy. [4]

The management team is reviewing the current base rates and adjustment factors. An insurance broker has a database of historical claim and sum insured values for all of its clients' properties and has offered to provide information from it.

    (ii) List the data that the company would require from this database. [4]

The refined data is given to an analyst, who uses a statistical package to determine a rating structure. The underwriter states that his base rate for offices is 0.07%, whereas the corresponding rate coming out of the package is 0.05%.

    (iii) Suggest possible reasons for the difference. [7]
                                                        [Total 15]

7 A large Lloyd's syndicate that writes a wide variety of business has been approached by a broker representing Wheely Welaxing Wayfarers (WWW), a company specialising in the organisation of long-distance one-day cycle events.

WWW is interested in obtaining insurance to cover the situation where it is necessary to cancel an event because of adverse weather. Participants (cyclists) are required to register and pay in advance for these events. If cancellation proves necessary, WWW would refund the entry fee to each participant.

    (i) Suggest the benefits that might be provided under this insurance. [2]

    (ii) Suggest sources of data that could be used for pricing this insurance. [3]

    (iii) Describe how the syndicate could determine a price for this insurance. [12]

    (iv) Suggest ways in which the insurance policy could be structured so that claims costs can be reduced. [4]
                                                        [Total 21]

8 A general insurance company is using a GLM to analyse claims on motor breakdown insurance. This insurance covers roadside assistance and recovery of the vehicle in the event of a breakdown.

(i) Recommend and justify an exposure measure that would be used for motor breakdown insurance. [2]

(ii) Describe the claims characteristics of motor breakdown insurance. [4]

(iii) State, for both claims frequency and severity:

    (a) the distribution that the company would be most likely to use for the GLM.

    (b) the prior weight that it would choose. [2]

The company already has a multiplicative GLM with no interaction terms, for each of frequency and severity, using two rating factors, car age and annual mileage. It has combined these to produce a model for the claims cost per unit of exposure, with the relativities shown.

Relativities

Car Age	0–1	2–6	7+
Relativity	0.8	1.0	3.0

Annual Mileage	0–8,000	8,001+
Relativity	0.5	1.0

Exposure

	Car Age		
Annual Mileage	0–1	2–6	7+
0 – 8,000	900	4,700	5,273
8,001 +	25,450	13,025	652

(iv) Suggest reasons why there is not much exposure data for older cars with a high annual mileage. [3]

(v) Derive the one-way tables for each of the two rating factors, giving predicted values to two decimal places and stating any assumptions that you make. [5]

(vi) Explain, using the results from part (v), why the GLM is a better approach to pricing than using either the car age table or the mileage table alone. [4]

[Total 20]

END OF PAPER