INSTITUTE AND FACULTY OF ACTUARIES

EXAMINATION

19 April 2017 (am)

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 of planning and reading time before the start of this examination. You may make separate notes or write on the exam paper but not in your answer booklet. Calculators are not to be used during the reading time. You will 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 11 questions, beginning your answer to each question on a new page.*

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 Describe:

(a) first loss scales (also known as exposure curves).
(b) increased limit factors.

[4]

2 (i) State the key features of a reinstatement premium. [3]

A reinsurance company wants to determine the aggregate claim cost for a particular class of business under different approaches to reinstatements.

The following table sets out the expected aggregate claim costs for this class of business, assuming different aggregate limits. The excess is $1,000,000 in all cases.

Aggregate Limit *($)*	*Expected Aggregate Claim Cost* *($)*
1,000,000	350,000
2,000,000	525,000
3,000,000	976,000
4,000,000	1,090,000
Unlimited	1,289,000

(ii) Calculate the expected aggregate claim cost for the reinsurance layer of $1,000,000 excess of $1,000,000, under the following options:

(a) unlimited free reinstatements with $1,000,000 annual aggregate deductible

(b) one free reinstatement

(c) one free reinstatement with $1,000,000 annual aggregate deductible

[3]
[Total 6]

3 (i) Describe situations under which a nil claim might occur in private motor insurance. [2]

A pricing actuary is trying to fit a distribution to average claim severity by analysing historical claims.

(ii) Suggest advantages and disadvantages of excluding nil claims from the historic data. [4]
[Total 6]

4 A pricing actuary is fitting a generalised linear model (GLM) to the average cost per claim for a certain peril. The claims data have been developed and trended, and checks on the accuracy of the data have been performed with no issues found.

Describe the further main data analyses the pricing actuary would usually carry out prior to fitting the GLM, including the purposes of each. [6]

5 A motor fleet account with 1,000 vehicles has approached a general insurance company for a premium quote.

Based on the company's overall portfolio experience, the expected claim frequency per vehicle-year is 20% and the expected claim severity is £20,000. Based on the data submitted for quotation, the risk premium per vehicle-year is estimated to be £3,200 based on 100 claims in the last year. The number of claims is assumed to follow a Poisson distribution while the claim severity is assumed to follow the exponential distribution.

It can be assumed that there is a 90% probability of the true risk premium being within 10% of the true mean.

Calculate the risk premium for this account using Classical credibility theory, showing all workings and stating any other assumptions made. [6]

6 A general insurance company has been writing motor insurance for fleets of taxis for a number of years. The product has been generally unprofitable in recent years. This has resulted in sharp increases in premiums, increases in excesses and stricter terms and conditions for all policyholders.

The insurer is proposing that its policyholders will have the option of buying a new type of policy. Under this new policy, the policyholders are guaranteed to be allowed to renew their policy each year for three years. The terms of the policy will not change, and rates are guaranteed to increase or decrease only in line with the claims experience of the fleet.

Suggest, with reasons, the conditions the insurer might put into the policy wording in order to reduce the chances of making a loss. [8]

7 The numbers and amounts of claims have been collected by a general insurance company for the last four years. It is believed that the number of claims incurred follows a Poisson distribution, and the severity of claims follows a gamma distribution.

Explain how Monte Carlo simulation could be used to model the aggregate claim amount distribution. [10]

8 (i) Describe the cover provided by employers' liability insurance. [2]

A general insurance company provides employers' liability insurance to a paint manufacturer. The pricing actuary intends to use a frequency-severity approach to rate the product.

(ii) Suggest, with reasons, adjustments to the claim data that might be appropriate in order to perform this exercise. [5]

The broker placing the business has informed the insurance company that the paint manufacturer wishes to reduce the premium by paying an excess on each claim. The paint manufacturer has suggested an excess of €5,000, but the broker would like to know how the premium would change if the excess was €10,000.

(iii) Explain how the pricing actuary should determine the difference in premium between these two excess levels. [3]

[Total 10]

9 The generalised linear model (GLM) may be expressed as:

$$Y_i = g^{-1}\left(\sum_{j=1}^{k} X_{ij}\beta_j + \xi_i\right) + \varepsilon_i$$

(i) Express the above in matrix form, and give a definition for each term. [4]

A pricing actuary has fitted a GLM with a binomial error structure to model the probability that customers renew their policy at the end of the policy year.

The fitted model has two factors: premium change at renewal and geographical area. Each of these factors has three levels, as shown below, along with the linear predictor estimates for each level.

Premium change at renewal	*Linear predictor estimates*
< –5%	–1.5277
≥ –5% and ≤ + 5%	0.0000
> +5%	2.0336

Geographical area	*Linear predictor estimates*
A	0.0000
B	0.9734
C	1.4483

The linear predictor for the base level is 1.9465.

(ii) Explain the concept of the base level in the context of the GLM described above. [1]

(iii) Determine the probability of renewal for a policyholder in geographical area B whose premium change at renewal is –7%. [3]

(iv) Suggest ways in which a customer retention model could be used by the insurance company. [4]

[Total 12]

10 A general insurance company writing product liability cover has been asked to quote for a pharmaceutical company which develops drugs. The following information is available:

Table 1: Unprojected historical incurred claims amounts (£000) for the last five accident years

Accident year	*Third party death or bodily injury*	*Third party property damage*	*Legal expenses*	*Product recall*
Year 1	1,250	15	10	0
Year 2	1,040	13	9	0
Year 3	1,120	11	17	24
Year 4	820	8	9	0
Year 5	760	8	11	0

Table 2: The ratios of incurred claims to ultimate projected claims

	Years of development				
	1	*2*	*3*	*4*	*5*
Third party claims	45%	50%	65%	80%	95%
Product recall	85%	92%	98%	105%	100%
Legal expenses	60%	70%	85%	95%	100%

The exposure measure used is turnover, which was £30m in Year 1. Growth in turnover has been 5% per annum, except in the year following the product recall when there was no growth.

Third party death or bodily injury claims and legal expenses have both inflated at 6% per annum for the past five years. Product recall costs have deflated at 2% per annum over Years 4 and 5, with no inflation prior to that. There was a one-off increase in third party property damage costs of 2.5% at the start of Year 4 following new legislation.

(i) Estimate the expected claims cost in Year 6 using the data provided, stating any assumptions made and showing all workings. [12]

The syndicate prices business to a target combined operating ratio of 95%, where the combined operating ratio is defined as:

$$\frac{\text{expected claims cost + expenses}}{\text{net (of tax) premium}}.$$

Administrative expenses are 20% of the net (of tax) premium, and claims handling expenses are 12.5% of the expected claims cost. Commission may be ignored.

(ii) Determine the profit the insurance company expects to make on this policy. [3]

[Total 15]

11 (i) Describe briefly the features of facultative reinsurance. [2]

Company A is a large general insurance company that only writes commercial property insurance.

(ii) Describe the reinsurance cover that Company A is likely to have in place. [6]

The finance director of Company A previously worked for a competitor, Company B. Both companies write approximately $100m of commercial property business each year.

The director has reviewed the reinsurance cover in place for the commercial property book in Company A and has found that the structure is not the same as that used by Company B.

(iii) Suggest reasons why Company A may not have the same reinsurance needs as Company B. [9]

[Total 17]

END OF PAPER