

INSTITUTE AND FACULTY OF ACTUARIES



EXAMINATION

26 April 2018 (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 must not start writing your answers in the booklet until instructed to do so by the supervisor.*
3. *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.*
4. *Mark allocations are shown in brackets.*
5. *Attempt all nine 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** An actuary is undertaking a pricing exercise to implement new premium rates on 1 January 2018.

Explain why she is unlikely to use data from claims and policies as at 31 December 2017. [5]

- 2** A general insurance company selling commercial property insurance undertakes an annual rating exercise to assess the competitiveness and profitability of its rates.

Before undertaking such a rating exercise, a pricing actuary performs an analysis to compare actual claims experience over the previous 12 months to what was expected at the previous review. The analysis shows that claims experience has been considerably better than expected; the underwriter has thus proposed reducing rates.

Discuss the underwriter's proposal. [8]

- 3** Company A is a large commercial property insurer that insures large commercial properties in various countries. It is currently reviewing its reinsurance needs.

- (i) State the factors that might influence Company A's decision in purchasing reinsurance. [6]

Company A decides to purchase a \$30m xs \$20m layer of risk excess of loss. All recoveries are paid in US dollars (\$), and losses incurred in pounds (£) are converted at a fixed exchange rate of £1 = \$1.25 for the purposes of calculating recovery amounts.

The insurer incurs a loss of £32m.

- (ii) Calculate (in \$) the recoveries to which the insurer is entitled from this excess of loss programme. [1]

When the insurer pays the claim, the exchange rate is £1 = \$1.35. Company A reports its financial results in £ only.

- (iii) Comment on the effectiveness of this reinsurance programme in terms of the above recovery. [2]

[Total 9]

- 4 In a generalised linear model, the linear predictor for a set of observations may be written in matrix form as

$$\eta = X\beta + \varepsilon$$

A trainee actuary is fitting a model to some pet insurance claims data with three factors:

- *pre-existing medical condition* – Yes or No
- *size of dog* – small, medium or large
- *age of dog* – 1–20 years

Pre-existing medical condition and *size of dog* will be fitted as categorical factors, whilst *age of dog* will be fitted by a quadratic polynomial.

Four of the observations are shown in the table below

<i>Observation</i>	<i>Pre-existing medical condition</i>	<i>Size of dog</i>	<i>Age of dog</i>
1	No	large	8
2	No	small	2
3	No	small	11
4	Yes	medium	5

- (i) Construct the matrix X for the four observations above, stating clearly what each of the columns in X represents. [5]

The trainee actuary has fitted two generalised linear models using the factors above and has obtained the following results:

<i>Model</i>	<i>Factors fitted</i>	<i>Deviance (unscaled)</i>
1	<i>pre-existing medical condition, age of dog</i>	45.5766
2	<i>pre-existing medical condition, size of dog, age of dog</i>	41.3718

Scale parameter = 0.36

- (ii) Determine, using a χ^2 test, whether the factor *size of dog* is statistically significant at the 5% level of significance. [5]
[Total 10]

- 5** A northern European country experiences frequent rain and sometimes hail. Although the risk of damaging hail in the country is generally very low, there have been three severe hail events historically where there have been large sized hailstones causing motor car damage.

A large general insurance company writing motor insurance in the country wants to design a hail catastrophe model that it can use for pricing.

- (i) List six other perils that a catastrophe model may be used for. [3]
 - (ii) Suggest how the event module can be created to model hail risk. [4]
 - (iii) Suggest the primary data sources used as input for the other modules in this hail catastrophe model. [3]
- [Total 10]

- 6** A general insurance company has been asked to quote for a professional indemnity policy. The pricing actuary will use a frequency-severity approach to calculate the risk premium. The broker offering the business has provided 10 years of historical claims data.

- (i) Outline other information or data that the pricing actuary is likely to need in order to derive the claims severity distribution. [5]

The pricing actuary wants to fit a lognormal distribution to the claims severity. The average cost of claims is \$5.96m and the standard deviation is \$1.04m.

- (ii) Calculate the parameters of the fitted lognormal distribution, using the method of moments. [4]
 - (iii) Describe how the pricing actuary could check whether the lognormal distribution is a good fit. [4]
- [Total 13]

- 7** A reinsurance company is pricing a quota share treaty for a particular line of business, with a ceding commission of 25% and no profit commission.

- (i) Define ceding commission. [1]
 - (ii) State the main factors that would determine the level of ceding commission. [2]
 - (iii) Describe how to assess the likely overall loss ratio for the treaty. [8]
 - (iv) Describe how to determine the level of ceding commission for the treaty. [2]
- [Total 13]

8 A general insurance company sells personal motor insurance in a small country.

Property damage claims amongst the company's insured drivers follow a claim size distribution X . The standard for full credibility when estimating the average property damage claim size is $n_X = 1,000$ claims for a given probability P and tolerance k .

Liability claims follow a distribution Y , where Y has a standard deviation that is twice as large as that for distribution X , and a mean that is five times that for X .

- (i) Calculate the standard for full credibility for severity of liability claims, assuming that the same P and k are required for both claim types. [4]

The insurer has recently been the first to launch a personal driverless car insurance policy. The policy is designed for consumers who have driverless features in their cars, such as self-parking, as well as those who own a car with autopilot features.

- (ii) Outline the additional cover that such a policy could provide, compared to a standard motor insurance policy. [2]

The government of that country is currently trialling fully driverless cars and expects them to be made available to the public by the year 2020. It has therefore introduced a law that all cars should be driverless by the year 2025.

- (iii) Assess the potential impacts on insurers of the new legislation on driverless cars. [8]
[Total 14]

9 (i) State two key advantages to an insurer of each of the following:

(a) binding authority

(b) profit commission

[2]

A Lloyd's syndicate entered into a four-year agreement, starting in 2014, with a third party: a "coverholder". Under the terms of this agreement, the coverholder sells employers' liability policies on behalf of the syndicate.

All claims and policy administration are handled by the coverholder, who provides the syndicate with aggregated data in the form of regular bordereaux.

(ii) Suggest potential problems that could arise for the syndicate as a result of the claims and policy information being handled by the coverholder and provided to the syndicate in aggregated form. [5]

The syndicate has agreed to pay the coverholder a profit commission for each underwriting year, equal to 8% of the written premium per year if the ultimate loss ratio for that year falls below 75%.

The total commission for the four-year period is calculated and paid at the end of the four-year agreement (i.e. the end of 2017).

A pricing actuary working for the syndicate has obtained the following data from the coverholder at the end of 2017:

<i>Underwriting year</i>	<i>Written premium</i>	<i>Reported claims</i>
2014	£20.2m	£10.6m
2015	£25.3m	£9.2m
2016	£30.3m	£2.7m
2017	£35.4m	£0.7m

The pricing actuary has also obtained the following claims development pattern based on a benchmark of a similar, larger book of business written by the insurer.

<i>Underwriting year</i>	<i>% developed</i>
2014	65%
2015	48%
2016	12%
2017	3%

- (iii) Calculate, using the above pattern, the profit commission for the underwriting years 2014–2017 inclusive. [5]
- (iv) Discuss the potential issues relating to the profit commission arrangement from the syndicate’s perspective, including how these issues could be addressed. [6]
- [Total 18]

END OF PAPER