INSTITUTE AND FACULTY OF ACTUARIES

19 October 2016

Module 5: Models and Audit Trails

Time allowed: 3 hours + 15 minutes reading time

INSTRUCTIONS TO THE CANDIDATE

1. You have 15 minutes reading time at 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 3 hours to complete the paper.

2. You must build your submission from the beginning and not use an imported e-template.

Your file names must include your ARN, the name of the document and the paper sat (e.g. 9000000-Summary) and each file should contain your ARN as a header or footer.

Please note that the content of this booklet is confidential and students are not to discuss or reveal the contents under any circumstances nor are they to be used in a further attempt at the exam.

If you encounter any issues during the examination please contact the Online Education team at online_exams@actuaries.org.uk T. 0044 (0) 1865 268 255

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Background

A magazine publishing company has asked your employer to assist them in calculating their expected profits from the sale of a new monthly actuarial magazine during the first year of publication.

The magazine is to be sold on a subscriptions basis with each subscription lasting exactly one year, i.e. 12 issues. However, subscribers will be given the option to cancel their subscriptions at any time during the year and receive a refund in respect of outstanding magazine issues. The company has some concerns about the extent to which refund payments and administration costs incurred in processing any subscription cancellations may affect profits.

The manager of the publishing company is particularly interested in understanding the probability that the profit on the new magazine is greater than £50,000 as he will receive a bonus payment of 10% of any profits in excess of £50,000 at the end of the year.

Based on their previous magazine cancellation experience your manager has simulated 100 monthly subscription cancellation rates for each of the 12 months in the subscription period of the new magazine (i.e. 1,200 in total). For each month, the rate shown represents the proportion of active subscribers at the start of the month that cancel their subscription during that month.

You have been provided with data for the 1,200 rates showing 100 simulations as rows and the 12 months as columns.

In addition, you have been provided with the following information:

- 5,000 subscriptions are assumed to be sold at the start of the year, each at a price of £24 for 12 issues.

- No new subscriptions will be sold during the year.

- Subscriber refunds are calculated as the subscription price multiplied by the number of complete subscription months remaining in the year divided by the total number of months (i.e. 12).

- The expected administration cost of processing a cancellation is £1.50 per cancellation.

- The annual cost of producing the magazines, incurred at the start of the year, is £15,000.

- Total expenditure is calculated as the sum of production costs, refund payments and administration costs.

- Total profit at the end of the year is calculated as the difference between the total income and the total expenditure for each projection.

In addition to the checks specified in part (i) you are required to carry out checks throughout your calculations in order to validate the results. In addition to the marks shown for questions (i) to (xi) there are 7 marks available for reasonableness checks and automated checks.

PLEASE TURN OVER

PART 1

(i) Perform a range of checks on the simulated subscription cancellation data provided. For example, check there are no negative cancellation rates, and comment on whether the data appears to be sensible. You are not required to make any alterations to the data. [5]

(ii) Set up a spreadsheet to include separate worksheets for the parameters, subscription projections, expense projections, profit calculations and any other worksheets as required. [2]

(iii) In the subscription projections worksheet, use the cancellation rate data provided to produce 100 sets of projections to determine the number of active subscribers at the end of each of the 12 months, starting with 5,000 at the start of month 1.

In the same worksheet show, in a separate table, the total number of active subscribers at the end of the year and the total number of cancellations during the year, for each simulation. [4]

(iv) In the projections worksheet, for each month of the active subscriber projection, calculate for each of the 100 projections:

(a) the maximum value
(b) the minimum value
(c) the median value
(d) the mean value

[2]

(v) Construct a chart to illustrate the data from part (iv) and show this in a separate worksheet. [3]

(vi) In the expense projections worksheet, calculate for each of the 100 projections:

(a) the expected monthly subscriber refund
(b) the expected monthly admin cost of processing cancellations
(c) the expected monthly total cost of processing cancellations

[6]

(vii) For each month of the expense projection, calculate for each of the 100 projections:

(a) the maximum value
(b) the minimum value
(c) the median value
(d) the mean value

[2]

(viii) Construct a chart to illustrate the data from part (vii) and show this in a separate worksheet. [3]

(ix) In the profit calculations worksheet calculate the total income from active subscribers at the start of the year, and therefore determine the expected profit for each of the 100 projections. [2]

(x)   In the profit calculations worksheet calculate the probability that new magazine will make at least £50,000 of profit. [2]

(xi) In the profit calculations worksheet, calculate:

  (a)   the manager's expected bonus payment
  (b)   minimum bonus payment
  (c)   maximum bonus payment

[4]

Marks available for spreadsheet model:

Model accuracy, completeness and good modelling techniques and data validation of initial data (part (i)) **[35]**

Checks not already mentioned in the main question **[7]**

[Sub-total 42]

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PART 2

You need to document all your work in an audit trail so that a fellow Analyst student (with similar experience to yourself) could:

- peer review and check your model.
- continue to work on your model, and
- run your model on different assumptions, or extend your model to allow for extra data fields or scenarios.

Your audit trail should include the following aspects:

- the purpose of the model
- any assumptions you have made
- any limitations of your assumptions or of the model
- your methodology, i.e. a description of what you have done, and how and where in the model you have done it
- an explanation of all the checks you have performed
- a description of the charts you have produced

The audit trail can be in a separate worksheet within your Excel model or in a separate Word document.

Marks available for audit trail:

Audit approach

- **Fellow Analyst student can review, check and modify the model** **[8]**
- **Written in clear English** **[4]**
- **Written in a logical order** **[3]**

Audit content

- **All model steps accurately covered** **[20]**
- **All checks clearly recorded** **[9]**
- **All steps clearly explained** **[9]**
- **Clear signposting and labelling** **[5]**

[Sub-total 58]

[Total 100]

END OF PAPER