CERTIFIED ACTUARIAL ANALYST GLOBAL

10 May 2017

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

This page has been left blank.

Background

An actuary, Alex, is modelling the behaviour of an investment asset. She wishes to use a simple projection to simulate the behaviour of the asset over the next 10 years.

Alex has written a program that randomly generates some annual returns for the asset and is in the process of testing this. She has asked you to help by analysing a small subset of the output. The model does not allow the value of the asset to become negative. However, there is no limit to the amount by which the asset can increase in value over a year.

You have been provided with 100 sets of 10 annual asset returns which are to be used to produce 100 sets of 10-year projections. The value of the asset starts at £10,000 at the beginning of year 1 and will change in value by the annual asset return each year for years 1 to 10.

PART 1

Alex has asked you to construct a spreadsheet model for projecting the value of the asset. You are required to carry out checks throughout your calculations in order to validate the results. In addition to the marks awarded for parts (i) to (xiii) below there are 8 marks available for reasonableness checks and automated checks.

(i)   Set up a spreadsheet to include separate worksheets for the data inputs, the asset value projection calculations, and any other worksheets for any further calculations that will be required. [2]

(ii)   Carry out a range of checks on the data provided and comment on whether it appears to be sensible. You are not required to make any alterations to the data. [5]

(iii)   Identify the parameters for the model and set these out in the parameters worksheet. [1]

(iv)   In the projection worksheet, use the data to produce 100 sets of 10-year projections. Show the value of the asset at the end of each year. [4]

(v)   Using a new worksheet, calculate the total return over the whole 10-year period for each of the 100 projections. [1]

(vi)   Using the same worksheet, use the results from part (v) to calculate the average annual compound return for each of the 100 projections. [1]

(vii)   Using the same worksheet, for each year of the projection, calculate the following values for the 100 projections:

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

      [4]

(viii) Still using the same worksheet, for each year of the projection, calculate for the 100 projections:

    (a)   the 25th percentile (defined as 0.25 * 25th smallest value, plus 0.75 * 26th smallest value)

    (b)   the 75th percentile (0.75 * 75th smallest value, plus 0.25 * 76th smallest value)

    [4]

Hint: You can use the SMALL function SMALL(range, n) to find the nth smallest number in a range.

(ix) Construct a line chart to show the median, the 25th percentile and the 75th percentile values for each year, as determined in parts (vii)(c), (viii)(a) and (viii)(b). [4]

(x) Determine the proportion of projections that have a value at the end of the period that is less than the starting value. [2]

(xi) For those loss-making projections in part (x), calculate the average monetary amount of the loss over the 10 year period. [2]

(xii) Determine how many of the projections from part (vi) have annualised returns over the 10 years in each of these ranges:

$$-10\% \le x < -5\%$$
$$-5\% \le x < 0\%$$
$$0\% \le x < 5\%$$
$$5\% \le x < 10\%$$
$$10\% \le x < 15\%$$
$$15\% \le x < 20\%$$
$$20\% \le x < 25\%$$

    [4]

(xiii) Construct a column chart to illustrate the results from part (xii) and show this in a separate worksheet. [4]

Marks available for spreadsheet model:

Model accuracy, completeness and good modelling techniques   **[38]**
Reasonableness and automated checks, other than in part (ii)   **[8]**

[Sub-total 46]

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** [19]
- **All checks clearly recorded** [8]
- **All steps clearly explained** [7]
- **Clear signposting and labelling** [5]

[Sub-total 54]

[Total 100]

END OF PAPER