CAA GLOBAL

EXAMINATION

1 May 2019 (am)

Module 5: Models and Audit Trails

Time allowed: Three hours and fifteen minutes

INSTRUCTIONS TO THE CANDIDATE

1. *You are given this question paper and an Excel file.*

2. *Mark allocations are shown in brackets.*

3. *Attempt all questions. Questions are to be answered as per "exam requirements".*

If you encounter any issues during the examination, please contact the Examinations Team at T. +44 (0) 1865 268 255

Background

Jeremy Owens is 45 years old exactly and plans to retire on his 65th birthday. He currently has £10,000 in his pension fund and hopes to accumulate sufficient money by the time he retires to take an income of £15,000 per year from his 65th birthday until he reaches his 90th birthday.

His pension fund is currently invested 50% in the fund 'Pension Accumulation I' ('PAI') and 50% in the fund 'Pension Accumulation II' ('PAII').

On retirement his accumulated pension funds will all be switched in to the fund 'Drawdown I' (DDI).

You are an actuarial analyst working for the financial advice firm HH Wealth Management Ltd ('HH'). Jeremy has come to HH for advice on how much he should contribute to his pension fund annually to meet his target (i.e. what are the minimum contributions required so that he has sufficient funds to provide an annual income of £15,000 from age 65 exactly up to and including age 89, with the fund being exhausted on his 90th birthday). Your manager has asked you to perform some modelling to calculate the contributions required.

A student actuary at your firm has provided projected monthly investment returns (net of all charges) for each of the three funds, assuming the following probability distributions:

- Pension Accumulation I monthly returns: Normal distribution with a mean of 0.4% and standard deviation of 0.05%
- Pension Accumulation II monthly returns: Normal distribution with a mean of 0.95% and standard deviation of 0.2%
- Drawdown I monthly returns: Normal distribution with a mean of 0.3% and standard deviation of 0.04%

The data consists of:

- 240 monthly investment returns for funds PAI and PAII, covering the 20 year period when Jeremy is aged 45 to 65
- 300 monthly returns for fund DDI, covering the 25 year period when Jeremy is aged 65 to 90.

The student has used the monthly investment returns to calculate the annual investment returns for each fund. You will use these annual investment returns in your fund projections.

You will also need to calculate the impact on Jeremy's income under a 'poor performance' scenario to illustrate the uncertainty in the projected returns.

Finally, you will need to check the student actuary's annual return calculations.

Details of the work you are required to carry out are provided in Part 1 below. Part 2 explains what should be included in your audit trail.

Additional information

When performing the calculations you should note the following:

- You may use the abbreviations PAI, PAII and DDI for the funds named Pension Accumulation I, Pension Accumulation II and Drawdown I.
- In retirement, Jeremy will withdraw his annual income from the fund at the start of each year. He will make 25 withdrawals in total.
- While saving, Jeremy makes his contribution to the fund at the start of each year. He will make 20 contributions in total. His first contribution will be made immediately, i.e. at age 45. Each contribution will be split equally so that 50% is invested in fund PAI and 50% in fund PAII.
- Note, that in calculating the contributions required you will have to work backwards. You will first have to determine the required size of the fund at retirement that will provide the income Jeremy needs and then calculate what contributions he will need to make to reach that size of fund.
- All figures are in today's values. You do NOT need to make any adjustment to the calculations for inflation.
- You should ignore mortality, missed payments and lapses (i.e. assume all payments are certain).
- You should ignore any expenses or other charges.
- You can assume Jeremy does not miss any payments.

PART 1

(i) Construct a spreadsheet model to include separate worksheets for the data, parameters, fund values during drawdown, fund values during accumulation, poor performance calculations, charts, annual return checks, and any other worksheets as required. [2]

(ii) Carry out a range of data checks on the projected **monthly** investment return data provided. You are NOT required to make any alterations to the data. [5]

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

(iv) Construct a projection of the fund value up to and including age 90 in the 'fund values during drawdown' worksheet, assuming a fund value of £300,000 at age 65. You should project in annual time steps, using the **annual** investment returns provided by the student actuary. The fund value at the end of each year will depend on the fund value at the start of the year, the withdrawal amount, and the annual return only. [4]

(v) Determine the minimum size of fund required at age 65 that will provide Jeremy with an annual income of £15,000 each year up to and including age 89 (so that the final fund value at age 90 is zero). Do this in the same worksheet as part (iv) above, using the Goal Seek function in Excel (see the information in the additional guidance section if required) or otherwise (for example, by trial and error). Note that the calculation of this fund value at age 65 will override the value of £300,000 initially assumed for part (iv). [3]

(vi) Construct a projection of the fund value up to and including age 65, in the 'fund values during accumulation worksheet', assuming an annual contribution of £2,500. [6]

(vii) Determine the minimum annual contribution required such that the fund value at age 65 is equal to the value calculated in part (v). Do this in the same worksheet as part (vi), using the Goal Seek function in Excel (see the information in the additional guidance section if required) or otherwise (for example, by trial and error). Note that the calculation of this annual contribution amount will override the value of £2,500 initially assumed for part (vi). [3]

(viii) Calculate what annual income Jeremy could take up to and including age 89 (so that the final fund value at age 90 is zero), if the fund value at age 65 was £200,000, in the 'poor performance calculations' worksheet. [3]

(ix) Construct a chart to show how the total fund value changes during the accumulation phase, from age 45 to 65. On the same chart show the total accumulated value in the PAI fund and the total accumulated value in the PAII fund over the period. [3]

(x) Construct a chart to show how the fund value progresses during the drawdown phase, from age 65 to 90. On the same chart, show how the fund value progresses under the poor performance scenario, as calculated in part (viii). [3]

(xi) In the 'annual returns checks' worksheet:

(a) Calculate the annual returns for each of the three funds from the monthly investment returns.
Hint: See the 'Annual Return' section of the additional guidance.

(b) Compare the results from (a) with the annual returns calculated by the student actuary.

[5]

Marks available for spreadsheet model:

Model accuracy, completeness and good modelling techniques and data validation of initial data (part (ii)) [38]

Reasonableness and automated checks, other than in part (ii) [4]

[Sub-total 42]

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.
- 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
- a description of the data used
- 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 to calculate the required values, and how and where in the model you have done it
- an explanation of all the checks you have performed
- your key results
- a description of the charts you have produced.

The audit trail should be 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 included [21]
- All checks clearly shown [8]
- All steps clearly explained [8]
- Clear signposting and labelling [6]

[Sub-total 58]

[Total 100]

Additional guidance

Annual Return

The annual return on a fund can be calculated by combining the monthly returns using the following relationship:

$$\left(1 + i_x\right) = \left(1 + i_{m1}\right) \times \left(1 + i_{m2}\right) \times \left(1 + i_{m3}\right) \ldots \times \left(1 + i_{m12}\right)$$

where

i_x is the annual return for year x
i_{mj} is the monthly return for month j (in the relevant year)

Useful Excel functions:
The Goal Seek functionality in Excel can be used to determine the input values needed to achieve a specific goal. In the Data Tools group of the Data menu tab, Goal Seek may be found in the What-If Analysis menu. This functionality will allow you to set a chosen output cell to a fixed value you specify by altering the input value in a specified cell. The function will then continuously change the input value until the output value matches the value you specified.

END OF PAPER