CAA GLOBAL

EXAMINATION

16 October 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

The performance of the Maths department at University Z was rated as 'poor' in a recent inspection. Professor Kingston has recently joined the department and plans to improve performance with new teaching methods.

You are a research assistant at the University. The Professor is measuring the effectiveness of his improvement plans by testing 100 students at two week intervals. He has provided data showing the age and gender of each student and the test mark (out of 100) for the last 12 consecutive tests, and asked you to analyse them. The data on the age of the students is from an old system with known errors, so the Professor is keen for you to look at the distribution of the ages to see if they look reasonable.

Note that each test is performed by the same 100 students.

The pass mark is set for each test by calculating the median test mark and rounding up to the nearest whole number. This means that the pass rate, i.e. the proportion of students that pass the test, is 50%. Professor Kingston is hoping that the pass mark will increase linearly from 40 on the first test to 66 on the final one.

As an incentive to study harder, the Professor decides to offer a prize to any student whose geometric mean percentage increase per test across all 12 tests is greater than 10%.

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 assume the following:

- A student passes if their test mark is greater than or equal to the pass mark.
- The age of each student remains constant across all tests.
- All ages are integers.
- The minimum and maximum possible test marks are 0 and 100 respectively.

PART 1

(i) Construct a spreadsheet model to include separate worksheets for the data, parameters, data statistics, test mark analysis, prize calculations and any other worksheets as required. [2]

(ii) Carry out a range of checks on the data provided and comment on whether the data appears to be sensible, given the information which has been 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' worksheet. [1]

(iv) Calculate the mean mark for male students and the mean mark for female students across all of the 12 tests in the 'data statistics' worksheet. You are not required to calculate separate means for each test.
Note: You can start by calculating the mean mark across the 12 tests for each individual student. [3]

(v) Plot your results from part (iv) on a suitable chart. [2]

(vi) Calculate the maximum and minimum student age in the same 'data statistics' worksheet. Then calculate the proportion of students in each three year age band, using the following ranges: less than or equal to 20, 21–23, 24–26, 27–29, 30–32, 33+. [4]

(vii) Plot your results from part (vi) on a suitable chart. [3]

(viii) Calculate the mean and median test mark and the standard deviation of the test marks for each of the 12 tests for all students in the 'test mark analysis' worksheet.
Note: You can calculate the standard deviation from first principles or using the Excel function STDEV.P. [4]

(ix) Determine the pass mark for each of the 12 tests and check that the pass rate is 50% in the same 'test mark analysis' worksheet.
Note: See the additional guidance section. [5]

(x) Determine the pass marks the Professor hoped to see for each test in the same 'test mark analysis' worksheet. [2]

(xi) Plot your results from parts (ix) and (x) together on a suitable chart. [2]

(xii) In the 'prize calculations' worksheet:

(a) Determine the geometric mean percentage increase in mark per test for each student.

(b) Determine how many students receive a prize.

Note: See the additional guidance section.

[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 recorded [8]
- All steps clearly explained [8]
- Clear signposting and labelling [6]

[Sub-total 58]

[Total 100]

Additional guidance

Geometric mean percentage increase in test mark

The geometric mean is calculated using the product of a set of values, unlike the arithmetic mean which uses the sum.

To calculate the geometric mean percentage increase in mark per test, first calculate the total increase across all tests using the following formula:

$$\left(1 + i_{total}\right) = \frac{Final\ test\ mark}{First\ \ test\ \ mark}$$

Where i_{total} is the total percentage increase in test mark.

The geometric mean increase per test can then be calculated using the following relationship:

$$\left(1 + i_{mean}\right)^{\left(N\,-\,1\right)} = \left(1 + i_{total}\right)$$

Where i_{mean} is geometric mean percentage increase in test mark per test and N is the number of tests.

Calculating how many students pass

For a given pass mark, p, you can calculate the number of students that have passed using the following Excel formula:

=COUNTIF(RANGE, “>=” & p)

Where RANGE is the list of pass marks for a particular test.

END OF PAPER