INSTITUTE AND FACULTY OF ACTUARIES

EXAMINATION BOOKLET

2015

CA2: Model Documentation, Analysis and Reporting

Paper 1

DO NOT OPEN UNTIL INSTRUCTED TO DO SO.

Examination instructions

1. You should periodically save all the files you are working on onto the PC's hard drive.

    You will be given instructions for submitting your work at the end of the examination.

    It is your responsibility to ensure your work is adequately saved.

2. Ensure that your spreadsheet, audit trail (if separate) and summary are clearly labelled and your filenames include your ARN **e.g. Summary_ARN.docx**

    Please note that you should use your ARN and NOT your name on all of the material you submit for marking.

    The work you submit MUST be saved in Microsoft 2007 format, i.e. using docx (Word) or xlsx (Excel) file extensions. Do not embed documents in your spreadsheet.

    Each file should contain your ARN as a header or footer on at least one page.

3. You must submit your spreadsheet model, audit trail and summary by the end of the stated exam time. By submitting your files you are confirming that all material is entirely your own work and you wish this to be taken into account for this assessment.

    It is your responsibility to ensure that a complete electronic copy of your work is submitted.

    You must stop working after this time as failure to do so could result in your exam not being marked.

4. You must also hand in this examination booklet, together with any other materials from the examination. This includes handing in any planning or rough notes that you have made during the examination, and any print-outs that you have done of your work.

Professional behaviour is mandatory and no material relating to the exam may be taken from the exam room nor disclosed or discussed with others.

Failure to comply with this will be deemed to be a breach of examination regulations and may result in disciplinary action.

This booklet contains an insert with additional guidance. Data has been provided electronically.

You should use the first 15 minutes of the exam as reading and planning time.

This page has been left blank.

Exam Requirements

1. Read the background document, which describes the scenarios that need to be modelled and documented for this project. Technical assistance for the modelling work, should you require it, can be found in the additional guidance contained in this booklet. *No penalty marks will be deducted for the use of this guidance.*

2. Construct a spreadsheet model that produces the following calculations and charts. You should ensure that your spreadsheet contains appropriate self-checks and that you have performed robust reasonableness checks at each stage of your calculations.

    (i) Perform appropriate checks on the data that have been provided. If necessary, make and document any changes to the data. **[10]**

    (ii) Illustrate the claims data (or amended data if changed) using a suitable chart. **[3]**

    (iii) Use the provided benchmark mortality table and the exposure data to determine the expected claim amounts during the investigation period for each age band and in total. **[2]**

    (iv) Calculate the ratio of actual claim amounts against expected claim amounts (A/E) for each age band and also at the total portfolio level. **[3]**

    (v) Illustrate your results using a suitable chart, showing A/E at both the age band and at the total portfolio levels. **[3]**

    (vi) Use the calculated A/E ratio at the total portfolio level to adjust the mortality table as required and hence determine the assurance factors and annuity factors that are required to calculate the premium rates for each age band. **[3]**

    (vii) Determine the level annual premium rate for each age band, using these factors. **[2]**

    (viii) Illustrate your results using a suitable chart. **[3]**

    (ix) Determine the overall weighted average premium rate and the total new business premium expected in 2016. **[2]**

    Marks available for spreadsheet model and checks:

    Accurate completion of above modelling steps and data checks **[31]**
    Demonstration of good modelling technique and practice **[7]**
    Other (non-data) checks **[7]**

    [Sub-total 45]

3. Produce an audit trail for your spreadsheet model which includes the following aspects:

- purpose of the model

- data and assumptions used

- methodology, i.e. description of how each calculation stage in the model has been produced

- explanation of any checks performed

You should ensure that your audit trail is suitable for both a senior actuary, who has been asked to approve your work, and a fellow student, who has been asked to peer review and correct your model, or to continue work on it, or to use it again for a similar purpose in the future.

Marks available for audit trail:

Audit approach

- **Fellow student can review and check methods used in the model** [8]
- **Senior actuary can scrutinise and understand what has been done** [8]
- **Written in clear English** [4]
- **Written in a logical order** [3]

Audit content

- **All steps clearly explained** [7]
- **Clear signposting included throughout** [5]
- **Statement of assumptions made** [5]
- **All model steps accurately covered** [15]

[Sub-total 55]

[Total 100]

Background

You are an actuarial student working for an insurance company, Life Co, in the country of Actuaria.

Life Co is a growing life insurance company that writes various types of business, including term assurance policies. Term assurance policies are life insurance policies which pay out a lump sum, known as the sum assured, if the policyholder dies during the term of the policy.

All term assurance policies that have been issued by Life Co have a term of 10 years and so are referred to as T-10 policies.

The T-10 policies have a maximum sum assured of $10,000 and can be taken out on an individual's birthday from age 30 up to age 50 inclusive. The policy expires the day before their birthday in 10 years' time.

If an individual dies during the term of the policy, the sum assured will be paid at the end of the policy year in which the death occurred.

Life Co is currently considering its business plan for 2016 and wants to determine the level annual premium rates which should be charged for T-10 policies in 2016.

These premium rates are determined by first calculating the level annual premium (payable for 10 years or until earlier death) which covers the expected cost of future claims and then applying a margin. In determining the level premium, Life Co has historically applied a margin of 30% to the expected claims cost. This margin is intended to cover Life Co's cost of capital, expenses and profit requirements.

It is common practice in Actuaria to quote level annual premium rates as the amount of level annual premium required to purchase $1,000 of sum assured.

A flat discount rate of 3% p.a. is used to determine the present value of cash flows.

Experience Data

The In-Force Management department of Life Co has provided you with data covering the results of an experience investigation into Life Co's term assurance business over the period from 1 January 2010 to 31 December 2014.

The worksheet "Exposure" in the Data file provides details of the amounts exposed to risk during the investigation period. This is grouped in five year age bands, where age x denotes the exposed to risk period from age x exact to age $x+1$ exact.

You have been informed that the exposure figures provided are initial exposed to risk that can be used directly with initial rates of mortality.

The worksheet "Claims" in the Data file provides details of each of the claims that occurred during the investigation period. This includes the age at the time of the claim and the claim amount. Age x at the time of the claim is equivalent to age x exact at the start of the policy year in which the claim was made.

PLEASE TURN OVER

New Business Data

The Sales department of Life Co has provided details of the T-10 business that it expects to write during 2016. These can be found in the worksheet "New Business" in the Data file.

Like the exposure data, the expected new business has been split by age band (which denotes age exact at entry). It has been confirmed that although in the past new policies have been sold to individuals aged 50 exact, this is not going to be the case in 2016. Therefore the maximum age at entry is 49 exact.

The expected new business refers to percentage of the total sum assured expected to be written in each age band.

The Sales department has indicated that it expects to write new business in 2016 for a total sum assured of $220m.

Experience Analysis

Your boss has asked you to analyse Life Co's experience.

She first wants you to determine the total amount of claims that would have been expected to have arisen during the experience investigation period, had mortality been in line with Life Co's internal benchmark mortality table.

This mortality table is unisex and provides initial rates of mortality split by age exact. A copy of the table can be found in the worksheet "Mortality Table" in the Data file.

Your boss wants you to calculate the expected claim amounts by age band (consistent with the exposure data provided) and in total.

She then wants you to compare these expected claim amounts against the actual amount of claims in order to determine the Actual over Expected (A/E) ratio. She has asked for this to be done for each age band and at the total portfolio level.

Premium Calculation

In order to determine the new business premium rates, your boss has asked you to apply the overall A/E percentage to Life Co's internal mortality table in order to produce an adjusted mortality table which can be used for pricing.

Using this adjusted mortality table, you should determine the level annual premium rate which Life Co should charge for each of the four age bands and also the weighted average premium rate at the total new business portfolio level.

You should also determine the total amount of premium that Life Co should expect to receive in 2016 from T-10 policies written in 2016.

Data

Initial Exposure in Amounts

Age	Exposure ($)
30–34	60,123,311
35–39	51,000,321
40–44	98,121,031
45–49	49,999,832
50–54	171,133,222
55–59	179,890,999

Source: In-Force Management Department – Life Co

Expected New Business – 2016

Age Exact	% of Total Sum Assured
30–34	10%
35–39	32%
40–44	26%
45–49	32%

Policies written in 2016 are expected to have a total sum assured of $220m.

Source: Sales Department – Life Co

Claims Data

See "Claims" worksheet.

Source: In-Force Management Department – Life Co

Mortality Table

See "Mortality Table" worksheet.

Source: Life Co

END OF PAPER

This page has been left blank.