Institute and Faculty of Actuaries

EXAMINERS' REPORT

CP2 - Modelling Practice

Core Practices

Paper Two

September 2022

Introduction

The Examiners' Report is written by the Chief Examiner with the aim of helping candidates, both those who are sitting the examination for the first time and using past papers as a revision aid and also those who have previously failed the subject.

The Examiners are charged by Council with examining the published syllabus. The Examiners have access to the Core Reading, which is designed to interpret the syllabus, and will generally base questions around it but are not required to examine the content of Core Reading specifically or exclusively.

For numerical questions the Examiners' preferred approach to the solution is reproduced in this report; other valid approaches are given appropriate credit. For essay-style questions, particularly the open-ended questions in the later subjects, the report may contain more points than the Examiners will expect from a solution that scores full marks.

The report is written based on the legislative and regulatory context pertaining to the date that the examination was set. Candidates should take into account the possibility that circumstances may have changed if using these reports for revision.

Sarah Hutchinson
Chair of the Board of Examiners
December 2022

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A. General comments on the *aims of this subject and how it is marked*

The aim of this subject is to ensure that the successful candidate can analyse data, develop a model, and document the work (including maintaining an audit trail for a fellow candidate and senior actuary). They should be able to analyse the methods used and outputs generated and communicate to a senior actuary the approach, results and conclusions.

The subject is split into two papers. The second, dealt with in this report, covers the objectives:

- Ability to analyse the methods used and the model's outputs.
- Ability to apply and interpret the results.
- Communication of the approach, results and conclusions to a senior actuary.

As the focus of the subject is on communication, the majority of the marks available are for the documentation and outputs generated rather than for technical modelling skills. For example, a technical mistake is only penalised once and candidates can still earn marks for accurate and clear communication of what was done.

Candidates who give well-reasoned points not in the marking schedule are awarded marks for doing so.

It is strongly recommended that prospective candidates attempt a number of past papers and look closely at both the model solutions and the marking schedule to get a better idea of the types of conclusions and next steps that the examiners are looking for. In particular the examiners want conclusions and next steps to be relevant for the scenario in the question.

B. Comments on *candidate performance in this diet of the examination.*

Modelling

The modelling required for this paper was reasonably straightforward, and most candidates scored well. This involved determining the impact of the CEO's value check. Less prepared candidates tended to apply the annuity factors to the projected final annuity payment, instead of the annuity payment at the valuation date.

There was additional work required to summarise and categorise the results into groups by term and annuity increase rate. Most candidates attempted all of the charts, however there were errors made in the data selected to plot, inappropriate grouping of the data and some unsuitable choice of chart type. Candidates are encouraged to carefully consider the graphs created as anecdotally there is a relationship between the quality of graphs produced and the conclusion commentary provided. By having graphs which clearly demonstrate patterns enable the user to draw observations and hence conclusions about the results.

Summary

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There are numerous elements of the summary which most candidates produce very well. The introduction, discussion of the data provided, and the assumptions are usually scored highly. When it comes to the description of the methodology, the better candidates are able to describe what is being done at a level appropriate for the senior actuary audience. Less prepared candidates tend to either refer to the spreadsheet (similar to what is done in the audit trail), include too much detail on the minor steps in the process, or skip out steps entirely. Some candidates simply copy and paste the audit trail into this section. That approach will not achieve any marks.

Results that were included in the summary were generally well produced, with most candidates able to produce graphs in line with what was required. Most candidates, however, did not include all the outputs that were expected. Prospective candidates should take care to read the question paper carefully to discern not just the outputs explicitly asked for, but also those mentioned in the background information as being relevant to the assignment.

A key expectation from the examiners in the Summary report is that there is a number of conclusions to the results. Candidates are expected to be able to identify notable aspects of the outputs and provide explanatory comments. There has been an improvement in the quality of this aspect of the exam over the past few years, but this continues to be a major differentiator between passing and failing candidates. Better prepared candidates are able to display an understanding of the assignment, and what the outputs mean, and communicate this appropriately.

The list of next steps is another area where better candidates differentiate themselves. They are able to produce a varied list of ideas covering a wide range of options, and make these relevant to the assignment. Less prepared candidates tend to produce a standard list of ideas without much effort at applying them to the situation in the exam, or without providing the level of detail and depth expected. Weaker submissions contain brief statements about tax, stochastic modelling, stress scenarios or updating the model as time progresses. These tend not to score well, but better candidates are able to explain which tax may be applicable and how it would affect results; which variable would be subject to stochastic modelling and what the benefit of this might be; what a suitable stress scenario might look like, and how it might be mitigated against; and what data might be collected as time progresses and what modifications to the model may ensue as a result.

In combination with Paper 1, this exam was slightly harder than an average CP2 sitting, which has been reflected in the pass marked.

Pass Mark

The Pass Mark for this exam was 57
1349 presented themselves and 775 passed.

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Solutions for Subject CP2-2 - September 2022

Q1
(i)
Spreadsheet Additional Scenario:
Calculate the cost of the amendment to the Company at 1 January 2023:

Value of unamended remaining annuity payments	[1]
Value of amended remaining annuity payments	[2]
Value of amended remaining annuity payments after value check	[1]
Auto check on new calculations	[1]

Most candidates performed well in this section. Less prepared candidates applied the annuity factor to the wrong level of annuity or did not calculate the correct value of the future payments after the change in legislation.

Q2
(i)
Chart Production:

Construction of one chart to illustrate the increase in Net Present Value of the total remaining payments, after the amendment, for all 100 annuities, just the 5% p.a. current increasing annuities and just the 3% p.a. current increasing annuities.	[2]
Data manipulation to enable the above	[1]

(ii)

Construction of chart showing the average proportion of the payment affected and the percentage increase in payment amount p.a. at the end of term in relation to the remaining term of annuity (rounded to the nearest year) for all 100 members	[2]
Data manipulation to enable the above	[4]

(iii)

Construction of chart showing the average proportion of the payment affected and the percentage increase in payment amount p.a. at the end of term in relation to the remaining term of annuity (rounded to the nearest year) for 5% increasing annuitants only	[1]
Data manipulation to enable the above	[1]

(iv)

Construction of chart showing the average proportion of the payment affected and the percentage increase in payment amount p.a. at the end of term in relation to the remaining term of annuity (rounded to the nearest year) for 3% increasing annuitants only	[1]
Data manipulation to enable the above	[1]

This section was generally well attempted. Most candidates were able to produce the graphs required albeit with some limitations as noted above. Less prepared candidates produced graphs that compared results other than those that were asked for, and

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appropriate partial credit was given in these cases. Candidates were generally able to summarise the data appropriately so that it could be presented in the graphs.

Q3

(i)

Summary:

Methodology (including purpose, data, approach and assumptions)

Statement of purpose [1]

Data used, including source [1]

Data validation/review [1]

Assumptions: up to 5 marks for a good list of "added value" assumptions [5]

(Award a total of 1 mark for restating assumptions from the audit trail. Award 1 mark for any valid assumption not included in the audit)

Projection of annuity amount at 1 January 2022 [1]

Projection of annuity amount at 1 January 2023 with current increase at 1 January 2023 [1]

and also with amended increase at 1 January 2023 (unaffected proportion 1; affected proportion 1) [3]

Annuity factors for amended and unamended annuities at amendment date (mention different interest rates to use, net discount rate, term) [2]

Value of annuity payments remaining before 1, and after amendment for each individual annuitant (proportion unaffected 1; proportion affected 1) [3]

Value of annuity payments remaining after value check [1]

Increase in value of remaining annuity payments due to amendment [1]

Projection of annuity amount to end of each policies term before and after amendment [2]

Senior actuary can understand what has been done *(maximum 5 marks)*

The level of detail included is appropriate for a senior actuary [2]

All methodology steps are set out clearly [2]

The senior actuary would be able to understand the approach taken without having to refer to other documentation [1]

[Marks available 27, maximum 26]

(ii)

Results, including charts: [5]

Chart showing the increase due to the amendment in paying remaining annuity Payments for all 100 annuities, just the 5% increasing annuities and just the 3% Increasing annuities [1]

Three charts, one each for 100 annuitants, 5% increasing annuitants and 3% increasing annuitants, showing the average proportion of the payment affected and the percentage increase in payment amount p.a. at the end of term in relation to the remaining term of annuity [1½]

Statement of the percentage increase in cost on all annuities, 5% annuities and 3% annuities [1½]

Statement of the NPV of the total cost to XYZ of making the amendments [1]

[Marks available 10, maximum 5]

(iii)

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Conclusions:
(Where results are observed but not explained only ½ mark should be awarded, unless the mark is specifically stated to be for an observation)
Applying the amendments will result in a cost to XYZ [1]
This cost is always positive given the CEO wishes to apply an underpin [1]
The impact of the amendments is greater the higher the proportion of an annuity is affected [1]
It can be seen that the increase is less for the current 5% increasing annuities than the 3% increasing annuities [1]
This can be explained by the fact that the current 3% increasing annuities benefit from the amendment uplift and the higher amended increases [1]
While the current 5% increasing annuities benefit from the amendment uplift but receive lower amended increases going forward [1]
over time the lower amended increases for current 5% increasing annuities gradually erodes the 10% uplift applied. The 1% lower increases completely erode the 10% uplift for annuitants with long enough terms [1]
Three members were affected by the value check (i.e. their annuities were not amended because the amended value was lower than the current value) [1]
These were all 5% current increasing members with longer terms [1]
Some 5% members will have a lower amended annuity payment p.a by the end of their terms even though the value check did not apply [1]
The value check does not apply for the members because less weight is placed on the later lower payments due to discounting [1]
It is important to consider the impact to future payments to annuitants, particularly for those 5% members who will receive lower annual payments at some point in future [1]
Annuities increasing at 3% have a strong direct relationship between proportion of annuity affected by amendment and the percentage increase in annuity amount p.a. at the end of term [2]
which appears to converge over time. [1]
The average proportion of payment affected decreases with the remaining term while the percentage increase in annuity payment increases with the remaining term [1]
because of the compounding effect [1]
At longer terms remaining, annuities increasing at 5% have a strong inverse relationship between proportion of annuity affected by amendment and the percentage increase in annuity amount p.a. at the end of term [2]
because the longer the annuity payments are projected the more the effect of the lower 4% p.a increases builds up which will lower the percentage increase in amount p.a. creating the inverse relationship [1]
At shorter durations the percentage increase for 5% increasing annuities exhibits a downward sloping line which is not very sensitive to the proportion of annuity payment affected [2]
This could be explained by the fact that at shorter durations the effect of the lower 4% p.a increases has less time to accumulate and the 10% uplift has a bigger impact [2]
The chart showing both 5% and 3% increasing annuities combined shows the Proportion of annuity affected by amendment and the percentage increase in annuity amount p.a. at the end of term is directly related for the first c10 years and then displays a rough inverse relationship [2]
This is because the reduction to the 5% increasing annuities from 5% to 4% future increases on the amended part has more time to build up and have a larger effect at

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longer terms [2]
Ultimately the cost will depend on the factors (increases and term) selected by individuals when they take out their annuity policy [2]
XYZ will need to consider if it would be able / want to cover all costs of the legislative changes without making any client worse off from a treating customers fairly perspective [2]
(Any other valid conclusion with the reason why)

[Marks available 32, maximum 22]

(iv)
Next steps:
Validate the data [1]
particularly the fraction of annuities affected by the amendment [1]
and confirm the details of the regulations [1]
Confirm that amendments should not be backdated [1]
Confirm that there are no different maturity amounts paid at the end of the term [1]
Check that there are no other affected annuitants [1]
Consider allowing for mortality, which will decrease the NPV and result in a more realistic cost [2]
Check that there are no provisions for surrender with this type of policy and potentially allow for withdrawal rate otherwise [2]
Consider if the method of checking whether members are better off after amendment is fair and reasonable. Particularly whether value or amount p.a. (overall or in any future year) should be used for the comparison [2]
Confirm if the discount rate of 6.5% is reasonable [1]
Sensitivity test the discount rate to analyse the impact on affected annuitants [1]
Consider what communication should be issued to members and if this should be different for 3% and 5% members [2]
Carry out further illustrations for 5% members for the CEO to consider, for example the cost of providing the better of amended or retained, without amendment payments for each future year [2]
Consider the impact on capital requirements and reserved held following the changes [1]
Consider whether policy documents will need to be amended [1]
Check that the increase in value of the remaining annuity payments will not cause problems with the Company's future cashflow planning or investments [2]
Investigate the impact on public relations of implementing the changes in the method suggested by the CEO [2]
Research what competitors are doing and what the industry standard approach to amending due to the regulation change [2]
Consider any additional cost involved in implementing such changes (e.g. admin cost) [1]
Consider the impact of additional payments on any tax paid by annuitants on annuity Income [1]
Obtain a peer review of the work performed [1]
Any other valid next steps [3]

[Marks available 32, maximum 19]

v)
Drafting:
Clear / concise drafting of the objective, and data summary/description [1]

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Clear / concise drafting of the assumptions and methodology	[2]
Clear / concise drafting of the results and conclusions	[2]
The summary report is written in clear, crisp and flowing English	[2]
Accurate spelling	[1]
The summary is well laid out, in a reasonable order, with good formatting to aid clarity	[2]
	[Total 82]
	[Paper Total 100]

Better prepared candidates are those able to clearly communicate the methodology followed, comment on and explain the results, and produce an appropriate list of next steps that are relevant to assignment at hand. Prospective candidates should focus on understanding the assignment and being able to demonstrate this through their submissions.

END OF EXAMINERS' REPORT

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Institute and Faculty of Actuaries

Beijing

14F China World Office 1 · 1 Jianwai Avenue · Beijing · China 100004
Tel: +86 (10) 6535 0248

Edinburgh

Level 2 · Exchange Crescent · 7 Conference Square · Edinburgh · EH3 8RA
Tel: +44 (0) 131 240 1300

Hong Kong

1803 Tower One · Lippo Centre · 89 Queensway · Hong Kong
Tel: +852 2147 9418

London (registered office)

7th Floor · Holborn Gate · 326-330 High Holborn · London · WC1V 7PP
Tel: +44 (0) 20 7632 2100

Oxford

1st Floor · Belsyre Court 57 Woodstock Road · Oxford · OX2 6HJ
Tel: +44 (0) 1865 268 200

Singapore

5 Shenton Way · UIC Building · #10-01 · Singapore 068808
Tel: +65 8778 1784

www.actuaries.org.uk

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