Institute and Faculty of Actuaries

EXAMINERS' REPORT

CP2 Modelling Practice
Core Practices
Paper One

September 2023

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.

For some candidates, this may be their first attempt at answering an examination using open books and online. The Examiners expect all candidates to have a good level of knowledge and understanding of the topics and therefore candidates should not be overly dependent on open book materials. In our experience, candidates that spend too long researching answers in their materials will not be successful either because of time management issues or because they do not properly answer the questions.

Many candidates rely on past exam papers and examiner reports. Great caution must be exercised in doing so because each exam question is unique. As with all professional examinations, it is insufficient to repeat points of principle, formula or other text book works. The examinations are designed to test "higher order" thinking including candidates' ability to apply their knowledge to the facts presented in detail, synthesise and analyse their findings, and present conclusions or advice. Successful candidates concentrate on answering the questions asked rather than repeating their knowledge without application.

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
November 2023

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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 student 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 first, dealt with in this report, covers the objectives:

- analysis of data.
- development of a model with clear documentation.

As the focus of the subject is on communication, most of the marks 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 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 approach to analysing data and model documentation that the examiners are looking for.

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

The overall difficulty of the paper is slightly more challenging than the average CP2 diet. This has been reflected in the pass mark.

Modelling
The paper has a slight focus on checking, cleaning, restructuring and transforming data to make sure it is appropriate and fit for purpose. Other than the usual checks such as checking min/max, computing averages, students needed to consider the situation at hand and come up with other valid checks (such as using a chart to check if there is any trend/seasonal effect) that add value. Regression, a new element, was introduced with plenty of guidance in the exam paper and most students who have attempted this part performed well.

Audit trail
Most candidates did well in the audit trail. The description of methodology, with emphasis on both what was done and how each step was performed was well handled by the better prepared students. Reasonableness checks continue to be a weak area for most students.

C. Pass Mark

The Pass Mark for this exam was 58.
1250 presented themselves and 714 passed.

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Solutions for Subject CP2 Paper 1 September 2023

Q1

(i)

Spreadsheet Model:

Validation of data:

Min/max/average longitude & latitude	[1½]
Min/max/average elevation, and identify and replace default value	[1½]
Summarise stations by continent (1), or other value-add checks	[2]
Average temperature by year	[½]
Graph of temperatures by year	[1]
Min/max/average temperature by month	[1]
Graph of temperatures by month	[1]
Identify and deal with default values	[2]

[Marks available 10½, maximum 9]

(ii)

Determine North/South, Continent and High/Low category for each data point	[2]
Calculate yearly average for each year/weather station	[1]
Calculate winter / summer average for each year/weather station	[2]

(iii)

Calculate overall average for each year	[1]
Calculate north/south average for each year	[½]
Calculate high/low average for each year	[½]
Calculate winter/summer average for each year	[1]
Calculate average for each continent for each year	[1]
Produce 4 charts for north/south, high/low, winter/summer and continents	[4]

(iv)

Prediction model:

Determine linear regression model	[3]
Produce chart of actual and predicted summer temperatures	[2]
Predict average summer temperatures for 2011-2030	[2]

(v)

Calculate costs for 2021-2030	[3]

[Total 32]

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There is a focus on data validation in this paper. Well prepared students were able to apply their judgement on data checking. The errors in the data were found and a variety of corrections (including deletion) were made, which were acceptable provided a reasonable rationale was given.

Some weather stations in the data had an elevation of 9,999m. Whilst the exam paper did not specify the elevation limit, candidates should apply common sense in their data checking.

Most students did the modelling well. Some students mixed up part (ii) and part (iii).

Part (ii) of the question asks about the average for each year at each weather station whereas part (iii) asks about the average for each year across all weather stations. Credit was given where the required results were produced, whatever route was taken to calculate them.

It is worth noting some candidates gave the sum (e.g. 220 degree Celsius) rather than the average (e.g. 18 degree Celsius) as the average annual temperature which was neither informative nor helpful.

When undertaking the modelling candidates may find it useful to remind themselves of the scenario and what it is the client is seeking to achieve. By taking that step back they may be able to gain a clearer understanding of what they are modelling and the results seeking to be output.

The regression element of the modelling is new and as such plenty of guidance was given in the exam paper. Better candidates were unfazed by the unfamiliarity and completed the regression modelling successfully. Less prepared candidates tended to either forwent this part completely (potentially due to time pressure) or over-engineered the modelling.

Candidates are reminded that the focus of the exam is on communication. The scenarios are not designed to be overly complex, and therefore if your approach to modelling is taking a complex route, perhaps pause and consider if there is an alternative method.

The construction of charts was generally well handled by the majority of the students.

Q2

(i)

Auto checks on the modelling completed in 1:

Check summer v winter temperatures	[1]
Check high v low temperatures	[1]
Any other reasonable auto check	[1 per check]
	[Marks available 3, maximum 2]

(ii)

Good spreadsheet practice:

No hard-coding (use of parameters and no copy and paste values)	[1]
Flagging rows/columns that don't copy down	[1]
Easy to follow (inputs, checks and outputs easy to find)	[1]
Logical order (left to right, top to bottom, within and between sheets)	[1]
Clear and accurate labelling within the spreadsheet - rows, columns, worksheets	[1]
Use of simple techniques (but not oversimplified) - formulae not overly complex/ steps split out and calcs built up	[2]

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[Total 9]

Few candidates scored well on the checks. There were some half-hearted attempts at some auto-checks, many which did not add any value.

The performance of students in spreadsheet practice has continued to improve. Most models have clear and logical layouts with good headings.

Q3

Audit Approach

(i)

Communication skills:

HOW the steps have been executed is clear, rather than just WHAT has been done being stated [2]

There is sufficient technical detail and does not include excessive use of Excel formulae to describe steps [1]

Sufficient detail is providing in the audit trail as a standalone document - does not refer references in the model [1]

(ii)

Fellow student can review & check the methods used in model:

For a newcomer, the audit trail is easy to follow i.e. the marker does not have to look at the model directly to understand what has been done [2]

All the steps are correctly and clearly described [1]

The workbook is well labelled and is easy to navigate through [1]

Where there are, or could be errors, the audit trail would enable the student to identify and correct errors [2]

Danger areas in the spreadsheet are appropriately flagged (e.g. goal seek) [1]

(iii)

Senior actuary can scrutinise & understand what has been done:

A reasonable overview of the model is included [1]

There are clear statements of the assumptions made i.e. concise list of value added assumptions, not long list with many not adding value [1]

Data sources are clearly described [1]

It is easy for a senior actuary to pick up the high-level detail of the modelling - can pick up the high level without having to read all the detail [2]

The level of detail is appropriate for a senior actuary - explanations are clear and concise [1]

Reasonableness checks are clearly stated and their results explained [1]

(iv)

Written in clear English:

The audit trail is written in clear, crisp and flowing English [2]

Accurate spelling [1]

The audit trail is laid out well, with good formatting to aid clarity [1]

(v)

Logical order:

Data is introduced before referring to it [1]

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Assumptions are stated before using them [1]
The methodology is described in a logical order i.e. nothing is introduced which would require that the reader has read ahead [1]

(iv)
Audit Content:
All steps CLEARLY explained
The level of detail in the audit trail is appropriate for a newcomer to understand what has been done [1]
All the methodology steps are set out clearly [2]
Data provided and any necessary adjustments made are described and justified clearly. [1]
All reasonableness checks applied are adequately documented [1]
The marker does not need to look directly at the model to understand what has been performed [2]

(vii)
Reasonableness checks:
Comment on overall trend [1]
Comment on distribution of weather stations around the world. [1]
Comment on overall average being closer to North than South average [1]
Comment on reasonableness of predicted linear trend [1]
Comment on expenses increasing by more than temperature [1]
The north average is much lower than the south, and shows slightly more volatility (such as from 1995-1999) [1]
Average temperature by continent. Africa and South America are well clear above 20°, with Europe notably lower than the rest below 10°. It appears that the continents with higher temperature have lower volatility. [1]
Any other reasonableness check [2]
[Marks available 9, maximum 5]

(viii)
Signposting / labelling CLEAR:
The audit trail allows the user to follow the model through [1]
The audit trail allows the user to understand each calculation easily [1]
There is adequate signposting in the audit trail to describe the purpose of each tab [1]
Model labelling is consistent with the audit trail (data, parameters, scenarios, outputs, charts) [1]

(ix)
(Up to 4 marks for including assumptions (1 for each distinct, reasonable "added value" one listed) [4]

(x)
Steps Accurately and CORRECTLY described:
Objective [1]
Data used, including source [1]
Data checks (Stations) [1]
Data checks (Data) [1]
Replacement of defaults [1]

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Allocation to high/low, continent and north/south categories	[1]
Calculation of overall average per year	[1]
Calculation of high/low, north/south and continental averages per year	[1]
Calculation of summer/winter averages per year	[1]
Determination of Linear Regression	[2]
Calculation of predicted temperatures	[1]
Calculation of predicted costs	[1]
Construction of charts	[2]
Any other distinct and valid step.	[1 per step]
	[Marks available 16, maximum 14]
	[Total 59]

In general, audit trails were fairly well written. Well prepared students showed evidence of time planning and were able to focus their attentions on key areas of the modelling an audit trail.

Most candidates struggled with providing assumptions that add value to the audit trail. Reinstating information provided in the background information or listing items not assumed to change are not assumptions that add value. Quality of the assumptions matters.

The methodology section was generally well written and at the level appropriate to both a fellow student and a senior actuary. Better students were able to provide clear communication of their models while less prepared students tended to focus on describing the steps and not providing enough detail as to how the steps had been implemented to give the reader an understanding whether model was correct or not.

Reasonableness checks is an area that has continuously been performed poorly. Students are reminded that reasonableness checks are different from auto checks. Reasonableness checks need to include a rationale behind the observation (hence it's called "reasonableness" checks). For example, expecting the average temperature in summer is higher than that of winter is a valid reasonableness check.

[Paper Total 100]

END OF EXAMINERS' REPORT

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