



Institute  
and Faculty  
of Actuaries

# EXAMINERS' REPORT

CP2- Modelling Practice

Core Practices

Paper One

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

## **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 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, the majority 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.

Follow on marks are always available so do not overlook some of the more straightforward marks even where you lack confidence in the modelling which they rely on. In question 1, parts (iii) and (v) were often overlooked with many candidates gaining no marks for these sections.

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

Prospective candidates should be reminded that there is an expectation that any element of the Core Principles subjects can be drawn on in the CP2 exam. It is therefore recommended that CP2 is best approached after being familiar with the content of these earlier subjects.

Prospective candidates should work through the mark schedule diligently, as this provides a good template for what the examiners are looking for in an audit trail. Past exam papers provide good examples of structure and style which seek to meet the needs of both a senior colleague and fellow student. In setting out the methodology candidates need to set out both what was done and how each step was performed, to enable the user of the audit trail to be able to follow the method that has been implemented. Finally, we encourage candidates to sense check their work as they progress through the exam. Setting out why the results look in line with your expectations is the requirement of the reasonableness checks, which is an area that is neglected by many candidates.

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

### **Modelling**

More emphasis was given in this paper to the analysis of data. While guidance was provided, explicit step by step instructions were not, with candidates expected to use their initiative to decide what steps to take to check the data. Prospective candidates should expect similar questions in future.

As could be expected, this resulted in the data analysis section being handled with a wide range of approaches. The better candidates were able to analyse the stock prices in a way that made comparisons between the sectors possible (for example, by calculating daily returns, or using cumulative returns to convert the prices to an index). They were also able to produce a chart or table to show the distribution of the stock prices (using a histogram or similar technique).

Less prepared candidates performed only the most basic of checks (for example, that prices are positive), and found challenging to understand the concept of stock prices (for example, equating the level of a stock price with return). Prospective candidates should aim to understand the relevance of the data provided to the assignment given and check that the data is suitable for the purpose for which it is provided.

Most candidates managed to complete the modelling for Strategy A without a problem. Strategies B and C caused more difficulty, particularly in the application of the concept of selling short and, more surprisingly, where there was no investment in the market. A common error was to have one instruction for where prices rose for three days, and another for all other scenarios, rather than the three-way instruction required. More marks were available for the investment instruction (whether to buy or sell the stock), and candidates who only erred in the short sell calculation did not lose many marks. Better candidates were able to perform the calculations and provide commentary on the relationship between these two strategies, and why the results were reasonable. We note that whatever approach was taken here by the student, marks were awarded for describing this in the audit trail.

Strategy D was usually handled well by those candidates who managed to attempt it. Any errors in approach that carried through to the later strategies were only penalised once.

There were a lot of marks available for charts and overall return calculations, but only the better candidates tended to achieve these, despite the marks being available for charts that were missing the results of some of the strategies.

The average marks attained by candidates was higher for Paper 1 than Paper 2. This demonstrates that candidates need to focus on the key output of Paper 1, namely, the communication element of the audit trail. The model is a means to get something to communicate, and a candidate that submits a poor model with a good audit trail is more likely to pass than one submitting a good model with a poor audit trail.

### **Audit Trail**

The performance of candidates in the audit trail continues to improve, with better descriptions of methodology in general. Where candidates scored poorly here, it seems that this was due to time pressure. This appears to be caused either by too much time being taken on trying to complete the modelling, or not enough modelling being done to give the candidate something to write about.

The essential introductory elements of the audit trail were generally dealt with well, these being the overview, data description and assumptions. However, a lot of candidates still struggle to find assumptions that are relevant to the situation at hand, relying on 'standard'

items which are perceived to be applicable in most situations. For example, an assumption that historical returns will be applicable in future was quite common, but irrelevant in a situation where historical returns are used without any attempt to project into the future. Candidates should also be aware that no credit is given for stating assumptions that are given in the exam paper.

The description of methodology, with emphasis on both *what* was done, and *how* each step was performed, forms the majority of the audit trail. Better candidates handled this well, providing clear communication of their models. Weaker candidates tended to neglect the *how* in each step, not providing enough detail to give the reader an understanding of whether the model was correct or not.

The one area where improvements have not really been evident over time is the production of reasonableness checks. These should show that the candidate understands the assignment and can provide logical reasoning to back up why the results are correct. The obvious case in this assignment was that the results from Strategies B and C should be opposite and roughly equal due to the nature of the transactions being made. Only the better candidates were able to pick up on this. Similar to comments about conclusions in Paper 2, this is the best way for candidates to demonstrate to the examiners that they understand the assignment and are able to communicate this understanding effectively. Candidates who score well in this area usually achieve a high overall mark for the paper.

In combination with Paper 2, 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

## Solutions for Subject CP2-1 - September 2022

### Q1

Validation of data:

(i)(a)

Calculation of prices indexed to 100 [1]

Calculation of daily returns [1]

Other reasonable checks to provide reassurance the data is accurate (for 2 marks check must be clearly labelled and automated, or involve the production of new data/summary of the data) [2]

(i)(b)

Calculation of avg / st dev / max / min of daily returns per stock (½ each) [2]

Chart comparing the returns of the five stocks [2]

(i)(c)

Chi-squared test [2]

Other reasonable checks to investigate a possible statistical distribution [2]

Graphing of daily returns (distribution - all stocks) [2]

Graphing of daily returns (distribution - each stock individually) [2]

[Marks available 16, maximum 8]

(ii)

Calculation of Fund Value for each strategy:

Calculation of Moving Averages (50/200 day - 1 each) [2]

Strategy A Calculation of fund value per stock [2]

Strategy B Calculation of transaction instruction:

Buy after three downs [1]

sell after three ups [1]

and hold otherwise [1]

Strategy B: calculation of fund value per stock [1]

Strategy C: calculation of transaction instruction and fund value per stock [2]

Strategy D: Transaction instruction for moving averages [2]

Strategy D: fund value per stock [1]

Total fund value per strategy [1]

(iii)

Chart of total fund value for each strategy [2]

(iv)

Calculation of statistics:

Calculation of daily return for each strategy [1]

Calculation average / std dev daily return (1 each) [2]

(v)

Chart of value per strategy per stock to show the optimal strategy for each stock [3]

**[Total 30]**

*As mentioned above, section (i) was not handled particularly well. Marks were awarded generously for any approach that added value to the process of checking the data.*

*Some candidates found challenging to deal with the 'real life' nature of the data. The appropriate response was to choose an approach and make suitable assumptions. Most candidates managed to do this, either explicitly or implicitly. Some exams in the past have made use of 'manufactured' errors, which candidates are expected to pick up. That wasn't the case here, and candidates were expected to confirm that there were no obvious errors, but also get a sense of the relative performance of each stock in order to make comments on the results of the various strategies.*

*The later sections (from (iii) to (v)) tended to get ignored due to time pressure on section (ii), despite more than a quarter of the marks being available. These marks were awarded even if not all the strategies were covered in section (ii).*

## Q2

(i)

Auto checks on the modelling completed in 1:

Check consistency of average return and final index value [1]

Check Max/Min returns [1]

Any other reasonable auto check [1]

[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]

Good automatic checks [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 [1]

**[Total 9]**

**[Total for spreadsheet model 39]**

*The performance of candidates in section (ii) has continued to improve, with most models having clear, logical layouts with good headings and spreadsheet practice. Improvements could be made on worksheet headings (as sheets often look very similar) and labelling of checks.*

*Few candidates scored well on the checks, and prospective candidates are encouraged to look at past model solutions for an idea of what these should look like.*

## Q3

Audit trail

|  |  |      |
|--|--|------|
| (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 stand-alone document - does not refer to comments 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]  |
| There is sufficient technical detail   |  | [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   |  | [1]  |
| 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   |  | [1½] |
| Accurate spelling  |  | [½]  |
| 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]  |
| 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]  |
| (vi)   |  |      |
| 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]                            |
| Areas where manual intervention or caution is required are well flagged (e.g. goalseeks or non-standard model areas) | [1]                            |
| The marker does not need to look directly at the model to understand what has been performed                         | [2]                            |
| (vii)  |                                |
| Other checks:  |                                |
| Comment on distribution of daily returns.  | [2]                            |
| Comment on volatility (st dev) compared to max/min daily returns.  | [1]                            |
| Comment on Strategy C vs Strategy B (equal and opposite)   | [1]                            |
| Comment on optimal individual strategy/stock combinations:   |                                |
| Tech & A   | [1½]                           |
| Banking/Energy & B   | [1½]                           |
| 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)  |     |
| <i>(Up to 4 marks for including assumptions (1 for each distinct, reasonable "added value one listed)</i> | [4] |

|   |                                   |
|---|-----------------------------------|
| (x)   |                                   |
| Steps correctly described:                                  |                                   |
| Objective or purpose  | [1]                               |
| Data used, including source                                 | [1]                               |
| Data checks (calculations)                                  | [1]                               |
| Data checks (charts)  | [1]                               |
| Further mark for detailed explanation of data checks        | [1]                               |
| Calculation of moving averages                              | [1]                               |
| Calculation Strategy A fund value                           | [1]                               |
| Calculation of daily returns                                | [1]                               |
| Strategy B trading instruction                              | [1½]                              |
| Strategy B fund value                                       | [1½]                              |
| Strategy C trading instruction / fund value                 | [1]                               |
| Strategy D trading instruction                              | [1½]                              |
| Strategy D fund value                                       | [1]                               |
| Summary statistics: total fund value per strategy per stock | [1]                               |
| Summary statistics: avg / std dev of daily returns          | [1]                               |
| Construction of charts                                      | [2]                               |
| Any other distinct and valid step.                          | [1]                               |
|   | [Marks available 19½, maximum 16] |

**[Total marks for audit trail 61]**

*There continues to be a discernible improvement in the average quality of audit trails being submitted. However, a key differentiator between good and poor audit trails continues to be the level of reasonableness checks which are applied to the results. The better candidates are able to understand the implications of the results their models produce and can explain these clearly. Weaker candidates are more likely to produce results which are clearly incorrect but make no effort to explain why this is the case, and what the fault may be.*

**[Paper Total 100]**

**END OF EXAMINERS' REPORT**



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