Institute and Faculty of Actuaries

A Guide to CP2 Modelling Practice

February 2025

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Introduction to CP2 Modelling Practice

The objective of this guide is to answer your questions about CP2, including:

- the format of the online exam;
- guidance on how to approach the exam effectively;
- administrative information, and
- technical information.

For any further queries, please contact exams@actuaries.org.uk

What is the CP2 exam?

This practical exam is assessing your actuarial business skills in a more 'rounded' approach with the prime emphasis on good communication when using and presenting spreadsheet work.

The focus for the CP2 exam is making clear what you have done, so that it can be followed by others. You are required to use judgment and state your assumptions.

The solutions to past exams (available on the IFoA website) show approaches that would qualify as a good pass standard over the two papers. However, it should be noted that these include more detail than would ordinarily be possible within the time allowed for the examination.

Why has CP2 been developed?

CP2 has been influenced by external pressures: the Actuarial Profession Standards (APSs), the International Standard of Actuarial Practice, the Actuaries' Code, the regulators, Sarbanes Oxley and Solvency II requirements. A summary of these is set out for reference below.

- **Actuarial Profession Standards (APSs)**

  The latest standards can be found on the IFoA website: **The Actuarial Profession Standards**

  These are standards which apply to all IFoA members regardless of location.

  – APS X1 sets out how to determine which standards are applicable to actuarial work. In particular, 2.1: [IFoA] Members should ensure that their Actuarial Work is carried out in a way that is substantially consistent with ISAP 1.

- **The Actuaries' Code**

  The latest Actuaries Code can be found on the IFoA website: **The Actuaries' Code**

  The Code requires us to "perform professional duties competently and with care" and to "ensure that their communication, whether written or oral, is clear…".

- **International Standards of Actuarial Practice (ISAP)**

  The latest ISAPs can be found on the International Actuarial Association's website: **The International Standards of Actuarial Practice (ISAP).**

  – **ISAP 1**: General Actuarial Practice. This is a model standard for actuarial standard-setting bodies to consider when setting standards relating to the guidance to actuaries when performing actuarial services.

    The interpretation of the standard varies by geographic location, but given the above requirements of APS X1 the following are relevant to CP2:

    ▪ Under 2.5, any data is required to be reliable for the purpose of the actuarial

services, provided that the data is materially accurate. Validation of data is required and consideration of any deficiencies in the data should be considered. Both of these areas should be documented in a report.

- The assumptions and methodology used (including, but not limited to, models and modelling techniques) are disclosed appropriately.
- Section 3 sets out the communication standards and in particular the reporting requirements.

– **ISAP 1A:** Governance of Models. This provides guidance to actuaries on model governance when performing actuarial services involving models.

- The IFoA considers the framework of standards applying to its members as substantially consistent with ISAP 1.

- **Regulators**

  In reviewing a firm's practices, regulators expect to see acceptable standards of documentation, agreed by the firm, and documented.

- **Sarbanes Oxley (SOX or SarBox)**

  This is American legislation that governs the need for full documentation of internal processes and controls.

- **Solvency II**

  This framework for insurance companies includes emphasis on documentation and evidencing of the calculation work undertaken.

What is the format of the CP2 exam?

This overview should be read alongside the current **CP2 Syllabus** available on the IFoA website, which includes the topics, weightings as well as syllabus objectives.

The CP2 exam consists of two 3-hour 20 minute papers that are held on consecutive days.

The main elements of the exam are:

Paper 1

1. Prepare and summarise data and undertake exploratory data analysis and visualisation.
2. Construct an actuarial model to solve a realistic problem.
3. Document the model by constructing an audit trail.

Paper 2

1. Analyse the methods used, and outputs generated.
2. Apply and interpret the results.
3. Communicate the results.

Each paper will use a different model with any additional guidance required included in the exam instructions; this might cover key technical or modelling aspects needed for the particular situation in the problem to be modelled.

Paper 1

In Paper 1, you will be given a problem to model, including data to analyse. You will need to include appropriate checks, and to provide a clear audit trail for the following individuals:

- a fellow student you should assume has about the same level of knowledge as you; and
- a senior actuary who will know the actuarial aspects and will need an overview of the actuarial, technical and assumption elements. They will not need the Excel details.

Paper 2

In Paper 2, you will be given a model plus an audit trail to review and will be asked to perform some further work.

You will need to provide a summary of the whole project which will be for the senior actuary only.

Important hint:

- Take care to give sufficient details of your approach, methods and assumptions in the summary.
- The senior actuary needs enough detail in the summary to be able to follow, and critique, what you have done.

What exams should I have passed before sitting CP2?

There are no eligibility requirements for CP2.

However, the models can be based on any of the Core Principles subjects: CM1, CM2, CS1 and CS2.

CP2 also uses principles from Core Practices subject CP1, and it also uses some features of the Core Practices subject CP3.

You may therefore prefer to wait until you have tackled CM1, CM2, CS1, CS2, CP1 and CP3 before sitting this exam.

I want to sit the exam. What do I need to do?

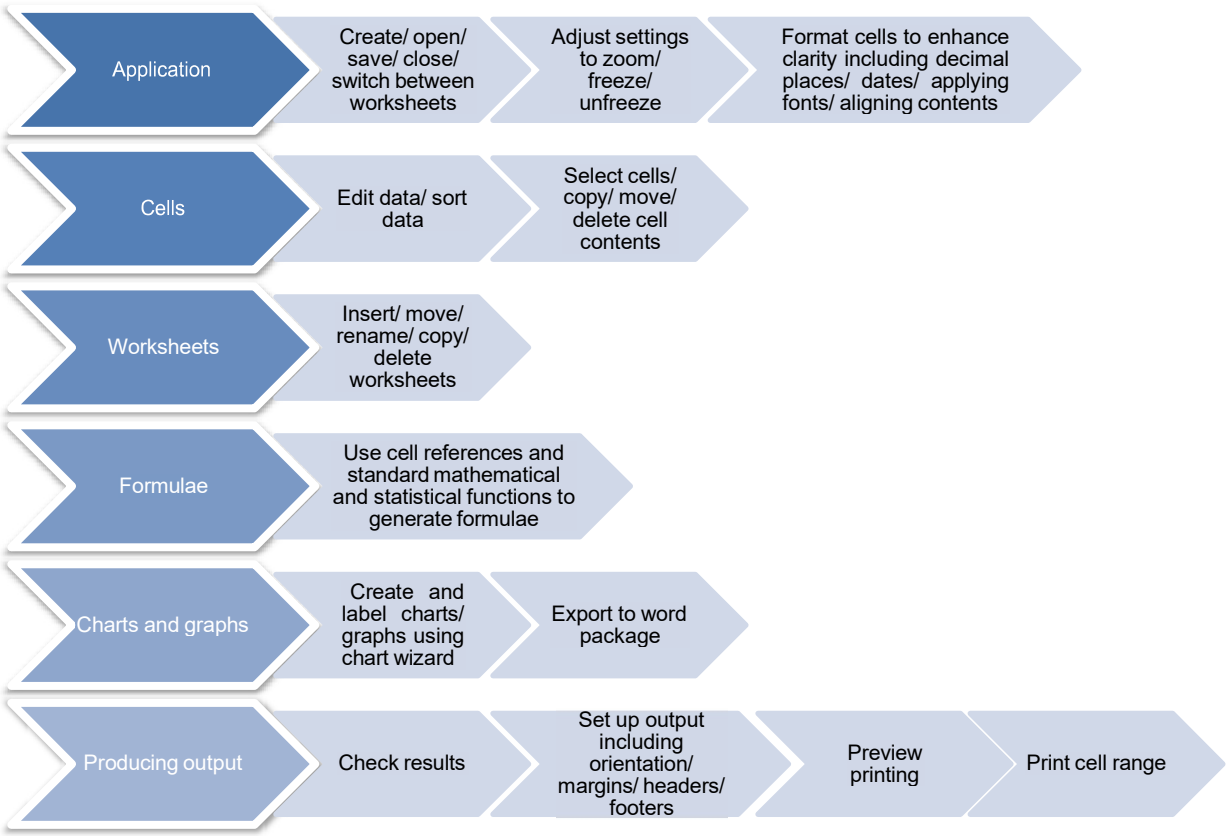
Further information and guidance on how to book an IFoA exam can be found on our website:

IFoA Exams.

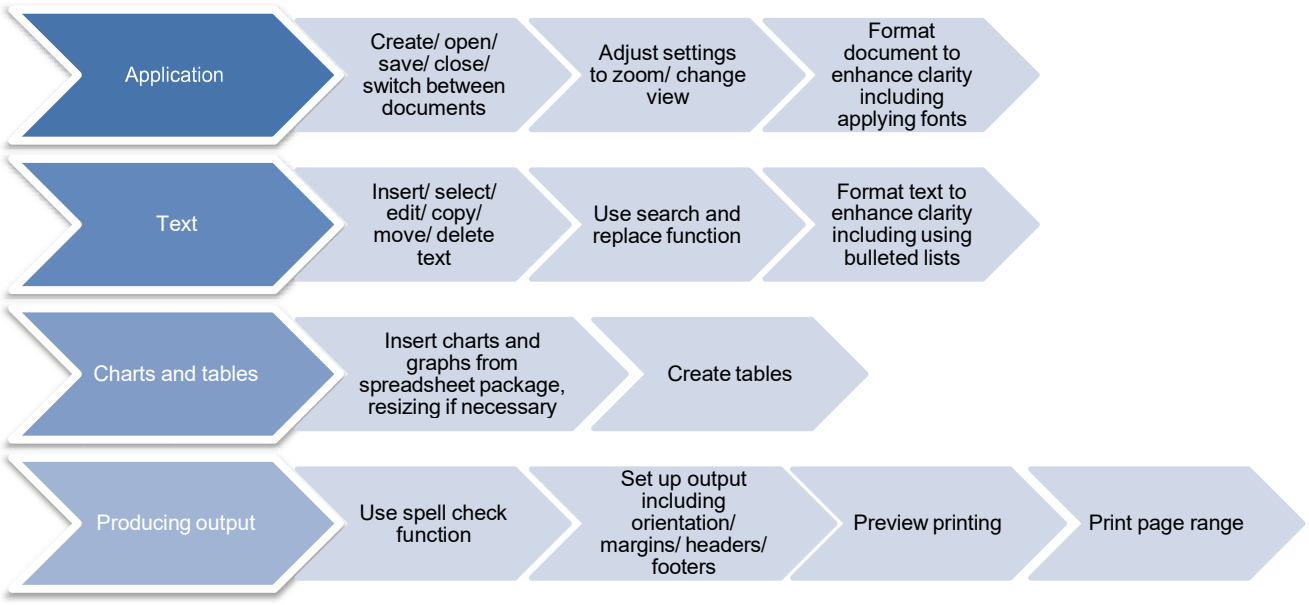
What should I know before sitting CP2?

You should have the following knowledge:

Spreadsheets



Word processing



Excel knowledge

Excel is the software package used for the modelling aspects of CP2. Although detailed knowledge of Excel is not part of the examination (and hence extensive knowledge of Excel functions is not necessary), candidates will be expected to model calculations effectively using this software.

You should have experience of using Excel and, importantly, be able to create a spreadsheet from scratch. Candidates who have limited experience or rarely have an opportunity to create spreadsheets are encouraged to practise before attending the examination; the **past exam papers** on the IFoA website offer a good opportunity for such practise.

The exams do not require advanced Excel techniques. However, candidates should be able to use the following Excel functions:

AVERAGE STDEV MIN / MAX MEDIAN LARGE / SMALL	SUM PRODUCT SUMPRODUCT SUMIF COUNT	COUNTIF VLOOKUP / HLOOKUP INDEX OFFSET IF GOALSEEK	AND / OR NOT ROUND ABS INT

As well as the above built-in functions, candidates should know how to sort data and how to create and modify charts.

There are a number of Excel reference books available in addition to the Help facility provided in Excel. Candidates are advised to look up the details of how to use the above features before the exam.

Good practice

In Excel, or any other modelling package, there are good practice steps that should be followed.

These help to:

- reduce the risk of errors within the model;
- assist others to use the model, and
- facilitate checking and correction of the model.

The following principles should be followed in building any computer model and should be demonstrated in the exam assignment:

- Adopt an approach that is as simple as possible.
- Ensure the model is easy to change.
- Make constants explicit as parameters rather than hard code them into formulae.
- Separate inputs, calculations and results.
- Structure a spreadsheet so that it can be read from left to right and from top to bottom.
- Keep all formulae as simple as possible – the calculations do not need to be performed in one formula and intermediate calculations can facilitate checking.
- In spreadsheets, avoid changes in cell formulae along rows/down columns. If this is not practical, make sure the changes are clearly flagged to other users who may have to make amendments.
- Avoid manual intervention wherever possible and try to ensure that the final result is updated whenever a change is made. If this is not possible, ensure that other users know what manual intervention is required and when.

There are many documents and articles which discuss good spreadsheet practice. However, a number of these contradict each other in some of their recommendations.

In part, this is due to considering different types of spreadsheet users with different needs. A spreadsheet designed to be used on a regular basis by non-experts needs different considerations to a model designed for use by a limited number of other users with a comparable level of technical knowledge to the developer.

A detailed discussion, considering the needs of different users, may be found in this article:
Actuarial Practice Forum.

How do I pass CP2?

Preparation is the key!

You need to be well practised in basic Excel skills.

You also need to be ready to turn a basic actuarial problem into a spreadsheet model. If you are familiar with updating an existing spreadsheet, but not with creating a model in a spreadsheet from scratch, you should practise this by attempting past papers.

The types of problems that are assessed in CP2 have been published on the IFoA website along with Examiners' Reports that may help you gain insights into how the CP2 exam is marked. For further information please visit: **Past Exam Papers and Examiners Reports.**

Essential skills

The following information highlights some of the skills required to pass this exam.

Use of time

Think about the time you have to complete all of the modelling and documentation and remember how important it is to spend time reading and understanding the paper before beginning to answer the questions.

For Paper 1

Allocate time for:

- reading and understanding the paper;
- planning the model;
- creating the model itself; and
- maintaining the audit trail (perhaps in sections).

A possible split is:

- Reading – 20 minutes.
- Planning – 30 minutes.
- Modelling – 1.5 hours.
- Audit trail – 1 hour.

For Paper 2

Allocate time for:

- reading and understanding the paper;
- planning the spreadsheet work required
- doing this work; and
- writing the summary.

A possible split is:

- Reading – 20 minutes.
- Working through the model & planning the extra work – 30 minutes.
- Spreadsheet work – 30 minutes.
- Summary – 2 hours.

1. Paper 1: Model

- Read the question carefully to ensure you know what is being asked.
- Note the results required and plan your approach well.
  - It's recommended you spend about 40-50 minutes reading and planning before you start your model.
- Keep your model simple and show all the calculations.
- Do not spend too long working with the data (unless this is clearly indicated in the question) but make sure that you do some basic checks.
- Do not get too involved in the detail of the model. If you get stuck, make a reasonable assumption, document it, and move on.
- Include adequate signposting and labelling in your model and audit trail so that the work on each sheet is clear, and references are provided.
- Be alert for checks you can apply. Test output frequently for accuracy and reasonableness – as you would do at work – and document these checks. If an answer does not look reasonable, check your formulae against the question. If you cannot find the error, note it in your audit trail and move on.

Remember: CP2 is not about determining the 'right' answer.

2. Paper 1: Audit trail

- Make your audit trail as comprehensive as you can, making sure that you cover:
  - all steps in your methods;
  - the assumptions; and
  - the reasons for your decisions.
- Include your checks – auto-checks and reasonableness checks on the various scenarios.
- Highlight any areas where special care needs to be taken, e.g. where a Goal Seek has been used.
- Keep in mind the requirements of your two audiences:
  - a fellow student: and
  - a senior actuary.

3. Paper 2: Spreadsheet work

- Read the question carefully to ensure you know what has been modelled and the additional work which is required.
- Note the results required and plan your approach.
  - It's recommended you spend about 30 minutes working through the model and planning the additional work before you start work on the spreadsheet.

- Keep your spreadsheet work simple and show all the calculations.
- Do not get too involved in the detail of the model. If you get stuck, make a reasonable assumption, document it in your summary, and move on.
- Be alert for checks you can apply. Test your output for accuracy and reasonableness – as you would do at work – and use the results of the reasonableness checks in your summary. If an answer does not look reasonable, check your formulae against the question. If you cannot find the error, note it in your summary.

  Remember: CP2 is not about determining the 'right' answer.
- You will not be required to add to the audit trail provided for this paper, but your summary will need to cover the whole project in the question, not just the additional work you have carried out.

Paper 2: Summary

- Focus on using the summary as a communication to your audience, a senior actuary.
- Include the approaches you have used for the whole project, not just for the additional work you have carried out.
  - Give sufficient and accurate details of these (and the data) so that a senior actuary would be able to check your methods and assumptions (they do not need to be able to check your Excel spreadsheet using this document).
- Do not simply 'copy and paste' the text given to you in the audit, but amend the content to be appropriate to a senior actuary.
- Consider the purpose of the Summary document and the target audience.
  - The Summary document is not intended to be used to help check the model, therefore Excel references are inappropriate.
  - Candidates who copy large sections of the information in the exam question and/or the audit trail provided into their Summary document are unlikely to gain credit from the examiners for it.
- Follow the instructions in the question carefully. In particular, ensure you include all the results which have been requested for the whole project.
- You need to include any added value comments that explain the results you have obtained and conclusions on the results, and any comments that follow from the reasonableness checks.
- You also should include a comprehensive set of possible next steps.

Why do some candidates fail CP2?

The examiners have provided the following reasons why some candidates that are more likely to fail and tips for overcoming these issues:

- Some candidates do not prepare sufficiently in advance of sitting the exam. It is vital that candidates understand how many marks are available for each aspect of the exam. Candidates can then prepare to spend an appropriate amount of time on each aspect based on the marks available.
    - For example, in Paper 1 there are often 30 marks available (out of a total of 100) for the candidate to complete the required spreadsheet modelling and checks.
    - If the candidate spends more than half of the available time in the exam on this aspect, then it is highly likely they will not have sufficient time to spend on the other aspects required in the paper. This will make it very difficult for them to pass.
    - Therefore, it is important to practise past exam papers under exam conditions to develop:
        - a thorough structural understanding of the papers, and
        - the techniques of planning and time management.
- Some candidates misread or misinterpret the instructions and so build an incorrect or overly complicated model. It is important to follow the instructions, use the information accurately and **plan the work before starting**.
- Candidates with failing marks do not fully understand what is involved in the assignment. They struggle to explain the work they have done in both the audit trail and the summary.
- There is sufficient time for the exam assignment, but candidates need to plan their time as for any other piece of work/exam.
- Some candidates do not apply enough checks to their work. Checks are often restricted to basic checks on the data, and other checks are omitted. In particular, checks that the results are reasonable, including those from different scenarios, are necessary. These will also lead to comments in the summary.
- Many candidates omit key details from the audit trail.
- Similarly, for the summary, which needs to be a concise, yet comprehensive, account for a senior actuary. In particular, sufficient detail on your approach, method and assumptions is

needed so that a senior actuary can follow, and critique, what you have done.

- Candidates should ensure submissions can be easily read and have a clear layout.

  - Eight pages of densely typed text in 8 point font will not produce an easy to follow or intelligible audit trail. For a CP2 assignment such detail would be excessive.

  - For the audit trail, consider the use of white space, sub-headings and highlighting key areas. Do not waste time on an elaborate format but invest some time in making it clear to follow and read.

  - Similarly, the summary should be clearly laid out.

- Proofread the intended submission, and use the spell checker, to make sure it says what you want it to say.

Remember your audience for both pieces of documentation.

Guidance on how CP2 is marked

To aid your preparation for the CP2 Modelling Practice exam, this simple guide has been created to help you:

- gain an understanding of how the scripts for Paper 1 and Paper 2 will be marked; and
- be more knowledgeable in your approach to the exam.

The guide sets out the criterion for passing CP2, together with the general format of the marking schedule which will be used by markers in assessing a candidate's submissions.

The CP2 examiners will assess a candidate's overall performance over both papers. Therefore, a candidate does not have to produce a pass standard for each separate paper, but does need to demonstrate a pass standard overall according to the following criterion:

The audit trail in Paper 1 and the summary in Paper 2 give a reasonable overview of the model and the results with the main focus for each paper being:

- Paper 1: a clear audit trail, including checks, which could be followed by a senior actuary and would enable the model to be worked on and corrected by a fellow student.
- Paper 2: a clear summary of the model and the results for a senior actuary.

Marking schedule

The marking schedule shows an approximate typical mark allocation over the combined papers, though the marks will vary to reflect the precise requirements in each paper. Marks for modelling techniques and checking will form part of the marking of both papers, with the approximate percentage allocation being:

Assessment area	Paper 1	Paper 2
Audit trail approach	10%	
Audit trail content	19%	
Data analysis and preparation	3%	
Checks	3%	
Model development and good techniques	15%	6%
Summary description and approach		12%
Summary results		10%
Summary conclusions and next steps		17%
Summary drafting		5%
Total	**50%**	**50%**

Assessed in Paper 1, with some spreadsheet techniques and checking also assessed in Paper 2.

Audit trail approach

Marks are awarded for:

- Ability for a fellow student to review and check the methods used in the model. Marks are awarded for:
  - For a fellow student who has not seen the model before ('fellow student'), the audit trail is easy to follow, and they do not have to look at the model to understand what has been done.
  - All the steps clearly describe how the calculations have been determined and are consistent with what has been done.
  - Sufficient technical and actuarial detail for a fellow student to be able to understand the approaches taken and identify any areas where corrections are required (without looking at the model).
  - A well labelled workbook which is easy to navigate.
  - 'Danger areas' highlighted, e.g. Goal Seek, sorted data, and clear instructions included on the use of any such techniques.

- Ability for a senior actuary to scrutinise and understand what has been done.

  - A good overview of the model.
  - Clear descriptions of data, sources, checks, adjustments.
  - Clear coverage of the assumptions made, with reasons where appropriate.
  - Clear coverage of methods, understandable by a senior actuary, in order for them to be able to gain confidence in the approaches taken (without looking at the model).
  - Avoidance of excessive reproduction of Excel formulae.
  - Clear statements of reasonableness checks performed, and their results explained.
- Use of clear English, including.
  - Accurate spelling.
  - Clear layout.
- A **logical** order:
  - Data is introduced before it is referred to.
  - Assumptions are stated before they are used.
  - Methods are described in a sequential order.

Audit trail content

Marks are awarded for:

- All steps being clearly explained.
  - Detail is appropriate for a fellow student without having to look at the model to understand what has been done.
  - Methods, data plus adjustments, checks, and danger areas clearly documented.
- Clear signposting to the model (from the audit trail) and labelling within it, including:
  - The audit trail allows the reviewer to follow the stages in the model.
  - Model labelling is consistent with the audit trail.
- Each step being correctly described. Examples of the steps are:
  - Statement of model's purpose.
  - Data description/source.
  - Data validation and adjustments.
  - Assumptions made (not just those stated in the question).
  - Each part of the method.
  - Construction and use of charts.

Checks

- Each distinct auto-check and reasonableness check. Possible examples of these types of checks are:
  - Auto-checks on data.
  - Auto-checks on calculations (e.g. a set of probabilities summing to 1).
  - Auto-checks that figures are within an appropriate range, e.g. probabilities between 0 and 1.
  - Checks that a subsequent set of calculations accords with an earlier one if the parameter is changed back.
  - Reasonableness checks that an initial result is sensible.
  - Reasonableness checks that the result for each new scenario is sensible.

Use of appropriate techniques in model

Marks are awarded for the use of correct approaches, calculation of the correct results and the use of appropriate spreadsheet techniques. Follow-on errors are not penalised.

Examples of the approaches and techniques are:

- Identification of errors or issues with the data.
- Reasonable corrections to the data.
- Correct methods for each stage of the calculations.
- Correct results for each stage of the calculations.
- Use of cell references and parameters rather than copy/pasting or hard-coding.
- Flagging any 'one-off' or 'danger' cells.
- Use of simple techniques.

The summary

Assessed in Paper 2, with some spreadsheet techniques and checking also assessed in Paper 2.

The summary is evaluated based on its overall content for its audience, a senior actuary. This senior actuary needs to understand what has been done, and also the outputs, in order to present the results and conclusions of the project to the client(s).

Description and approach

Marks are awarded for accurate descriptions of the approaches used and the assumptions made in the whole project. Examples of the descriptions are:

- Statement of project's purpose.
- Data: nature, sources, verification and adjustments.
- Assumptions made in the modelling.
- Methods used for each stage of the calculations.

Results

Marks are awarded for appropriate presentation of the results from the whole model. Examples are:

- chart comparing adjusted data to original data (if relevant).
- appropriate charts illustrating each stage of the results.
- clear statements of any other results.

Conclusions and next steps

Marks are awarded for appropriate conclusions (based on the results for the whole project, together with next steps). Examples of comments are:

- Significant caveats on the validity of results, e.g. being based on very limited data, or being highly sensitive to a particular assumption.
- Analytical comments on each stage of the results, including explaining patterns in the results and any unusual features.
- An explanation of the differences between the results under the various scenarios modelled.
- Overall recommendations (if appropriate).

Next steps need to be specific to the project, with some mention of the validity of each. Possible examples of next steps are:

- Validate the data / information.
- Obtain further data / information.
- Sensitivity / scenario test on key assumptions / parameters.
- Use a different model type / make the model more sophisticated.

Drafting

The summary should be understandable to a senior actuary. It should use appropriate language, clear formatting, accurate spelling and grammar and be in a sensible order.

Marks are awarded for:

- A clear, concise statement of the purpose and objective of the project.
- A clear summary of the data and assumptions.
- Descriptions of the methods so that a senior actuary will understand what has been done.
- Clear presentation and interpretation of the results.
- A clear layout.
- A professional tone and style throughout.

Appendix: Frequently Asked Questions

Below are some answers to questions that relate to the CP2 Modelling Practice exam.

Do I need any specific computer knowledge?

The assignments will require knowledge of computer spreadsheets and word processing. Guidance has been given earlier in this document on the level of knowledge required. Past exam questions are provided to help candidates understand the level of knowledge required. Employers are encouraged to look at these to provide guidance to students.

What is the emphasis of the assessment?

The emphasis is on the audit trail developed in the spreadsheet and the ability to analyse outputs and interpret the results obtained so that conclusions may be drawn. The key assessments are clear communication throughout both the audit trail and summary.

The aims of the exam are that the successful candidate should demonstrate the ability to:

1. Prepare and summarise data and undertake exploratory data analysis and visualisation.
2. Construct an actuarial model to solve a realistic problem.
3. Document the model by constructing an audit trail.
4. Analyse the methods used, and outputs generated.
5. Communicate the results.

The communication aspects are the main part of the CP2 exam and these account for around 80% of the marks. There are relatively few marks for the techniques used in the models. However, it will be much more difficult to present useful documentation if the model does not reflect what the client has actually asked for. Similarly, it will be much more difficult to include good reasonableness checks in the audit trail and added value analysis of the results in the summary, if the results are not robust and/or do not make sense. The sample projects illustrate what is required.

What happens if I have technical issues during the exam?

Any technical issues that arise should be reported to the team as soon as it happens so we can resolve it as quickly as possible. Please refer to the **Examinations Handbook** for further guidance.

END