Subject CP2

CMP Upgrade 2021/22

CMP Upgrade

ActEd often produces a free CMP Upgrade, which provides details of changes to the Syllabus objectives and Course Notes. This year, however, due to the large number of changes to the Course Notes and Assignments, it is not practical to produce a full upgrade.

Note that as there is no Core Reading for Subject CP2, the changes are all to the ActEd materials. This document *outlines* the most significant changes so that you are aware of the main differences between the 2021 study material and that for the 2022 exams. However, given the large number of detailed changes to the course, we strongly recommend that you use the 2022 study materials for the 2022 exams.

We offer a full set of up-to-date Course Notes / CMP at a discounted price if you have previously bought the full-price Course Notes / CMP respectively in this subject.

We only accept the current version of assignments for marking, *ie* those published for the sessions leading to the 2022 exams. If you wish to submit your script for marking but have only an old version, then you can order the current assignments free of charge if you have purchased the same assignments in the same subject in a previous year, and have purchased marking for the 2022 session.

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0   Retaker discounts

When ordering *retaker-price material*, please tick the relevant box when using the e-store.

Students have the choice of purchasing the full CMP (printed or eBook) or just the Course Notes (printed).

Further information on retaker discounts can be found at:

www.acted.co.uk/paper_reduced_prices.html

1   Changes to the Syllabus

This section contains all the ***non-trivial*** changes to the syllabus objectives.

There have not been any changes to the syllabus objectives.

2   Changes to the Course Notes

This section contains all the ***non-trivial*** changes to the Course Notes.

General

Chapter 1 has been deleted from the course. The remaining chapters have been re-numbered.

Chapter 10

The question in this chapter has been amended to break up the calculation into stages. A sample marking schedule has also been included.

Chapter 11

The question in this chapter has been extended and the solution spreadsheet amended accordingly. A sample marking schedule has also been included. Note that the solution spreadsheet available from the ActEd website relates to the most recent version of the question.

3   Changes to the X Assignments

Assignment X1

There have been some changes to the solution of X1.2(iv). Replacement pages are attached.

Assignment X2

There have been some changes to the solution of X2.3(ii) to reflect the latest version of Microsoft Office. Replacement pages are attached.

Assignment X3

There have been some minor changes to the question in this assignment. The solutions are unchanged. Replacement pages are attached.

4   Other tuition services

In addition to the CMP you might find the following services helpful with your study.

4.1   Study material

We also offer the following study material in Subject CP2:

- ASET (ActEd Solutions with Exam Technique) and Mini-ASET

- Mock Exam and AMP (Additional Mock Pack).

For further details on ActEd's study materials, please refer to the 2022 *Student Brochure*, which is available from the ActEd website at **www.ActEd.co.uk**.

4.2   Tutorials

We offer the following (face-to-face and/or online) tutorials in Subject CP2:

- a Preparation Day Tutorial

- an Online Classroom.

For further details on ActEd's tutorials, please refer to our latest *Tuition Bulletin*, which is available from the ActEd website at **www.ActEd.co.uk**.

4.3   Marking

You can have your attempts at any of our assignments or mock exams marked by ActEd. When marking your scripts, we aim to provide specific advice to improve your chances of success in the exam and to return your scripts as quickly as possible.

For further details on ActEd's marking services, please refer to the 2022 *Student Brochure*, which is available from the ActEd website at **www.ActEd.co.uk**.

4.4   Feedback on the study material

ActEd is always pleased to receive feedback from students about any aspect of our study programmes. Please let us know if you have any specific comments (*eg* about certain sections of the notes or particular questions) or general suggestions about how we can improve the study material. We will incorporate as many of your suggestions as we can when we update the course material each year.

If you have any comments on this course, please send them by email to **CP2@bpp.com**.

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Legal action will be taken if these terms are infringed. In addition, we may seek to take disciplinary action through the profession or through your employer.

These conditions remain in force after you have finished using the course.

There are other areas of the data that could be investigated for potential issues, for example:

- the person in row 10 was based in Ireland but appears to have an Italian name.   [½]

- the number of children in G9 could be incorrect given the duration of marriage.   [½]

However, these could be valid entries. We could raise these as queries and leave the existing values unless they are found to be incorrect.   [½]

[Maximum 5]

(v)(a)   *Checks for accuracy*

We could check that all the dates are valid years, *eg* integers in the range 1750 to 1950. (Any ?'s can be stripped out first.)   [½]

We can check that there are no missing 'born' or 'died' dates (or ?'s if these are uncertain).   [½]

We could compare the data for each individual in the spreadsheet with the information in the main text of the book.   [½]

We could check the data for each individual against an independent source, *eg* by googling it or looking on Wikipedia.   [½]

We could check that the countries all have one of the four names England, Scotland, Ireland or Wales.   [½]

We could spellcheck the 'name', 'field' and 'country' columns.   [½]

(v)(b)   *Checks for consistency*

We could check the 'born' and 'died' dates to see whether the person died between ages 20 and 100 (say).   [½]

We could check the 'born' and 'married' dates to see whether people with a 'married' date got married between age 16 (say) and their date of death.   [½]

We could check that the people did not have more children that the number of years they were married (although it is possible that some had twins or the men had some children born outside their marriage).   [½]

(v)(c)   *Checks for reasonableness*

We could check the 'born' and 'died' dates to see whether the person was actually alive at some point during the Victorian period.   [½]

We could query any people whose names don't appear to match their country.   [½]

We could query any people who had children but don't have a 'married' date.   [½]

We could query any people who were married for a number of years but had no children. (Large families were the norm in those days.)   [½]

There is some overlap between the different types of checks here. So marks can be awarded for suggestions that appear anywhere in part (iii) provided they can be considered to be of the type the student has indicated.

[Maximum 1 for each of parts (v)(a), (v)(b) and (v)(c)]

[Total 3]

Solution X1.3

(i)(a) ***Parameters versus assumptions***

A parameter is a key variable in the model (usually numerical) that may be used in a number of calculations whose value the user is able to specify.   [1]

An assumption is a factual statement (usually expressed in words) that underlies the calculations in the model and may affect the validity of the results.   [1]

There is no set wording for the definitions of parameters and assumptions, so markers should award marks to students based on how clearly they have explained each concept and made clear the distinction between the two.

(i)(b) ***Examples of parameters and assumptions***

Suitable examples would include:

Parameter	Assumption
The interest rate used in the calculations (set to 4%, say)	The interest rate is assumed to be constant OR Interest has been ignored
The inflation rate used in the calculations (set to 3%, say)	The inflation rate is assumed to be constant OR Inflation has been ignored
The term of investment used in the calculations (set to 10 years, say)	The term of investment is fixed OR Investments cannot be realised before the maturity date
An adjustment made to the mortality rates (*eg* 90% of the … table)	Mortality is assumed to follow … table OR Mortality has been ignored
The name of an investment fund (to appear in all the tables and graphs)	Investments will be made in a single fund
The type of an option (CALL or PUT)	The option is a standard call or put option
An indicator variable specifying whether results are to be shown in real or nominal amounts	The calculations are / are not adjusted to allow for future inflation
The step size used (in a calculation where the time frame is subdivided)	The step size is small enough to give a sufficiently accurate approximation

Markers should award marks for any suitable examples of a pair of parameters and assumptions that are related (1 mark each).

[Total 4]

(ii)(b)   *Instructions*

For reference only, here are our 'improved' versions. We've kept the two periods separate so that you can see the issues for the two different chart types.

Popularity of political parties for Years 1 to 5

Popularity of political parties for Years 6 to 10
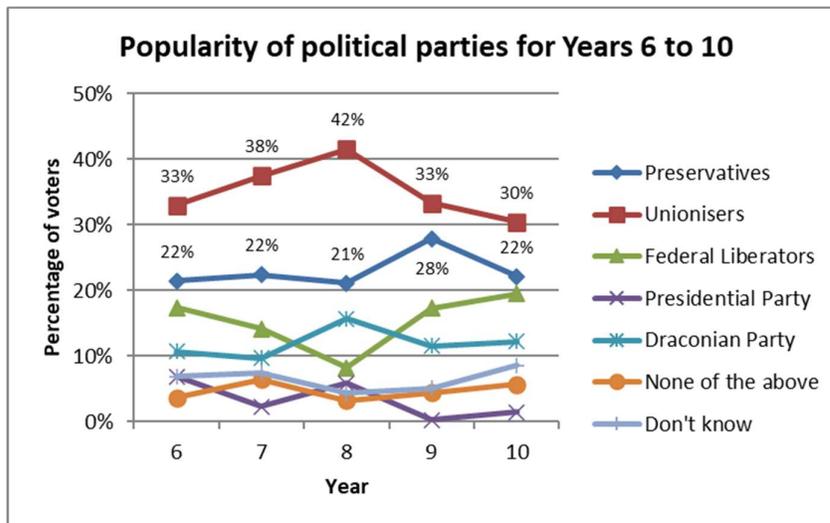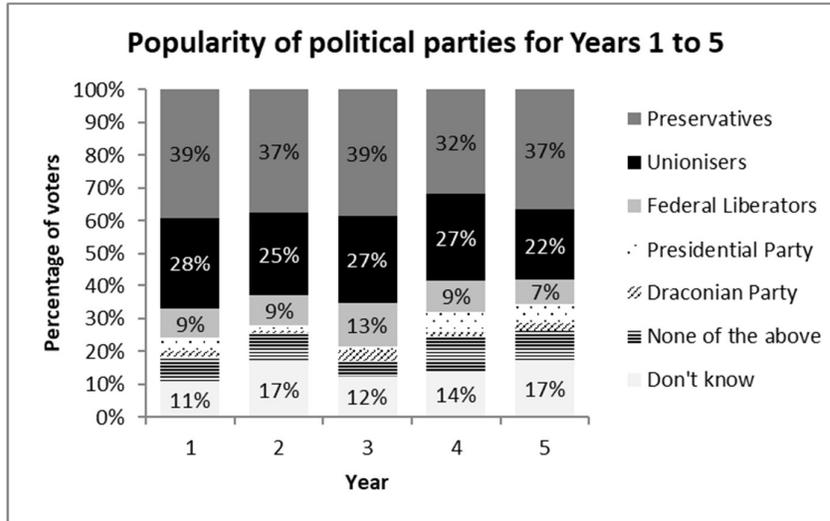
A combined version would look like this:
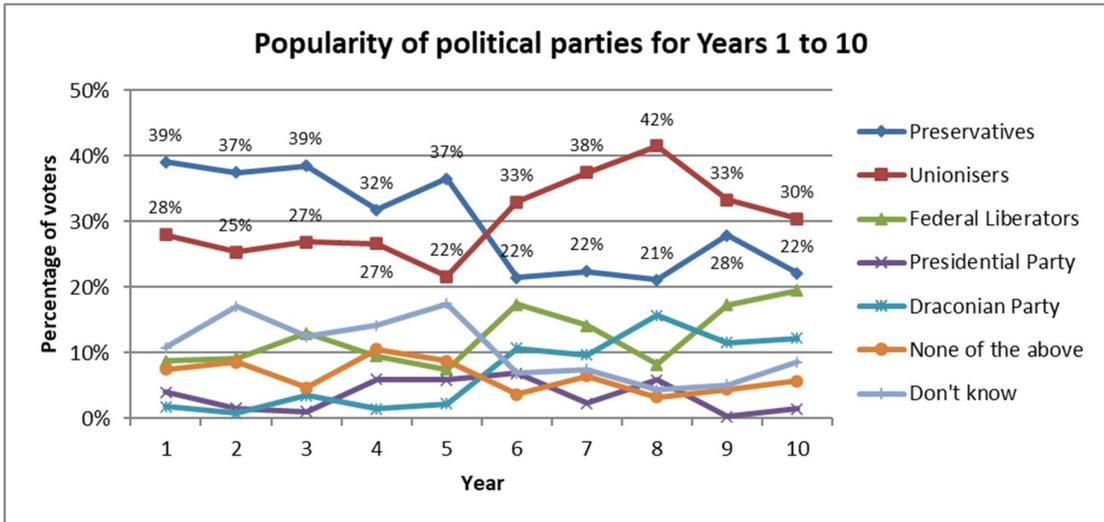
Full marks [2 for each improvement] should be awarded either for full instructions or for instructions in an abbreviated form, provided that they would be sufficiently clear for a less experienced user to follow. Marks for partially correct answers should be scaled down accordingly.

Note that there may be equally good alternative methods of carrying out these tasks and that the precise steps and menu options will depend on the particular version of Excel the student is using.

Adding titles

Click on the chart to select it.

Click on the Chart Design menu at the top of the screen.

Click on Add Chart Elements.

Click on Chart Title.

Select Above Chart (say).

Enter the text you wish to appear in the title.   [2]

Labelling the axes

Click on the chart to select it.

Click on the Chart Design menu at the top of the screen.

Click on Add Chart Elements.

Click on Axis Titles.

Select Primary Horizontal (say).

Enter the text you wish to appear as a label on the axis.   [2]

Changing the values shown on the horizontal axis

Right-click on the chart.

Click on 'Select Data'.

Click the 'Edit' button the right-hand side.

Enter the values you wish to show (6,7,8,9,10 in this case) or select a range where these values will be entered and enter that cell range.   [2]

Changing gridlines

Right-click on the vertical axis of the chart.

Click on 'Format Axis'.

Next to 'Major Units', click fixed and enter 0.01 in the shaded box.   [2]

We've removed the gridlines completely from the first chart using:

> *Click on the chart > Add Chart Elements > Gridlines > None*

Adding data labels

Right click on one of the main series.

Click 'Add Data Labels'.   [2]

We've also made the bars wider on the first chart using:

> *Right click on one series > Format Data Series > Series Options > Gap width = 50%*
>   [2 marks for each instruction, maximum 6]
>   [Total 9 for part (ii)]

(iii)(a)   ***Generating comments***

Other methods of generating comments include:

- comment on the salient features brought out by the graph

- comment on any trends or other patterns that can be seen from the graph

- relate aspects of the graph to previous results or background information

- apply reasonableness checks to some of the results shown in the graph

- make comparisons between scenarios (where applicable)

- comment on any inadequacies of the graph / suggest areas for improvement.
                                                            [½ mark for each valid method, maximum 2]

(iii)(b) *Comments on the graphs*

There are some noticeable changes between the first 5-year period and the second.

These changes could be related to the political crisis.

The dominant party seems to have changed from the Preservatives to the Unionisers. Voters may now have a preference for the Unionisers' policies or their leaders or their track record.

The Draconian Party has become much more popular. They may be proposing a new policy that is popular.

In the second period the rises and falls in the Unionisers and Federal Liberators are mirror images with the total roughly constant. This could indicate voters switching between these two parties.

The percentage of 'Don't know' respondents has dropped, suggesting that the political crisis may have polarised voters' opinions.

There is a fair amount of 'random' variation from year to year. However, there now appears to be a consistent ranking of the main parties in the order Unionisers, Preservatives, Federal Liberators and the Draconian Party.

The Presidential Party has never had much support.

[1 mark for each valid comment, maximum 4]

[Total 6]

For reference, here is the original data on which these charts were based:

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Preservatives	39%	37%	39%	32%	37%	22%	22%	21%	28%	22%
Unionisers	28%	25%	27%	27%	22%	33%	38%	42%	33%	30%
Federal Liberators	9%	9%	13%	9%	7%	17%	14%	8%	17%	20%
Presidential Party	4%	2%	1%	6%	6%	7%	2%	6%	0%	1%
Draconian Party	2%	1%	4%	1%	2%	11%	10%	16%	12%	12%
None of the above	8%	9%	5%	10%	9%	4%	6%	3%	4%	6%
Don't know	11%	17%	12%	14%	17%	7%	7%	4%	5%	9%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

CP2 Assignment X3 – Instructions

This assignment requires an Excel file containing the spreadsheet model.

This can be downloaded from the ActEd website at
www.acted.co.uk/help_and_advice_CP2.html

Read the background document, which describes the scenarios that need to be modelled and documented for this project.

Read the audit trail, which has been written by your colleague, another actuarial student, for the calculations that they performed. This will assist you in following and understanding the calculations performed in the Excel model provided.

You are not required to add to or amend the audit trail.

You should assume that your colleague's calculations have been checked and are correct.

1.   **Spreadsheet model**

        (i)   Expand the spreadsheet model **CP2 Assignment X3 spreadsheet.xlsx** to produce
                 the required additional calculations for the additional scenario.   [6]

        (ii)   Incorporate the proposed flat-rate system in the calculations and in the two
                 existing charts.   [4]

You should ensure that the additional work you undertake on the spreadsheet contains appropriate self-checks and you should not overwrite the existing calculations.

2.   **Charts**

        Construct, for each of the following, a chart suitable for publication in a newspaper to illustrate:

        (i)   a comparison of the amount of income tax payable by individual workers on each
                 of the six income levels under the proposed flat-rate system and the current
                 system

        (ii)   how the total amount of tax collected by the government under the current
                 system breaks down according to the pay level of the workers.   [10]
                                                                                        [Sub-total 20]

3.   Summary document

Prepare a summary document of five to seven pages, capturing the main features and results of the work done by you and your colleague. You can assume that the summary is being prepared for your manager, a senior actuary, who will present the work to a government representative.

Your summary should include the following:

•   purpose of the project, data, method and assumptions used by you and your colleague

•   results, including relevant tables and charts

•   commentary on the results

•   key conclusions

•   suggested next steps.

Comments on the results should cover, but not be limited to:

•   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.

Next steps need to be specific to the project, with some mention of why each is a valid next step.

The summary should cover the full scope of the project, including the current approach that was modelled in the spreadsheet provided.

You are not required to add to or amend the audit trail.

Marks available for the summary:

(i)   Methodology (including purpose, data, method and assumptions)   [20]

(ii)   Results, including charts   [10]

(iii)   Commentary on results and conclusions   [20]

(iv)   Next steps   [20]

(v)   Drafting   [10]
                                                                                     [Sub-total 80]

                                                                                     [Total 100]

Background

Your company has been asked by the government of Taxland to help them review the amounts of income tax and the average tax rates paid by workers.

The current system operates by dividing an individual's annual income into four bands, which attract different tax rates, as shown in the table below.

Band	Income	Tax rate
Band 1	0 - 10000	0%
Band 2	10000 - 50000	20%
Band 3	50000 - 100000	40%
Band 4	100000+	50%

For example, for a person who earns 75,000:

$$\text{Tax} = \underbrace{10,000 \times 0\%}_{\text{Band 1}} + \underbrace{40,000 \times 20\%}_{\text{Band 2}} + \underbrace{25,000 \times 40\%}_{\text{Band 3}} + \underbrace{0 \times 50\%}_{\text{Band 4}} = 18,000$$

$$\text{Average tax rate} = \frac{18,000}{75,000} = 24\%$$

In their calculations the government assumes that pay levels in the population have the following structure:

Level	Average income	Number (million)
Level 1	5000	5
Level 2	15000	10
Level 3	25000	20
Level 4	45000	10
Level 5	75000	3
Level 6	150000	2

They wish to look at the effect on the overall amount of tax paid and the average rate of tax paid (as a percentage of pay) by workers at each income level if they make the following changes to the tax bands and rates:

(a)   increasing the threshold between Bands 1 and 2 from 10,000 to 12,500

(b)   increasing the tax rate for Band 3 to 45%

(c)   increasing the tax rate for Band 4 to 60%

(d)   applying all of (a), (b) and (c) together.

Additional scenario

The Government of Taxland now wishes to explore an additional scenario where all workers pay a flat rate of income tax of 18%, irrespective of their level of income. Under this system there is no 0% band for low earners. Your manager has asked you to update the existing model for this scenario.

Audit trail

Introduction

The government of Taxland are reviewing the bands and rates currently used to calculate income tax for workers.

They have asked us to investigate the effects of some proposed changes to their current system.

The purpose of the model is to calculate the total tax that will be collected, and the average rate of tax, under the current system and under some proposed alternative arrangements. Graphs comparing the total tax and the average tax rates are also produced.

The accompanying Excel spreadsheet includes all the calculations that have been carried out. Detailed descriptions of each worksheet are set out below.

The following colour conventions have been used:

- Pale shading (orange) indicates input cells that can be changed by the user

- Dark shading (green) indicates key results

- Checks are shown in green

- Warning messages and cells requiring special attention are shown in red.

Data

The government's tax department have provided a table showing a breakdown of income levels within the working population.

Assumptions

The spreadsheet model makes the following assumptions:

- The population data accurately represents the worker population and this will not change.

- The tax payable by workers is calculated correctly by the authorities and collected in full.

- Pay levels will not exceed 1,000,000.

- There are no increases in pay levels.

- Changing the tax system will not affect workers' pay.