Mastering CM1 and CM2 exams: support and guidance from the experts

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Actuarial Education Company (ActEd)

The Actuarial Education Company
on behalf of the Institute and Faculty of Actuaries

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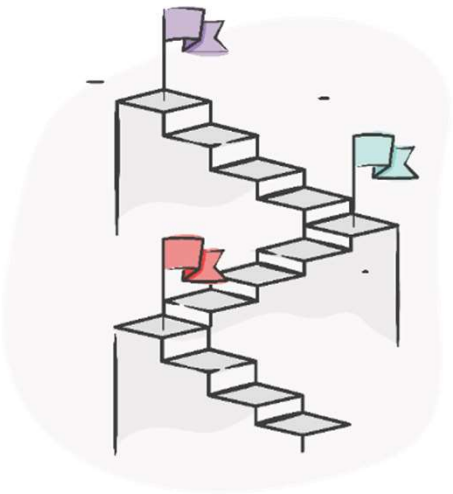

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- Educating student actuaries for 35 years
- One of the largest, most experienced, actuarial educators in the world
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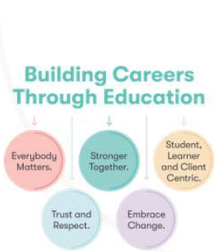
Introduction to CM1 and CM2 exams



CM1: Actuarial Mathematics for Modelling

CM2: Economic Modelling

- (70%) Paper A: 3hrs 20mins Word

- (30%) Paper B: 1hr 50mins Excel

actuaries.org.uk/qualify/curriculum/actuarial-mathematics/

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IFoA rules and guidance

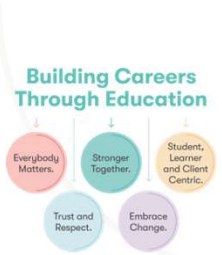
Be familiar with the latest rules and guidance:

- Assessment Regulations
  - actuaries.org.uk/qualify/prepare-for-your-exams/assessment-regulations/
- Examinations Handbook
  - actuaries.org.uk/qualify/examinations-handbook/
- IFoA exams information
  - actuaries.org.uk/qualify/my-exams/ifoa-exams/
- Mitigating circumstances policy
  - actuaries.org.uk/qualify/after-exams/mitigating-circumstances

Open book exams

Using notes and reference materials

A poll for you …

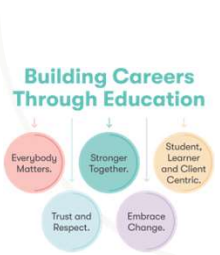


Open book exams

Using notes and reference materials

- **You can…**
  - use built-in Help functions
  - use any standard function available in Word or Excel, except Macros
  - refer to written/electronic reference material provided in exam
  - refer to your own personal notes and course materials
  - copy and paste data or formulae / workings from Excel into Word, or include screen shots provided the full workings out are visible to be marked
- **You can't…**
  - use pre-existing templates or calculations (unless provided in the exam materials)
  - include links to any other documents in your script – all calculations should be present in the files submitted in full
  - use handwritten answers – keyboard entry only permitted (unless agreed otherwise with IFoA)

Exam technique



- Time management
- Ordering questions
- Reading and interpreting questions
- Using MS Word
- Using MS Excel

Time management & ordering questions

- Spread out time evenly
- Minutes per mark (1.8 in Paper A, 0.9 in Paper B, plus 20 minutes spare)
- Aim to answer/attempt all questions (and part questions)
- Be prepared to move on
- All questions need doing – (start with something you like the look of, *eg* a loans question in CM1, or run-off triangle in CM2)
- Consider the order but don't waste too much time
- Finish on time

Using MS Word for equations

	Keyboard entry	Equation Editor	Copy from Excel
Approach	IFoA suggested notation (Examination Handbook) But anything sensible is OK	Use Equation Editor function within Word	Copy the formula used for a calculation in Excel
Advantage	Quicker to input	Clearer / more familiar	Avoids duplication
Disadvantage	Harder to read / check	Takes time to learn & more time consuming for most	Won't work for everything Care showing working
Tips	Keyboard shortcuts Recently used symbols Frequently used expressions	Keyboard shortcuts	Name cells Use the 'Show formulas' button

Practice to see which you feel most comfortable with. You can also use a combination of approaches, whatever feels best for the question.

Using Word – keyboard entry examples

	IFoA recommendation
$i^{(p)}$	i(p)
δ	delta
$\bar{a}_{\overline{n}\|}$	abar:<n>
$a^{(p)}_{\overline{n}\|}$	a(p):n>
$\frac{I_y}{I_x}$	Ly/Lx
${}_k p_x$	kpx
$\ddot{a}^{(p)}_{x:y:\overline{n}\|}$	adue(p):x:y:<n>

Full list in the IFoA examinations handbook

actuaries.org.uk/qualify/examinations-handbook/

Also worth an internet search for 'Word shortcut keys' to find

support.microsoft.com/en-gb/office/keyboard-shortcuts-in-word-95ef89dd-7142-4b50-afb2-f762f663ceb2

As well as frequently used: Ctrl C, Ctrl V, Ctrl B *etc*

There are many more, *eg*:

Ctrl= subscript$_{\text{subscript}}$

Ctrl Shift+ superscript$^{\text{superscript}}$

which can be useful for formula, *eg* v^2

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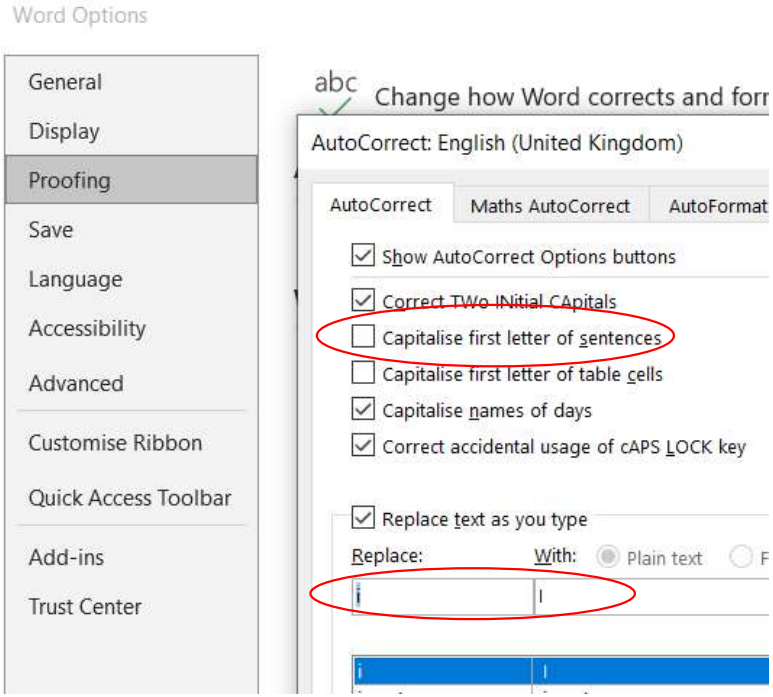
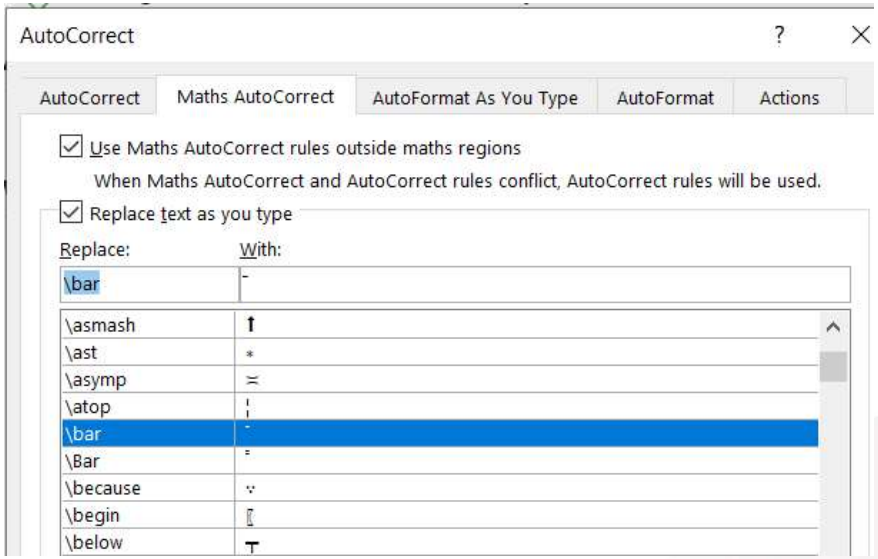
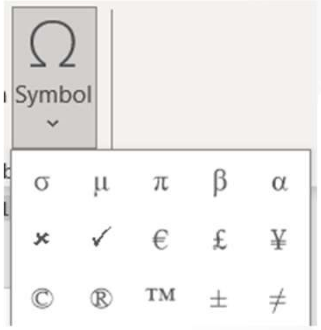
Using Word – keyboard entry tips

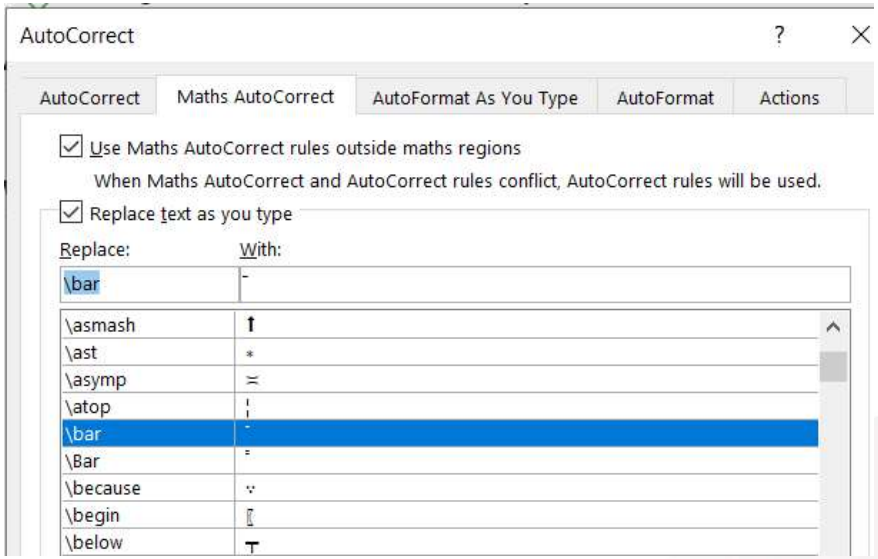


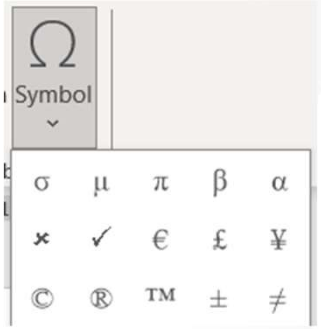




Using Equation Editor

\int	$\int$
\partial	∂
a\ddot	$\ddot{a}$
\quadratic	x=(-b±√(b^2-4ac))/2a
\alpha	α
\ge	$\geq$





Using Excel in Paper A

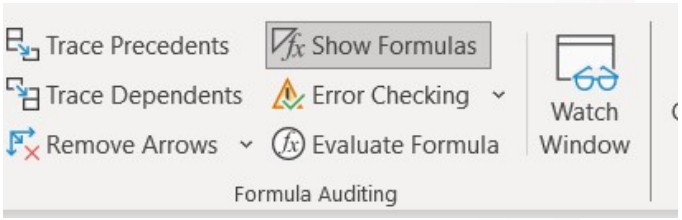
You are allowed to use Excel for Paper A.

The Examination Handbook states:

- *Data within Excel (or similar) should be copied and pasted directly into your answer file.*
- *Screen shots or image capture will be accepted for marking but you will need to ensure all workings are visible to be marked, unless specifically advised not to.*
- *Data copied from Excel (or similar) must not be 'linked' to another source file.*
- *Do not copy/insert an Excel (or similar) 'sheet' into Word.*

Using Excel in Paper A

- A number of approaches could be used
- Use a method suitable for Paper A
- You will predominately be using Excel as a calculator, with occasional use of more sophisticated functions
- Present working in a way that be easily followed – avoid excessive cell references
- Use cell/range names (if efficient)
- Use the “Show formulas” button



Writing formulas in Word - example

- As presented in an ActEd course:

$$-2,000,000+400\times 365\bar{a}_{\overline{1}|}+500\times 1.1\times 365\bar{a}_{\overline{1}|}v+500\times 1.1\times 1.01^2\times 365\bar{a}_{\overline{1}|}v^2$$

- Using MS Word Equation Editor

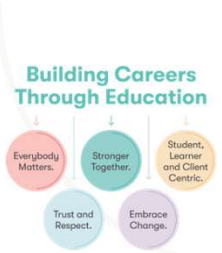
$$-2,000,000+400\times 365\bar{a}_{\overline{1}|}+500\times 1.1\times 365\bar{a}_{\overline{1}|}v+500\times 1.1\times 1.01^2\times 365\bar{a}_{\overline{1}|}v^2$$

- Using IFoA suggested notation

-2,000,000 + (400 * 365 * abar:<1>) + (500 * 1.1 * 365 * abar:<1> * v)

+ (500 * 1.1 * 1.01^2 * 365 * abar:<1> * v^2)

Writing formulas in Word - example

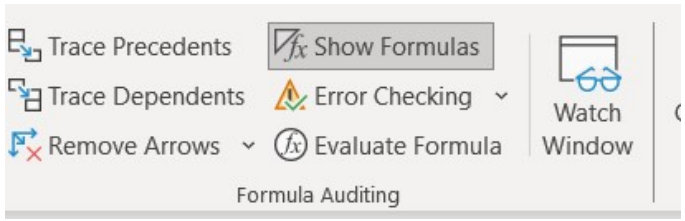


- Alternative using MS Word

  $-2m + 400*365* abar1 + 500*1.1+365* abar1 * v + 500*1.1*1.01^2*365 * abar1 * v^2$

- Or $-2m + 400*365* abar_{l>} + 500*1.1+365* abar_{l>} * v + 500*1.1*1.01^2*365 * abar_{l>} * v^2$

Or copied from working in Excel:



i	0.05
v	=1/(1+i)
abar1	=+(1-v)/LN(1+i)
=	=-2000000 + 400*365* abar1 + 500*1.1+365* abar1 * v + 500*1.1*1.01^2*365 * abar1 * v^2

i	0.05
v	0.952380952
abar1	0.975996872
=	- 1,675,328

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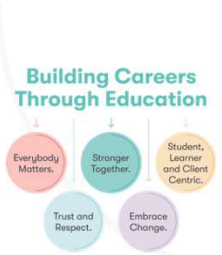
Level of detail in calculation questions

- Calculations questions often have a lot of interim steps and explanations.
- There is a balance between answering questions quickly and efficiently, and providing enough detail to convey your approach.
- A correct answer alone will not get full marks.

The Examination Handbook states:

Unless specifically advised not to, include all calculation steps, and/or sufficient formulae for examiners to understand and assess how you determined your answer.

Level of detail – avoid the unnecessary



Example

"In this question we have to find the point of minimum variance, which means that we have to differentiate the variance with respect to xA, set this equal to 0 and then solve it for xA. Then we need to differentiate again to check it is a minimum"

- None of the above is necessary – save time.
- Your workings will show what method you used.

Level of detail – tips

- You can save time by copying formulae from one line to the next, in particular where only one part is changed from line to line.
- Use Examiners Reports as a guide to understand the level of detail required.
- Note that you won't need to expand every basic formula. For example:
  - $i = 2.5\% \rightarrow d^{(12)} = 2.4667\%$ $\quad sdue^{(12)}_{<10>} = 11.3545$ is enough
  - Not:

$i = 2.5\% \rightarrow d^{(12)} = (1 - (1+i)^{-(1/12)}) = 2.4667\% \quad sdue^{(12)}_{<10>} = ((1+i)^{10} - 1) / d^{(12)} = 11.3545$

Exam technique – Commentary questions

Comment on	Give brief conclusions on.

actuaries.org.uk/qualify/prepare-for-your-exams/command-verbs-used-in-the-associate-and-fellowship-exams

Be prepared for commentary questions – don't skip them – they are often easier than you think.

Questions you can ask yourself are:

- What story is the question trying to tell?
- What part of the course is being tested and is there anything else to say *eg* some common bookwork?
- Have I explained the implication of previous answers?
- Is there anything to say from comparing previous answers with each other?
- Don't forget to state the obvious!

Example – CM1
April 2024, Paper A, Question 3(i)

Question on spot / forward rates & bond prices

Extract key information, *eg* C=4, R=103, P_1=104

Three bonds, A, B and C, each pay coupons at 4% annually in arrears and are redeemed at 103%. The outstanding terms of the bonds are exactly 1, 2 and 3 years, respectively. The prices of the bonds per £100 nominal are £104, £105 and £106, respectively.

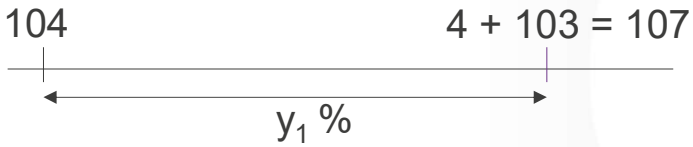
(i) Using the information above and showing all working:

(a) Determine all possible discrete spot rates.

(b) Determine all possible discrete future rates. [8]

Use a timeline, on paper, if it helps:

Then your first equation should follow, *eg*:
$104\ (1+y_1) = 107$



Finally, solve: $y_1 = 2.885\%$

Example – CM2
September 2022, Paper A, Question 8(i)

Question on CAPM

As these are the only risky assets, the market portfolio will comprise these assets weighted by market capitalisation

Consider the following assets in a world where the capital asset pricing model holds. These are the only risky assets in the market.

Asset	Expected return (% *pa*)	Total value of assets in market ($m)	Beta
Risky asset A	3.5	20	1.5
Risky asset B	2.2	30	0.2
Risky asset C	4.4	10	2.4

We are provided with the betas (and not the standard deviations), so use the security market line, not the capital market line

Write out the security market line: $E_i - r = \beta_i (E_M - r)$

(i) Calculate:

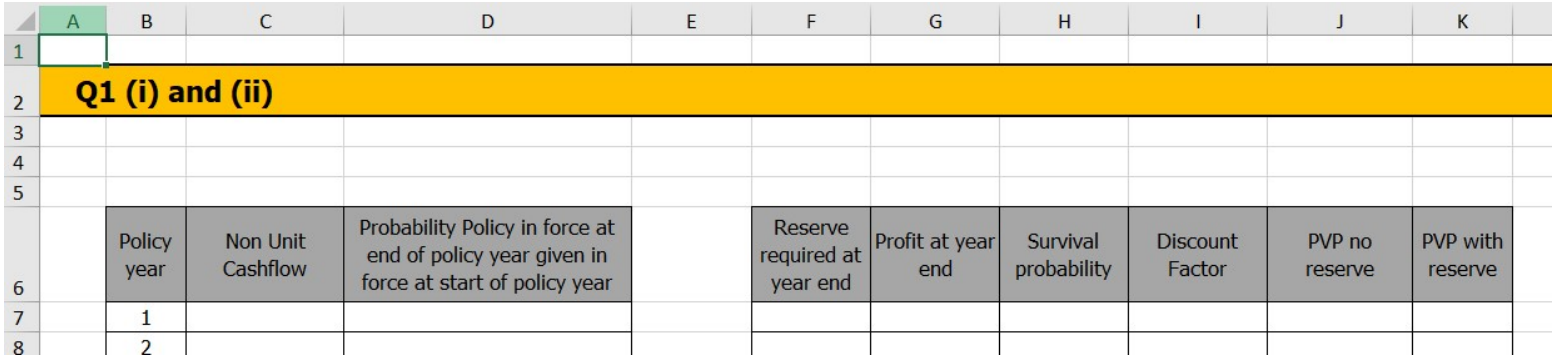
E_M is the average expected return of the market portfolio. Then use the security market line to find r.

Alternatively, use the security market line for two assets and solve simultaneously for E_M and r.

(a) the risk-free rate of interest.

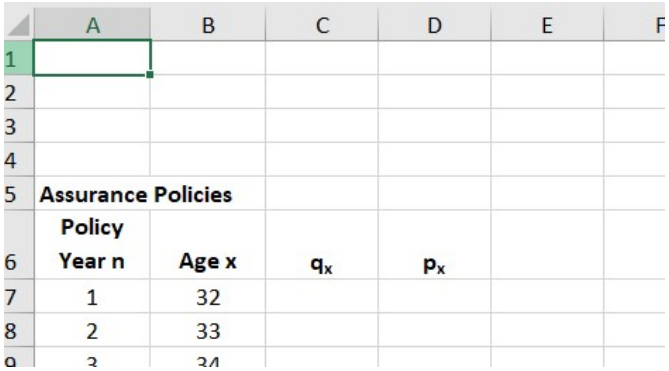
(b) the expected return on the market portfolio. [4]

Exam technique – Paper B templates



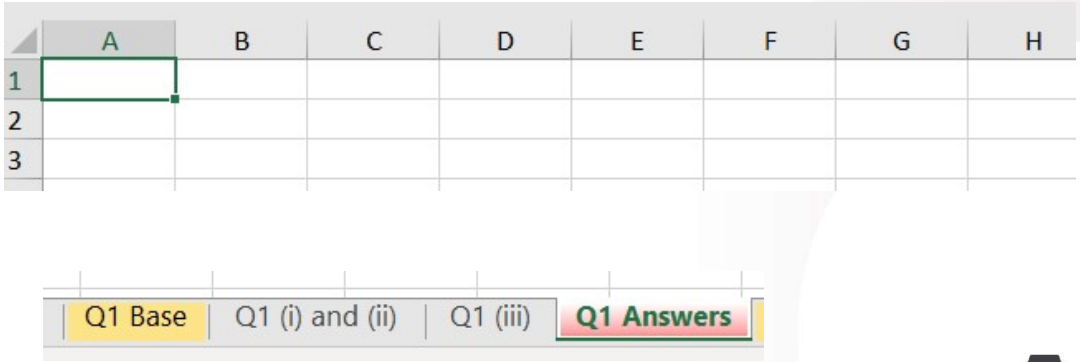
Q1 (i) and (ii)

Policy year	Non Unit Cashflow	Probability Policy in force at end of policy year given in force at start of policy year	Reserve required at year end	Profit at year end	Survival probability	Discount Factor	PVP no reserve	PVP with reserve
1								
2								



Assurance Policies

Policy Year n	Age x	q_x	p_x
1	32		
2	33		
3	34		



Q1 Base | Q1 (i) and (ii) | Q1 (iii) | Q1 Answers

Exam technique – Paper B method

- Usually many ways of approaching a question
- Using Excel naturally shows working – but keep things simple and clear
  - Often best to avoid referencing other sheets in long formula
  - Pull the data in first from the base/data sheet provided, then use it
- Don't do too much in one go – *eg* use more columns
- If not obvious, label columns or cells, so a marker knows what you are trying to do
- Regularly press F2 – check you're referencing what you intend to

Exam technique – Paper B – Goal Seek

If you use Goal Seek – tell the examiners, *eg*:

H	I	J	K	L
		PV@IRR	Set to 0 with GoalSeek,	
Project B	IRR	0.00	varying I3.	
	9.64%			

K	L	M	N	O	P	Q
			Goal Seek		?	×
Premium	403.960793		Set cell:	L3		
PV(S) - PV(P)	-		To value:	0		
PV (S)	PV (P)		By changing cell:	L2		
210.68	389.8747603		OK	Cancel		
212.47	376.2554293					
223.53	363.0671524					

Exam technique – Paper A – Goal Seek

And if using Goal Seek in Paper A (sometimes useful), ensure to show your working and say what you've done, *eg* display the equation Goal Seek solves. For example:

$$100{,}000 = 4{,}000 \times \frac{240.5}{256.0} \times v + 4{,}000 \times \frac{240.5}{272.8} \times v^2 + 104{,}000 \times \frac{240.5}{286.6} \times v^3$$

$$\Rightarrow \quad 100{,}000 = 3{,}757.81v + 3{,}526.39v^2 + 87{,}271.46v^3$$

i = -1.92%, solved using Goal Seek

BUT the question may rule out Goal Seek in Paper A by asking you, for example, to solve using linear interpolation.

Exam technique – other random tips

- Calculator *v* Excel? It's your choice!
- Ensure you can carry out basic calculations quickly (practice!)
  - Maximise the time for thinking and method, not number crunching
- Use Excel to save time, *eg* NORM.S.DIST(z, TRUE) for the CDF of a standard Normal distribution, rather than using the *Tables*
- Turn off AutoSave to avoid accidental saving of your script outside the exam time

Exam resources

- Quick reference notes
  - Make your own
  - Use annotated chapter summaries
- PC and peripherals – carry out all the required checks
- Consider a second screen
- Pen, paper, calculator, the *Tables*
- ActEd video on preparing for online exams, and other study tips

  acted.co.uk/help-and-advice.html?v=991228#study-plan

Common mistakes – before the exam

- Using pen, paper and calculator and leaving Word / Excel practice until too late
- Getting to past paper questions too late
- Not preparing your personal notes and becoming very familiar with them
  - Use them when attempting past papers – adapt them as you revise
- Not practicing Paper B until it is too late
  - We recommend using ActEd's PBOR and past papers
  - Attempting Paper B question can help develop understanding and hence help with both Paper A and Paper B
- Not carrying out the equipment checks recommended by the IFoA

Common mistakes – during the exam

- Overexplaining – avoid the unnecessary
- Providing insufficient working / detail
- Small avoidable slips
- Not providing a title, axes labels, scales, legends for graphs in Paper B
- Commentary questions, *eg* not stating obvious conclusions
- Taking too long on making equations in Word / Excel look pretty
- Poor time management and question ordering
- Not linking the question to the right part of the course
- Missing out on units, *eg* a DMT is a number of *years*
- Incorrect question labelling, *eg* labelling Q3 instead of Q4
- Opening and re-saving document after the end time
- Uploading the wrong document – take your time!

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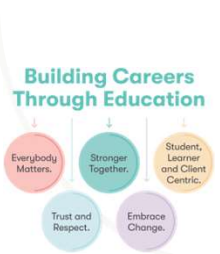
Study resources

- IFoA past papers / Examiners' Reports
- ActEd's CM1 / CM2 ASET (ActEd Solutions with Exam Technique)
- Study resources from ActEd or elsewhere:
  - ActEd Website → Subjects → CM1 / CM2
- Including Online Classroom and PBOR
- ActEd's discussion forum at ActEd.co.uk/forums

Revision tips

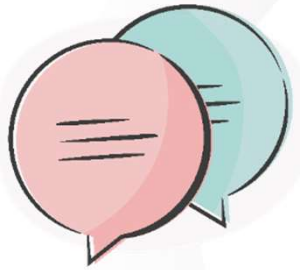
- Start revision early!
- Get to past paper question / Word / Excel practice and identify your preferred approach early (including presentation of answers)
- Practise lots of questions on the same topic to master each one
- Practise papers / questions under exam conditions for time management. They may take a while at the start but you will speed up!
- Do not neglect Paper B!

Resits …

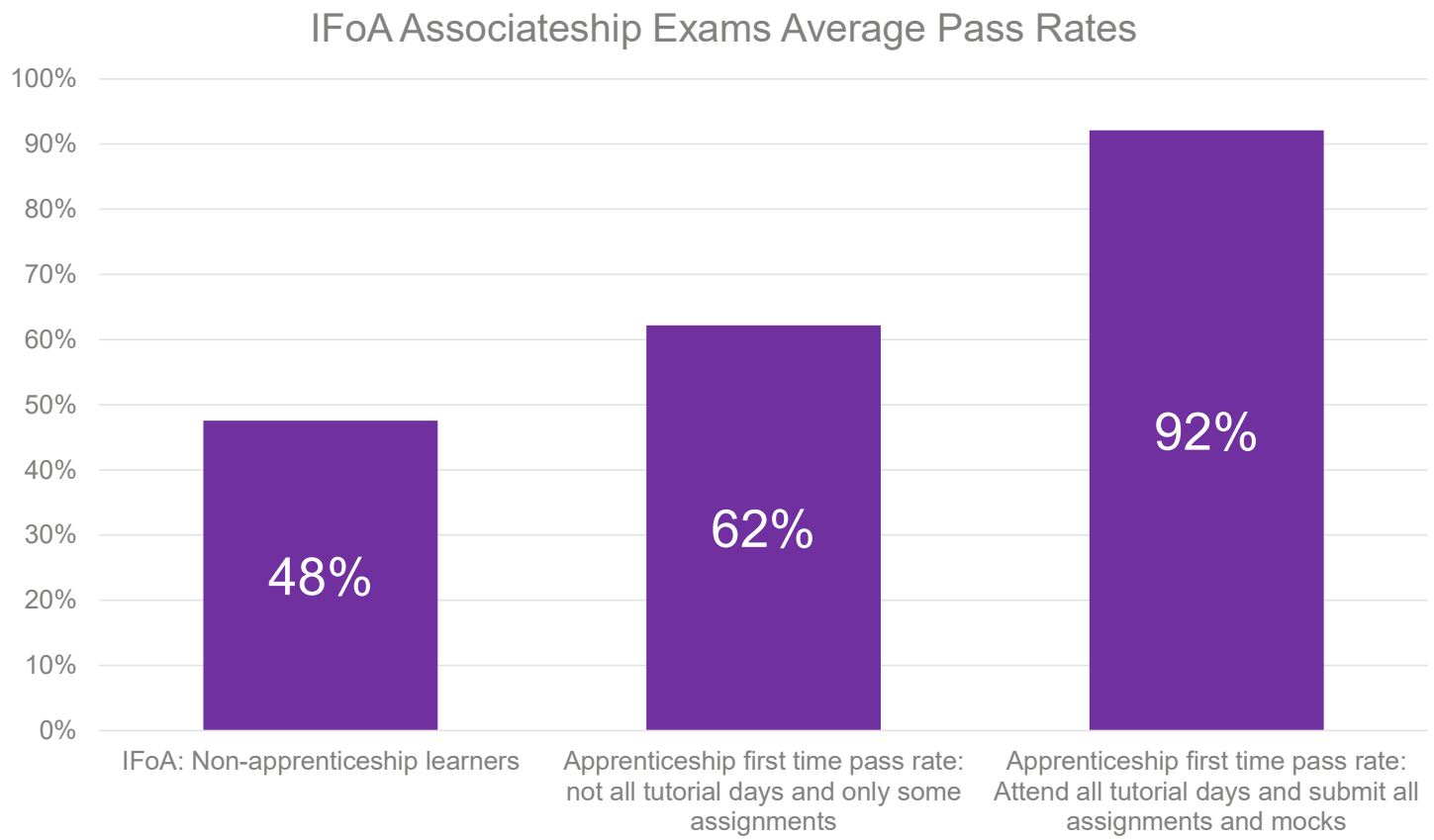


What can you do next time?

- Aim for a higher level
- More question practice
- Do something different
- Know your weaknesses
- Unused resources



Success is in your hands



BPP ActEd Level 7 Apprentices
Last 3 years of exams
First attempts in CM/CS/CB/CP exams

Further support

- Past papers — actuaries.org.uk/qualify/prepare-for-your-exams
- ActEd website — ActEd.co.uk — Subjects → CM1/CM2
- Forum — ActEd.co.uk/forums
- Tutor Talk — ActEd.co.uk/help-and-advice.html?v=827420#tutor-talk
  ActEd website → Help & Advice → Tutor Talk

ActEd@bpp.com examsupport@actuaries.org.uk

Time for questions

Thank you for your time

Good luck!

Contact us

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