



VCE Exam Advice – Unit 3 & 4 Further Maths

Before the Exam

- Further Maths revision should start with a careful review of the Study Design to ensure that all topics are covered. The Study Design should be used as headings for revision. Summary notes should be made using notes taken in class and also using summaries from your textbook. The course material should be summarised down to approximately two A4 pages for each of the subsections of Data Analysis (Univariate Data, Bivariate Data, and Time Series), two A4 pages for Recursion and Financial Modelling, and two A4 pages for the module studied. The summaries should include simple definitions, formulas, 'templates' for common interpretation questions, examples of common questions, as well as 'watchouts' such as 'ensure calculator in degrees'.
- Further Maths students are able to take a bound book of notes into the exam, and it can be tempting not to prepare summaries in the belief that they are not required. This is simply untrue. Students who prepare summaries often learn as they do so and summary sheets allow a quick reference to formulas during the exam. Many students spend far too long during the course of the exams locating a section of notes to assist them, wasting valuable exam time. Don't be tempted to use someone else's summary sheet; it may emphasise the wrong aspects of the course for you and the actual writing of the sheet is a learning experience.
- As soon as possible students should be using commercially prepared revision books, that work through individual sections of the course. These books are particularly helpful in that you can revise a section such as Univariate Data and then complete questions on just that material. Remember the first step is always revision; completing practice books comes second. Revision should involve reading through notes, and actually writing your summary as you do so. This is a good method to ensure that you are taking in the information that you are reading. After completing the section in the practice book, your summary should be considered again. Ask yourself questions such as "did it cover all the sections?", "were the notes clear?", "do I need to add any specific examples?" and having noted any deficiencies, rewrite your summary. Of course, attending prepared revision lectures with notes such as those provided by TSFX will make much of the revision process easier and ensure that your revision is appropriately focussed.
- Once all sections have been revised, commercial exam papers written for 2020 such as the TSFX trial exams, the MAV trial exams and Heffernan Exams are useful. These resources have consistently been well written and appropriate to course materials for a number of years. Be aware that some other commercial exams are not always appropriate to the course or pitched at the correct level, so if you find anything unexpected or that you are unsure about in other papers, check with the study design and/or your teacher. This will be particularly important this year to get timings right due to the altered study design for 2020.
- In the weeks leading up to the exam it is important for students to complete as many practice exam questions as possible and to constantly review the material on their summary sheet. A new study design was introduced in 2016, and it is important when completing exams from before 2016 to know which questions are still relevant (more on later in this document).

- The structure of exams has been changed for 2020. Any commercially produced 2020 practice exams should reflect this, however previous years' exams will be set out quite differently. Here is a summary of the current exam structure:

Exam 1: Multiple Choice - 40 questions

Core: Data Analysis: 20 questions Recursion & Financial Modelling: 10 questions
Modules: Module: 10 questions

Exam 2: Written Examination – 60 marks

Core: Data Analysis: 30 marks Recursion & Financial Modelling: 15 marks
Modules: Module: 15 marks

Past Exams:

- Exams from 2016 to 2019, including the NHT exams will have relevant questions, but you must be aware that they will be timed differently due to the changes made for 2020. When completing these exams to time give yourself 12 minutes reading time and 72 minutes to complete each exam.
- Exams from 2006 – 2015 will also still have some relevant questions and can be used for extra practice, but you need to be aware of what is no longer relevant. If in doubt, refer to the study design, or ask your teacher.

Reading Time / Writing Time/ Practice Exams:

- When completing exams written for this year work to an exam schedule, allow yourself 15 minutes reading time and then complete questions in the allowed 90 minutes. It is just as important to practise reading time as it is to practise writing time. Reading time should be used to read questions carefully and to think about how to approach each question. If it is a routine question, recognise that and move on. If it is a trickier conceptual question, think about a starting point or find a relevant example in your notes that might help you. Remember you may access your notes during reading time, but you may not write or use your calculator.
- Examiners' reports often make the observation that 'students appeared to run out of time', particularly in Exam 2. Keeping to time during practice exams is very important. Don't be concerned if the first exams you do seem quite long and you are unable to complete them in the allowed time. This is normal and the more you practise, the faster you will become. If you have not completed the entire exam in the allotted time it may be useful to continue after the set time using a different coloured pen. This way you get the experience of all questions, but you can evaluate how much of the exam you completed in the allotted time, and you become aware of how much quicker you need to work.
- VCAA have made the stipulation that the written exam (Exam 2) needs to be completed in black or blue pen. This is because exam papers are now scanned for assessing, and it is imperative that your work is clear and easy to read. It is important for you to practise completing exams in black or blue pen, and in fact it would be a good habit to get into when completing your classwork and your homework also.
- Make sure that you answer exactly what is being asked. Mark the exams using the VCAA assessment reports as a guide and carefully review any section that you have not completed well. Don't be tempted to refer to answers during the course of a practice exam. The exam should be completed as you would a proper exam and you need to practise the skill of being able to continue in a question even when you are unsure that you have the first part correct. If your first part is incorrect, you can still pick up marks, so long as you show that you have used your incorrect answer from a previous part.

- Many questions in exams are repeated in another form from year to year and you should be looking out for these questions. Generally speaking about 80% of multiple choice questions have appeared in similar form in previous years' exams. Recognition of these questions and how to approach them enables you to move through the exam at a relatively quick pace, and you can spend more time on questions that appear unfamiliar.
- Both exams have 90 minutes of writing time, and the Data Analysis section of the core is weighted more heavily in both exams. In each exam this year you should aim for 40 minutes for the Data Analysis, 20 minutes for Recursion & Financial Modelling and 20 minutes for your module. This timeframe will allow 10 minutes at the end for checking your work. Please note that this is just a general guideline. You may have particular strengths / weaknesses that allow you to finish some sections more quickly than others. Generally speaking, the earlier questions in each section will require less work and time than the later questions in each section.
- While you should aim to complete the exam within the time frame, you should also allow enough time to do each question properly. A common mistake is to rush through and assume that then you will be able to find any errors in review as you will have additional time available. Often students do not check thoroughly when they review and do not pick up mistakes they have made. Once a question has been misinterpreted once, it is often read incorrectly again in review.
- You do not have to complete the exam in sequential order. If there is a particular section of the course that you are more confident with, or feel you can complete quickly, then feel free to tackle it first. If you run out of time, you don't want to have missed a section that you think you could have done well. This is particularly relevant in Exam 1, the multiple choice exam. Easy questions are worth exactly the same marks as hard questions, so make sure that you get all of the easy marks. Don't spend too much time labouring over a difficult question worth one mark, when there will be an easy question in the next section, also worth one mark. You can always go back to the difficult question.
- Even though working is not marked in a multiple choice exam, if you show some working beside each question in the exam booklet, you will find it easier to check your work when you go back to that question. Try to avoid the trap of doing all working straight onto your CAS calculator, and then having to start from scratch when you go back to check your working.

Make use of the VCAA Website / Examiners' Reports:

- The VCAA website is an absolute must and reading the Examiner's reports when marking past papers will ensure that you answer questions in the expected manner. These reports list what was an acceptable answer for each question in that year, and also make a point of detailing unacceptable responses. For example in 2016, Exam 2, students were asked to describe the shape of a boxplot. The correct response was 'positively skewed with an outlier'. The reports states that 'common unacceptable answers included symmetrically skewed, evenly distributed, bell-shaped and normally distributed'. It is this sort of detail in examiners' reports that can really help students who read them, by alerting them to common errors and misconceptions.
- Also on the VCAA website are the rules for your bound reference, the cover sheets for the exams you will be doing and sample multiple choice answer sheets (cover sheets and answer sheets are usually added during October). Using the multiple choice answer sheets during your practice exams is useful. You should be fully conversant with the allowed equipment in the exam, the times that the exams start and how to successfully complete the answer sheet. VCAA's bound reference rules do not allow the use of removable tabs, but you can divide your notes into sections by using dividers, colour coding, indented or non-removable tabs. Officeworks will bind your reference notes on-the-spot for a relatively small fee.
- Examiners' reports have indicated that students are not reading questions correctly and they are not answering what has been asked. Practise reading carefully during reading time and using a highlighter during writing time. Use the highlighter to bring key words to your attention. When you arrive at an answer always read the question again and ensure that you have answered what was being asked.

'Show that' Questions:

- A trend that has appeared in the examinations in recent years is requiring students to demonstrate an answer to a question rather than just giving an answer. For example "Show that the average depreciation in the value of the caravan per year was \$2750." This style of question gives you the answer to a basic and appropriate calculation and you are required to *write* that calculation. *You cannot use the given number in the calculation; it must be the result of the calculation.* If a particular rule is asked for, then you cannot solve this question another way. A 'show that' question must work through the problem *towards* the expected result. You cannot use the answer to demonstrate the concept by working backwards.
- If show that questions confuse you, it is often a good idea to ignore that you already have the answer, and instead just work through the question as you would if you didn't have the answer. Of course, the answer you arrive at should be the same as what you were being asked to show.
- The given number in a 'show that' question is sometimes needed in a following question. Examiners' reports stipulate that you can still attempt the following question using this given answer, even if you can't complete the 'show that' part of the question. This is important advice for those who have difficulty responding to 'show that' questions.

Maximising your Marks:

- During reading time, note the marks available for each question. These should give you an idea of how much is expected in the answers. Questions worth two or more marks have method marks, so you must show the basics of your working for each question. Most questions in current examinations are worth only 1 mark and there are no half marks. A few questions are worth 2 marks. The examiner's reports clearly state that organised setting out is essential for high marks. They note that many students write answers without calculations for 2 mark questions, even though an incorrect answer could still be eligible for method marks or consequential marks if correct working is shown.
- In multi-part questions if you get the answer to the first part wrong, and use this in a subsequent part, you may still be eligible for consequential marks **ONLY** if you show that you used your previous incorrect answer. Of course, your incorrect answer must still lie within a reasonably expected range to earn the consequential mark. It is often wise to estimate answers where possible to exclude absurd calculation results.
- The Examiners' Reports highlight that students are urged to consider their answers within the context of the problem. If the answer seems unreasonable, then an error has been made, and may be found and corrected if time permits. When you arrive at an answer always ask yourself 'does my answer make sense?' While this won't necessarily tell you if your answer is correct, it may alert you to an obviously incorrect response.
- Don't waste time writing your answer in a sentence; it is not usually expected unless that question asks you to explain something, but do make your answer clear to the examiner by highlighting it or underlining it, particularly if your working is untidy. A recent complaint made by examiners has been a lack of legibility of answers. If the marker cannot be sure what is written then *they are obliged to mark the answer incorrect*, so make sure that your answers are legible.
- Recently rounding to a correct number of significant figures was introduced. This means it is now imperative that when you read a question, you take careful note of how the answer is to be rounded. All exam questions will explicitly state how you are to present your answers. Make sure you pay attention to this, as it would be a shame to know how to answer a question, only to lose marks because you did not pay attention to whether the rounding was to a specific number of significant figures, or to a correct number of decimal places. The exception to this rule is decimal currency which will be expected to be rounded correct to the nearest cent unless instructed otherwise.
- Make sure that your calculator is set so as not to round to a specific number of decimal places, as this could restrict you from writing answers correct to the required number of decimal places or significant figures.

- Rounding errors are punished once per section of the paper marked. As the paper is broken into about six or seven sections each year for marking this could amount to a significant penalty. If you round an answer without writing down the unrounded version first, this is NOT considered a rounding error, and is marked INCORRECT every time it occurs. The point to note from this is that you should ALWAYS write down the unrounded answer first, and then round to the required number of decimal places or significant figures.

Specific Concerns from Recent Examiners' Reports

Data Analysis:

- Classifying data and appropriate graphs for different types of data
 - Deciding whether data is ordinal or nominal (Under 50 / 50 & Over is ordinal)
 - Deciding on the type of data necessary to draw a particular graph
- Use a ruler for graphs; lines drawn free-hand in a graphical situation will not be marked correct
- Determining explanatory and response variables.
 - When information is presented in a table, students often assume that the first column is the explanatory variable and the second column will be the response variable, but this is not always the case.
- Describing the shape of a distribution
 - Ensure you use terminology appropriate to the area of the course. While boxplots and histograms can be described as positively skewed, this is not appropriate terminology for a scatterplot, which should be described in terms of direction, strength and form. A scatterplot can be positive, but not positively skewed.
 - Don't employ a scattergun approach! If your answer has additional irrelevant information and the examiner is of the opinion you are writing information without being sure what your answer is, you will be marked wrong.
- Noting whether answers should be given as a number or a percentage.
 - Read questions carefully; they will always stipulate what form the answer should be in. Multiple choice answers will generally contain both the number and the percentage answers, so double check that you've picked the right one.
- Interpreting the slope / intercept of a regression line or interpreting r^2
 - You will always be required to give interpretation answers, and there is no excuse for getting these wrong. Your bound reference should include templates of the appropriate responses, so that all you need to do is insert the appropriate value and units, and the correct variable name.
- Plotting a regression line on a graph from a given or found equation.
 - Much has been documented about students' inability to draw a regression line onto a graph. The best way to do this is to pick 2 x-values, one from the start and one from the end of the x-axis, substitute these into the regression equation to get 2 y-values, and then plot these two points, and join with a straight line.
- Understanding that outliers in a boxplot must still be considered when determining maximum and minimum values.
- Interpretation of a residual plot needs to refer to a clear pattern or randomness of a plot. Just noting that 'points are all scattered evenly above or below...' is not an appropriate response.

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- When establishing if a relationship exists (or not) between two variables, you need to mention a difference (or similarity), *as well as* quoting the values. Just one of these does not suffice.
- Students often neglect to answer questions where no lines have been left for writing; questions where you are asked to highlight something on a graph, or plot a point are often overlooked because there are no lines left for working out.

Recursion and Financial Modelling

- Confusion between the use of recursion and the use of rules.
 - Recursion begins with the initial value of V_0 , followed by the recurrence relation
 - If the question states 'using recursion' then you must show that you have used recursion
- Incorrectly assuming that you should round to the nearest 5c or 10c or to the nearest dollar.
 - Questions relating to money and finance should always be answered accurately to 2 decimal places, unless otherwise stipulated.
- Two-step problems using the financial solver, where you must first calculate one answer, and then use that answer to form part of the next calculation.
- Reluctance to use the financial solver, and instead trying to rely on the compound interest formula.

Note that in a multiple mark question, you may earn a method mark if you write down the correct input table for the financial solver.

- Not understanding that PV and FV should always have opposing signs when using the financial solver.
- Understanding how interest is calculated at each stage in a reducing balance loan.

Module 1 Matrices:

- If the answer is a matrix, you need to show brackets.
- Correctly drawing a transition matrix from given information.
- Being able to interpret information in a matrix.
- Values in a matrix need to be extracted to answer a question; just writing the matrix is insufficient. From the 2016 Examiners' Report: "Many students found the correct matrix, but did not extract the answer".
- Understanding that rules in the form $S_{N+1} = TS_n + B$ must be worked through state by state; there is no simple rule using powers.
- Clear and logical setting out and correct labelling of matrices along the way to a solution will help to maximise marks.

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Module 2 Networks:

- Recognising a planar graph when drawn in non-planar form.
- Finding a minimum spanning tree using Prim's algorithm.
- Identifying the minimum cut in a practical flow problem with more than one source.
- Criteria for a critical path and reducing this time (crashing) needs more attention.
- Understanding that arrows need to be included in directed graphs.
- Use of the Hungarian algorithm.

Module 3 Geometry:

- Checking whether your answer is reasonable – often errors can be picked up this way.
- Use of incorrect formulas for simple concepts such as circumference of a circle.
- Solving problems using scale factors continues to be an issue for many students. Students need to understand the relationship between length, area and volume scale factors and be able to apply them to written questions.
- Solutions are often poorly set out and method marks can't be allocated. To be considered for method marks even if the answer is incorrect, you need to set out a solution that shows multiple steps and calculations.
- Rounding answers too early in a question requiring more than one calculation. Rounding should not take place until the final answer (and you should also show the unrounded answer prior to this). You are however welcome to use a rounded answer from a previous question in an extended response question, but always show that this is what you have done.
- Questions to do with distances around the earth and time zones are not well answered. Expect these to be revisited in future exams.

Module 4 Graphs & Relations:

- Consideration of whether to round up or down to an integer and whether an answer is reasonable needs to be considered in the context of the question.
- Being able to write a constraint in a mathematical form, when it is given in everyday language.
- When interpreting an inequality, reference needs to be made to that inequality (i.e. 'no more than', or 'less than or equal to').
- The use of the sliding line to understand maximising or minimising feasible regions. From the 2016 Examiners' Report: 'The majority of students either had no understanding of the sliding-line technique or applied it inaccurately...'. Expect this to be revisited in future examinations.
- The study design specifically states that students should shade the feasible region not outside. You should clearly label which part of the graph is the feasible region.

This Year's Exams

- This year's exams are likely to reflect concepts that have been poorly handled over the last few year's exams, which is why reading examiners' reports can be so advantageous.
- As in the past, the use of your calculator is mandatory, but many questions will test your underlying understanding of concepts rather than just relying on the calculator.
- In all modules you should expect to *demonstrate* solutions rather than just give a calculated answer as this method of assessing your knowledge is widely used.

Some Final Words of Advice:

- You should expect the majority of questions in this year's papers to be worth only one mark each, as this has been an increasing trend, with a small number of two mark questions. You should expect questions to have a range of levels of difficulty so that students will be able to be separated in terms of ability. With this in mind you must revise ALL concepts in order to be fully prepared, rather than just concentrating on aspects of the course likely to be more problematic.
- One final piece of advice that is advantageous in both exams – after every question, ask yourself two things:
 - Have I answered the question?
 - Does my answer make sense?

More subject specific advice will be issued to students at our "VCE Exam Revision Lectures".

Good luck with your exam preparations!
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**vce exam
highlights**

COMPREHENSIVE EXAM REVISION LECTURES

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