

**MathsNET**A joined up approach to
teaching and learning
mathematics

Weekly workload: SOR3012

At the start of the semester you should buy yourself a hardback notebook to keep your notes inside. Stick the pages of this guide into the first few pages of your notebook and **make sure that you bring your notebook to all classes and tutorials**. Similarly buy a usb memory key or create a folder on a cloud service such as google drive or dropbox and use this to store all the word processed reports and python notebooks that you write for this module together with the feedback I provide on these assignments. If you have a laptop or tablet please feel free to bring it to all tutorials, lectures and computer classes. If you have this with you it will allow you to access the resources on my website and other online resources.

All the reports that you hand in to be assessed for this module should:

- Have your name written in the top right corner of the first page - if your name is not written on your assignment you will be awarded a mark of zero.
- Be word processed - hand written assignments will be awarded a mark of zero.
- Be free of spelling errors and basic grammatical errors - use a spell checker and/or a grammar checker (see www.grammarly.com for a free grammar checker)

SOR3012 is a 20 CAT point module and as such you are expected to work for 200 hours on this module. Over the course of twelve week semester this works out at about 16 hours per week. Subtracting from this the five contact hours a week you have for this module leaves 11 hours per week that you are expected to spend doing self study for this module. The following sections detail what I recommend you spend those 11 hours in each week working on. Lastly, notice that the conceptual equivalents for a 2.1 at level 3 state that your work must provide:

Synthesis/integration of material from other modules/experience as well as the current module, well-developed arguments with evidence of independent thought and evidence of wide and relevant use of learning resources

This is thus the main thing I am looking for when I mark the portfolio and report assignments for this module. The assessment for this module includes the following components:

- One two page report on random variables , which counts 10 towards you final module mark and which is due in at 16:00 Tuesday Week 4
- One two page report on continuous time Markov chains , which counts 10 towards you final module mark and which is due in at 16:00 Tuesday 19th December
- One portfolio of work done during the semester , which counts 20 towards you final module mark and which is due in at 16:00 Tuesday Week 13 (1st week of second semester)
- One three hour examination in which all questions on the paper must be answered , which counts 60 towards you final module mark and which is due in at April exam period



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A recommended work plan for the weeks that follow is given on the following pages

Week 1

Read notes and watch all videos on random variables in content and understanding sections of website. Use comprehension exercises to make notes on this material. Attempt programming exercises on random variables in apply section.

What we will be doing in the tutorial: No tutorial this week. Ensure you know which tutorial you will attend next week.

What work should I be handing in this week: Half page report for portfolio , which is due on 16:00 on Tuesday of week 2 .

Week 2

Finish programming exercises on random variables in apply section. Transfer what you have learnt about generating random variables from exercises in apply section to a python notebook by performing exercises on random variable in extend section. Begin writing first draft of random variable project.

What we will be doing in the tutorial: Bring multiple copies of the report that you wrote for your portfolio. We will be doing small group discussions that start by you reading each others reports on what aspects of the module you are finding easy/difficult.

What work should I be handing in this week: Half page report for portfolio , which is due on 16:00 on Tuesday of week 3 .

Week 3

Finish random variable project and try the final projects on random variables.

What we will be doing in the tutorial: Bring a draft of your random variable report to the tutorial. We will be doing small group discussions that start by you reading each others reports on random variables.

What work should I be handing in this week: Half page report for portfolio , which is due on 16:00 on Tuesday of week 4 . Short report on random variables , which is due on 16:00 on Tuesday of week 4 .

Week 4

Read notes and watch all videos on the central limit theorem in content and understanding sections of website. Use comprehension exercises to make notes on this material. Attempt programming exercises on the central limit theorem from the apply section.

What we will be doing in the tutorial: You will be attempting some short problems on the central limit theorem in groups during the tutorial. Please make sure that you can state the central limit theorem and that you know how to calculate a confidence limit before the tutorial.



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What work should I be handing in this week: Half page report for portfolio , which is due on 16:00 on Tuesday of week 5 .

Week 5

Finish programming exercises on central limit theorem in apply section. Transfer what you have learnt about the central limit theorem from exercises in apply section to a python notebook by performing exercises on the central limit theorem in the extend section.

What we will be doing in the tutorial: Please bring your random variables report and the feedback that I wrote about your random variable report. In class you will be doing a discussion exercise with your peers in which you read my feedback and think about what you could do differently to make your subsequent projects better.

What work should I be handing in this week: Half page report for portfolio , which is due on 16:00 on Tuesday of week 6 .

Week 6

Attempt to finish at least one of the projects from the extend section of the section of the website about the central limit theorem. Attempt the problem on estimating the area of the Mandelbrot set.

What we will be doing in the tutorial: Bring your ideas and notes on how to solve the final project for the central limit theorem. To be clear the project in question is the one about determining the area of the Mandelbrot set.

What work should I be handing in this week: Half page report for portfolio , which is due on 16:00 on Tuesday of week 7 .

Week 7

Read notes and watch all videos on Markov chains in discrete time in content and understanding sections of website. Use comprehension exercises to make notes on this material. Attempt programming exercises on the Markov chains in discrete time from the apply section.

What we will be doing in the tutorial: You will be attempting some short problems on Markov chains in discrete time during the tutorial. Please make sure that you can state the Markov property, use the Chapman-Komogorov relation and determine whether states in Markov chains are transient or recurrent before the tutorial.

What work should I be handing in this week: Half page report for portfolio , which is due on 16:00 on Tuesday of week 8 .

Week 8

Finish programming exercises on Markov chains in discrete time in apply section. Transfer what you have learnt about Markov chains in discrete time from exercises in apply section to a python notebook by performing exercises on Markov chains in discrete time in extend section.



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What we will be doing in the tutorial: You will be attempting some short problems on Markov chains in discrete time during the tutorial. Please make sure that you can state the Markov property, use the Chapman-Komogorov relation, determine whether states in Markov chains are transient or recurrent, calculate stationary distributions for Markov chains and hitting times and hitting probabilities. To do the last two of these things you will need to know how to use Gaussian elimination and how to invert matrices. You have been shown in other modules how to multiply and invert matrices and how to use Gaussian elimination. If you need to revise this material do so. I will not be going through it again.

What work should I be handing in this week: Half page report for portfolio , which is due on 16:00 on Tuesday of week 9 .

Week 9

Finish programming exercises on Markov chains in discrete time in extend section. These are more difficult than the projects in previous weeks so you may not have time to do the final project on Markov chains in discrete time. If you have the time, however, you should definitely attempt it.

What we will be doing in the tutorial: You will be attempting some problems on Gamblers ruin and the Ehrenfest urns. You should thus have familiarised yourself with these problems by performing the associated programming exercises in the extend section of the section of the website on Markov chains in discrete time.

What work should I be handing in this week: Half page report for portfolio , which is due on 16:00 on Tuesday of week 10 .

Week 10

Read notes and watch all videos on Markov chains in continuous time in content and understanding sections of website. Use comprehension exercises to make notes on this material. Attempt programming exercises on the Markov chains in continuous time from the apply section.

What we will be doing in the tutorial: You will be attempting some short problems on the Poisson process during the tutorial. You will do the questions under exam conditions but you will be allowed to use your notes. To do these problems you will need to be able to solve variable separable first order differential equations and to solve first order differential equations using an integrating factor. Both of these techniques are covered in the first year and I will not be going over this material again. Therefore, if you need to revise this material please do so. Furthermore, notice that the required mathematics is covered in the videos on the Poisson process.

What work should I be handing in this week: Half page report for portfolio , which is due on 16:00 on Tuesday of week 11 .

Week 11

Finish programming exercises on the Markov chains in continuous time from the apply section. Transfer what you have learnt about Markov chains in continuous time from exercises in apply section to a python notebook by performing exercises on random variable in extend section. Begin writing first draft of project on Markov chains in continuous time.



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What we will be doing in the tutorial: Bring a draft of your Markov chains in continuous time report to the tutorial. We will be doing small group discussions that start by you reading each others reports on Markov chains in continuous time.

What work should I be handing in this week: Half page report for portfolio , which is due on 16:00 on Tuesday of week 12 .

Week 12

Finish report on Markov chains in continuous time. Attempt final project on Markov chains in continuous time and gather the two reports (which should by this stage already be written) to hand in for portfolio.

What we will be doing in the tutorial: Drop in session for you to ask for advice about what to hand in for your portfolio.

What work should I be handing in this week: Two best reports for portfolio - please hand in as a single document , which is due on 16:00 on Tuesday of week 13 (i.e. first week of second semester) . Report on continuous time Markov chains , which is due on 16:00 on Tuesday 19th December .