School of Mathematics University of New South Wales

MATH3711: Higher Algebra (2007,S1)
Studying for this course [1]

Mathematics went through quite a revolution around the turn of the 20th century. In particular, axiomatics infiltrated the mathematical paradigm, both as a tool to ensure mathematical rigour and to abstract common principles working in a variety of different settings. In many ways, the UNSW mathematics program reflects this historical development, in first and second year courses, you are slowly introduced to axiomatics and when you reach third year, it seems to become all-pervasive. The axiomatic revolution took mathematicians quite a long while to swallow, so don't expect to come to terms with it immediately. Third year pure maths courses differ from those in 1st and 2nd in many other ways too and most likely, you will have to adapt your learning patterns to cope. Below are some tips that you will hopefully find useful. Throughout the course of the session, you should look back at this handout periodically. It will make more sense to you after seeing some lectures and doing some tutorial problems.

How 3rd/4th year pure maths courses differ from 1st/2nd year ones

- For most 1st/2nd year courses, the basic skills required to answer questions are computational. In this course, the basic skills are logical and set-theoretic. If you have done discrete maths, then this should not be a problem for you.
- In most 1st/2nd year courses, the questions in tests are usually the same as in your homework, just with some of the numbers and other minor details changed. This is no longer the case in this course. Often, changing numbers slightly will turn an easy problem into an impossibly hard one.
- There are far fewer homework questions in third year courses. You will need to find other ways to learn the material. The next section contains some suggestions.

Some different learning patterns

At school, you are told that you learn by paying attention in class, reading the textbook and doing questions. Many of you will supplement this with other learning activities too. After your undergraduate career, whether you continue with postgraduate work or pursue a non-academic career, you will have to learn without pre-assigned homework questions.

To make up for the lack of homework exercises in this course, you should come up with your own questions and, perhaps more importantly, just toy with the ideas presented in class. This is an essential part of the learning process and many of you, do this already. To kick you off in this direction here are some suggestions.

[1]by Daniel Chan

- Whenever you meet a new concept, ask yourself why you should study it and its role in the bigger picture of mathematics. Does it remind you of other concepts or examples you have seen before?

- Many results/ideas regarding groups and rings have their analogues for vector spaces. Each time you see a new concept, ask yourself if there's a version for vector spaces. If so, try to understand the vector space analogue. In what ways does the vector space analogue capture the flavour of the group or ring version?

- For every definition you read, try to find a stereotypical example and a perverse example. How typical is the stereotypical example? How perverse is the perverse example?

- Have your pet examples of groups, rings etc. Whenever you read a proof, see how it works on your pet examples.

- Whenever you read a proof, try to find a new proof that makes more sense to you. Can you generalise the proof? Does the proof simplify if you add some (mild/strong) hypotheses? Can you strengthen the proof to omit some hypotheses?

- Whenever you read a theorem, try to find a counter-example! No I'm not joking. Just because it's doomed to failure (hopefully) doesn't mean you won't learn from this exercise. Indeed, any counter-example to the conclusion of the theorem must fail one of the hypotheses so this will give you an appreciation of the hypotheses. Also, many mathematical results are discovered when people try to find counter-examples, are unsuccessful, and then eventually prove that you can never be successful.

I will be helping you do these things throughout the lectures, tutorials and in the problem sheets. In some ways, reading mathematics is like reading a good thriller, you can't wait to turn the page. The difference is that mathematics often needs to be read slowly. Indeed, sometimes mathematicians will read a short definition and then spend half an hour pondering over it before reading on.