

Advice for mathematics majors (Gorodetski, Reilly, Occhipinti, Pantano)

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1. Work hard

Do not expect to understand everything on the spot. It is absolutely normal to struggle with the material of an upper division math course. Just put more effort, more studying time, and ask more questions. Figure out what you can do to improve the way you study.

2. Choose courses properly

- *Choose the courses you actually need.* Having a serious motivation for taking a course will help you succeed in it. Choose your courses according to your career goals (e.g., an actuary must take courses in probability; an applied mathematician working in industry must take courses in differential equations, dynamical systems, and computational math). If you are heading to graduate school, figure out what math you love, and strive to get deeper background in those areas, so you can start research sooner.
- *Take sequences in consecutive quarters*
- *Do not believe in rumors.* Upper division courses may not be easier in summer.
- *Do not overload the first quarter in your junior year.* Avoid taking 140A, 120A and 121A all in the same quarter.

3. Make the most of your textbooks

- *Read the textbook in advance.* You'll get the most of your lectures.
- *Check out other books.* Go to the library and find the textbook that best suits your learning style. See a different approach. Find extra problems for practice.
- *Try to link the material in the textbook to the material from lecture.* Be aware that there may be material in the textbook that is not covered in lecture, and vice versa, or that is presented using a different notation.
- *Read your math textbook actively.* Have pencil and scratch paper next to you. When you meet a new definition, write it down, and construct examples and non-examples. When the book implies that something is obvious and you don't see it immediately, work it out. Make sure to work through all the key examples. If there is something you do not understand after investing this effort, talk about it with a classmate or ask your TA or professor.
- *Use the index.* Use the index of the textbook to guide your review, asking yourself questions about definitions and basic material.

4. Ask questions in class

Talk to the TA. Talk to the instructor. Talk to your classmates. **Ask questions! As many questions as you can, and as often as you need!**

5. Attend office hours

Start attending office hours at the beginning of the quarter (with a friend, if you feel intimidated). Before you go, **make sure you have a good question.**

Sample **bad** questions:

- How do I do it?
- What is the answer?
- What does this word in the problem statement mean?

Sample **good** questions:

- ✓ I have looked the word _____ up in the index of the book, and read the book's definition on page 63 of the text, but I do not understand what it means by _____.
- ✓ I have attempted the following solution, but I feel stuck. Let me show it to you by writing it on the board and explaining my thought process.
- ✓ I am struggling to understand _____. In lecture you worked out this one example about _____, but I do not understand it. Can we go over that again?

6. Make the most of your lectures

Copying accurately everything from the board into your notes does not give you a chance to actually understand what is going on. Most of the things you might be copying are already in the textbooks. **Use the time to listen to the instructor and ask questions.**

Do not feel intimidated if a classmate "gets the math" much more quickly than you do. Most upper division students succeed in math because they try really hard.

7. Study in the correct way

- **Know your definitions.** You should be able to correctly state every definition in the course, and create examples and non-examples off the top of your head. The math major's MOTTO should be: "*If nothing else works, try using the definitions*".
- **Learn** the difference between "If" and "Only if", "Necessary" and "Sufficient".
- Expect to be asked to state a definition or a theorem on every quiz.

8. Work diligently on your homework assignments

- Use scratch paper. **Write down all the definitions, try out some examples.** Don't be afraid to write things that are wrong, you are brainstorming.

- Be sure to **use theorems and propositions** from lecture when working on homework. Deducing *everything* from the definitions may be very difficult.
- Mathematics (and being a mathematics major) is very **difficult and time consuming**. Do not despair if you spend two hours on one homework problem.
- **Start your homework early** so that you have plenty of time to think about the questions and let them simmer.
- Write **excellent solutions to homework problems**:
 - ✓ Do not make excessive use of logical symbols
 - ✓ Use complete sentences
 - ✓ Detail the key steps of the problem (not the computations)
 - ✓ Do not include information you do not use
 - ✓ Identify where each hypothesis in the statement is used.
- **Reflect** on the homework problems. “*What was the key point?*”
- On average, students who type their homework do FAR better than those who do not. **Learn LaTeX**.
- Even if you study with a friend, **always write solutions by yourself**.
- Do *not* attempt to solve homework problems right after lecture. **Take the time to read and understand the theory before you work on problems**.

9. Make effective use of study groups

The best way to learn is to teach. As you explain to others the concepts you understand better than they do, you may discover areas where you still need to clarify things.

What to do in a study group

- ✓ Read the textbook and review the class notes on your own; mark the most difficult parts, try to figure them out on your own before asking for clarifications.
- ✓ Ask each other to state theorems and definitions; verify you state them correctly.
- ✓ Reflect upon *the ideas* behind theorems and why they are important.
- ✓ Create examples and non-examples for each definition you encounter.
- ✓ Review the theory and the examples you have worked out, then come up with “strategies” to solve certain problems, and a list of “facts” and “properties” you may use in solving them.
- ✓ Prepare an interesting list of questions, and go to office hours together.
- ✓ Do an *ongoing* review of the material. When you are done with your weekly homework, spend a little extra time on problem from previous sections.
- ✓ Ask the instructor to activate the message board on EEE.

What not to do in a study group

Do not work on homework in groups of more than two people. You will not learn anything if other people do your work for you. Make sure you understand every step.