

# Math Survival Kit

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## 1 Introduction

This capsule is intended as a guide to the ins and outs of introductory courses in mathematics. It includes information on courses, grades, classes, instructors, exams, studying, and resources. It is by no means comprehensive and you will probably have questions that it does not answer. We have tried to answer questions that students ask most often. If you have other questions, ask your instructors: they will be glad to help you.

This is not a recipe for learning math without doing any work, nor is it a guide which will guarantee you an A. Some of these suggestions will prove useful to you; others may not help you at all. If you have suggestions for this handout let somebody in the Math Support Center know: it will benefit the students who come after you.

Since students taking math courses will necessarily be given grades, this kit attempts to give you some practical suggestions for doing well in these courses. But the students who do the best in their math courses are normally those who really understand the concepts and are able to apply them, so the emphasis here is on tips for learning and understanding mathematics, with good grades hopefully coming as a result.

Some of you may dislike thinking about mathematics or feel quite anxious about your math courses. For these students there are some references at the end of this module that may be useful

and interesting. The goal we have in mind is for you to become comfortable with the concepts you are learning and to have some fun working with them.

A key message we hope you will get from this discussion is that if you take ownership of the learning process you will get the most satisfaction, enjoy your courses, and in the long run do your best.

Some of you may be thinking about the possibility of a major in mathematics. If this applies to you, follow the link labeled “Undergraduate Study” at the department website ([www.math.cornell.edu](http://www.math.cornell.edu)). You will find a lot of information about the major at this site. We hope that you enjoy your mathematics course(s) this semester and end up at least thinking about a math major.

This capsule contains the following sections:

- Courses
- Grades
- Classes, the Instructor(s) and Homework
- Exams
- Studying
- Resources
- Summary

## 2 Courses

Before you do anything else, make sure you are in the right course! This can mean one of two things. In the first place you may not be registered for the course you plan to take (or you may be registered for a course you don’t want). Check your class schedule on Just the Facts to make sure it is correct.

You might also want to know whether you belong in a certain course or not. Talk to your instructor first. If you have questions about prerequisites (e.g. if you are a transfer student or took some calculus elsewhere), AP credit, transferring credit, the different course sequences, or courses in general, a good place to look for answers is on the Mathematics Department website. Go to the site [www.math.cornell.edu](http://www.math.cornell.edu) and follow the link labeled “Courses”.

If you are interested in adding a course it is often useful to talk to the instructor who is teaching it. To find out who that is look at the University Course Roster. You can link to this either from the Math Department website or from [www.Cornell.edu/Academics](http://www.Cornell.edu/Academics). If you have questions that are not answered by using the information on the department website or by talking to a specific instructor, you can talk to Prof. Lars Wahlbein (573 Malott Hall), the Director of Undergraduate Studies.

## 3 Grades

Although the main emphasis of this capsule is how to learn mathematics and enjoy the process, the subject of grades is of course always in the background (or sometimes in the foreground). So before going on let’s address the issue of grades.

Grades have a way of making people unhappy, instructors included. Nobody likes to receive low grades and most instructors would be happy if everyone in the class earned a high grade. So how can you do well in your math courses?

Everyone would rather receive good grades than bad ones. But worrying constantly about grades may not be the best thing even if all you want is that “A”. A lot of people find college painful or boring precisely because they set the wrong objectives for themselves. The ideal reason for going to school is to learn, and keeping this in mind is likely to make the experience a great deal more satisfying.

Try to become curious about what you are learning. Ask yourself questions; ask your instructors questions. Why does this work? Why did people think of doing it this way? How can it be used? There is nothing wrong with being directed toward a specific career, but if you are, ask how what you are doing relates to it. Even if the specific techniques you learn are not used, the general approach and mental habits you develop may be important. And you may be surprised to learn later on that those concepts you learned actually do come up in practice (for example when reading a paper on medical research).

A lot of people take mathematics simply because they are required to. This is not an ideal state of affairs, but you can still benefit from the course you are taking. If you make an effort to get something out of your course, you will; if you don't make that effort it's your time that has been wasted. Concentrate on learning and the grades will take care of themselves.

The calculation of grades for courses varies with the course and the instructor, so we will not give you any general rules here. At the start of the semester your instructor will usually give you detailed information on how you will be graded for the course. This may include attendance and class participation, homework and individual or group projects as well as exams.

Instructors sometimes avoid talking about grading policy on the grounds that students will worry too much about grades. Unfortunately, people sometimes worry more when the policy is vague. So if you have this concern, talk to your instructor and you will almost certainly get a clearer picture of the policy.

According to university policy, the grade of “Incomplete” can be given only when the student has a “substantial equity at a passing level in the course ...” and “the student has been prevented by circumstances beyond the student's control ... from completing [the course on time]”. If you think you may need an Incomplete and think it is appropriate, speak to the instructor as far in advance as possible. You should not expect one simply because you do not feel like finishing the course on time.

If, after receiving your grade, you feel that you have not gotten what you deserved, you may wish to speak to the instructor about it. Do so promptly, i.e at the start of the following term if you are not able to make contact before that. While instructors are usually patient with requests for changes and want to make sure you were graded appropriately, they may become unhappy if they think you are nitpicking. But if your grade really seems out of line, do speak up: occasionally something is simply not recorded correctly.

## 4 Classes, the Instructor(s) and Homework

Some courses involve two or three lectures and two recitations each week. For a few such courses lectures can be large but recitations average only 20 to 25 students. Other math courses (such as Math 1110-1112) are taught as completely independent sections with no more than 25 or so

students per section. Whichever type of course you find yourself in, it is tempting to skip classes now and then. Certainly, in a large auditorium with 100-200 other people you wouldn't be missed.

Why go to class then? The most important reason for going to class is that this is the best way to learn the material. Your lecturer will try to explain *why things are true* and *how isolated facts fit together*. Getting the big picture is vital to a thorough understanding of the subject and lectures are meant to help you do it. Your instructors spend a great deal of time thinking about how to present topics in comprehensive and meaningful ways. They will lead you through relevant examples and address questions that come up. So make use of their efforts to help you understand the material. Also remember that even in the larger classes you can ask questions when you are confused. If you are confused, the chances are good that you are not alone, so be courageous and ask.

If skipping a lecture or recitation is unwise from the point of view of learning the material, skipping recitation or one of the smaller classes is also unwise for a more pragmatic reason. Your instructor or TA may appear to be in Outer Space, but don't kid yourself: they know when people skip class. They are people too and it is hard to think generously of someone who is frequently absent. Remember that your attendance and class participation are often part of your grade. And unless you have been sick you cannot expect your instructor to help you catch up on missed classes.

For the large lectures, recitations will probably stress problem-solving techniques (applying the material addressed in lecture); the independent sections will incorporate problem-solving within the lectures. In either case, your instructor will spend time working examples and homework problems, and it is a good time to ask questions and see the nitty-gritty details that are often omitted from the more theoretical treatments of the topic. People often have questions about the material covered in lecture or sections assigned in the textbook; this is the time to straighten out those points that puzzled you. Asking questions helps your instructor associate a person with the name in the rollbook. In addition, as your instructor gets to know you better, (s)he may notice that you have a particular way of looking at the material and may be able to tailor explanations to your learning style. So ask questions!

There are a number of things you can do to get more out of your classes. For example, people sometimes complain that they are so busy taking notes that they have no time to think about what is being said. If you have this problem, you might find it helpful to organize a group of students in the same class. One person (with legible handwriting) is assigned to take notes each lecture and distribute them to the group soon after the lecture. The others are then free to concentrate on what the instructor is saying. Your group can also get together regularly to discuss the lectures and the concepts taught.

Come to class prepared with questions. You will almost certainly encounter things which puzzle you when you are studying: make a note of them and bring them to class. If you miss a problem on the homework or on an exam, and you fail to understand it after looking at it again, then ask your instructor. If you clear up problems as they arise, things will be easier for you when you're reviewing for exams. You will probably find it easier to ask questions in recitation or in the smaller lectures (though most lecturers are pleased when people ask them anything); however, if you are too shy to ask questions during class, you can always ask the instructor afterward. Don't think that your questions are "too stupid" to be worth asking. If you knew all the answers, you wouldn't be taking the course. Your classmates probably have the same questions that you do. *Ask!* Every sign of interest is welcome.

On those (hopefully!) rare occasions when illness or other emergencies force you to miss class, take every opportunity to find out what was covered. You may be able to obtain the notes from

another student; you should talk to the instructor about obtaining any handouts that were distributed. Instructors understand that events beyond your control may force you to be absent; you can expect sympathy and tolerance as long as things don't get out of hand.

When you are in class be considerate of the instructor and your fellow students. Keep any conversations short and as quiet as possible. If you have a question, ask the instructor, not the person sitting next to you. Pay attention to the lecture and not to your latest text message. Think about sitting near the front of the class. It may help you concentrate more and follow the lecture more easily.

Homework is usually assigned and collected weekly; your instructor or TA will tell you when it is due. Most often, sample solutions are provided to the assignments: you should go over any problems you missed and be certain that you understand what you did wrong. If you can't figure things out by yourself *ask your instructor*. Don't wait until the week of the prelim - ask your questions while they are fresh in your mind. In mathematics new concepts often build on old ones, so it is also important to deal with any confusion you might have on one topic before beginning the next one.

A lot of people find it helpful to work with others on the homework. Before you do this make sure you know your instructor's guidelines on working with others. Some of the lower level mathematics courses have scheduled times and places for homework study groups with an experienced undergraduate there to help you. Make use of these if they are offered for your course. Aside from being a nice way to make new friends, working with others is an excellent way to learn. If you get stuck on a problem chances are that one of your study mates will know how to do it. So collaboration is encouraged with the understanding that you should write up the problems *in your own words*) for turning in. Copying someone else's solution or the answer in the back of the book may seem like a great shortcut, but the act of thinking through how to write up a solution and actually putting pencil to paper to do it adds a lot to the learning process

Another useful device when working with others is to take turns explaining concepts and examples to the others in your group. When you explain the ideas and techniques to others you will clarify your own understanding and may discover subtleties or confusion you had not noticed before. Teaching someone else is one of the best ways to learn material yourself.

Since instructors differ in their policies regarding late homework, you should find out at the start of the course what is expected of you. Make every attempt to get your assignments in on time; instructors or TAs notice when people constantly turn their homeworks in late. Keep up with homework assignments and don't underestimate the dangers of procrastination!

Falling behind in one course can eventually undermine an entire term. Save yourself the misery of cramming and all-nighters and keep up with your work. If, however, you should miss an assignment it is still a good idea to do the problems and check them with the sample solutions. If you are not sure your answers are correct ask your instructor or TA to look at them for no grade. Remember that the homework is assigned to help you learn how to do problems related to the concepts you are studying. So missing an assignment leaves a gap in this process.

Go to office hours. Your instructor will post office hours at the beginning of the course. Take advantage of them to ask questions that are too long for class time. Most instructors spend hours sitting in their offices, wondering why no one comes to see them; they are usually impressed when someone does. You *will* have questions and bringing them to office hours not only gets them answered, but helps your instructor get to know you. Go to office hours even if you have no specific questions. Listen to questions asked by other students and it may clarify your own questions.

Occasionally, students have gripes about the way the course is being run. Maybe your lecturer

talks too quickly; perhaps your TA is always late to class. If you should have such concerns, talk to your instructor or TA. If it seems awkward to talk to the instructor or TA involved, take your complaints about lecture to your TA and your complaints about recitation to your instructor. Try to be fair; try to suggest ways to correct the problem, and by all means don't wait until the end of the term! Constructive feedback will often produce surprising results. Your instructors are people too – they have days when they feel lousy, just like you do; they often get nervous when speaking to a class, just as you would. Most of them would love to know how they're coming across. *Tell them*. But don't forget to tell them what they're doing right – that way they'll keep doing it.

## 5 Exams

Most elementary mathematics courses have two or three prelims and a final. Prelims for most of the introductory courses and finals exams for all of the courses are scheduled in advance to avoid conflicts; the dates and times appearing on a Cornell website. You can link to this website through the math department website or go directly to [www.cornell.edu/acdemics/courses.cfm](http://www.cornell.edu/acdemics/courses.cfm). Prelim rooms are normally scheduled at least a week before the test and are also published at this website.

You should find out where you are supposed to go and make certain you know how to get there. Your instructors will announce the times and places during class.

Few people claim that exams provide a *completely* accurate assessment of what you've learned, but it is hard to come up with a good alternative. It's true that testing creates pressure and fosters an orientation towards grades, both of which are incompatible with the ideal of going to college to learn. However, testing does insure a certain amount of fairness and objectivity in the evaluation process. In addition, exams do get you to keep up and learn the material. Studying for exams gets you to review old concepts, analyze how various concepts fit together, and in general consolidate your learning.

What attitude, then, should you take toward exams? To begin with, while not treating them lightly, you should put them in the proper perspective. *Blowing an exam is not the end of the world*. Try to look at them in a *positive, constructive way*. When you get an exam back, begin by congratulating yourself on what you were able to do right. Look at the things you weren't able to do. Review the exam solutions and make a note of the things you missed. At the next possible opportunity, review them if you are confused and *talk with your instructor or TA*.

In other words, use the exam both as proof of the progress you're making and as an indication of the things that require more work. Don't be discouraged if you didn't do as well as you'd have liked. If you've done your best and make a decent attempt to learn the material, *that is all anyone can expect*.

The first thing you need to know to prepare for an exam is the material to be covered. Ask your instructor well in advance. Don't be annoying, but try to get as many specifics as possible. What sections in the textbook will be covered? What material, if any, is specifically excluded? Are there topics covered in lecture that are not in the text? What formulas or information will be provided on the exam? Are there any subjects you ought to concentrate on while studying? Your instructor may wish to hand out "Practice exams". Go over old homework problems and practice new problems for which the answers are in the back of the book.

It's usually helpful to begin reviewing well in advance of an exam. Memorizing techniques by brute force is painful and inefficient; if you do a lot of problems over an extended period of time, things will "sink in" with *much less* effort. You should do a broad spectrum of problems, but don't

get bogged down in the details of any single one. If you get stuck, better to ask your instructor about it than to beat your head against the wall for an hour.

Try to avoid self-imposed pressure. Pressure can cause you to forget what you have learned; it can lead to careless errors and oversights on exams. This is another reason for beginning your preparation well in advance.

Pulling an all-nighter before the exam to cram is not only inefficient from the point of view of learning the material, but also physically and mentally disastrous. Even if what you've studied is still there during the exam, and even if you manage to stay awake, you will probably end up reviewing everything the next time you need to use it. In addition, all-nighters tend to interfere with the clarity of thinking one needs during a mathematics exam.

If you have a time conflict that would prevent you from taking an exam at the scheduled time, you should talk to your instructor *well in advance* and find out whether the instructor considers your conflict a legitimate excuse. If you are excused from the exam you should also discuss whether you are to take a make-up exam and, if so, when and where it will be. It is also helpful to remind your instructor of the make-up a day or two before you have to take it and make sure you have the correct time and place. **Note:** Since prelim times are listed at the start of the semester, you will not get a make-up exam without a very good reason.

Only a very serious emergency should cause you to skip an exam without talking to your instructor as before hand or as soon as possible afterwards (e.g. if you are really too sick to get in touch ahead of time). Even in an emergency, if you are unable to talk to your instructor, get a friend to do it for you. You may have to make up the exam later; if so, arrange a place and time promptly. If you skip an exam without offering a compelling excuse (usually accompanied by confirmation of the situation) do not expect any breaks.

After the exam, check the problems you missed and be sure you understand what went wrong. If you had trouble budgeting your time, make a note to pay attention to this the next time. Check to see that your points were added up correctly – mathematicians can make arithmetic mistakes sometimes too! If you feel that you have not received as many points as you deserve, you may submit it for regrading. **Warning:** If you submit your exam for a regrade, *make no additional marks on it and do not erase anything*; doing so is considered *de facto* evidence of cheating. Make any explanations or comments on a separate sheet of paper.

In some cases instructors will give you the opportunity to make corrections on your exams to earn some extra points. Done the right way, you can learn a lot by doing the corrections at the same time as earning some points for your grade. Even if you cannot earn points back by doing corrections, do so anyway and ask for feedback on your corrections. That way you can consolidate your understanding and clarify any confusion you may have before going on to new topics.

## 6 Studying

This section is not intended to be a comprehensive guide to study techniques: we will focus on problems and methods specific to math courses. Books and pamphlets on the subject may be obtained in libraries and bookstores; your instructor may be able to make suggestions. We've already suggested that you work with friends on the homework, and collaboration is not a bad idea in general.

Also be sure that you are really getting something done and not just socializing. Also be sure that you are being an active learner and not just trying to absorb what others say. Mathematics is an active sport. Since different people learn in different ways, you should adjust your study techniques

to fit your personality. If you feel better studying by yourself, that's fine too. Whatever works for you is probably the best thing. But if you work by yourself it can be valuable to talk to friends afterward about different solutions to the problems.

It is often valuable to rewrite your notes slowly and carefully after class, filling in any gaps. Studies have shown that people learn and retain material best if they use more than one means of going over it, i.e. hearing it, seeing it, and writing it. Add to this an effort at explaining the material to someone else. If no one wants to listen to you just pretend you have an audience.

Use your textbook wisely, not slavishly. No textbook will work well for everyone, and you should not be discouraged if there are parts which you have trouble understanding. When you are reading, make a reasonable effort to understand what the book is saying: if you get stuck, *make a note of the problem and go on*. Take your problems to your instructor. It is frustrating and useless to spend hours crawling through the book line by line, attempting to understand everything the first time through. *Don't create problems for yourself!* Your instructor is there to answer questions; you should concentrate on getting the main ideas and learning to do the problems. Try to do the problems using what you've learned in class; use the book as a reference and a guide.

Textbooks usually contain more theory than you really need. Learning the theory behind the detail deepens your understanding; you can see why things are done the way they're done and how the subject hangs together. Do your best to understand the theory since not only is it interesting, but it will also help you understand how to apply the concepts. However, your first priority should be acquiring basic functional competence in the subject – i.e. learning to do problems. That is a sizable task for anyone.

If you have difficulty with the textbook or if you'd like to see some other points of view, ask your instructor to suggest books for you to look at. The Math Library has a huge collection of calculus books; there are also lots of books in area bookstores. The Math Support Center has numerous textbooks you can look at. Some textbooks have an accompanying "Student Supplement" which you might like to get. Typically it will contain solutions to some of the problems and perhaps a few explanations.

It is important to budget your time carefully and to keep up with the course. Math courses normally require from 2-4 hours of studying per week for each hour of class time. (Generally this will vary with some weeks easier and some weeks harder) a little arithmetic shows that if you goof off for a week, you will wind up 6 to 12 hours in the hole. It's hard to sit down and study when that prelim is 3 or 4 weeks away, but spending a little over an hour each day is easier than pulling two all-nighters in a row to cram.

There is no getting around the fact that math courses call upon you to remember a great deal of information. The efficient way to remember things is to do it in small pieces over a long period of time. Aside from being easier on you, this method makes it more likely that you'll remember things later when you need them. If you learn things *well* as you go through the term, you'll have an easier time when you're studying for the final. You won't need to go back to learn the stuff over again.

Some of the things we discussed when we looked at textbooks apply to doing problem sets. In particular, don't let your self get bogged down! Some people feel that they have to struggle with a problem until it succumbs, even if it takes the whole evening. While you shouldn't give up too easily, you should realize that doing a dozen problems that you *can* do may be more useful than wrestling with one that you *can't*. It is important that you see a wide variety of problems, both to broaden your experience and to reinforce your understanding. When it is clear that you aren't getting anywhere, make a note of the problem and ask your instructor about it. It is, of course,

particularly satisfying to finally figure out a problem by yourself, but sometimes this works best if you put it away for the day and return to it some other time. A day's rest will often produce results.

## 7 Resources

There are two important resources on campus that you should know about: The Math Support Center and the Learning Strategies Center. You can learn more about both of these by going to [www.math.cornell.edu](http://www.math.cornell.edu). Follow the link for courses and look for the link labeled *Academic Support for Mathematics Students*.

The Math Support Center (MSC) is located in 256 Malott Hall. Sign up for tutoring or just show up. Some students like to sit here to do their homework and ask questions as they come up. The MSC has a large collection of capsules available here on paper or via links from the website. Let us know if there are new topics you would like to see us cover.

The Learning Strategies Center (LSC) provides supplementary courses for some of the introductory level courses. For detailed information on these courses see the website given above. For general information about the LSC and the many resources they provide see the website [www.lsc.sas.cornell.edu](http://www.lsc.sas.cornell.edu). They can help you with the general issues of managing your time, taking exams, reducing stress, taking notes, etc.

For those of you who have real problems with “math anxiety”, there are a number of books on the subject. A good resource is the book *Overcoming Math Anxiety*, by Sheila Tobias. There are several editions of this in the mathematics library in Malott Hall.

## 8 Summary

There are a few ideas which summarize a lot of what we have said here.

1. Learning does require discipline and hard work, but ....
2. .... there are lots of people who are eager to help you and ...
3. .... you can make decisions which will have a large effect on whether you learn or not.
4. Although learning mathematics can be hard work it can also be fun
5. .... so dive in and experience the satisfaction that will come from figuring it all out.

If you keep those in mind you should be in good shape. *Good luck!*