Tips for Successful Mathematics Studies

Introduction

Starting mathematics studies reqires determined attitude from the beginning. Compared to school mathematics studies at the university are more abstract, deduction is emphasized instead of calculating and accurance is paid more attention to. This is the reason why the step between school and university mathematics is challenging. Following only teaching doesn't lead to learning mathematics: student's independent work is what counts.

Most of the studies consist of class courses that contain calculation exercises. Attending lectures isn't mandatory but this freedom shouldn't misguide one since excperience shows that absorbing course content through self study is troublesome for many. Calculation exercises are conducted in small groups during which excercises given at the lectures are gone through with the help of a teaching assistant. It's very important to try and solve independently as many calculation exercises as possible. Mastering mathematics isn't about knowing the information content by heart but the ability to apply mathematical information into solving new problems. Apparently the only way to gain this ability is practice. One of the basic ideas of calculation exercises is that the students perform their solutions to the group. Therefore calculation exercises also improve students' ability to perform in front of people.

The ability to absorb mathematics and the way of doing it change individually but independent studying should always be given enough time in mathematics. Matters to be taught are usually strongly based on what's been taught perviously, which means that studying should from the beginning be aimed at understanding matters properly. The better information of the basic courses have been learnt, the easier will the studying be in the future.

The purpose of this guide is to offer information about teaching and studying mathematics in easy to understand form without any byrocracy involved. The guide isn't an official source of information. It's ment to be used along with the stydy guide of your own department.

The content of this guide is based on the author's experience of studying mathematics as well as on the discussions with other students and lecturers. The purpose of the guide is to offer students guidance and tips that will hopefully be helpful in studying mathematics and planning the studies. Additionally information that is hard to find in official information sources is easier found in this guide. Courses used here are based on Finnish university education but comparable courses are also offered in high school and in polytechnical universities.

Beginning of Studies

Studying mathematics is strongly cumulative, which means that the courses taken later are mainly based on the matters gone through during the basic studies. The better one masters the content of the basic studies, the easier it is later to proceed into intermediate and advanced studies. Therefore studying mathematics doesn't in any way fit with the thought: "I'll party the first year and study later." For the same reason it is also important that the student doesn't take so many courses that the understanding of the basics is left halfway. When the graduating students have been asked: "What would you do differently if you could start your studies again? one of the answers has almost always been following: "I would pay much more attention to the basic studies.

Tips for Choosing Courses

When thinking of how many courses to take, it's worth noting that university courses require much more independent work than the courses in high school. That's why the amount of hours spent in classes and calculatig excersises may seem small on paper. The courses that one should definitely choose during the first autumn semester are "Analysis I" and "Linear Algebra". Before absorbing the content of these courses the mathematics studies can hardly be continued. In addition to these it's recommended to choose from one to three courses of the secondary subject. Naturally more courses can be started and then leave drop out of the courses if it feels that there isn't enough time. One should, however, be careful when using this technicue because it's easy to drift into the situation where one hangs on to the course even though one hasn't got the time to study.

Counseling

All the teachers in the mathematics departments answer to the students' questions. Specially advising students is a part of the job of advising assistants and teacher tutors. General study related questions can also be asked from the student advisor.

The general rule is: If you have something to ask, then ask. If you happen to ask the worng person, he/she surely directs you to the right place.

Also during the lectures and calculating exercises one can and should ask if there are matters that are unclear. All the subjects in the class are easy for the lecturer. Thus, if the students don't ask questions at the lectures the lecturers easlily lose their touch with the subjects that are difficult for the students and therefore should be explained in more detail.

Personal Study Plan

At the beginning of the studies each student prepares a personal study plan with one's teacher tutor. The plan is updated each semester with the teacher tutor until choosing the subject to be studied. After choosing the subject with the plan is updated with the person responsible it within the subject.

Studying Technique

Learning university level mathematics without completing the excercises is almost impossible so it's important to do the calculating excercises actively from the beginning of the course. First year exams may although be passed even if one doesn't do anything during the course but instead studies hard two weeks prior to the exam. This isn't, however, the technique to absorb information and the wall rises during the second year of the studies. Even though matters feel easy in the beginning of the course it's worth taking them seriously. In most cases matters become more difficult sneakily and the observation: "Well, this doesn't seem so trivial any more." is very quikly followed by the notion: "I don't understand anythig about this." Team work is a very good working method in mathematics. When contemplating a problem among two or more people the cooperation is often fruitful. The person that has thought of a matter and has realised how it's solved is also often capable to explain it clearly to others still thinking of the matter. Explaining the matter to others often also improves the understanding of the matter for the person who is explaining. So that group work would be useful it has to be a true group effort where all involved are making an effort.

Grading Studies

Studies are graded with whole numbers from one to five. The grading principles of studies at the university differ greatly from what one is used to in high school. In high school one usually got graded with seven if one could at least do something and five for mercy even if one didn't know anything. At the university even getting graded with one requires that one has been able to give a proper answer (it's usually been said that to pass an exam one needs to give the right answer to over half of the questions). You shouldn't therefore be depressed even if the grades are worse than you've used to.

Mathematics Course Choises

Course choises are naturally affected with which field of mathematics one is interested in. Following aims to present course choises from the point of view of different subjects.

In the future, when mentioning number theory the subject of number theory and algebra is meant. Courses that are recommended for the subject of mathematic modelling are recommended also if the student is interested in insurance mathematics or optimation.

Course Basics of Algebra I is a part of intermediate studies but altogether mandatory for everyone. Basics of Algebra II is essential in the future if one is studying information technology mathematics or number theory. This course is also very useful in analysis, mathematic modelling and for future teachers. Because the course is usually easiest to carry out in continuation with Basics of Algebra I it's recommended that the course is taken during the first spring semester.

Differential Equations is recommended to be studied during the first spring semester, at least if one intends to aim at studying mathematical modelling or completing a secondary subject in physics (differential equations are needed in almost all the courses in the subjects of modelling and analysis and practically in all the physics courses). Almost all the other students need to pass the course at some point so if one feels that one is able to take also this course during the first spring semester, it's worth taking. The course is mandatory for the future teachers.

Mathematical Optimization I and II are primarily courses that support Mathematical Modelling subject. Future studies don't require these courses to be taken during the first spring semester. These courses´ requirements however are such that they may be carried out already at that point. The course mathematics is considerably less abstract than in other courses to be studied in the beginning of studies. Taking these courses can be recommended for the students who look for a concrete connection between practice and the studies already at this stage.

There are two courses above others when considering courses that students usually take during their second year of studies. Courses Functions of Several Variables and Function Theory are such a fundamental part of mathematical general education that everyone should pass them with a grade that is as good as possible.

Functions of Several Variables is a course that is worth studying regardless of ones subject choises. The contents of the course is so fundamental part of mathematical general education that a student will confront its content several times during the studies. Particularly important the course is in the subjects of modelling and analysis, also future teachers will certainly need the teachings of the course. This course makes studying physics as a secondary subject a lot easier.

Metric Spaces is lectured in continuum with the previous course though it isn't a follow-up course but a completely different course. Metric Spaces is kind of an introduction course for abstract analysis which is especially needed in the subjects of mathematical modelling and analysis. The course may already be taken during the second year of studies. Not passing the course may somewhat narrow down the course choises during following spring and autumn semester. If passing the course, however, feels far too abstract, studying it may be postponed until the third study year because usually at this stage there are courses to study without having the knowledge of Metric Spaces.

Number Theory (and the follow-up course) is worth taking, if one is intends to choose either number theory or information technology mathematics. Also many future teachers take this course. The course may also be recommended to others because it's a nice introduction to "pure" mathematical way of thinking, however, on a fairly concrete level.

Courses of propability calculus are simple enough already for the second year stydent and they are very useful especially in the subject of modelling and for the future teachers. Students of these subjects should definitely take as many propability calculus classes as are offered. The basics of propability calculus are needed also in number theory, coding theory and cryptography. The course Propability Theory I is mandatory for future teachers and in mathematic modelling. Also the course Propability Theory II is mandatory in mathematic modelling.

Mathematical Software course teaches the use of the Mathematica software. Mathematical software is particularly used in the subject of mathematical modelling. However, if one can use Mathematica, many ways to make studies easier later may be discovered with it. The course may well be taken already in the course of the second year of studies. The downside of taking the course already during the second year is that matters rehearsed at the course may easily be

forgotten unless one uses them regularly. And in the beginning of the studies it isn't heavily needed. Mathematical Methods course I and II are useful courses in all the subjects even though they aren't obligatory in any.

The knowledge that the courses offer of numeric calculation methods is very useful at the latest in working. Using MatLab software is learnt at the course and the same comments concern this that did the Mathematical Software course. Geometry mainly rises the level of mathematical general education but it isn't much needed at the later stages of studies.The course is mandatory for the future teachers.

Algorithmic Mathematics is a basic course of information technology mathematics that is definitely worth studying before attending advanced courses of information technology mathematics. Algorithmic problem solving is learnt at the course which is often useful in other fields of mathematics because many problems of modern mathematics are algoritmic in nature.

History of Mathematics is an obligatory intermediate study course that may, if one wants, be taken already during the second year of studies. One gets more out of the history course when all the other intermediate studies have already been studied. For that reason the course is worth taking during the third study year. The course is studied as a book exam.

Function Theory is definetly worth taking if one's course of studies is modelling or analysis. If one doesn't take this course it will take its toll many times in the course of studies. The teachings of the couse have a central part also in the other subjects. For example analythical number theory is totally based on function theory. Even though matters at the course may feel ununusably abstract they prove to be very useful during advanced studies. Taking the course at some point is also recommended for the future teachers because it gives a very good picture of how useful abstract mathematics ultimately is. Also the question "What is the use of these complex numbers?" is easier to answer after the course.

Logic (and its follow-up course) is a good course that improves logic thinking and is of use especially in information technology mathematics. Knowing logigs is useful also in information technology studies. At least the basic course can be recommended for future teachers also.

Combinatorics (and its follow-up courses) is most useful in information technology mathematics but the course teachings won't go to waste if studying other subjects. Combinatorics can be recommended also for a future teacher.

Data processing is mandatory. It's the most important secondary subject especially for mathematicians. Data processing studies shouldn't be feared even though one hadn't even seen the coumputer before. That's because the teaching isn't about how Windows works, but more theorethical studies in which previous experience doesn't really count. Instead of how the programs work it's been familiarized with how the machine itself works and programming. All the studies start from the basics of data processing, which means that anyone can attend the courses.

Also statistics is an important secondary subject in all the fields of mathematics, especially if the student is interested in applied mathematics and perhaps wishes to work in the corporate world or in medical research in the future.

The student who intends to become a teacher should choose ones secondary subjects out of these three subjects: data processing, physics and chemistry. That's because when applying for a position as a teacher the subjects to be taught are usually a combination of mathematics and these three. The subjects to be taught are usually specified in teacher positions. To apply for a position where subjects to be taught are for example mathematics and physics, should the teacher be qualified to teach both. Still a big amount of teacher positions are even three subject (mathematics, physics and chemistry) positions, which is very problematic. That's because to be qualified to apply for this kind of a position the teacher has been required to take a considerable amount of extra studies.

Literary Work

The purpose of the literary work in mathematics is to prepare the student for:

- independent mathematical working
- using mathematical literature
- producing mathematical texts
- using finnish well in mathematics

Writing an essay or a paper is also good practice for writing the thesis work when working independently can first be practised with smaller projects. There are versatile programs that are worth getting familiar with as early as possible.

Finally

Menestyminen matematiikan opinnoissa merkitsee kurinalaisuutta, ajankäytön suunnittelua ja harjoittelua. Sananlasku ”Harjoitus tekee mestarin” pätee tässäkin.

Succeeding in mathematics studies requires dicipline, time management and practise. The saying: “Practice makes perfect” applys to this as well.

Computer-Assisted Mathematics

As recently as half a century ago calculating meant moslty using a pen and a paper. More advanced aids were logarithm tables, slide rule and mechanical calculators that were able to perform four basic calculations. Then the situation started to change: large computers, calculators, ever more complicated software, tabletop computers much more efficient than former large computer, super computers, graphic applications and finally information networks appeared.

The possibilities concerning calculatig have thereby increased beyond measure. With appropriate software a tabletop computer calculates logarithm tables of the past days in no time. Models may be created for phenomena and phenomena may be examined with calculative measures in such a way that wasn't possible half a century ago.

The significance of using computers in mathematics studies and later in working life, increases all the time. Routine calculations in many fields are far too complicated even to be conducted with a calculator. Using mathematics softwares is worth learning as early as possible – they aren't only useful in mathematics courses but also in other studies in ones own field and in working life.

There are manuals available in several languages of all the programs but the programs themselves are mainly in English. Familiarizing oneself profoundly with one program helps one to understand also the inner logig of other programs.

Always remember, however, when using a mathematics software that it's always more important to find out what one is doing than how one is doing it!

Success for your studies!

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