Mathematics Department
University of Oregon
Guide to math major (and minor)
as of July 3, 2013

Preparation for the major:

Calculus: A year-long calculus sequence is required for almost all upper division courses. There are two options for most majors:

1. 251-253 is our year-long course for science and math majors. It concentrates on techniques and applications of calculus.
2. 261-263 is our calculus with theory course. This is suitable for strong, well-prepared majors and covers proof and the theory behind calculus (as well as the techniques and applications covered in 251-253). This sequence also satisfies the bridge requirement as well as the Math 315 requirement is waived for students who take this sequence.

Some students will come not yet ready for calculus. Such students may need to take Math 112 (precalculus) or Math 111 (college algebra) and Math 112 before taking calculus. The department's placement exam can give guidance on this.

Bridge requirement: Before taking most upper division courses, preferably in the same year that a student takes calculus, majors should satisfy the department's "bridge requirement" for a course where mathematical proof is an important part of the course. There are 3 ways to do this:

1. Take Math 261-262. This will simultaneously satisfy the need for calculus. It is a challenging, but worthwhile course.
2. Take Math 231-232 (first two terms of discrete math). These courses are taught Fall-Winter (F-W), Winter-Spring (W-Sp) as well as in the Summer (Su). The prerequisite is Math 112, just like the prerequisite to Math 251.
3. Take Math 307 (Introduction to Proof). This is offered Fall-Winter-Spring (F-W-Sp) and has a prerequisite of Math 252, so it can be taken alongside Math 253.

Six course core (all options except secondary ed option):

Most major options require the six course core (but see the separate explanation below for the secondary education option). These courses are available to students who have taken calculus, and in addition Math 315 requires that the student have satisfied the bridge requirement (described above).

1. Math 256: Differential Equations. Prereq. Math 253. (F-W-Sp-Su).
2. Math 281-282: Multivariable (or Vector) Calculus. Two-term sequence. Prereq. Math 253, preferable to do Math 256 first. (F-W, W-Sp) also taught in 4-week summer sessions).
3. Math 341-342: Elementary Linear Algebra. Two term sequences. Prereq. Math 252. (F-W and W-Sp, 341 taught in summer).
4. Math 315: Introduction to Analysis. Prereq. Math 253 plus the bridge requirement. Completing 261-263 waives the 315 requirement. (F-W-Sp-Su).

Upper division electives (all options except secondary ed option):

To complete a **pure** math major, you need to take (in addition to the six course core) at least four courses from the **pure** math courses listed below. *Pure math courses typically stress proof over calculation and application.*

To complete an **applied** math major, you need to take (in addition to the six course core) at least four courses from the **applied** math courses listed below. *Applied math courses typically stress calculation and application over proof.*

A "**design your own**" major consists of at least four courses (in addition to the six course core) chosen from the pure and applied lists ***with your advisor.*** Failure to get your advisor's approval in advance may result in being denied graduation as a major.

Pure mathematics courses:

- 391-393: Fundamentals of Abstract Algebra. Prerequisite: 341 plus the bridge requirement. (F-W-Sp).
- 394-395: Geometry. Prerequisite: 253 plus the bridge requirement. (F-W).
- 413-415: Analysis. Prerequisite: Math 315 or Math 263. (F-W-Sp).
- 431-432: Topology. Prerequisite: Math 315 or Math 263. (F-W-Sp).
- 433: Differential Geometry. Prerequisite: Math 282,342, and the bridge requirement. (Sp)
- 441: Linear Algebra. Prerequisite. Math 342 and the bridge requirement. (Sp)
- 444-446: Abstract Algebra. Prerequisite: Math 342 and the bridge requirement. This sequence covers some concepts from 391-393 but more material and from a more advanced point of view. (F-W-Sp)
- 467: Stochastic Processes. Prerequisite: Math 461. If 461-467 are taken as a sequence, they can be counted either as both pure electives or as both applied electives. (W).

Applied mathematics courses:

- 343: Statistical Models and Methods. Prerequisite: Math 252. Review of theory and applications of mathematical statistics including estimation and hypothesis testing.
- 351-352: Numerical Analysis. Prerequisite: Math 253 and the bridge requirement; CIS 210 recommended. Covers techniques of efficient, accurate, approximation and contains material of interest to applied mathematicians, computer science and physical science majors (F-W).
- 411-412: Complex Analysis. Prerequisite: Math 281 and the bridge requirement. Covers the calculus of functions of a complex variable. Besides math majors, this course is potentially useful for physics majors and for students considering an engineering career. (W-Sp).
- 420: Ordinary Differential Equations. Prerequisite: Math 315 or 263. Covers methods of solution of differential equations, and proves the existence and uniqueness theorem. (F).
- 421-422: Partial Differential Equations and Fourier Analysis. Prerequisite: Math 281 and either Math 256 or Math 420. Methods for solving many of the differential equations that arise in classical physics, and of interest to physics and math majors alike.(W-Sp).

- 456: Networks and Combinatorics. Prerequisite: Math 231 or 346, and the bridge requirement. An advanced course in combinatorics, which includes topics, such as graph theory and Boolean algebras. It is of potential interest to both math majors and computer science majors. (W).
- 457: Discrete Dynamical Systems. Prerequisite: Math 256 and the bridge requirement. Introduces "dynamical systems" (systems subject to change over time) in the discrete context (changes occur in steps rather than continuously). It covers applications in science and discusses chaos and fractals. (Sp).
- 458: Introduction to Mathematical Cryptography. Prerequisite: Math 341. Mathematical theory of public key cryptography. (Sp)
- 461-463: Probability and Statistics. Prerequisite: Math 253 plus the bridge requirement. Covers continuous probability, statistical tests and applications. It is a useful course for students interested in statistics, and for those who may be interested in pursuing actuarial work. (F-W-Sp).

Secondary Education Option:

This option is for future middle or high school math teachers. While it is not necessary to do this option to become a teacher, the courses have been chosen to match content areas high school teachers should know, and to prepare students for the PRAXIS exams which are part of teacher certification (in Oregon as well as many other states).

Students should take calculus and satisfy the bridge requirement (as with the other major options) but instead of taking the six course core and upper division electives, should take the following courses:

- 341 (Linear Algebra). Prerequisite: Math 252. (F-W-Su)
- 346 (Number Theory). Prerequisite: Math 253 plus bridge requirement (Spring).
- 315 (Introduction to Analysis). Prerequisite: Math 253 plus bridge requirement. (F-W-Sp-Su)
- 391-393 (Fundamentals of Abstract Algebra). Prerequisite: Math 341 plus bridge requirement. (F-W-Sp)
- 394-395 (Geometry). Prerequisite: Math 253 plus bridge requirement. (F-W)
- 343: (Statistical Models and Methods). Prerequisite: Math 252. **Note:** You may still take math 461 in place of this course for the secondary education option but it is recommended that you take math 343.
- CIS 122 or equivalent. (Programming and algorithms). Prerequisite: Math 111, CIS 110 or equivalent (F-W-Sp, typically).

Math Minor

The minor is 30 credits at the 200-level of above, at least 15 of which are upper division (300 or 400 level). Math 425 and 426 cannot be taken as part of the minor. Effectively, this is 8 courses, at least 4 of which must be upper division. It is difficult to complete a minor without taking calculus because calculus is a prerequisite for so many upper division courses.

Mathematics and Computer Science Major (MACS)

This major combines courses from Computer Science with courses from Mathematics. It is a challenging major suitable to students who are looking for a career in the more challenging sides of informatics or software development.. The major is handled jointly by the Mathematics and Computer Science departments and students will normally have an advisor in each department.

Students will need to complete:

- Premajor: Math 251-253 (or equivalent), Math 231-232, CIS 210-212.
- Mathematics core: Math 341-342, Math 315, plus either Math 351-352 or Math 461-462.
- Computer Science core: CIS 313, 314, 315, 425.
- Computer Science Project: CIS 422 or 441 or 445.
- Writing: WR 320 or 321.
- 12 credit science requirement: BI 211-213, CH 221-223, CH 224-226, PHYS 201-203, PHYS 251-253, or 8 credits from Psychology 430-468 plus 4 more Psychology credits at the 200 level or above.
- Math elective: One other 4-credit upper division mathematics course (not 425 or 426).
- Computer Science elective: two other 4-credit approved upper division CIS courses. All work must be done at the C- level or above.

Advising, Hilbert Space and the Department

The department is split between Fenton Hall (which contains the main department offices, about half the faculty, and the Mathematics Library) and Deady Hall (which contains the other half of the faculty).

Deady Hall also contains “Hilbert Space” (Deady 107) which is a study area/lounge/office for math majors. The room has tables, chalkboards, a small library, computers, and stained glass windows.

The name “Hilbert Space” is a mathematical pun named after the great German mathematician David Hilbert (1862-1943). “Hilbert Space” (mathematically) is a way of generalizing properties of finite dimensional spaces like ordinary two or three dimensional space to infinitely many dimensions.

As students advance, there are opportunities to get involved with the department in other ways besides courses. Undergraduates can mark homework for more elementary classes, become undergraduate teaching assistants (UGTA’s) for certain classes, become math peer advisors, and can write honors theses with faculty advisors.

Peer advisors can be found in Deady 107. For questions that peer advisors can’t answer (or even ones they can) the department’s Head Undergraduate Advisor (Hayden Harker) is in Deady 108A and the Director of Undergraduate Studies (Dan Dugger) is in Fenton 317. The department office in Fenton 202 can also provide contact information for term-to-term walk-in advising.