A degree in mathematics or statistics: Excellent preparation for many top careers

Graduates from mathematics and statistics programs rarely hold positions that are explicitly called “mathematician” or “statistician.” Thus few people realize how many of the top positions in a wide range of professions are held by graduates from mathematics or statistics programs. A good starting place to read more about the many options is this listing of career profiles maintained by the Mathematical Association of America. Indeed, undergraduate degrees in mathematics and statistics are among the most versatile degrees that provide excellent preparation for disciplines ranging from business, and law, to the sciences and medicine, and many more. Every year, degrees in mathematics and statistics are unanimously rated at, or near, the top: ranked by entry-level and mid-term pay levels, by job satisfaction, and by value as preparation for many careers. This is no surprise as mathematics plays an ever more important role in ever more professions, and problem solving skills and training in clear logical thinking become ever more important. Some good references are the recent Business Week article “Math Will Rock Your World” (with this eye-catching cover image). Professions that build on a thorough mathematical education consistently occupy most of the highest ranks, see e.g. the article “Top Ten College Majors That Lead to High Salaries?” by Payscale. Also in terms of job satisfaction mathematicians and closely related professions ranked top and near the top in surveys by CareerCast in 2010, 2011, and 2012.

Mathematics & Statistics: Vibrant research with exciting new discoveries every day
Contrary to widespread misconceptions, mathematics is a vibrant field that is characterized by new discoveries and powerful applications every day. These range from very abstract theories such as algebraic number theory and cryptography which are at the heart of modern telecommunications (e.g. cell phones) to modeling, analysis, and computer simulation of biomedical problems (e.g. spread of infectious diseases), fluid flows (e.g. weather, or airflow over the wing of a plane), and the business world (the world’s economic and financial systems). Common to ever more disciplines is the need for professionals with ever better training in mathematics, making a degree (or dual degree) in mathematics or statistics ever more valuable.

**Undergraduate coursework, honors credit, and meeting possible thesis advisors**

The common starting point is three semesters of calculus (MAT 270, 271, and 272) which much resemble mathematics classes at the high school level with the familiar mix of calculation and exercises in symbol manipulation. Most students continue with a first course in differential equations (MAT 274 or 275), which has a similar format. Following these are a required course in linear algebra (MAT 342 or 343), which mixes calculations with more abstract study, and the “transition course” MAT 300.

The School of Mathematical and Statistical Sciences (SoMSS) regularly offers special sections -- for honors students only -- of all the above courses. All Barrett, the Honors College students are strongly encouraged to select these special sections in which they automatically earn honors credit. Not only do these small sections provide a superior environment for deeper probing questions, but they are usually also taught by the best research faculty. As such they offer some of the best ways to get to know research faculty and their research interests, laying the basis and making the contacts for possible later research projects leading to honors theses. Most other sections at the 200 level are taught by full-time lecturers. Classes are significantly larger, but usually still offer the possibility to engage in special projects defined by honors contracts. Such contracts typically encompass more-in-depth studies that go substantially beyond the class syllabus. Typical are eight hours of extra contact with the instructor plus the time needed to do the work. However, the full-time lecturers teaching these classes do not normally supervise honors theses, and students thus miss the opportunity to get to know research faculty who might later direct thesis research.

MAT 300 is a writing-intensive class that is normally taught by resident research faculty. It focuses on constructing rigorous arguments, writing and polishing “mathematical proofs.” This class is always taught in small sections with close interaction between students and faculty and is another excellent place to build relationships that may lead to thesis work. Almost all subsequent courses build in essential ways on the material covered in MAT 300 and its follow-on course MAT 371. Beyond these two classes students have the choice between many courses that quickly diverge into many different directions. Usually there are no special honors sections offered for any of the classes beyond MAT 371, but most instructors will be happy to supervise work beyond the normal syllabus to be specified in honors contracts. Projects often involve
study of chapters not normally addressed in the class, or small research projects that arise from questions asked in class. It is not unusual that such studies evolve into larger research projects that then become the foundation for an honors thesis.

**Undergraduate degrees**

The SoMSS offers several undergraduate degree programs. For details please follow the links to the official descriptions and requirements. This place can only summarize some key differences.

- Bachelor of Arts in Mathematics *(major map)*,
- Bachelor of Science in Mathematics, with concentration in Secondary Education *(major map)*,
- Bachelor of Science in Mathematics *(major map)*,
- Bachelor of Science in Mathematics with concentration in Statistics *(major map)*,
- Bachelor of Science in Computational Mathematical Sciences *(major map)*,
- Minor in Computational Mathematical Sciences,
- Minor in Mathematics, and
- Minor in Statistics.

The **Bachelor of Arts** has a more liberal arts flavor and requires study of a second language at the 202-level or higher, this degree works well for students interested in applying mathematical knowledge to disciplines outside of math, such as education, social sciences, humanities, and the arts. The **Bachelor of Science** (BS) requires deeper theoretical and abstract coursework formalized in the Depth Course requirement of the major (a minimum of two courses from a list of the most advanced 400 level courses). Whereas the generic BS in Mathematics allows much freedom regarding the area of specialization at the 400-level, the **concentration in Statistics** requires coursework following a narrowly defined program. Complementing these degrees, which have the more traditional focus on theoretical and abstract work, SoMSS also offers a BS in **Computational Mathematical Sciences** that focuses on modeling and simulation using modern computer technology. This latter path requires the computation-focused versions of the first courses in differential equations (MAT 275) and linear algebra (MAT 343). For both of these, SoMSS routinely offers dedicated honors sections, which are some of the best places to make contacts with research faculty and lay the foundations for research work that leads to the honors thesis. In fall 2012, SoMSS launched a new degree, the BS in Mathematics with **concentration in Secondary Education**. This interdisciplinary degree provides students the rigor and depth of study found in our traditional BS degree with preparatory coursework and classroom experiences that will prepare students for certification as a secondary education teacher. In addition to our current degree programs, SoMSS also provides coursework and workshop opportunities for students interested in **Actuarial Science** and **Cryptology**.

Note that students who succeed in top graduate programs, especially in pure mathematics and statistics, usually complete courses that go substantially beyond the (minimal) requirements for the BS degrees and include several graduate courses, most notably MAT 543 and MAT 570. For more information please contact the honors faculty advisor, **Dr. Nancy Childress**, in the SoMSS.
It is very easy and popular to work towards dual (or even triple) degrees, one of which is in mathematics. However, students need to be aware of the detailed rules, which courses may count towards both or all degrees, which and how many credits must be unique for each degree. Please schedule an appointment with our honors academic advisor (Tracey Hayes) for sorting out all such details.

**Areas of specialization and research opportunities**

All areas of mathematics and statistics offer opportunities for undergraduates to do original research, discovering new mathematics that no-one else has done before. For a detailed listing of areas of interest and specialization of faculty at SoMSS visit our Research webpage. From here follow the links to the faculty members working in the respective areas. Check their webpages and look into their recent talks and publications, if available. Make contact - send an e-mail requesting an appointment or drop in during their office hours! Most will be very happy to discuss mathematics and statistics in their favorite areas, and opportunities to engage in work in these areas. If you need help, ask the honors faculty advisor Nancy Childress for assistance identifying suitable faculty and for making introductions.

The main areas of faculty research in SoMSS are Mathematics Education, Statistics and Probability, Analysis, Algebraic Number Theory, Discrete Mathematics, Differential Geometry, and many areas of specialization in Applied and Computational Mathematics.

**REUs, CSUMS, other opportunities and summer programs**

All students are encouraged to engage actively in the discovery process beyond the routine study in regular coursework. Among the most exciting opportunities are summer research programs offered in many places around the country, generally supported by grants from the National Science Foundation and known collectively as REUs (Research Experiences for Undergraduates). You need to plan ahead and apply early as spots in these programs are competitively awarded. Make sure that you have a strong preparation so you can write a compelling application. Many REUs not only offer the opportunity of doing exciting mathematics and making new friends, but they also provide generous travel support and stipends that may be worth several thousand dollars for a few weeks in a cool place!

At SoMSS, arguably the most well known REU-like program is CSUMS, which offers exciting projects in computational mathematics, usually involving substantial modeling tasks. Participation in CSUMS can earn HON 4xx credit, and routinely leads to honors theses. Visit the CSUMS webpage for more information, application requirements, and links to previous and ongoing research projects.

SoMSS offers many more programs and opportunities of a similar nature. Visit the webpages for Special Programs at SoMSS, ask your honors faculty advisor, and the professors in your classes for more suggestions.

If you are interested in learning how to use mathematics in business, government, and industry - then start early to plan for possible internships. Generally, you may earn credit for MAT 484
through these experiences. Requirements, forms, and descriptions may be found on the webpage for undergraduate advising in SoMSS.

The language of mathematics is the same all around the world. This makes it very easy and very attractive to spend a semester or two away from campus, as different places typically have different strengths and specializations. Unlike many other disciplines, it is generally very easy to transfer the credit for coursework and research from another institution. Just to be safe, you are encouraged to inquire about “course equivalency” and submit the appropriate forms before you leave. For details and forms, see the webpage for undergraduate advising. Among many other exciting opportunities, two of the most exciting programs in which math majors from BHC recently participate are Mathematics Advanced Study Semester (MASS) at PennState and Budapest Semesters in Mathematics, also consider Math in Moscow.

More on honors theses

For the honors thesis, prospectus, deadlines and requirements, the main references are the BHC webpages, which also offers much additional general advice. The guidelines presented here only add some remarks about honors research and thesis at SoMSS.

As already mentioned above, SoMSS is a very large place with a huge number of students taking mathematics classes every semester. Thus, it is critically important that you take special initiative to get to know possible thesis advisors early. Key steps are to stay in regular contact with the honors faculty advisor, Nancy Childress, in SoMSS and to register for the small honors sections in calculus, differential equations, and linear algebra whenever possible. Especially, when considering work in applied mathematics, you likely may have identified both a possible topic and a likely thesis supervisor by the time you complete these classes! Else you really will have to hustle in the fall semester of your junior year. To get an idea of the wide array of different areas of specialization in mathematics and statistics, you should start attending as many public events that are aimed at a general audience such as: events organized by student organizations (e.g. Math Club or ASU AWM); SoMSS events (e.g. seminars, colloquia, public lectures, and more). To make the most informed decision, start learning as soon as possible what the different areas in mathematics and statistics are about, what they have to offer, and which is the best match for you.

By the time you are taking MAT 300 and MAT 371 you should be well on your way to narrowing down the area that you would like to write your thesis on, and already have gotten to know some of the faculty working in that area. If you need advice and help, make use of the honors faculty advisor in SoMSS.

Respect the very strict deadlines of BHC for submitting your prospectus to BHC for approval (the beginning of the semester before completing the thesis), as well as scheduling your thesis defense and submitting the final copy of your completed thesis (just barely after mid-semester). Be a role model for the next generation of honors students and invite underclassmen and student colleagues to attend your honors thesis defense so they have a better idea how to prepare for their own.
Obtaining permission to register for MAT 492 Honors Directed Study (Research) or for MAT 493 Honors Thesis is very straightforward. Typically these are three credit hours each, which may also count towards your degree as additional 400-level courses. Note that neither MAT 492 nor MAT 493 can be repeated, and 6 is the maximal number of credits that may count towards your degree. The SoMSS Undergraduate Office only requests a brief e-mail from your thesis advisor confirming that she or he will direct your work, and confirming the number of credits for the semester. You should draft the e-mail request to be allowed to register, and ask your thesis advisor to approve it and forward the e-mail to Tracey Hayes (Tracey.M.Hayes@asu.edu) and Nancy Childress (nc@asu.edu). Additionally, you must complete the Barrett Thesis Preparation Requirement, before you will be eligible to enroll in MAT 492.

**Summary: Year-by-Year Time-line** (this is not a complete list!!!!)

**Freshman Year**
- Register for honors sections of calculus and meet possible thesis advisors
- Become a member of the Math Club and/or ASU AWM and participate in club activities
- Visit some CSUMS meetings and presentations
- Attend honors thesis defenses
- Schedule appointments with your academic advisor Tracey Hayes
- Begin looking for summer programs and REUs

**Sophomore Year**
- Register for honors sections of differential equations and linear algebra, meet possible thesis advisors, and complete small projects going beyond the nominal class syllabus
- Schedule appointments with your academic advisor Tracey Hayes and/or the honors faculty advisor in SoMSS, Nancy Childress
- Attend honors thesis defenses
- Apply for CSUMS or other summer programs and REUs
- Attend the SUnMaRC conference
- Excel in MAT 300 and ask faculty for special projects introducing different areas of mathematics (algebra, analysis, number theory, discrete math, probability, …)
- Participate in the student organization activities, especially events that introduce the many specializations available for juniors and seniors, and the areas of faculty research

**Junior Year**
- Excel in MAT 371 and ask faculty for special projects
- Schedule appointments with your academic advisor Tracey Hayes and the honors faculty advisor in SoMSS, Nancy Childress
- Identify an area you want to specialize in, take advanced courses in that area, and engage in an honors contract with faculty specializing in that area
- Attend honors thesis defenses
- Identify a thesis advisor and agree on a research plan
- Register for MAT 492 Honors Directed Study (Research)
- Identify a second (and third, if your thesis advisor requires this) reader, prepare a Prospectus for your research project, and submit it for approval to BHC. Note that the deadlines are very strictly enforced.
- Apply for funding if applicable for your research
- Consider taking a leadership position in a student organization, and participate in and organize events that introduce interesting areas of mathematics
- Participate in seminar presentations and attend colloquia that are targeted at broader audiences, or that address topics of your interest, and attend all honors thesis defenses
- Attend the SUnMaRC conference and apply for summer programs and REUs or consider an internship

**Senior Year**

- Register for MAT 493 Honors Thesis
- Collect your research findings and formally write them up in your honors thesis, schedule a date for defense, invite other students, and submit the thesis for approval to BHC. Note that the deadlines are very strictly enforced.
- Present at the SUnMaRC conference and possibly at other conferences. If feasible, attend the Joint Math Meetings in January. Plan ahead so that you can apply for travel grants.
- Consider enrolling in graduate-level mathematics courses on topics that interest you
- Apply for internships, jobs, graduate schools, graduate research scholarships (applications for the most prestigious ones such as the NSF-GRFP are due as early as September of your senior year)

---

Last updated: August 2013
Contact: Nancy Childress, SoMSS.