

REVIEW OF THE B.A., B.S. IN MATHEMATICS

Classification of Instructional Programs (CIP) Code: 27.0101
Mathematics, General

OVERVIEW

The B.A., B.S. in Mathematics program is housed in the Department of Mathematics within the College of Arts and Sciences. The department also offers an undergraduate minor in Mathematics, an M.S. in Mathematics, and a Ph.D. in Mathematics Education. The last review of the B.A., B.S. in Mathematics program occurred in 2010-2011.

Students in the B.A., B.S. in Mathematics program may pursue a general course of study or enroll in one of four sequences: actuarial science, mathematics teacher education, pedagogy emphasis, or statistics. The actuarial science sequence prepares students for careers in a variety of fields dealing with the risk of financial losses, such as life insurance, health insurance, financial risk management, property/casualty/liability insurance, pensions, or employee benefits. Students successfully completing the mathematics teacher education sequence qualify for initial teacher licensure in Illinois with an endorsement to teach high school mathematics. The pedagogy emphasis sequence serves students who are interested in teaching but who do not pursue teacher licensure. The statistics sequence prepares students for work in industry and government, with emphases in biometrics, econometrics, or psychometrics. Regardless of their plan of study, students preparing for a specific career may take courses recommended by faculty as helpful to their career preparation. Course lists are available for six careers: business management; secondary teaching; business, government, and industry; applications or research in physical sciences; applications or research in social sciences; or graduate study and research in mathematics.

In addition to serving its majors, the Department of Mathematics offers courses for every other major at the University, with almost every first-time-in-college student taking a mathematics course. The majority of credit hours produced by the department are generated through courses that qualify for General Education credit or that are preparatory to General Education courses.

Enrollment by Plan of Study, Fall Census Day, 2011-2018

B.A., B.S. in Mathematics, Illinois State University
First Majors Only

	2011	2012	2013	2014	2015	2016	2017	2018
No sequence	51	44	49	58	53	46	29	22
Actuarial Science sequence	97	103	105	133	143	144	141	127
Mathematics Teacher Education sequence	242	216	203	166	133	137	138	133
Pedagogy Emphasis sequence						0	0	0
Statistics sequence	3	11	11	12	22	25	29	22
Total	393	374	368	369	351	352	337	304

Degrees Conferred by Plan of Study, Graduating Fiscal Year 2011-2018

B.A., B.S. in Mathematics, Illinois State University
First Majors Only

	2011	2012	2013	2014	2015	2016	2017	2018
No sequence	18	17	14	14	15	20	21	14
Actuarial Science sequence	17	11	18	15	14	15	19	22
Mathematics Teacher Education sequence	42	47	47	40	28	19	29	24
Pedagogy Emphasis sequence							0	0
Statistics sequence	4	0	2	2	3	5	5	13
Total	81	75	81	71	60	59	74	73

[See table notes on the following page]

Table notes:

Graduating Fiscal Year consists of summer, fall, and spring terms, in that order. For example, Graduating Fiscal Year 2018 consists of the following terms: summer 2017, fall 2017, and spring 2018.

The pedagogy emphasis sequence was established effective May 16, 2016.

EXECUTIVE SUMMARY PROGRAM REVIEW SELF-STUDY REPORT

Program goals

The B.A., B.S. in Mathematics program is designed to help students acquire knowledge of mathematics commensurate with career/sequence goals; construct and critically analyze mathematical arguments; develop problem-solving skills, logical reasoning, and creative thinking; develop a positive attitude toward mathematics and its uses; and use the language of mathematics to communicate ideas.

Students learning outcomes

- Demonstrate an understanding of the key concepts in mathematics, actuarial science, statistics, or secondary mathematics education.
- Demonstrate the ability to construct and analyze mathematical arguments.
- Demonstrate the ability to solve problems and apply mathematical knowledge to new problem situations.
- Demonstrate an appreciation of mathematics as a vital, growing field.
- Be able to use mathematics terms appropriately and correctly.
- Demonstrate the ability to communicate mathematics.

Program curriculum (2018-2019)

Students may enroll in one of four sequences or complete the program without enrolling in a sequence. Sequences are actuarial science, mathematics teacher education, pedagogy emphasis, and statistics.

Graduation requirements (actuarial science):

120 credit hours including 71 credit hours in the major and 39 credit hours in General Education courses, with the balance earned through completion of elective courses. Students complete a senior portfolio.

Graduation requirements (mathematics teacher education):

120 credit hours including 50 credit hours in mathematics course, 27 credit hours in professional development (educator preparation) courses required of all candidates for initial teacher licensure regardless of program, and 39 credit hours in General Education courses, with any balance earned through completion of elective courses. Students complete a senior portfolio, a student teaching assignment, and the state-mandated edTPA capstone assessment.

Graduation requirements (pedagogy emphasis):

Same as mathematics teacher education, except students are not required to complete edTPA.

Graduation requirements (statistics):

120 credit hours including 50 credit hours in the major and 39 credit hours in General Education courses, with the balance earned through completion of elective courses. Students complete courses in two of three cognate areas of statistical application selected from biometrics, econometrics, and psychometrics.

Graduation requirements (non-sequence):

120 credit hours including 45 credit hours in mathematics courses and 39 credit hours in General Education courses, with the balanced earned through completion of elective courses. Students complete a senior portfolio.

Program delivery

The program is offered on the Normal campus.

The program is delivered primarily through face-to-face or blended face-to-face/online instruction.

Department faculty (Fall 2018)

27 tenure track faculty members (16 Professors, 5 Associate Professors, and 6 Assistant Professors)

27 non-tenure track faculty members (20 full-time and 7 part-time, totaling 24.16 FTE)

Undergraduate student to faculty ratio: 5.8 to 1

Undergraduate student to tenure-line faculty ratio: 10.6 to 1

Specialized accreditation

The mathematics teacher education sequence is affiliated with the teacher education unit at Illinois State University which was last accredited by the National Council for Accreditation of Teacher Education (NCATE) in 2012. The teacher education unit has applied for initial accreditation by the Council for the Accreditation of Educator Preparation (CAEP), which is the successor to NCATE. In addition to being part of an accredited teacher education unit, the mathematics teacher education sequence is currently recognized by the National Council of Teachers of Mathematics (NCTM), a specialized professional association previously affiliated with NCATE. NCTM recognition of the sequence is scheduled to expire February 1, 2020. Faculty members have opted not to continue program affiliation with NCTM beyond that date, to instead focus on CAEP accreditation and compliance with state educator preparation program guidelines.

In 2009 the actuarial science program at Illinois State University, consisting of actuarial science sequences in the undergraduate and graduate mathematics programs, was one of the first nine programs in the U.S. designated a Center of Actuarial Excellence by the Society of Actuaries (SOA). In 2014 the actuarial science program was subject to a comprehensive five-year review by SOA, which resulted in continued accreditation through Calendar 2019. In 2016 the Casualty Actuarial Society, the other major professional actuarial organization in the U.S., began its own system of recognizing actuarial science programs. The program at Illinois State was one of the first four such programs in the world recognized by the society.

Changes in the academic discipline, field, societal need, and program demand

Major trends in mathematics since the last program review include continued demand by employers for students trained in mathematics or allied fields, emphasis on application of mathematics in other fields, and use of technologies to provide mathematics education and foster collaborative learning environments. In part due to increasing emphasis on data-driven decision making, job growth in fields that employ mathematics program graduates is expected to exceed growth in other fields nationally, at least through 2026. The B.A., B.S. in Mathematics program is helping meet the demand for job applicants with mathematics skills, as enrollments in its actuarial science and statistics sequences have continued to grow. The Department of Mathematics has expanded its efforts to educate its students about the importance of mathematical tools and techniques in other fields. The department has introduced a weekly colloquium for undergraduate students and continues to sponsor special events during Math Awareness Month. With regard to technologies, the department continues to expand its repository of online courses and has started using online homework systems in some 100-level courses. There also has been increasing emphasis on fostering a sense of community among students and alumni through use of social media platforms and through creation of a student lounge near the department office. Technological change does not usually happen without challenges. Since the prior program review, the University transitioned from a mainframe student information system to a new cloud-based system. During the transition some student data were not available to the department, resulting in challenges for academic advisors who work closely with students. A trend specific to Illinois since the prior program review that has negatively impacted mathematics instruction at the University is the long-term decline in state funding for higher education. Indeed, there was an 18-month period since the last review during which the state did not allocate funds to its public universities. This trend has made it increasingly difficult for the University to provide instructional capacity sufficient to meet all program goals. To meet all goals of the undergraduate mathematics program, more tenure track faculty positions and additional summer term funding would be needed.

Responses to previous program review recommendations

The 2010-2011 program review resulted in five recommendations: determine optimal enrollment in light of rising demand for the program, continue efforts to establish clinical sites for students in the mathematics teacher education sequence, continue to develop advisement structures and assess their effectiveness, continue recruiting for diversity,

and investigate the feasibility of a five-year B.S./M.S. program in biomathematics. The Department of Mathematics has made progress addressing each of the five recommendations. The department worked with the Enrollment Management and Academic Services unit at the University to establish an enrollment target of 375 students for the undergraduate mathematics program and worked with that office to reach that target. Since then, enrollment in the program has decreased, necessitating counter actions to maintain and increase enrollment. For the benefit of its teacher education students, the department has established and maintained at least 25 clinical (i.e., student teaching) sites. All are located within 40 miles of campus. At the time of the prior review, student advising was distributed among tenure track faculty members in the department. Since then the department has hired a full-time academic advisor to help with student advising, recruitment, and retention. This new approach is expected to positively impact students and free faculty time for instruction and research. The department continues to sponsor several long-standing initiatives intended to encourage students identifying with traditionally underrepresented racial/ethnic groups to enroll in the undergraduate mathematics program. In part as a result of those efforts, the percentage of majors from underrepresented groups has increased to approximately 21.5 percent. To benefit well-prepared advanced students, the faculty has made significant progress toward establishing accelerated programs in mathematics and biomathematics, which would make it possible for students to earn both a bachelor's degree and a master's degree in either field within five years. The accelerated biomathematics program has been approved and is scheduled to begin in 2020. A proposal for an accelerated mathematics program has been submitted for review by the appropriate curriculum committees.

Major findings

The B.A., B.S. in Mathematics program is working well. Faculty members have increased the rigor of the curriculum since the last program review and have added courses to better prepare students for the growing data analysis needs of employers. The actuarial science sequence and its companion sequence in the M.S. in Mathematics program comprise one of the leading actuarial science programs in the world, designated as a Center of Actuarial Excellence by the Society of Actuaries. The mathematics program continues to be one of the top producers of secondary mathematics teachers in Illinois. Enrollment in the statistics sequence has grown. The demand for students graduating with a major in mathematics or a related program such as statistics or actuarial science continues to grow. Occupations requiring expertise in mathematics, statistics, or actuarial science consistently rank above others with respect to job growth rates and median salaries. Despite this increased demand, enrollment in the B.A., B.S. in Mathematics program has decreased since the prior program review. This has been a cause for introspection in the department. Faculty members have worked hard to maintain high quality teaching and scholarship, involve students in research, and support students through tutoring, advising, and scholarships. Those efforts will continue. The department will also seek additional ways to meet students' career goals through additional emphases on applied mathematics and through innovations in program delivery. One challenge to increasing enrollment is having sufficient instructional capacity to provide individualized attention to students and to teach in newly-established innovative programs. For example, faculty has prioritized assigning tenure-line faculty members to teach calculus and linear algebra courses to help recruit and retain majors, but there are not enough faculty members to do so. The ability to offer joint programs with other academic units has been hampered by having too few faculty members to teach upper division and graduate-level statistics and actuarial science courses. The recent hiring of a full-time academic advisor with student recruitment and retention responsibilities should free some faculty time for instruction and research. However, additional attention to instructional capacity is warranted.

Initiatives and plans

- Implement newly-adopted student recruitment strategies.
- Increase the number of tenure track faculty positions to improve student learning experiences, especially at the 100-level.
- Augment pure mathematics instruction with more applied coursework.
- Investigate establishing a joint mathematics-computer science program with the School of Information Technology.
- Continue revising the statistics sequence to better prepare students for employment in data analytics and data science positions.
- Maintain the Center of Actuarial Excellence designation by continuing to adapt the curriculum to changing standards in the profession.

- Continue to adapt the mathematics teacher education curriculum to changing state and professional standards.
- Better publicize mathematics programs at Illinois State to increase awareness of the programs among prospective students.

PROGRAM REVIEW OUTCOME AND RECOMMENDATIONS FROM THE ACADEMIC PLANNING COMMITTEE

Review Outcome. The Academic Planning Committee, as a result of this review process, finds the B.A., B.S. in Mathematics program to be in Good Standing.

The committee thanks the program and department for a thorough, critical, and clearly written self-study report. In the report, faculty and staff of the program state that, “students in our programs are our pride.” Indeed, the report evidences a program that is student-centered as well as dynamic.

The committee commends faculty and staff for their efforts to graduate students from the program within four years. From Fiscal 2010 through Fiscal 2017, on average 72.2 percent of program completers graduated within four years compared to 63.5 percent across all undergraduate programs offered by the University. Six-year graduation rates for both first-time-in-college students and external transfer students have also consistently exceeded university-wide rates. For first-time-in-college students enrolling in the program in fall 2009, fall 2010, or fall 2011, the six-year graduation rate averaged 75.8 percent compared to 71.5 percent across all undergraduate programs at the University. Six-year graduation rates for external transfer students averaged 80.9 percent compared to 76.6 percent university-wide. Graduates have fared well with respect to employment or admission to graduate programs. In some years, for example, 95 percent of students graduating from the actuarial science sequence obtained jobs in the field.

The committee commends faculty efforts to encourage and support student participation in the University Honors program. In fall 2017, participation of undergraduate mathematics students in the Honors program reached an eight-year high of 29.1 percent, compared to 6.9 percent university-wide. The committee recognizes efforts by faculty to involve all students, whether participating in the Honors program or not, in research. In addition to research conducted by students in their courses, students have opportunities to work with faculty on research through independent studies. Students are encouraged to present their research findings at the annual University Research Symposium or at a session of the undergraduate colloquium sponsored by the Department of Mathematics. Other venues for learning outside the classroom include two registered student organizations sponsored and facilitated by the department (the Math Education Club and the Actuarial Club) and a mathematics-themed residential learning community, located in Hewitt Hall. Since the last program review, the department has created a space in Stevenson Hall in which students can study, socialize, or work on group projects.

The committee commends the program for its numerous community outreach efforts, including two summer programs designed to interest high school students in actuarial science: the Redbird Risk Management Program and the Midwest High School Scholars Analytics Academy. The latter has been offered by the department for more than 20 years to high school students self-identifying with racial/ethnic groups traditionally underrepresented in the discipline. Students completing either summer program receive a scholarship to enroll at Illinois State. The Analytics Academy has likely contributed to an increase in the percentage of students in the undergraduate mathematics program who are students of color, from 11.9 percent at the time of the prior program review to 27.3 percent in fall 2017. For Chicago public high school students interested in mathematics, university students attending the Research Experiences for Undergraduates in Mathematics program sponsored annually by the Department of Mathematics hold a week-long mathematics summer camp in the city.

In addition to teaching and mentoring mathematics majors, mathematics faculty members and graduate assistants contribute extensively to the General Education program of the University by teaching introductory mathematics courses to students across all undergraduate programs of the University. Nearly every first-time-in-college student enrolling at Illinois State (nearly 3,300 students in fall 2017) and many external transfer students (nearly 900 entering with freshman or sophomore status in fall 2017) take one or more of those courses. The department is responsible for the assessment instrument used by the University to determine the most appropriate introductory mathematics course for each student. The department also offers tutoring services for students, major or non-major, enrolled in any one of nine introductory mathematics courses. The committee thanks mathematics faculty and staff for these contributions.

Since the last program review, faculty members have made numerous changes to the program in response to changes in the discipline to best position program completers for employment or graduate study. Among those changes are establishment of emphases or tracks for students not enrolled in a sequence and adding coverage of special education theory and practice to the mathematics teacher education curriculum. The committee recognizes faculty for its ongoing monitoring of the actuarial science sequence for curricular changes necessitated by changes to the national actuarial examinations. The committee congratulates faculty for national and international recognition of the actuarial science program since the last program review. In 2009 it was one of the first nine actuarial programs in the U.S. designated by the Society of Actuaries as a Center of Actuarial Excellence (reaffirmed in 2014), and in 2016 it was one of the first four actuarial science programs in the world honored for its excellence by the Casualty Actuarial Society.

The committee acknowledges efforts by faculty and staff to develop non-traditional offerings of the program. Those efforts have included a partnership with Jiangsu Normal University (China), through which students from Jiangsu complete the fourth year of the Jiangsu undergraduate mathematics program while in residence at Illinois State and then remain at Illinois State to complete its M.S. in Mathematics program. The committee encourages faculty to continue nurturing the arrangement with Jiangsu, as it has potential to attract more international students to campus and, thereby, help further internationalize the University for the benefit of the campus community. Another non-traditional initiative underway at this time is establishment of accelerated sequences in the undergraduate mathematics program that will make it possible for high-achieving students to complete a bachelor's degree and a master's degree in mathematics from Illinois State within five years rather than six.

At the time of the 2010-2011 review of the B.A., B.S. in Mathematics program, its faculty members were relying almost exclusively on quantitative methods to assess student learning. As a follow-up to that review, mathematics faculty members have adopted a multiple-methods approach to student learning outcomes assessment, including strategies for assessing learning on the sequence level. The fall 2018 self-study report submitted by the program evidences implementation of the revised assessment plan to guide the numerous changes made by faculty to the program in recent years. The committee recognizes mathematics faculty for those efforts.

Recommendations. The Academic Planning Committee makes the following recommendations to be addressed within the next regularly scheduled review cycle. In the next program review self-study report, tentatively due October 1, 2026, the committee asks the program to describe actions taken and results achieved for each recommendation.

Implement newly-established strategies for student recruitment and retention. Enrollment in the B.A., B.S. in Mathematics program has steadily declined since the prior program review, from 397 students in fall 2010 to 304 students in fall 2018. While the decline in numbers was most precipitous in the mathematics teacher education sequence (a decrease of 98 students), enrollment of students pursuing a general mathematics plan of study declined 63 percent. Modest enrollment growth in the actuarial science sequence (from 101 to 127) and in the statistics sequence (from 5 to 22) has not been sufficient to fully offset the losses. However, with recent enhancements to student recruitment efforts, including the production of recruitment videos and plans to give mathematics talks to high school students, and with the hiring of an advisor who will also coordinate undergraduate recruitment, the department is well positioned to reverse enrollment decline. To coordinate and streamline those efforts, the committee suggests that the department work with Enrollment Management and Academic Services at the University to develop a recruitment, retention, and enrollment management plan for the program. The committee suggests that the plan address enrollment at the sequence level. Having that granularity could help the department not only with recruitment and retention but also with planning for faculty teaching assignments, including coverage of introductory mathematics courses by tenure-line faculty members (see below).

Continue to consider innovative approaches to undergraduate mathematics education. To best prepare students for employment or graduate education in light of changes in the discipline, the committee recommends that faculty continue its practice of periodic, systematic review of the program structure, curriculum, and delivery modes to help faculty identify and develop innovative approaches to structuring and delivering the program. Those new approaches could, in turn, aid student recruitment and retention efforts. The committee encourages the department to continue its work with Jiangsu Normal University, seek similar arrangements with other universities if deemed appropriate by faculty, and to fully establish and implement the accelerated sequences in development at this time. The committee supports faculty in their plans to explore establishing a pure and applied mathematics sequence and a joint major with the School of Information Technology. Given the limit to resources available to the department, the

committee encourages faculty to use the department strategic planning process underway at this time to prioritize the numerous potential program development initiatives.

Work to maintain and improve the quality of instruction in introductory courses. The quality of introductory mathematics instruction is critical to the success of students in every program offered by the University, since nearly every first-time-in-college student and many external transfer students must complete at least one mathematics course at the University to meet General Education requirements. In addition, the quality of instruction in introductory mathematics courses for mathematics majors is critical to engaging and retaining those students in the program. The self-study report indicates that faculty resources of the department are insufficient to assign tenured or tenure track faculty members to teach all or even most introductory mathematics courses. The report indicates that introductory courses for majors are instead taught primarily by non-tenure track faculty members while introductory courses for non-majors are taught by non-tenure track faculty or graduate assistants. In light of that situation, the committee makes two recommendations. First, the committee recommends that the department revisit its graduate teaching assistant training program and consider expanding it beyond a single day, to include more in-depth training in pedagogy and classroom management. Expanded graduate assistant training might also include additional faculty mentoring throughout the academic year. Faculty might look to its comparator and aspirational programs to identify models for this training. Second, the committee encourages the department to continuing working with the College of Arts and Sciences to seek ways to increase the percentage of introductory mathematics courses taught by tenured or tenure track faculty members. The committee notes that the B.A., B.S. in Mathematics program each year loses 30 percent or more of its freshmen cohort by the beginning of its sophomore year, almost all to other programs at the University. Having more tenure-line faculty members teach introductory mathematics courses could help with student recruitment and with improving student retention rates.

Continue efforts to increase faculty diversity. According to the self-study report, the Department of Mathematics has achieved a stable gender balance in its faculty ranks whereby approximately half of its full-time faculty members and approximately 40 percent of its tenure-line faculty members are women. The report further states that nearly two-thirds of tenure-line faculty members were born outside the U.S. The report observes that there is room for increasing diversity among its U.S.-born faculty. The committee encourages the department to pursue doing so during the next program review cycle as opportunities to hire faculty arise. The committee recommends recruiting for diversity with respect to groups traditionally underrepresented in the discipline, including racial/ethnic groups, but also with respect to expertise, interests, and perspectives faculty members may bring to the department.

Collaborate with Milner Library to further integrate information fluency instruction in the curriculum and promote the article delivery service. The committee recognizes collaborative program-library efforts to identify goals for information fluency in the B.A., B.S. in Mathematics program and to teach to those goals. The committee encourages program and library faculty to expand those efforts by specifying information fluency learning outcomes related to each goal, mapping those outcomes to the curriculum, and integrating information fluency training related to those outcomes into the student learning outcomes assessment plan for the program. With regard to research resources needed to support mathematics teaching and learning, the committee is aware that the costs of acquiring access to research resources of the discipline continue to increase at rates greater than increases in university allocations for those purchases (if there are any increases at all). The committee is also aware that this phenomenon has resulted in cancellation of numerous journal subscriptions. While this phenomenon is not unique to mathematics, it is most acute in STEM disciplines (Science, Technology, Engineering, and Mathematics). Since the last program review, Milner Library has introduced an article delivery service branded *Get It Now* to provide students and faculty access to literature published in journals to which the library does not subscribe. The service is free, and materials are made available electronically, often within hours of a request. The committee recommends that the department and library collaborate to increase awareness of the service among mathematics faculty and students.

Continue efforts to assess student learning and utilize assessment findings to inform program design and implementation. The committee encourages faculty to continue assessing student learning, utilizing assessment findings to make program improvements if deemed necessary based on the findings and to help guide strategic planning efforts, and documenting its assessment work, including the rationale for program changes. The committee encourages faculty to periodically review the assessment plan for its effectiveness in guiding program evaluation and for its sustainability in light of department resources.