

Request for Entitlement to Plan Major in Actuarial Science

Program Identification:

Title of Proposed Program:

Bachelor of Arts in Actuarial Science

Department Sponsoring the Program:

Department of Mathematical Sciences

College or School:

College of Letters and Sciences

Timetable for Initiation:

This program can be initiated as soon as it is approved. All courses required for the program are currently offered at UWM, and the program already exists as a sub-major in Mathematical Sciences, the Option in Actuarial Science.

Program Description:

Objectives:

The primary objective of the proposed major (and of the current sub-major) is to prepare students for careers as actuaries. To accomplish this goal the program does two things:

- (a) It gives students the necessary foundation in statistics, mathematics and economics so that they will be prepared for advancement in the field.
- (b) It prepares them to pass the first two actuarial examinations. (A description may be found at <http://www.soa.org/eande/examinations.html>, Course 1 and Course 2 examinations.)

Curriculum:

Students will be required to meet all existing requirements for earning a Bachelor of Arts degree from the College of Letters and Science. No new courses are proposed. Required courses (preparatory and specialized) are as listed below, followed by a list of recommended courses. Finally, we list a proposed schedule showing how a student can be expected to meet these requirements in eight semesters, not including Summer or UWinteriM.

Students who intend to complete the program in four years should have a mathematics placement level of B or better or plan to take summer coursework in mathematics. Upon admission to the University a student must consult with a Department of Mathematical Sciences advisor to plan a course of study which will allow the student to graduate in a timely manner, as there are many dependencies among the required courses, and the program is very structured.

Required (Preparatory)

We require the following courses or their equivalents (number in parentheses is the number of course credits):

Accounting:

One of

- 216-201 Understanding and Using Financial Statements (4)
- 216-204 Introduction to Financial Statement Preparation and Use (4)

Calculus:

One of

- 600-222 Honors Calculus II (5)
- 600-233 Calculus and Analytic Geometry (4)

Note that either of these courses has numerous prerequisite sequences ranging from 1 to 5 previous mathematics courses, depending on a student's initial mathematics placement. One expects the typical student to take 600-225, 600-226 and then 600-232 before enrolling in 600-233, based on current trends in mathematics placement test scores at UWM.

Computer Programming:

Seven credits chosen from

- 262-151 Introduction to Scientific Programming in Fortran (3)
- 262-152 Computer Programming I (4)
- 601-461 Data Analysis and Graphing Using SAS I (2)
- 601-462 Data Analysis and Graphing Using SAS II (2)

Economics:

The following courses are required:

- 296-103 Principles of Microeconomics (3)
- 296-104 Principles of Macroeconomics (3)

Linear Algebra and Differential Equations:

The following course is required:

- 600-234 Linear Algebra and Differential Equations (4)

Statistics:

One of the following three courses,

- 216-210 Introduction to Management Statistics (3)
- 296-210 Economic Statistics (3)
- 601-215 Elementary Statistical Analysis (3)

(601-215 is the recommended choice), plus the following sequence:

- 601-361 Mathematical Statistics I (3)
- 601-362 Mathematical Statistics I (3)

Required (Specialization)

The following 21 credit hours are required.

- 600-311 Theory of Interest (3)
- 600-571 Introduction to Probability Models (3) This course will serve as the capstone course for the major.
- One of

- 601-563 Regression Analysis (3)
 - 601-564 Time Series Analysis (3)
- Three of the following four courses (9)
 - 216-350 Principles of Finance (3)
 - 216-450 Intermediate Finance (3)
 - 296-301 Intermediate Microeconomics (3)
 - 296-301 Intermediate Macroeconomics (3)

Interested students should inquire of the School of Business whether they may take 216-450 without taking 216-350.

- Any 3 credit Mathematics or Mathematical Statistics course numbered 300 or above from the Applied Mathematics Group, the Computational Mathematics Group, the Probability and Statistics Group or the Pure Mathematics Group of courses (as designated by the Department). (3)

Recommended

These courses are relevant to the major and will satisfy some of the College's distribution requirements:

- 245-103 Public Speaking (3 credits in Humanities)
- 245-105 Business and Professional Communication (3 credits in Social Science)
- 296-248 Economics of Discrimination (satisfies Cultural Diversity Requirement) Allows students to examine issues such as insurance red-lining.
- 296-351 (396) Introduction to International Economic Relations (satisfies 3 credits of International Requirement). Allows students to examine issues relating to foreign exchange.
- 296-455 (576) International Finance (satisfies 3 credits of International Requirement).
- 350-205 Business Writing (satisfies Writing Intensive Requirement)
- 600-241 Seminar: Introduction to the Language and Practice of Mathematics (satisfies Seminar Requirement). Allows students to strengthen their logical skills in a mathematics setting.
- Any 500 level courses from the 601 (Mathematical Statistics) curricular code.
- 736-211 Elementary Logic (3 credits of Humanities)
- 736-241 Introductory Ethics (3 credits of Humanities)
- 754-209 Physics I
- 754-214 Laboratory for Physics I
- 754-210 Physics II
- 754-215 Laboratory for Physics II

Potential Course of Study

We outline a possible progression of courses, assuming students start in Math 225 in a fall semester. (This is an appropriate first course in Mathematics for a student who meets UWM's entrance requirements for number of units of high school mathematics. Roughly 27 percent of entering freshman meet or exceed this level of mathematics preparation as measured by the UW System Mathematics Placement Examination.) There are 68 credits required to complete the program required courses. 10 to 17 of these credits are not in Letters and Science. Between 21 and 28 credits of 300 level and above Letters and Sciences coursework is required.

In order to meet the Letters and Science requirement of 36 credit hours in upper division course work, students will be advised to satisfy as many Letters and Sciences and GER requirements as possible by taking upper division courses. An (R) indicates the course is required. An (S) indicates it is suggested.

Fall I:

13 credits

- 600-225 Calculus (R)
- 296-103 Economics (R)
- 245-103 Public Speaking (S)
- 296-248 Economics of Discrimination (S)

Spring II:

16 credits

- 600-226 Calculus (R)
- 296-104 Economics (R)
- 245-105 Business and Professional Communication (S)
- 601-215 Statistics (R)
- 350-205 Business Writing (S)

Fall III:

11 credits

- 600-232 Calculus (R)
- 216-204 Accounting (R)
- 736-211 Elementary Logic (S)

Spring IV:

13 credits

- 600-233 Calculus (R)
- 600-311 Interest Theory (R)
- 736-241 Introductory Ethics (S)
- 600-241 Mathematics (S)

Fall V:

14 credits

- 600-234 Linear Algebra/Differential Equations (R)
- 601-361 Probability (R)
- 601-461 Computer Programming (7 week course) (R)
- 601-462 Computer Programming (7 week course) (R)
- 296-301 Economics (R)

Spring VI:

13 credits

- 601-362 Statistics (R)
- 216-350 Finance (R)
- 296-302 Economics (R)
- 262-152 Computer programming (R)

Fall VII:

14 credits

- 754-209 Physics I
- 754-214 Laboratory for Physics I
- 600-571 Probability (R)
- 296-351 Economics (S)
- 296-455 Economics (S)

Spring VIII:

11 credits

- 600-371 (Financial Modeling)
- 601-564 (Statistics)
- 754-210 Physics II (S)
- 754-215 Laboratory for Physics II (S)

Interrelationship with Other Curricula:

Students who complete this major will automatically complete the requirements for a minor in mathematics, and will be 12 credit hours short of a major. Similarly they will be 3 credit hours short of a minor in economics and 12 credit hours short of a major. This directly benefits the Economics Department as there will be an increased number of minors, as evidenced by the number of students in the current sub-major who have already chosen to minor in economics.

Method of Assessment or Evaluation:

Assessment of the program may be based on

- its record of placing students into actuarial and related positions,
- students' grades, and
- students' performance on the Course I and Course II Actuarial Examinations.

A disparity between performance on these examinations and grades in corresponding courses may indicate problems in the program. Conversely, agreement in these measures would indicate that the program is of high quality.

Accreditation Requirement:

There is no formal accreditation of actuarial programs at this time. However, the Casualty Actuary Society (CAS) and the Society of Actuaries (SOA) maintain a self-reported data base on programs at <http://www.soa.org/academic/actcol.html> where one can view various measures of program effectiveness.

Career Advising:

The Department has one faculty member with professional actuarial experience, and an Actuarial Club that periodically invites recruiters to speak to our students. The Department periodically offers review courses for the SOA examinations.

Outreach:

At this time, no formal outreach activity is planned. It should be noted that non-degree students are already attending some of the courses in this program. This additional source of students may be expected to expand as the program becomes better known as a full-fledged major.

Integration of Technology:

Computing courses are required for this program. Statistics and probability courses in Mathematical Sciences currently incorporate computer technology for problem solving, and faculty use the web to make available course materials.

Rationale: There are several reasons for instituting this program.

Nature of the current actuarial option:

The Department has long offered courses designed to prepare students for several SOA examinations, and has been a test center for many years. However, the examination system changed in 2000. In addition to the standard mathematical subjects, students now need preparation in finance and economics to pass the early examinations, which are highly interdisciplinary.

In preparation for these changes the Department began offering a redesigned Option in Actuarial Science in Fall 1999, replacing 9 credits of junior/senior level course work in mathematics and statistics with three credits of economics, 3 credits of finance and 3 credits from either mathematics, finance or economics. This in turn requires preparatory coursework outside of mathematics and statistics as well. While still within the Department's educational mission, the resulting program falls outside of what is normally called a mathematics major. The Option was established with the understanding that a separate major would be pursued.

Demand:

The present Option in Actuarial Science has been in existence for three semesters, and currently (Spring 2001) enrolls 14 students. In the first year of the program's official existence, three students graduated.

The Department currently has enrollments of about 50 mathematics majors. Over the past 3 years roughly 37% of all students earning bachelor's degrees in mathematics concentrated in actuarial science. Roughly 30% of entering freshman have sufficient preparation in mathematics (as measured by the mathematics placement examination) to complete this program in four years.

In fact, actuarial science has been the most popular option within UWM's Mathematics Major for many years. (Other options are Pure Mathematics, Applied Mathematics, Computational Mathematics, and Statistics.) At the Fall 2000 UWM Open House there were about 12 inquiries about the program. To put this in perspective, this exceeded the number of all other inquiries concerning either Mathematics or Atmospheric Science (housed within the Department).

The job market for actuaries has been strong and the outlook continues to be good for graduates. In January 2001 a search of the SOA Job Link showed 55 openings posted in the previous 60 days. All of the Department's recent actuarial graduates are employed as actuaries.

In Fall 2000 alone the Department had five inquiries by companies for graduates from our program, even though the program is virtually invisible. The number of inquiries the Department receives from recruiters suggests strongly that the program at UW-Madison does not graduate enough students to meet the industry's needs. This is further supported by the ease with which UWM's actuarial graduates find placement in industry.

The Department predicts that in five years time it can achieve enrollments on the order of 30 students in the Actuarial Major, around half that of UW-Madison, particularly as the program's visibility rises.

Greater visibility:

Because it is not listed as a major, many students and employers do not know that an actuarial program exists at UWM. Advisors within the College are not always aware of the current Actuarial Option, nor are other program units. There is no question that this is the major impediment to enrollment in actuarial science at UWM.

Thus when Trustmark Insurance Company in Lake Forest Illinois wanted to interview candidates for actuarial positions at UWM, its representatives contacted the School of Business. The School could not provide them with any undergraduate candidates and did not contact the Mathematical Science Department or refer Trustmark to us.

Appeal to liberal arts students:

This program is housed within the College of Letters and Science, rather than the School of Business (as is the case at UW-Madison and many other institutions). At the same time it does not have the requirements of a full mathematics major. The program is thus attractive to liberal arts students, who will in turn bring certain important strengths to the profession, particularly a broad background including skill in written and oral expression.

Relation to Institutional Mission, Strategic Plan, Goals, and Objectives

The insurance industry is well-represented in Wisconsin, particularly in the Milwaukee area, and the Department has had considerable success in the past in placing its students in both permanent positions and internships. Its graduates are already well-thought of in industry, but program visibility is needed to increase their numbers.

This program represents a tangible way for the Mathematical Sciences Department to contribute to the Milwaukee Idea by fostering cooperation between UWM and the business community. Approval of this major will demonstrate an institutional commitment to the actuarial program, which will allow the Department to pursue endowed positions such those that exist at UW-Madison. Our growing relationship with the local actuarial industry is exemplified by our selection to participate in the Northwestern Mutual Life Actuarial Scholarship Program (beginning in 2000), and by an offer from a management consulting firm based in Milwaukee to explore arrangements by which it would pay students' SOA examination fees. A local actuarial consulting firm has offered to help financially in recruitment.

An important benefit to the University will be to attract more students having superior mathematics preparation. The proposed major is also an opportunity to recruit out-of-state students to UW-Milwaukee as there seems to be a shortage nationwide of actuarial programs.

A low pass rate for the Course 1 examination reported by the SOA in 2000 (after its new examinations went into effect) suggests that many schools delayed making the appropriate changes in their programs. UWM's actuarial graduates continue to do well, and may be expected to be highly competitive in the job market. This is therefore a propitious time for UWM to elevate this program to a major.

Relation to Other Academic Programs in the UW System, the Region and the Nation

This is the only program in Actuarial Science at UWM. It differs from that at UW-Madison in two important respects:

- (a) It will be housed in the College of Letters and Sciences, rather than the School of Business.

(b) Students may be admitted to this program as freshmen. UW-Madison requires junior standing.

In addition to a bachelor's degree, master's and PhD degrees are also offered. According to the SOA, UW-Madison graduated an average of 25 undergraduates per year over the last three years. As students need to have junior standing to be admitted to the program, this implies a total of 50 to 75 students in the program. There are three faculty members whose primary responsibility is to teach actuarial science courses, and at least one more faculty member with part-time duties in the program. The program appears to emphasize business aspects of actuarial science as no mathematics courses are offered by the program directly. Instead, students take such courses from the Mathematics and the Statistics Departments. Recruiters have indicated that they prefer UWM's actuarial students to UW-Madison's because UWM's students have a better mathematics background.

UWM and UW-Madison have the only actuarial programs in Wisconsin which the SOA labels "Undergraduate - Advanced (Curriculum covers all topics on first two CAS/SOA exams plus 12 semester hours of topics on third and fourth)" (<http://www.soa.org/academic/schoollist.html>). Indeed, there are only 57 such programs in all of North America. There are also programs at UW-Whitewater and UW-Superior labeled "Undergraduate - Introductory (Curriculum covers all topics on the first CAS/SOA exam, and includes intro. math of finance and micro/macro economics courses)". These programs do not lead to a bachelor's degree, but do prepare students for the first examination. They are not comparable in scope to the proposed major, and will not be discussed further.

There are programs comparable to the proposed major at

- Ball State University
- Bradley University
- DePaul University
- Drake University
- University of Evansville
- University of Illinois at Urbana-Champaign
- Illinois State University
- University of Iowa
- University of Michigan
- Purdue University
- Southern Illinois University - Edwardsville

All offer roughly the same curriculum as that offered currently at UW-Milwaukee. The average number of graduates annually is about 12 per institution, with a range of 2 (Bradley University) to 30 (University of Illinois). There are no comparable programs in Minnesota, so it is not possible for Wisconsin students to take advantage of reciprocity agreements with Minnesota institutions.

Nationwide there are fewer than 60 programs which prepare students for the first two actuarial examinations. (See <http://www.soa.org/academic/schoollist.html> for a list.)

Projected Source of Resources:

There is no funding requirement beyond the current funding currently available to the Mathematical Sciences Department. The program itself is already in existence. No additional library or other resources are required for it. While classroom space is generally tight, no additional classroom space or other capital expenditure is required by this proposal.

No new courses are currently being proposed for the major, and existing courses can be taught with current faculty. Additional hires for actuarial science would of course free faculty to cover other Departmental needs while allowing the development of new courses and the more frequent offering of existing courses as needed. It should be noted that it is typical for established programs in this field to have positions endowed by industry. For example, UW-Madison has two such endowed positions. The Department is eager to explore this possibility once this major is approved.

It is possible that a demand will develop for a master's level program in Actuarial Science (about 5 inquiries a year are received for such a program now). Such a program would require additional faculty to provide expertise currently lacking in the Department or elsewhere on campus.