

Proposal for a BS/MS Combination Degree in Actuarial Science and Quantitative Risk Management

Program Rationale

The following document presents the rationale and plan for creation of a combined BS/MAQRM degree in Actuarial and Quantitative Risk Management (AQRM), to be implemented in the Spring of 2026. Currently, the Mathematics Department offers a BS undergraduate degree in Actuarial Science and a professional degree Master in Actuarial and Quantitative Risk Management (MAQRM). After reviewing the curriculum and the advanced courses being taken by high-performing students in the undergraduate major, it is possible for accelerated students to complete the requirements for their undergraduate degree as well as coursework for a MAQRM degree in five years. The plan described below fits the Graduate School's description of the purpose of a combined program as "to give outstanding students an opportunity to pursue simultaneously two degrees in different colleges or schools by reducing the amount of time required to complete both sets of degree requirements."

Executive Summary

The proposed combined BS/MAQRM degree program allows students to double-count some 5000 level courses in actuarial science and mathematics, which are normally taken by advanced undergraduate students as electives or by beginning graduate students. By double counting nine credits of these electives for both the undergraduate and graduate degrees, a student in the combined degree program can fulfill the undergraduate degree requirements generally in their fourth year and be able to complete the remaining requirements for the MAQRM degree in an additional year. All course work at the 5000 level that is approved as an elective for the undergraduate BS is eligible to count towards the 9 credit hours that count towards both the BS and MAQRM. This combined degree plan allows students to enhance their undergraduate training with graduate-level coursework and complete an MAQRM degree with a reduced time commitment.

The undergraduate BS degree in Actuarial Science requires completion of 121 credit hours consisting of at least 33 general education credits and up to 12 world language credits, prerequisite coursework in Math, Economics, Communication, Accounting, and Computer Science, and 35 to 36 credits specific to the Actuarial Science major (Appendix A). The Actuarial Science major requirements include 26 credits of required coursework in Math, Statistics, Business Finance, and English, and 9 credits of elective courses in upper-level mathematics courses which are focused on advanced actuarial topics. Many students come to Ohio State University with Advanced Placement, College Credit Plus, or other college-level credits enabling them to accelerate their progress toward the Actuarial Science major and many take upper-division (5000-level) courses as early as their third year. The MAQRM degree requires 33 credit hours of coursework, and by applying 9 of these credit hours towards the fulfillment of undergraduate major elective credits, students can complete the combined degree in five years. Overviews and advising materials and for the BS and MS programs are found in Appendices A-C.

Student enrolled in the ASC Honors Program for the Actuarial Science major are required to complete all requirements for ASC honors. Students need

- a minimum of 18 hours of Honors coursework including:
- All GE Theme courses must be Honors or Honors-quality courses
- At least one Honors or Honors-quality course in EACH of the following disciplines
 - o Natural and Mathematical Sciences
 - o Arts and Humanities
 - o Social and Behavioral Sciences
- The ASC Honors survey course
- An Honors enhanced ePortfolio

- Honors Project
- Honors requirements within the math major.

A description of the major requirements and sample schedule for ASC Honors Program Actuarial Science Majors are found in Appendices A and B respectively.

The first semester of graduate study in MAQRM includes about 9-12 credit hours of 5000-level math courses (Appendix C). The combined degree program will allow accelerated undergraduate students to take the first semester of graduate coursework and apply 9 of these credit hours towards the fulfillment of the 9 undergraduate major elective credits. The remaining requirements for the MAQRM degree include 24 credits of additional coursework which can be completed in an additional year and a master level examination or completion of a master level thesis and defense (description found in Appendix D). Students must complete all requirements for the BS in Actuarial Science and all the requirements for the MAQRM degree. A sample plan for the combined BS/MAQRM degree for actuarial science majors is presented in Appendix B and a complete listing of course options and requirements for the MAQRM degree is contained in Appendix D. Changes to the requirements to the MAQRM program including a reduction in required credit hours are detailed in Appendix I. Description of requirements for students in the combined degree who optionally choose the thesis option is contained in Appendix E. Current and proposed advising sheets for the MAQRM program as in Appendix C. Program goals and assessments for both the BS and MAQRM degrees are contained in Appendices F and G respectively.

The MAQRM program is not designed as an online master's degree program, and we have no intentions of allowing this to become an optionally distance learning degree. The courses in the mathematics department approved for 100% distance learning are: Math 2568, Math 5630, Math 5631, Math 5632, Math 5633, and Math 5634. It would not currently be possible for students in the combined degree to obtain the MAQRM degree as a distance learning degree. A complete list of mathematics and statistics courses approved for distance learning are included in Appendix H.

Students will be made aware of the opportunity to participate in the combined degree program at the point of declaring their major in Actuarial Science and during appointments with advisors. It is anticipated that most candidates will apply during the Spring semester of the student's third year following consultation with the major advisor for admission to the program at the beginning of the student's fourth year. However, students may apply for admission to the combined degree program as soon as they meet the requirements for admission. By the time of admission, applicants to the combined degree program must:

1. be in good academic standing (at least 3.5 GPA)
2. have completed the major core courses (Math 4530 or Stat 4201)
3. have completed the prerequisite economics courses (Econ 2001 and Econ 2002)
4. have completed at least 90 credit hours as an undergraduate

GRE scores will not be required for the combined BS/MS degree. Applications will be reviewed by the Mathematics Department MAQRM Committee to determine if the student is ready and capable of accelerated studies. Upon admission, the Director of the actuarial science MAQRM program, or another Mathematics faculty member designated by the GSC Chair after consultation with the student, will serve as the students BS/MAQRM advisor. Both thesis and non-thesis master's degree candidates will complete a master's examination in accordance with the existing MAQRM program requirements. (Department of Mathematics Graduate Program Handbook section 9.4.3).

Based on actuarial science and mathematics advising reports, 2-5 students each year are interested in completing the MAQRM degree if they were able to begin the program as an undergraduate student. We anticipate this number will enroll in the combined program.

A student in the combined degree program can elect to leave the program without penalty. The completed graduate courses will continue to count as elective credits towards the student's undergraduate BS degree. In particular, by not changing the requirements for the baccalaureate program, the combined program will ensure that students meet the expected baccalaureate program outcomes before the BS degree is awarded, whether they complete the combined degree or leave the program before meeting the requirements for the MAQRM degree.

Admission to the program results in enrollment of the student as a graduate student and credit will be charged according to the graduate degree rates of the University; however, the hours that will be double-counted for completion of the undergraduate degree will be charged at the undergraduate rate. Additionally, as graduate students, the undergraduate course prerequisite requirements for graduate courses (5000 and above) will be waved, as is the case for new graduate students in the MAQRM program from outside the university. The MAQRM program does not provide financial support through graduate teaching assistants.

We believe the opportunity to obtain a BS and MAQRM degree will be attractive to ambitious students at Ohio State University preparing for employment in actuarial science and mathematical finance fields where a master's degree will position them ahead of or open better career-related positions than those available to BS degree-holding graduates. It will also prepare and enable students who wish to matriculate into advanced PhD programs to be competitive in actuarial science programs. We will measure the success of the combined degree through an annual survey administered to graduating students, wherein we will record data related to their career success. In addition, the advanced knowledge and training of graduates with an MS degree will enhance the reputation of Ohio State University programs in scientific fields and industries.

Appendix A

Effective Term: Autumn 2025

Bachelor of Science Major: Actuarial Science

Students in this major will complete a minimum of 121 hours outlined as follows.

General Education Requirements		
Requirement	Course Options	Hours
GE Launch Seminar	<i>General Education Seminar</i>	1
Writing and Information Literacy	<i>Student Choice*</i>	3
Mathematical & Quantitative Reasoning/Data Analysis	<i>Student Choice*</i>	4-5
Literary, Visual and Performing Arts	<i>Student Choice</i>	3
Historical & Cultural Studies	<i>Student Choice</i>	3
Natural Science	<i>Student Choice</i>	4-5
Social & Behavioral Sciences	<i>Student Choice*</i>	3
Race, Ethnic and Gender Diversity	<i>Student Choice</i>	3
Theme: Citizenship for a Diverse & Just World^a	<i>Student Choice</i>	4-6
Theme: Student Choice^a	<i>Student Choice</i>	4-6
GE Reflection	<i>Understanding a Diverse & Just World</i>	1
General Education Credit Hours:		33-39

Major Supporting Courses	
* The following courses are prerequisites and/or corequisites to this major. The may also fulfill certain GE Requirements above.	
Course (hrs)	GE Category or Course Title
Math 1151 & 1152 (10)	Mathematical & Quantitative Reasoning/Data Analysis
Econ 2001 & 2002 (6)	Social & Behavioral Sciences
CSE 2111 or CSE 1222 or 1223 (3)	Spreadsheets and Databases or Computer Programming in C++/Java
ACCTMIS 2000 (3)	Foundations of Accounting/Intro to Accounting I & II
Comm 2367 or Comm 2110 or Comm 2131 (3)	Persuasive Communication Principles of Effective Public Speaking Business and Professional Speaking
Math 1295 (1)	Math Seminar

College/Degree Requirements		
Requirement	Course Options	Hours
World Language*	1101	4
	1102 or 1155	4
	1103	4
ASC 1100.xx	University Survey	1
*Based upon student's language placement		Credit Hours: 1-13

^a Students complete either a 4-credit course or two 3-credit courses in each of two General Education Theme areas: Citizenship for a Diverse & Just World (required), and the student's choice of available GE Themes. If any major-required courses are identified as a GE Theme course, one course in each GE Theme area may double count in the GE and major hours. Theme courses are identified with a ♦ symbol.

Major Coursework		
Course	Title	Hours
Math 2153	Calculus III	4
Math 2568	Linear Algebra	3
Choose 1 course: Math 4530 Stat 4201	Probability Statistics I	3-4
Stat 4202	Statistics II	4
Math 3588	Practicum in Actuarial Science	3
Math 3618	Theory of Interest	3
BusFin 3120	Foundations of Finance	3
Choose 1 course: English 3304 English 3305	Business and Professional Writing Technical Writing	3
Choose 3 courses: Math 5630 Math 5631 Math 5632 Math 5633 Math 5634 Math 5637	Life Contingencies Life Contingencies Financial Mathematics for Actuaries Loss Models Topics in Risk Modeling	9
Credit Hours:		35-36

General Education	33-39
College/Degree Requirements	1-13
*Major Pre-Requisite Courses	26
Major	35-36
Open Electives	19-37
Minimum Total Credit Hours	121

Embedded Literacies:

- Math 3618 Theory of Interest – embedded technology
- English 3304 Business and Professional Writing or English 3305 Technical Writing – embedded writing
- Stat 4202 Statistics II – embedded data

Bachelor of Science
Major: Honors Actuarial Science

Students in this major will complete a minimum of 121 hours outlined as follows.

General Education Requirements		
Requirement	Course Options	Hours
GE Launch Seminar	General Education Seminar	1
Writing and Information Literacy	Student Choice*	3
Mathematical & Quantitative Reasoning/Data Analysis	Student Choice*	4-5
Literary, Visual and Performing Arts	Student Choice	3
Historical & Cultural Studies	Student Choice	3
Natural Science	Student Choice	4-5
Social & Behavioral Sciences	Student Choice*	3
Race, Ethnic and Gender Diversity	Student Choice	3
Theme: Citizenship for a Diverse & Just World^a	Student Choice	4-6
Theme: Student Choice^a	Student Choice	4-6
GE Reflection	Understanding a Diverse & Just World	1
General Education Credit Hours:		32-39

Major Supporting Courses	
* The following courses are prerequisites and/or corequisites to this major. The may also fulfill certain GE Requirements above.	
Course (hrs)	GE Category or Course Title
Math 1151 & 1152 (10) or Math 1181H (5)	Mathematical & Quantitative Reasoning/Data Analysis
Econ 2001 & 2002 (6)	Social & Behavioral Sciences
CSE 2111 or CSE 1222 or 1223 (3)	Spreadsheets and Databases or Computer Programming in C++/Java
ACCTMIS 2000 (3)	Foundations of Accounting/Intro to Accounting I & II
Comm 2367* or Comm 2110 or Comm 2131 (3)	Persuasive Communication Principles of Effective Public Speaking Business and Professional Speaking

College/Degree Requirements		
Requirement	Course Options	Hours
World Language*	1101	4
	1102 or 1155	4
	1103	4
ASC 1100.xxH	University Survey	1
*Based upon student's language placement		Credit Hours: 1-13

* Students complete either a 4-credit course or two 3-credit courses in each of two General Education Theme areas: Citizenship for a Diverse & Just World (required), and the student's choice of available GE Themes. If any major-required courses are identified as a GE Theme course, one course in each GE Theme area may double count in the GE and major hours. Theme courses are identified with a ♦ symbol. Communication 2367H will both fulfill the honors requirement in the Citizenship Theme, and qualify as Social and Behavioral Science

Major Coursework		
Course	Title	Hours
Math 2153 or 2182H	Calculus III or Honors Calc II	4-5
Math 2568 or 2568H	Linear Algebra	3
Choose 1 course: Math 4530 Stat 4201	Probability Statistics I	3-4
Stat 4202	Statistics II	4
Math 3588	Practicum in Actuarial Science	3
Math 3618	Theory of Interest	3
BusFin 3120	Foundations of Finance	3
Math 5632	Financial Economics for Actuaries	3
English 3304	Business and Professional Writing	3
Choose 2 courses: Math 5630 Math 5631 Math 5633 Math 5634 Math 5637	Life Contingencies I Life Contingencies II Loss Models I Loss Models II Topics in Risk Modeling	6
Credit Hours:		35-37

General Education	32-39
College/Degree Requirements	1-13
*Major Pre-Requisite Courses	20-25
Major	35-37
Open Electives	19-37
Minimum Total Credit Hours	121

Embedded Literacies:

- Math 3618 Theory of Interest – embedded technology
- English 3304 Business and Professional Writing – embedded writing
- Stat 4202 Statistics II – embedded data

ASC Honors Program Requirements:

- a minimum of 18 hours of Honors coursework including:
- All GE Theme courses must be Honors or Honors-quality courses
- At least one Honors or Honors-quality course in EACH of the following disciplines
 - Natural and Mathematical Sciences
 - Arts and Humanities
 - Social and Behavioral Sciences
- The ASC Honors survey course
- An Honors enhanced ePortfolio
- Honors Project

ASC Honors Program Requirements: Students pursuing such a program must complete at least "5 honors math eligible courses" (in green) selected in consultation with an honors math advisor.

Appendix B



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Actuarial Science Combined Degree Sample Schedule

	Autumn		Spring	
Year 1	Math 1151***	5	Math 1152	5
	CSE 1222	3	AcctMIS 2000	3
	Econ 2001 or 2002**	3	Econ 2001 or 2002**	3
	ARTSSCI 1100.10	1	Open Elective	3
	GE Launch Seminar (GENED 1201)	1	Math 1295	1
	Open Elective	3		
	Semester Credit Hours	16	Semester Credit Hours	15
Year 2	Math 2153	4	Math 2568	3
	Math 3618	3	Math 4530	3
	GE Historical and Cultural	3	Comm 2367*	3
	World Language	4	World Language	4
			GE Race, Ethnicity, and Gender	3
	Semester Credit Hours	14	Semester Credit Hours	16
Year 3	Open Elective	3	Math 3588	3
	BusFin 3120	3	Open Elective	3
	GE Citizenship	3	English 3304	3
	GE Theme Student Choice	3	Stat 4202	4
	World Language	4	GE Writing and Information	3
	Semester Credit Hours	16	Semester Credit Hours	16
Year 4	Math 5630	3	Math 5631	3
	Open Elective	3	GE Theme Student Choice	3
	Math 5633	3	GE Literary, Visual and Performing Arts	3
	Open Elective	3	GE Reflection (GENED 4001)	1
	GE Natural Sciences	4	Open Elective	2
	Semester Credit Hours	16	Semester Credit Hours	12
Year 5	Math 5401	3	Math 5402	3
	Stat 6301	3	Stat 6302	3
	Math 5632	3	Math 5634	3
	Math 5601	3	Math 5588	3
	Semester Credit Hours	12	Semester Credit Hours	12

*Comm 2367 fulfills GEN Theme Citizenship Requirement

**Econ 2001 or 2002 fulfills GEN Social and Behavioral Sciences requirement

***Math 1151 fulfills GEN Mathematical & Quantitative Reasoning/Data Analysis requirement

Credits Before Year 4	93
Total BS Credits	121
Total MAQRN Credits	33
Total Credits	145

Honors Actuarial Science Sample Schedule

	Autumn		Spring	
Year 1	Math 1151***	5	Math 1152	5
	CSE 1222	3	AcctMIS 2000	3
	Econ 2001H or 2002H**	3	Econ 2001H or 2002H**	3
	ARTSSCI 1100.01H	1	Open Elective	3
	GE Launch Seminar (GENED 1201)	1		
	Open Elective	3		
	Semester Credit Hours	16	Semester Credit Hours	14
Year 2	Math 2182H	4	Math 2568H	3
	Math 3618	3	Math 4530	3
	GE Hisotrical and Cultural	3	Comm 2367H*	3
	World Language	4	World Language	4
			GE Race, Ethnicity, and Gender	3
	Semester Credit Hours	14	Semester Credit Hours	16
Year 3	Open Elective	3	Math 3588	3
	BusFin 3120	3	Open Elective	3
	GE Citizenship	3	English 3304	3
	GE Theme Student Choice	3	Stat 4202	4
	World Language	4	GE Writing and Information	3
	Semester Credit Hours	16	Semester Credit Hours	16
Year 4	Math 5630	3	Math 5631	3
	Open Elective	3	GE Theme Student Choice	3
	Math 5632	3	GE Literary, Visual and Performin	3
	Open Elective	3	GE Reflection (GENED 4001)	1
	GE Natural Sciences	4	Open Elective	3
	Semester Credit Hours	16	Semester Credit Hours	13

*Comm 2367 fulfills GEN Theme Citizenship Requirement

**Econ 2001 or 2002 fulfills GEN Social and Behavioral Sciences requirement

***Math 1151 fulfills GEN Mathematical & Quantitative Reasoning/Data Analysis requirement

Completion of ASC Honors Program requirements: For a full list of requirement, please see the executive summary. Students must complete at least "5 honors math eligible courses" selected in consultation with an honors math advisor.

Total Credits

121

Honors Actuarial Science Combined Degree Sample Schedule

	Autumn		Spring	
Year 1	Math 1151***	5	Math 1152	5
	CSE 1222	3	AcctMIS 2000	3
	Econ 2001H or 2002H**	3	Econ 2001H or 2002H**	3
	ARTSSCI 1100.01H	1	Open Elective	3
	GE Launch Seminar (GENED 1201)	1		
	Open Elective	3		
	Semester Credit Hours	16	Semester Credit Hours	14
Year 2	Math 2182H	4	Math 2568H	3
	Math 3618	3	Math 4530	3
	GE Historical and Cultural	3	Comm 2367H*	3
	World Language	4	World Language	4
			GE Race, Ethnicity, and Gender	3
	Semester Credit Hours	14	Semester Credit Hours	16
Year 3	Open Elective	3	Math 3588	3
	BusFin 3120	3	Open Elective	3
	GE Citizenship	3	English 3304	3
	GE Theme Student Choice	3	Stat 4202	4
	World Language	4	GE Writing and Information	3
	Semester Credit Hours	16	Semester Credit Hours	16
Year 4	Math 5630	3	Math 5631	3
	Open Elective	3	GE Theme Student Choice	3
	Math 5632	3	GE Literary, Visual and Performin	3
	Open Elective	3	GE Reflection (GENED 4001)	1
	GE Natural Sciences	4	Open Elective	3
	Semester Credit Hours	16	Semester Credit Hours	13
Year 5	Math 5401	3	Math 5402	3
	Stat 6301	3	Stat 6302	3
	Math 5633	3	Math 5634	3
	Math 5601	3	Math 5588	3
	Semester Credit Hours	12	Semester Credit Hours	12

*Comm 2367 fulfills GEN Theme Citizenship Requirement

**Econ 2001 or 2002 fulfills GEN Social and Behavioral Sciences requirement

***Math 1151 fulfills GEN Mathematical & Quantitative Reasoning/Data Analysis requirement

Completion of ASC Honors Program requirements: For a full list of requirement, please see the executive summary. Students must complete at least "5 honors math eligible courses" selected in consultation with an honors math advisor.

Credits Before Year 4	92
Total BS Credits	121
Total MAQRM Credits	33
Total Credits	145

Appendix C

Advising Sheet for MAQRM

Prerequisites:

Course	Name	Credits	Semester	Grade	Comments
Math 2153	Calculus III				
Math 4530 or Stat 4201	Probability or Introduction to Math. Stat.				
Math 3618	Theory of Interest				
Econ 2001	Principals of Microeconomics				
Econ 2002	Principles of Macroeconomics				
Programming	(Recommended)				

Master of Actuarial and Quantitative Risk Management (33 credit hours)

Course	Name	Credits	Semester	Grade	Comments
Core					
Stat 6301	Probability for Statistical Inference	3			
Stat 6302	Theory of Statistical Analysis	3			
Math 5588	Practicum in Risk Management	3			
Math 5632	Financial Economics	3			
Sequences (Choose at least two sequences)					
Math 5630	Life Contingencies I	3			
Math 5631	Life Contingencies II	3			
Math 5633	Loss Models I	3			
Math 5634	Loss Models II	3			
Math 5635	Stochastic Calculus for Finance I	3			
Math 5636	Stochastic Calculus for Finance II	3			
Math 5637	Topics in Pred. Modeling (repeated)	3			
Math 5601	Essentials of Numerical Methods	3			
Math 5602	Computational PDEs	3			
Other Electives					
Math 5201	Real Analysis I	5			
Math 5202	Real Analysis 2	5			
Math 5401	Applied Differential Eq. 1	3			
Math 5402	Applied Differential Eq. 2	3			
Math 5603	Numerical Linear Algebra	3			
Stat 5740	Introduction to SAS Software	2			
Stat 6450	Applied Regression Analysis	4			
Stat 6500	Statistical Machine Learning	3			
Stat 6540	Applied Stochastic Processes	3			
Stat 6550	The Stat Analysis of Time Series	2			
Stat 6560	Applied Multivariate Analysis	3			
Stat 6605	Applied Survival Analysis	3			
Math 6999	Thesis Research	3			

Total Credit Hours _____ Name _____ OSU ID _____

Appendix D

Description of the MAQRM requirements

MAQRM Prerequisites:

Applicants to the MAQRM program should present the following preparation and materials in their applications:

- Strong coursework in calculus, on par with MATH 2153 (4 cr. hrs.) [Calculus III](#)
- Solid preparation in calculus-based probability, on par with MATH 4530 (3 cr. hrs.) [Probability](#) or STAT 4201 (4 cr. hrs.) [Intro to Mathematical Statistics I](#)
- Elementary economics, at the level of ECON 2001.01 or .03H (3 cr. hrs.) [Principles of Microeconomics](#) and ECON 2002.01 or .03H (3 cr. hrs.) [Principles of Macroeconomics](#)

Background in interest theory and actuarial science is not required, though strongly recommended. Incoming MAQRM students are expected to have already passed the FM Exam (Financial Mathematics Exam), an actuarial exam administered by the Society of Actuaries and the Casualty Actuarial Society. If a student does not meet this prerequisite, MATH 3618 can be taken during the first semester of a student's MAQRM study.

- MATH 3618 (3 cr. hrs.) [Theory of Interest](#) (Required during the first semester in MAQRM if FM Exam not passed)

We strongly recommend proficiency in a computer programming language at the level of one of the following

- CSE 1222 (3 cr. hrs.) [Intro to Computer Programming in C++](#)
- CSE 1223 (3 cr. hrs.) [Intro to Computer Programming in Java](#)
- CSE 1224 (3 cr. hrs.) [Intro to Computer Programming in Python](#)

Required Core Courses (12 credit hours):

A student will need to pass all required core, required sequences, and elective courses with at least a grade of C- by the end of the Spring Semester of the second year.

*students who start during a Spring Semester are expected to complete these requirements by Autumn of the second year

Mathematics & Statistics

- MATH 5632 (3 cr. hrs.) [Financial Economics for Actuaries](#)
- STAT 6301 (3 cr. hrs.) [Probability for Statistical Inference](#)
- STAT 6302 (3 cr. hrs.) [Theory of Statistical Analysis](#)
- MATH 5588 (3 cr. hrs.) Practicum in AQRM.

Required AQRM Sequences (12+ credit hours):

Students must choose at least 2 of the following year-long course sequences. A student may request to use other courses to satisfy the sequence requirement. The request should be submitted by the student and advisor to the Graduate Studies Committee (GSC) for approval.

Life Contingencies

- MATH 5630 (3 cr. hrs.) [Life Contingencies I](#)
- MATH 5631 (3 cr. hrs.) [Life Contingencies II](#)

Loss Models

- MATH 5633 (3 cr. hrs.) [Loss Models I](#)
- MATH 5634 (3 cr. hrs.) [Loss Models II](#)

Stochastic Calculus for Finance

- MATH 5635 (3 cr. hrs.) Stochastic Calculus for Finance I
- MATH 5636 (3 cr. hrs.) Stochastic Calculus for Finance II

Topics in Risk Management

- MATH 5637 (3 cr. hrs.) Topics in Risk Management (repeatable up to 6 credit hours)
- MATH 5637 (3 cr. hrs.) Topics in Risk Management (repeatable up to 6 credit hours)

Numerical Analysis

- MATH 5601 (3 cr. hrs.) [Essentials of Numerical Methods](#)
- MATH 5602 (3 cr. hrs.) [Computational Partial Differential Equations](#)

Elective Courses (6+ credit hours):

Elective credit must consist of unused courses from the sequences above or from the listed electives below. The course sequences may be completed in full or may be mixed and matched as electives. Electives courses and if applicable, the Thesis Writing Course (3 cr. hrs.), must add up to the total 33 cr. hrs. required for the MAQRM degree. A student may request to use other courses to satisfy the elective requirement. The request, in the form of a petition, should be submitted to the MAQRM program director for approval.

Real Analysis

- MATH 5201 (5 cr. hrs.) [Introduction to Real Analysis I](#)
- MATH 5202 (5 cr. hrs.) [Introduction to Real Analysis II](#)

Differential Equations

- MATH 5401 (3 cr. hrs.) [Applied Differential Equations I](#)
- MATH 5402 (3 cr. hrs.) [Applied Differential Equations II](#)

Numerical Linear Algebra

- MATH 5603 (3 cr. hrs.) [Numerical Linear Algebra](#)

Statistics

- STAT 5740 (2 cr. hrs.) [Introduction to SAS](#)
- STAT 6450 (4 cr. hrs.) [Regression Analysis](#)
- STAT 6500 (3 cr. hrs.) [Statistical Machine Learning](#)
- STAT 6540 (3 cr. hrs.) [Applied Stochastic Processes I](#)
- STAT 6550 (2 cr. hrs.) [Time Series](#)
- STAT 6560 (3 cr. hrs.) [Applied Multivariate Analysis](#)
- STATE 6605 (3 cr. hrs.) [Applied Survival Analysis](#)

Oral and Comprehensive Examinations:

Students in the thesis option need to complete a thesis defense as prescribed by Graduate School rules (details below). Students in the non-thesis option are required to satisfactorily complete the two-part comprehensive examination. Each part of the examination is approximately 2 hours long and tests one of two areas chosen by the student. Students can choose from the following five subjects:

1. Stochastic calculus with applications in Finance
2. Predictive modeling
3. Numerical analysis
4. Life contingencies
5. Loss models

The two comprehensive exams will fulfill the requirement of the Graduate School master's examination requirement.

Thesis Option (3 credit hours):

The MAQRM degree offers both a non-thesis and a thesis option. Students should decide on which option they elect by the beginning of their second semester of study.

Each student must select a thesis advisor by the end of the Autumn Semester of the second year (or the Spring Semester of the second year if the student started during a Spring Semester) and submit a Change of Advisor form to the Graduate Office. The thesis advisor needs to be a Mathematics Department faculty member of [category M level](#) or higher. Typically, this will be the MAQRM program director. Thesis research and writing will occur during the second year and should be completed by the end of the Spring Break of the

second year (or the equivalent timeframe within the alternate semester of graduation). During this time students should generally be signed up for **3 hrs. of MATH 6999** with the supervising Master's Faculty (Thesis) Advisor.

- **MATH 6999** (3 cr. hrs.) Graduate Thesis Research

The thesis will be written during the second year under the supervision of the thesis advisor and prepared in compliance with university rules. All students are expected to apply to graduate with the Master of Actuarial and Quantitative Risk Management (AQRMAQRM) degree via the Thesis-Option before the second Friday of the semester of graduation. In order to apply, a student also must choose a second member of the examination committee by the beginning of the same semester. This must be a Graduate Faculty member but may be from another OSU unit related to the specialization. The oral examination must be scheduled and passed after submission of a draft of the thesis. An additional written examination is not required. The thesis needs to follow university formatting guidelines, be approved by the committee, and be submitted to the Graduate School.

For further details see Section VI of the [Graduate School Handbook](#).

The credits earned from required core, required sequences, and elective courses must be at least **30** credit hours. Additionally, **MATH 6999 Thesis Writing** counts for **3** more hours toward the degree. Independent studies, group studies, and research credit hours, or hours from unapproved courses **do not count** toward the required **33** total hours of coursework.

Appendix E

Thesis option requirements for students in combined degree:

Students in the combined degree may also choose between the non-thesis option and the thesis option. Students who matriculate into the MAQRM program through the combined degree program must select a thesis advisor by the end of the Autumn Semester of the first year in the MAQRM program (typically autumn of their fifth year at OSU) and submit a Change of Advisor form to the Graduate Office if their advisor is not the MAQRM program director. The thesis advisor needs to be a Mathematics Department faculty member of [category M level](#) or higher. Thesis research and writing will occur during the fifth year of study at OSU and should be completed by the end of the Spring Break of the fifth year (or the equivalent timeframe within the alternate semester of graduation). During this time students should generally be signed up for **3 hrs. of MATH 6999** with the supervising Master's Faculty (Thesis) Advisor.

- **MATH 6999** (3 cr. hrs.) Graduate Thesis Research

The thesis will be written under the supervision of the thesis advisor and prepared in compliance with university rules. All students are expected to apply to graduate with the Master of Actuarial and Quantitative Risk Management (AQRMAQRM) degree via the Thesis-Option before the second Friday of the semester of graduation. In order to apply, a student also must choose a second member of the examination committee by the beginning of the same semester. This must be a Graduate Faculty member but may be from another OSU unit related to the specialization. The oral examination must be scheduled and passed after submission of a draft of the thesis. An additional written examination is not required. The thesis needs to follow university formatting guidelines, be approved by the committee, and be submitted to the Graduate School.

For further details see Section VI of the [Graduate School Handbook](#).

The credits earned from required core, required sequences, and elective courses must be at least **30** credit hours. Additionally, **MATH 6999 Thesis Writing** counts for **3** more hours toward the degree. Independent studies, group studies, and research credit hours, or hours from unapproved courses **do not count** toward the required **33** total hours of coursework.

Honors students who complete an honors thesis cannot use the same work for the MAQRM thesis; these works must be completed independently.

Appendix F

Actuarial Science (BS), Program Goals:

Goal 1: To supply a strong general background in mathematics, statistics, and relevant concepts from the insurance industry.

Assessment Method Category: Direct - Embedded testing

Assessment Method: Embedded test questions in junior and senior math and statistics courses.

Results evaluated every semester by course coordinators.

Criteria: Students get grades of C- or better in major courses.

Goal 2: To prepare students to take some of the national actuarial examinations administered by the Society of Actuaries and the Casualty Actuarial Society.

Assessment Method Category: Direct - Certification or licensure examination

Assessment Method: Students take the professional exams administered by the professional societies.

Criteria: Students pass the professional exams administered by the professional societies.

Appendix G

MAQRM Program Goals:

The MAQRM program has three unofficial tracks. Students can specialize in actuarial science, mathematical finance, or coursework to prepare for further graduate school. Our goal is to help students succeed in achieving success in whichever path is best for them.

Actuarial Science: Success in actuarial science requires actuaries to progress through a series of actuarial exams (6 exams to reach the first designation of Associate of the Society of Actuaries (ASA)), coursework (called Validation by Educational Experience (VEE)), and success in the Associateship Professionalism Course (APC). The APC is administered by the SOA and is only available to candidates who meet all other requirements. It typically takes professionals 5 or more years to obtain the ASA designation. After one obtains the designation of ASA, they may then work on the further qualifications of a Chartered Enterprise Risk Analyst (CERA) or Fellow of the Society of Actuaries (FSA).

We provide the opportunity for our students to meet all the requirements to qualify for the APV before they graduate. Indeed, some MAQRM students even obtain the designation of ASA before they graduate. We provided courses which cover the material on all preliminary SOA exams, and students who succeed in our courses are prepared to pass the exams and/or earn VEE credit.

Additionally, our department requires MATH 5588: Practicum in Actuarial Science, which covers similar material as the APC. Our graduates are able to succeed in the APC course more easily and obtain the ASA designation quicker. MATH 5588 also trains students to give clear, effective, and persuasive presentations on technical results; a skill which is required in the actuarial science profession.

Mathematical Finance: Mathematical or quantitative finance is a highly competitive field, and successful graduates are rewarded with high salaries and tremendous potential for career development.

In order to succeed, students need to learn a variety of technical skills taught in our required class MATH 5632, as well as our core tracks in Stochastic Calculus for Finance and Topics in Risk Modeling. Students with strong mathematical backgrounds in these areas, who also have a mastery of statistical concepts and techniques, are highly competitive in this field. Additionally, students need to have excellent communication skills.

Preparation for Graduate School: Our goal for students interested in this track is to provide a pathway for students to matriculate into highly competitive graduate schools in areas such as applied mathematics, actuarial science, and agricultural economics. In order to succeed, students need a strong background in Real Analysis (MATH 5201-5202), Numerical Analysis (MATH 5601-5602), probability and statistics (STAT 6301-6302). They also must have the opportunity to demonstrate their potential for success in research (and we often recommend the thesis option for these students).

MAQRM Program Assessment Plans:

Outcome: Core Knowledge in Discipline

MAQRM students are expected to acquire proficiency in core subjects of actuarial and financial mathematics.

Assessment Methods:

- Direct-Classroom assessment: Performance in the required and elective courses will be evaluated every semester via the cumulative GPA achieved by the students. This provides a reasonably uniform and objective measure since the curriculum in the MAQRM program is fairly prescribed and grading standards in core course do not vary much.

Criteria: Minimum criteria is that 60% of students achieve a first year cumulative GPA of 3.5 or higher.

Aspirational criteria is that 80% achieve a cumulative GPA of 3.8 or higher.

- Final Exam assessment: All students in the program are required to pass a final exam in two of five areas to graduate. Each comprehensive exams provides a uniform and objective measure of subject area mastery in a core AQRM area.

Criteria: Minimum criteria is that 80% of students pass two final exams on their first attempt. Aspirational criteria is that 100% of students pass two final exams on their first attempt.

Assessment Method Schedule: Every year.

Outcome: Communication and Presentation

Graduates should be able to communicate and to present technical results to both general audience and to professionals effectively and clearly.

Assessment Methods:

- Direct-Practicum Project Presentation - Thesis/Comprehensive Examination: Students need to complete and present two or more projects in the practicum and topics courses.

Criteria: Success in MATH 5588 and/or successful thesis examination. Assessment Method Schedule: Every semester.

Appendix H

Courses in the mathematics and statistics departments approved for 100%distance learning are:

1. **Math 2568 (100% DL)**
2. **Math 5630 (100% DL)**
3. **Math 5631 (100% DL)**
4. **Math 5632 (100% DL)**
5. **Math 5633 (100% DL)**
6. **Math 5634 (100% DL)**
7. **Statistics 1350.02 (100% DL)**
8. **Statistics 1430.02 (100% DL)**
9. **Statistics 2450.02 (100% DL)**
10. **Statistics 2480.02 (100% DL)**
11. **Statistics 3201 (100% DL)**
12. **Statistics 3202 (100% DL)**
13. **Statistics 3301 (100% DL)**
14. **Statistics 3302 (100% DL)**
15. **Statistics 3440 (100% DL)**
16. **Statistics 3410 (100% DL)**
17. **Statistics 3450.02 (100% DL)**
18. **Statistics 3470.02 (100% DL)**
19. **Statistics 4302 (100% DL)**
20. **Statistics 5301 (100% DL)**
21. **Statistics 5302 (100% DL)**
22. **Statistics 5730 (100% DL)**
23. **Statistics 5731 (100% DL)**
24. **Statistics 5732 (100% DL)**
25. **Statistics 5740 (100% DL)**
26. **Statistics 6201 (100% DL)**
27. **Statistics 6450 (100% DL)**
28. **Statistics 6510 (100% DL)**
29. **Statistics 6550 (100% DL)**
30. **Statistics 6610 (100% DL)**
31. **Statistics 7430 (100% DL)**

Appendix I

Changes to the MAQRM program requirements since its inception are twofold; first, we allow students to take more courses from the elective sequence list. Second, we require 33 credit hours instead of 36-39 credit hours to graduate.

More courses from the list of sequences: The list of sequences represents the core courses which define the degree. The sequences: Life Contingencies, Loss Models, and Topics in Risk Management are required to pass the 4 advanced exams needed for the Associate of the Society of Actuaries credential. The Stochastic Calculus for Finance sequence covers material on one of the optional exams students take to become a Fellow of the Society of Actuaries. Thus, students pursuing the actuarial profession are interested in taking courses in these four core areas. Moreover, the courses selected for these sequences were selected precisely because they represent the most important material we offer in this degree. Thus, it makes sense to encourage students to take more courses from the list of required sequences, rather than a different elective.

Due to these reasons, since the inception of the MAQRM program, the directors of the program and the mathematics department have routinely allowed students to take more of these courses in place of other electives.

Reduction from 36-39 cr. hrs. to 33 cr. hrs.: The MAQRM program was originally approved for 36-39 credit hours. The number of electives was subsequently reduced for the following reasons.

1. For students pursuing the actuarial science career path (80% of our students), some of the electives are not particularly beneficial to their career success. We typically recommend students take statistics courses like Time Series analysis or Applied Multivariate Analysis.
2. It is important that students can graduate in no more than 3 semesters. Starting salaries for actuaries are high and an additional semester of schooling costly. Other MS programs in actuarial science, including UIUC and Columbia, have 2-3 semester long programs.