4-19-2018

Curricular Report No. 2017-18-10 from the Graduate Council to the Faculty Senate: M.S. Mathematics - Applied Mathematics Track

University of Rhode Island Faculty Senate

THE
UNIVERSITY
OF RHODE ISLAND
FACULTY SENATE OFFICE
Green Hall, 35 Campus Avenue, Kingston, RI 02881 USA p: 401.874.2616

THINK BIG WE DO

Serial Number #17-18-36

TO: President David Dooley
FROM: Mark Conley, Chairperson of the Faculty Senate

1. The attached BILL titled, Curricular Report No. 2017-18-10 from the Graduate Council to the Faculty Senate: M.S. Mathematics – Applied Mathematics Track, is forwarded for your consideration.

2. This BILL was adopted by vote of the Faculty Senate on April 19, 2018.

3. After considering this bill, will you please indicate your approval or disapproval. Return the original, completing the appropriate endorsement below.

4. In accordance with Section 10, paragraph 4 of the Senate's By-Laws, this bill will become effective May 10, 2018 three weeks after Senate approval, unless: (1) specific dates for implementation are written into the bill; (2) you return it disapproved; or (3) the University Faculty petitions for a referendum.

Mark Conley
Chairperson of the Faculty Senate

April 19, 2018

ENDORSEMENT

TO: Chairperson of the Faculty Senate

FROM: President of the University

a. Approved ____.

b. Approved subject to Notice of the Council on Postsecondary Education ✓. Noticed 6/20/18

c. Disapproved ____.

Signature of the President

4.26.18
(date)

THE GRADUATE SCHOOL - UNIVERSITY OF RHODE ISLAND
NEW PROGRAM REPORT FROM THE GRADUATE COUNCIL TO THE FACULTY SENATE
CURRICULAR REPORT 2017-2018-10; 26 March 2018

At Meeting No. 515 held on 26 March 2018, the Graduate Council approved the attached proposal that is now submitted to the Faculty Senate.

SECTION I
ABSTRACT AND BACKGROUND INFORMATION

ABSTRACT (modified from proposal)

For many years, the mathematics department has been offering a well-established B.S. Applied Mathematics option and Ph.D. Applied Mathematics track. The current M.S. program does not have an Applied Mathematics track and is generally used by the department as a feeder program into the Ph.D. Pure Mathematics track. The Department of Mathematics is proposing to add an Applied Mathematics track to the existing M.S. degree and renaming the existing program, Pure Mathematics track. The renaming is in line with the existing Ph.D. in mathematics program (Pure Mathematics track and Applied Mathematics track). The new Applied Mathematics track will be offered starting in Fall 2018. The existing M.S. program, which will now be called Pure Mathematics track, will be used as the feeder program into the Ph.D.

BACKGROUND (modified from proposal)

The new track has been designed by the department to enhance students' knowledge and computational skills in advanced mathematics with a special focus on the necessary mathematical proficiencies needed for industry work. This curriculum gives URI students a competitive edge in a wide range of mathematically based careers. The M.S. Applied Mathematics track will consist of 30 credits or 24 credits plus thesis (6 credits): 12 credits in core math courses and the remaining 18 credits are electives that can be chosen based on students' interests and skills. For the non-thesis option, one credit is required for a substantial paper involving significant independent research.

SECTION II
RECOMMENDATION

The Graduate Council approved the proposal to create a **M.S. Mathematics – Applied Mathematics Track** *at* its Meeting No. 515 held on 26 March 2018, and forwards it to the Faculty Senate with a recommendation for approval.

THE
UNIVERSITY
OF RHODE ISLAND

REVISED 12/2016

Modified Form
For New Interdisciplinary Minors, and New Tracks/Options/Sub-plans/Concentrations

A Proposal for: M.S. Mathematics – Applied Mathematics Track

Date: 12/28/2017

A. PROGRAM INFORMATION

A1. Name of institution: University of Rhode Island

A2. Name of department, division, school or college
Department: Mathematics
College: Arts and Sciences

A3. Title of proposed program and Classification of Instructional Programs (CIP) code
Program title: M.S. Mathematics – Applied Mathematics Track
Classification code (CIP) 27.0301, 27.0304, 30.3001

A4. Intended initiation date of program change. Include anticipated date for granting first degrees or certificates, if appropriate.
Initiation date Fall 2018
First degree date Spring 2020

A5. Intended location of the program: Department of Mathematics

A6. Description of institutional review and approval process

	Approval Date
Department: Mathematics	12/20/2017
College	2/27/2018
CAC/Graduate Council	
Faculty Senate	
President of the University	

A7. Summary description of proposed program (not to exceed 2 pages)

The Department of Mathematics is proposing to add an Applied Mathematics track to the existing M.S. degree and renaming the existing program, Pure Mathematics track (see graduate catalog description, page 16). The renaming is in line with the existing Ph.D. in mathematics program (Pure Mathematics track and Applied Mathematics track). The new Applied Mathematics track will be offered starting in Fall 2018. For many years, the mathematics department has been offering a well-established B.S. Applied Mathematics option and Ph.D. Applied Mathematics track. The current M.S. program does not have an Applied Mathematics track and is generally used by the department as a feeder program into the Ph.D. Pure Mathematics track. The existing M.S. program, which will now be called Pure

Mathematics track, will be used as the feeder program into the Ph.D. Pure Mathematics track. This new Applied Mathematics track in the M.S. program is directly addressing several action steps in the URI 2016-2021 Academic Strategic Plan (see section C1). The new track has been designed by the department to enhance students' knowledge and computational skills in advanced mathematics with a special focus on the necessary mathematical proficiencies needed for industry work. This curriculum gives URI students a competitive edge in a wide range of mathematically based careers. The M.S. Applied Mathematics track will consist of 30 credits or 24 credits plus thesis (6 credits): 12 credits in core math courses and the remaining 18 credits are electives that can be chosen based on students' interests and skills. For the non-thesis option, one credit is required for a substantial paper involving significant independent research. This track, unlike the traditional M.S. degree, will not require a written comprehensive exam. This flexibility is one of the reasons that will make this program attractive to a diverse group of students and people in industry. The program is designed in a way that can accommodate full-time graduate students and part-time working professionals.

As stated above, the new Applied Mathematics track necessitates the need to rename the current M.S. degree to distinguish it from the proposed Applied Mathematics track. Therefore, the current M.S. program will be renamed the Pure Mathematics track, see graduate catalog description.

A8. Signature of the President

_____
David M. Dooley

A9. Person to contact during the proposal review

Name:	James Baglama
Title:	Chair of Mathematics Department
Phone:	401-874-4412
Email:	jbaglama@uri.edu

A10. List and attach any signed agreements for any cooperative arrangements made with other institutions/agencies or private companies in support of the program.

Not applicable.

B. RATIONALE: There should be a demonstrable need for the program.

B1. Why is the new program being developed?

The Society of Applied and Industrial Mathematics (SIAM) broadly defines a career in applied mathematics *"as a career that uses mathematics to solve problems in the environment*

of your choice."[1] Considering that expertise in many disciplines is substantially enhanced by having a better understanding of mathematics and computational methods, this program will make URI graduates better prepared and more competitive for a career in industry.

According to the Bureau of Labor Statistics[2] (BLS) "a master's degree in mathematics is ideal, especially for mathematicians interested in working in the private sector." Unfortunately, no university, public or private, in Rhode Island offers a terminal master degree in applied mathematics (see section D1a), and the purpose of the proposed track is to fill that gap. The need for this program is furthermore supported with the fact that people with a M.S. degree in mathematics have a median salary of approximately $80,000 with a job outlook substantially higher than in other fields.

By supporting this new track, URI would not only increase its graduate enrollment in mathematics and generate new revenue, but also establish itself as a principal provider of professional graduate degrees with a job outlook higher than the average.[3] The latter goal also fully supports the URI's 2016-2021 Academic Strategic Plan (see section C1).

Finally, the report by the Council of Graduate Schools[4] shows that between Fall 2013 and Fall 2014, first-time graduate enrollment increased by 3.5%, the largest spike since 2009. The fields that saw the biggest increase in enrollment were Applied Mathematics and Computer Science, which is indicative of potential enrollment in the proposed track. With a steady enrollment, we can expect to build a healthy and a competitive applied math program and funnel our graduates into the private sector in the New England area.

B2. What is the economic need and workforce data related to the program?

a. Provide information on jobs available as a result of successfully completing the certificate or degree: job titles, job outlook/growth, and salaries.

People with a B.S. or M.S. in (applied) mathematics are generally hired for a variety of positions with a different title, for example: Actuary, Business Analyst, Cryptanalyst, Data Scientist, Algorithms Engineer, Quantitative Scientist (quant), Risk Analyst, Simulation Engineer, Software Engineer, Modeling Engineer, Operations Researcher. This should come as no surprise considering that mathematics is an integral part in many of the applied sciences.

According to the Report on Best STEM Jobs[5] in 2017, published by U.S. News, Mathematician is listed at #4. Other careers in the top ten jobs include Statistician (#1), Financial Advisor (#5), Actuary (#6) and Operations Research Analyst (#10), all of which are highly enhanced by having strong mathematical skills.

1 https://www.siam.org/careers/thinking.php
2 https://money.usnews.com/careers/best-jobs/mathematician
3 https://www.bls.gov/ooh/math/mathematicians-and-statisticians.htm
4 https://www.usnews.com/education/best-graduate-schools/articles/2015/10/08/expand-career-options-with-a-graduate-degree-in-math
5 https://money.usnews.com/careers/best-jobs/rankings/best-stem-jobs

Additionally, and possibly more surprising, the title Mathematician is ranked #2 in the Report on Best Business Jobs[6] in 2017, also published by U.S. News.

Summary of the facts about mathematics as a career, published by the Bureau of Labor Statistics (BLS)[7], is given below.

Quick Facts: Mathematicians and Statisticians	
2016 Median Pay	$81,950 per year
Typical Entry-Level Education	Master's degree
Job Outlook, 2016-26	33% (Much faster than average)

B3. What entities are advocating for this program? Was an advisory board used to develop the curriculum?

The faculty of Mathematics Department is advocating for addition of the new Applied Mathematics track within the existing M.S. program. The curriculum was initially developed by several faculty members in the Mathematics Department. The proposed curriculum was approved, subject to minor revisions, by the Mathematics Graduate Committee on October 23, 2017 and all full-time faculty members in the department on December 20, 2017.

C. INSTITUTIONAL ROLE: The program should be clearly related to the published role, scope, and mission of the institution and be compatible with other programs and activities of the institution.

C1. Explain how the program is consistent with the published role, scope, and mission of the institution and how it is related to the institution's Academic Plan.

Applied mathematics is inherently interdisciplinary and viewed as the application of mathematics to real-world problems that arise in science, engineering, business, computer science, data science, and industry. As stated above, we have been offering a well-established B.S. Applied Mathematics option and Ph.D. Applied Mathematics track. The current M.S. program (will be renamed Pure Mathematics track) does not have an Applied Mathematics track and is generally used by the department as a feeder program into the Ph.D. Pure Mathematics track. Students in the current M.S. math program are encouraged to take many theoretical math courses to obtain a solid mathematical foundation for doctoral studies in mathematics. Because of our applied mathematics programs in the B.S. and Ph.D. degrees, the mathematics department offers many senior level and graduate level applied math courses and M.S. students can take them as electives. The new M.S. Applied Mathematics track as described in this document will

6 https://money.usnews.com/careers/best-jobs/rankings/best-business-jobs
7 https://www.bls.gov/ooh/math/mathematicians-and-statisticians.htm

focus on these applied math courses, with a strong emphasis on interdisciplinary studies and applications. The M.S. Applied Mathematics track is a careful design of our current applied math course offerings along with two new courses, to be a terminal, hence professional, degree for people already in industry.

Data science and applied mathematics are very closely related and many universities are incorporating data science into their applied math programs.[8] The M.S. Applied Mathematics track will complement the URI's Big Data and data science initiatives. Furthermore, the M.S. Applied Mathematics track will allow students with strong analytical skills to pursue graduate level studies involving data science related courses (e.g. new graduate level optimization and matrix analysis courses) and be competitive with local Applied Math based data science graduate degrees, e.g. University of Massachusetts Dartmouth's interdisciplinary program[9] or Brown University's data science initiative.[10]

Therefore, the M.S. Applied Mathematics track directly addresses the following in the URI 2016-2021 Academic Strategic Plan:[11]

- Academic Plan Goal 1: Enhance student success. Strategy 2. Action 8.
  - *Develop more interdisciplinary learning opportunities for all students including those in professional master's degree programs.*
- Academic Plan Goal 1: Enhance student success. Strategy 5. Action 7.
  - *Encourage and increase collaboration between departments that would lead to innovative interdisciplinary masters and doctoral programs.*
- Academic Plan Goal 2: Expand Research, Scholarship, and Creative Work. Strategy 2. Action 4.
  - *Attract new graduate students by developing new programs and renewing existing programs.*
- Academic Plan Goal 2: Expand Research, Scholarship, and Creative Work. Strategy (All Actions steps)
  - *Develop high performance research computing initiatives to facilitate research and advance big data analysis and applications across all disciplines.*

D. INTER-INSTITUTIONAL CONSIDERATIONS:

D1. What are the similar programs in the state and region?

a. If similar programs exist, how is this program different or why is duplication necessary?

8 September 2017 SIAM News "Integrating Data Science in Applied Mathematics Curricula" https://sinews.siam.org/Details-Page/integrating-data-science-in-applied-mathematics-curricula
October 2017 AMS, "Ensuring that Mathematics is Relevant in a World of Data Science" https://www.ams.org/publications/journals/notices/201709/rnoti-p986.pdf

9 https://www.umassd.edu/interdisciplinary/datascience/

10 https://www.brown.edu/initiatives/data-science/academic-programs/masters-data-science

11 http://web.uri.edu/academic-planning/files/academic_plan_handbook.pdf

There are no similar M.S. programs offered by public institutions of higher education in Rhode Island, namely Rhode Island College or Community College of Rhode Island. Two private universities in Rhode Island, Bryant University and Brown University, also do not offer a similar program. Brown University does have an option for a student to receive an M.S. degree in Applied Math, but it is restricted to either their undergraduate students through 4+1 program or to their Ph.D. students who automatically obtain this degree after successfully completing the first two years.[12]

Regional public universities that are comparable to URI, vary in offerings of M.S. degrees in Mathematics, let alone in Applied Mathematics. However, three peer regional universities, the University of New Hampshire, the University of Vermont, and the University of Maine, all have M.S. programs specializing in Applied Mathematics. It should also be emphasized that according to URI's Peer Institution Analysis[13], Carnegie Classification[14], and the American Mathematical Society (AMS) groupings[15] the University of New Hampshire's Mathematics Department is peer to URI's Mathematics Department (similar number of undergraduate and graduate students, research output, faculty, and size).

Students majoring in applied mathematics are highly desirable in the workforce with a great job outlook. However, URI does not have an applied mathematics track in its M.S. program, even though applied mathematics tracks exist within the B.S. and Ph.D. programs in the department. This proposed track will remove this inconsistency.

b. Have you communicated with other institutions about the development of this program and have any concerns been raised related to role, scope, and mission or duplication?

No. As stated in part a., there are no similar degrees offered by any public or private institution of higher education in Rhode Island.

D2. How do courses in this program transfer to other schools?

Most regional peer institutions have listed an M.S. program in Applied Mathematics (Universities of Maine, New Hampshire, and Vermont) and courses will transfer.

D3. How does this program align to academic programs at other institutions?

12 https://www.brown.edu/academics/applied-mathematics/sites/brown.edu.academics.applied-mathematics/files/uploads/Masters%20Degree%20ScM%20in%20Applied%20Mathematics%202017.pdf
13 http://web.uri.edu/ir/files/exce_summary1.pdf
14 http://carnegieclassifications.iu.edu/
15 http://www.ams.org/profession/data/annual-survey/groups

As mentioned in D1, most regional peer institutions have listed M.S. in Applied Mathematics as one of its programs within Mathematics (and Statistics) Department.

D4. Are recipients of this credential accepted into programs at the next degree level without issue?

Yes.

D5. How does this program of study interface with degree programs at the level below them?

Very naturally. In fact, students graduating with B.S. in Mathematics, Applied Mathematics option, from URI exceed pre-requisites for program admission. Students with B.A. in Mathematics from Rhode Island College also meet admission requirements.

D6. Are cooperative agreements or affiliations established? If so, what?

No.

E. PROGRAM:

E1. Are there pre-requisite courses? If so, please explain/list?

Please see the "Attachment E1" (page 12).

E2. Curriculum

a. How many credit hours are required to graduate (include all general education and pre-requisites)?

30 credits (31 credits for non-thesis option). There is no general education prerequisites.

b. What courses are required for the program?

Please see the "Attachment E2b" (page 13).

c. What are the new courses and descriptions that will go into the course catalog?

MTH 518: Matrix Analysis and Applications
MTH 581: Optimization Methods

For detailed description of these courses, please see the attachment.

d. Are there specializations and options? If so, please describe.

No.

e. Is the program content guided by program-specific accreditation standards or other outside guidance?

No.

f. What are the learning goals (what students are expected to gain, achieve, know, or demonstrate by completion of the program)?

At the end of the program students should be able to:

1. formulate and analyze mathematical problems, precisely define the key terms, and draw clear and reasonable conclusions;
2. use mathematical techniques to solve well-defined applied problems;
3. communicate effectively their mathematical work, both in oral and written format, to various audiences (students, mathematicians and non-mathematicians);
4. explain the practical limitations of mathematical techniques and the validity of results;
5. demonstrate ability to work on an independent and/or a collaborative project.

F. FACULTY AND STAFF: The faculty and support staff for the program should be sufficient in number and demonstrate the knowledge, skills, and other attributes necessary to the success of the program.

F1. What are the number of each needed?

The new M.S. Applied Mathematics track can be started and maintained by the current tenure-track mathematics faculty (N=14). For many years, we have been offering a well-established B.S. Applied Mathematics option and Ph.D. Applied Mathematics track. Many faculty members have active research programs in areas of applied mathematics (e.g. mathematical modeling, networks, numerical methods, linear algebra, financial mathematics, probability, math biology, and statistical methods for big data). Furthermore, the math faculty have established working relationships with faculty in other disciplines and people in industry. Therefore, the mathematics department faculty have the necessary skills required to advise, develop, and establish a successful M.S. Applied Mathematics track.

F2. Are these new positions or reassignments?

No.

F3. What are the minimal degree level and academic/technical field requirements and certifications required for teaching in this program?

Ph.D. in Mathematics or Applied Mathematics.

G. STUDENTS:

G1. How are students selected for the program?

Students are selected though the application process. There will be no cap on the number of accepted students provided they meet minimum admission requirement.

G2. Are there admission requirements?

Yes. Please see the attachment E1 (page 12).

G3. What is the primary source of students?

a. New students or drawn from other programs?

Two primary sources of students will be new graduate students or URI seniors majoring in Mathematics (Applied Mathematics Option).

b. Industry sponsored students/ employees? Describe.

The Department has explored several possibilities of enrolling students that are industry sponsored (preliminary contacts have been made with the Naval Undersea Warfare Center and Raytheon). We expect that some of our future students will be working professionals. In order to accommodate this potential source of students, we plan to offer certain classes later in the afternoon and/or having them meet only once per week.

G4. What is the estimated number of students in the program?

In the first year (2018-2019) we expect to have 2 students enrolled, mainly due to the fact that the Mathematics Department will not have a chance to promote this program. The University of New Hampshire's M.S. Applied Mathematics program has had consistently 3-5 students enrolled in the program for the past 4 years.[16] Our B.S. General and Applied Mathematics Options have had consistently strong enrollments. Currently, there are about 100 Math B.S. General and Applied Mathematics Option majors (e-campus query), and we estimate about 5% from existing programs will be interested in the new Applied Mathematics track. Therefore, we expect an enrollment to grow from 2 to about 10 over the next 4 years.

G5. What is the estimated number of annual graduates?

The Mathematics Department has conferred on average 3 M.S. degrees per year for the last 4 years.[17] This track will only add to the total number of M.S. degrees conferred by the department each year (separate counts for tracks are not provide by the institution)[18]. We expect that once this new track is established we will confer about 6-8 M.S. degrees per year (includes both tracks, pure and applied).

16 https://www.unh.edu/institutional-research/major
17 http://web.uri.edu/ir/reports-and-surveys/pr_degrees/and Central Department Data spreadsheet
18 http://web.uri.edu/ir/reports-and-surveys/pr_degrees/

H. EVALUATION:

H1. How will the program be evaluated?

a. Performance measures to evaluate the program.

Same measures that are used to evaluate the existing M.S. program in Mathematics.

b. Will the program be accredited? If so, when? How?

No.

I. WHAT SPECIAL EQUIPMENT OR RESOURCES ARE NEEDED?

I1. Special instructional resources and services needed? (Clinical space, internships, proctors)

Not applicable.

I2. Facilities and capital equipment?

None.

J. IS THE PROGRAM FINANCIALLY VIABLE?

J1. ALL PROPOSALS: Complete the Rhode Island Office of Postsecondary Commissioner Budget Form demonstrating either

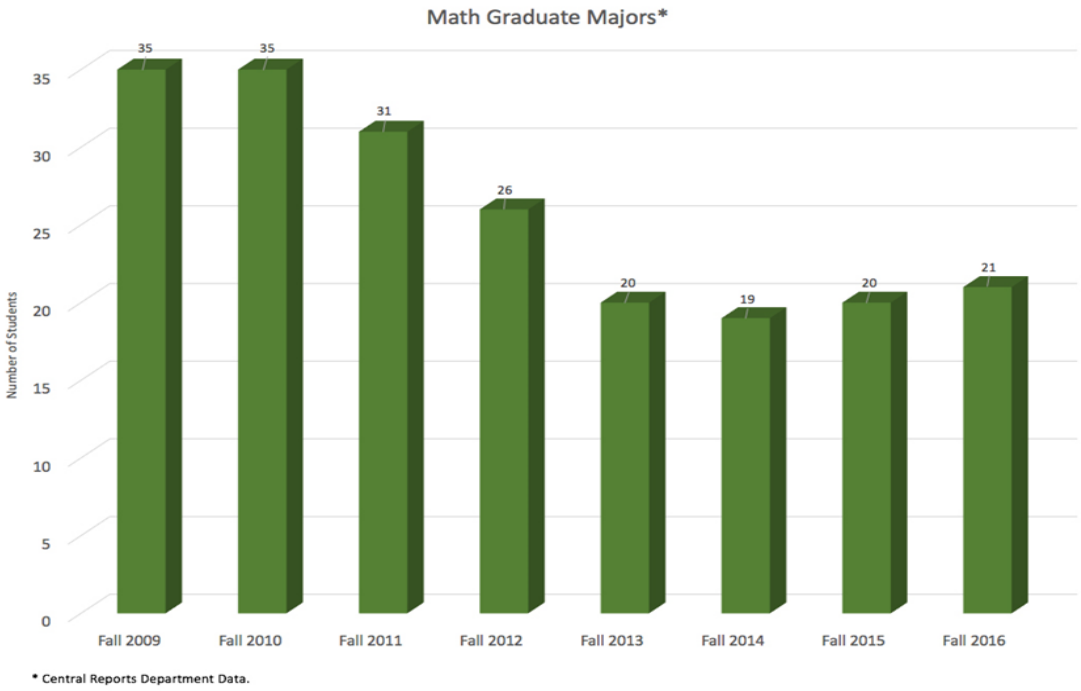
a. the need for additional resources or

b. that existing funds are sufficient for carrying out the program.

The completed proposal with Budget Form requires review by the URI Budget and Financial Planning Office. If no new funds are requested, proposers shall request a Statement of No Financial Impact from the URI Budget and Financial Planning Office.

No additional funds are being requested at this time. Additionally, the Mathematics Department does not need any additional equipment or facilities resources for the M.S. Applied Mathematics track. The number of math graduate students has slowly declined over the past eight years (see graph below) and the current existing funds are sufficient for starting this track. This track is an effort that is in line with the 2016-2021 Academic Strategic Plan to attract new graduate students and renew our graduate program so that we can bring enrollments back to where they were eight years ago. If enrollment in this program begins to expand beyond our current capabilities, we will seek new faculty

positions through the normal position allocation process, via the Arts and Sciences Dean's office.



Attachment (E1)

Entering students are expected to have taken courses in calculus (including multivariate calculus and differential equations), linear algebra, advanced calculus or analysis, and computer programming. The students at URI who would satisfy these requirements include any undergraduate with: a minor in Mathematics (including MTH 244), some programming experience, and who has completed either the sequence MTH 437/438 or MTH 435/436. Students receiving B.A. from Rhode Island College also satisfy admission requirements.

Attachment (E2b)

Program Requirements: 30 Credits (31 non-thesis option)

1. Complete the following 12 semester credits of specified courses:

    - MTH 441 – Introduction to Partial Differential Equations (3 credits)
    - MTH 571 – Numerical Analysis (3 credits)
    - MTH 518 – Matrix Analysis and Applications (3 credits) – new course
    - MTH 581 – Optimization Methods (3 credits) – new course

    With the approval of the Director of the (Math) Graduate Program, a student may substitute approved electives for any of the specified courses above which were previously taken.

2. Non-thesis option, complete an additional 1 credit independent study course, MTH 591 or 592, involving a substantial paper.

3. Complete at least 18 semester credits of approved electives different from the above courses. At least 6 of those 18 elective credits must be in Math (MTH).

4. At least 15 credits from the entire curriculum must be at 500 level of higher (excluding MTH 591/592).

5. A master's thesis option, MTH 599 (6 credits) is an option.

6. No written comprehensive examination required.

7. Recommended elective courses include MTH 451, 452, 453, 472, 542, 543, 545, 546, 550, and 572.

New Courses

Courses MTH 518 and MTH 581 are new courses and proposals for them have already been submitted. The e-Campus course descriptions are provided below.

MTH 518: Matrix Analysis and Applications

Topics in matrix analysis with applications - similarity and eigenvalues; Hermitian and normal matrices; canonical forms; norms; least square, eigenvalue localizations; singular value decomposition; definite matrices.

MTH 581: Optimization Methods

Introduction to optimization emphasizing problem formulation, methodologies, and underlying mathematical structures. Topics covered: linear programming, simplex method, duality, sensitivity; constrained and unconstrained optimization; line search and Newton methods.

Attachment N (Sample Curriculum Sheet)

M.S. Mathemathics - Applied Mathematics Track (2-year schedule)

First Year - Fall		
Course	**Description**	**Cr**
MTH 571	Numerical Analysis	3
MTH 441	Intro to Partial Differential Equations	3
	Total Credits	6

First Year - Spring		
Course	**Description**	**Cr**
MTH 518	Matrix Analysis and Applications (new)	3
	Elective	3
	Elective	3
	Total Credits	9

Second Year - Fall		
Course	**Description**	**Cr**
MTH 581	Optimization Methods (new)	3
	Elective	3
	Elective	3
	Total Credits	9

Second Year - Spring		
Course	**Description**	**Cr**
	Elective	3
	Elective	3
MTH 591/ 592	(if non-thesis)	(1)
	Total Credits	6 (or 7)

Total number of credits	30 (31 if nonthesis)
MTH Electives	451, 452, 453, 472, 542, 543, 545, 546, 550, and 572 (at least two 500-level courses are required)
Non-MTH Electives	at most 12 credits with prior approval of the Director of the Graduate Studies, Department of Mathematics.

Current catalog language.

MASTER OF SCIENCE

Admission requirements: bachelor's degree with strong undergraduate background in mathematics. Applicants with deficiencies in mathematics may be accepted subject to taking certain undergraduate courses in addition to the graduate program requirements.

Program requirements: 30 credits (or 24 plus thesis), including at least 18 credits in mathematics of which at least 15 must be at the 500 level or above. A course requiring a substantial paper involving significant independent study and a written comprehensive examination are required for the nonthesis option. MTH 435 and 513 must be completed with a grade of A or B. Recommended courses include MTH 515, 525, 535, 536, and 562.

Changes are highlighted

MASTER OF SCIENCE

Admission requirements: bachelor's degree with strong undergraduate background in mathematics. Applicants with deficiencies in mathematics may be accepted subject to taking certain undergraduate courses in addition to the graduate program requirements.

Program requirements: Two tracks are offered: Pure Mathematics and Applied Mathematics. 30 credits or 24 plus thesis (6 credits) are required, out of which at least 15 credits must be at the 500 level or above. Additionally, for the nonthesis option, one MTH 591 or 592 credit is required for a substantial paper involving significant independent research.

For the pure mathematics track, required courses are MTH 435, 436, and 513. Recommended courses include MTH 515, 525, 535, 536, and 562. At most 4 credits can be taken outside of the mathematics program (MTH) with prior approval of the Director of the Graduate Studies, Department of Mathematics. Additionally, a written comprehensive examination is required.

For the applied mathematics track, required courses are MTH 441, 518, 571, and 581. Recommended courses include MTH 451, 452, 453, 472, 542, 543, 545, 546, 550, and 572. At most 12 credits can be taken outside of the mathematics program (MTH) with prior approval of the Director of the Graduate Studies, Department of Mathematics.

THE
UNIVERSITY
OF RHODE ISLAND

THINK BIG WE DO℠

BUDGET AND FINANCIAL PLANNING
Adams House, 85 Upper College Road, Kingston, RI 02881 USA p: 401.874.2509 f: 401.874.5824 uri.edu/budget

DATE: January 24, 2018

TO: Nasser Zawia
Dean, Graduate School

FROM: Linda Barrett
Director, Budget and Financial Planning

SUBJECT: Proposal for MS Mathematics – Applied Mathematics Track

As requested in an email from James Baglama, Professor and Chairperson of the Department of Mathematics, dated December 28, 2017, the Budget and Financial Planning Office has reviewed the proposal for the MS Mathematics –Applied Mathematics Track.

According to the proposal, the Applied Mathematics Track will require no new funding by the University. The program utilizes existing resources and has the potential to contribute positively to the University's revenue in future years. The proposal indicates that there are no colleges or universities in the State of Rhode Island that offer a terminal Master's degree in Applied Mathematics and this proposal will fill this gap.

Please let us know if you require any further information.

cc: Donald DeHayes
Matthew Bodah
Nancy Eaton
James Baglama
Cheryl Hinkson
Dean Libutti
Jeannette Riley
Nancy Neff
Joanne Lawrence
Colleen Robillard

Office/Budget Impact statements/MS Mathematics/MS Mathematics Track Budget Impact Statement

ACADEMIC PROGRAM BUDGET FORM Not a new program, it should have no changes

Department of Mathematics M.S. Applied Math Track

Use this form for programs that can be pursued on a full-time basis, part-time basis, or through a combination of full-time and part-time attendance. **Page 1 of 3**

Choose one: **X** Full-time ☐ Part-time ☐ Combination of full- and part-time

REVENUE ESTIMATES

	Year 1 FY2019		Year 2 FY2020		Year 3 FY2021		Year 4 FY2022	
Tuition: In-State	$13,226		$13,760		$13,760		$13,760	
Tuition: Out-State	$25,854		$26,236		$26,236		$26,236	
Tuition: Regional	$19,840		$20,640		$20,640		$20,640	
Mandatory fees per student	$1,598		$1,712		$1,712		$1,712	
FTE # of New Students: In-State	0		2		4		5	
FTE # of New Students: Out-State	0		0		0		0	
# of In-State FTE students transferring in from the institution's existing programs	1		1		2		3	
# of Out-State FTE students transferring in from the institution's existing programs	1		1		2		2	
TUITION AND FEES	Newly Generated Revenue	Revenue from existing programs	Newly Generated Revenue	Revenue from existing programs	Newly Generated Revenue	Revenue from existing programs	Newly Generated Revenue	Revenue from existing programs
First Year Students								
In-State tuition	$0.00	$13,226.00	$27,520.00	$13,760.00	$55,040.00	$27,520.00	$68,800.00	$41,280.00
Out-of-State tuition	$0.00	$25,854.00	$0.00	$26,236.00	$0.00	$52,472.00	$0.00	$52,472.00
Regional tuition								
Mandatory fees	$0.00	$3,196.00	$3,424.00	$3,424.00	$6,848.00	$6,848.00	$8,560.00	$8,560.00
Second Year Students								
In-State tuition			$0.00	$13,760.00	$27,520.00	$13,760.00	$55,040.00	$27,520.00
Out-of-State tuition			$0.00	$26,236.00	$0.00	$26,236.00	$0.00	$52,472.00
Regional tuition								
Mandatory fees			$0.00	$3,424.00	$3,424.00	$3,424.00	$6,848.00	$6,848.00
Total Tuition and Fees	**$0.00**	**$42,276.00**	**$30,944.00**	**$86,840.00**	**$92,832.00**	**$130,260.00**	**$139,248.00**	**$189,152.00**

GRANTS	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
CONTRACTS	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
OTHER (Specify)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Grants, Contracts, Other	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**
TOTAL	**$0.00**	**$42,276.00**	**$30,944.00**	**$86,840.00**	**$92,832.00**	**$130,260.00**	**$139,248.00**	**$189,152.00**

NOTE: All of the above figures are estimates based on projections made by the institution submitting the proposal.

ACADEMIC PROGRAM BUDGET FORM Not a new program, it should have no changes

Department of Mathematics M.S. Applied Math Track

Use this form for programs that can be pursued on a full-time basis, part-time basis, or through a combination of full-time and part-time attendance. **Page 1 of 3**

Choose one: **X** Full-time ☐ Part-time ☐ Combination of full- and part-time

REVENUE ESTIMATES

	Year 1 FY2019		Year 2 FY2020		Year 3 FY2021		Year 4 FY2022	
Tuition: In-State	$13,226		$13,760		$13,760		$13,760	
Tuition: Out-State	$25,854		$26,236		$26,236		$26,236	
Tuition: Regional	$19,840		$20,640		$20,640		$20,640	
Mandatory fees per student	$1,598		$1,712		$1,712		$1,712	
FTE # of New Students: In-State	0		2		4		5	
FTE # of New Students: Out-State	0		0		0		0	
# of In-State FTE students transferring in from the institution's existing programs	1		1		2		3	
# of Out-State FTE students transferring in from the institution's existing programs	1		1		2		2	
TUITION AND FEES	Newly Generated Revenue	Revenue from existing programs	Newly Generated Revenue	Revenue from existing programs	Newly Generated Revenue	Revenue from existing programs	Newly Generated Revenue	Revenue from existing programs
First Year Students								
In-State tuition	$0.00	$13,226.00	$27,520.00	$13,760.00	$55,040.00	$27,520.00	$68,800.00	$41,280.00
Out-of-State tuition	$0.00	$25,854.00	$0.00	$26,236.00	$0.00	$52,472.00	$0.00	$52,472.00
Regional tuition								
Mandatory fees	$0.00	$3,196.00	$3,424.00	$3,424.00	$6,848.00	$6,848.00	$8,560.00	$8,560.00
Second Year Students								
In-State tuition			$0.00	$13,760.00	$27,520.00	$13,760.00	$55,040.00	$27,520.00
Out-of-State tuition			$0.00	$26,236.00	$0.00	$26,236.00	$0.00	$52,472.00
Regional tuition								
Mandatory fees			$0.00	$3,424.00	$3,424.00	$3,424.00	$6,848.00	$6,848.00
Total Tuition and Fees	**$0.00**	**$42,276.00**	**$30,944.00**	**$86,840.00**	**$92,832.00**	**$130,260.00**	**$139,248.00**	**$189,152.00**
GRANTS	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
CONTRACTS	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
OTHER (Specify)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Grants, Contracts, Other	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**
TOTAL	**$0.00**	**$42,276.00**	**$30,944.00**	**$86,840.00**	**$92,832.00**	**$130,260.00**	**$139,248.00**	**$189,152.00**

NOTE: All of the above figures are estimates based on projections made by the institution submitting the proposal.

ACADEMIC PROGRAM BUDGET FORM
Department of Mathematics M.S. Applied Math Track

Use this form for programs that can be pursued on a full-time basis, part-time basis, or through a combination of full-time and part-time attendance.

	Year 1 FY2019	Year 2 FY2020	Year 3 FY2021	Year 4 FY2022
BUDGET SUMMARY OF COMBINED EXISTING AND NEW PROGRAM				
Total Revenue	$42,276.00	$117,784.00	$223,092.00	$328,400.00
Total Expenses	$0.00	$0.00	$0.00	$0.00
Excess/Defeciency	**$42,276.00**	**$117,784.00**	**$223,092.00**	**$328,400.00**
BUDGET SUMMARY OF EXISTING PROGRAM ONLY				
Total Revenue	$42,276.00	$86,840.00	$130,260.00	$189,152.00
Total Expenses	$0.00	$0.00	$0.00	$0.00
Excess/Defeciency	**$42,276.00**	**$86,840.00**	**$130,260.00**	**$189,152.00**
BUDGET SUMMARY OF NEW PROGRAM ONLY				
Total of Newly Generated Revenue	$0.00	$30,944.00	$92,832.00	$139,248.00
Total of Additional Resources Required for	$0.00	$0.00	$0.00	$0.00
Excess/Deficiency	**$0.00**	**$30,944.00**	**$92,832.00**	**$139,248.00**

NOTE: All of the above figures are estimates based on projections made by the institution submitting the proposal.

Current catalog language.

The Department of Mathematics offers a Bachelor of Arts (B.A.) degree and a Bachelor of Science (B.S.) degree. The department also offers the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees.

For information on URI's minor in mathematics, see the end of this section.

Faculty: Professor Baglama, chairperson. Professors Eaton, Kaskosz, Kulenovic, Merino, and Wu; Associate Professors Bella, Comerford, Medina-Bonifant, and Thoma; Assistant Professors Barrus, Chavez Casillas, Kinnerseley, Sharland, and Perovic; Professors Emeriti Beauregard, Clark, Datta, Driver, Finizio, Fraleigh, Grove, Ladas, Lewis, Roxin, Schwartzman, and Verma.

BACHELOR OF ARTS

Students in the B.A. curriculum may tailor a program to suit their individual needs and interests. They should meet with their advisor no later than the end of the first semester of the sophomore year to plan a complete program. This program, and any subsequent changes in it, must be approved by the advisor and the department chairperson. It must contain at least 32 credits (maximum 45) in mathematics, and include MTH 141, 142, 215, 243, 307 and 316, plus 12 or more additional credits in mathematics, at least three credits of which must be at the 400 level.

Credits earned in MTH 101, 103, 104 105, 106, 107, 108, 109, 110, 111, 208, 209, or 362 cannot be applied toward this degree.

A total of 120 credits is required in the B.A. curriculum. At least 42 of these must be in courses numbered 300 or above.

BACHELOR OF SCIENCE

Students in the B.S. curriculum may elect either the general program or the applied mathematics option. The Office of the Dean must be informed of any substitutions.

General Program. This program stresses basic theories and techniques, and includes an introduction to the principal areas of mathematics. It is recommended for students considering graduate study in mathematics. Students in this program must complete MTH 141, 142, 215, and 243. These courses should normally be taken in the freshman and sophomore years. Students must complete an additional 29 credits in mathematics, including MTH 307, 316, 435/436, and 462.

Applied Mathematics Option. This program is intended for the student who anticipates a career as an applied mathematician or mathematical consultant with an organization such as an industrial or engineering firm or with a research laboratory. The student learns the mathematical ideas and techniques most often encountered in such work. Although a theoretical foundation is developed, the applications are emphasized. The student must take MTH 141, 142, 215, and 243, preferably by the end of the sophomore year. The student must complete an additional 18 credits in mathematics including one of the sequences MTH 435/436 or 437/438, and of the 12 remaining credits in mathematics, at least three credits should be at the 400-level. Also, the student must complete an additional four courses, one of which must be chosen from CSC 106, 200, 201, 211, 212, PHY 410, or CHE 272, and three other courses chosen from Group I (Applications).

Group I: BME 207; BUS 320, 321, 335, 337; CHE 272, 313, 314; CHM 431, 432: CSC 340, 350, 406, 418, 440, 445; ECN 323, 324, 327, 328, 375; ELE 313, 314, 322, 438, 457; ISE 411, 412, 432, 433; MCE 341, 354, 366, 372, 411, 466; NRS 409, 410; OCE 301; PHY 306, 322, 331, 410, 420, 451, 452, 455; STA 307, 308, 409, 411, 412. Other courses may be used for this group with prior permission of the chairperson.

Credits earned in MTH 101, 103, 104, 105, 106, 107, 108, 109, 110, 111, 208, 209, 362, or 420 cannot be applied toward this degree (general program and applied mathematics option).

Both B.S. programs require 120 credits for graduation.

Minor in Mathematics

In addition to fulfilling all the basic requirements for a minor (see Minor Fields of Study), students declaring a math minor must earn credit for MTH 141, 142, 215, and 243, and two three-credit math courses chosen from MTH 244, 307, 316, 322, or any 400-level course. At least one of these two courses must be at the 400 level. Substitutions may be made with permission of the chairperson.

Changes are highlighted

The Department of Mathematics offers a Bachelor of Arts (B.A.) degree and a Bachelor of Science (B.S.) degree. The department also offers the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees.

For information on URI's minor in mathematics, see the end of this section.

Faculty: Professor Baglama, chairperson. Professors Eaton, Kaskosz, Kulenovic, Merino, and Wu; Associate Professors Bella, Comerford, Medina-Bonifant, and Thoma; Assistant Professors Barrus, Chavez Casillas, Kinnerseley, Sharland, and Perovic; Professors Emeriti Beauregard, Clark, Datta, Driver, Finizio, Fraleigh, Grove, Ladas, Lewis, Roxin, Schwartzman, and Verma.

BACHELOR OF ARTS

Students in the B.A. curriculum may tailor a program to suit their individual needs and interests. They should meet with their advisor no later than the end of the first semester of the sophomore year to plan a complete program. This program, and any subsequent changes in it, must be approved by the advisor and the department chairperson. It must contain at least 32 credits (maximum 45) in mathematics, and include MTH 141, 142, 215, 243, 307 and 316, plus 12 or more additional credits in mathematics, at least three credits of which must be at the 400 level.

Credits earned in MTH 101, 103, 104 105, 106, 107, 108, 109, 110, 111, 208, 209, or 362 cannot be applied toward this degree.

A total of 120 credits is required in the B.A. curriculum. At least 42 of these must be in courses numbered 300 or above.

BACHELOR OF SCIENCE

Students in the B.S. curriculum may elect either the general program or the applied mathematics option. The Office of the Dean must be informed of any substitutions.

General Program. This program stresses basic theories and techniques, and includes an introduction to the principal areas of mathematics. It is recommended for students considering graduate study in mathematics. Students in this program must complete MTH 141, 142, 215, and 243. These courses should normally be taken in the freshman and sophomore years. Students must complete an additional 29 credits in mathematics, including MTH 307, 316, 435/436, and 462.

Applied Mathematics Option. This program is intended for the student who anticipates a career as an applied mathematician or mathematical consultant with an organization such as an industrial or engineering

firm or with a research laboratory. The student learns the mathematical ideas and techniques most often encountered in such work. Although a theoretical foundation is developed, the applications are emphasized. The student must take MTH 141, 142, 215, and 243, preferably by the end of the sophomore year. The student must complete an additional 18 credits in mathematics including one of the sequences MTH 435/436 or 437/438, and of the 12 remaining credits in mathematics, at least three credits should be at the 400-level. Also, the student must complete an additional four courses, one of which must be chosen from CSC 106, 200, 201, 211, 212, PHY 410, or CHE 272, and three other courses chosen from Group I (Applications).

Group I: BME 207; BUS 320, 321, 335, 337; CHE 272, 313, 314; CHM 431, 432: CSC 340, 350, 406, 418, 440, 445; ECN 323, 324, 327, 328, 375; ELE 313, 314, 322, 438, 457; ISE 411, 412, 432, 433; MCE 341, 354, 366, 372, 411, 466; NRS 409, 410; OCE 301; PHY 306, 322, 331, 410, 420, 451, 452, 455; STA 307, 308, 409, 411, 412. Other courses may be used for this group with prior permission of the chairperson.

Credits earned in MTH 101, 103, 104, 105, 106, 107, 108, 109, 110, 111, 208, 209, 362, or 420 cannot be applied toward this degree (general program and applied mathematics option).

Both B.S. programs require 120 credits for graduation.

The 5th-Year Master of Science: Applied Mathematics track is designed for students who want to enter the program while still undergraduates and earn the degree in the year following completion of their bachelors. In general, students will earn 9-12 credits for the degree M.S. Applied Mathematics track during their fourth year, leaving 18-21 credits to be completed during the fifth year. For more information on the M.S. Applied Mathematics track, see Graduate Degree Programs, Mathematics.

Minor in Mathematics

In addition to fulfilling all the basic requirements for a minor (see Minor Fields of Study), students declaring a math minor must earn credit for MTH 141, 142, 215, and 243, and two three-credit math courses chosen from MTH 244, 307, 316, 322, or any 400-level course. At least one of these two courses must be at the 400 level. Substitutions may be made with permission of the chairperson.

Current catalog language.

MASTER OF SCIENCE

Admission requirements: bachelor's degree with strong undergraduate background in mathematics. Applicants with deficiencies in mathematics may be accepted subject to taking certain undergraduate courses in addition to the graduate program requirements.

Program requirements: 30 credits (or 24 plus thesis), including at least 18 credits in mathematics of which at least 15 must be at the 500 level or above. A course requiring a substantial paper involving significant independent study and a written comprehensive examination are required for the nonthesis option. MTH 435 and 513 must be completed with a grade of A or B. Recommended courses include MTH 515, 525, 535, 536, and 562.

Changes are highlighted

MASTER OF SCIENCE

Admission requirements: bachelor's degree with strong undergraduate background in mathematics. Applicants with deficiencies in mathematics may be accepted subject to taking certain undergraduate courses in addition to the graduate program requirements.

Program requirements: Two tracks are offered: Pure Mathematics and Applied Mathematics. 30 credits or 24 plus thesis (6 credits) are required, out of which at least 15 credits must be at the 500 level or above. Additionally, for the nonthesis option, one MTH 591 or 592 credit is required for a substantial paper involving significant independent research.

For the pure mathematics track, required courses are MTH 435, 436, and 513. Recommended courses include MTH 515, 525, 535, 536, and 562. At most 4 credits can be taken outside of the mathematics program (MTH) with prior approval of the Director of the Graduate Studies, Department of Mathematics. Additionally, a written comprehensive examination is required.

For the applied mathematics track, required courses are MTH 441, 518, 571, and 581. Recommended courses include MTH 452, 453, 472, 542, 543, 545, 546, 550, and 572. At most 12 credits can be taken outside of the mathematics program (MTH) with prior approval of the Director of the Graduate Studies, Department of Mathematics.

The Consolidated 5th-Year Master of Science: Applied Mathematics track is designed for students who want to enter the program while still undergraduates and earn the degree in the year following completion of their bachelors. In general, students will earn 9-12 credits for the degree M.S. Applied Mathematics track during their fourth year, leaving 18-21 credits to be completed during the fifth year.

M.S. Mathemathics - Applied Mathematics Track (2-year schedule)

First Year - Fall		
Course	Description	Cr
MTH 571	Numerical Analysis	3
MTH 441	Intro to Partial Differential Equations	3
	Total Credits	6

First Year - Spring		
Course	Description	Cr
MTH 518	Matrix Analysis and Applications (new)	3
	Elective	3
	Elective	3
	Total Credits	9

Second Year - Fall		
Course	Description	Cr
MTH 581	Optimization Methods (new)	3
	Elective	3
	Elective	3
	Total Credits	9

Second Year - Spring		
Course	Description	Cr
	Elective	3
	Elective	3
MTH 591/592	(if non-thesis)	(1)
	Total Credits	6 (or 7)

Total number of credits	30 (31 if nonthesis)
MTH Electives	451, 452, 453, 472, 542, 543, 545, 546, 550, and 572 (at least two 500-level courses are required)
Non-MTH Electives	at most 12 credits with prior approval of the Director of the Graduate Studies, Department of Mathematics.

Five Year (Consolidated) BS/MS - Applied Mathematics Track

Freshman Year - Fall		
Course	Description	Cr
MTH 141	Calculus I (Gen Ed)	4
URI 101	Traditions and Transformations	1
	Gen Ed	3
	Gen Ed	3
	Gen Ed	3
	Gen Ed	3
		17

Freshman Year - Spring		
Course	Description	Cr
MTH 142	Calculus II	4
	Gen Ed	3
	Gen Ed	3
	Gen Ed	3
	Gen Ed	3
		16

Sophomore Year - Fall		
Course	Description	Cr
MTH 243	Calculus III	3
MTH 215	Intro to Linear Algebra	3
	Gen Ed	3
	Gen Ed	3
	Gen Ed	3
	Elective	3
		18

Sophomore Year - Spring		
Course	Description	Cr
MTH 244	Intro to Differential Equations	3
CSC 200	Introduction to Computer Programming	3
	Applications Course I	3
	Elective	3
	Elective	3
		15

Junior Year - Fall		
Course	Description	Cr
MTH 451	Probability	3
MTH 437	Advanced Calculus and Applications I	3
	Applications Course II	3
	Elective	3
	Elective	3
	Elective	3
		18

Junior Year - Spring		
Course	Description	Cr
MTH 452	Mathematical Statistics	3
MTH 438	Advanced Calculus and Applications II	3
MTH 442	Introduction to Difference Equations	3
STA 409	Statistical Methods in Research I	3
	Elective	3
		15

Senior Year - Fall		
Course	Description	Cr
STA 412	Statistical Methods in Research II	3
MTH 571	Numerical Analysis	3
	Elective	3
	Elective	3
	Elective	3
	Elective	3
		18

Senior Year - Spring		
Course	Description	Cr
MTH 453	Introduction to Random Processes	3
MTH 518	Matrix Analysis	3
MTH 441	Introduction to Partial Differential Equations	3
	Elective	3
	Elective	3
		15

Fifth Year - Fall		
Course	Description	Cr
MTH 581	Optimization Methods	3
	Graduate Elective	3
	Graduate Elective	3
		9

Fifth Year - Spring		
Course	Description	Cr
	Graduate Elective	3
	Graduate Elective	3
	Graduate Elective	3
MTH 591	(if nonthesis)	1
		10

Total Credits: 150 (120 Undergraduate + 30 Graduate) -- (+1 credit if nonthesis)

Color Coding - Legend
Required Courses for BS in Applied Math
Additional four MATH courses for BS (electives)
Applied Courses for BS (many options)
Graduate Courses

General Comment:

Fourth and Fifth year might be different for students, depending on when they enroll in the program. Since most of our upper level courses are on a two-year rotation, advisors will have to make sure students choose courses properly.

Five Year (Consolidated) BS/MS - Applied Mathematics Track

Freshman Year - Fall		
Course	Description	Cr
MTH 141	Calculus I (Gen Ed)	4
URI 101	Traditions and Transformations	1
	Gen Ed	3
	Gen Ed	3
	Gen Ed	3
	Gen Ed	3
	Total Credits	17

Freshman Year - Spring		
Course	Description	Cr
MTH 142	Calculus II	4
	Gen Ed	3
	Gen Ed	3
	Gen Ed	3
	Gen Ed	3
	Total Credits	16

Sophomore Year - Fall		
Course	Description	Cr
MTH 243	Calculus III	3
MTH 215	Intro to Linear Algebra	3
	Gen Ed	3
	Gen Ed	3
	Gen Ed	3
	Elective	3
	Total Credits	18

Sophomore Year - Spring		
Course	Description	Cr
MTH 244	Intro to Differential Equations	3
CSC 200	Introduction to Computer Programming	3
	Applications Course I	3
	Elective	3
	Elective	3
	Total Credits	15

Junior Year - Fall		
Course	Description	Cr
	MTH Elective (e.g. MTH 451)	3
MTH 437	Advanced Calculus and Applications I	3
	Applications Course II	3
	Elective	3
	Elective	3
	Elective	3
	Total Credits	18

Junior Year - Spring		
Course	Description	Cr
	MTH Elective (e.g., MTH 452)	3
MTH 438	Advanced Calculus and Applications II	3
MTH 442	Introduction to Difference Equations	3
STA 409	Statistical Methods in Research I	3
	Elective	3
	Total Credits	15

Senior Year - Fall		
Course	Description	Cr
	Graduate Course	3
	Graduate Course	3
	Elective	3
	Elective	3
	Elective	3
	Elective	3
	Total Credits	18

Senior Year - Spring		
Course	Description	Cr
	MTH Elective (e.g., MTH 453)	3
	Graduate Course	3
	Graduate Course	3
	Elective	3
	Elective	3
	Total Credits	15

Fifth Year - Fall		
Course	Description	Cr
	Graduate Course	3
	Graduate Course	3
	Graduate Course	3
	Total Credits	9

Fifth Year - Spring		
Course	Description	Cr
	Graduate Course	3
	Graduate Course	3
	Graduate Course	3
MTH 591	(if nonthesis)	1
	Total Credits	10

Total Credits: 150 (120 Undergraduate + 30 Graduate) -- (+1 credit if nonthesis)

Color Coding - Legend
Required Courses for BS in Applied Math
Additional four MTH courses for BS (electives)
Applied Courses for BS (many options)
Graduate Courses

General Comment:

Fourth and Fifth year might be different for students, depending on when they enroll in the program. Since most of our upper level courses are on a two-year rotation, advisors will have to make sure students choose courses properly.