

**From:** [noreply@wsu.edu](mailto:noreply@wsu.edu)  
**To:** [curriculum.submit](#)  
**Subject:** 038 524263 Mathematics and Statistics Requirements Revise - Revise or Drop Graduate Plan  
**Date:** Monday, August 19, 2019 11:52:40 AM  
**Attachments:** [2019.08.19.11.52.35.07.FormData.html](#)  
[2019.08.19.11.52.33.99.currentCatalogFile\\_MS\\_Math\\_Applied\\_Rationale.docx](#)  
[2019.08.19.11.52.33.99.currentCatalogFile1\\_MS\\_Math\\_Applied\\_Updated\\_GS\\_Requirements.docx](#)  
[2019.08.19.11.52.33.99.currentCatalogFile2\\_MS\\_Math\\_Applied\\_Current\\_Handbook\\_version.pdf](#)  
[2019.08.19.11.52.33.99.currentCatalogFile3\\_MS\\_Mathematics\\_Applied\\_Proposed\\_Handbook.pdf](#)

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Emily Lewis has submitted a request for a major curricular change. His/her email address is: [emily.m.lewis@wsu.edu](mailto:emily.m.lewis@wsu.edu).

**Requested change:** Revise or Drop Graduate Plan

**Degree:** M.S. in Mathematics

**Title:** Applied (non-thesis)

**Requested Effective Date:** Fall 2020

Revise plan requirement: Yes

**Dean:** Swindell, Samantha - CAS,

**Chair:** Moore, Charles,

\_\_\_\_\_  
Catalog Subcommittee  
Approval Date

\_\_\_\_\_  
AAC, PHSC, or GSC  
Approval Date

\_\_\_\_\_  
Faculty Senate  
Approval Date

**From:** [Swindell, Samantha](#)  
**To:** [curriculum.submit](#); [charles.n.moore@wsu.edu](mailto:charles.n.moore@wsu.edu)  
**Subject:** RE: 038 524263 Mathematics and Statistics Requirements Revise - Revise or Drop Graduate Plan  
**Date:** Thursday, August 22, 2019 9:58:58 AM

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1. I approve this proposal in its current form.

**From:** curriculum.submit@wsu.edu <curriculum.submit@wsu.edu>  
**Sent:** Monday, August 19, 2019 11:53 AM  
**To:** charles.n.moore@wsu.edu; Swindell, Samantha <sswindell@wsu.edu>  
**Subject:** 524263 Mathematics and Statistics Requirements Revise - Revise or Drop Graduate Plan

Moore, Charles,

Swindell, Samantha - CAS,

Emily Lewis has submitted a request for a major curricular change.

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**Requested Effective Date:** Fall 2020

Revise plan requirement: Yes

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Both Chair and Dean approval is required to complete the submission process. Please indicate that you have reviewed the proposal by highlighting one of the statements below and **reply all** to this email. ([curriculum.submit@wsu.edu](mailto:curriculum.submit@wsu.edu).) [Details of major change requested can be found in the attached supplemental documentation]

1. I approve this proposal in its current form.
2. I approve this proposal with revisions. Revisions are attached.
3. I do not approve this proposal. Please return to submitter.

If you do not respond within one week, you will be sent a reminder email. If no response is received within three weeks of the submission date, the proposal will be returned to the submitter.

Thank you for your assistance as we embark on this new process. If you have any questions or concerns, please let us know [wsu.curriculum@wsu.edu](mailto:wsu.curriculum@wsu.edu).

**From:** [Moore, Charles](#)  
**To:** [curriculum.submit](#)  
**Subject:** Re: 038 524263 Mathematics and Statistics Requirements Revise - Revise or Drop Graduate Plan  
**Date:** Monday, August 19, 2019 2:24:49 PM

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1. I approve this proposal in its current form.

Charles Moore  
Professor of Mathematics  
Chair, Department of Mathematics and Statistics  
Washington State University  
Pullman, Washington 99164  
On 8/19/2019 11:52 AM, [curriculum.submit@wsu.edu](mailto:curriculum.submit@wsu.edu) wrote:

Moore, Charles,

Swindell, Samantha - CAS,

Emily Lewis has submitted a request for a major curricular change.

**Requested change:** Revise or Drop Graduate Plan

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Thank you for your assistance as we embark on this new process. If you

## **MS Mathematics (Applied Option) Rationale for Updates**

June 11, 2019

The main update to the MS Mathematics (Applied Option, non-thesis) program is to clarify and expand on the student's elective choices. Previously, the program required three additional courses from a list of courses separated in three groups. Two courses needed to be from one group as an emphasized area of study. However, this did not allow for students with an area of study outside these three groups to count courses in that subject towards their degree (e.g. computer science, data analytics, linear algebra). We have now removed the required emphasis areas in favor of allowing the student and their advisor to select courses that best fit their career and research interests. These courses can be from within or outside the department.

Additionally, Math 443 was removed as it is no longer in the WSU catalog.

All changes were first approved by the departmental Graduate Studies Committee and then by a quorum of the graduate faculty in Mathematics & Statistics, including faculty at the Vancouver and Everett campuses, on February 14, 2019.

## Graduate School Requirements Issued 5/31/19

### Applied Track:

- Proseminar: must complete the following (1 credit):
    - MATH 500
  - Core: must complete all 5 of the following (15 credits):
    - MATH 443 or STAT 443
    - MATH 464, MATH 516, MATH 540, MATH 548
  - MATH 564 or MATH 566: 1 course minimum (3 credits):
    - MATH 564, MATH 566
  - STAT 523 or STAT 572: 1 course minimum (3 credits):
    - STAT 523, STAT 572
  - Elective: 9 credits minimum, with at least two courses from one area of emphasis, subject to the advisory committee's approval.
    - ~~Numerical Analysis/Optimization\*~~
    - ~~Modeling/Simulation\*~~
    - ~~Statistical Analysis\*~~
    - ~~MATH 415, MATH 423, MATH 486, MATH 523, MATH 536, MATH 570, MATH 571, MATH 573, MATH 579, MATH 586, STAT 423 or STAT 523, STAT 536, STAT 544, STAT 572, STAT 573~~
  - Research Credits: 4 credits minimum:
    - MATH 702
  - Total Graded Credits: 26 credits minimum
  - Total Credits: 35 credits minimum
- \*Note: Refer to the student handbook for listings of courses in each of these areas.*

### Applicable Graduate School Requirements (General, Applied, and Computational Finance Tracks):

- Required Course: must complete the following:
  - MATH 500
- Graded Credits: 26 credits minimum:
  - Students may use a maximum of 6 9 credits of undergraduate coursework (3 credits of 300-level, up to 9 credits of 400-level)
- Research Credits: 4 credits minimum
  - MATH 702
- Total Credits: 31 credits minimum

## 1.1 THE M.S. IN MATHEMATICS – APPLIED MATHEMATICS OPTION

**Description and Learning Outcomes** – This is a two-year professional degree specifically designed to train mathematicians and scientists/engineers with strong mathematics backgrounds in up-to-date applied mathematical, computational and statistical skills. Such training is intended to produce individuals who can confidently undertake interdisciplinary research. The focus will be in preparing individuals to face the mathematical and other research challenges in business and/or industrial sectors. In order to achieve these goals the program requires:

- A broad background in the areas of Numerical Analysis/Optimization, Modeling/Simulation, and Statistical Analysis;
- A concentration in one of the above areas or one that matches the student's interests;
- Development of an individual project
- A strong computing component.

The MS in Mathematics (Applied Option) is designed to meet the following learning outcomes:

- **Problem Solving:** Students will be able to identify mathematical and computational methods in order to solve problems.
- **Deductive Thinking:** Students will be able to read and write logical arguments in order to prove advanced mathematical results.
- **Effective Communication:** Students will be able to effectively communicate mathematical concepts, problems and their solutions in written and oral form.

**Courses** – The M.S. in Mathematics Applied Option requires at least 35 hours of approved graduate course work from the list below, of which 26 hours are the core and required courses listed below. The remaining 9 credit hours of electives must include at least two courses in an emphasis area of the student's choice, subject to the advisory committee's approval. Please note that the electives must differ from the chosen core courses and that only three 400-level courses are permitted by the Graduate School for an M.S. degree.

Required courses:     Math 500 Proseminar (1 credit)  
(5 credits)             Math 702 Directed Study (4+ credits)

Core Courses:           Math 464 Linear Optimization (3 credits)  
(21 credits)            Math 516 Simulation Methods (3 credits)  
                              Math 540 Applied Mathematics I (3 credits)  
                              Math 548 Numerical Analysis (3 credits)  
                              Math 564 OR Math 566 – Optimization (3 credits)  
                              Stat 443 Applied Probability (3 credits)  
                              Stat 523 OR Stat 572 – Statistical Methods (3 credits)

Graduate Electives: Three additional graduate level courses (of which one may be 400 level) including at least two from a chosen emphasis area. (9 credits)  
Examples include (but are not limited to) two courses in Optimization (Math 564, 565, 566, 567, 574), Numerical Analysis (Math 545, 546), Modeling (570, 571, 579, 586), Data Analytics (Stat 435, 437, 536, 577, CptS 415, 570, 577), or any other focus. Courses from another department related to the student's research interests may be included.

**Math 702 and M.S. Examination** – Students must take at least four hours of Math 702. Ordinarily, the student must complete a project in Applied Mathematics under the direction of his or her advisor and committee. The final MS exam also covers all of the student's coursework and the content of Math 401 & 402 Analysis, Math 420 Linear Algebra, and Math 421 Abstract Algebra. The student's advisory committee will conduct this examination when all other requirements for graduation have been fulfilled. The format of the final examination and project is at the discretion of the advisory committee.

**Electives and Internships** - During a standard two-year program, a student taking 10 credit hours (most students take more) will have time to include several elective courses in addition to the course work required. Students are strongly encouraged to take additional courses in math or other departments spend a summer on an internship, and to attend seminars in applied mathematics. These elective courses, internship, and the project completed in Math 702 should form an effective combination in a particular area of interest to each student.

Current, Feb 2016

## 4 The MS in Mathematics (Applied Mathematics Option)

### 4.1 Description and Learning Outcomes

This is a two-year professional degree especially designed to train mathematicians and scientists/engineers with strong mathematics backgrounds in up-to-date applied mathematical, computational and statistical skills. Such training is intended to produce high caliber individuals who can confidently undertake interdisciplinary research. The focus will be in preparing talented individuals to face the mathematical and other research challenges in business and/or industrial sectors. In order to achieve these goals the program requires:

- a broad background in the areas of Numerical Analysis/Optimization, Modeling/Simulation, and Statistical Analysis;
- a concentration in one of the above areas;
- both group and individual projects;
- a strong computing component.

The learning outcomes in §3.1 also apply.

Departmental requirements and regulations for the MS in Applied Mathematics are specified below. The regulations of the Graduate School for master's programs are available in the Graduate School Policies and Procedures Manual.

### 4.2 Prerequisites

Same as in §3.2.

### 4.3 Courses and Hours

A candidate must complete at least 35 semester hours of course work. This includes:

- (a) a core consisting of:

Math 540 and 548;  
 Math 464 and either 566 or 564;  
 Math 516;  
 Math 443 and either Stat 523 or 572;  
 and Math 500; and

- (b) at least three additional graduate level mathematics courses including at least two from one of the following groups (*Note*: these three courses should not have been used to satisfy the above core requirements):

Numerical Analysis/Optimization	Modeling/Simulation	Statistical Analysis
Math 544, 545, 546, 564, 565, 566, 567, 574	Math 415, 570, 571, 579, 586; Stat 536	Stat 523, 544, 572, 573



#### **4.4 Transfer Credit**

Same as in §3.4.

#### **4.5 The Program of Study**

Same as in §3.5.

#### **4.6 The MS Examination**

Each MS in Applied Mathematics student must pass a final oral examination that covers all of the student's course work plus the content of Math 401, 402, 420 and 421, and includes an oral presentation on the results of the student's Math 702 individual project (see §4.8 below). This examination may be scheduled when all requirements of the Department and the Graduate School have been satisfied (or are expected to be satisfied by the end of the current semester). The deadlines for scheduling this examination are indicated in §2. The student's advisory committee will conduct this examination.

#### **4.7 The Application for Degree**

Same as in §3.7.

#### **4.8 Thesis**

There is no thesis requirement. However, a student must take four hours of Math 702. Two of the Math 702 credits must involve the completion of a group project and two of the Math 702 credits must involve the completion of an individual project.

The group projects should normally be completed by the end of the third semester of the student's work on the degree. A team of at least two faculty members, drawn from different areas of applied mathematics or other application areas, will supervise these projects. Each project group must submit a group project report by the end of the project semester, and each group must provide an oral presentation to the project committee, summarizing the results of the project.

The individual project should normally be completed by the end of the fourth semester of the student's work on the degree. The student's advisory committee members will supervise this project. A written project report should be submitted when the project is completed. The final MS examination must include an oral presentation by the student about the results of the project, with questions from the student's MS committee.

#### **4.9 The Electives and Internship**

During a standard two-year program, a student taking 10 credit hours (most students take more) will have time to include several elective courses in addition to the course work required in §§5.3,4.8. Students are strongly encouraged to spend a summer on an internship and to attend seminars in applied mathematics. These elective courses, internship, and the individual project (see §4.8) should be unified to form an effective combination in a particular specialty of interest to each student.