

From: noreply@wsu.edu
To: [curriculum.submit](#)
Subject: 695995 Mathematics and Statistics Requirements Revise - Revise or Drop Graduate Plan
Date: Thursday, March 10, 2022 3:56:53 PM
Attachments: [2022.03.10.15.53.00.66.FormData.html](#)
[2022.03.10.15.52.52.94.currentCatalogFile1_MS_Mathematics_Applied_Proposed_Handbook.pdf](#)
[2022.03.10.15.52.52.94.currentCatalogFile1_MS_Mathematics_Applied_Current_Handbook.pdf](#)
[2022.03.10.15.52.52.94.currentCatalogFile2_GS_Proposed_Requirements.docx](#)
[2022.03.10.15.52.52.94.currentCatalogFile3_MS_Mathematics_Applied_Rationale.pdf](#)

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

Requested change: Revise or Drop Graduate Plan

Other curriculum change being requested: Change of course requirements

Degree: MS Mathematics MS Mathematics (Applied Option)

Title: Applied Option

Requested Effective Date: Fall 2023

Revise plan requirement: Yes

Dean: Swindell, Samantha - Assoc Dean - CAS,

Chair: Moore, Charles – Chair – Mathematics and Statistics,

Catalog Subcommittee
Approval Date

AAC, PHSC, or GSC
Approval Date

Faculty Senate
Approval Date

From: [Moore, Charles](#)
To: [Swindell, Samantha](#); [curriculum.submit](#)
Subject: Re: 695995 Mathematics and Statistics Requirements Revise - Revise or Drop Graduate Plan
Date: Monday, May 2, 2022 2:49:36 PM

1. I approve this proposal in its current form.

Chuck

From: curriculum.submit@wsu.edu <curriculum.submit@wsu.edu>
Sent: Thursday, March 10, 2022 3:53 PM
To: Moore, Charles <cnmoore@wsu.edu>
Cc: Swindell, Samantha <sswindell@wsu.edu>
Subject: 695995 Mathematics and Statistics Requirements Revise - Revise or Drop Graduate Plan

Moore, Charles – Chair – Mathematics and Statistics,
Swindell, Samantha - Assoc Dean - CAS,
Emily Lewis has submitted a request for a major curricular change.
Requested change: Revise or Drop Graduate Plan
Other curriculum change being requested: Change of course requirements
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Title: Applied Option
Requested Effective Date: Fall 2023
Revise plan requirement: Yes

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]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]wsu.curriculum@wsu.edu.

Blaine Golden, Assistant Registrar
Graduations, Curriculum, and Athletic Compliance
Washington State University
Registrar's Office

From: [Swindell, Samantha](#)
To: [curriculum.submit](#); [Moore, Charles](#)
Subject: RE: 695995 Mathematics and Statistics Requirements Revise - Revise or Drop Graduate Plan
Date: Monday, May 2, 2022 2:14:32 PM

1. I approve this proposal in its current form.

From: curriculum.submit@wsu.edu <curriculum.submit@wsu.edu>
Sent: Thursday, March 10, 2022 3:53 PM
To: Moore, Charles <cnmoore@wsu.edu>
Cc: Swindell, Samantha <sswindell@wsu.edu>
Subject: 695995 Mathematics and Statistics Requirements Revise - Revise or Drop Graduate Plan

Moore, Charles – Chair – Mathematics and Statistics,

Swindell, Samantha - Assoc Dean - CAS,

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March 10, 2022

MS Mathematics (Applied Option) Rationale for Updates

The Department of Mathematics and Statistics would like to update the MS Mathematics (Applied Option) curriculum. The goals in updating the requirements are principally to provide greater flexibility to students and to increase the attractiveness of this degree to prospective students. Currently, the degree has seven core courses that the student must take, and allows for three elective choices. However, for almost every core course required, there are alternatives that would satisfy the same objective. For example, it is not necessary that a student in this degree take Stat 523 or Stat 572 in particular, only that they take a graduate level statistics course. Therefore, the graduate faculty of the department wish to keep the essence and breadth of the degree, while allowing for latitude among the chosen courses to gain the desired skillset.

Of the five elective choices, three of them are to be from a particular area of focus relevant to the student's research interests. The professional society representing applied mathematics is the Society of Industrial and Applied Mathematics (SIAM). The SIAM website (<https://siam.org/>) lists 16 research areas in Applied mathematics. Students should be allowed to choose an area of focus (with the approval of their committee members) that include application areas outside of what is traditionally considered mathematics, as this degree will now allow.

The department hopes that in updating this degree to be flexible and more relevant to the current job market and to other fields like mathematical engineering, mathematical finance, and mathematical biology, the enrollment in the MS Mathematics (Applied Option) will increase. Providing example emphasis areas but allowing the freedom to choose design their own will hopefully appeal to students and give them the agency to develop a course plan to further their individual goals.

All curriculum 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 campus, on February 17, 2022.

Mathematics MS (Non-Thesis):

Applied Track:

- *Proseminar: must complete the following (1 credit):*
 - MATH 500
- ~~*Core: must complete all 5 of the following (15 credits):*~~
 - ~~MATH 464, MATH 516, MATH 540, MATH 548, STAT 443~~
- ~~*MATH 564 or MATH 566: 1 course minimum:*~~
 - ~~MATH 564, MATH 566~~
- *Differential Equations Requirement: Select 1 of the following (3 credits)*
 - *MATH 415, MATH 512, or MATH 540*
- *Computational Requirement (3 credits):*
 - *MATH 548 or other course as approved by student's committee*
- *Statistics Requirement (3 credits):*
 - *Select STAT 435, 443, or any 500-level Statistics course to satisfy this requirement*
- ~~*STAT 523 or STAT 572: 1 courses minimum:*~~
 - ~~STAT 523, STAT 572~~
- *Optimization Requirement: Select 1 of the following (3 credits):*
 - *MATH 464, MATH 564, MATH 565, MATH 566, MATH 567, MATH 574*
- *Electives: ~~9~~ 15 credits minimum, with at least ~~two~~ three courses from one area of emphasis, subject to the advisory committee's approval.*
- *Research Credits: 4 credits minimum:*
 - MATH 702
- *Total Graded Credits: ~~26~~ 27 credits minimum*
- *Total Credits: ~~35~~ 32 credits minimum*

Applicable Graduate School Requirements:

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

5 THE M.S. IN MATHEMATICS – APPLIED MATHEMATICS OPTION - Current Handbook

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 M.S. 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 of emphasis areas 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 M.S. exam may also cover 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.

The M.S. in Mathematics – Applied Mathematics Option

Proposed Handbook

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 is 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 M.S. 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 32 hours of approved graduate course work from the list below, 27 of which are graded credits. Twelve of these graded credits are requirements from different areas (one course each from the Differential Equations, Computational, Statistics, and Optimization categories), and the remaining 15 credit hours are electives that:

- must include at least three courses in an emphasis area of the student's choice, subject to the advisory committee's approval. This emphasis area should be included on the Research Topic/General Area section of the Program of Study.
- include at most three 400-level courses on the program of study, as permitted by the Graduate School for an M.S. degree.

At least seven of the nine required graded courses for this degree must have the prefix MATH or STAT. At most one course involving mathematics education (e.g. Math 531, 532, 534, 535, 590) may be counted.

Required courses (5 credits)

Math 500 Proseminar (1 credit)

Math 702 Master's Directed Study (minimum 4 credits)

Differential Equations Requirement (3 credits) – Select one of the following courses:

Math 415 Intermediate Differential Equations

Math 512 Ordinary Differential Equations

Math 540 Applied Mathematics I: PDEs

Computational Requirement (3 credits)

Select either Math 548 Numerical Analysis or another computational course as approved by student's committee

Statistics Requirement (3 credits)

Select Stat 435, Stat 443, or any 500-level Statistics course

Optimization Requirement (3 credits) – Select one of the following courses:

Math 464 Linear Optimization

Math 564 Convex and Nonlinear Optimization

Math 565 Nonsmooth Analysis and Optimization with Applications

Math 566 Optimization in Networks

Math 567 Integer and Combinatorial Optimization

Math 574 Topics in Optimization

Graduate Electives (15 credits):

Five additional graduate-level courses, including at least three from a chosen emphasis area (see below for examples). Courses from another department related to the student's research interests may be included, but note that students are responsible for the prerequisite material before taking a course. Topics courses may be included where appropriate and if approved by the student's committee.

Examples of emphasis areas include (but are not limited to) courses in the following, or any other focus approved by the student's committee or chair of the graduate studies committee:

Optimization*:

Math 464, 564,
565, 566, 567,
574

Mathematical

Modeling:

Math 570, 571,
579, 586

Data Analytics:

Stat 435, 437,
536, 577, CptS
415, 570, 577

Computational

Science:

Math 516, 544,
545, 546, 566,
CptS 515, 570

Mathematical

Finance:

Math 516, 545,
546, 564, 565,
566, Stat 516,
519, 544, EconS
510, 511, 512,
Fin 429, 427,
481

Mathematical

Biology:

Math 512, 516,
563, 579, 586,
CptS 570, Stat
435, 544

**Mathematical
Engineering**

Math 512, 516,
544, 545, 546,
566, 570, Stat
523, 544,
Engineering
courses

*As one course is already taken for the Optimization elective, only two additional courses are needed to complete an Optimization emphasis

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 M.S. exam may also cover 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.