From:	noreply@wsu.edu
To:	curriculum.submit
Subject:	040 524265 Mathematics and Statistics Requirements Revise - Revise or Drop Graduate Plan
Date:	Monday, August 19, 2019 11:56:44 AM
Attachments:	2019.08.19.11.56.36.10.FormData.html 2019.08.19.11.56.35.13.currentCatalogFile_MS_Math_Comp_Finance__Rationale.docx 2019.08.19.11.56.35.13.currentCatalogFile1_MS_Math_Comp_Finance__GS_Updates.docx 2019.08.19.11.56.35.13.currentCatalogFile2_MS_Math_Comp_Finance__Current_Handbook.pdf 2019.08.19.11.56.35.13.currentCatalogFile3_MS_Math_Comp_Finance__Proposed_Handbook.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

Degree: M.S. in Mathematics

Title: Computational Finance (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
Subject: RE: 040 524265 Mathematics and Statistics Requirements Revise - Revise or Drop Graduate Plan
Date: Thursday, August 22, 2019 9:59:12 AM

---

1. I approve this proposal in its current form.

From: curriculum.submit@wsu.edu <curriculum.submit@wsu.edu>
Sent: Monday, August 19, 2019 11:57 AM
To: charles.n.moore@wsu.edu; Swindell, Samantha <sswindell@wsu.edu>
Subject: 524265 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.

Requested change: Revise or Drop Graduate Plan

Degree: M.S. in Mathematics

Title: Computational Finance (non-thesis)

Requested Effective Date: Fall 2020

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.) [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.

From:	Moore, Charles
To:	curriculum.submit
Subject:	Re: 040 524265 Mathematics and Statistics Requirements Revise - Revise or Drop Graduate Plan
Date:	Monday, August 19, 2019 2:25:26 PM

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 11:56 AM, 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
>
> **Degree:** M.S. in Mathematics
>
> **Title:** Computational Finance (non-thesis)
>
> **Requested Effective Date:** Fall 2020
>
> 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.) [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

MS Math (Computational Finance) Program Updates Rationale June 13, 2019

The following changes are requested in order to make the MS Math (Computational Finance) program more accessible and to correct a few mistakes in the original version.

- Math 464 Linear Optimization has been replaced with a graduate class, Math 566 Optimization in Networks, to increase the rigor of the core courses.
- Math 575 and Math 576 should have been listed among the required courses when this program track was proposed. These courses, Asset Pricing in Financial Engineering and Quantitative Risk Management, are two critical, relevant courses that are fundamental to the program.
- Math 536 was removed because it is no longer in the WSU Catalog.
- The two groups of electives were redesigned to provide students with more elective choice. Students are now required to take two courses from each group instead of two and three in order to make it more consistent. With the influx of INTO students, we have discovered a number of problems with the current offerings. In particular, the 500 level Finance courses previously required by the degree are now offered through the Online MBA program in a different scheduling block than normal academic semesters. Requiring our international students to take online courses that do not fit with their normal schedule and cost more than Pullman courses is not feasible. For this reason, we have included the 400 level version of in-person courses as options (Fin 421, 427, etc) as well as several Economics courses. Because some of these Finance courses are reserved for certified majors in Finance or Business, students may have to wait until the seats are released for open enrollment. This worked satisfactorily in the 2018-2019 school year. Secondly, the faculty involved in this program have determined a number of other courses that are useful to Computational Finance students including optimization, statistics, and mathematical modeling. These have been included as well. A total of 13 courses are added as elective choices.
    - Math 540, 560, 564, Stat 556, and Stat 544 were added to Group 1 electives
    - Fin 421, 427, 428, 429, 481, EconS 510, 511, and 512 were added to Group 2 electives
    - Math 545, 548, 565 and Stat 523 were switched from Group 2 to Group 1.
- An additional elective within the department of Mathematics & Statistics was added to keep the required number of credits for the program above 26 after changing the Group 2 electives from three to two courses. This course can be any class with prefix MATH or STAT.

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
Computational Finance Track:

- *Proseminar: must complete the following (1 credit):*
  - MATH 500
- *Computational Finance Core: must complete all of the following (6 credits):*
  - MATH 575, MATH 576
- *Optimization: 1 course minimum (3 credits):*
  - ~~MATH 464~~ or MATH 564 or MATH 566
- *Simulation: 1 course minimum (3 credits):*
  - MATH 516, ~~MATH 536~~ or STAT 536
- *Group One Electives: 2 courses minimum (6 credits):*
  - ~~0~~ MATH 540, MATH 545, MATH 548, MATH 560, MATH 564, MATH 565, STAT 523, STAT 556, STAT 544 ~~FIN 521, FIN 526, FIN 527, FIN 528, FIN 581~~
- *Group Two Electives~~: 3 courses minimum~~ 2 courses minimum (6 credits):*
  - ~~MATH 523 or STAT 523, MATH 545, MATH 548, MATH 565,~~ FIN 421, FIN 427, FIN 428, FIN 429, FIN 481, FIN 521, FIN 526, FIN 527, FIN 528, FIN 581, STAT 516, STAT 519, ECONS 510, ECONS 511, ECONS 512
- *Graduate Course in Mathematics or Statistics: 1 course minimum (3 credits)*
  - Any course with prefix MATH or STAT
- *Research Credits: 4 credits minimum:*
  - MATH 702
- *Total Graded Credits: 26 credits minimum*
- *Total Credits: 32 credits minimum*

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*

Proposed June 11, 2019

1.1 THE M.S. IN MATHEMATICS – COMPUTATIONAL FINANCE OPTION

Description and Learning Outcomes – This is a Master of Science degree specifically designed to provide students with strong mathematics backgrounds in up-to-date mathematical and computational skills in quantitative finance and insurance. Such training is intended to produce individuals who can confidently undertake interdisciplinary research and analysis in modern financial risk management. The focus will be in preparing individuals to face the quantitative and computational challenges in financial service and insurance sectors. In order to achieve these goals the program provides:

- Solid training in Financial Mathematics, Optimization, and Stochastic Simulation;
- Broad background in the areas of Finance and Insurance, Numerical Analysis, and Statistical Analysis;
- Both group and individual projects;
- A strong computing component and acquisition of programming languages through coursework or independent study.

The M.S. in Mathematics (Computational Finance 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 (Computational Finance Option) requires at least 32 hours of approved graduate course work from the list below. Core requirements make up 17 of these hours, 12 hours must be comprised of courses listed in Group 1 (at least 2 courses) and Group 2 (at least 2 courses) below, and the remaining 3 hours can be filled with any additional mathematics or statistics course.

Required Courses:	Math 500 Proseminar (1 credit)
(5 credits)	Math 702 Directed Study (4+ credits)
Core Courses:	Math 564 OR Math 566 – Optimization (3 credits)
(12 credits)	Math 516 OR Stat 536 – Simulation Methods (3 credits)
	Math 575 Asset Pricing in Financial Engineering (3 credits)
	Math 576 Quantitative Risk Management (3 credits)

Graduate Electives: (12 credits) — At least two courses from Group 1 (Analysis, Computation, and Statistics) and two courses from Group 2 (Economics, Finance, and Management)

Group 1	Math 540 Applied Mathematics I Math 545 Numerical Analysis of Parabolic and Hyperbolic PDEs Math 548 Numerical Analysis Math 560 Partial Differential Equations I Math 564 Convex and Nonlinear Optimization Math 565 Nonsmooth Analysis and Optimization with Applications Math/Stat 547 Computational Stochastic Processes Stat 523 Statistical Methods for Engineers and Scientists Stat 556 Introduction to Statistical Theory Stat 544 Applied Stochastic Processes
Group 2	Fin 421 Financial Institutions and Intermediation Fin 429 Financial Modeling Fin 521 Interest Rates and Financial Markets Fin 526 Financial Management Fin 427/527 Investment Analysis Fin 428/528 Portfolio Theory and Financial Engineering Fin 481/581 International Finance Stat 516 Time Series Stat 519 Applied Multivariate Analysis EconS 510 Statistics for Economists EconS 511 Econometrics I EconS 512 Econometrics II

Elective (3 credits) — Any graduate level mathematics or statistics course

Math 702 and MS Examination – Each student will take at least four hours of Math 702 that must involve the completion of an individual project. Topics of individual projects include, for example, analysis of financial time series data, pricing of financial derivatives via simulation, asset allocation optimization, or formulation of a solution to the problem encountered during a summer internship. The student's advisory committee will supervise this project, and a written project report should be submitted by the end of the student's fourth semester when the project is completed. The final MS examination will include an oral presentation by the student about the results of the project, with questions from the student's advisory committee. In addition, the final oral examination will cover the student's coursework and the content of Math 401, 402, 420, and 421 (Analysis, Linear and Abstract Algebra).

5 The MS in Mathematics (Computational Finance Option)

5.1 Description and Learning Outcomes

This is a Master of Science degree especially designed to train students with strong mathematics backgrounds in up-to-date mathematical and computational skills in quantitative finance and insurance. Such training is intended to produce high caliber individuals who can confidently undertake interdisciplinary research and analysis in modern financial risk management. The focus will be in preparing talented individuals to face the quantitative and computational challenges in financial service and insurance sectors. In order to achieve its goals this program requires:

- a solid training in Financial Mathematics, Optimization, Stochastic Simulation;
- a broad background in the areas of Finance and Insurance, Numerical Analysis, and Statistical Analysis;
- 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 Computational Finance are specified below. The regulations of the Graduate School for master's programs are available in the Graduate School Policies and Procedures Manual.

5.2 Prerequisites

Same as in §3.2.

5.3 Courses and Hours

A candidate must complete at least 31 semester hours of course work. This includes:

(a) a core consisting of:

Math 464 or Math 564, Optimization;
Math 516 or Stat 536, Simulation;
Math 575, Asset Pricing in Financial Engineering;
Math 576, Quantitative Risk Management; and

(b) at least two additional graduate level courses from Group 1 and at least three additional graduate level courses from Group 2 below:

(1) Fin 521 (Interest Rates and Financial Markets), Fin 526 (Problem in Financial Management), Fin 527 (Investment Analysis), Fin 528 (Portfolio Management), Fin 581 (International Finance).

(2) Math 545 (Numerical Analysis of Evolution Equations), Math 548 (Numerical Analysis), Math 565 (Nonlinear Optimization), Stat 523 (Statistical Methods), Stat 516 (Time Series), Stat 519 (Applied Multivariate Analysis).

5.4 Transfer Credit

Same as in §3.4.

5.5 The Program of Study

Same as in §3.5.

5.6 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.

5.7 The Application for Degree

Same as in §3.7.

5.8 Thesis

There is no thesis requirement. However, a student must take four hours of Math 702 that must involve the completion of an individual project. The topics of individual projects include, for example, analysis of financial time series data, pricing of financial derivatives via simulation, asset allocation optimization, or formulation of a solution to the problem encountered during a summer internship. 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 consisting of three mathematics faculty 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.