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: MS in Statistics

Title: 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

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 10/10/2019 11:48 AM, curriculum.submit@wsu.edu wrote:

> Moore, Charles,
>
> Swindell, Samantha - CAS,
>
> Emily Lewis has submitted a request for a major curricular change.
>
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>
> 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

1. I approve this proposal in its current form.

From: curriculum.submit@wsu.edu [mailto:curriculum.submit@wsu.edu]
Sent: Thursday, October 10, 2019 11:49 AM
To: charles.n.moore@wsu.edu; Swindell, Samantha <sswindell@wsu.edu>
Subject: 529997 Mathematics and Statistics Requirements Revise - Revise or Drop Graduate Plan

Moore, Charles,

Swindell, Samantha - CAS,

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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.

MS Statistics Updates Rationale

The Department of Mathematics and Statistics would like to update the MS Stats curriculum. This degree has a few important additions and changes to keep abreast of current course offerings and the job market. The following changes are requested to the program's current curriculum for the reasons explained below.

- Math 500 is no longer a required course due to the influx of students in this program from other doctoral programs. Math 500 is an orientation course, and students affiliated with another program at WSU do not need an additional orientation requirement. Students solely affiliated with our department will still be required to take the course, but it will be internally enforced.
- Math 536 and Math 556 were crosslisted courses with Stat 536 and Stat 556 (both still on the core curriculum) but have since been offered only as their Stat-prefix equivalent.
- Stat 535 and Stat 530 will both prepare students for data analysis, so Stat 535 was added as an additional option for students to take.
- Stat 575 is currently replacing Stat 533. At this time, we would accept either course as meeting the requirement. In the future, we expect to only accept Stat 575.
- The elective requirements have changed substantially. Instead of completing three courses in one declared specialization, students must take three courses among the entire list of electives. These courses must be from two or more field areas (i.e. they cannot all be from the same field area).
  - The first area is now more broadly called "Statistical Theory." Stat 577 Statistical Learning Theory is a newly developed course that belongs in this category.
  - The second area has been more broadly retitled to "Applied Statistical Methods." Math 516 was deemed no longer appropriate for this section. Stat 535 is a possible core course or the material is covered in the related Stat 530; thus Stat 535 is no longer appropriate as an additional elective. Stat 572, 573, 574, and 576 are all courses dealing with statistical methods that should be included in the list of choices. Stat 574 and 576 are newly developed courses that are now being offered regularly.
  - The fourth area should no longer include Stat 552, 553, ENVR_SCI 508, or GEOLOGY 508 as these are no longer in the catalog.
- The final exam setup has also changed; although that may be outside the scope of the committee reviewing this, more project options were added to lessen the workload of current Statistics faculty. We are experiencing an influx of MS Statistics students from PhD programs in Economics, Business Administration, Communication, and Sociology, so we have developed a more flexible final project structure. The format of the final oral exam remains the same.

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 and Everett campuses on February 14, 2019. The changes to the final project/exam structure were approved in the same manner on October 7, 2019.

7 The MS in Statistics

7.1 Description and Learning Outcomes

Students can enroll into the Masters of Science in Statistics program either directly or while seeking a PhD in another field at WSU (see §8).

This MS program is designed to lead the student to the following learning outcomes:

1. Problem solving skills: Students are expected to learn the fundamental tools of statistical modeling and implementation. Skills for identifying and solving statistical problems arising in various interdisciplinary areas is an important expected learning outcome associated with this degree.

2. Ability to work individually or in groups: Statistical modeling can be pursued at an individual level or as part of a group effort with the group comprised of experts in various allied fields. The students are expected to develop such skills so that modeling and analysis gets done in a timely and efficient manner.

3. Communication skills: Good communication skills are expected so that students can present in an effective manner the interpretation, as well as implications of the results obtained from a statistical model and its analysis.

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

7.2 Prerequisites

Students considering the MS in Statistics should have a major in Mathematics, Statistics or a field in which statistics is heavily used. Students must adhere to Graduate School admission requirements, including a 3.0 grade point average during their last 60 hours of undergraduate study. Though not required, the Department strongly recommends submission of verbal and quantitative GRE scores.

The following list of courses form the basis for minimum admission requirements for the MS in Statistics degree program:

Prerequisites for Admission

- Math 171, 172, and 273 (Calculus I, II, and III, 3 semesters)
- Math 220 (Linear Algebra, 1 semester),
- At least one 3-credit course in computer programming
- Statistical Methods (3 credits)

In addition, the following courses are recommended by the Department as prerequisites for admission into the MS in Statistics degree program:

Recommended Prerequisites

- Math 401/402 (Analysis I and II) 2 semesters
- Math 420 (Linear Algebra II) 1 semester

7.3 Courses and Hours

Requirements for the Master of Science Degree in Statistics include: at least 30 credit hours of coursework of which 26 must be graded, 4 credits of Stat 702, a written special project, and passage of a comprehensive oral examination. Courses are chosen from five field areas: Advanced Theory and Stochastic Processes, Linear Models and Multivariate Analysis, Data Analysis, Bioinformatics and Biostatistics, and Econometrics and Time Series. The core requirements include Stat 443, 512, 530, 533, 556, at least one course in statistical computing (e.g., Stat 536), and a minimum of two credit hours of statistical consulting (Stat 590). The remainder of the 30 hours must include 3 or more courses from at least 2 field areas, chosen from the following:

- Advanced Theory and Stochastic Processes: Stat 544, 548, 549.

- Linear Models and Multivariate Analysis: Stat 519, 535, Math 516.

- Data Analysis: Stat 422, 428, 514, 536, 555, 572, 573.

- Bioinformatics and Biostatistics: Stat 520, 522, 565, Math 563.

- Econometrics and Time Series: Stat 508, 516, EconS 511, 512, 513.

Any changes to the above requirements for a particular student can be made only with prior approval of the students MS Committee and the Chair of the MGSC Committee. Special topics covered in Stat 510 may be used to satisfy some of the field area requirements with approval of the students committee. Students who do not have a background in a field outside of statistics, mathematics, or computer science are encouraged to take at least two courses in another substantive area.

7.4 The Program of Study

Same as in §3.5.

7.5 Transfer Credit

Credit appropriate to the program of study (with a grade of B or higher) earned in other accredited graduate schools after the award of the bachelors degree may be transferred and applied toward a students graduate degree program. The number of such credit hours is limited to no more than half of the total graded course credits required. Transfer credit is requested by listing the courses on the Program of Study (see §3.5); approval of the Program of Study implies approval of transfer of credit. Other general regulations regarding Transfer Credit can be found in Chapter 6 of the Graduate School Policies and Procedures Manual.

7.6 MS Committee and MS Project

There is no thesis requirement; however, an MS in Statistics student is required to do a special written Masters project equivalent to 2-4 hours of Stat 702. Therefore, early in the students graduate program (by the second semester as recommended by the Graduate School), he/she should obtain a project supervisor and formulate an MS committee. The students project supervisor will normally serve as the head of the MS committee, which will usually include two additional faculty

members with interest in Statistics. The student is required to make the final draft of the project report available to the MS committee at least two weeks prior to the final Masters oral exam. It is the committees responsibility to give final approval to the project.

7.7   The MS Examination

The final Masters oral exam is a two-hour oral exam conducted by the students M.S. committee. The oral exam will consist of (i) a 30-minute presentation of the students Masters project, (ii) a 15-minute period following the Masters project presentation for questions by the committee related to the results contained in the Masters project, and, (iii) a 75-minute period devoted to a comprehensive oral exam covering the material in Stat 443, Stat 512, Stat 530, Stat 533, Stat 556 as well as material covered in additional course work. The student is expected to be thoroughly familiar with a wide array of statistical concepts as contained in the list of topics and concepts obtained from the department.

7.8   The Application for Degree

Same as in §3.7.

1.1 THE M.S. IN STATISTICS

Description and Learning Outcomes – This is a two-year degree designed to prepare students to work in industry or to apply to a PhD program by providing them with a broad statistical skill set. Students may enroll in the M.S. in Statistics program directly or while seeking a PhD in another field. Students can choose courses from four field areas: Statistical Theory, Applied Statistical Methods, Bioinformatics and Biostatistics, and Econometrics and Time Series.

This MS program is designed to lead the student to the following learning outcomes:

- Problem solving skills: Students are expected to learn the fundamental tools of statistical modeling and implementation. Skills for identifying and solving statistical problems arising in various interdisciplinary areas is an important expected learning outcome associated with this degree.
- Ability to work individually or in groups: Statistical modeling can be pursued at an individual level or as part of a group effort with the group comprised of experts in various allied fields. Students are expected to develop such statistical skills so that modeling and analysis can be done in a timely and efficient manner.
- Communication skills: Students should develop good communication skills so that the interpretation and implications of the results obtained from analysis of a statistical model can be presented in an effective manner.

Courses – The MS in Statistics requires a total of 33 credit hours, including four credits of Stat 702; a written special project; and passage of a comprehensive oral examination. Any changes to the requirements for a particular student can be made only with prior approval of the student's committee and the chair of the Math Graduate Studies Committee. Special topics covered in Stat 510 may be used to satisfy an elective with approval of the student's committee. Students who do not have a background in a field outside of statistics, mathematics, or computer science are encouraged to take at least two upper division courses in another substantive area.

Core requirements account for 24 of the required credit hours; the remaining 9 hours must include three or more courses representing at least two field areas chosen from the table below.

Required Courses: (4 hours)	Stat 702 Master's Special Problems/Directed Study
Core Courses: (20 hours)	Stat 443 AND Stat 556 Probability and Statistical Theory (6 hours) OR Stat 548 AND Stat 549
	Stat 512 Analysis of Variance of Designed Experiments (3 hours)
	Stat 536 Statistical Computing (3 hours)
	Stat 530 OR Stat 535 Regression (3 hours)
	Stat 575 The Theory of Multivariate Analysis (3 hours)
	Stat 590 Statistical Consulting Practicum (2 hours)

Electives:
(9 hours)

Three courses from at least two field areas in the table below

Statistical Theory*	Stat 544 Applied Stochastic Processes
	Stat 548 Statistical Theory I
	Stat 549 Statistical Theory II
	Stat 577 Statistical Learning Theory
Applied Statistical Methods	Stat 519 Applied Multivariate Analysis
	Stat 572 Quality Control
	Stat 573 Reliability
	Stat 574 Linear and Nonlinear Mixed Models
	Stat 576 Bayesian Analysis
Bioinformatics and Biostatistics	Stat 520 Statistical Analysis of Qualitative Data
	Stat 522 Biostatistics and Statistical Epidemiology
	Stat 565 Analyzing Microarray and Genomic Data
	Math 563 Mathematical Genetics
Econometrics and Time Series	Stat 508 Environmental Spatial Statistics
	Stat 516 Time Series
	Econ 511 Econometrics I
	Econ 512 Econometrics II
	Econ 513 Econometrics III

*Stat 548 and 549 cannot be used in the field area if counted for the core requirements.

Stat 702 and MS Examination - There is no thesis requirement; however, an MS in Statistics student is required to do a special written Masters project equivalent to 2-4 hours of Stat 702. Therefore, early in the students graduate program (by the second semester as recommended by the Graduate School), he/she should obtain a project supervisor and formulate an MS committee. The student's project supervisor will normally serve as the head of the MS committee, which will usually include two additional faculty with interest in Statistics. The student is required to make the final draft of the project report available to the MS committee at least two weeks prior to the final Masters oral exam. It is the committee's responsibility to give final approval to the project.

The student must select one of three MS project options in order to satisfy the project requirement. Selection of the project option must be made in consultation with the student's MS committee chair. The three project options are as follows:

1. The student can do an independent research project (advised by the supervisor). Acceptable topics for a project include an original data analysis or original

research on a statistical problem. The student is required to write the final draft of the project report.
2. The student can thoroughly study a statistical modeling and methodology paper (suggested by the supervisor). The student then reads the selected paper, together with at least three other relevant papers and then prepares a comprehensive written report which includes, but is not limited to, the central objectives of the problem, modeling, methodology, implementation, results, and conclusions. The student is required to write a summary report on the topic and to include in the report the computer code for implementation of the methodology.
3. The student can complete an internship that is compatible with the student's chosen career specialization within statistics (approved by the supervisor). The internship should be a full-time affiliation for a period of not less than eight weeks duration and not less than 400 hours. A monthly report is required during the internship and a written report is to be turned in at the end of the internship.

For all three options, the student is required to write a final summary report on the subject and make it available to the MS committee at least two weeks prior to the final Master's Examination. It is the committee's responsibility to give final approval.

The final Masters oral exam is a two-hour oral exam conducted by the student's M.S. committee. The oral exam will consist of a (i) 30-minute presentation of the student's project/paper/internship, (ii) 15-minute period following the Master's project presentation for questions by the committee related to the results contained in the Masters project, and (iii) 75-minute period devoted to a comprehensive oral exam covering the material in Stat 443, Stat 512, Stat 530, and Stat 556, as well as material covered in additional course work. The student is expected to be thoroughly familiar with a wide array of statistical concepts contained in the list of topics and concepts obtained from the graduate coordinator.

5/31/19

Statistics MS (Non-Thesis):

- ~~*Proseminar: must complete the following:*~~
    - ~~MATH 500~~
- *Core: 6 courses minimum (18 credits):*
    - ~~MATH 536, MATH 556,~~ STAT 512,
    - STAT 530 OR STAT 535
    - STAT 533 OR STAT 575
    - STAT 536
    - STAT 556 & STAT 443 OR STAT 548 & 549
- *Statistical Consulting: (2 credits):*
    - STAT 590
- ~~*Complete Requirements for one specialization:*~~ *Complete 3 courses from at least two field areas (9 credits):*
    - ~~*Advanced*~~ *Statistical Theory ~~and Stochastic Processes (3 courses minimum)~~:*
        - MATH 568, MATH 569, STAT 544, STAT 548, STAT 549, STAT 577
    - *Applied Statistical Methods: ~~Linear Models and Multivariate Analysis (complete all 3 of the following):~~*
        - ~~MATH 516,~~ STAT 519, ~~STAT 535,~~ STAT 572, STAT 573, STAT 574, STAT 576
    - *Bioinformatics and Biostatistics ~~(3 courses minimum):~~*
        - MATH 563, STAT 520, STAT 522, STAT 565
    - *Econometrics and Time Series ~~(3 courses minimum):~~*
        - ECONS 511, ECONS 512, ECONS 513, STAT 516, ~~STAT 552, STAT 553; ENVR_SCI 508 or GEOLOGY 508 or~~ STAT 508
- *Research Credits: 4 credits minimum:*
    - STAT 702
- *Total Graded Credits: 26 credits minimum*
- *Total Credits: 33 credits minimum*

Applicable Graduate School Requirements:

- *Graded Credits: 26 credits minimum:*
    - Students may use a maximum of 6 credits of undergraduate coursework (300-400)
- *Research Credits: 4 credits minimum*
    - STAT 702
- *Total Credits: 30 credits minimum*