

Proposal to Establish a Master of Applied Economics in the School of Economic Sciences

Submitted by the
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Overview

The School of Economic Sciences (SES) proposes to create a new Master of Applied Economics (MAE) degree program to train industry leaders in quantitative economic analysis. This proposed degree emphasizes quantitative coursework. Students will graduate from this program with strong knowledge and skills in economic analysis, applied econometrics, and data analytics. They will also be required to communicate economic findings based on investigations of data to an industry-type audience.

The program will be housed in SES in the College of Agricultural, Human, and Natural Resource Sciences (CAHNRS) at Washington State University (WSU). SES is a combined General Economics and Agricultural Economics academic unit. We argue this new professional degree program will be beneficial to SES, CAHNRS, WSU, potential students, and industry stakeholders.

Relationship to Institutional Role, Mission and Academic Unit Priorities

The School of Economic Sciences was formed in 2004 by merging the Department of Agricultural and Resource Economics and the Department of Economics. SES is a unified general and agricultural economics program committed to the land-grant heritage and tradition of discovery, education, and service to society. SES is the sole provider of economics instruction at WSU. Thus, a major institutional role is to provide service courses for students across WSU and especially in the Carson College of Business.

SES has 22 full-time tenure-line faculty, one Extension professor, four teaching faculty, and three research professors; all holding Ph.Ds. Two additional tenure-line faculty will join SES in August 2020. SES has four full-time support staff, 80 PhD students and 17 MS students. Undergraduate enrollment currently includes 250 majors on the Pullman campus, another 60 majors through Global campus, and more than a thousand students taking Economics courses as part of their degree programs or electives every year.

SES offers a B.S. degree in Economics on the Pullman campus with options in Agricultural Economics, Environmental and Resource Economics, Business Economics, Financial Markets, International Economics and Development, Economics, Policy and Law, and Quantitative Economics. In addition, on the Pullman campus, SES offers a B.S. in Agricultural and Food Business Economics. SES also offers a B.S. in Economics that is entirely online through WSU Global Campus. SES offers graduate programs leading to the Master of Science in Economics and Doctor of Philosophy degrees in Economics and in Agricultural Economics.

The School's mission includes the following: "To extend economic knowledge through effective educational programs in which emerging scholars are mentored to realize their highest potential and assume roles of leadership, responsibility, and service to society." The proposed MAE degree directly supports this mission.

The proposed MAE will be differentiated from the MS in Economics (recently changed from MS in Applied Economics) both in terms of program content and objectives. The MS in Economics is targeted to students interested in economic research support positions or for those who are planning to continue their studies with a PhD degree. In contrast, the MAE is targeted toward students who are professionally orientated towards a career in industry. The MAE curriculum will include new courses in Big Data for Economics and Business (using Python and R) and Machine Learning for Economics and Business. These courses will also be available for students across the university,

including in Statistics, Business, Math, and Computer Science. Thus, the proposed MAE curriculum will be complementary to current offerings.

Documentation of Need for the Program

Global and National demand

There has been increased demand for workers trained in both economics and data science. Economists understand the variables that are important in maximizing profits or other objectives. Data Scientists have the skills to analyze big data. Both skills are needed in the new economy. Economists with data science skills know which variables to measure and know how to accomplish the measurement.

Student demand for this type of program is increasing. In the last decade, SES experienced an increasing number of students inquiring about a professional economics degree options at the graduate level. Table 1 below lists the number of students in the SES MS in Economics (recently changed from Applied Economics) program in the last four cohorts, categorized by geographic origin, including in-state domestic, out-of-state domestic, international, and INTO Program.

Table 1. SES Recent School of Economic Sciences M.S. Enrollments

	Domestic In-state	Domestic Out-of- State	International	INTO (international) students	Total students
2019-20	7	3	3	4	17
2018-19	3	2	4	6	15
2017-18	3	2	0	0	5
2016-17	1	0	2	0	3

The M.S. enrollment has been significantly increasing, despite not offering any research assistantships or teaching assistantships for M.S. students. These students essentially pay for the entire cost of their education. This increase has been driven mainly by students interested in completing our program and then going to work in industry positions with an applied focus, and they are expressly not interested in writing or defending a thesis/project. Internationally, two large institutions in China, Shanghai University of Finance and Economics and Dalian University of Technology, have already expressed interest in signing an agreement with our School in order to be able to enroll at least 25 students per year to take applied economics graduate-level courses at WSU. Given our limited number of faculty, our School has had to cap admissions in the last two cohorts and could not sign agreements with the aforementioned Chinese institutions.

Several prestigious universities already offer both types of programs (MS in Economics and MAE), including such universities as Duke, UCLA, and Johns Hopkins. These type of MAE programs are also common in top European universities, which offer a variety of Masters-level opportunities, including Masters degrees in Economics (often known as the “PhD track” that aims to train students for careers in academia, which is equivalent to our current MS degree) and several degrees/certificates in Econometrics or Economics for Public Policy, among others (i.e., the “Masters track,” which is more applied in nature and less oriented toward careers in academia). Examples of schools offering

these programs include the London School of Economics, University College London, University of Bath, Universitat Pompeu Fabra (Barcelona), and Universidad Carlos III (Madrid).

Regional and State

There is currently no graduate program similar to the MAE in the State of Washington and no similar programs in the region.

Unique Aspects of the Program

The features of a one-year professional master's degree that focuses on economics and data science encompasses the following criteria:

1. The degree improves the student's Economics preparation and emphasizes the utilization of quantitative techniques.
2. It can be taken by students with Business/Finance/Agricultural/Engineering backgrounds with basic training in Microeconomics, Macroeconomics, and Econometrics/Statistics.
3. The program is focused on the application of economics, preparing students for industry/government jobs, and analyzing empirical problems with large data sets.
4. The degree is a terminal degree and does not require students to complete a thesis or project. Rather the MAE students will complete a capstone project that will be completed in a course.
5. The degree can be completed within 10 months.

WSU currently offers a graduate certificate in Bioinformatics, which includes multidisciplinary training in molecular biology, genomics, and computer science. Much of the content in that program is not relevant for the type of positions that MAE graduates would be offered. WSU's M.S. in Applied Mathematics with a Computational Finance option is a closer alternative. However, computational finance has a business focus that does not include the Economics expertise.

In addition, there are currently no courses at WSU that focus on big data and machine learning for Economics and Business. These courses will help precisely what students need to be prepared for securing and being successful in industry positions.

Curriculum

Coursework

To graduate from the program, students must successfully complete a minimum of 27 graded semester credits. Of these, a maximum of 9 graded credits can be taken at the 400-level (equivalent to three 3-credit courses), and all other graded credits must be at the 500-level.

The structure of MAE program coursework is the following:

- *August prior to the Fall semester* (three weeks, class Monday-Friday, 3 cr.):
 - EconS 523 (new course) Big Data Management and Processing for Economics (Python and R), 3 cr. This course would be taught as a "Summer Camp" where students are exposed to an introduction to programming in Python and R.
- *Fall semester courses* (12 credits)
 - EconS 527 (Master's Microeconomic Analysis), 3 cr.
 - EconS 528 (Master's Macroeconomics), 3 cr.
 - Stat 435 (Statistical Modeling for Data Analytics), 3 cr.
 - EconS 529 (Writing and Presentation Skills for Economists--research methods), 3 cr.
- *Spring semester courses* (15 credits)
 - EconS 525 (Master's Econometrics), 3 cr.

- EconS 5xx (new course) Applied Machine Learning for Economics and Business, 3 cr
- EconS 701 Economics Capstone, 3 cr.
- Elective courses: Choose 2 electives, 6 cr. (including but not limited to the following):
 - EconS 522 Financial and Commodity Derivatives, 3 cr.
 - EconS 533/AgEc 533 International Trade and Policy, 3 cr.
 - AgEc 535 Applied Industrial Organization, 3 cr.
 - EconS 536 (Applied Statistics and Econometrics for Economics and Finance)
 - Stat 437 High Dimensional Data Learning and Visualization, 3 cr.

Students must complete 3 semester credits of EconS 701 to graduate (3 credits second semester). In this course, students will complete a capstone project that integrates economic analysis with data analytics. Assessments of students for this course will be conducted by a committee of three faculty.

All EconS courses will be offered in the daytime, in-person at the Pullman campus of Washington State University, unless otherwise specified. Courses with the AgEc prefix refer to optional electives and are offered at the University of Idaho. A student enrolled in full-time study can finish the program in one academic year, including the late summer special session prior to fall semester.

This degree program classifies as STEM (CIP Code 45.0603: Econometrics and Quantitative Economics).

Learning Objectives

The MAE degree program has five inter-related learning objectives.

1. Understand and be able to apply economic theory to real-world scenarios.
2. Understand and be able to apply econometric and statistical analysis to analyze data, estimate relationships, and forecast.
3. Acquire the ability to obtain, organize, and clean data, analyze and visualize data, and use version control.
4. Achieve familiarity and skills with programming languages (e.g. R, Python and various statistical software).
5. Develop communication and presentation skills essential for success in any aspect of business and other forms of collaboration.

Student Assessment

Student achievement of the learning goals will be assessed via evaluation of performance in coursework and successful completion of the Capstone Project. The Capstone will integrate coursework in a project. A balloted evaluation of the student's completion of the capstone project will be implemented by SES graduate faculty.

Admission

We plan to attract diverse, highly motivated students from both in-state and out-of-state and international. Candidates for admission must meet the following requirements:

1. *GPA.* A Bachelor's degree in Economics, Agricultural Economics, Business, Finance, Engineering, or related fields, with a cumulative GPA of 3 or higher (out of a scale of 4).
2. *Courses.* Coursework in statistics, mathematics, including linear algebra and calculus, is expected. Upper-division coursework in Economics is beneficial and may be used as a determinant of admission to rank applicants if enrollment capacity is reached for any entering cohort.

3. *GRE/GMAT exams.* No GRE or GMAT exams are required to apply. However, applicants who took either of these exams are encouraged to include the scores in their application.
4. *TOEFL/IELTS exam.* The minimum TOEFL score is 213 in the computer version (which corresponds to 550 points in the paper version, and 80 points in the internet version). If a student took the IELTS exam, the minimum IELTS score is 7 points. By WSU policy, the TOEFL/IELTS exams are waived for students graduating from universities in the following countries: Australia, Bahamas, Barbados, Botswana, Canada, Guyana, Kenya, United Kingdom, Republic of Ireland, Jamaica, New Zealand, Nigeria, and Trinidad and Tobago.
5. *Letters of recommendation.* Applicants must provide the names and contact information of three (3) faculty members, employers, or individuals who can write a letter of recommendation on their behalf.

Infrastructure Requirements

Facilities for MAE training will be provided by SES and WSU. No infrastructure improvements are required for this program. Classroom space can be accommodated within WSU's current resources. Library resources include electronic access to journals, online databases, search engines, and reference materials. WSU facilities include information technology (IT) support, access to software packages, high-speed internet access, and data storage capacity.

Faculty

Program Faculty

The School of Economic Sciences has distinguished faculty in economics and applied econometrics. They include award-winning instructors, AAAS and AAEA Fellows, and an NBER Fellow. They have published graduate-level and undergraduate textbooks in Econometrics, Microeconomics, and Statistics for Economics and Business. Program faculty are listed in appendix III. The program faculty will have primary responsibility for administering the proposed MAE program.

Program Governance

The Graduate Faculty in SES will have final oversight over the MAE program. The SES Graduate Studies Committee in SES will assess the program on at least an annual basis.

SES will create a MAE Advisory Board consisting of industry stakeholders, alumni, 1 or 2 current students, and faculty to advise SES on creating and providing excellence within the MAE program.

Administration

The proposed MAE will be administered by SES. Funds will be allocated for program recruiting, support, placement, and alumni relations, as well potentially hiring additional faculty as program growth warrants. We will initially appoint a 1.0 FTE staff to provide program support.

Students

Prospective students will have completed in bachelor's degree with coursework in economics and quantitative. They will be professionally orientated towards a career in industry. We will recruit students regionally and nationally. In addition, SES will recruit internationally. For example, the two institutions in China, Shanghai University of Finance and Economics and Dalian University of

Technology, are interested in signing an agreement with our School to send students to SES graduate programs.

SES initially expects a class of 15 students, but this number should grow. In a larger growth scenario, SES would hire additional faculty to meet the instructional demands of larger cohorts.

In this professional degree, students are expected to self-fund their education. The School of Economic Sciences does not plan to offer teaching or research assistantships to MAE students. The current M.S. of Economics (formerly Applied Economics) was almost entirely self-funded.

Upon completing the MAE, graduates will use their economic and data analytics skills in roles as professionals primarily in industry.

Diversity

The School of Economic Sciences is committed to the recruitment and retention of outstanding and diverse graduate students. Quantitative economics is a white, male-dominated field. SES performs better than other Ph.D.-granting academic units in Economics and Agricultural Economics. Nationally, women only represent under 20% of faculty in Ph.D. granting departments. One third of SES faculty are female, including its leadership. Our faculty come from nine countries, including four Spanish-speaking countries. SES has had success recruiting graduate students with Native American backgrounds and other under-represented minorities.

We will recruit women and under-represented minority students through email listservs and personal contacts with the Committee for Women in Agricultural Economics (CWAE) and the Committee on the Status of Black Agricultural Economists (COSBAE) of the Agricultural and Applied Economics Association (AAEA) and through the Committee on the Status of Women in the Economics Profession (CSWEP) Committee on the Status of Minority Groups in the Economics Profession of the American Economic Association.

Program Assessment

The MAE program will be comprehensively reviewed every five years. In addition, a MAE Advisory Board will assess the program quality, curriculum, and student outcomes. The SES Graduate Studies Committee will also assess the MAE program with input from the MAE Advisory Board. The SES Graduate Faculty will assess MAE metrics (including student grades and graduation, capstone projects, and placements) annually.

Budget

Appendix V includes a summary to the MAE program costs and revenues for years 1-5. We estimate the costs to be about \$250,000 per year, which includes one FTE faculty hire fully devoted to the program and one FTE staff member fully devoted to the program. The costs are expected to be fully covered by the tuition-sharing agreement. We anticipate an initial class of 15 students. We project this to grow by 10% per year.

Appendix I: Collaborations

The MAE program anticipates collaborations with academic units across WSU and at the University of Idaho. At WSU, the Program in Statistics (now combined into the Department of Mathematics and Statistics at WSU) has been an outstanding group with whom SES collaborates. Currently, about one third of SES Ph.D. students simultaneously obtain a M.S. in Statistics and some of SES courses are cross-listed with Statistics. The Carson College of Business is also a long-time collaborator with SES. Economics courses are required for many of their programs. WSU has an agreement with the University of Idaho (the two universities are only separated by 7 miles) that students can take classes at either university without paying additional tuition. SES cooperates with the Department of Agricultural Economics at the University of Idaho (UI). This cooperation leverages course offerings at the master's level.

Appendix II: Course Descriptions

EconS 523 Big Data Management and Processing for Economics, 3 cr.

An introduction to data management and processing. The course will cover concepts related to efficiently collecting and storing data, cleaning data, and version control, as well as descriptive data analysis, and effective programming for achieving these concepts.

EconS 527 Master's Microeconomic Analysis, 3 cr.

Consumer and producer behavior; partial and general equilibrium; game theory; imperfectly competitive markets; and market failures. Required preparation must include intermediate microeconomics and calculus course work. Cooperative: Open to UI degree-seeking students.

EconS 528 Master's Macroeconomics Analysis 3 cr.

Master's-level course to develop a coherent theoretical framework to interpret macro data and to analyze macro policy. Cooperative: Open to UI degree-seeking students.

STAT 435 Statistical Modeling for Data Analytics 3 cr.

Multiple linear regression with model selection, dealing with multicollinearity, assessing model assumptions, the LASSO, ridge regression, elastic nets, Loess smoothing, logistic regression, Poisson regression, and the application of the bootstrap to regression modeling.

EconS 529 (revised) Research Methods/Writing and Presentation Skills for Economists, 3 cr.

Designed to develop communication and presentation skills essential for success in any aspect of business. Practice in writing economics documents for variety of professional audiences. Writing taught as process—brainstorming, collaborating, continually revising, and challenging ideas. Presentation skills to focus on presenting information clearly and organizing ideas, with emphasis on role of audience when presenting, because audience determines diction, style, tone, organization, research, and ideas. Grammar incorporated as needed, especially in regard to writing.

EconS 525 Master's Econometrics, 3 cr.

Theory and practice of multiple regression methods; applications to the study of economic and other phenomena; use of computer regression programs. Required preparation must include introductory statistics course. Cooperative: Open to UI degree-seeking students.

EconS 536 Applied Statistics and Econometrics for Economics and Finance 3

Data and problem driven approach to formulating, estimating, and interpreting models that address problems in the area of finance and financial economics; review relevant basic statistics and probability concepts, and apply these to linear regression, regression diagnostics, and time series econometrics.

EconS 524 (placeholder number, new course) Applied Machine Learning for Economics, 3 cr.

This course introduces machine learning algorithms and concepts. Broadly, the course will cover supervised and unsupervised learning methods, providing foundational theory and application to data in order to build theoretical understanding. The statistical and computational methods associated with each learning problem will also be explored.

EconS 701 (new course) Economics Capstone, 3 cr.

Course Prerequisite: Admitted to the Master of Applied Economics program. This is the capstone for professional master's degree. It will integrate the MAE coursework in a project. The course will include a balloted evaluation of the student's completion of the capstone project by the three of the program's graduate faculty. (This is evaluated with Satisfactory/Unsatisfactory grades.)

Elective courses

EconS 522 Financial and Commodity Derivatives 3 cr.

Design, trading, structure, and pricing of derivatives; working knowledge of how derivative securities work, how they are used, and how they are priced.

STAT 437 High Dimensional Data Learning and Visualization 3

Course Prerequisite: STAT 435. Data visualization, metric-based clustering, probabilistic and metric-based classification, algebraic and probabilistic dimension reduction, scalable inferential methods, analysis of non-Euclidean data. Typically offered Spring.

EconS 533 International Trade and Policy 3 cr.

International trade theories, policies, and research issues related to world trade with emphasis on agricultural commodity markets. Cooperative: Open to UI degree-seeking students.

AgEc 535 Applied Industrial Organization (University of Idaho), 3 cr.

Economic and strategic management theories and their relevance to agribusiness decision-making, including empirical applications. Cooperative: open to WSU degree-seeking students.

Appendix III: Program Personnel

WSU School of Economic Sciences Faculty

Name	Degree	Rank
Bai, Jinhui	PhD	Associate Professor
Batina, Raymond G	PhD	Professor
Blundell, Wes	PhD	Professor
Brady, Michael	PhD	Associate Professor

Cook, Joseph H	PhD	Associate Professor
Cowan, Benjamin W	PhD	Associate Professor
Espinola-Arredondo, Ana	PhD	Associate Professor
Fortenbery, T Randall	PhD	Professor
Gallardo, Karina	PhD	Associate Professor
Gibson, Mark	PhD	Associate Clinical Professor
Galinato, Gregmar	PhD	Associate Professor
Jessup, Eric	PhD	Research Professor
Kuzyk, Patricia	PhD	Associate Clinical Professor
Love, H. Alan	PhD	Professor
Luckstead, Jeff	PhD	Assistant Professor
Mandal, Bidisha	PhD	Associate Professor
Manian, Shanthi	PhD	Assistant Professor
Marsh, Thomas Lloyd	PhD	Distinguished Professor
McCluskey, Jill J	PhD	Regents Professor & Director
McCracken, Vicki A	PhD	Professor & Associate Dean
Mittelhammer, Ron	PhD	Regents Professor
Munoz-Garcia, Felix	PhD	Associate Professor
Nadreau, Tim	PhD	Assistant Research Professor
Neibergs, J. Shannon	PhD	Professor of Extension
Prera, Alex	PhD	Assistant Clinical Professor
Reilly Gurocak, Elizabeth	PhD	Assistant Clinical Professor
Yan, Jia	PhD	Professor
Yoder, Jon	PhD	Distinguished Professor

School of Economic Sciences Adjunct Faculty

Name	Degree	SES Rank	Position Outside WSU
Andrew Cassey	PhD	Adjunct Associate Professor	Vice President, Quantitative Risk Modeling, Bank in Delaware
Xiaoxue Du	PhD	Adjunct Assistant Professor	Assistant Professor, University of Idaho
Greg Duncan	PhD	Adjunct Professor	Senior Principal Economist, Amazon & Affiliated Faculty, University of Washington
Liang Lu	PhD	Adjunct Assistant Professor	Assistant Professor, University of Idaho
Christopher McIntosh	PhD	Adjunct Professor	Professor, University of Idaho
Philip Watson	PhD	Adjunct Associate Professor	Associate Professor, University of Idaho

Jason Winfree	PhD	Adjunct Associate Professor	Associate Professor, University of Idaho
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Staff

Name	Title	Responsibilities
Dahl, Jaimie	Graduate Coordinator and Principal Assistant	Liaison with Graduate School, general administration
Dahl, Tom	Administrative Assistant	Maintain SES website, general administration and support
Hoeft, Rich	Budget Finance Manager	Budget oversight, staffing oversight
Liao, Rebecca	Academic Coordinator	Academic Advising and Recruiting
New staff	MAE Coordinator	Daily program coordination, recruiting, placement, and alumni relations

Appendix IV: Enrollment Targets (headcounts)

2021-22	2022-23	2023-24	2024-25	2025-26
18	20	22	24	26

Note: These targets are conservative. Enrollments could be higher if an agreement is signed with international universities.

Appendix V: Summary of Program Costs and Revenue

See attached spreadsheet for budget.