WASHINGTON STATE UNIVERSITY
Office of the Dean, Graduate School

MEMORANDUM

TO: Dorene Branson, Principal Assistant
Faculty Senate

FROM: Graduate Studies Committee

DATE: March 20, 2013

SUBJECT: MSc in Mathematics (Computational Finance Option)

On Tuesday, March 19, the Graduate Studies Committee approved the creation of the Computational Finance Option in the Masters in Mathematics degree program. Please forward this to the Faculty Senate for appropriate approvals.

PO Box 641030, Pullman, WA 99164-1030
509-335-6424 • Fax: 509-335-1949 • www.gradsch.wsu.edu

Washington State University

MAJOR CHANGE FORM - - REQUIREMENTS

(Submit original signed form and TEN **copies to the Registrar's Office, zip 1035.)**

See https://www.ronet.wsu.edu/ROPubs/Apps/HomePage.ASP *for this form.*

*Submit an additional copy to the Faculty Senate Office, French Administration 338, zip 1038.

Department Name Mathematics

1. CHECK PROPOSED CHANGES.

*☐ Change department/program name *from* _____ *to* _____
*☐ New degree or program *in* _____
*☐ Change name of degree *from* _____ *to* _____
*☐ Drop degree or program *in* _____
*☐ Extend existing degree or program *to* _____ campus

☐ New Major *in* _____
☐ Change name of Major *from* _____ *to* _____
☐ Revise Major requirements *in* _____
☐ Drop Major *in* _____
☐ Revise certification requirements for the Major *in* _____

☑ New Option *in* MSc in Mathematics (Computational Finance Option)
☐ Revise requirements for the Option *in* _____
☐ Drop Option *in* _____

☐ New Minor *in* _____
☐ Revise Minor requirements *in* _____
☐ Drop Minor *in* _____

☐ New Undergraduate Certificate *in* _____
☐ Revise Undergraduate Certificate requirements *in* _____
☐ Drop Undergraduate Certificate *in* _____

☐ Other _____

Effective term/year Fall 2013

Haijun Li	(509) 335-5279	lih@math.wsu.edu
Contact Person	Contact Phone No.	Contact email

2. GIVE REASONS FOR EACH REQUEST MARKED ABOVE. *(Attach additional paper if necessary; see reverse side.)* See attached.

4. SIGN AND DATE APPROVALS.

9/6/2012 (Chair Signature/date) _____ 10-1-12 (Dean Signature/date) _____ (General Education Com/date)

_____ (Catalog Subcom/date) _____ (Academic Affairs Com/date) _____ (Graduate Studies Com/date) _____ (Senate/Date)

The Rationale for the MS in Mathematics (Computational Finance Option)

Computational Finance is a cross-disciplinary field which utilizes computational methods (such as numerical analysis, stochastic simulation, and optimization) to investigate financial investment strategies, analyze financial risk arising from financial instruments, and to make trading and hedging decisions. Most equity trades are now done by high speed computer programs on a daily basis in the U.S. and other countries, and computational financial mathematics has become increasingly important in modern finance and actuarial science.

Demand for people who can apply mathematical and computational skills in financial and insurance sectors is growing rapidly, but a typical undergraduate mathematics degree may not adequately prepare a student to work effectively in a business environment that requires modern quantitative risk analysis and technical skills.

Washington State University's MS Degree in Mathematics (Computational Finance Option) prepares a graduate for work in an analytic capacity across a wide spectrum of the financial service industry-investment firms, consulting firms, insurance companies, banks, brokerage houses, government regulatory institutions, natural resource-based firms, power companies, and any large multi-national corporations with exposure to exchange rate or commodities risk.

The proposed program stems from the interdisciplinary strength of the Departments of Mathematics and Finance at WSU, and emphasizes computational financial mathematics, and problem-solving skills that dramatically increase the graduate's value to an employer. The proposed program is summarized as follows.

- The degree program combines MS level coursework in Mathematics (theories and computing/simulation) with MBA level coursework in Finance (markets, instruments, and management). The degree requires at least 31 semester credit hours, including 12 credits from financial markets and risk management, at least 15 credits in computational and statistical methods, and a 4 credit industry internship/final exam.
- A core curriculum consists of four mathematics courses in Financial Mathematics, Optimization, Stochastic Simulation. Two new courses, Math 575 (Asset Pricing in Financial Engineering) and Math 575 (Quantitative Risk Management), have been approved by the WSU Faculty Senate.
- A formal agreement between the Department of Mathematics and College of Business has been established in writing (see attached) that allows the students in this proposed program to enroll in graduate level finance courses offered at the WSU College of Business. The contact person at the College of Business is Cheryl Oliver, Director of Graduate Programs (509-335-7617, cheryl.oliver@wsu.edu).
- All the courses will be available from Fall 2013 and taught by the current mathematics and finance faculty members.
- The proposed program is expected to attract students with interests in STEM fields and financial economics.

Math Graduate Handbook Description

The Requirements for the MS in Mathematics (Computational Finance Option)

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 these goals the 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;
- practice in both professional written and oral communication;
- both group and individual projects;
- a strong computing component.

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 (http://www.gradsch.wsu.edu).

Prerequisites

All graduate students are expected to have a background in mathematics equivalent to that provided by our undergraduate degree. Ideally, this would include familiarity with the material covered in Math 401 and 402, and Math 420 and 421, and some experience with computer programming. Students with a deficient background are expected to make up these deficiencies at the earliest opportunity.

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:

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

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

Transfer Credit

Up to eight hours of transfer credit may be given for suitable course work done elsewhere.

The Program of Study

A Program of Study must be submitted by the deadlines indicated in Section 3. It is however suggested that this be done in the second semester of graduate work. The appropriate form is available at the Graduate School Office or may be downloaded from its web site.

The MS Examination

Each MS student must pass a final oral examination that covers all of the student's course work, and includes an oral presentation on the results of the student's Math 702 individual project (see 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 §3. The student's advisory committee will conduct this examination.

The Application for Degree

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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 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.

REVISED

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Math 575: Asset Pricing in Financial Engineering

Course Name: Asset Pricing in Financial Engineering

Instructor: Dr. Hong-Ming Yin
303 Neill Hall, WSU Pullman Campus
Telephone: (509)335-7263. Email: hyin@wsu.edu

Course Objective: This course will introduce basic tools to derive various asset pricing models such as stocks and security options. It will also introduce the basic hedging techniques by using options in financial markets. One of the fundamental elements for this course is that the rigorous mathematical analysis is used throughout the course. Particularly, various models for option prices of stocks and index will be derived.

Familiar with Advanced Calculus is desired, some knowledge on Differential Equations (Math 315) is preferred, but not required.

Credits of the Course: 3 credits.

Textbook: There is no single text book for this course. This course will be based on materials from several textbooks. Major topics contain

(a) Valuation of stocks.
(b) Valuation of options by binomial tree methods.
(c) Valuation of options by continuous stochastic differential equations.
(d) Solution Formulas for European Options and American Options.
(e) Numerical methods for Computing option pricing.
(f) Hedging techniques and asset Management.

The main reference books are as follows:

(1) The mathematics of Finance: Modeling and Hedging,
Edited by: Joseph Stampfli and Victor Goodman, The Brook/Cole Publishing, 2001.
(2) Mathematical Modeling and Methods of Option Pricing,
Edited by: Lishang Jiang, World Scientif Publishing, 2006.
(3) Valuing a Stock, second edition
Edited by G. Gray, P. J. Cusatis and J. Woolridge, McGraw-Hill, 2004.

Course Grade:

There are five homework assignments with 10 points each. Each homework assignment will consist of some proofs and some computations. A final project will be worthy 50 points. The final grade will be based on Homework assignments and a project. Project topics will be designed from the materials covered in the course. The students will be given the choice to select a topic and conduct some self-reading and research for the selected topic. One example is to determine option price for an index if some conditions and assumptions are given.

The final grade will be as follows:

A (92%-100%),A-(86%-91%),B+(81%-85%),B(76%-80%),B-(70%-75%),C+(65%-69%),C(61-64%),C-(56%-60%),D(50%-55%), F (< 50%).

Other University Policies.

(a) **Academic Integrity**
The Department of Mathematics and WSU are intolerant of **any form** of academic dishonesty. For information, see: http://www.conduct.wsu.edu/default.asp?PageID=343 also
see: http://www.wsulibs.wsu.edu/plagiarism/main.html

(b) **WSU Disability Statement**

Reasonable accommodations are available for students with a documented disability. If you have a disability and may need accommodations to fully participate in this class, please visit the Access Center (Washington Building 217) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center.

(c) **WSU Safety**

Please familiarize yourself with information regarding campus emergencies/school closings by visiting this website: http://oem.wsu.edu/emergencies

Timeline for the course Math 575.

	Major Topics
Week 1	Interest Rate and Money Market
Week 2	Bonds and Fixed Income Models
Week 3	Arbitraging and Hedging, Game theory
Week 4	Security valuation Models: Value and Growth
Week 5	Discounted Cash-flash model
Week 6	Security option pricing models: Binomial tree Method for European option-pricing
Week 7	Binomial tree method for American option-Pricing.
Week 8	Brownian motion and Ito integration
Week 9	Continuous Option-Pricing Model for European options
Week 10	Numerical Methods for Solutions of European Options
Week 11	Properties of European Option Prices.
Week 12	Continuous Model for American option-Pricing models
Week 13	Optimal Exercise strategy
Week 14	Numerical Solutions for American option pricing model
Week 15	Asian Option and other exotic option models

MATH 576: Quantitative Risk Management (3 credits)

Instructor: **Dr. Haijun Li**
Office Locations: Neill 217
Phone: (509) 335-5279
Email: lih@math.wsu.edu
Office hours: by appointment (contact me to arrange day & time)

Required Textbook

McNeil, A.J., Frey, R. and Embrechts, P., 2005: ***Quantitative Risk Management,*** Ch 1~7, Princeton University Press, New Jersey

Course Purpose

This course provides an introduction to fundamental concepts in modern risk theory and mathematical methods in quantitative risk management. Although some concepts and methods covered in this course can be applied to managing risks in other areas, this course focuses on risk analysis and management in finance and insurance.

Course Contents

This course covers basic concepts in financial risk management, stylized facts of risky assets, coherent risk measures, stochastic models of risk factors, volatility modeling, risk estimation, multivariate dependence analysis using copulas, risk aggregation and allocation, extreme value theory, tail risk analysis.

Week-to-Week Course Outline

Week1: Loss distribution and risk factors
Week2: Stylized facts of risky assets and stochastic models of risk factors
Week3: Multivariate modeling and normal mixture distributions
Week4: Elliptical distributions
Week5: Copulas and basic properties
Week6: Dependence measures and tail dependence functions
Week7: Archimedean copulas
Week8: Fitting copulas to financial data
Week9: Coherent risk measures and their dual representations
Week10: Value-at-risk and tail conditional expectations
Week11: Risk aggregation and allocation
Week12: Generalized extreme value distributions and maximum domain of attraction
Week13: The Hill estimation for heavy tail index
Week14: Extreme value copulas and tail risk.
Week15: Fitting a multivariate tail risk model

Learning Outcomes

Students will be able to (1) have a broader view on the relevant theoretical literature on

financial risk management; (2) acquire state-of-the-art quantitative techniques for modeling financial risk factors and managing financial risk; (3) use an open source software to get hands-on experience with real financial data.

Grade Breakdown

Homework assignments	30%
Midterm Exam	20%
Projects	30%
Final exam	20%
	100%

Grade Distribution

A	93-100%	C	71-74
A$^-$.....	89-92	C$^-$	68-70
B$^+$.....	85-88	D$^+$.....	65-67
B	81-84	D	60-64
B$^-$	78-80	F	< 60
C$^+$.....	75-77		

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Gmail by Google

Haijun Li <haijun.li@gmail.com>

Fwd: Computational Finance

Oliver, Cheryl A <cheryl.oliver@wsu.edu> Fri, May 25, 2012 at 5:24 PM
To: "K. A. Ariyawansa" <ari@math.wsu.edu>
Cc: "Lai, Gene C" <genelai@wsu.edu>, Haijun Li <lih@math.wsu.edu>, "Manoranjan, Valipuram S" <mano@wsu.edu>, "Pietz, Valeria Nicoli" <vpietz@wsu.edu>, "Sprott, David Eric" <dsprott@wsu.edu>

Dear Ari,

I am sorry for the delay in reply. We will be pleased to allow your students to enroll in our graduate level finance courses as long as they are in good standing in the MS in Computational Finance and meet the pre-requisite requirements of the courses in Finance. Please let me know if you need specific information about the pre-requisites.

I do want to be very transparent about our ability to consistently offer the courses listed in Finance at a rate that will allow people to complete the program within 12 months of full-time studies. Can you tell me whether this is expected to be an online or face:face program?

At this time, we are not offering the MBA program in Pullman (where we would at least be consistently offering FIN 526 on an annual basis). We intend to re-open the MBA in Pullman in Fall 2013.

We are offering the MBA Online and FIN 526 and FIN 581 are available with 2 additional finance electives to be offered in the coming year. However, we only offer the FIN 526 course every 22 months. The courses we consider possible MBA program electives are FIN 527, FIN 581, FIN 528 and FIN 521. Three of these will be offered online on a semi-regular basis each spring and every other summer (one elective class per respective term) starting May of 2013.).

The FIN 525 course has been used as a foundation course (to count for Finance 325 MBA pre-requisite) for the program and is likely not going to be offered in Pullman or online specific to the MBA.

None of the Finance courses listed in the proposal are offered as part of our PhD program.

Many thanks,
Cheryl

From: K. A. Ariyawansa [mailto:ari@math.wsu.edu]