2013-2014 LONG SIGNATURE SHEET

UNC CHARLOTTE

Proposal Number: FINN 10-01-13

Proposal Title: Major Changes to MSMF Program of Study

Originating Department: Finance

TYPE OF PROPOSAL: UNDERGRADUATE_____ GRADUATE__√__ UNDERGRADUATE & GRADUATE____
(Separate proposals sent to UCCC and Grad. Council)

DATE RECEIVE	DATE CONSIDERED	DATE FORWARDED	ACTION	SIGNATURES
10/01/2013	10/01/2013	10/26/2013	Approved	**DEPARTMENT CHAIR** [print name here:] Tao-Hsien Dolly King
10/26/2013	11/4/2013	11/6/2013	Approved	**COLLEGE CURRICULUM COMMITTEE CHAIR** [print name here:] Alan Blankley
12/2/2013	12/6/2013	12/6/2013	Approved	**COLLEGE FACULTY CHAIR (if applicable)** [print name here:] Rob Roy McGregor
12/6/13	12/6/13	12/6/13	Approved	**COLLEGE DEAN** [print name here:] Steven H. Ott
			Approved	**GENERAL EDUCATION** (if applicable; for General Education courses) [print name here:]
			Approved	**UNDERGRADUATE COURSE & CURRICULUM COMMITTEE CHAIR** (for undergraduate courses only)
12-9-13	1-14-14	2-10-14	Approved	**GRADUATE COUNCIL CHAIR** (for graduate courses only) ALAN R. FREITAG
				FACULTY GOVERNANCE ASSISTANT (Faculty Council approval on Consent Calendar)
				FACULTY EXECUTIVE COMMITTEE (if decision is appealed)

UNC CHARLOTTE

LONG FORM
COURSE AND CURRICULUM PROPOSAL

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*To: Belk College Graduate Council

From: Department of Finance

Date: October 26, 2013

Re: Major Changes to MSMF Program of Study

The Long Form is used for major curriculum changes. Examples of major changes can include: creation of a new major, creation of a new minor, creation of a new area of concentration, or significant changes (more than 50%) to an existing program (Note: changing the name of an academic department does not automatically change the name(s) of the degree(s). The requests must be approved separately by the Board of Governors.)

Submission of this Long Form indicates review and assessment of the proposed curriculum changes at the department and collegiate level either separately or as part of ongoing assessment efforts.

University of North Carolina at Charlotte

Revised Graduate Program of Study

Proposal from: Department of Finance

Title: **Major Changes to Master of Science in Mathematical Finance Program of Study**

I. PROPOSAL

A. PROPOSAL SUMMARY AND CATALOG COPY

1. PROPOSAL SUMMARY

The Department of Finance proposes the following changes to the Master of Science in Mathematical Finance (MSMF) Program and establishes three MSMF Concentrations.

1.1 Changes to "Total hours required"

From: "A minimum of thirty hours of coursework beyond the bachelor's degree is required to earn the degree. The student must complete the required 24 hours from the program core and 6 hours of approved electives."

To: "A minimum of thirty hours of coursework beyond the bachelor's degree is required to earn the degree. The student must complete the required six program core courses and four concentration courses corresponding with the selected concentration."

1.2 Changes to "The Program Core"

a. Remove the following two courses from "The Program Core" section:

MATH 6202 Derivatives II: Partial Differential Equations for Finance (3)
MATH 6204 Numerical Methods for Financial Derivatives (3)

b. Modify the program core course "MATH 6201 or ECON 6113" as follows:

From: MATH 6201 Statistical Techniques for Finance (3) -OR- ECON 6113 Cross-Section and Time Series Econometrics (3)

To: STAT 6113/ECON 6113 Cross-Section and Time Series Econometrics (3)

c. Modify course titles and descriptions of FINN 6210, FINN 6211, and MATH 6203

From: FINN 6210 Derivatives I: Financial Elements of Derivatives (3)

FINN 6210. Derivatives I: Financial Elements of Derivatives. (3) Prerequisite: FINN 6152 or equivalent, or permission of Department. Theory and practice of financial derivatives markets including forwards, futures, and options markets. Topics include: the economics of derivatives markets, pricing models for instruments in these markets, strategies for hedging and speculation, as well as regulatory and governance issues. *(On demand)*

To: FINN 6210 Financial Elements of Derivatives (3)
FINN 6210. Financial Elements of Derivatives. (3) Prerequisite: FINN 6152 or equivalent, or permission of Department. This course examines the nature and functions of futures and options markets. Topics include hedging for risk reduction and the role of derivative instruments in the capital markets. The course focuses on basic pricing techniques which are derived from no arbitrage relations. (*On demand*)

From: FINN 6211 Risk Management and Fixed Income Derivatives (3)
FINN 6211. Risk Management and Fixed Income Derivatives. (3) Prerequisite: FINN 6210 or permission of Department. Risk management of fixed income portfolios as well as the theory and practice of fixed income markets. Topics include fixed income instruments, term structure models, pricing methods, portfolio management, duration and convexity, securitization, and hedging. (*On demand*)

To: FINN 6211 Fixed Income Securities and Credit Risk (3)
FINN 6211. Fixed Income Securities and Credit Risk. (3) Prerequisite: FINN 6210 or permission of Department. This course studies fixed income securities and portfolios as well as the theory and practice of fixed income markets. Topics include fixed income instruments and sectors, duration and convexity, term structure of interest rates, securitization, portfolio management, hedging, and credit risk. (*On demand*)

From: MATH 6203 Stochastic Calculus for Finance (3)
MATH 6203. Stochastic Calculus for Finance. (3) An introduction to those aspects of partial differential equations and diffusion processes most relevant to finance, Random walk and first-step analysis, Markov property, martingales and semi-martingales, Brownian motion. Stochastic differential equations: Ito's lemma, backward and forward Kolmogorov equations, the Feynman-Kac formula, stopping times, Hull and White Models, Cox-Ingersoll-Ross Model. Applications to finance including portfolio optimization and option pricing.

To: MATH 6203 Stochastic Calculus for Finance I (3)
MATH 6203. Stochastic Calculus for Finance I. (3) Prerequisite: Admission to Graduate Program and Permission of Program Director. This course starts with the probability theory in discrete probability space, discrete-time stochastic processes, and derivatives pricing in the Binomial model. The second part covers probability theory in general probability space and continuous-time martingale and Markov processes. Topics include the It'o integral, Black-Scholes model, It'o-Doeblin formula, Girsanovs theorem, and Martingale Representation theorem. Applications to pricing of exotic derivatives and American options are discussed.

d. Modify course description of FINN 6203

From: FINN 6203 Financial Economic Theory (3)
FINN 6203. Financial Economic Theory. (3) Cross-listed as ECON 6203. Prerequisites: Admission to Graduate Program and Permission of program director. Review of financial

economic theory using discrete-time models. Topics include: risk measurement; choices under uncertainty; portfolio selection; capital asset pricing model (CAPM); Arrow-Debreu pricing; options and market completeness; the Martingale measure; arbitrage theory; consumption-based CAPM; and valuation of the firm. *(On demand)*

To: FINN 6203 Financial Economic Theory (3)
FINN 6203. Financial Economic Theory. (3) Cross-listed as ECON 6203. Prerequisite: Admission to Graduate Program and Permission of Program Director. This course offers the fundamental principles of risk pricing and risk allocation in a unified framework. Discrete-time model is employed to underscore the relationship between the techniques used in finance and the economic analysis of risk. The objective is to understand the economics of asset pricing and how derivatives and options are used in practice and their limitations. *(On demand)*

e. FINN/ECON 6219 Financial Econometrics remains to be one of the core courses and no changes are made to this course.

1.3 Remove the "Approved Mathematical Finance Electives" section title and all listed courses.

1.4 Establish three concentrations in the program: (1) "Computational Finance" Concentration, (2) "Risk Management" Concentration, and (3) Financial Data Analytics.

Add "Concentrations" section immediately after "The Program Core" section:

"**Concentrations**
The program offers three concentrations leading to a Master of Science in Mathematical Finance Degree. Students who plan to pursue careers in quantitative modeling and pricing analysis are encouraged to elect the Computational Finance Concentration. Students planning to pursue a career in risk management and insurance are encouraged to pursue the program with the Risk Management Concentration. Students interested in a career in financial data analysis and applications are encouraged to elect the Financial Data Analytics concentration.

Computational Finance Concentration
In addition to the six courses specified in "The Program Core" section, the following four courses are required for a Master of Science in Mathematical Finance Degree with a Computational Finance Concentration.

MATH 6204 Numerical Methods for Financial Derivatives (3)
MATH 6205 Financial Computing (3)
MATH 6206 Stochastic Calculus for Finance II (3)
FINN 6212 Advanced Financial Derivatives (3)

Risk Management Concentration

In addition to the six courses specified in "The Program Core" section, the following four courses are required for a Master of Science in Mathematical Finance Degree with a Risk Management Concentration.

FINN 6213 Risk Management and Financial Institutions (3)
FINN 6214 Asset and Portfolio Management (3)
FINN 6215 Risk Management in Insurance Companies (3)
FINN 6216 Quantitative Risk Management (3)"

Financial Data Analytics Concentration
In addition to the six courses specified in "The Program Core" section, the following four courses are required for a Master of Science in Mathematical Finance Degree with a Financial Data Analytics Concentration.

ECON 6217 Advanced Microeconometrics (3)
ITCS 6114 Algorithm and Data Structures (3)
ITCS 6160 Database Systems (3) OR ITIS 5160 Applied Databases
MBAD 6201 Business Intelligence and Analytics (3)"

1.5 Add six new courses associated with the three concentrations:

MATH 6206 Stochastic Calculus for Finance II (3)
MATH 6206. Stochastic Calculus for Finance II. (3) Prerequisite: MATH 6203 or permission of Department. This course focuses on the applications of stochastic calculus techniques to advanced financial modeling. Topics include pricing of European, American and fixed-income derivatives in the Black-Scholes and stochastic volatility models. The Jump-diffusion model will also be introduced. (*On demand*)

FINN 6212 Advanced Financial Derivatives (3)
FINN 6212. Advanced Financial Derivatives. (3) Prerequisite: FINN 6210 or permission of Department. The course covers multi-factor derivative pricing models. Topics include the discrete-time and discrete-state models, Ito processes, relevant topics on stochastic calculus, Risk Neutral Valuation, and review of the Black-Scholes model. Additional topics include commodity pricing models, stochastic volatility models, multi-period discrete-time (GARCH) models, and the interest rate models such as the Vasicek and CIR models. (*On demand*)

FINN 6213 Risk Management and Financial Institutions (3)
FINN 6213. Risk Management and Financial Institutions. (3) Prerequisite: FINN 6203 or permission of Department. This course describes the following: how market risk, credit risk and operational risk are quantified; Basel II regulatory framework; estimation of aggregate economical capital; calculation and use of RAROC; and recent bank risk management tools: back test, CCAR and Dodd-Frank proposals. It will also address recent big losses that have occurred in financial markets and how they can be avoided. (*On demand*)

FINN 6214 Asset and Portfolio Management (3)

FINN 6214 Asset and Portfolio Management. (3) Prerequisite: FINN 6203 or permission of Department. This course provides students with a foundation in investments and portfolio management from the perspective of an institutional investor. Particular attention will be given to the issues associated with managing assets of an insurance company. Topics include: measuring and modeling return and risk, expected return models, information ratio, valuation theory and practice, forecasting, portfolio construction, transaction costs, turnover and trading, performance analysis, asset allocation, securities analysis, and the legal and regulatory landscape of institutional investing. (*On demand*)

FINN 6215 Risk Management in Insurance Companies (3)
FINN 6215 Risk Management in Insurance Companies. (3) Prerequisite: FINN 6203 or permission of Department. This course examines the operations and risks of an insurance firm and how to evaluate and manage those operations and risks in a dynamic business environment. The following topics are covered: 1. The role of insurance firms within the financial services industry, 2. The functions of insurance firms with emphasis on operations unique to insurers, 3. Insurer financial and risk management in the complex regulatory environment and 4. Financial and strategic analysis of insurance firms. (*On demand*)

FINN 6216 Quantitative Risk Management (3)
FINN 6216. Quantitative Risk Management. (3) Prerequisite: FINN 6203 or permission of Department. This course offers the quantitative techniques and tools for the risk management. It starts with the basic concepts and methodologies. Topics include risk measures such as VaR and Expected Shortfall, univariate and multivariate models, copulas and tail dependence in risk management framework, and back testing. This course also discusses how to estimate VaR and Expected Shortfall parametrically, semi parametrically and non-parametrically. (*On demand*)

2. Proposed Catalog Copy (see Attachment 3)

B. JUSTIFICATION

1. Identify the need addressed by the proposal and explain how the proposed action meets the need.

The Department of Finance and the MSMF Committee, within the Belk College of Business, faced the following issues in 2012-2013.

a. **Changing needs**: Since the inception of the MSMF program 10 years ago, no revision has been made to reflect significant changes in the global and domestic businesses and financial markets. In particular, after the start of the financial crisis in 2007-2008, the financial industry and the demand for workforce have dramatically changed. It is important to respond to the changing needs of the business community. It is also important to design a curriculum that incorporates the upcoming trends in the future. The proposal contains significant revisions to the curriculum structure and an establishment of three concentrations. We believe that, with this curriculum proposal,

we have taken an instrumental step in developing one of the most updated and forward-looking MSMF computational finance programs in the world.

b. A compelling curriculum to attract the best students: Given the highly competitive market we need to create an exciting and compelling curriculum to attract the best students in the world. We should define our vision with future trends in mind and reflect the vision in the curriculum. Charlotte is the second largest financial center in the world. Many well-known financial institutions, e.g., Bank of America, Wells Fargo, and BB&T, are headquartered or have heavy presence in Charlotte. We need to consider this regional advantage when designing a cutting-edge curriculum.

One of UNC Charlotte's major goals as an ``urban research university" is to ``respond to regional needs and contributes to the economic needs to be relevant to the region." This proposed curriculum was mainly driven by external needs, as expressed by several executives in the financial industry. We believe that the proposed changes make our curriculum most relevant and forward-looking and help us better ``respond to regional needs and contributes to the economic needs of the region."

c. **Revisions made to "Program Core":** There are two areas in the MSMF program that can be improved to reflect the market demand in mathematical finance area. The first area is the knowledge of derivatives. The second one is the quantitative methods that serve as important tools in the field of mathematical finance. In the proposed curriculum, we make significant changes related to these areas.

First, to strengthen students' knowledge of derivatives, we create a new required program core course based on a special topics course previously offered as FINN 6058 "Special Topics in Financial Services" on advanced derivatives. The course number and title is FINN 6212 "Advanced Financial Derivatives." See **Attachment 4** for course syllabus.

The revised titles and course contents of core courses (FINN 6210, FINN 6211, MATH 6201 and MATH 6203) are designed to accurately reflect the updated content of the courses. The revised description of FINN 6203 more accurately reflects the current content of the course. See **Attachment 5** for revised course syllabus.

Second, revision is made to offer efficiency to students by reducing overlapping materials among courses. Since a significant portion of the materials in MATH 6202 have been covered in MATH 6203, we remove this course from the list of core courses.

In addition, we make changes to maintain consistency in program structure and to allow for feasible scheduling of courses across three departments in this multidisciplinary program. In particular, we remove MATH 6201 as an alternative course to ECON 6113. ECON 6113 is proposed to be cross-listed with STAT 6113, with both courses having the same title and description. We move MATH 6204 from the "Program Core" to the concentration courses for the Computational Finance Concentration because it provides the quantitative techniques most suitable for this concentration. We remove

the "Approved Mathematical Finance Electives" section and all listed courses to correspond to the new program structure with three concentrations. Students are required to complete six program core courses plus four concentration courses associated with the concentration selected.

d. **Establishment of three concentrations:** We create three concentrations in the program to best address the needs of the market trends and demands as discussed above. In particular, the Computational Finance Concentration is designed for students who are interested in quantitative modeling and analysis. A new course is introduced in this concentration, MATH 6206 "Stochastic Calculus for Finance II," with the purpose to discuss more advanced mathematical and quantitative tools. In this new concentration course, the students will learn stochastic calculus and its implications for finance in a continuous-time framework. This course serves as the appropriate advanced course following MATH 6203 that focuses on stochastic calculus and its implication for finance in a discrete-time framework. The Risk Management Concentration addresses the needs of the business community for qualified students with a strong background in quantitative finance and in-depth knowledge of risk management. Four new courses are introduced in this concentration. Finally, the Financial Data Analytics Concentration fits well with the timely challenge of corporations in analyzing the massive consumer/financial data. Four existing courses are included in this concentration.

2. **Discuss prerequisites/corequisites for course(s) including class-standing, admission to the major, GPA, or other factors that would affect a student's ability to register.**

   Students complete the same prerequisite before entering the program, regardless of the concentration selected.

3. **Demonstrate that course numbering is consistent with the level of academic advancement of students for whom it is intended.**

   All new proposed courses are at the 6000-7999 level, which is designated for Master-Level Courses. Therefore, course numbering in the proposal is consistent with the level of academic advancement of students for whom it is intended.

4. **In general, how will this proposal improve the scope, quality and/or efficiency of programs and/or instruction?**

   Charlotte is one of the largest financial centers in the world and the entire financial markets have experienced significant changes in market dynamics, regulatory and risk management requirements. There are substantial market demands for students with strong backgrounds in computational finance, risk management, and financial data analytics areas. We believe developing these three concentrations in the MSMF program is both strategic and timely as it is widely accepted that these three areas are keys to a well-functioning corporation and the financial industry as a whole. Many financial institutions are facing well-documented shortages of well-trained graduate students in these areas.

C. IMPACT.

1. **What group(s) of students will be served by this proposal? (Undergraduate and/or graduate; majors and/or non-majors, others? Explain). Describe how you determine which students will be served.**

   The changes will impact the students in the master science of mathematical finance program. The new courses offered will be open to other graduate students from the Department of Economics and Department of Mathematics and Statistics.

2. **What effect will this proposal have on existing courses and curricula?**
   a. When and how often will added course(s) be taught?

   The added new courses MATH 6206, FINN 6212, FINN 6213, FINN 6214, and FINN 6215 will be offered once a year. The added existing courses ITIS 5160/ITCS 6160, ITCS 6114, and MBAD 6201 are offered twice a year.

   b. How will the content and/or frequency of offering of other courses be affected?

   The scheduling and content of courses not previously included in the program are not affected by the proposal. The original elective courses that are removed from the program will not be affected by this proposal.

   c. What is the anticipated enrollment in course(s) added (for credit and auditors)?

   Based on past enrolment experience, it is anticipated that the student enrollment in the new courses will be between 25 and 35.

   d. How will enrollment in other courses be affected? How did you determine this?

   For the same reason as specified in both (b) and (c), it is expected that the enrollment in other courses will not be noticeably affected.

   e. Identify other areas of catalog copy that would be affected, including within other departments and colleges (e.g., curriculum outlines, requirements for the degree, prerequisites, articulation agreements, etc.)

   The revised catalog copy can be found in **Attachment 3**. Catalog entries of other programs are not affected by this proposal.

   The student learning outcomes (SLOs) will be not be affected by this proposal.

II. RESOURCES REQUIRED TO SUPPORT PROPOSAL.

A. PERSONNEL

1. HIRING:

No new faculty members are needed for the Computational Finance and Financial Analytics Concentrations.

Department of Finance plans to recruit for the Harris Chair in Risk Management and Insurance in 2013-2014. This new faculty member will be heavily involved in the Risk Management Concentration given his/her expertise in this area. In addition, there is a great pool of qualified financial practitioners in the Charlotte area who are excellent candidates as part-time instructors to cover the new courses in the Risk Management Concentration.

2. **Qualified faculty members scheduled to cover the new courses**

FINN 6212	Advanced Financial Derivatives	Keener Hughen
FINN 6213	Risk Management and Financial Institutions	Harris Chair or Part-time Instructor
FINN 6214	Asset and Portfolio Management	Harris Chair or Part-time Instructor
FINN 6215	Insurance Risk Management	Faith Neale
FINN 6216	Quantitative Risk Management	Weidong Tian
MATH 6206	Stochastic Calculus for Finance II	Mingxin Xu

B. PHYSICAL FACILITY.

Current facilities are adequate.

C. EQUIPMENT AND SUPPLIES:

Current equipment and supplies are adequate.

D. COMPUTER.

Current computer resources are adequate.

E. AUDIO-VISUAL.

Current audio and visual resources are adequate.

F. OTHER RESOURCES.

No applicable

G. SOURCE OF FUNDING

No applicable

III. CONSULTATION WITH THE LIBRARY AND OTHER DEPARTMENTS OR UNITS

A. **LIBRARY CONSULTATION**. Indicate written consultation with the Library Reference Staff at the departmental level to ensure that library holdings are adequate to support the proposal prior to its leaving the department. (Attach copy of ***Consultation on Library Holdings***).

B. **CONSULTATION WITH OTHER DEPARTMENTS OR UNITS**

We have consulted with the Department of Mathematics and Statistics regarding possible enrollment of MSMF students in MATH 6203, MATH 6204, MATH 6205 and MATH 6206. We have consulted with the Department of Economics about possible enrollment of MSMF students in ECON 6113 and ECON 6217. We have consulted with the Department of ITCS regarding possible enrollment of MSMF students in ITIS 5160/ITCS 6160 and ITCS 6114. We have consulted with the Department of BISOM regarding the inclusion of MBAD 6201.

IV. INITIATION, ATTACHMENTS AND CONSIDERATION OF THE PROPOSAL

A. **ORIGINATING UNIT**

Master Science of Mathematical Finance Program Committee, Belk College of Business, University of North Carolina at Charlotte. The committee members, including Steven Clark, Dolly King, Mingxin Xu, Hwan Lin, and Weidong Tian (Program Director), recommended this proposal on April 25, 2013.

B. **ATTACHMENTS**

Attachment 1: Library Consultation
Attachment 2: Departmental Consultations
Attachment 3: Proposed Catalog Copy
Attachment 4: Course Syllabi for Proposed New Courses
Attachment 5: Course Syllabi for Courses with Significant Content Changes

ATTACHMENT 1. Library Consultations

UNCCHARLOTTE
J. Murrey Atkins Library

Consultation on Library Holdings

To: Dr. Dolly King

From: Nicole Spoor

Date: September 26, 2013

Subject: MATH 6206 Stochastic Calculus for Finance II

Summary of Librarian's Evaluation of Holdings:

Evaluator: Nicole Spoor, Business Librarian **Date:** September 26, 2013

Please Check One:

1. Holdings are superior ☐
2. Holdings are adequate ☒
3. Holdings are adequate only if dept. purchases additional items ☐
4. Holdings are inadequate ☐

Comments:
As the proposed course would require limited literature searching, library resources should be adequate to support student work. Students who would like to access materials to supplement their classwork for this course will have access to books on the subject and relevant electronic resources such as Business Source Complete.

After an evaluation of Atkins Library resources with regards to journals, databases, and circulating books that are relevant to the establishment of the course, Stochastic Calculus for Finance II, it is found that the library's resources are sufficient to support this course.

Evaluator's Signature: Nicole Spoor, Business Librarian, Atkins Library

Date: September 26, 2013

UNCCHARLOTTE
J. Murrey Atkins Library

Consultation on Library Holdings

To: Dr. Dolly King

From: Nicole Spoor

Date: September 26, 2013

Subject: FINN 6212 Advanced Financial Derivatives Course Proposal

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Summary of Librarian's Evaluation of Holdings:

Evaluator: Nicole Spoor, Business Librarian **Date:** September 26, 2013

Please Check One:

1. Holdings are superior ☐
2. Holdings are adequate ☒
3. Holdings are adequate only if dept. purchases additional items ☐
4. Holdings are inadequate ☐

Comments:

After an evaluation of Atkins Library resources with regards to journals, databases, and circulating books that are relevant to the establishment of the course, Advanced Financial Derivatives, it is found that the library's resources are sufficient to support this course.

Evaluator's Signature: Nicole Spoor, Business Librarian, Atkins Library

Date: September 26, 2013

UNCCHARLOTTE
J. Murrey Atkins Library

Consultation on Library Holdings

To: Dr. Dolly King

From: Nicole Spoor

Date: September 26, 2013

Subject: FINN 6213 Risk Management and Financial Institutions

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Summary of Librarian's Evaluation of Holdings:

Evaluator: Nicole Spoor, Business Librarian **Date:** September 26, 2013

Please Check One:

1. Holdings are superior ☐
2. Holdings are adequate ☒
3. Holdings are adequate only if dept. purchases additional items ☐
4. Holdings are inadequate ☐

Comments:

After an evaluation of Atkins Library resources with regards to journals, databases, and circulating books that are relevant to the establishment of the course, Risk Management and Financial Institutions, it is found that the library's resources are sufficient to support this course.

Evaluator's Signature: Nicole Spoor, Business Librarian, Atkins Library

Date: September 26, 2013

UNCCHARLOTTE
J. Murrey Atkins Library

Consultation on Library Holdings

To: Dr. Dolly King

From: Nicole Spoor

Date: September 26, 2013

Subject: FINN 6214 Asset and Portfolio Management

Summary of Librarian's Evaluation of Holdings:

Evaluator: Nicole Spoor, Business Librarian **Date:** September 26, 2013

Please Check One:

1. Holdings are superior ☐
2. Holdings are adequate ☒
3. Holdings are adequate only if dept. purchases additional items ☐
4. Holdings are inadequate ☐

Comments:

After an evaluation of Atkins Library resources with regards to journals, databases, and circulating books that are relevant to the establishment of the course, Asset and Portfolio Management, it is found that the library's resources are sufficient to support this course.

Evaluator's Signature: Nicole Spoor, Business Librarian, Atkins Library

Date: September 26, 2013

UNCCHARLOTTE
J. Murrey Atkins Library

Consultation on Library Holdings

To: Dr. Dolly King

From: Nicole Spoor

Date: September 26, 2013

Subject: FINN 6215 Risk Management in Insurance Companies

Summary of Librarian's Evaluation of Holdings:

Evaluator: Nicole Spoor, Business Librarian **Date:** September 26, 2013

Please Check One:

1. Holdings are superior ☐
2. Holdings are adequate ☒
3. Holdings are adequate only if dept. purchases additional items ☐
4. Holdings are inadequate ☐

Comments:

After an evaluation of Atkins Library resources with regards to journals, databases, and circulating books that are relevant to the establishment of the course, Risk Management in Insurance Companies, it is found that the library's resources are sufficient to support this course.

Evaluator's Signature: Nicole Spoor, Business Librarian, Atkins Library

Date: September 26, 2013

UNC CHARLOTTE
J. Murrey Atkins Library

Consultation on Library Holdings

To: Dr. Dolly King

From: Nicole Spoor

Date: September 26, 2013

Subject: FINN 6216 Quantitative Risk Management

Summary of Librarian's Evaluation of Holdings:

Evaluator: Nicole Spoor, Business Librarian **Date:** September 26, 2013

Please Check One:

1. Holdings are superior ☐
2. Holdings are adequate ☒
3. Holdings are adequate only if dept. purchases additional items ☐
4. Holdings are inadequate ☐

Comments:

After an evaluation of Atkins Library resources with regards to journals, databases, and circulating books that are relevant to the establishment of the course, Quantitative Risk Management, it is found that the library's resources are sufficient to support this course.

Evaluator's Signature: Nicole Spoor, Business Librarian, Atkins Library

Date: September 26, 2013

Attachment 2
Departmental Consultations

UNC CHARLOTTE
The University of North Carolina at Charlotte
9201 University City Boulevard
Charlotte, NC 28223-0001

Fax: 704/687-6415
E-Mail: math@uncc.edu

Department of Mathematics & Statistics
704/687-2580

Memorandum

To: Dr. Dolly King, Chair, Department of Finance

From: Dr. Yuanan Diao, Chair, Department of Mathematics and Statistics

Subject: Consultation Regarding Proposal FINN 09-16-13 titled "Major Changes to MSMF Program of Study"

Date: September 23, 2013

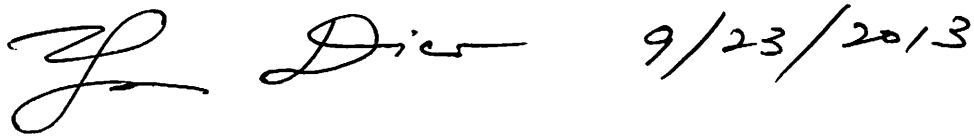
Thank you for consulting with the Department of Mathematics and Statistics on the major changes in our joint Master's Program in Mathematical Finance. The proposed changes are the results of joint efforts from faculty members from Economics, Finance and Mathematics and Statistics Departments. I have consulted with faculty members from my department who are involved with the MSMF program. It is my understanding that the proposed changes will bring our MSMF program up to date and will better prepare our students for today's job market. Our department fully supports these proposed changes. Please let me know if you need further assistance.

In the current MSMF program, the core courses offered by the Math Dept include MATH 6201, MATH 6202, MATH 6203, MATH 6204 and MATH6205. MATH 6204 is covered by Dr. Lin from the ECON Dept. In return, a faculty member from the Math Dept taught ECON 6113 (which is a statistics course in nature). In the proposed new MSMF program, MATH 6201 and MATH 6202 are removed, MATH 6203 will be modified, MATH 6204 and MATH 6205 are retained and a new course MATH 6206 (Stochastic Calculus for Finance II) will be added. A new listing (not a new course) STAT 6113 will be created: it will be cross-listed with ECON 6113 (with identical title and syllabus) and will be taught by Dr. Yang Li from the Math Dept in the spring semesters (ECON 6113 will be taught by an ECON faculty member in the fall semesters). Dr. Lin from the Econ Dept will continue covering MATH 6204.

In the current MSMF program, 4 additional Mathematics courses are listed as electives. These are MATH5128, MATH5129, MATH5143 and MATH5171. All of these are removed in the proposed new program, as the entire electives are replaced by 3 concentration tracks. These new tracks will enable students to develop in an area of their interest and strength and are much better structured and designed. The removal of these courses from the elective list will not affect the

offering of these courses in the Math Dept as these courses are mainly for graduate students in the master's and doctoral programs of the Math Dept.

The total number of core and concentration courses offered by the Math Dept remains the same under the new proposal and the resources needed to cover these courses do not increase. The Math Dept has been authorized to recruit two tenure track faculty members, one each in the areas of statistics and mathematical finance. These new hires will offset the deficit created by the retirement and resignation of two Math Dept faculty members involved in the MSMF program. Thus the Math Dept will have enough resources to cover its share of courses under the new proposal.



9/23/2013

UNC CHARLOTTE
BELK COLLEGE *of* BUSINESS

9201 University City Blvd, Charlotte, NC 28223-0001
t/ 704.687.7577 f/ 704.687.4014 www.belkcollege.uncc.edu

Memorandum

To: Dr. Dolly King, Chair, Department of Finance

From: Dr. Jennifer Troyer, Chair, Department of Economics

Subject: Consultation Regarding Proposed Changes to the Mathematical Finance Program of Study

Date: September 25, 2013

Thank you for consulting with the Department of Economics regarding the proposed changes to the Mathematical Finance program.

There are three main changes that are relevant to the Department of Economics. The first key change is to remove MATH 6201 and replace it with a cross-listed version of the ECON 6113 course. The new course will be STAT 6113. This change will allow the Department of Economics and the Department of Mathematics and Statistics to share in the responsibility of offering this core course in Fall and Spring. Faculty from Economics who have taught ECON 6113 and I are in favor of this change, as it will provide students with a more consistent background in econometrics. The second key change is to eliminate the set of Approved Mathematical Finance Electives in favor or a set of four required concentration courses. In particular, several ECON courses that are currently taken by a subset of Mathematical Finance students will no longer be needed by Mathematical Finance students. While faculty have appreciated having the unique perspective of the Mathematical Finance students in these courses, we understand the motivation for wanting to eliminate individual electives from the program. The third key change is the addition of the ECON 6217 course (Advanced Microeconometrics) to the Financial Data Analytics concentration. The faculty member who teaches this course and I are very supportive of this change and believe that Mathematical Finance students in this concentration would benefit from exposure to the material covered in this course.

Please let me know if I can be of further assistance.

King, Dolly

From: Ribarsky, William
Sent: Wednesday, September 18, 2013 6:00 PM
To: Chen, Ken; King, Dolly
Cc: Amato, Christie; Tian, Weidong
Subject: RE: Belk College of Business Master of Science in Mathematical Finance Program Change - Consultation Request

Thanks, Ken. As noted, we hope to get additional teaching resources as the DSBA PSM and other programs are put in place. At that point, we should be able to sustain our commitments.
Bill

Dr. William Ribarsky
Bank of America Endowed Chair in Information Technology
Chair, Computer Science Department
Director, Charlotte Visualization Center
College of Computing and Informatics
University of North Carolina at Charlotte
www.viscenter.uncc.edu

From: Chen, Ken
Sent: Wednesday, September 18, 2013 5:57 PM
To: King, Dolly; Ribarsky, William
Cc: Amato, Christie; Tian, Weidong
Subject: RE: Belk College of Business Master of Science in Mathematical Finance Program Change - Consultation Request

Dear Dolly:

Due to MS CS enrollment surge, CS has increased the offering of ITCS 6114 from 2 sections a semester to 3 sections a semester, and plan to increase the offering of ITCS 6160 from 1 section a semester to 3 sections a year (we have scheduled 2 sections of ITCS 6160 in Spring 2014), also plan to increase the offering of ITCS 6162 from every Fall to every Spring and Fall. So in the near future, we should be able to handle the small additional demand on these three courses from the new Financial Data Analytics Concentration of your Master of Science in Mathematical Finance Program. Hopefully, CS will get additional teaching resource for its rapid growth so we can continue provide enough seats in these 3 ITCS graduate courses for students in the Financial Data Analytics Concentration in the foreseeable future.

Sincerely,
Ken

Keh-Hsun Chen (Ken), Ph.D.
Professor and Associate Chair of Computer Science
Computer Science MS Program Director
UNC Charlotte | Dept. of Computer Science
9201 University City Blvd. | Charlotte, NC 28223
Phone: 704-687-8545 | Fax: 704-687-1651| Office: Woodward 403C
chen@uncc.edu | www.cci.uncc.edu/cs/site/

From: King, Dolly
Sent: Wednesday, September 18, 2013 4:01 PM
To: Ribarsky, William; Chen, Ken
Cc: Amato, Christie; Tian, Weidong
Subject: Belk College of Business Master of Science in Mathematical Finance Program Change - Consultation Request

Hi Bill and Ken:

I am writing to request a consultation from the Department of Computer Science. The Department of Finance is proposing significant changes to the Master of Science in Mathematical Finance Program of Study. There is one change that are related to ITCS and ITIS courses:

1. Creation of Financial Data Analytics Concentration
   One of the concentrations that we propose to create is the Financial Data Analytics Concentration. We propose to include three ITCS/ITIS courses in the list of concentration courses. Please see below for the proposed section related to the list of concentration courses for this concentration. These are required course for students who choose this concentration. We expect to have 7 to 10 students per year in each of the courses from Mathematical Finance.

   Financial Data Analytics Concentration
   In addition to the six courses specified in "The Program Core" section, the following four courses are required for a Master of Science in Mathematical Finance Degree with a Financial Data Analytics Concentration.

   ECON 6217 Advanced Microeconometrics (3)
   ITCS 6114 Algorithm and Data Structures (3)
   ITCS 6160 Database Systems (3) OR ITIS 5160 Applied Databases
   ITCS 6162 Knowledge Discovery in Databases (3)

Can you please provide a consultation regarding the proposed changes stated above in the Mathematical Finance Program of Study?

Thank you,

Dolly

Tao-Hsien Dolly King, Ph.D. | Rush S. Dickson Professor of Finance
Chair, Department of Finance
UNC Charlotte | Belk College of Business
211A Friday Building
9201 University City Blvd. | Charlotte, NC 28223
Phone: 704-687-7652| Fax: 704-687-1412
tking3@uncc.edu| http://belkcollegeofbusiness.uncc.edu/tking3/

FW: Belk College of Business Master of Science in Mathematical Finance Program Change - Consultation Request

Saydam, Cem
Sent: Friday, October 25, 2013 11:54 AM
To: King, Dolly
Cc: Saydam, Cem

Dear Dolly,

The Business Information Systems and Operations Management Department endorses the Finance Department proposal revising the Master of Science in Mathematical Finance, in particular supports the proposed Financial Data Analytics concentration.

Best wishes,

Cem

Cem Saydam, Ph.D. | Chair | Professor of Operations Management
UNC Charlotte | Dept. of BIS and Operations Management
9201 Univ City Blvd. | Charlotte | NC 28223
Phone: 704-687-7616 | Fax: 704-687-6330
saydam@uncc.edu | http://www.uncc.edu

From: Subramaniam, Chandra
Sent: Wednesday, October 23, 2013 3:27 PM
To: Saydam, Cem
Cc: Park, SungJune; Zhou, Jing; He, Xiuli
Subject: RE: Belk College of Business Master of Science in Mathematical Finance Program Change - Consultation Request

Cem:

The C&CC, after discussing and obtaining feedback from the BISOM faculty, endorses the Finance department proposal for changes to the Math Finance masters program. In particular, we looked at the "Financial Data Analytics Concentration" and the revised list of four courses required for this concentration as given below and support the list of courses.

ECON 6217
ITCS 6114
ITCS 6160 or ITIS 5160
MBAD 6201

Please let us know if you have any questions.

Best regards,
Chandra

Chandrasekar Subramaniam, PhD

Associate Professor of Business Information Systems
UNC Charlotte | Belk College of Business
9201 University City Blvd. | Charlotte, NC 28223
Phone: 704-687-7604 | Fax: 704-687-6330
csubrama@uncc.edu | http://belkcollege.uncc.edu

From: Saydam, Cem
Sent: Friday, October 18, 2013 12:51 PM
To: Subramaniam, Chandra
Subject: FW: Belk College of Business Master of Science in Mathematical Finance Program Change - Consultation Request

Chandra,

Pls have our CCC look at this proposal and make a recommendation to me/our faculty.

I personally think that it is just fine and MBAD 6201 is a good course to include in this concentration.

BTW I asked Dolly about algorithms course. Indeed they want their students to have heavy coding background and this course (I know) will provide that. So, over all they crafted a good concentration. So, I fully support it as-is.

Cem

From: King, Dolly
Sent: Friday, October 18, 2013 11:34 AM
To: Saydam, Cem
Subject: Belk College of Business Master of Science in Mathematical Finance Program Change - Consultation Request

Hi Cem:

I am writing to request a consultation from the Department of Business Information System and Operation Management. The Department of Finance is proposing significant changes to the Master of Science in Mathematical Finance (MSMF) Program of Study. There is one change that are related to BISOM courses:

1. Creation of Financial Data Analytics Concentration
   One of the concentrations that we propose to create is the Financial Data Analytics Concentration. We propose to include one ECON Course and three courses on the topics of data structure and databases in the list of concentration courses. Please see below for the proposed section related to the list of concentration courses for this concentration. These are required course for students who choose this concentration. We expect to have 7 to 10 students per year in each of the courses from Mathematical Finance.

Financial Data Analytics Concentration

In addition to the six courses specified in "The Program Core" section, the following four courses are required for a Master of Science in Mathematical Finance Degree with a Financial Data Analytics Concentration.

ECON 6217 Advanced Microeconometrics (3)
ITCS 6114 Algorithm and Data Structures (3)
ITCS 6160 Database Systems (3) OR ITIS 5160 Applied Databases
MBAD 6201 Business Intelligence and Analytics (3)

Can you please provide advice as to the inclusion of MBAD 6201 in this Financial Data Analytics Concentration of the MSMF Program of Study?

Thank you,

Dolly

Tao-Hsien Dolly King, Ph.D. | Rush S. Dickson Professor of Finance
Chair, Department of Finance
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Phone: 704-687-7652| Fax: 704-687-1412
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MASTER OF SCIENCE IN MATHEMATICAL FINANCE

The Master of Science in Mathematical Finance program is designed to prepare students to pursue careers in quantitative finance. Increasingly firms of all types, but especially financial institutions, investment banks, and commodities firms, rely upon highly sophisticated mathematical models to identify, measure, and manage risk. The advent of these models has triggered the emergence of a new discipline, Mathematical Finance. This new discipline, sometimes also referred to as "financial engineering," "computational finance," or "quantitative finance," requires professionals with extensive skills in both finance and mathematics.

The Mathematical Finance program at UNC Charlotte is a joint program of the Departments of Finance and Economics in the Belk College of Business and the Department of Mathematics and Statistics in the College of Liberal Arts & Sciences. Students take courses from all three departments in an integrated curriculum. Students may use electives to tailor the program to their specific interests.

Additional Admission Requirements

In addition to the general requirements for admission to the Graduate School, the following are required for admission to the Master of Science in Mathematical Finance program.

1. A baccalaureate degree in a related field with a GPA of at least 2.75 out of 4.0 with an average of 3.0 in the junior and senior years.
2. Acceptable scores on each portion of the GRE or GMAT.
3. For applicants from non-English speaking countries, a language requirement score of 557 on the TOEFL or 220 on the new computer-based TOEFL or 78% on the MELAB. Non-native speakers of English, may, at the discretion of either the Graduate School or the Program Committee for the MS in Mathematical Finance, be required to enroll in English as a Second Language (ESL) courses at the English Language Training Institute.
4. Specific coursework equivalent to the following: introductory course in the Theory of Finance; a standard three semester sequence in Calculus; Linear algebra; working knowledge of a suitable programming language; at least one upper-level course in Probability and Statistics. Students lacking this coursework may be admitted subject to the condition that they satisfactorily complete such coursework during the first two semesters that they are enrolled in the program and prior to their taking any program courses where prerequisites are missing.

Prerequisite Requirements

Students may enter this program from a variety of undergraduate backgrounds, including finance, mathematics, economics, computer science, actuarial science, statistics, information systems and engineering. As a result, many students admitted will not have the required background to immediately begin taking advanced courses from each of three areas of study. In such cases, the student may be required to take prerequisite courses prior to enrolling in advanced courses in specific fields. These prerequisites would be in addition to the advanced 30 semester hours required for the degree. In general students must have the following background in each field before taking advanced courses in that field:

1. Finance: Have earned an acceptable grade in an introductory course in finance from an AACSB-accredited business school at either the undergraduate or MBA level.
2. Economics: Have earned an acceptable grade in microeconomics and macroeconomics courses at either the undergraduate or MBA level.
3. Mathematics: Have earned acceptable grades in the equivalent of a three course sequence in calculus (differential and integral calculus), a course in linear algebra, and an upper-level course in probability and statistics.
4. Programming: Students should be familiar with at least one programming language, most preferably C or C++.

Again, students may be admitted to the program without meeting all of these requirements. The Program Director, in conjunction with the Departmental Graduate Coordinators, will evaluate each incoming student's academic background to determine in which prerequisite courses the student will be required to enroll. A student who~~that~~ meets the prerequisites in a field may begin taking advanced courses in that field while still taking prerequisite courses in another field. A student must, however, be making satisfactory progress toward fulfilling ~~their~~his or her prerequisites in all fields to remain enrolled in the program.

Degree Requirements

Total hours required:

A minimum of thirty hours of coursework beyond the bachelor's degree is required to earn the degree. The student must complete the required six program core courses and four concentration courses corresponding with the selected concentration~~A minimum of thirty hours of coursework beyond the bachelor's degree is required to earn the degree. The student must complete the required 24 hours from the program core and 6 hours of approved electives~~.

The Program Core:

- ECON/FINN 6203 Financial Economic Theory (3)
- STAT 6113/ECON 6113 Cross-Section and Time Series Econometrics (3)~~MATH 6201 Statistical Techniques in Finance (3) OR ECON 6113 Cross-Section and Time Series Econometrics (3)~~
- FINN/ECON 6219 Financial Econometrics (3)
- FINN 6210 ~~Derivatives I:~~ Financial Elements of Derivatives (3)
- FINN 6211 ~~Risk Management and~~ Fixed Income ~~Derivatives~~ Securities and Credit Risk (3)
- ~~MATH 6202 Derivatives II: Partial Differential Equations for Finance (3)~~
- MATH 6203 Stochastic Calculus for Finance (3)
- ~~MATH 6204 Numerical Methods for Financial Derivatives (3)~~

~~**Approved Mathematical Finance Electives:**~~

- ~~ECON 6090 Topics in Economics (3)~~
- ~~ECON 6100 Mathematical Economics (3)~~
- ~~ECON 6201 Advanced Macroeconomic Theory (3)~~
- ~~ECON 6202 Advanced Microeconomic Theory (3)~~
- ~~ECON 6235 Monetary Theory and Financial Theory (3)~~
- ~~ECON 6800 Directed Study Economics (3)~~
- ~~FINN 6058 Special Topics in Financial Services (3)~~
- ~~MATH 5128 Applied Probability I (3)~~
- ~~MATH 5129 Applied Probability II (3)~~
- ~~MATH 5143 Analysis I (3)~~
- ~~MATH 5171 Numerical Solution of Ordinary Differential Equations (3)~~
- ~~MATH 6205 Financial Computing (3)~~

Concentrations

The program offers three concentrations leading to a Master of Science in Mathematical Finance Degree. Students who plan to pursue careers in quantitative modeling and pricing analysis are encouraged to elect the Computational Finance Concentration. Students planning to pursue a career in risk management and insurance are encouraged to pursue the program with the Risk Management Concentration. Students interested in a career in financial data analysis and applications are encouraged to elect the Financial Data Analytics concentration.

Computational Finance Concentration

In addition to the six courses specified in "The Program Core" section, the following four courses are required for a Master of Science in Mathematical Finance Degree with a Computational Finance Concentration.

MATH 6204 Numerical Methods for Financial Derivatives (3)
MATH 6205 Financial Computing (3)
MATH 6206 Stochastic Calculus for Finance II (3)
FINN 6212 Advanced Financial Derivatives (3)

Risk Management Concentration

In addition to the six courses specified in "The Program Core" section, the following four courses are required for a Master of Science in Mathematical Finance Degree with a Risk Management Concentration.

FINN 6213 Risk Management and Financial Institutions (3)
FINN 6214 Asset and Portfolio Management (3)
FINN 6215 Risk Management in Insurance Companies (3)
FINN 6216 Quantitative Risk Management (3)"

Financial Data Analytics Concentration

In addition to the six courses specified in "The Program Core" section, the following four courses are required for a Master of Science in Mathematical Finance Degree with a Financial Data Analytics Concentration.

ECON 6217 Advanced Microeconometrics (3)
ITCS 6114 Algorithm and Data Structures (3)
ITCS 6160 Database Systems (3) OR ITIS 5160 Applied Databases
MBAD 6201 Business Intelligence and Analytics (3)

Admission to Candidacy Requirements

An Admission to Candidacy form listing graduate-level courses that apply to the degree must be submitted to the Mathematical Finance Program Director four weeks prior to the semester in which the student plans to complete the coursework for the degree.

Assistantships

A number of assistantships are available each year. In order to be competitive, applications should be submitted by March 15. Additional information is available from the Program Director.

Advising

Advising is done by the Program Director, in conjunction with the Area Coordinators of each of the participating Departments.

Transfer Credit

No more than 6 credit hours and only courses with a grade of A or B at an accredited institution. Requires the recommendation of the Program Director and approval of the Graduate School.

Comprehensive Examination

Student will be required to pass a comprehensive examination. An examining committee will be appointed by the program director and will be constituted from the program's faculty. The exam may be, at the committee's discretion, either written or oral.

Application for Degree

Each student should make application for his/her degree by completing the online Application for Degree through Banner Self Service no later than the filing date specified in the University Academic Calendar.

COURSES IN MATHEMATICAL FINANCE

Economics Courses (ECON)
See descriptions of ECON courses under Economics in the Belk College of Business section of this *Catalog.*

Mathematics Courses (MATH)
See descriptions of MATH courses under Mathematics in the College of Liberal Arts & Sciences section of this *Catalog.*

FINN 5158. Student Managed Investment Fund I. (3) Cross-listed as MBAD 5158. Prerequisites: FINN 3120 or MBAD 6152, FINN 3222 or FINN/MBAD 6153, and permission of instructor. Management of an actual portfolio consisting of a portion of the University's Endowment Fund. Students are required to take FINN 5159 following this course. *(Fall)*

FINN 5159. Student Managed Investment Fund II. (3) Cross-listed as MBAD 5159. Prerequisites: FINN 5158, FINN 3120 or MBAD 6152, FINN 3222 or FINN/MBAD 6153, and permission of instructor. Management of an actual portfolio consisting of a portion of the University's Endowment Fund. *(Spring)*

FINN 6058. Special Topics in Financial Services. (3) Cross-listed as MBAD 6160. Prerequisite: MBAD 6152. Each year, the subject matter of this course deals with a different specialized and contemporary topic of interest to students who are preparing for management careers in the financial services industry. The topics are chosen and covered in a way that builds on and supplements the topics covered in other courses in the Financial Institutions/Commercial Banking concentration. Emphasis is placed on the managerial implications of the subject matter as well as the impact on the financial system. Topics covered may vary from semester to semester, and the course may be repeated a maximum of one time for academic credit. *(On demand)*

FINN 6151. Financial Institutions and Markets. (3) Cross-listed as MBAD 6151. Major financial institutions, particularly commercial banks, and their role in the intermediation process and as suppliers of funds to the money and capital markets. Comparative financial policies of these institutions are examined in the context of their legal and market environment. *(Yearly)*

FINN 6152. Financial Management. (3) Cross-listed as MBAD 6152 and MSRE 6152. Theory and practice of corporate finance including asset management, cost of capital and capital budgeting, optimization problems and socio-economic aspects of financial management. Computer technology may be employed when applicable. *(Fall, Spring)*

FINN 6153. Investment Management. (3) Cross-listed as MBAD 6153. Prerequisite: MBAD 6152. Theory and practice of investment decisions of individuals and fund managers. Topics include: the status of capital market theory, the efficient market hypothesis literature, and a portfolio performance measurement. Standard institutional and investment analysis topics, futures and options markets, and international investment topics are covered. *(Yearly)*

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FINN 6154. Applied Business Finance. (3) Cross-listed as MBAD 6154. Prerequisite: MBAD 6152. Examination of business finance topics which typically confront the firm's primary finance functional areas (CFO, Treasurer, Controller). The purpose is to develop advanced analytical skills in those topic areas. Topics include: lease vs. buy (borrow); leveraged buy-outs: merger analysis (emphasis on valuation); international operations of American firms (capital budgeting and cost of capital); capital structure; risk management. Such additional topics as working capital management; risk management; and relevant current topics are included as time permits. *(On demand)*

FINN 6155. Multinational Financial Management. (3) Cross-listed as MBAD 6155. Prerequisite: MBAD 6152. Financial management of the multinational firm including management of foreign exchange risk and political risk, and the control and evaluation of financial policies of multinational firms. *(Yearly)*

FINN 6156. Commercial Bank Management. (3) Cross-listed as MBAD 6156. Prerequisite: MBAD 6152. Techniques for the management of commercial banks. Topics include: industry structure, administrative organization, management of assets, liabilities, and capital, and financial analysis of the banking firm. *(Yearly)*

FINN 6157. Advanced Corporate Finance. (3) Cross-listed as MBAD 6157. Prerequisite: MBAD 6152. Theories of modern corporate finance, including theory of efficient capital markets; uncertainty and the theory of choice; market equilibrium asset pricing models (capital asset pricing model, arbitrage pricing theory, Black-Scholes); theories of capital structure and the cost of capital; dividend policy; and leasing. *(Yearly)*

FINN 6203. Financial Economic Theory. (3) Cross-listed as ECON 6203. Prerequisite: Admission to Graduate Program and Permission of Program Director. This course offers the fundamental principles of risk pricing and risk allocation in a unified framework. Discrete-time model is employed to underscore the relationship between the techniques used in finance and the economic analysis of risk. The objective is to understand the economics of asset pricing and how derivatives and options are used in practice and their limitations. *(On demand)*

~~**FINN 6203. Financial Economic Theory. (3)** Cross-listed as ECON 6203. Prerequisites: Admission to Graduate Program and Permission of program director. Review of financial economic theory using discrete time models. Topics include: risk measurement; choices under uncertainty; portfolio selection; capital asset pricing model (CAPM); Arrow-Debreu pricing; options and market completeness; the Martingale measure; arbitrage theory; consumption-based CAPM; and valuation of the firm. *(On demand)*~~

FINN 6210. Financial Elements of Derivatives. (3) Prerequisite: FINN 6152 or equivalent, or permission of Department. This course examines the nature and functions of futures and options markets. Topics include hedging for risk reduction and the role of derivative instruments in the capital markets. The course focuses on basic pricing techniques which are derived from no arbitrage relations. (*On demand*)

~~**FINN 6210. Derivatives I: Financial Elements of Derivatives. (3)** Prerequisite: FINN 6152 or equivalent, or permission of Department. Theory and practice of financial derivatives markets including forwards, futures, and options markets. Topics include: the economics of derivatives markets, pricing models for instruments in these markets, strategies for hedging and speculation, as well as regulatory and governance issues. *(On demand)*~~

FINN 6211. Fixed Income Securities and Credit Risk. (3) Prerequisite: FINN 6210 or permission of Department. This course studies fixed income securities and portfolios as well as the theory and practice of fixed income markets. Topics include fixed income instruments and sectors, duration and convexity, term structure of interest rates, securitization, portfolio management, hedging, and credit risk. (*On demand*)

~~**FINN 6211. Risk Management and Fixed Income Derivatives. (3)** Prerequisite: FINN 6210 or permission of Department. Risk management of fixed income portfolios as well as the theory and practice of fixed income markets. Topics include: fixed income instruments, term structure models, pricing methods, portfolio management, duration and convexity, securitization, and hedging. *(On demand)*~~

FINN 6212 Advanced Financial Derivatives (3)
FINN 6212. Advanced Financial Derivatives. (3) Prerequisite: FINN 6210 or permission of Department. The course covers multi-factor derivative pricing models. Topics include the discrete-time and discrete-state models, Ito processes, relevant topics on stochastic calculus, Risk Neutral Valuation, and review of the Black-Scholes model. Additional topics include commodity pricing models, stochastic volatility models, multi-period discrete-time (GARCH) models, and the interest rate models such as the Vasicek and CIR models. (*On demand*)

FINN 6213 Risk Management and Financial Institution (3)
FINN 6213. Risk Management and Financial Institutions. (3) Prerequisite: FINN 6203 or permission of Department. This course describes the following: how market risk, credit risk and operational risk are quantified; Basel II regulatory framework; estimation of aggregate economical capital; calculation and use of RAROC; and recent bank risk management tools: back test, CCAR and Dodd-Frank proposals. It will also address recent big losses that have occurred in financial markets and how they can be avoided. (*On demand*)

FINN 6214 Asset and Portfolio Management (3)
FINN 6214 Asset and Portfolio Management. (3) Prerequisite: FINN 6203 or permission of Department. This course provides students with a foundation in investments and portfolio management from the perspective of an institutional investor. Particular attention will be given to the issues associated with managing assets of an insurance company. Topics include: measuring and modeling return and risk, expected return models, information ratio, valuation theory and practice, forecasting, portfolio construction, transaction costs, turnover and trading, performance analysis, asset allocation, securities analysis, and the legal and regulatory landscape of institutional investing. (*On demand*)

FINN 6215 Risk Management in Insurance Companies (3)
FINN 6215 Risk Management in Insurance Companies. (3) Prerequisite: FINN 6203 or permission of Department. This course examines the operations and risks of an insurance firm and how to evaluate and manage those operations and risks in a dynamic business environment. The following topics are covered: 1. The role of insurance firms within the financial services industry, 2. The functions of insurance firms with emphasis on operations unique to insurers, 3. Insurer financial and risk management in the complex regulatory environment and 4. Financial and strategic analysis of insurance firms. (*On demand*)

FINN 6216 Quantitative Risk Management (3)
FINN 6216. Quantitative Risk Management. (3) Prerequisite: FINN 6203 or permission of Department. This course offers the quantitative techniques and tools for the risk management. It starts with the basic concepts and methodologies. Topics include risk measures such as VaR and Expected Shortfall, univariate and multivariate models, copulas and tail dependence in risk management framework, and back testing. This course also discusses how to estimate VaR and Expected Shortfall parametrically, semi parametrically and non-parametrically. (*On demand*)

FINN 6219. Financial Econometrics. (3) Cross-listed as ECON 6219. Prerequisites: ECON 6218 or MATH 6201. Advanced time series with financial applications. Topics covered include time series regressions (univariate and multivariate, stationary and non-stationary) and time series models (including ARMA, ARCH, GARCH, stochastic volatility and factor models). The emphasis will be on model properties, estimators, test statistics, and applications in finance. *(On demand)*

MATH 6203. Stochastic Calculus for Finance I. (3) Prerequisite: Admission to Graduate Program and Permission of Program Director. This course starts with the probability theory in discrete probability space, discrete-time stochastic processes, and derivatives pricing in the Binomial model. The second part covers probability theory in general probability space and continuous-time martingale and Markov processes. Topics include the It'o integral, Black-Scholes model, It'o-Doeblin formula, Girsanovs theorem, and Martingale Representation theorem. Applications to pricing of exotic derivatives and American options are discussed.
~~**MATH 6203. Stochastic Calculus for Finance. (3)** An introduction to those aspects of partial differential equations and diffusion processes most relevant to finance, Random walk and first step analysis, Markov property, martingales and semi-martingales, Brownian motion. Stochastic differential equations: Ito's lemma, backward and forward Kolmogorov equations, the Feynman Kac formula, stopping times, Hull and White Models, Cox Ingersoll Ross Model. Applications to finance including portfolio optimization and option pricing.~~

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MATH 6206 Stochastic Calculus for Finance II (3)
MATH 6206. Stochastic Calculus for Finance II. (3) Prerequisite: MATH 6203 or permission of Department. This course focuses on the applications of stochastic calculus techniques to advanced financial modeling. Topics include pricing of European, American and fixed-income derivatives in the Black-Scholes and stochastic volatility models. The Jump-diffusion model will also be introduced. (*On demand*)

ATTACHMENT 4. Course Syllabi for Proposed New Courses

MATH 6206: Stochastic Calculus for Finance II

Course Objectives: This course focus on applying stochastic calculus techniques to advanced financial modeling. In the first part (week one through six), we discuss European, American and Fixed-income derivative pricing in the Black-Scholes model. In the second part (week seven through week eleven), we discuss the same topics in the stochastic volatility model. In the last part (week twelve through week fourteen), jump-diffusion model will be introduced.

Prerequisite: MATH 6203 or permission of Department.

Textbooks: Steven Shreve, *Stochastic Calculus for Finance II: Continuous-Time Models*, Springer.

Lecture Plan:

- Week One: Risk-neutral pricing for exotic derivatives and the pricing PDE in the Black-Scholes model
- Week Two: American option pricing and its relation to optimal stopping problems, part I
- Week Three: American option pricing and its relation to optimal stopping problems, part II
- Week Four: Term structure models: short rate models
- Week Five: Term structure models: HJM model
- Week Six: Swap derivative pricing
- Week Seven: Implied volatility model vs. stochastic volatility model
- Week Eight: Asymptotics for European derivative pricing in the stochastic volatility model
- Week Nine: Implementation and calibration
- Week Ten: American option pricing in the stochastic volatility model
- Week Eleven: Fixed-income derivative pricing in stochastic volatility model
- Week Twelve: Stochastic calculus with respect to jump diffusion model
- Week Thirteen: European option pricing in the Jump diffusion model
- Week Fourteen: American option and Fixed-income derivative pricing in the jump diffusion model

Course Expectations and Policies:

- Students are expected to attend all lectures where exercises, homework due dates, grading, and exam announcements will be made. Reading the relevant chapters in the textbooks before or after each lecture will enhance the learning experience and is highly recommended.
- Class announcements (about schedule changes, homework due dates, exam information...) will be made in class, or posted through the 'News Forum' on Moodle (https://moodle.uncc.edu), or sent through email (to your @uncc.edu account).
- Students should make individual efforts on the homework and exercises given in class. Then they are very much encouraged to seek help from the professor, or discuss with fellow students. Forming a study group to learn new materials is a great idea. Each student is expected to write up **independent** solutions to homework at all time and collaborations of any type will be absolutely forbidden during the exams. *All students are required to read and abide by the Code*

of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at http://integrity.uncc.edu.

- The use of cell phones, beepers, or other communication devices is disruptive, and is therefore prohibited during class. Students are permitted to use computers during class for note-taking and other class-related work **only**.

Homework and Exams:

- Homework 20%;
- Midterm exam 30% (Closed-book/notes)
- Final exam 50% (Closed-book/notes).
- No late homework will be accepted. No make-up exam will be given unless the instructor is contacted in advance, valid reasons are given and permission is granted. Validation through the Office of Dean of Students (http://dso.uncc.edu) must be presented for extraordinary circumstances.

Grading

A =100-90
B = 89-80
C = 79-70
U = 69-0

Statement on Academic Integrity:
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Statement on Diversity:
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FINN 6212 Advanced Financial Derivatives

Course Objectives:
The course will cover multi-factor derivative pricing models. We will first review the basic theoretical background, including the discrete-time and discrete-state model, Ito processes and some relevant topics from stochastic calculus, and Risk Neutral Valuation. We will then review the Black-Scholes model. From there we will study commodity pricing models, including the popular 2-factor Gaussian models and then move to stochastic volatility models and their generalizations. We will show that these stochastic volatility models give "quasi" closed-form solutions for futures and options prices. We will also discuss multi-period discrete-time models (GARCH models) and how they differ from continuous time models. Time permitting; in the latter part of the course we may discuss interest rate models, focusing on the multi-factor affine models that are quite popular among practitioners. These include the multi-factor versions of the Vasicek and CIR (Cox, Ingersoll, and Ross) models.

Prerequisites:
I will assume students have a good understanding of options and derivatives at the level of FINN 6210. Although we will briefly review some topics from stochastic calculus, students will need to have a good basic understanding of MATH 6203. Also, students should have some programming experience and be able to do things like simple Monte Carlo simulations and optimizing functions over 2 or 3 variables. I will not require a specific programming language; however I probably will not be able to provide any programming help for anything other than Matlab.

Text:
There is no assigned textbook, mainly because I haven't found one I'm completely happy with. Some books you may find useful are:

1. *Options, Futures, and Other Derivatives*, by John Hull. We use this in FINN6210 and some of the later chapters are relevant for what we'll cover in this course.
2. *An Introduction to the Mathematics of Financial Derivatives*, by Salih Neftci

Tentative Order of Topics Covered:

- Brief overview of course
- Review and Background
    - discrete-time and discrete-states models
        - binomial model
    - stochastic calculus
        - Weiner processes
        - Ito processes and Ito's lemma
        - Stochastic integration
    - Black-Scholes model
        - log-normal call property
    - Risk-neutral valuation
        - Girsanov's Thm
        - Pricing kernel
- Affine option pricing models

    - Gaussian models: 1-factor, 2-factor, and generalizations
        - futures pricing
        - options pricing
        - estimation
    - Stochastic volatility models
        - Fourier transform
        - Monte Carlo simulation
        - estimation using FFT
    - General affine models
- GARCH models used for option pricing
- Interest rate models (time permitting)
    - basic ideas
    - 1-factor models: Vasicek, CIR, general 1-factor affine model
    - multi-factor models: 2- and 3-factor affine models

Exams and Assignments:
There will be 4 or 5 graded assignments and a final exam. The grade breakdown is as follows: the assignments together will count for 60% and the final exam will count for 40% of your grade.

Because there is no course textbook, you will occasionally be assigned papers to read to help fill in the details. I will expect you to read the assigned paper(s) before class.

Grading

A =100-90
B = 89-80
C = 79-70
U = 69-0

Statement on Academic Integrity:
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FINN 6213 Risk Management and Financial Institutions

Course Objectives

This course describes:

- how market risk, credit risk and operational risk are quantified
- Basel II regulatory framework
- estimation of aggregate economical capital
- calculation and use of RAROC
- Recent bank risk management tools: back test, CCAR and Dodd-Frank proposals.

It will also address recent big losses that have occurred in financial markets and how they can be avoided.

Prerequisite: FINN 6203 or permission of Department.

Course Textbook

John Hull 2006, *Risk Management and Financial Institutions*

Outline

Session 1: Introduction to Risk

- Classification of Risks
- Risks in Financial Products

Topics covered include: introduction to risk and return for investors and companies; bank capital; approaches to managing risk; basic financial and insurance products such as equities shares, debt, forwards, futures, options, guaranteed products and how they are used for risk management purposes.

Session 2: Managing Risk Exposure

- How Front-Office Manages Risk Exposure "Greeks"
- Interest Rate Risk Management

This session explains what are termed the "Greeks". Each of the Greeks measures a different aspect of risk in a trading position. The front-office hedges risk by ensuring individual market risk variables. It will explain in detail how interest rate risk is quantified and managed.

Session 3: Credit Risk Management

- Estimating Default Probabilities
- Credit Risk Losses and Credit VaR
- Credit Risk Plus and Credit Metrics

In this session we describe several ways of estimating default probabilities, credit risk loss distribution and the calculation of Credit VaR. It will also serve as a brief introduction to two popular credit portfolio risk models: Credit Risk Plus and Credit Metrics

Session 4: Bank Capital and Developments in Basel II-III

- Regulating Bank Capital and Development
- Credit Risk Capital under Basel II
- Economical Capital
- RAROC

This session introduces the development of bank regulating: starting with the 1988 BIS ACCORD to BASEL II. Then we illustrate in detail credit risk capital under Basel II. It will introduce economic capital and its key components, as well as risk-adjusted return on capital (RAROC).

Session 5: Bank Stress Test

This session introduces basic techniques and methodologies of bank scenario stress tests.

Session 6: Advanced Development: Dodd-Frank and CCAR

- Dodd-Frank: Major Issues
- Comprehensive Capital Analysis and Review

This session will discuss more advanced and recently risk management proposals: Dodd-Frank and CCAR.

Course Assessment

The course requirement consist of four problem sets (the questions are chosen from the textbook and the reading book listed below), course participation, one midterm exam and a final exam.

Course Requirements

---Homework (4)
----Midterm exam
---Final exam

Grading

A =100-90
B = 89-80
C = 79-70
U = 69-0

Attendance

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Honor Code

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Accommodations for Disabilities

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FINN 6214 Asset and Portfolio Management

Course Objectives

This course provides students with a foundation in investments and portfolio management from the perspective of an institutional investor. Particular attention will be given to the issues associated with managing assets of an insurance company. Topics include: measuring and modeling return and risk, expected return models, information ratio, valuation theory and practice, forecasting, portfolio construction, transaction costs, turnover and trading, performance analysis, asset allocation, securities analysis, and the legal and regulatory landscape of institutional investing.

Prerequisite: FINN 6203 or permission of Department.

Textbooks

Active Portfolio Management: A Quantitative Approach for Producing Superior Returns and Controlling Risk, by Richard Grinold and Ronald Kahn

Modern Portfolio Theory and Investment Analysis, 8e, by Elton, E.J., Gruber, M.J., Brown, S.J., and Goetzmann, W.N,

Course Outline

This course provides students with a foundation in investments and portfolio management from the perspective of an institutional investor. Particular attention will be given to the issues associated with managing assets of an insurance company. Topics include: measuring and modeling return and risk, expected return models, information ratio, valuation theory and practice, forecasting, portfolio construction, transaction costs, turnover and trading, performance analysis, asset allocation, securities analysis, and the legal and regulatory landscape of institutional investing.

Grading Policies

Students will be graded on the basis of grades received on homework assignments (worth 20% of the course grade), an in-class midterm exam (worth 30% of the course grade), and an in-class comprehensive final exam (worth 50% of the course grade).

Grading Scale

The lower bounds for final grades of A, B, C will be no higher than 90, 80, and 70 percent of the total available points, respectively. Total available points lower than 70 will be assigned a grade of U. Grades will be curved if necessary.

Statement on Academic Integrity:

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FINN 6215 Risk Management in Insurance Companies

Course Description

The overall goal of this course is for the student to understand the operations and risks of an insurance firm and how to evaluate and manage those operations and risks in a dynamic business environment. To facilitate this understanding the following topics are covered: 1. The role of insurance firms within the financial services industry, 2. The functions of insurance firms with emphasis on operations unique to insurers, 3. Insurer financial and risk management in the complex regulatory environment and 4. Financial and strategic analysis of insurance firms.

Course Objectives

1. Understand the financial industry and regulatory environment within which insurers operate.
2. Understand and manage the main functions and risks of insurance firms.
3. Interpret information contained in insurer financial statements and assess insurer strategy.
4. Analyze an insurance firm including diversification strategy, pricing, marketing and distribution, underwriting, claims handling and liability and liquidity management.

Prerequisite: FINN 6203 or permission of Department.

Required Texts

Management of Insurance Firms, 1st Edition, customized book in development, The Institutes, 2013
ISBN# in development

Life & Health Insurance, 13th Edition, Kenneth Black, Jr. and Harold D. Skipper, Jr.
ISBN# 0-13-891250-5 (customized text to be developed)

Required Resources

1. Additional readings as assigned.
2. *SNL Financial* data subscription located at www.snl.com. Students may sign up for this service at no cost using their UNCC e-mail address and a university computer.

Grading

The course grade will be based on two examinations – a midterm and final exam (50% of the course grade), a project (25%), assignments (20%) and participation (5%). Each of these will be graded on a scale of 1 through 100. The exams will be worth 25% each of your final course grade. The final exam will be administered according to the schedule outlined in the UNCC Final Exam Schedule. Your final grade will be based on the following scale:

90 and above = A, 80 to 89.99 = B, 70 to 79.99 = C, less than 70 = U

Exams

Make-up exams will not be given. If the mid-term exam is missed and the absence is excused based on university guidelines, then the final exam will account for 50% of your final course grade. If the absence is unexcused then you will be given a zero for that exam. Excluding emergencies, an absence is automatically considered unexcused if advance notice, at least 24 hours prior to the exam, of the absence is not provided to the instructor. All subsequent missed exams will result in a zero for that exam.

Assignments

Students will be responsible for four to five assignments during the course of the semester that will constitute 20% of your final course grade. Assignments will be from the following topics: investments, pricing, risk transfer, claims handling, and insurer analysis.

Class Participation

Class participation includes attendance, assignments, activities, and meeting the general requirements of the course. Class participation also includes class discussion and respectful behavior.

Project

Each student is required to will work with 2-3 other students on a semester long study of an active insurance firm. The final project grade will be based on content, organization, presentation and writing mechanics. Students needing assistance with writing and presentations should consult the Writing Resource Center at http://www.uncc.edu/writing/wrcindex.html. The instructor also will refer you to the Writing Resource Center if needed.

Student Conduct

All students must be familiar with and abide by UNC Charlotte's Code of Student Responsibility defined in the 2013-2014 Graduate Catalog and located online at http://catalog.uncc.edu/sites/catalog.uncc.edu/files/media/Graduate-Catalogs/2013-2014-Grad-Catalog-11-student-conduct.pdf

1. The UNC Charlotte Code of Student Academic Integrity (p. 45)
2. The UNC Charlotte Code of Student Responsibility (p. 46)

Class Policies

Special accommodations:	Students needing special accommodations should inform the instructor of the type of accommodation needed during the first week of class.

E-mail:	A great deal of communication is done by e-mail. Students are responsible for checking their UNCC e-mail account throughout the semester.
Cell phones:	Please use cell phones in a respectful manner. Cell phones are not allowed to be on during exams. Specifically, during an exam cell phones may not be in view of, or in contact with, any student. Violations of this policy will result in a zero on the exam. In the case of family emergencies accommodations may be made with the instructor.
Class materials and notes:	Additional materials may be provided as needed by the instructor throughout the course. If a student misses a class when this material is provided it is the student's responsibility to arrange to obtain this material from another student or from the instructor during the instructor's office hours. If you miss a day of class, lecture notes and materials should be obtained from another student.
Course communications:	The outlines for the class lectures as well as other class materials including announcements will be posted on Moodle2 or e-mailed to the student. It is the student's responsibility to check the Moodle2 website and their e-mails frequently to keep updated on the class.
Exams:	Exams generally include multiple choice questions requiring scantron answer sheets and short answer questions. Students are responsible for providing their own #2 pencils and calculators, if needed, on the day of exams.
Laptops:	Laptops may be used during class for class purposes only and are permitted at the instructor's discretion. Those using laptops are to sit on the back row of the classroom. If the laptop becomes a distraction the student will be required to turn it off and put it away immediately upon the instructor's request. Failure to do so will result in removal from class that day. If laptop use continues to be a distraction, the instructor may prohibit their use for the remainder of the semester.
Turnitin.com	As a condition of taking this course, all required papers may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. No student papers will be submitted to Turnitin.com without a student's written consent and permission. If a student

does not provide such written consent and permission, the instructor may: (i) require a short reflection paper on research methodology; (ii) require a draft bibliography prior to submission of the final paper; or (iii) require the cover page and first cited page of each reference source to be photocopied and submitted with the final paper. Therefore, students should take care when choosing group members for the project.

COURSE SCHEDULE

Risk Management in Insurance Companies

Week	Date	Topic
1	January 13th	Overview of Financial Markets and Insurance Industry
	January 20th	MLK Day - UNCC Off
2	January 27th	Insurance Products; Risks of Financial Institutions
3	February 3rd	Life Insurer Financial Management
4	February 10th	Management of Interest Rate Risk
5	February 17th	P&C Financial Management
6	February 24th	Liquidity, Liability and Off Balance Sheet Risk
	March 3rd	UNCC Spring Break
7	March 10th	Mid-Term Exam
8	March 17th	Financial Management and Regulation
9	March 24th	Financial Management and Analysis
10	March 31st	Marketing and Distribution
11	April 7th	Risk Classification and Selection
12	April 14th	Risk Diversification and Transfer
13	April 21st	Actuarial Operations: Pricing and Reserving
14	April 28th	Claims Administration/Project Due
	May 5th	Final Exam

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FINN 6216 Quantitative Risk Management

Course Objectives

This course offers the quantitative techniques and tools for the risk management. It starts with the basic concepts and methodologies. Some important risk measures such as VaR and Expected shortfall are introduced by examples. Then it discusses in greater details the univariate and multivariate models, copulas and tail dependence in risk management framework. This course introduces how to estimate VaR and Expected Shortfall in following situations: parametrically, semi parametrically and non-parametrically. At last back testing is introduced.

Prerequisite: FINN 6203 or permission of Department.

Course Textbook

A.J. McNeil, R. Frey and P. Embrechts, Quantitative Risk Management-Concepts, Techniques, Tools", Princeton Series in Finance, 2005

Outline

Session 1: Basic Concepts in Risk Management

Session 2: VaR: Idea and Applications

Session 3: Coherent Risk Measure and Expected Shortfall

Session 4: Multivariate Models

Session 5: Copulas and Tail Dependence

Session 6. Estimation of VaR and Expected Shortfall

Session 7: Back Testing and other Simulation Tools

Course Assessment

The course requirement consist of four problem sets (the questions are chosen from the textbook and the reading book listed below), course participation, one midterm exam and a final exam.

Course Requirements

---Homework (4)
----Midterm exam
---Final exam

Grading

A =100-90
B = 89-80
C = 79-70
U = 69-0

Attendance

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Accommodations for Disabilities

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Other Reading Textbooks

Philippe Jorion: Value at Risk. The New Benchmark For Managing Financial Risk, third edition, McGraw Hill, 2007.

Michel Crouhy, Dan Galai, and Robert Mark. The Essentials of Risk Management, McGraw Hill, 2006.

ATTACHMENT 5. Course Syllabi for Courses with Significant Changes to Structure and Content

FINN 6203 Financial Economic Theory

Course Objectives

This course offers the fundamental principles of risk pricing and risk allocation in a unified framework. Discrete-time model is employed to underscore the relationship between the techniques used in finance and the economic analysis of risk.

For master students, the objective is to understand the economics of asset pricing and how derivatives and options are used in practice and limitation.

For doctoral students, the objective is to begin developing a research agenda in the field.

Prerequisite: Admission to Graduate Program and Permission of Program Director.

Course Textbook

Stanley R. Pliska. *Introduction to Mathematical Finance: Discrete Time Models*, Wiley, 1997.

George Pennacchi. *Theory of Asset Pricing*, Addison-Wesley Series in Finance, Pearson Education, Inc. 2008.

Other Reading Textbooks

Steven E. Shreve, *Stochastic Calculus for Finance I: The Binomial Asset Pricing Model*, Springer Finance, 2003.

Stephen A. Ross, *Neoclassical Finance*, Princeton University Press, 2005.

John C. Cox and Mark Rubinstein, *Options Markets*, Prentice-Hall, Inc, 1985.

John Hull. *Options, Futures and Other Derivatives*, (sixth edition), 2005.

Gabrielle Demange and Guy Laroque. *Finance and the Economics of Uncertainty*, Blackwell Publishing, 2006.

Course Outline:

Four parts are proposed in this course. The specific objective of each part is explained as follows:

(1). Multiperiod Securities Markets

---*Arbitrage pricing concept*
---*Fundamental Theorems and Martingale concepts*
---*Complete and Incomplete Market*

(2). No-Arbitrage Derivatives Pricing

---*Forward, Future pricing*
---*Arbitrage-free Pricing of Options*
---*Exotic Option Pricing*

(3). Interest Rate Derivatives

----*Interest Rates and Yield Curves*
----*Discrete-time Term Structure Model*
----*Interest Rate Derivatives*

(4). Mean-Variance Analysis and CAPM

----*Quadratic Utility*
----*Optimal Portfolio Choice*
----*Market Portfolio*
----*Capital Asset Pricing Model*

Course Assessment

The course requirement consist of four problem sets (the questions are chosen from the textbook and the reading book listed below), course participation, one midterm exam and a final exam.

Course Requirements

---Homework (4)
----Midterm exam
---Final exam

Grading

A =100-90
B = 89-80
C = 79-70
U = 69-0

Attendance

The UNC Charlotte Catalog lists the following attendance policy.

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Accommodations for Disabilities

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FINN 6210 Financial Elements of Derivatives

Course Description:
This course provides students with the opportunity to examine the nature and functions of futures and options markets. Topics include hedging for risk reduction and the role of derivative instruments in the capital markets; however, the course focuses on basic pricing techniques which are derived from no arbitrage relations.

Course Objectives:

- To develop an understanding of the role derivatives and options play in the economy and their importance in completing financial markets.
- To understand the economics of derivatives pricing.
- To understand how derivatives/options are used in practice and their limitations.

Prerequisite: FINN 6152 or equivalent, or permission of Department.

Text: *Options, Futures, and Other Derivatives,* by John C. Hull.

[The 8th Edition is the most recent. You may use an earlier edition if you already have it, but you are responsible for making sure the material and exercises coincide with assigned material.]

The solutions manual is optional but **strongly** recommended.

Order of Topics Covered:

Topic	Reading
Introduction	Ch 1
Futures and Forwards -- Market Mechanics and Hedging Begin Pricing	Ch 2 and Ch 3 Ch 5 (begin)
Futures and Forwards -- Pricing	Ch 5 (cont'd)
Interest Rates Commodity Swaps	Ch 4.1 – 4.7 Notes
Options-- Market Mechanics begin Options Properties	Ch 9 Ch 10
MIDTERM EXAM	
Properties and Trading Strategies	Ch 10 (cont'd) and Ch 11
Binomial Trees	Ch 12
Binomial Trees (cont'd) Risk Neutral Valuation	Ch 12 and Ch 20.1 – 20.5 Notes
Black-Scholes (part 1)	Ch 13 and Ch 14
MIDTERM EXAM	
Black-Sholes (part 2) Volatility	Ch 14 (cont'd), Ch. 16, Ch. 17 Ch 22.1 – 22.4 and Ch 19.1 – 19.5

Hedging Parameters (the Greeks) Monte-Carlo Method (Numerical)	Ch 18 Ch 20.6
Exotic Options	Ch 25
Extending Black-Scholes	Notes
FINAL EXAM	

Exams and Assignments:
There will be 2 or 3 graded assignments, 2 midterm exams, and a final exam. The graded assignments will be somewhat involved, and you are allowed (and encouraged!) to work in groups of 3 or 4. The exams will be closed book, but you will be allowed to bring in a "cheat sheet", filled with whatever formulas you wish. The final exam will focus on the final third of the course material, but the earlier material is fair game. The grade breakdown: the assignments together will count for 10% and each of the exams will count for 30% of your grade.

Finance doctoral students will also write a proposal for a research paper that focuses on any issue in derivatives in any area that we cover in this class. You are not expected to produce a finished paper; however the proposal must identify an outstanding research issue, discuss the current literature, and propose a research methodology. Basically I'm looking for you to answer the three questions in your write-up: What will you do, why will you do it, and how will you do it? Please see me for consultation on topics.

Missed Exams:
The midterm exams will be administered in class on Feb 13 and Mar 27. The final exam is on May 8. Please do not miss any of the exams. If you miss an exam and I don't hear from you beforehand then you will need to provide me with appropriate documentation for your absence that explains your emergency (emergencies include accidents, severe sickness, or life-or-death situations, **not** laziness or lack of preparation!), and we will make alternate arrangements.

Grading

A =100-90
B = 89-80
C = 79-70
U = 69-0

Statement on Academic Integrity:
All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html

Statement on Diversity:

The Belk College of Business strives to create an inclusive academic climate in which the dignity of all individuals is respected and maintained. Therefore, we celebrate diversity that includes, but is not limited to ability/disability, age, culture, ethnicity, gender, language, race, religion, sexual orientation, and socio-economic status.

FINN 6211 Fixed Income Securities and Credit Risk

Course Objectives:

The purpose of this course is to introduce the students to various aspects of the fixed-income securities and markets. Topics include the basic concepts of the fixed income securities, interest rates and yield curve, bond volatility measures, major fixed income sectors, bonds with embedded options, bond portfolio management, hedging and credit risk.

The material in this course is inherently quantitative. We will also introduce institutional details of the markets and market participants. Overall, you will get a big picture of the fixed income securities and markets. By the end of the course, you should expect to be able to

- Master the basic concepts of bond mathematics: yields, duration, and convexity.
- Understand the determinants of term structure.
- Learn about various sectors and participants in the fixed income security market, including the sovereign, mortgage backed, and international markets.
- Grasp the structure and valuation of bonds with embedded options.
- Learn about bond performance measures and portfolio management.
- Explore the structure and tools for hedging strategies.
- Examine credit risk.

Prerequisite: FINN 6210 or permission of Department**.**

Required Text: *Bond Markets, Analysis, and Strategies*, by Frank J. Fabozzi, 8th edition, 2013, Pearson. (Note: 7th edition is fine.)

Optional Text: *Fixed Income Securities: Tools for Today's Markets*, by Bruce Tuckman and Angel Serrat, 3rd edition, 2012, Wiley.

Reference: *Fixed Income Markets and their Derivatives*, by Suresh Sundaresan, 3rd edition, 2009, Academic Press/Elsevier.

Course Schedule

Week	Topic	Readings
1	**Introduction to the Fixed Income Securities (Lecture 1)**	**Fabozzi Ch.1. Tuckman Ch. 1 Sundaresan Ch. 1**
2	**Lecture 1, continued Bond Valuation and Yields (Lecture 2)**	**Fabozzi Ch. 2, 3 Tuckman Ch. 3 Sundaresan Ch. 2**
3	**Bond Price Volatility (Lecture 3)**	**Fabozzi Ch. 4 Tuckman, Ch. 4 Sundaresan Ch. 7**
4	**Lecture 3, continued Factors Affecting Bond Yields and the Term Structure of Interest Rates (Lecture 4)**	**Fabozzi Ch. 5 Tuckman Ch. 2 Sundaresan Ch. 3, 8**
5	**Lecture 4, continued Major Fixed Income Sectors, Part 1 Treasury, Agency, Corporate (Lecture 5)**	**Fabozzi Ch. 6, 7 Sundaresan Ch. 6**
6	**Lecture 5, continued Major Fixed Income Sectors, Part 2 Sovereign and International Bonds (Lecture 6) HW#1 Due!**	**Fabozzi Ch. 9**
7	**Midterm Exam (closed-books and notes), 5:30pm to 7:30pm**	
8	**Mortgaged Backed Securities (Lecture 7)**	**Fabozzi Ch. 11 Tuckman Ch. 20 Sundaresan Ch. 11,12**
9	**CMOs (Lecture 8)**	**Fabozzi Ch. 12, 18**

Course Schedule (continued)

Week	Topic	Readings
10	**Bonds with Embedded Options (Lecture 9)**	**Fabozzi Ch. 17, 19**
11	**Bond Portfolio Management (Lecture 10)**	**Fabozzi Ch. 22, 23**
12	**Lecture 10, continued**	
13	**Hedging (Lecture 11)**	**Tuckman Ch. 5, 6**
14	**Credit Risk (Lecture 12)**	**Fabozzi Ch. 20** **Sundaresan Ch. 10**
15	**Final Exam (closed-books and notes)** **Research Project Final Report Due!**	

Research Project

You are required to form a group of 3 students to work on a research project on one type of fixed income securities or derivatives. Once you have formed a group, decide on which particular fixed income instrument you would like to research on. You need to do a thorough research on this instrument and include in your project report the following items: (1) Current size, breadth and depth of the market, (2) main players, (3) purpose(s) of this instrument, (4) conditions of the secondary market, (5) risks in the instrument, and (6) how this instrument is valued in a theoretical framework. The attached document (at the end of the syllabus) titled "Research Project on Fixed Income Securities" contains the detailed requirements and instructions for the project.

Grading:

Two HW Assignments	20%
Min (Midterm Exam, Final Exam)	15%
Max (Midterm Exam, Final Exam)	45%
Research Project	20%
Total	*100%*

Grade Range: A: 90 to 100
B: 80 to 89
C: 70 to 79
U: 69 or below

Grades will be curved is necessary.

UNC Charlotte "Code of Student Academic Integrity" (the Code)

All UNC Charlotte students have the responsibility to be familiar with and to observe the requirements of The UNC Charlotte Code of Student Academic Integrity (see the Catalog). This Code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials (such as Library books on reserve), and complicity in academic dishonesty (helping others to violate the Code). Any further specific requirements or permission regarding academic integrity in this course will be stated by the instructor, and are also binding on the students in this course. Students who violate the Code can be punished to the extent of being permanently expelled from UNC Charlotte and having this fact recorded on their official transcripts. The normal penalty is zero credit on the work involving dishonesty and further substantial reduction of the course grade. In almost all cases, the course grade is reduced to "F." If you do not have a copy of the Code, you can obtain one from the Dean of Students Office or access it online at http://www.legal.uncc.edu/policies/ps-105.html. Standards of academic integrity will be enforced in this course. Students are expected to report cases of academic dishonesty they become aware of to the course instructor who is responsible for dealing with them.

Use of Cell Phones and Other Communications Devices

The use of cell phones or other communication devices is disruptive, and is therefore prohibited during class. Except in emergencies, those using such devices must leave the classroom for the remainder of the class period.

Disability Services

Students in this course seeking accommodations to disabilities must first consult with the Office of Disability Services (phone 704-687-4355, 230 Fretwell Building) and follow the instructions of that office for obtaining accommodations.

MATH6203 Stochastic Calculus for Finance I

Course Objectives

This course starts with the probability theory in discrete probability space, discrete-time stochastic processes, and derivatives pricing in the Binomial model. The second part covers probability theory in general probability space and continuous-time martingale and Markov processes. Topics include the It'o integral, Black-Scholes model, It'o-Doeblin formula, Girsanovs theorem, and Martingale Representation theorem. Applications to pricing of exotic derivatives and American options are discussed.

Prerequisite: Admission to Graduate Program and Permission of Program Director.

Textbooks: Steven Shreve:
Stochastic Calculus for Finance I: The Binomial Asset Pricing Model;

Course Description: We first study the probability theory in discrete probability space, and discrete-time stochastic processes, and then derive the Arbitrage Pricing Theory for derivatives in the Binomial model using martingale approach. Then we proceed to study probability theory in general probability space, including conditional expectation; and continuous-time martingale and Markov processes, in particular the Brownian motion. Integration with respect to stochastic processes, the Itô integral, will be introduced; and stochastic modeling, in particular the Black-Scholes model, will be analyzed. Stochastic calculus techniques involving Itô-Doeblin formula, Girsanovs theorem, and Martingale Representation theorem will be covered, as well as their applications to Risk-Neutral derivative pricing theory using martingale approach. This leads to the study of the First Fundamental Theorem of Mathematical Finance about equivalence between No-Arbitrage and the existence of risk neutral probability measures; and the Second Fundamental Theorem about the equivalence between market completeness and the uniqueness of the risk neutral probability measure. The Feynman-Kac formula will connect the risk neutral price to the solution of a partial differential equation in a Markovian setting. Applications to exotic derivative pricing (Lookback, Barrier and Asian options) and American option pricing will be presented. The change of numeraire techique will be discussed with its application to Foreign Exchange model, Forward Measure for interest rate dependent derivative pricing, and PDE dimension reduction for Asian option.

Lecture Plan:

1. Probability theory on an N-period binomial tree.
   - Random variable, stopping time, expectation (linearity, Jensen's inequality)
   - Discrete-time stochastic process, adapted process, first passage time, stopped process
   - Conditional expectation (linearity, take out what is known, independence, iterated conditioning, conditional Jensen's inequality), martingale ($X_n = E_n[X_{n+1}]$), Markov process ($\forall f, \exists g \ s.t. \ E_n[f(X_{n+1})] = g(X_n)$), Independence lemma, higher dimensional Markov process (for example, the stock price and its running maximum)
   - Martingale representation theorem, Radon-Nikodým derivative theorem, state price density
   - Martingale approach for European derivative pricing
     Risk Neutral Pricing Formula: for $n = N-1, N-2, ..., 0$,

$$(*)\ V_n = \tilde{E}_n\left[\frac{V_N}{(1+r)^{N-n}}\right] \ \Leftrightarrow \ V_n = \frac{1}{1+r}\tilde{E}_n[V_{n+1}], \quad \Delta_n = \frac{V_{n+1}(H)-V_{n+1}(T)}{S_{n+1}(H)-S_{n+1}(T)},$$

     where the Risk Neutral probabilities are

$$\tilde{p} = \frac{1+r-d}{u-d}, \quad \tilde{q} = \frac{u-1-r}{u-d}.$$

Path-independent case: for $n = N-1, N-2, ..., 0$,

$$V_n = v_n(S_n) \text{ and } \Delta_n = \delta_n(S_n)$$

where

$$(**) \quad v_n(x) = \frac{1}{1+r}(\tilde{p}v_{n+1}(ux) + \tilde{q}v_{n+1}(dx)) \text{ and } \delta_n(x) = \frac{v_{n+1}(ux)-v_{n+1}(dx)}{ux-dx}$$

- Path-dependent American derivative pricing formula

$$(*) \quad V_n = \max\left\{G_n, \frac{1}{1+r}(\tilde{p}V_{n+1}(H) + \tilde{q}V_{n+1}(T))\right\}, \quad \Delta_n = \frac{V_{n+1}(H)-V_{n+1}(T)}{S_{n+1}(H)-S_{n+1}(T)}.$$

  Path-independent formula: $V_n = v_n(S_n)$ and $\Delta_n = \delta_n(S_n)$

$$(**) \quad v_n(x) = \max\left\{g(x), \frac{1}{1+r}(\tilde{p}v_{n+1}(ux) + \tilde{q}v_{n+1}(dx))\right\} \text{ and } \delta_n(x) = \frac{v_{n+1}(ux)-v_{n+1}(dx)}{ux-dx}$$

- Foreign-Exchange option example

2. General probability theory
   - Probability measure defined on the sigma algebra of a probability space $(\Omega, \mathcal{F}, P)$, Examples: infinite tree, Borel sigma algebra and lebesgue measure on $[0,1]$
   - Random variables, distribution measure (discrete case $\mu_X(\{x_i\}) = p_i$, continuous case $\mu_X(dx) = f_X(x)dx$), expectation as the Lebesgue integral ($E[X] = \int_\Omega X(\omega)dP(\omega)$), properties of expectation ($E[X] = \int_{\mathbb{R}} x\mu_X(dx)$, monotonicity, linearity, Jensen's inequality, Cauchy-Schwarz inequality)
   - Black-Scholes formula, Put-Call parity
   - Absolute continuity and equivalence between probability measures, Radon-Nikodým derivative theorem, examples: how distribution of a random variable changes under change of probability measures
   - Using σ-algebra to represent information: σ-algebra generated by a random variable $\sigma(X)$; measurability (X is $\mathcal{G}$-measurable where $\mathcal{G}$ is a sigma-algebra); independence between events, σ-algebra, and random variables (and its relation to joint distribution measures); Example: joint normal distribution
   - Conditional expectation ($E[X|\mathcal{G}]$ where $\mathcal{G}$ is a σ-algebra), calculation of conditional expectation using conditional density, properties of conditional expectation: linearity, take out what is known, independence, iterated conditioning, conditional Jensen's inequality
   - Continuous-time stochastic process, filtration $\mathcal{F}_t$, adapted process, martingale ($X_t = E[X_s|\mathcal{F}_t]$), Markov process ($\forall f, \exists g \ s.t. \ E[f(X_s)|\mathcal{F}_t] = g(X_t)$), Independence lemma
3. Stochastic process and Itô integral
   - Brownian motion as the limit of a symmetric random walk
   - Discretizing the Black Scholes model to the binomial model and convergence of the option pricing formula
   - Formal definition of the Brownian motion: On $(\Omega, \mathcal{F}, P)$, a stochastic process W_t which has
     1. Continuous paths:
        Fix $\omega \in \Omega$, $W_t(\omega)$ is a continuous function of t; $W_0 \equiv 0$
     2. Independent increments: Fix $0 < t_1 < t_2 < ...$,
        $W_{t_1} - W_0$, $W_{t_2} - W_{t_1}$, $W_{t_3} - W_{t_2}$, ... are independent
     3. Stationary and normally distributed increments: $W_{t_{i+1}} - W_{t_i} \overset{\mathcal{D}}{\sim} N(0, t_{i+1} - t_i)$

     is called a Brownian Motion. The filtration $\mathcal{F}_t$ for B.M. W_t satisfies

     1. W_t is $\mathcal{F}_t$-measurable for all $t \geq 0$
     2. $W_t - W_s$ is $\mathcal{F}_s$-independent for all $0 \leq s \leq t$

- Properties of Brownian motion: independent and stationary increments, reflection principle, martingale property, Markov property (transitional density), constant quadratic variation, nowhere differentiable
- Stopping time in general, first passage time for Brownian motion and its distribution, joint distribution of Brownian motion and its running maximum, pricing European Barrier option
- Multi-dimensional Brownian motion, Lévy theorem, higher dimensional Black-Scholes model
- Itô integral: $X_t = \int_0^t \delta_s dW_s$ where δ_t is an adapted process and W_t is a Brownian motion.
- Properties of Itô integral: linearity, continuous path, adaptivity, martingale property, quadratic variation (calculation using differential rules), Itô isometry

- Itô-Doeblin formula:

$$df(W_t) = f'(W_t)dW_t + \frac{1}{2}f''(W_t)dt$$

$$df(t, W_t) = f_t(t, W_t)dt + f_x(t, W_t)dW_t + \frac{1}{2}f_{xx}(t, W_t)dt$$

- Itô integral with respect to Itô process: $\int_0^t \gamma_s dX_s$, where γ_t is an adapted process and X_t is an Itô process $dX_t = \theta_t dt + \delta_t dW_t$.

- Itô-Doeblin formula for Itô processes:

$$\begin{aligned}
df(X_t) &= f'(X_t)dX_t + \frac{1}{2}f''(X_t)dX_t dX_t \\
df(t, X_t) &= f_t(t, X_t)dt + f_x(t, X_t)dX_t + \frac{1}{2}f_{xx}(t, X_t)dX_t dX_t \\
df(t, X_t, Y_t) &= f_t(t, X_t, Y_t)dt + f_x(t, X_t, Y_t)dX_t + f_y(t, X_t, Y_t)dY_t \\
&\quad + \frac{1}{2}f_{xx}(t, X_t, Y_t)dX_t dX_t + \frac{1}{2}f_{yy}(t, X_t, Y_t)dY_t dY_t + f_{xy}(t, X_t, Y_t)dX_t dY_t
\end{aligned}$$

- Examples: Black-Scholes (geometric Brownian motion), mean reverting process (Ornstein-Uhlenbeck process, Vasicek interest rate model), Cox-Ingersol-Ross model, Hull-White model.
- Recognizing Itô process as a martingale, recognizing Itô process as a Markov process, higher dimensional Markov process
- Girsanov theorem, martingale representation theorem
- Martingale approach for European derivative pricing in the Black-Scholes model
  Risk Neutral Pricing Formula:

$$(*)\ V_t = \tilde{E}\left[e^{-r(T-t)}V_T|\mathcal{F}_t\right]$$

  Path-independent case:

$$V_t = v(t, S_t) \text{ and } \Delta_t = \delta(t, S_t),$$

  where the value function satisfies the Black-Scholes-Merton PDE:

$$(**)\begin{cases} v_t(t,x) + rxv_x(t,x) + \frac{1}{2}\sigma^2x^2v_{xx}(t,x) = rv(t,x),\ t \in [0,T),\ x \in [0,\infty) \\ v(T,x) = f(x) \end{cases}$$

  and the Delta hedge is

$$\delta(t,x) = v_x(t,x)$$

- Examples: Call option pricing PDE, Knock-Out Barrier option pricing PDE:

$$\begin{cases} v_t(t,x) + rxv_x(t,x) + \frac{1}{2}\sigma^2 x^2 v_{xx}(t,x) = rv(t,x),\ t \in [0,T),\ x \in [0,L] \\ v(T,x) = (x-K)^+,\ x \in [0,L] \\ v(t,0) = 0,\ t \in [0,T] \\ v(t,L) = 0,\ t \in [0,T) \end{cases}$$

  Lookback Call option pricing PDE and Asian option pricing PDE:

$$\begin{cases} v_t(t,s,y) + rsv_s(t,s,y) + sv_y(t,s,y) + \frac{1}{2}\sigma^2 s^2 v_{ss}(t,s,y) = rv(t,s,y), \\ \qquad\qquad 0 \le t < T,\ s \ge 0,\ y \in \mathbb{R} \\ v(T,s,y) = (\frac{y}{T} - K)^+,\ s \ge 0,\ y \in \mathbb{R} \\ v(t,0,y) = e^{-r(T-t)}(\frac{y}{T} - K)^+,\ 0 \le t < T,\ y \in \mathbb{R} \\ \lim_{y \searrow -\infty} v(t,s,y) = 0,\ 0 \le t < T,\ s \ge 0 \end{cases}$$

- Multi-dimensional Girsanov theorem, Multi-dimensional martingale representation theorem
- Multi-dimensional market model and risk neutral pricing formula, fundamental theorems of mathematical finance (existence of risk neutral measure equivalent to absence of arbitrage, uniqueness of the risk neutral measure equivalent to market completeness), Examples: two-dimensional Black-Scholes model, Heston model

4. American derivative securities and optimal stopping

- Optional decomposition theorem for Snell envolope

$$(*) \quad V_t = \operatorname*{esssup}_{\tau \in \mathcal{T}_t^T} \tilde{E}\left[e^{-r(\tau - t)} G_\tau | \mathcal{F}_t\right]$$

- Probabilistic and analytic optimality condition. For American derivatives with path-independent payoff function $G_t = g(S_t)$:

  Theorem 1 (Analytic Optimality Condition) *Define operator $\mathcal{L}$ as $\mathcal{L} = \frac{\partial}{\partial t} + rx\frac{\partial}{\partial x} + \frac{1}{2}\sigma^2 x^2 \frac{\partial^2}{\partial x^2}$. Suppose $v(t,x)$ has continuous first derivative $v_x(t,x)$ and satisfies*

$$(**) \quad \begin{cases} \max\{g(x) - v(t,x), \mathcal{L}v(t,x) - rv(t,x)\} = 0,\ t \in [0,T) \\ v(T,x) = g(x) \end{cases}$$

$$\begin{aligned} \textit{Define} \qquad \mathcal{C}_t &= \{x \in \mathbb{R} : v(t,x) > g(x)\} \quad \textit{Continuation Region} \\ \mathcal{D}_t &= \{x \in \mathbb{R} : v(t,x) = g(x)\} \quad \textit{Stopping Region} \end{aligned}$$

  and $\tau^* = \inf\{t \ge 0 : S_t \in \mathcal{D}_t\}$. Then $(v(0,S_0), \tau^*)$ is the solution to the main optimal stopping problem faced by the buyer:

$$v(0,S_0) = V_0^B = \max_{\tau \in \mathcal{T}_0^T} \tilde{E}[e^{-r\tau} G_\tau] = \tilde{E}[e^{-r\tau^*} G_{\tau^*}]$$

  and the Delta Hedge $\Delta_t = v_x(t,S_t)$ is the super-hedging strategy.

- Examples: American call, finite and infinite horizon American put

5. Advanced topics

   - Pricing FX option
   - Change of numeraire approach. Application: Asian option pricing PDE dimension reduction

     $$V_t = S_t g(t, M_t)$$

     with the Black-Scholes-Merton PDE

     $$\begin{cases} g_t(t,m) + \frac{1}{2}\sigma^2(\Delta_t - m)^2 g_{mm}(t,m) = 0,\ 0 \le t < T, m \in \mathbb{R} \\ g(T,m) = m^+ \end{cases}$$

     Application: Forward measure and interest rate derivative pricing (Black caplet formula)

Grading

A =100-90
B = 89-80
C = 79-70
U = 69-0

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King, Dolly

From: Watson, Johnna
Sent: Monday, February 03, 2014 12:35 PM
To: King, Dolly
Cc: Tian, Weidong
Subject: RE: MS in Mathematical Finance: new concentrations

Dolly,

Certainly! The plan sounds great and we can create them once the proposal is finalized.

Thanks for the speedy inquiry and response.

Johnna

From: King, Dolly
Sent: Monday, February 03, 2014 12:20 PM
To: Watson, Johnna
Cc: Tian, Weidong
Subject: RE: MS in Mathematical Finance: new concentrations

Dear Johnna,

I have discussed with Dr. Weidong Tian about how students choose concentrations in the revised program. We would like to go with the last option (out of the three options you listed below): We allow students to choose a concentration when they apply, but leave an "Other/Not Decided" choice. Students who choose to be in the "Other/Not Decided" group will need to declare a concentration by the end of their first semester.

Please let me if we can set it up this way. I am finalizing the revisions of the long form proposal and will submit to the Graduate Council as soon as I get the confirmation from you.

Thank you!

Dolly

_____
Tao-Hsien Dolly King, Ph.D. | Rush S. Dickson Professor of Finance
Chair, Department of Finance
UNC Charlotte | Belk College of Business
211A Friday Building
9201 University City Blvd. | Charlotte, NC 28223
Phone: 704-687-7652| Fax: 704-687-1412
tking3@uncc.edu| http://belkcollegeofbusiness.uncc.edu/tking3/
_____

From: Watson, Johnna
Sent: Friday, January 31, 2014 2:51 PM
To: King, Dolly
Subject: RE: MS in Mathematical Finance: new concentrations

Hi, Dolly,

Thanks for reaching out to me regarding the new concentrations for the MS in Mathematical Finance. The concentration will appear on the student transcript, but NOT on the diploma. Also, a couple questions/comments for you:

- Must applicants choose a concentration at the point of application for admission? If yes, then the application will be set up as three distinct programs to identify the specific concentration.
- If no, students can declare (or change) a concentration later on in the academic program by submitting an Academic Petition.
- Some programs will allow applicants to choose a concentration but will leave the option not to do so; if the program wishes to do this, I will set up the application for admission to have four distinct programs (three with concentrations and one without).

Johnna

From: King, Dolly
Sent: Wednesday, January 29, 2014 9:34 PM
To: Watson, Johnna
Subject: MS in Mathematical Finance: new concentrations

Hi Johhna,

The Finance Department is proposing major changes to the MS in Mathematical Finance Program and one of the major changes is to create three concentrations within the program. Based on the suggesiton by the Graduate Council, we need to consult with you about having the concentrations appear on student transcripts and diplomas. Can you please advise how we should go about doing that?

Thank you,

Dolly

_____
Tao-Hsien Dolly King, Ph.D. | Rush S. Dickson Professor of Finance
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_____

From: Parks, Annette
Sent: Wednesday, January 29, 2014 4:56 PM
To: King, Dolly
Cc: Blankley, Alan; McGregor, Rob; Freitag, Alan; Schwarz, Peter
Subject: Requested Revisions to Graduate Course Proposal - FINN 10-01-13

Sent on behalf of Dr. Alan Freitag, Graduate Council Chair
by: Annette Parks, Graduate Council Secretary

Hi Dolly,

The Graduate Council met on January 14, 2014 to consider the attached long form graduate course proposal. The Council voted to defer approval until the following requirements are satisfied. Please revise your proposal and send a

revised version in Word and Pdf formats to me and I will secure Chair Freitag's approval signature and forward to the Faculty Governance Assistant.

Because there were 17 graduate course proposals to review at this meeting, Chair Freitag assigned subgroups to review the proposals. Your subgroup was Susan McCarter, Peter Schwarz and Kelly Anderson.

A. FINN 10-01-13: Major Changes to MSMF Program of Study
Subgroup Reviewers: McCarter, Schwarz, Anderson

Chair Freitag called for a motion to consider. A discussion took place and the following revisions were requested:

- Long form proposal seems to be in good order, however, the syllabus lacks standardization and many are missing pre- and co-requisites, course objectives and graduate grading schemes (several listed the undergraduate grading scheme).
- Page 39 of pdf (or printed page 22) Use graduate grading scale – make grading scheme mutually exclusive – no overlap between grade points.
- If program wants concentrations to appear on the student transcripts, please contact Johnna Watson (Graduate School).
- Does this affect Student Learning Outcomes? If so, is this addressed?

There being no further discussion, Chair Freitag made a motion to approve pending revisions. McCarter the motion with a second from Anderson. The motion was unanimously approved.

Thank you,

Annette
Annette Parks, Executive Assistant to the Dean
Graduate Council Secretary
The Graduate School at UNC Charlotte
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