

**GRADUATE SCHOOL OF BUSINESS**  
**QUANTITATIVE METHODS I - MATHEMATICS FOR FINANCE**  
**AND ECONOMICS**  
**SYLLABUS**

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Monday 6.00-9.00pm

1. COURSE DESCRIPTION

Quantitative Finance is a type of applied mathematics that is applicable to financial markets and their participants. The goal of this course is ambitious in that it seeks to survey the underlying mathematics that will be encountered in applications such as Fixed Income, Option Pricing, Portfolio Theory and Risk Analysis. It draws from the following areas of mathematics: Calculus, Linear Algebra, Probability Theory and Partial Differential Equations. Each one of these areas is deep area of study and deserves its own course(s). However, we will only cover what is needed for its direct application to finance. We will also cover the computational aspects of Quantitative Finance. During the course you will also learn the Matlab programming language and apply it various financial problems.

2. INSTRUCTOR HOURS, AVAILABILITY

I will hold office hours on Mondays 5.15-6.00 pm. If you need further help, you may email me for an appointment.

3. GRADING

Midterm 30% Final 30% Homework 40%

For some of the homework assignments, in particular those that require programming, you are strongly urged to collaborate and form small groups of 2,3 students.

4. TEXTBOOK / SOFTWARE

I will provide comprehensive class notes just prior to the class and will base my lectures on them. However, there is one required book which contains supplementary readings and problems.

This book will serve you well both for this course as well as for other courses down the road.

- (1) John Hull, Options Futures and other derivatives This book is a classic and is found on the desks of many quants and MBA grads. Although it is quite technical, the material is introductory and the math is kept to a minimum. You may use either the 6th or 7th edition.

For the programming assignments, we will be using the *Matlab* programming language from Mathworks. You may purchase the *Student Edition of* directly from Mathworks for \$99 or you have another option which is also perfectly acceptable.

You may download *Octave* from the internet for free. Prior to downloading Octave you must also download another freeware package called *gnuplot* which enables plotting. The advantage of Matlab over Octave is that its documentation is terrific and it is quite stable and more powerful in terms of functionality.

## 5. COURSE OUTLINE

- Lecture 1: (Nov. 10) Calculus Review  
Functions, limits, derivatives, series and sequences, logarithms, integration, multivariate functions, partial derivatives, introduction to partial differential equations.
- Lecture 2: (Nov. 17) Bond/Fixed Income Mathematics:  
This lecture will cover the mathematics underlying fixed income and describe how to price most common bonds (ie. Zero Bonds, Coupon bearing bonds etc). Bond analytic measures such as yield to maturity, duration and convexity will also be covered. Description of the family of swap instruments. Pricing a Vanilla Swap.
- Lecture 3: (Nov 24) Probability Survey  
The goal of this lecture is to present concepts from basic probability that are applicable to finance.
- Lecture 4: (Dec 1) Options Pricing Theory:  
Parabolic Partial Differential Equations (PDEs), Black Scholes PDE, relation to heat equation, Analytical Greeks.
- Lecture 5: (Dec 8) Mathematics of Portfolio Theory  
Survey of Linear Algebra, solving multivariate systems of equations. Matrices and vectors, matrix decompositions, Eigenvalues, Eigenvectors, Discrete Fourier Transforms
- **MIDTERM (Jan 12)**
- Martin Luther King Day – (Jan 19) NO CLASS
- Lecture 6: (Jan 26) Application of Linear Algebra to Interest Rates.  
Bootstrapping/smoothing a yield curve, Principal Components Analysis
- Lecture 7 (Feb 2) Mathematics of Portfolio Theory I  
Mean Variance Portfolios, Calculation of volatility and correlation from past returns, Efficient Portfolios.
- Lecture 8: (Feb 9) Mathematics of Portfolio Theory II  
Risk Measures, Discussion of VaR, Credit Risk.  
Ethical Implications Discussion
- **Review and Final (Feb 16)**