

# Syllabus

## Course Meeting Times

Lectures: 2 sessions / week, 1.5 hour / session

## Prerequisites

- [18.01 Single Variable Calculus](#)
- [18.02 Multivariable Calculus](#)
- [18.03 Differential Equations](#)
- [18.05 Introduction to Probability and Statistics](#) or [18.440 Probability and Random Variables](#)
- [18.06 Linear Algebra](#)

Broad familiarity with linear algebra, statistics, stochastic processes and partial differential equations will be helpful (but not required). Prior knowledge of economics or finance is not required but may be helpful for some lectures.

## Description

The purpose of the class is to expose undergraduate and graduate students to the mathematical concepts and techniques used in the financial industry. The course will consist of a set of mathematics lectures on topics in Linear Algebra, Probability, Statistics, Stochastic Processes and Numerical Methods. Mathematics lectures will be mixed with lectures illustrating the corresponding application in the financial industry.

MIT mathematicians will teach the mathematics part while industry professionals will give the lectures on applications in finance. We also plan to organize an optional field trip to visit Morgan Stanley offices in New York.

## Goals for the Class

1. Be able to derive price-yield relationship and understand convexity.
2. Bootstrap a yield curve.
3. Compute standard Value At Risk and understand assumptions behind it.
4. Estimate volatility of an option.
5. Derive Black-Scholes equations using risk-neutral arguments.
6. Understand decomposition of matrices in statistics (and probability) point of view, e.g. principle component analysis.

7. Use statistical techniques and methods in data analysis; understand the advantages and limitations of different methods.
8. Understand basic limiting theorems and assumptions behind them.
9. Understand Ito's lemma and its applications in financial mathematics.
10. Understand Girsanov's theorem and change of measure.

### **Assessments**

The class will have problem sets for each math lecture due in two weeks after each math lecture, and a final paper on a math finance topic of student's choice. There will be no exams.

### **Grading**

The final grade will be 75% based on the homework and 25% on final paper.

### **About the Instructors**

Dr. Peter Kempthorne is a Lecturer in the MIT Department of Mathematics on financial mathematics and statistics. He is also President of Kempthorne Analytics and formerly was an Associate Professor and Principal Research Scientist at MIT Sloan School of Management with research focus on statistical modeling in finance.

Dr. Choongbum Lee is an Instructor in the MIT Department of Mathematics. His interests include Extremal Combinatorics, Ramsey Theory, Random Structures and other related fields.

Dr. Vasily Strela is a Research Affiliate in the MIT Department of Mathematics. He is also a Managing Director and the Global Head of Fixed Income Modeling at Morgan Stanley.

Dr. Jake Xia is a Research Affiliate in the MIT Department of Mathematics and a Visiting Scholar in the MIT Sloan Business School. He is Managing Director and Chief Risk Officer of Harvard Management Company. Prior to that, he was Managing Director of Morgan Stanley.