RMSC 4003
Statistical Modeling in Financial Markets

1. Description:

This course is designed to introduce the current developments in risk management in the financial markets. Risk management ideas associated with two general important areas in finance will be discussed: asset management and derivative pricing. Emphasis will be placed on the statistical modeling aspects of some of the commonly used models in the area of market risk.

2. Prerequisites:

A sound familiarity with undergraduate statistics and probability at the level of STAT 2001-2006. Working knowledge of multivariate calculus and linear algebra. Some knowledge of computer programming and finance will be helpful. You will have to use the computer package **R** during the semester.

3. Learning outcomes

After finishing the course, students should be able to

- understand the concepts of mean-variance analysis, Markowitz optimal portfolio, and efficient frontier for a one-period investment.
- develop statistical skills in analyzing some of the models employed in market risk management procedures, including factor models, capital asset pricing model (CAPM), and arbitrage pricing theory (APT)
- understand the idea of pricing of equities and derivatives, including diffusions, Brownian motions, Ito's calculus and the Black-Scholes formula.

3. Course Content

Topic	Contents/ concepts
0. Introduction	Overview of market risk analysis
1. Portfolio theory	Markowitz Portfolio Theory, Tangency Portfolio, No-short-sell constraints
2. Capital asset pricing model (CAPM)	Capital asset pricing model (CAPM), Parameter estimation in CAPM
3. Arbitrage Pricing Theory (APT)	Fama-French Factor Models, Arbitrage pricing theory (APT), Time Series Regression, Cross-Sectional Regression
4. Discrete Time Financial Model	Discrete time financial model, Principle of No-Arbitrage Pricing, Risk neutral probability, Multi-period Binomial models
5. Continuous Time Financial Model	Continuous time financial model, Black-Scholes formula
6. Stochastic Calculus	Functional Central Limit Theorem, Brownian motions, Diffusion processes, Ito's calculus, Black-Scholes formula.

4. Tentative course schedule

Class/ week	Topic
1	Topic 0
2	Topic 1
3	Topic 1
4	Topic 2
5	Topic 2 & 3
6	Topic 3
7	Mid-Term
8	Topic 4
9	Topic 4 & 5
10	Topic 5
11	Topic 6
12	Topic 6
13	Topic 6

4. Assessment Scheme

Type	Description	Weight
Assignment	4-5 assignments on problems solving	20%
Mid-term Examination	One two-hour written mid-term test	30%
Final Examination	One two-hour written examination	50%

Absolute grading:

- **A : overall mark ≥ 90**
- **A- : overall mark lies in [80, 90)**
- **B+ : overall mark lies in [70, 80)**
- **B : overall mark lies in [60, 70)**
- **B- : overall mark lies in [50, 60)**
- **C+: overall mark lies in [45, 50)**
- **C : overall mark lies in [40, 45)**
- **C-, D, F are determined case-by-case**

6. Teachers' contact details

Instructor	
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7. Course materials

a) Lecture notes and other course materials can be downloaded from Blackboard.

b) References:

1. **Hull, J. (2003). Options, Futures, and Other Derivatives, 5th Ed. Prentice Hall, New Jersey.**
2. **Sharpe, W.F., Alexander, G.J., and Bailey, J.V. (2003). Investments, 7th Ed. Prentice Hall, New Jersey.**
3. **Shiller, R.J. (2003). The New Financial Order. Princeton University Press, Princeton.**
4. **Lai, T.L. and Xing, H. (2008). Statistical Methods and Models for Financial Markets. Springer-Verlag, New York.**
5. **Ruppert, D. (2004) Statistics and Finance. Springer Science+Business Media, New York**
6. **Financial Times (www.ft.com)**
7. **Risk Magazine (www.risk.net)**

8. Academic honesty and plagiarism

The Chinese University of Hong Kong places very high importance on honesty in academic work submitted by students, and adopts a policy of *zero tolerance* on cheating and plagiarism. Any related offence will lead to disciplinary action including termination of studies at the University. Relevant information can be allocated via: http://www.cuhk.edu.hk/policy/academichonesty/.