

RMSC5101
Statistical Modeling in Financial Markets

Instructor: Professor N.H. Chan Lady Shaw G18, 39438519, nhchan@sta.cuhk.edu.hk

Textbooks:

1. Luenberger, D.G. (1998). *Investment Science*. Oxford University Press, New York.
2. Ruppert, D. (2004). *Statistics and Finance: An Introduction*. Springer-Verlag, New York.
3. Chan, N.H. and Wong, H.Y. (2006). *Simulation Techniques in Financial Risk Management*. Wiley, New York.

Prerequisites: A sound familiarity with undergraduate statistics and probability at the level of 2001-2006. A working knowledge of multivariate calculus and linear algebra. A certain amount of “maturity” for a beginning postgraduate level course. Some knowledge of computer programming and finance will be helpful. You will have to use some computer packages during the semester, most likely **S-Plus** or **R**.

Description: This course is designed to introduce the current developments of 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 on some of the commonly used models in the area of market risk. The following are useful 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.

Learning Outcomes and Objectives: This course comprises the following three modules. The learning outcomes and objectives of each module can be stipulated as follows.

1. The first module consolidates and deepens some of the concepts previously acquired in other finance/economics related courses.
 - (a) To explain the notion of variation as a measure of risk and its relationship to statistics and risk management.

- (b) To demonstrate the ability to understand the concepts of mean-variance analysis and Markovitz optimal portfolio for a one-period investment.
 - (c) To be able to interpret and infer from the mean-variance analysis and the ideas of efficient frontiers and minimum variance portfolio.
2. The second module develops statistical skills in analysing some of the models employed in market risk management procedures. Both simulations and analytical approaches will be discussed.
 - (a) To understand the notion of factor models and their relationship to linear regressions.
 - (b) To relate the celebrated CAPM model with factor model and their statistical underpinnings.
 - (c) To explain the concepts of APT and its reconciliation with the CAPM.
 3. The third module introduces the idea of market risk management in financial world related to pricing of equities, portfolio management, derivative products, and other related activities. To understand the role of risk management in the financial sector, some of the commonly used statistical models in finance will be discussed in detail.
 - (a) To explain and demonstrate the basic notion of diffusions and their applications to finance and risk management.
 - (b) To demonstrate a basic understanding of the Itô's calculus.
 - (c) To demonstrate a working knowledge of applying Itô's calculus, in particular with respect to standard Brownian motion.
 - (d) To be able to differentiate both conceptually and practically the notion of integration by parts between ordinary and Itô's calculus.
 - (e) To apply Itô's calculus to option pricing and the Black-Scholes formula.
 4. Finally, this course also prepares students to acquire the necessary background for other courses in risk management and finance, including but not limited to RMSC5102, RMSC5001 and RMSC5002.
 - (a) The first module prepares background for topics in courses like RMSC5102 and RMSC5001.
 - (b) The second module prepares background for topics covered in RMSC5102 and RMSC5002.
 - (c) The third module prepares preliminary background for topics covered in RMSC5102, RMSC5001 and RMSC5002.

Learning Activities: This course mainly consists of regular classroom lectures and tutorials. Format of the lecture includes regular teaching, discussions and/or problem

solving. Tutorials cover discussions of assignments and computer exercises. Teaching materials will be uploaded to the Webct prior to lectures. Students are expected to browse through the lecture notes before attending lectures and to engage in classroom discussions. From time to time, students may be required to use the web to download further reading materials related to the course.

Assignments:

1. Regular problem sets and/or projects (20%).
2. A mid term exam (35%).
3. A final exam (45%).

Note: Assignments should discuss the results of your analysis. Conclusions and interpretation of the results are the most important part of your write-up. **Never hand in raw computer output.** Cut out plots, tables etc. from the output and include them in your report as needed.

Academic Honesty: Students are required to honestly conduct all academic activities and in utmost good faith. Acts of academic dishonesty such as plagiarism, impersonation, cheating in examinations and collusion are strictly prohibited. Any alleged cases of academic dishonesty will be reported to the appropriate Disciplinary Committee. Established cases will lead to disciplinary action including termination of studies.

Web and Related Resources:

1. *Financial Times*
2. *International Herald Tribune*
3. *Risk Magazine*
4. <http://www.investwords.com>
5. <http://www.investopedia.com>
6. <http://webct.cuhk.edu.hk>

Office Hours:

By appointment.