Unit Outline*

FINA2205
Quantitative Methods for Finance

1st Semester, 2011
Crawley Campus

Unit Coordinators: Sirimon Treepongkaruna & Andrei Volodin

EQUIS

Business School
www.business.uwa.edu.au

* This Unit Outline should be read in conjunction with the Business School Unit Outline Supplement available on the Current Students web site http://www.business.uwa.edu.au/students
UNIT DESCRIPTION

Introduction

The unit Quantitative Methods for Finance (FINA2205) is run jointly by UWA Business School and UWA School of Mathematics and Statistics. Dr Andrei Volodin from the School of Mathematics and Statistics is teaching the selected topics from statistics that are essential for understanding the concepts in finance. The parts of the unit that primarily relate to applications in finance are taught by Dr Sirimon Treepongkaruna. The lectures are accompanied by workshops.

Since the ground breaking work of Nobel laureates Markowitz, Black, Scholes and Merton, mathematics has emerged as an essential tool to address fundamental questions in finance. Quantitative finance is an important and rapidly growing discipline and has made great contributions to the theory and practice of finance. There is a large demand for qualified graduates with a strong background in finance, probability, and statistics.

This unit aims to provide a sound background at the second-year level in concepts and methods of probability and its applications for students in Accounting and Finance intending to proceed to third-year units in derivative securities and/or to Honours in Accounting and Finance. The topics covered in FINA2205 lay a foundation for advanced units that emphasize the theory of pricing and hedging options, and investments decisions like portfolio selection. The third year unit FINA3306 Derivatives Investment Strategies covers most aspects of pricing and hedging of options, futures and forward contracts. Further option pricing theory and portfolio theory are provided in the postgraduate units FINA7463 Current Developments in Derivative Securities, and FINA7481 Advanced Investments. FINA2205 also introduces students at an elementary level to time series models, which is treated in detail in the postgraduate unit offered by the economics discipline, ECON7413/8513 Topics in Applied Econometrics.

Unit content

The main emphasis of FINA2205 is placed on understanding concepts and methods of probability, like mean and variance, and relate them to settings in finance, where, e.g., mean and variance can be associated with expected return and risk of an investment. The main fields of applications in this unit are (i) Markowitz’ optimal portfolio theory; (ii) determining the fair price of derivative securities, in particular the binomial and the Black-Scholes models for pricing option contracts; and (iii) risk management and value at risk. Common time series models such as AR, MA, ARCH and GARCH are also introduced at an elementary level, with particular examples from finance.

The unit emphasises practical rather than theoretical aspects, but contains sufficient material for students to feel comfortable with the basic properties of random variables and joint distributions, elementary ideas of conditional distributions and a survey of common distributions including the normal, log-normal, Bernoulli, Binomial and Poisson. Some statistical ideas related to the multivariate normal are developed. In addition, the concept of Brownian motion is introduced that is fundamental for understanding modern option pricing theory of Black and Scholes. Applications throughout are in terms of financial models and complemented with hands-on exercises using real data.
Learning outcomes

Students are expected, on completion of this unit, to be able to:

♦ grasp the concept of distributions of a random variable, e.g., return on a stock, which can be made explicit be the random variable’s mean, expectation, and more comprehensively by its distribution function and density function;
♦ relate to prominent distributions like normal, Bernoulli, binomial, Poisson, exponential, log-normal, uniform;
♦ utilize methods of generating functions, conditional probability, and law of total probability in order to describe a random variable, and compute expectations of transformed random variables;
♦ describe dependence between two random variables by their joint distribution;
♦ construct portfolios in an optimal way using the Markowitz’ theory of optimal allocation of securities;
♦ utilize the non-arbitrage principle to price options in the binomial framework of Cox, Ross and Rubinstein and solve for risk-neutral probabilities;
♦ recognize the framework of Black and Scholes for pricing options as a continuous time limit of the binomial model, and become acquainted with the concept of Brownian motion replacing the binomial distribution when proceeding to the continuous time framework of Black and Scholes;
♦ compute Value-at-Risk of an investment as a prominent measure of risk; and
♦ identify and understand the properties of commonly-used time series models.

Educational principles and graduate attributes

In this unit, you will be encouraged and facilitated to develop the ability and desire to:

♦ relate problems in finance to a model and developing this model by using concepts of probability theory;
♦ apply quantitative techniques for solving finance problems once they are stated in a sound model;
♦ apply software like Excel as tool for solving numerical problems; and
♦ understand the limitations that are inherent when using a model for approximating the real world.

TEACHING AND LEARNING RESPONSIBILITIES

Teaching and learning evaluation

You may be asked to complete two evaluations during this unit. The Student Perception of Teaching (SPOT) and the Students’ Unit Reflective Feedback (SURF). The SPOT is optional and is an evaluation of the lecturer and the unit. The SURF is completed online and is a university wide survey and deals only with the unit. You will receive an email from the SURF office inviting you to complete the SURF when it is activated. We encourage you to complete the forms as your feedback is extremely important and can be used to make changes to the unit or lecturing style when appropriate.

Attendance

Participation in class, whether it be listening to a lecture or getting involved in other activities, is an important part of the learning process, therefore it is important that you attend classes. More formally, the University regulations state that ‘to complete a course or unit students shall attend prescribed classes, lectures, seminars and tutorials’.
CONTACT DETAILS

We strongly advise students to regularly access their student email accounts. Important information regarding the unit is often communicated by email and will not be automatically forwarded to private email addresses.

<table>
<thead>
<tr>
<th>Unit coordinator/lecturer</th>
<th>Name: Sirimon Treepongkaruna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email:</td>
<td><a href="mailto:sirimon.treepongkaruna@uwa.edu.au">sirimon.treepongkaruna@uwa.edu.au</a></td>
</tr>
<tr>
<td>Phone:</td>
<td>6488 7853</td>
</tr>
<tr>
<td>Consultation hours:</td>
<td>TBA</td>
</tr>
<tr>
<td>Lecture times:</td>
<td>Tuesday 4-6 pm</td>
</tr>
<tr>
<td>Lecture venue:</td>
<td>Chemistry: Tattersall Lecture Theatre</td>
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<table>
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<tr>
<th>Name: Andrei Volodin</th>
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<tbody>
<tr>
<td>Email: <a href="mailto:andrei@math.uwa.edu.au">andrei@math.uwa.edu.au</a></td>
</tr>
<tr>
<td>Phone: 6488 3356</td>
</tr>
<tr>
<td>Consultation hours: TBA</td>
</tr>
<tr>
<td>Lecture times: Tuesday 4-6 pm</td>
</tr>
<tr>
<td>Lecture venue: Chemistry: Tattersall Lecture Theatre</td>
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</tbody>
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Note: Teaching staff will only respond to emails with reference to the sender’s student name and student number.
TEXTBOOK(S) AND RESOURCES

Prerequisites
A background in probability and statistics at least to the level of STAT1520 Economic and Business Statistics will be assumed. Students must also have passed one of the mathematics units MATH1010, MATH1040, MATH1165, or MATH2030.

Unit website
This unit is on WebCT. Lecture notes and solutions to tutorial questions will be downloadable from WebCT. Class announcements in relations to examinations will also be posted to this site. You need your student number and pin number to log on.

Required text

Optional text

Software requirements
Password for accessing the computers in the labs. Please make sure that you have access at the beginning of the semester so that your lab hours can be efficiently utilised.

Additional resources
Will be posted to WebCT from time to time.

Workshops
Students will be allocated to one of the two weekly workshops. Attendance in workshops is extremely important for understanding unit material and developing collaborative skills in small groups.

The questions and problems in the workshops will be mainly related to material in the lectures immediately before them but may require knowledge from previous weeks.
## UNIT SCHEDULE

<table>
<thead>
<tr>
<th>Week No. &amp; date</th>
<th>Topic</th>
<th>Lecture</th>
<th>Text reference</th>
</tr>
</thead>
</table>
| 1 1 Mar        | Introduction to the unit Basic concepts | Financial data, Returns, risk, random walk, Brownian motion, and their geometric versions | Bean 1.5  
Ruppert 3.1-3.3 |
| 2 8 Mar        | Revision of probability concepts | probability, random variables and probability laws, independence, expectation, variance, Averages and law of large numbers, CLT | Bean: 3.1, 4.1.1-5, 5.1, 2.2, 4.2.1, 8.4, 8.5 |
| 3 15 Mar       | Simple and compound growth | Simple and compound growth, perpetuities, Types of random variables, cdfs, pmfs, pdfs | Bean: 2.4, 4.1.1-4.1.7 |
| 4 22 Mar       | Discrete random variables | Bernoulli, binomial and geometric laws, binomial trees, generating functions | Bean: 5.1, 5.2, 5.4  
5.2 |
| 5 29 Mar       | Continuous random variables | Conditional probability, Law of total prob., Bayes theorem, Continuous rv's: exponential, normal, lognormal | Bean: 3.3, 3.4  
6.1.1, 6.2.2, 6.3.2 |
| 6 5 Apr        | Expectation and joint distributions | Functions of rv’s, $E(g(X))$, transforms of rv’s, Joint distributions | Bean: 7.1, 7.2, 4.3.1  
4.1.8 |
| 7 12 Apr       | Bivariate random variables | Conditional distributions  
Convolutions | Bean: 4.1.8  
8.1.3 |
| 8 19 Apr       | Mid-exam TBA | | |
| 9 3 May        | Optimal portfolios | Markowitz theory of optimal portfolio Allocation | Bean 10.1-10.4; see also Ruppert 5.1-5.4 |
| 10 10 May      | Option pricing(1) | Option pricing; Binomial Framework (discrete-time model) | Lecture notes Hull 10 |
| 11 17 May      | Option pricing(2) | Option pricing : Black-Scholes model (continuos model) | Lecture notes Hull 11 and 12 |
| 12 24 May      | Value at risk (VaR) | VaR with one asset, VaR for a portfolio of assets | Lecture notes Ruppert 11.1, 11.2.1-11.2.2, 11.4-11.5 |
| 13 31 May      | Simple time series models; Revision | AR, MA, ARCH, GARCH | Ruppert 4.3.1, 4.6.1, 12.1-12.3, 12.6 |

**IMPORTANT:** Before lectures/workshops each week, students are expected to print out the relevant material (lecture notes, workshop and assignment questions) that becomes available on WebCT by 5pm on previous Friday.
ASSESSMENT MECHANISM

The purpose of assessment

There are a number of reasons for having assessable tasks as part of an academic program. The assessable tasks are designed to encourage you to explore and understand the subject more fully. The fact that we grade your work provides you an indication of how much you have achieved. Providing feedback on your work also serves as part of the learning process.

Assessment mechanism summary

The assessment of this unit is composed of the marks of six fortnightly assignments, the mid-term exam mark, participation in workshops 9-13 and the final exam mark. Students MUST attempt each assessment component. The details of each component are as follows.

<table>
<thead>
<tr>
<th>Item</th>
<th>Weight</th>
<th>Due date</th>
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<tbody>
<tr>
<td>Assignments</td>
<td>10%</td>
<td>TBA</td>
</tr>
<tr>
<td>Mid-Semester Exam</td>
<td>40%</td>
<td>2 hours</td>
</tr>
<tr>
<td>Participation</td>
<td>10%</td>
<td>Workshops 9-13</td>
</tr>
<tr>
<td>Final Exam</td>
<td>40%</td>
<td>TBA</td>
</tr>
</tbody>
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Mid-Semester exam

The mid-term exam will be held at week 8. The duration is two hours. The mid-exam will cover the topics of weeks 2-7.

Final exam

The final exam will cover the material in week 1 and weeks 9-13. There will be a revision in week 13.

Participation

Data and the set questions for workshops 9-13 will be posted on WebCT in advance. Students are encouraged to attend these workshops and solve those set questions using excel spreadsheet or other softwares in the computer labs. Lecturer will assess work done during these workshops.

Submission of assignments

You are encouraged to discuss among yourselves the work required for assignments and Stat Labs, and to seek my help if required. However all work submitted for assessment must be your own work, it must be attributed if it is not your own work. Submitting work done by others as if it were your own is one form of plagiarism, a serious offence against UWA regulations. Refer to the Faculty policy on this matter.

The assignments are to be submitted to the Computer Lab (MCL) at the School of Mathematics and Statistics (M19). Please remember to attach an Assignment Cover Sheet to the front of your assignment. You can
download and print your Assignment Cover Sheet from the StudentNet web page
http://www.business.uwa.edu.au/studentnet/assessments

Student Guild
Phone: (+61 8) 6488 2295
Facsimile: (+61 8) 6488 1041
E-mail: enquiries@guild.uwa.edu.au
Website: http://www.guild.uwa.edu.au

Charter of Student Rights and Responsibilities

Appeals against academic assessment
The University provides the opportunity for students to lodge an appeal against assessment results and/or progress status (refer http://www.secretariat.uwa.edu.au/home/policies/appeals).