UNSW AUSTRALIA

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COURSE OUTLINE

MATH5995

Quantitative Modelling of Operational Risk and Insurance Analytics

Semester 2, 2016

MATH5995 – Course Outline

Information about the course

Course Authority: Professor Pavel Shevchenko

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Room: RC-3066

Consultation: every Friday 10:30-12:00 (from 5 August to 21 October 2016)

Credit, Prerequisites, Exclusions:

This course counts for 6 Units of Credit (6 UOC).

Once you have been admitted to the postgraduate program of the School of Mathematics and Statistics, there are no further formal prerequisites. It will be assumed that students have basic knowledge of probability concepts and statistics, and basic numerical computing skills in MS Excel.

Lectures: There will be three hours of lectures per week.

Friday 17:00-20:00 RedC2035

Lectures will start in **Week 2** (**the 5th August!**) and continue until **Week 13** (**21 October**).

Online materials: Further information, most of the lecture slides and other materials will be provided via Moodle.

Course aims

To develop practical mathematical/statistical and relevant numerical computing skills in important new area of quantitative operational risk modelling based on actuarial methods from insurance. Operational risk identification, estimation and prediction is a current issue and a central activity not only in banking, insurance and superannuation industries but also in areas such as health, IT, environmental safety, ecology, disaster management, and medicine. Broadly speaking, *operational risk is defined as the risk of loss resulting from inadequate or failed internal processes, people and system or from external events.* The concept of operational risk is generic for organizations of all types. This course will equip students with the necessary tools to undertake core quantitative risk modelling activities required from risk modellers/quantitative analysts in modern financial institutions and large corporations.

Student Learning Outcomes

- Key quantitative requirements of the Basel II/III banking accord regulations for Operational Risk: basic, standard and advanced measurement approaches under the Basel II/III regulator framework.
- Frequency and heavy tailed severity models for Operational Risk types including estimation of the model parameters and model selection.
- Risk estimation and allocation of capital to business units from the institutional level.
- Dependence modelling within frequency-severity model structure. Familiarity with particular classes of copula statistical models of basic relevance to practical Operational Risk modelling.
- Approaches to combine different sources of data for risk estimation (including Bayesian approach, credibility theory).
- Loss aggregation methods to calculate Operational Risk loss distributions.

The above listed outcomes include not only theoretical understanding of these concepts but also the necessary numerical computing skills.

Relation to graduate attributes

These outcomes are closely related to the graduate attributes "Research, inquiry and analytical thinking abilities", "Communication" and "Information literacy".

Teaching strategies underpinning the course

The textbook *P.V. Shevchenko (2011). Modelling Operational Risk Using Bayesian Inference. Berlin, Springer* will be the main reference source for this course. Other materials and textbooks will be used for deeper understanding. New ideas and models are first introduced and demonstrated in lectures, then students develop these skills by applying them to specific tasks (theoretical and numerical) in assessments. Also, some parts of the lectures may be done in computing lab to develop the necessary computing numerical skills. This is not a course in computing; the computing part is mainly used to illustrate the theory/methodology and solve some numerical problems necessary for better understanding of the course material.

Rationale for learning and teaching strategies

We believe that effective learning is best supported by a climate of inquiry, in which students are actively engaged in the learning process. Hence this course is structured with a strong emphasis on problem-solving tasks in assessments, and students are expected to devote the majority of their study time to the solving of such tasks.

Effective learning is achieved when students attend all classes. Some parts of the lectures will be done in computing laboratory to develop necessary numerical skills that will be important for understanding the subject, academic research in future and to undertake core quantitative risk modelling activities required from risk modellers/quantitative analysts in modern financial institutions and large corporations.

Furthermore, lectures should be viewed by students as an opportunity to learn, rather than just copy down or skim over lecture notes.

Assessment

Knowledge and abilities assessed: All assessment tasks will assess the learning outcomes outlined above.

Assessment

Assessment task	%	Available	Due	Notes
Assignment 1	10%	19 August	26 August	No late assignments!
Assignment 2	20%	2 September	16 September	No late assignments!
Assignment 3	20%	30 September	14 October	No late assignments!
Final exam	50%	N/A	TBA	

In all assessments, marks will be awarded for correct working and appropriate explanations and not just the final answer.

Assignments

Rationale: Assignments will give an opportunity for students to try their hand at more difficult problems requiring more than one line of argument and also introduce them to aspects of the subject which are not explicitly covered in lectures. Also, some assignment problems will require numerical solutions.

Assignments must be YOUR OWN WORK, or severe penalties will be incurred.

You should consult the University web page on plagiarism

Late assignments will not be accepted.

Examination

Duration: Three hours.

Rationale: The final examination will assess student mastery of the material covered in the lectures.

Further details about the final examination will be available in class closer to the time.

Additional resources and support

Lecture slides

Most of the lecture slides will be provided on Moodle.

Textbooks

The textbooks are listed below according to their relative importance for this course.

PVS P.V. Shevchenko (2011). Modelling Operational Risk Using Bayesian Inference. Berlin, Springer.

CPS M. G. Cruz, G.W. Peters and P.V. Shevchenko (2015). Fundamental Aspects of Operational Risk and Insurance Analytics: Handbook of Operational Risk, Wiley.

Moodle

Most of the lecture slides and other useful materials will be available on Moodle. You should check regularly for updates. Some notes and tutorial solutions may be handed out as a hard copy only.

Course Evaluation and Development

The School of Mathematics and Statistics evaluates each course each time it is run. We carefully consider the student responses and their implications for course development. It is common practice to discuss informally with students how the course and their mastery of it are progressing.

Administrative matters

School Rules and Regulations

Details of the general rules regarding attendance, release of marks, special consideration etc are available via the School of Mathematics and Statistics Web page at `http://www.maths.unsw.edu.au/currentstudents/assessment-policies`.

Plagiarism and academic honesty

Plagiarism is the presentation of the thoughts or work of another as one's own. Issues you must be aware of regarding plagiarism and the university's policies on academic honesty and plagiarism can be found at
`http://www.maths.unsw.edu.au/currentstudents/assessment-policies`.

Occupational Health and safety

Please refer to the UNSW Occupational Health and Safety policies and expectations: `http://www.gs.unsw.edu.au/policy/documents/ohspolicy.pdf`.

Equity and diversity

Any equity and diversity issues should be directed to the Student Equity Officers (Disability) in the Student Equity and Diversity Unit (9385-4734). Further information for students with disabilities is available at

`http://www.studentequity.unsw.edu.au/`

Detailed course schedule

It is intended that the following topics will be covered in the given order. Variation from this will be advised by the lecturer. Some material may not be possible to cover in details and in such cases, at the discretion of the lecturer, part of some lectures will be used as a Problem Class where instead of new theoretical material, just some examples are shown. Also, at the discretion of the lecturer, some parts of the lectures can be done in computing laboratory.

Topic	Lecture number (approx)
Operational Risk in perspective – key components of Operational Risk models (introductory course overview lecture)	1
Loss Distribution Approach, basic Monte Carlo simulation method	2
Risk measures and capital allocation	3
Loss Aggregation	4
Estimation of frequency and severity models	5
Model estimation and selection	6
Heavy tailed risk modelling	7
Modelling dependence in the Loss Distribution Approach framework	8
Advanced dependence modelling	9
Scenario analysis and combining different data sources	10
Combining different data sources: Bayesian approach and credibility theory	11
Multi-Factor modelling	12