Foundations of Quantitative Risk Management
ACTSC 964, Winter 2024

Instructor:	Ruodu Wang
Email:	wang@uwaterloo.ca
Office:	M3 3122
Lectures:	MW 11:30-12:50, M3 4206
Course website:	https://learn.uwaterloo.ca/
Target audience:	Ph.D. students and Master's students
	in Actuarial Science, Quantitative Finance, or Statistics

Objectives

At the ASTIN meeting in 2005, Professor P. Embrechts (ETH Zurich, Switzerland) referred to those actuaries working in enterprise risk management as *actuaries of the fourth kind*. The knowledge of risk management becomes crucially important for modern actuaries.

In this course, we study fundamental concepts in quantitative risk management (QRM). Topics include: basics of risk management and regulation, risk measures, financial time series, extreme value theory, copulas, multivariate distributions, risk aggregation and allocation, and applications. This course should be treated as a mathematical or statistical course.

The aim of the course is to build a good understanding of the foundations of QRM and its practice.

The course contents have a considerable overlap with those of ACTSC445/845, with a different focus. If you have already taken 445/845, I recommend you not to take this course, and to take some more specialized courses instead.

Office hours

- Every Monday 2:00-3:00 I will host office hours in my office. Outside this time, you can book an appointment with me by email.

References

The course slides and other materials are available on Learn.

[1] There is a main reference book

(i) McNeil, A. J., Frey, R. and Embrechts, P. (2015). *Quantitative Risk Management: Concepts, Techniques and Tools*. Revised Edition. Princeton, NJ: Princeton University Press.

[2] Materials are also available on a third-party website

(ii) QRM Tutorial: `http://qrmtutorial.org`.

[3] There is an exercise book available (also uploaded to Learn)

(ii) QRM Exercises: `https://www.qrmtutorial.org/exercises`.

[4] Recommended reading

(iv) Föllmer, H. and Schied, A. (2016). *Stochastic Finance*. 4th edition, De Gruyter.

Test materials are based on lecture notes. Some chapters in the lecture notes will not be discussed, and this will be made clear during the lectures.

Codes

All codes will be in `R` (the main coding language for statisticians). If you prefer another language such as `Python`, you will have to create your own codes for all exercises and tasks. This is encouraged as `Python` is more popular in the financial industry.

Midterms

Two midterms are planned. Tentative schedule:

(1) February 7 (W), 1.5 hours

(2) March 27 (W), 1.5 hours

Exams will be given in person during the lecture time.

Data implementation project

At the end of each chapter (from Chapters 3-7), I will assign a data implementation task to one student or two students in a group (depending on the number of total enrolled students). The task is relatively simple. It involves applying the learned methods to a new dataset or some datasets and a short presentation.

Essay and presentation

Towards the end of the term, each student will write an essay about recent developments of a specific QRM topic based on reading one or a few research papers. The students will also present a short presentation of their essay. If the number of students is more than what time allows, then the projects will be in groups of 2 or 3.

Course Evaluation Breakdown

(1) Midterm #1, 20%;

(2) Midterm #2, 20%;

(3) Chapter project, 20%;

(4) Essay, 20%;

(5) Presentation of essay, 20%.

Tentative Schedule

	Weeks	Topics	Chapter
Part I	1-2	**Introduction to QRM**	
		Risk in perspective	1
		Basics concepts in risk management	2
Part II	3-6	**Methods for univariate risks**	
		Empirical properties of financial data	3
		Financial time series	4
		Extreme value theory	5
Part III	7-10	**Methods for multivariate risks**	
		Multivariate models	6
		Copulas and dependence modeling	7
		Risk aggregation and allocation	8
Part IV	11-12	**(Flexible)**	
		Applications (if time allows)	9-11
		Presentations	

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Relevant University Policies:

Policy 71 - Student Discipline Policy 73 - Intellectual Property Rights