Topics in Quantitative Risk Management
ACTSC 964, Winter 2021

Instructor:	Ruodu Wang
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Course website:	https://learn.uwaterloo.ca/
Target audience:	Ph.D. students and Master's students
	in Actuarial Science, Quantitative Finance, or Statistics

Format

The instructor will provide online recorded lectures and slides, supplemented by R codes. Lecture slides will be available on Learn before the corresponding lectures. A few short lecture videos will be uploaded every week before or on each Monday. They will be available on Learn. You are required to read the slides (corresponding to the lecture videos each week) by yourself before watching the lecture videos.

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*. Thus, 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 applications. This course should be treated as a mathematical course.

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 Wednesday 10am to 11am (EST) I will host office hours on WebEx. The information can be found on Learn.

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] Recommended reading

(iii) 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.

Assignments

I plan to set two individual question-solving assignments. The assignments do not account to the final grade.

Midterms

Two midterms are planned. Tentative schedule:

(1) February 25, 2 hours

(2) April 8, 2 hours

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 upload a short presentation of their essay online.

Course Evaluation Breakdown

(1) Midterm #1, 25%;

(2) Midterm #2, 25%;

(3) Essay 25%;

(4) Presentation 25%.

Exams will be given and collected using Crowdmark.

Tentative Schedule

	Weeks	**Topics**	**Chapter**
Part I	1-3	**Introduction to QRM**	
		Risk in perspective	1
		Basics concepts in risk management	2
		Empirical properties of financial data	3
Part II	4-7	**Methods for univariate risks**	
		Financial time series	4
		Extreme value theory	5
		Scaler measures of risk	8
Part III	8-11	**Methods for multivariate risks**	
		Multivariate models	6
		Copulas and dependence modeling	7
		Risk aggregation and allocation	8
Part IV	12	**(If time allows, usually not)**	
		Other topics	

Policy on Intellectual Property

Students should be aware that this course contains the intellectual property of their instructor, TA, and/or the University of Waterloo. Intellectual property includes items such as:

Lecture content, spoken and written (and any audio/video recording thereof); Lecture handouts, presentations, and other materials prepared for the course (e.g., PowerPoint slides); Questions or solution sets from various types of assessments (e.g., assignments, quizzes, tests, final exams); and Work protected by copyright (e.g., any work authored by the instructor or TA or used by the instructor or TA with permission of the copyright owner). Course materials and the intellectual property contained therein, are used to enhance a student's educational experience. However, sharing this intellectual property without the intellectual property owner's permission is a violation of intellectual property rights. For this reason, it is necessary to ask the instructor, TA and/or the University of Waterloo for permission before uploading and sharing the intellectual property of others online (e.g., to an online repository).

Permission from an instructor, TA or the University is also necessary before sharing the intellectual property of others from completed courses with students taking the same/similar courses in subsequent terms/years. In many cases, instructors might be happy to allow distribution of certain materials. However, doing so without expressed permission is considered a violation of intellectual property rights.

Please alert the instructor if you become aware of intellectual property belonging to others (past or present) circulating, either through the student body or online. The intellectual property rights owner deserves to know (and may have already given their consent).

Relevant University Policies:

Policy 71 - Student Discipline Policy 73 - Intellectual Property Rights