Syllabus, Quantitative Risk Management (QRM)
Block 2, 2022-23

Lecturer: Jeffrey Collamore (E3.08; phone: 35 32 07 82; e-mail: collamore@math.ku.dk)

Course details: Lectures: Monday 15-17 in Aud. 6; Wednesday 15-18 in Aud. 6 (namely, 5 hrs./wk. over approximately 6 weeks). For questions about registration, please contact our secretary, Lone Baltzersen, on the first floor of the mathematics building. For her contact information, see: www.math.ku.dk/ansette/

Prerequisites: An introductory measure-theoretic probability course.

Evaluation: Your grade will be based on a 30-minute oral exam and exercises. As a requirement, all of the homework problems must be handed in and both homework sets must be passed in order to participate in the final oral exam.

The oral exam will take place during the usual Block 2 exam week (and possibly also during the end of the prior week due to the many students).

Course description: This will be an introductory graduate-level course in the mathematical and statistical methods of risk management. The aim of the course will be to provide a mathematical framework for quantifying risk, which can ultimately be applied in concrete problems. The course will provide useful quantitative methods and techniques for the three main disciplines of risk management: market risk, credit risk, and operational risk. Primary focus will be devoted to market risk. We will discuss different measures of risk (value-at-risk, expected shortfall), and various techniques for computing them, such as historical simulation, bootstrap, Monte Carlo simulation, and methods from extreme value theory (where many of these techniques also apply more generally to various other types of risk, e.g. climate risk). Multivariate models such as elliptical distributions and copulas will also be introduced and discussed in detail. We will conclude the course by discussing some commonly-used models in credit risk (KMV, CreditRisk+) and in operational risk.

Schedule:

- Risk measures. Risk measurement and loss operators; methods for computing VaR and expected shortfall. (Approx. 3 lectures.)
- Extreme value theory with heavy tails; Hill estimator; POT method. (Approx. 1 lecture.)
- Multivariate distributions and dependence. Elliptical distributions; copulas. (Approx. 4 lectures.)
- Credit risk modelling. (Approx. 2 lectures.)
- Models for operational risk. Possibly some additional discussion related to GARCH processes, as these are both examples of *stochastic processes* arising in risk management. (1-2 lectures.)

References:

The main reference for the course is:
A. J. McNeil, R. Frey and P. Embrechts, *Quantitative Risk Management: Concepts, Techniques, and Tools* (revised edition). Princeton University Press, 2015. [Original edition 2005.]
(Roughly speaking, we will mainly cover material in the revised edition from Ch. 2, 5, 6, 7, 10, 11, 13, or in the original edition from Ch. 2, 3, 5, 7, 8, 10. Precise reading assignments can be found on the course home page.)

Another useful reference (available on Absalon) is:
H. Hult and F. Lindskog, *Mathematical Modeling and Statistical Methods for Risk Management.* Lecture notes (KTH Stockholm), 2007.

An expanded version of these notes has subsequently appeared in book form, and is also recommended if you would like another point of view (not required):
H. Hult, F. Lindskog, O. Hammarlid and C. J. Rehn, *Risk and Portfolio Analysis: Principles and Methods.* Springer, 2012.

All slides from lectures will be made available on Absalon, where two homework sets will also be posted. A precise schedule for the course will also be posted on Absalon during the first week.