

University of Manchester
School of Mathematics
Math48181: Extreme Values and Financial Risk
Semester 1

Lectures: Mondays 9:00-10:00am, Humanities Bridge Street Cordingley Theatre; Tuesday 9:00-10:00am, Roscoe Theatre B; Fridays 10:00-11:00am, Alan Turing Building, Room G.114.

Example Classes: Mondays 12:00noon-13:00pm, Alan Turing Building, Room G.107; Tuesdays 16:00-17:00pm, Chemistry, G.54. You need to attend only one of these sessions.

Lecturer: Dr. Saralees Nadarajah

Office: Alan Turing 2.223.

Office Phone: 0161 275 5912.

Office Hours: 14:00-15:00 Tuesday, 14:00-15:00 Thursday.

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WWW: <https://minerva.it.manchester.ac.uk/~saralees/extremes4.html>

Unit code: MATH48181.

Credit rating: 15.

Pre-requisite units: Statistical inference (Math38001), Statistical methods (Math20802).

Aims: To introduce probabilistic fundamentals and some statistical models in extreme value theory with applications to finance.

Brief description: The course will give some probabilistic and statistical details of univariate and bivariate extreme value theory. The topics covered will include: fundamental of univariate extreme value theory, the three extreme value distributions, various models for univariate extremes, fundamentals of bivariate extreme value theory, and various models for bivariate extremes. The course will contain a great deal material on applications of the models to finance. Software in R will be used.

Intended learning outcomes: On successful completion of this unit students will: 1) have some understanding of the probabilistic fundamentals of univariate and bivariate extreme value theory; 2) be able to choose and fit appropriate extreme value models for a given data (univariate and bivariate); 3) be able to calculate probabilities associated with total portfolio loss, maximum portfolio loss and minimum portfolio loss; 4) be able to estimate financial risk measures; 5) be able to fit copulas to real data sets; 6) be able to fit GARCH type models to real data sets.

Course Contents: I plan to cover all of the following topics:

1. Fluctuations of univariate maxima: the theory (4),

2. Fluctuations of univariate upper order statistics: the theory (2),
3. Some statistical models for univariate extremes (4),
4. Real data applications for univariate extremes using the R software (1),
5. Portfolio theory (2),
6. Real data applications (1),
7. Financial risk measures and their estimation (3),
8. Real data applications (1),
9. Models for stock returns (2),
10. Real data applications (1),
11. Some models for bivariate extremes (4),
12. Real data applications for bivariate extremes using the R software (1),
13. Copulas (2),
14. Real data applications (1),
15. GARCH type models (2),
16. Real data applications (1).

The total number of lectures is 32.

Textbooks:

Embrechts, P., Klüppelberg, C. and Mikosch, T. (1997) *Modelling Extremal Events: for Insurance and Finance*, Springer-Verlag, Berlin.

Leadbetter, M.R., Lindgren, G. and Rootzén, H. (1983) *Extremes and Related Properties of Random Sequences and Processes*, Springer-Verlag, Berlin.

Resnick, S.I. (1987) *Extreme values, Regular Variation and Point Processes*, Springer-Verlag, Berlin.

Coles S. (2001) *An Introduction to Statistical Modelling of Extreme Values*, Springer-Verlag, London.

Kotz, S. and Nadarajah, S. (2000) *Extreme Value Distributions: Theory and Applications*, Imperial College Press, London.

Learning and teaching processes: Three lectures and one example class each week. In addition students are expected to do at least four hours private study each week on this course unit.

Assessment: There will be five quizzes due at the following times:

Tuesday 9 October 2018, 12:00noon

Tuesday 23 October 2018, 12:00noon

Tuesday 6 November 2018, 12:00noon

Tuesday 20 November 2018, 12:00noon

Tuesday 4 December 2018, 12:00noon

Each quiz will be worth 2 percent.

There will be an in-class test on **Tuesday 13 November 2018, 9:00-9:40am** accounting for 10 percent. The formulas you will need to remember for this test are in

<https://minerva.it.manchester.ac.uk/~saralees/cwformula201819v2.pdf>

The final exam for this course will be in January 2019, the formulas you will need to remember for this exam are in

<https://minerva.it.manchester.ac.uk/~saralees/formula201819v2.pdf>

The final exam will account for 80 percent of your final mark.