MATH5805 – Special Topics in Statistics

A Modern Introduction to Extreme Value Theory

<u>Synopsis</u>

Unlike most statistical techniques which seek to understand the mean levels of a process, extreme value theory aims to empower the user to understand, quantify and model the extremes of a process. **Understanding the mathematical behaviour of extremes allows us to have confidence in our ability to predict future extremes, even far beyond the range of the observed data!** Extreme value theory is a critical methodology for quantifying and modelling risk that has found application in many areas, including economics, climate and the environment, insurance, and many others.

This course aims to introduce the fundamentals and practice of modern extreme value theory. After completing this course, you will possess a sound knowledge of the mathematical construction of extreme value models, and practical experience in how to use them in the analysis of real-world data.

At each stage you will be presented with the **underlying theory and illustrative exercises** designed to reinforce your understanding. You will also be provided with a more statistical treatment where the developed models will be **applied in practice to tackle real-world problems**. You will gain knowledge on parametric statistical modelling, inferential techniques, and coding in statistical software (R).

<u>Course Overview</u>

The course presents three main themes: the analysis of univariate extremes; extensions to the multivariate setting and the characterisation of extremal dependence; and the extremes of stochastic processes and spatial extremes. Specific topics include:

- Limiting distributions of maxima
- Block maxima
- Threshold exceedances
- Point process representation
- Asymptotic independence
- Max-stable processes
- Generalised Pareto processes

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Lecturer: Dr Boris Beranger
(b.beranger@unsw.edu.au)