STA4507H1F: EXTREME VALUE THEORY AND APPLICATIONS
2015-2016

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Office hours: Thursday 10am to noon or by appointment. However, many issues can be resolved by e-mail so feel free to contact me at the address given above — I try to respond to e-mails within a few hours.

Recommended background: Mathematical statistics at the level of STA355H or STA352Y and probability at the level of STA347H.

Course materials: There is no required textbook for the course although an excellent reference is

> *Statistics of Extremes: Theory and Applications* by Beirlant, Goegebeur, Segers & Teugels. (publisher Wiley)

This book is available as an e-book through the University of Toronto Library system. You can also purchase the book (for example, through amazon.ca) although be warned ... it is not cheap! I will also distribute some handouts and papers to supplement the lectures.

Grading: Problems (30%), Term paper (70%). The term paper will focus on some theoretical or applied aspect of extreme value data; the topic is quite open and should be of interest to you.

Computing: This course will not involve a lot of computing. However, I will be making fairly extensive use of the statistical programming language R — more information on R can be found at www.r-project.org. If you have not already done so, you are strongly recommended to download R (for free!) from cran.utstat.utoronto.ca. R runs on a wide variety of operating systems (Mac OS X, Windows, Linux) and the download process (in addition to being free) is very straightforward.

Course outline: The following is a tentative outline, which will likely evolve as the course progresses.

1. Introduction: Distribution of order statistics and representations, point process of exceedances and convergence to Poisson processes.
2. Extreme value types: conditions for converge in distribution of extremes, generalized extreme value distribution, connections to stable laws for heavy-tailed distributions.
3. Tail index estimation: Hill and Pickands estimators, asymptotics and bias/variance tradeoffs, the Hill (horror) plot.
4. Regression modeling of extreme value data: Peaks-over-threshold models, quantile regression, record data.
5. Bivariate and multivariate extremes: Extremal dependence, copula models.