**ACTS:7730 Advanced Topics in Actuarial Science/Financial Mathematics - Extreme Value Theory**

**Instructor: Dr. Qihe Tang**

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Course Schedule: 11:30 A.M. – 12:45 P.M. on Monday and Wednesday in E226 AJB
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**Course Description**

Recent decades were characterized by an unprecedented surge in the frequency and severity of extreme events; e.g., earthquakes, floods, droughts, hurricanes, tsunamis, mortality catastrophes, financial crises, terrorist attacks, cyber attacks, nuclear crises, and wars. All such events produce widespread destruction on the environment, economy, and society despite their low likelihood of happening. However, existing quantitative studies of extreme risks remain scarce and fall short of practical applications. There is an urgent need for a robust approach to modeling, measuring, and managing a wide variety of extreme risks.

In this course, we shall learn basics in extreme value theory and explore its applications to insurance and finance. Intended topics include:

1. Modelling Extremal Events
   - Heavy tails, univariate regular variation, multivariate regular variation

2. Limit Theorems for Maxima
   - Maximum domains of attraction, Fréchet/Weibull/Gumbel MDAs, generalized extreme value distribution

   - Block maxima method, peaks-over-threshold method

4. Modelling and Managing Credit Risk
   - Static credit risk models, dynamic credit risk models, portfolio credit risk management, asymptotics for large portfolios
This course is designed for graduate students or high-level undergraduate students with a good background in mathematics, probability, and statistics to seek an entrance to the area of extreme value theory. It will stress the fundamentals and explore the topics at a somewhat technical level. Nevertheless, the course will be made as self-contained as possible so that students who are strong in mathematics but have not taken advanced courses in probability and statistics can still follow.

An important feature of this course is that, while studying the intended topics and some selected papers, we shall initiate and focus on some interesting research problems, either theoretical or applied, in the interdisciplinary area of statistics, insurance, and finance. The course is particularly suitable for those who desire to pursue a research topic in an applied area in the presence of extreme risks.

Main References

- A list of papers and book chapters selected from the recent literature of insurance, finance and risk management.

Evaluation System

Each student has the option to choose an A/B/C/D grade or an S/U grade. For those who choose an A/B/C/D grade, the grades will be given based on the following:

- Two homework assignments: 60%  
  You are not allowed to discuss homework problems with other students. What you hand in must ultimately be your own work.
- One final project: 30%  
  At the beginning of November, a list of papers and book chapters selected from the recent literature will be released. Each student will be asked to pick up one from the list, to study it and make a 30-minute presentation.
- Class attendance and engagement in discussions: 10%

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