Summer 2016 NSERC Undergraduate Research Assistantships  
Department of Statistical Sciences, University of Toronto

General information:  
Applications are invited for Undergraduate NSERC Research Assistantships. These projects provide undergraduate students with an opportunity for research experience during the summer. Each award is for sixteen weeks during May to August 2016, and pays between $1,500 and $2,000 per month, depending on qualifications.

Projects  
In this proposal the student will be able to opt for one of the following four projects:

Statistical Methods for Genetic Studies of Complex Human Traits  
Supervised by: Professor Lei Sun

This project is in a specialized research area called Statistical Genetics. Qualified applicants must have taken the STA480 – Fundamentals of Statistical Genetics course or have equivalent training.

The overall objective of the research program is to develop statistical methods and computational tools to solve problems arising from genetic studies of complex human traits. The current research focuses on analytical challenges encountered in big data generated from the high-through genotype technology.

Among the many statistical problems that this research program is interested in is how to combine statistical evidence from multiple datasets or data integration. The classical approach is to perform meta-analysis, however it is not clear if this approach is statistically optimal. The first step of this proposed project is to conduct extensive simulation studies; provide empirical evidence for the performance of meta-analysis as compared to alternative ways of data integration such as the sFDR approach. The second step is to apply the different methods to real genetic data and obtain additional empirical evidence. The last step is to prove or disprove the optimality of the meta-analysis and identify regularity conditions. Additional methodological questions include studying the impact of correlation between tests on false discovery rate and stratified FDR controls and developing corresponding remedies. Finally, the Professor is very open to the possibility that the student is interested in other analytical problems as long as they fit under the general umbrella of Statistical Genetics.

The student will be provided with opportunities to meet with other members of the large and vibrant statistical genetics and genetic epidemiology community in Toronto, and to participate relevant seminars.

MCMC for Big Data  
Supervised by: Professor Radu Craiu

Summary: Running Markov chain Monte Carlo in the context of Bayesian inference for massive samples raises serious challenges related to computational cost and/or efficiency. The project consists in implementing some of the methods that were proposed in the literature and in drawing empirical comparisons. Computational expertise is a must.
Loss Reserving and Ruin Probabilities  
Supervised by: Associate Professor Andrei Badescu

Loss reserving is of paramount importance for Property and Casualty insurance since it is a cornerstone for ratemaking and solvency evaluation. Among the many categories of reserves, Incurred But Not yet Reported (IBNR) claim reserve is an important and rather unique one. For lines of business featuring a long reporting lag, it is highly possible that a large proportion of claims incurred during the evaluation period are reported long after the evaluation date. Failing to recognize the IBNR claims will undermine the validity of the subsequent product pricing and even threaten the soundness of solvency management of the insurance company.

While ``macro-level'' models were designed to tackle with relatively coarse data before the advent of powerful computers, nowadays more exquisite (both mathematically and statistically) models are required to extract more information from the complex datasets (or big data) available in practice.

The current project proposes to dig into “micro-level” models and analyze certain dependencies that occur among reporting lags, settlement legs and claim sizes. On top of this, we plan to incorporate some of these quantities in a closely related insurance area, in ruin theory. One object that we try to investigate here is how to calculate ruin probabilities under various scenarios when the IBNR and the RBNS reserve is taken into consideration.

Foreign Exchange Derivatives Modeling  
Supervised by: Associate Professor Sebastian Jaimungal

Foreign exchange (FX) markets are one of the largest and liquid markets world-wide. Due to no arbitrage considerations, to model, and value, options on FX, one needs to account for stochastic interest rates as well as the FX rates themselves. Moreover, volatility of FX is itself stochastic. Incorporating both effects – stochastic volatility and stochastic interest – is a challenging and interesting problem. This project will involve learning about and implementing various FX models for option valuation, calibrating those models to implied volatility data sets, testing the robustness of the model, and comparing their performance in and out-of-sample. Ideally, the successful candidate should have some understanding of statistical time-series, finance, financial mathematics, basic PDEs and numerical algorithms (programming will be conducted in Matlab).

How to Apply

Applicants should be undergraduate students in mathematics, statistics or actuarial science with a “B” standing. In accordance with NSERC regulations, applicants must hold Canadian citizen or permanent resident of Canada. Students should be registered (at the time of application), in a bachelor’s degree program (and not holding higher degrees) at an eligible university in the term immediately before holding the award. If a student already holds a bachelor’s degree and is studying towards a second bachelor’s degree in the natural sciences or engineering, they are also eligible. Interested students should submit their application(s) to Gillis Aning, Department of Statistical Sciences Room 6018 in person or email it as an attachment to gillis.aning@utoronto.ca.
How to submit your application(s):

1. Submit the 1st page of NSERC USRA form, an unofficial transcript from ROSI and a cover letter stating why you want a summer research award, and also state which project you would like to apply for. Students may apply for more than one project. If you are applying for more than one project, please prepare a separate application for each project.

2. Student applications are due to the department by **Monday, February 22nd**. The supervisors have one week to decide whether or not to interview the prospective student(s). When the supervisor decides, the student(s) will be contacted to order an official transcript and have it sent directly to the department or deliver in person. Please do not open the transcript if delivered in person.

3. Unsuccessful students will be contacted by email regarding the decision.

*Please Note: USRA application information will be captured from the NSERC On-line System. Therefore, all applications **MUST** be completed by students and their supervisors online ([https://ebiz.nserc.ca/nserc_web/nserc_login_e.htm](https://ebiz.nserc.ca/nserc_web/nserc_login_e.htm)). Applications must be submitted online and then be printed for submission to Research Services. Those prepared by any other means (e.g., handwritten or manually typewritten) will **NOT** be accepted.

**Completed applications are due by Friday, February 26, 2016 (Supervisors due date to the department.)**