General information:
Applications are invited for Undergraduate NSERC Research Assistantships. These projects provide undergraduate students an opportunity for research experience during the summer. Each award is for sixteen weeks during May to August 2015, 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:

Are the Current Hedging Credits Effective? – Regulatory Arbitrages in the US Variable Annuity Reserve and Required Capital Regulations
Supervised by: Jingjing (Vicki) Zhang

In a preliminary study of the regulatory guidelines of variable annuity products with guarantees (AG43 reserve standard, C3P2 required capital standard), our stochastic projection model for a simple VA with GMAB product showed that there are various hedging strategies that can result in artificial hedging credits, without providing genuine hedging benefits. In this follow-up study, we would like to explore the issue of effectiveness of hedging credits in the current regulations using a more realistic VA product (i.e. with more complex guarantees) and employing other real-life scenarios of market returns and volatilities. We will build upon our current stochastic model but eliminate the approximations we made in the preliminary study. The model will be a “stochastic on stochastic on stochastic” one. The significance of the study lies in its evaluation of the recent principles-based VA regulations, and its potential of pointing to a direction of further regulatory reform that minimizes regulatory arbitrage opportunities.

The student selected for this project will be given a detailed tutorial on the use of the current model and the relevant regulations. The student will then be asked to explore various product features, pricing and valuation assumptions, projection scenarios, and hedging strategies using the model under the close guidance of the principal investigators (myself and a research collaborator). Applicants must have a basic understanding of actuarial pricing and valuation, and of dynamic derivative hedging of variable insurance products. They should also have basic knowledge and some experience in using the actuarial software AXIS (e.g. enrolled in course ACT475, internships using AXIS, etc).

Methods to Estimate the Incurred but not Reported Reserve in P&C Insurance
Supervised by: Associate Professor Andrei Badescu

Loss reserving is of paramount importance for General Insurance (also known as Property and Casualty Insurance (P&C)) since it is a cornerstone for ratemaking and solvency evaluation. Among the many categories of reserves, the Incurred But Not Yet Reported (IBNyR) claim reserve (also known as the pure" Incurred But Not Reported (IBNR)) is an important and rather unique one. For lines of business featuring a long reporting lag (e.g., third-party bodily injury in automobile insurance, medical malpractice in health insurance, etc.), 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 IBNyR reserve will undermine the validity of the subsequent product pricing and even threaten the soundness of solvency management of the insurance company. At the same time, while other claim reserves can be estimated in various ways (e.g., the Known Claims” reserve is usually estimated by case reserve experts, the Unearned Premium Reserve (UPR) is proportional to exposure units, etc.), IBNyR reserve can only be evaluated by constructing actuarial models.

In this project we analyze the IBNR reserve using a “micro-level” model that proposes to extract more information from the complex datasets available in practice. The student will work on a dataset obtained from an European insurance company, analyzing the effect of using various severity and frequency distributions and comparing the reserves obtained using the “micro-level” model to the classical aggregate reserving methods, such as the chain ladder one.

The successful student is expected to have good programming skills and potentially to have been passed the SOA exam C (or equivalently to obtain an 80+ grade in Loss Models I and II courses at U of T).

**Optimal Execution in the Presence of Order-Flow Information**
Supervised by: Associate Professor Sebastian Jaimungal

Large institutional investors often rebalance their portfolios, requiring huge positions in assets to be liquidated. The optimal placement of orders is a key problem they face: trading too quickly will result in the agent receiving poor prices (since other market participants will reposition their offers to reflect this increased order flow), while trading slowly will subject the agent to market uncertainty. Understanding how to balance these two sources of risk is an active area of research and in this project, the successful candidate will work on posing and solving stochastic control problems that are backed by statistical models of how high frequency financial markets work. This will require a blend of theory and practice (using real data), and the successful candidate should be comfortable with programming, have some knowledge of simple data mining (machine learning models) as well as with the basics of stochastic calculus.

**High Dimensional Data Analysis**
Supervised by: Professor Muni Srivastava

Recent Advances in technology to obtain DNA microarrays have made it possible to measure quantitatively the expression of thousands of genes. These observations are, however, correlated to each other as the genes are from the same subject. Since the number of subjects available for taking the observations are so few as compared to the gene expressions, high dimensional multivariate theory and analysis is required to analyze the data. In this project recent available theory will be applied to analyze the available data.
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 **Friday, February 13th**. 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: New* – Starting this competition, 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**). Applications must then be printed and signed manually. Those prepared by any other means (e.g., handwritten or manually typewritten) will **NOT** be accepted.

**Completed applications are due by Friday, February 20, 2015 (Supervisors due date to the department.)**