DIVISION OF NATURAL SCIENCE

NATS 1500 M 3.0 Statistics and Reasoning in Modern Society

2015-2016

Course Outline
(Winter term)

Description

How do you know what you know? Why do you feel very confident that some things are true but you feel less sure about others? Do you feel very sure about some things that, perhaps, you shouldn't be so sure about? And unsure about things that you should, in fact, be confident of.

Statistical reasoning is crucial for a critical understanding of the flood of data and information we face daily in modern society. For example, we are frequently exposed to contradictory claims about the effectiveness of drugs or of new social policies. How can a citizen who is not a specialist have an informed opinion when it seems that experts do not agree? Understanding the principles of statistical reasoning and being aware of a number of widespread errors in statistical thinking is a key for distinguishing arguments that are sound from those that are fallacious. Above all, understanding statistical reasoning helps us distinguish between solid claims and those that are at best tentative and about which we should keep an open mind and wait for further evidence.

This course stresses the logic and reasoning behind statistics avoiding emphasis on complex mathematical formulas. Statistical reasoning will be applied to a critical analysis of current events reported in the media and current scientific, medical and social controversies.

The course will incorporate 1) working with real problems and real data including the completion of a project using readily available software, 2) classroom activities to bridge the gap between the abstract concepts and their very real significance and 3) concepts of multiple regression are applied to understanding the role of statistical control for confounding variables with observational data.

The concepts covered include:

- Beyond 'correlation is not causation': randomized experiments versus observational studies; prediction versus cause. Experimental versus statistical control.
- Statistical significance versus practical importance.
- The difference between finding "no effect" or "no evidence of an effect."
- Common sources of bias in surveys and experiments.

- Interpreting improbability and coincidence: why the improbable is often highly probable.
- "Confusing the inverse" Conditional probability in one direction is confused with the conditional probability in the other direction. Implications for fallacious interpretation of information and decision making.
- Understanding that variability is natural and that the average is not necessarily typical.

All concepts will be actively applied to the clarification of current scientific, medical and social controversies.

Instructor

Georges Monette
Office: North 626 Ross
Telephone: 416-736-2100 ext 77164
Home page: georges.blog.yorku.ca
Email: georges+nats1500@yorku.ca

When and where

- Lectures: Mondays 2:30 to 4:30 and Wednesdays 2:30-3:30 in Vari Hall C
- Tutorials (optional): Wednesdays 3:30-4:30 in Vari Hall C
- First meeting January 4, 2016
- No classes on February 15 and 17 for reading week
- **Mid-term on Saturday, February 27, 2016. The exact time will be announced.**
- Last class: April 4, 2016

Textbook and references

- Textbook: Jessica Utts and Robert Heckard, (2006) *Statistical Ideas and Methods*, Thomson, Belmont, CA
- Additional references will be provided through the course website.

Software

We will be using free open source software that can be downloaded and used on Windows PCs, MACs or on Linux workstations. The software is called R and can be downloaded from http://cran.r-project.org/ . There is some information on how to get started at http://wiki.math.yorku.ca/index.php/R:_Getting_started

It is expected that most students will have access to a computer at home or a laptop. Those who do not will be able to have access to PCs in the Gauss Lab.

Course work and grading (Tentative – official version available on first week of classes)

	Date	Weight
Mid-term test	Feb. 27	25%
Assignment 1 (team)	Due Jan. 27	5%
Assignment 2 (team)	Due Feb. 25	10%
Assignment 3 (team)	Due March 16	10%
Project (individual)	Due April 4	10%
Participation	up to April 4	5%
Final exam	Exam period	35%

Degree Credit Exclusions and restrictions

- Course credit exclusion: SC/MATH 1532 3.00. NCR Note: Not open to students who have passed or are taking AK/AS/SC MATH 2560 3.00, or who have received advanced standing for the equivalent.

Mathematical Content

The course assumes high school algebra to the level of grade 11.

Important Dates:

- Last day to ENROL without requiring the permission of the Course Director is January 17, 2016. The instructor never grants permission for late enrolment unless a student can demonstrate that she or he has been attending and participating in the course from the very first meeting of the course.
- Last day to DROP the course without a grade being submitted: Please check http://www.registrar.yorku.ca/enrol/dates/fw15.htm.

Accommodations:

Students who feel that there are extenuating circumstances that may interfere with their ability to successfully complete the course requirements are encouraged to discuss the matter with the instructor as soon as possible.

Students with physical, learning or psychiatric disabilities who require reasonable accommodations in teaching style or evaluation methods should discuss this with the instructor early in the term so that appropriate arrangements can be made.

Religious Observance Days:

Should any of the dates for tests or exams pose a conflict with a religious observance day for your particular religion, you must complete an **Examination Accommodation Agreement**

Form (available online at Registrar's Office site) and submit it to the instructor **at least 3 weeks before the date of the test or 3 weeks before the start of the examination period.**

Academic Honesty:

York students are required to maintain high standards of academic integrity and are expected to be familiar with and to follow the Senate Policy on Academic Honesty (see http://www.yorku.ca/secretariat/legislation/senate/acadhone.htm)

Cheating and plagiarism are major academic offences and carry serious penalties, ranging from a failing grade on the work in question to expulsion from the university. For more details about cheating, see York University's academic honesty policy at the above link.

Students should also review materials on the Academic Integrity website (http://www.yorku.ca/academicintegrity/students/students.htm) and complete the online tutorial available at that site.

Missed Tests and Exams:

Students who miss a test or exam due to an illness or emergency must provide supporting documentation to the instructor as soon as possible. Tests and exams missed on the ground of medical circumstances must be supported by an Attending Physician's Statement, which can be downloaded from:
http://www.registrar.yorku.ca/pdf/petitions/attending_physician_statement.pdf, or a statement by a psychologist or counsellor. **Students are NOT expected to disclose the nature of the illness.** The document must specify:
1) date of consultation.
2) contact information (e.g. phone number of the hospital; legible name of the health provider) that would allow verification of the document.
3) a statement that the student would not have been able to attend class (or carry out activities) during the relevant period of time.

The documentation must be dated on the same day as the exam or earlier, or it will not be accepted. The Course Instructor must be notified by email within 24 hours in the case of a missed test or exam. Appropriate documentation must be submitted to the Course Instructor within one week after the test or exam. No opportunities to make up missed term test will be offered. However, after acceptable justification for a missed test has been received, a grade for the missed test will be imputed from the final exam in April.

If the final examination (in April) is missed, you must submit a **Deferred Standing Agreement Form** with appropriate documentation to the Course Instructor. If deferred standing is not granted by the course instructor, you may **petition through the Registrar's Office for deferred standing** to write the final exam. In the latter case the decision to grant or not grant deferred standing is made by the Faculty Petitions Committee.