Department of Biology Course Outline

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GS/BIOL BIOL5081 3.00 INTRODUCTION TO BIOSTATISTICS

FALL 2022

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Course Description

This course examines common statistical methods used in biology. Data science and statistical workflows are developed. Descriptive statistics, generalized linear models, regression, nonparametric tests, bootstrapping, randomization tests, multivariate statistics, and bioinformatic analyses may be considered. The R programming language and RStudio will be used. Students will be required to complete a course project using a biological dataset and statistical methods of their choosing.

Prerequisites (strictly enforced)

BIOL 2060 or an undergraduate course in biostatistics or statistics in required.

Course Instructor(s) and Contact Information

Dr. C. Lortie
218 Lumbers
Telephone: 416-736-2100 ext. 20588
e-mail: ecodata@yorku.ca

Dr. Ryan K. Schott
356 Farquharson
Telephone: 416-736-2100 ext. 40038
e-mail: schott@yorku.ca

Schedule

Date and Time: T: 2:30-5:30 p.m.
Location: REMOTE
Course Session: FALL 2022 - Start date: September 13, 2022.
Course ID.: M82F01

Evaluation

Evaluation Components of Final Grade and related information.
Final course grades may be adjusted to conform to Program or Faculty grades distribution profiles.

Module 1
The first 6 weeks are administered by Dr. Lortie
Fundamental stats review   25%
Take-home statistical test   25%

Module 2
The remaining 6 weeks are administered by Dr. Schott
Lab assignments   20%
Project Outline   5%
Final Project   25%

Important Dates

Part A. Fundamental statistics and data
Oct 18th, 2022: Review due to Dr. Lortie using https://www.turnitin.com
October 25th, 2022: Take-home statistical test 1 due to Dr. Lortie using https://www.turnitin.com

Part B. Introduction to statistical tools and methods for ecology, evolution, and genomics
November 22, 2021: Project outline due
December 6th, 2021: Project due to Dr. Schott

Drop Deadline: Nov. 11, 2022 (last day to drop without course on transcript)
Course Withdrawal: Nov. 13 to Dec. 7, 2022 (course still appears on transcript with 'W")

Resources

The New Statistics with R: An Introduction for Biologists by Andy Hector.
Print ISBN-13: 9780198729051

Readings and other online resources including peer-reviewed publications provided in class.

R (https://www.r-project.org/) and RStudio (https://www.rstudio.com/)

PAST (https://www.nhm.uio.no/english/research/infrastructure/past/)

Linux (https://www.linux.org/)

Conda (https://docs.conda.io/en/latest/) and Bioconda (https://bioconda.github.io/)

Learning Outcomes

Upon successful completion of this course, students should be able to:

1. Build a data model for a graduate-level dataset.
2. Develop a reproducible data and statistical workflow.
3. Design and complete intermediate-level data visualizations appropriate for a graduate-level tidy dataset.
4. Identify a range of suitable univariate and multivariate statistical approaches that can be applied to any dataset.
5. Interpret statistical output to quantify statistical model performance.
6. Complete fundamental exploratory data analysis on any dataset.
7. Appreciate the strengths and limitations of open science, data science, and evidence-based collaboration models.
8. Identify and apply approaches for bioinformatics software installation and management
9. Ability to perform basic bioinformatics analyses using the linux command line and to interpret and visualize results.

Professional Skills

The following skills will be developed in this course.

1. Critical thinking skills for quantitative evidence.
2. The capacity to manage and manipulate diverse forms of data.
3. Data visualization skills and competency with contemporary statistical tools including familiarity with the tidyverse in the R programming language.
4. Fundamental biostatistical analysis skills including distribution assessment, generalized linear mixed models, regression analyses, multivariate analyses, and bioinformatics.
5. Effective communication skills of quantitative challenges in the biosciences in written, oral, and graphical modalities.

Course Content

Module 1: Dr. CJ Lortie
Sept 13:   Tidy data in R.
Sept 20:   Literate statistical coding.
Sept 27:   Statistics for ecology and evolution I.
Oct 4:   Statistics for ecology and evolution II.
Oct 11:   Reading Week (no class).
Oct 18:   Hackathon to explore mixed models.
Oct 27:   Take-home statistical test.

Module 2: Dr. Ryan Schott (subject to change)
Nov 1:   Introduction to other statistical tools, stats review and introduction to multiple regression
Nov 8:   Project planning (class, but no lecture).
Nov 15:   Introduction to multivariate statistics and phylogenetic comparative methods.
Nov 22:   Introduction to genome assembly and variant Calling. **Project outline due.**
Nov 29:   Introduction to differential expression analyses.
Dec 6:   Introduction to GO analysis. **Final project due.**

Experiential Education and E-Learning

R studio and R will be used to share code, wrangle data, and do statistics. The linux command line and conda package manager will be used to install software packages and perform bioinformatic analyses.

Course Expectations

Attendance is recommended because the lectures will provide an opportunity for the students not only to listen to summary lectures by the professor of statistics but to also engage in the analyses. In the meetings, we will work together to actively handle data and do statistics. All information presented in class is testable. For module 1 with Dr. Lortie, both assignments must be submitted to turnitin.com.
Class ID: 35404972
Key: rstats4bio

Course Policies

Alternative dates for assignments/evaluations are not available in this course. If documentation is provided for valid absences on test dates, accommodation will be granted in mutual discussion with the professors. To promote fairness and student responsibility, all in class exercises are due on the dates specified herein. A 20% penalty will be applied for the first day the exercise is late and 5% every day thereafter. Students who anticipate being unable to submit the exercises on the due date are encouraged to submit early. Grades on exercises and exams are not negotiable. Every reasonable action is made to ensure advance reminders are provided and instruction. Thus, the course directors should only be contacted if there is calculation or clerical error present. The Document Submission System must be used to submit all documentation associated with absences.
https://science.apps01.yorku.ca/machform/view.php?id=84113

Students are not allowed to record lectures or lab tutorials using their own devices.

University Policies

Academic Honesty and Integrity
York students are required to maintain the highest standards of academic honesty and they are subject to the Senate Policy on Academic Honesty (http://secretariat-policies.info.yorku.ca/policies/academic-honesty-senate-policy-on/). The Policy affirms the responsibility of faculty members to foster acceptable standards of academic conduct and of the student to abide by such standards.
There is also an academic integrity website with comprehensive information about academic honesty and how to find resources at York to help improve students' research and writing skills, and cope with University life. Students are expected to review the materials on the Academic Integrity website at - http://www.yorku.ca/academicintegrity/

Important A note from the Faculty of Science Committee on Examinations and Academic Standards: Numerous students in Faculty of Science courses have been charged with academic misconduct when materials they uploaded to third party repository sites (e.g. Course Hero, One Class, etc.) were taken and used by unknown students in later offerings of the course. The Faculty's Committee on Examinations and Academic Standards (CEAS) found in these cases that the burden of proof in a charge of aiding and abetting had been met, since the uploading students had been found in all cases to be willfully blind to the reasonable likelihood of supporting plagiarism in this manner. Accordingly, to avoid this risk, students are urged not to upload their work to these sites. Whenever a student submits work obtained through Course Hero or One Class, the submitting student will be charged with plagiarism and the uploading student will be charged with aiding and abetting.

Note also that exams, tests, and other assignments are the copyrighted works of the professor assigning them, whether copyright is overtly claimed or not (i.e. whether the © is used or not). Scanning these documents constitutes copying, which is a breach of Canadian copyright law, and the breach is aggravated when scans are shared or uploaded to third party repository sites.

Access/Disability
York University is committed to principles of respect, inclusion and equality of all persons with disabilities across campus. The University provides services for students with disabilities (including physical, medical, learning and psychiatric disabilities) needing accommodation related to teaching and evaluation methods/materials. These services are made available to students in all Faculties and programs at York University.
Student's in need of these services are asked to register with disability services as early as possible to ensure that appropriate academic accommodation can be provided with advance notice. You are encouraged to schedule a time early in the term to meet with each professor to discuss your accommodation needs. Please note that registering with disabilities services and discussing your needs with your professors is necessary to avoid any impediment to receiving the necessary academic accommodations to meet your needs.
Additional information is available at the following websites:
Counselling & Disability Services - http://cds.info.yorku.ca/
Counselling & Disability Services at Glendon - https://www.glendon.yorku.ca/counselling/
York Accessibility Hub - http://accessibilityhub.info.yorku.ca/

Religious Observance Accommodation
York University is committed to respecting the religious beliefs and practices of all members of the community, and making accommodations for observances of special significance to adherents. Should any of the dates specified in this syllabus for an in-class test or examination pose such a conflict for you, contact the Course Director within the first three weeks of class. Similarly, should an assignment to be completed in a lab, practicum placement, workshop, etc., scheduled later in the term pose such a conflict, contact the Course director immediately. Please note that to arrange an alternative date or time for an examination scheduled in the formal examination periods (December and April/May), students must complete and submit an Examination Accommodation Form at least 3 weeks before the exam period begins. The form can be obtained from Student Client Services, Student Services Centre or online at https://registrar.yorku.ca/pdf/exam-accommodation.pdf