Department of Biology Course Outline

SC/BIOL 2060 3.00 Statistics for Biologists
Fall 2021
This course is either fully online OR has a mix of online and in-person components depending on the lab section in which you are enrolled
This course is presented in Toronto time (Eastern Time Zone)

Course Description

Statistical problem solving for biologists. Basic theory for the analysis of parametric and non-parametric data. Includes a tutorial period for discussion and solving of statistical problems. Two lecture hours, one tutorial period per week. One term. Three credits.

Course Format, Hardware and Software Requirements

For students enrolled in LAB 01 all components of the course will be conducted online. For those enrolled in LAB 02 there will be a mix of online and in-person components. See the Schedule box below for details.

- Students must have a laptop or desktop computer with a camera and microphone. Reliable high-speed internet access is required.
- Some aspects of the course will involve **Zoom** video conferencing software.
- Microsoft Office, including Word, Excel and Power Point, are strongly recommended.

Prerequisites

Prerequisites: LE/CSE 1520 3.00, or LE/CSE 1530 3.00, or LE/CSE 1540 3.00, or LE/EECS 1520 3.00, or LE/EECS 1530 3.00, or LE/EECS 1540 3.00; and SC/MATH 1014 3.00, or SC/MATH 1505 6.00, or both SC/MATH 1013 3.00 and SC/MATH 1025 3.00, or ISCI 1410 6.00, or both ISCI 1401 3.00 and 1402 3.00, or both ISCI 1401 3.00 and MATH 1025 3.00, or equivalents.

Course Credit Exclusions: AP/ECON 2500 3.00, AP/ECON 3210 3.00, AP/ECON 3480 3.00, AP/ECON 3500 3.00, AP/GEOG 2420 3.00 or SC/GEOG 2420 3.00, HH/KINE 2050 3.00, HH/KINE 3150 3.00, SC/MATH 1131 3.00, SC/MATH 2560 3.00, SC/MATH 2565 3.00, SC/MATH 2570 3.00, AP/POLS 3300 6.00, HH/PSYC 2020 6.00, HH/PSYC 2021 3.00, AP/SOCI 3030 6.00.

Course Instructor and Contact Information

Instructor: Dr Mark Vicari
- Email: mvicari@yorku.ca. Please include BIOL 2060 in the subject line.
- Virtual Office Hours: Tuesdays and Thursdays, 11:30 -12:30 p.m. A Zoom link will be posted on the course website.

Copyright Protection of Course Material

Schedule

Lectures For all students, lectures will be delivered remotely (online) on Tuesday and Thursday mornings, 10:30-11:30 a.m.. Lectures will be delivered "live" (synchronous) but will be recorded; therefore lecture attendance during the 10:30-11:30 time slot is optional.

Tutorials

- **For students enrolled in LAB 01**, tutorials will be will be online and synchronous, via Zoom, on most Friday afternoons throughout the term beginning at 2:30 p.m.. Virtual attendance in tutorials is optional, except on days when tests are held (see Evaluation below).
- **For students enrolled in LAB 02,** tutorials will be held in person **except on days when tests are held;** tests will be online. In-person tutorials will be held in ACW 004 on most Friday afternoons throughout the term, beginning at 2:30 p.m. Tutorials will be led by the course TA (TBA). Attendance in tutorials is optional, except on days when tests are held (see Evaluation below).
- **For all students**, tutorials will usually be 1 to 1.5 hours and will be devoted to a number of tasks including:
    1) taking up problem sets assigned throughout the course;
    2) learning to use the statistical computing software R, and use the Data Analysis add-in in Microsoft Excel;
    3) writing tests;
    4) addressing student questions

Some tutorial material will not be recorded. However, answers to problem sets will be posted on the course website for all students.

Evaluation

1. Two tests – 36%	
Test 1 (18%)	Friday Oct 22, online at 2:30 p.m.
Test 2 (18%)	Friday Nov 19, online at 2:30 p.m.
	Final exam grade will replace the lowest test grade IF the exam grade is higher
2. Three assignments – 30%	
Assignment 1 (10%)	Due Thursday Oct 7, 6:00 p.m.
Assignment 2 (10%)	Due Thursday Nov 11, 6:00 p.m.
Assignment 3 (10%)	Due Tuesday Dec. 7, 6:00 p.m.
3. Final exam – 34%	Cumulative (covering the whole course)
	Online during the December exam period, Dec. 9-23. Exact date and time TBA by the registrar.

Important Dates

Test 1: Friday Oct 22, 2:30 p.m. (online)
Test 2: Friday Nov 19, 2:30 p.m. (online)
Last date to drop course without receiving a withdrawal note on your transcript: **Friday Nov. 12**
Final Exam: to be held during the **fall examination period, Dec. 9-23**. Exact date and time TBA by the registrar's office.

NOTE: for additional important dates such as holidays, refer to the "Important Dates" section of the Registrar's Website at https://registrar.yorku.ca/enrol/dates

Textbook: M.C. Whitlock and D. Schluter, 2020. *The Analysis of Biological Data*, 3rd edition. W.H. Freeman & Co., New York.
- We will largely follow the text from the beginning up to and including at least chapter 17. See below for explicit details of which chapters and sections.
- Note that if you have a copy of the 2nd edition of this book, it may suffice, but it is your responsibility to ensure that all the material in the 3rd edition that we cover, is indeed covered in the 2nd edition

Website: The course will be managed through an eClass site. Please log in at https://eclass.yorku.ca

Course Content

TENTATIVE COURSE OUTLINE (material may change due to unforeseen circumstances)

1) INTRODUCTION TO STATISTICS (read chapter 1)
What is statistics?
Populations and samples
Random sampling
Types of data - categorical versus numeric
Explanatory versus Response variables
Frequency and probability distributions

2) DISPLAYING DATA (read chapter 2)
Plotting frequency distributions
Bar graphs, histograms
Contingency tables
Scatterplots for two variables

3) DESCRIBING DATA (read chapter 3)
Sample mean and sample median
Variance and standard deviation
(computational formula)
Quartiles and box plots
Cumulative frequency distribution
Proportions

4) Estimation with uncertainty (read chapter 4)
Estimating a population parameter
Sampling distribution of the estimates
e.g. mean
Standard error
Confidence intervals

5) Probability (read chapter 5 sections **5.1 through 5.9** up to "sampling without replacement")
Probability of events
Mutually exclusive events
Probability distributions
Addition and multiplication rules
Independent events
Probability trees
Conditional probability (except Bayes' Theorem)
Pseudoreplication (interleaf 2)

6) Hypothesis testing (Chapter 6 & 7)
Null (Ho) versus Alternative (Ha) hypotheses
One versus two-sided tests
Examples
Handedness and Chlorophyll
P-value
Type I and Type II errors

Analysing proportions and hypothesis tests using the Binomial distribution
OMIT THE MATERIAL ON CALCULATING CONFIDENCE INTERVALS FOR PROPORTIONS ON PAGES 190-91(pages 189-191 in 2nd Ed).

7) Goodness-of-Fit and Contingency tests (Chapters 8 & 9)
X^2 goodness-of-fit tests
assumptions
Fitting data to probability distributions
Relative risk / Odds ratios
Contingency tests / Fisher's Excact test

8) The normal distribution (Chapter 10 sections 10.1-10.6)
The standard normal distribution and probabilities
Normal distribution of sample means
Central limit theorem
IGNORE NORMAL APPROXIMATION FOR THE BINOMIAL DISTRIBUTION (section 10.7)

9) Student's t-test (Chapter 11 & 12)
the t-distribution
confidence intervals
one- and two-sample t-tests
assumptions
paired t-test
F-test of equal variances
OMIT SECTION 11.5 ON CONFIDENCE LIMITS FOR VARIANCE AND STANDARD DEVIATION

10) Violations of assumptions, transformation and non parametric tests (Chapter 13)
Detecting deviations from normality read section, but won't carry out Shapiro Wilk test for normality.
Transforming data to meet normality assumption
Non-parametric alternatives to t-tests

IGNORE CHAPTER 14.

11) Analysis of Variance (Chapters 15)
Single factor ANOVA
Section 15.2, Nonparametric alternatives: you don't need to know details but you should know of their existence and when to use them.
Planned versus unplanned comparisons
Fixed versus random effects

12) Correlation and Regression (Chapter 16 and 17)
Chpt 16 only sections 16.1-16.5 (but ignore confidence interval material in section 16.1)
Correlation coefficient
Assumptions and error
Spearman's rank correlation
Chpt 17 section 17.1 (ignore confidence interval)
Linear regression
Estimation of least squares line
Hypothesis test of slope
IGNORE 17.2 CONFIDENCE IN PREDICTIONS
17.3 Testing hypotheses (ignore ANOVA approach).
IGNORE 17.4 REGRESSION TOWARD THE MEAN
Section 17.5 assumptions
Section 17.6 transformations

This course uses the statistical computing packages *Excel* (including the data analysis add-in) and *R.*

Course Policies

Online Tests/Exams – general:
- Tests will be "open book"; you may consult the course textbook, power point slides, your own lecture notes and the eClass website for the course during a test.
- Tests are strictly individual exercises. Communication of any kind with any person other than the course director (to ask questions via email) during a test is prohibited and will be treated as academic misconduct.
- Consulting websites other than the course website during a test is prohibited and will be treated as academic misconduct.
- The final exam may be conducted with the aid of an online proctoring service.

Missed test policy:
- There are no makeup tests.
- If you miss one test, the grade for the missed test will be the final exam grade. No documentation is required to transfer the weight of the missed test to the final exam; the transfer will be automatic.
- You must write at least two tests to be eligible to write the final exam.
- If you access or view a test in any way it will be considered completed. The grade of the test (even if you do not complete any part of it and the grade is zero) will apply to your final grade.

Missed exam policy
- If you miss the final examination please complete and submit a Deferred Standing Agreement (DSA) form available from the Registrar's website to mvicari@yorku.ca together with a letter outlining the reason for missing the exam, within one week of the missed exam.
- If you are approved to write a deferred exam, an in-person final exam will be arranged on campus whenever approval to do so is granted.

Penalty for late submission of assignments: 10% per calendar day

Email etiquette
Subject line: please begin with "BIOL 2060" followed by a brief, but reasonably detailed, indication of the subject of your email (e.g., "question about lecture 3", etc.)
Body of the email: remember to include your name and student number at the end of every email.
Response time: please allow 2 working days.

Religious observance days
Should the dates for a test pose a conflict with a religious observance day for your particular religion, you must notify the instructor **at least 3 weeks before the date of the test.** In the event of a religious observance conflict with the final exam, students must complete an **Examination Accommodation Agreement Form**, available at:

https://secure.students.yorku.ca/pdf/religious-accommodation-agreement-final-examinations.pdf

and submit it to the instructor **at least 3 weeks before the date of the exam.**

Some Advice on How to Succeed in This Course

1) Acquire a copy (or e-copy) of the textbook and use it. You are responsible for all chapters in the textbook indicated and all material in those chapters unless certain pages/sections are explicitly excluded by the instructor.

2) Keep up with lectures and readings. While the online format allows some flexibility in terms of when lectures are viewed, you should not allow unviewed lectures to accumulate, as you will fall behind very quickly. Note that housekeeping announcements (most of which will <u>not</u> be emailed as Course Announcements) are made at the beginning of lectures. You should check the announcement slides every Tuesday and Thursday when lectures are posted (even if you cannot view the whole lecture at that time).

3) Attend tutorials.

4) Do all the problem sets. Do as many problems/questions as you can.

5) Use the statistical programs and software taught during the course. They will be important tools in this course, and, more importantly, you will use them extensively in future years in your other undergraduate courses.

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 Course Director as soon as possible.

University Policies

Academic Honesty

All students are expected to familiarize themselves with the following information, available on the Senate Committee on Academic Standards, Curriculum & Pedagogy webpage (see Reports, Initiatives, Documents)

https://secretariat-policies.info.yorku.ca/policies/academic-honesty-senate-policy-on/

· 	Senate Policy on Academic Honesty and the Academic Integrity Website

· 	Ethics Review Process for research involving human participants

· 	Course requirement accommodation for students with disabilities, including physical, medical, systemic, learning and psychiatric disabilities

· 	Student Conduct Standards

· 	Religious Observance Accommodation

Academic Standards: Third Party Repository Sites

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, Chegg, 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 third party repository sites, 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.

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/spark/academic_integrity/index.html

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.

Students 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 & Development Services - https://counselling.students.yorku.ca
Counselling & Disability Services at Glendon – https://www.glendon.yorku.ca/counselling/
York Accessibility Hub - https://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 one of the formal examination periods (December, April or June/August), students must complete an Examination Accommodation Form, which can be obtained from Student Client Services, Student Services Centre or online at https://secure.students.yorku.ca/pdf/religious-accommodation-agreement-final-examinations.pdf

Student Conduct in Academic Situations
Students and instructors are expected to maintain a professional relationship characterized by courtesy and mutual respect. Moreover, it is the responsibility of the instructor to maintain an appropriate academic atmosphere in the classroom and other academic settings, and the responsibility of the student to cooperate in that endeavour. Further, the instructor is the best person to decide, in the first instance, whether such an atmosphere is present in the class. The policy and procedures governing disruptive and/or harassing behaviour by students in academic situations is available at - http://secretariat-policies.info.yorku.ca/policies/disruptive-andor-harassing-behaviour-in-academic-situations-senate-policy/