

Department of Biology Course Outline

SC/BIOL 2060 3.00 Statistics for Biologists
Winter 2022

This course consists of a mixture of in-person and online components

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

This course consists of a mixture of in-person and online components. The first two weeks of the course will be delivered online. After the first two weeks lectures, tests, and the final examination will be delivered in-person. Tutorials will be delivered online. Access to reliable high-speed internet is required:

- Some aspects of the course will involve **Zoom** video conferencing software.
- Microsoft Office, including Word, Excel and Power Point, are strongly recommended.
- See Schedule information below for details regarding the format of lectures and tutorials.

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; 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 equivalents.

Course Credit Exclusions: SC/BIOL 3090 3.00, AP/ECON 2500 3.00, AP/ECON 3210 3.00, AP/ECON 3480 3.00, AP/ECON 3500 3.00, ES/ENVS 2010 6.00, AP/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. Ryan Schott

- Email: schott@yorku.ca. Please include BIOL 2060 in the subject line.
- Virtual Office Hours: Fridays after tutorial or by appointment.

Copyright Protection of Course Material

All material associated with this course is the intellectual property of the instructor and/or protected under Canadian Copyright Law. All course material, including lecture recordings, activities, tests/exams, problem sets and assignments, are to be used for personal study purposes only.

Unauthorized distribution in any form can lead to a violation under Canadian Copyright Law and/or

Academic Misconduct charges under York University Senate Policy. Unauthorized distribution includes sharing and/or uploading of material anywhere and with anyone.

Penalties under Academic Misconduct can include failure in the course, a transcript notation and/or suspension.

Schedule

Lectures: Other than for the first two weeks, Lectures will be held **in-person** at 10:30 am in ACW 206, although the instructor will also attempt to record and post lectures to the course website. The first four lectures will be posted as recordings (asynchronous) to the course website. Other lectures may also need to switch to an online format due to changes to University policy or illness.

Tutorials: will be “live” (synchronous), via Zoom, on most Friday afternoons throughout the term, beginning at 2:30 p.m. Attendance in tutorials is optional, except on days when **in-person tests** are held (see Evaluation below). Tutorials will usually be 45 minutes 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 may not be recorded. However, answers to problem sets will be posted on the course website. After tutorials, a virtual office hour will be held to answer any remaining questions and provide additional help. Additional office hours may be scheduled on an individual basis.

Evaluation

1. Three tests – 45%	
Test 1 (15%)	Friday Feb 4, in-person at 2:30 pm in ACW 206.
Test 2 (15%)	Friday March 4, in-person at 2:30 pm in ACW 206.
Test 3 (15%)	Friday March 25, in-person at 2:30 pm in ACW 206.
	Final exam grade will replace the lowest test grade IF the exam grade is higher.
2. Two assignments – 20%	
Assignment 1 (10%)	Due Friday Feb 11, 11:59 p.m.
Assignment 2 (10%)	Due Friday April 8, 11:59 p.m.
3. Final exam – 35%	
	Cumulative (covering the whole course)
	Online during the exam period, April 12–29. Exact date and time TBA by the registrar.

Important Dates

Test 1: Friday Feb 4, 2:30 pm (in-person).

Test 2: Friday March 4, 2:30 pm (in-person).

Test 3: Friday March 25, 2:30 pm (in-person).

Last date to drop course without receiving a withdrawal note on your transcript: **Friday March 18.**

Final Exam: to be held during the **winter examination period, April 12–29.** 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>

Resources

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 (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 (Chapter 2)

- Plotting frequency distributions
- Bar graphs, histograms
- Contingency tables
- Scatterplots for two variables

3) DESCRIBING DATA (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 (Chapter 4)

- Estimating a population parameter
- Sampling distribution of the estimates
- Mean
- Standard error
- Confidence intervals

5) PROBABILITY (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

- Pseudoreplication (Interleaf 2)

6) HYPOTHESIS TESTING (Chapter 6 & 7)

- Null (H_0) versus Alternative (H_a) 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 190-191 (pages 189-191 in 2nd ed)**

7) GOODNESS-OF-FIT AND CONTINGENCY TESTS (Chapters 8 & 9)

- χ^2 goodness-of-fit tests
- assumptions
- Fitting data to probability distributions
- Relative risk / Odds ratios
- Contingency tests / Fisher's Exact 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 (Chapters 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 (Chapter 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 (Chapters 16 & 17)

- Ch. 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
- Ch. 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

Experiential Education and E-Learning

This course uses Microsoft *Excel* (including the data analysis add-in) and the statistical computing environment *R* (<https://www.r-project.org/>) along with *RStudio* (<https://rstudio.com/products/rstudio/download/>).

Course Policies

Tests/Exams – general:

- Tests will be “open book”; you may consult the course textbook (printouts or hardcopy) and your own printed (paper) notes during a test.
- Electronic devices other than a scientific calculator are prohibited.
- Tests are strictly individual exercises. Communication of any kind with any person other than the course director during a test is prohibited and will be treated as academic misconduct.

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.

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 schott@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 and attend in-person lectures when possible. While lecture recordings allow some flexibility in terms of when lectures are viewed, do not allow unviewed lectures to accumulate, as you will fall behind very quickly. Note that housekeeping announcements (most of which will not be emailed as Course Announcements) are made at the beginning of lectures.
- 3) Attend the synchronous online tutorials.
- 4) Do all the problem sets. Do as many problems/questions as you can.
- 5) Use the statistical program and software taught during the course. It will be an important tool in this course, and, more importantly, you will use it 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, 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.

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 the formal examination periods (December and April/May), 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/>