

Department of Biology Course Outline

SC/BIOL 2060 3.00 Statistics for Biologists Fall 2015

Course Description

Statistical problem solving for biologists. Basic theory for the analysis of parametric and non-parametric data. A project period is devoted to discussion and solving of statistical problems. Two lecture hours, one project period. One term. Three credits.

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 Instructors and Contact Information

Dr. Kyle (Vladimir) Belozarov

Office: Farquharson Bldg. Room 020B

Phone: (416)736-2100 ext. 66643

E-mail: vbelozar@yorku.ca (communication by e-mail is HIGHLY preferred)

Office hours: Fridays, 4:30 pm – 5:30 pm (last hour of the regularly scheduled lab)

Schedule

Lectures: Tuesdays and Thursdays 10:30 am – 11:30 am, Lassonde Lecture Hall A

Lab: Fridays, 2:30 pm – 5:30 pm, Lassonde Lecture Hall A

Evaluation

Midterm #1 (October 9, 120 min)	15%
Midterm #2 (November 13, 120 min)	20%
Individual project:	7% (Due by December 4 th , 5:30 pm)
Labs:	18% (9 labs, 2% each)
10 pop quizzes (given on random dates throughout the semester in the beginning of lecture, 5 min each)	10%
Final exam (cumulative)	30%
TOTAL:	100%

Important Dates

First class – September 10, 2015
Drop deadline – November 9, 2015
Last class – December 4, 2015
Midterm #1 - October 9, 2015
Midterm #2 - November 13, 2015
Individual project due date – December 4, 2015 by 5:30 pm
Final exam - TBD

Resources

REQUIRED TEXT BOOK

Whitlock and Schluter. THE ANALYSIS OF BIOLOGICAL DATA. Roberts and Company, Publishers. Either the first or the second edition will work. York book store will have the second edition in September. Buy it and begin reading! We will largely follow the text from the beginning up to and including at least chapter 17.

Learning Outcomes

Statistics is an extremely important field for biology, and many other disciplines.

By the end of this course students should be able to:

- 1) Provide a summary of categorical and numeric data using graphical methods and statistics
- 2) Apply the most powerful hypothesis test(s) to data from a range of biological experiments involving categorical or numeric data.
- 3) Test the assumptions of various hypothesis tests
- 4) Interpret the results of the hypothesis tests carried out
- 5) Carry out the hypothesis tests using the appropriate statistical tests

Course Content

COURSE OUTLINE

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) VISUALIZING DATA (read chapter 2)

Plotting frequency distributions

Bar graphs, histograms

Cumulative frequency distributions

Contingency tables

Scatterplots for two variables

3) DESCRIPTIVE STATISTICS (read chapter 3)

Sample mean and sample median

Variance and standard deviation (computational formula)

Quartiles and box plots

Proportions

4) Estimation (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 5.8 inclusive)

Probability of events
Mutually exclusive events
Probability distributions
Addition and multiplication rules
Independent events
Probability trees

6) Hypothesis testing (Chapter 6 & 7)

Null (H_0) versus Alternative (H_a) hypotheses
One versus two-sided tests
Examples
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 (162-163).

7) Goodness-of-Fit and Contingency tests (Chapters 8 & 9)

χ^2 goodness-of-fit tests
assumptions
examples
Fitting data to probability distributions
Contingency tests
G-statistic
OMIT SECTION 9.2 ON ESTIMATING ASSOCIATION IN 2X2 TABLES: ODDS RATIOS

8) The normal distribution (Chapter 10)

Ignore normal approximation for the binomial distribution (section 10.7)
The standard normal distribution and probabilities
Normal distribution of sample means
Central limit theorem

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

Planned versus unplanned comparisons
Fixed versus random effects
(Ignore Nonparametric alternatives pg. 404, but you should know of their existence and when to use).

12) Correlation and Regression (Chapter 16 and 17)

Chpt 16 only sections 16.1 (but ignore confidence interval material), include 16.2, 16.3
Chpt 17 only sections 17.1 (ignore confidence interval), include 17.3 (ignore ANOVA approach).

Correlation coefficient

Linear regression

Estimation of least squares line

Hypothesis test of slope

Assumptions and transformations

13) Recent advances in statistics

Experiential Education and E-Learning

E-Learning components:

- Moodle Website
- group work on practice problems (online forum)

Other Information

Tutorials will be structured as follows: 1st hour (2:30 – 3:30 pm) – learning how to solve statistical problems with the help of the professor and fellow students. 2nd hour (3:30 – 4:30 pm) – individual quiz. 3rd hour (4:30 – 5:30 pm) – office hours, optional, you may leave after quiz if you don't have questions for the professor.

Course Policies

Missed midterm test policy: There will be no make-up for the “mid-term” tests in this course. Students who miss a test must have legitimate medical documentation describing their illness. If the medical documentation is deemed to be legitimate the percent value of the missed test will be added to that student's final exam. Your documentation MUST be date-stamped and submitted to the Undergraduate Biology office (Farquharson Rm 108) no later than 5 business days after the date of the missed test.

Missed labs: If you can't attend a lab (for any reason), and would like to have the weight of the lab transferred to your final, you must e-mail a TA (his name is Chris and his address is plants@yorku.ca), PRIOR to the time of the lab. If you send the e-mail after 2:30 pm, the 2% will not be transferred. If you do attend a lab and submit your work, but later do not like your score, you cannot request transfer of the weight of that lab to your final.

Missed pop-quizzes: If you can't attend a lecture (for any reason), and would like to have the weight of the pop-quiz (if there happens to be a pop-quiz on that date!) transferred to your final, you must e-mail a TA (his name is Chris and his address is plants@yorku.ca), PRIOR to the time of the lecture. If you send the e-mail after 10:30 am, the 1% will not be transferred. If you do attend a lab and submit your work, but later do not like your score, you cannot request transfer of the weight of that lab to your final.

Individual projects submitted after 5:30 pm on December 4, 2015 will not be accepted, and you will receive 0% for this assignment. No medical excuses will be considered because you will have the whole semester to work on your project.

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/>

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 & Disability Services - <http://cds.info.yorku.ca/>

Counselling & Disability Services at Glendon - <http://www.glendon.yorku.ca/counselling/personal.html>

York Accessibility Hub - <http://accessibilityhub.info.yorku.ca/>

Ethics Review Process

York students are subject to the York University *Policy for the Ethics Review Process for Research Involving Human Participants*. In particular, students proposing to undertake research involving human participants (e.g., interviewing the director of a company or government agency, having students complete a questionnaire, etc.) are required to submit an *Application for Ethical Approval of Research Involving Human Participants* at least one month before you plan to begin the research. If you are in doubt as to whether this requirement applies to you, contact your Course Director immediately.

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

http://www.registrar.yorku.ca/pdf/exam_accommodation.pdf (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-and-or-harassing-behaviour-in-academic-situations-senate-policy/>