

BIOL 2060 3.00 – STATISTICS FOR BIOLOGISTS

LECTURES: TUE. & THUR. 10:30 am - 11:30am

LOCATION: ACE 102

TUTORIALS: FRI. 1:30 - 4:30 LOCATION: ACE 102

COURSE DIRECTOR: Dr. Joel S. Shore, Professor of Biology

OFFICE HOURS AND HELP: during the latter portion of the tutorial and by appointment.

GRADING SCHEME

Midterm 1 (20%) - 10 Oct 2014

Midterm 2 (30%) - 7 Nov 2014

Exam (50%) – tba during the December exam period

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 (e.g. if you were hospitalized and could not write the second midterm test, and you provided legitimate medical documentation, then your final exam would be worth 80% or your grade).

REQUIRED TEXT BOOK

Whitlock and Schluter 2009. THE ANALYSIS OF BIOLOGICAL DATA. Roberts and Company, Publishers.
(buy it and begin reading!). We will largely follow the text from the beginning up to and including at least chapter 17. But see below for explicit details of which chapters and sections.

TUTORIALS

The tutorials 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 SAS.
- 3) Midterm tests will be written during the tutorial period.
- 4) Dealing with individual problems/questions of students.

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 both by “hand” and using the statistical computer program called SAS

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

IMPORTANT COURSE INFORMATION FOR STUDENTS (copied from the Senate Committee on Academic Standards, Curriculum & Pedagogy BASIC COURSE OUTLINE MODEL)

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)

<http://www.yorku.ca/secretariat/senate/committees/ascp/index-ascp.html>

- 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

IMPORTANT DATES

<http://www.registrar.yorku.ca/enrol/dates/index.htm>

The drop deadline (last day to drop a course without receiving a grade) 7 Nov 2014

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.