

Biostatistics for Biologists - EEB 225H
Department of Ecology and Evolutionary Biology
Course Outline – Spring 2013

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Course Instructors

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TAs

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Course Prerequisites

BIO150Y1 or BIO120H1

Course Description

Biologists need to use statistical methods to test their hypotheses. Given the increasing complexity of experiments carried out by biologists, they need to understand the limitations of these statistics; how to select appropriate statistics for their needs; and how to interpret the results properly, both statistically and biologically. The goal of this biostatistics course is to teach biologists how to choose and use statistics so that they can address relevant biological questions and test them with appropriate methods. To do so, a combination of lectures and computer laboratory sessions will be used. A wide range of statistical methods will be covered: probability, probability distributions, descriptive statistics (mean, variance, etc.), sampling design, experimental design, testing hypotheses, power analysis, randomization tests, chi-square tests, correlation (partial, non-parametric), linear regression, multiple regression, *t*-tests, ANOVA (factorial, ANCOVA; non-parametric). Statistical computer packages (EXCEL and R) will be used in this course to summarize and analyze data.

Course Objectives

The objectives of this course are to provide: (1) the students with a general understanding of the areas of statistics so they can be knowledgeable of quantitative information that is presented in papers and textbooks, and (2) the statistical background needed for future undergraduate courses.

By the end of the semester, a successful student will:

- be familiar with the design of experiments and sampling;
- be able to gather their own data;
- be able to interpret simple charts and graphs of one or more samples;
- be familiar with issues of data collection, analysis, and drawing conclusions from data;
- select the appropriate statistics to analyse data and interpret the results;
- report statistical findings (plot data, summarize using tables).

Location and Time

Lectures: Tuesdays from 3-4 pm in room RW110
 Thursdays from 3-4 pm in room RW110

Lab: Most labs will be held in CQUEST rooms RW107 and RW109. Announcements will be made when labs are held in other rooms.

Schedule by lab group:

	Tuesday	Wednesday	Thursday
10:10 to 12:00	Lab: Group 301		
1:10 to 3:00		Lab: Group 101	
3:10 to 5:00		Lab: Group 201	
3:10 to 4:00	Lecture		Lecture

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Office Hours

Thursdays: 4:00 to 5:00.

By appointment: Email to schedule an appointment.

Course Email Policy

If the email subject line does not contain “EEB225” it may go unnoticed for some time or even end up in a junk mail folder.

We will try to answer course-related email queries within 3 working days, but cannot guarantee this.

Questions about exams, quizzes or labs that are less than 24 hours before the due date/exam time will not be answered.

Required Textbook

Whitlock, M. and D. Schluter. 2015. The analysis of biological data, second edition. Roberts & Company Publishers. (The first edition of this book is also fine, but contains less practice problems).

Topics and Timetable

DATE	TOPICS	ACTION
Jan 6	Introduction to the goals and format of the course Displaying data and summary statistics	Chapters 1-3
Jan 8	Designing experiments (randomization, independence, blocking) Data and Sampling	Chapters 14
Jan 6/7		NO LAB
Jan 13	Probability and discrete distributions	Chapters 5, 7.1, 7.4, 8.6
Jan 15	Probability and sampling	Chapter 1, 4
Jan 13/14	RW 122: Experiment set-up RW107/109-Computer lab: Excel 101: How to enter, analyse and plot data; How to use functions and equations; mean and standard deviation by groups	Excel Pass/Fail: 2%
Jan 20	Hypothesis Testing; Significance testing: parametric Chi square test	Chapters 6, 7, 8
Jan 22	Chi square test, Fisher test; <i>G</i> test; mini-review	Chapters 8, 9
Jan 20/21	RW 122: Record germination data; enter it in google docs before the end of lab	
Jan 27	Mid-term 1	Chapters 10
Jan 29	Continuous distributions, focus on normal distribution; Central limit theorem	Chapters 10, 11
Jan 27/28	RW 122: Measure height of plants, enter data in google docs before the end of lab. Chi square with the 7 steps of experimentation: In class assignment 1: Testing germination success	2% (ASSIGN. 1)
Feb 3	Data transformations; Confidence interval of the mean; One sample test with continuous data: <i>z</i> -test	Chapters 10, 11
Feb 5	Two sample tests with continuous data: <i>t</i> -test; paired <i>t</i> -test	Chapters 11, 13

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Feb 3/4	ASSIGNMENT 1 DUE AT START OF LAB ASSIGNMENT 2: In class: Comparing two means using Excel	3% (ASSIGN. 1) 1% (ASSIGN. 2)
Feb 10	Two sample tests with continuous data: t -test; paired t -test; Comparing means of two groups that are not normally distributed: non-parametric tests	Chapters 11, 13
Feb 12	Mid-Term 2	
Feb 10/11		
Feb 16-20	READING WEEK	
Feb 24	Mid-term follow-up; Introduction: Jeremy Gray	
Feb 26	Comparing means of more than two groups: parametric test using an Analysis of Variance (ANOVA); R 101	Chapter 15
Feb 24/25	ASSIGNMENT 2 DUE AT START OF LAB R 101: How to enter, analyse and plot data	4% (ASSIGN. 2) R Pass/Fail: 2%
March 3	ANOVA Model I, Model II multiple comparisons Factorial ANOVA	Chapter 15, 18
March 5	Nested ANOVA	Chapter 15, 18
March 3/4	ASSIGNMENT 3: ANOVA using R	1% (ASSIGN. 3)
March 10	Comparing means of groups that are not normally distributed: non-parametric tests	Chapter 15, 18
March 12	Quiz	
March 10/11		NO LAB
March 17	Correlation (parametric; non-parametric) Partial Correlation	Chapter 16
March 19	Linear Regression Residual analysis; Introduction to non-linear regression	Chapter 17
March 17/18	ASSIGNMENT 3 DUE AT START OF LAB ASSIGNMENT 4: Regression using R	4% (ASSIGN. 3) 1% (ASSIGN. 4)
March 24	Multiple Regression; Co-linearity; Dummy Variables; Model Selection Criteria	Chapters 16, 17
March 26	Multiple Regression; Co-linearity; Dummy Variables; Model Selection Criteria	Chapters 16, 17
March 24/25		NO LAB
March 31	Analysis of Covariance (ANCOVA)	Chapters 17, 18
April 2	Review	
April 1/2	ASSIGNMENT 4 DUE AT START OF LAB	4% (ASSIGN. 4)
	Final Exam (To be scheduled by the Faculty of Arts and Sciences)	

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Assignments and Evaluation

Grading will be performed by the instructors and TAs.

- 4 Assignments :
 - Ass. 1 (lab portion: 2%, written assignment 3%)
 - Ass. 2 (lab portion: 1%, written assignment 4%)
 - Ass. 3 (lab portion: 1%, written assignment 4%)
 - Ass. 4 (lab portion: 1%, written assignment 4%)
- Excel lab = 2%
- R Pass/Fail = 2%
- TOTAL LAB GRADE: 24%

- Mid-Term1: 13%
- Mid-Term2: 15%
- Quiz: 8%
- Final Exam: 40%

→ **Assignments are due one week following the computer lab AND should be handed in during each group's appropriate computer lab session (i.e. to the TA in charge of that lab). You are free to discuss your reports with other students, but the write up must be done individually. Results or write ups that are copied are considered PLAGIARISM.**

→ **LATE PENALTIES: There will be a grace period of one week for late assignments. Assignments turned in after the grace period or not turned in at all will receive a grade of zero. Out of fairness to the students who turn in their assignments on time, the TAs and instructor will provide no assistance once the due date has passed and the assignment is officially late.**

Remember: If you miss the grace period by even five minutes, an excuse such as "My bus was late" will not work because the assignment is already one week overdue.

The late penalty per written assignment (without permission) is 1 mark off the assignment grade per day. So if the assignment is 5 points, 1 point out of 5 points per day.

No late assignments will be accepted once the marked assignments have been returned to the class.

Computer Labs

How to get a CQUEST account:

Follow the links from this page: <http://www.cquest.utoronto.ca/>

OR, go directly to: https://acct.cquest.utoronto.ca/newacct/new_acct.html

Exams

All students are expected to bring calculators to exams. Cell phones (even to use as a calculator) are NOT permitted. Students will be provided with 'cheat sheets' containing all of the formulas they may need.

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Course Website

Like many other courses EEB225 uses Blackboard for its course website. To access the EEB225 website, or any other Blackboard-based course website, go to the UofT portal login page at <http://portal.utoronto.ca> and log in using your UTORid and password. Once you have logged in to the portal using your UTORid and password, look for the My Courses module, where you'll find the link to the EEB225 course website along with the link to your Blackboard based courses.

Getting Help

If you have questions about the course or material, they should be raised during the lectures or labs. You may also send instructors an email with a particular question from the text book that you would like to have explained – we may choose to go over it in class. Questions not pertinent to the class in general can be brought to the attention of the instructor or TAs personally before or after lectures or during labs and office hours. Note that office hours should not be treated as personal tutorials, particularly not before tests and assignments.

Please find the information about academic integrity at this website: www.artsci.utoronto.ca/osai/students
