

1 Biol611/EVSS624 Syllabus: Biometry

1.1 Overview and Learning Objectives

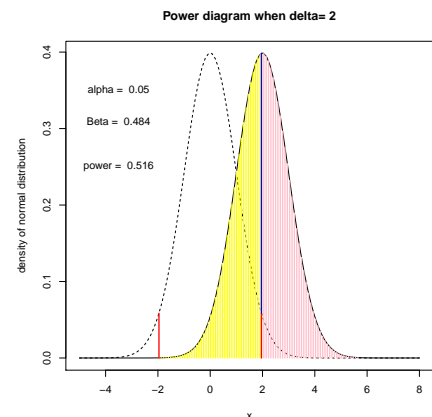
This course is intended as a rigorous introduction into statistical inference for biological data. The course will introduce and cover examples of probability distributions, descriptive statistics, and parametric and non-parametric hypothesis tests. Students should also become versed in automated data handling and basic elements of experimental design.

I expect that by the end of the semester each student should be able to take a dataset and along with explanation of the origin of those data, they should be able to summarize the data graphically and using descriptive statistics. As important, students should be able to construct and conduct hypothesis tests associated with the biological questions that motivate the data.

Finally, the basic principles of reproducible research and analysis will be introduced and reinforced throughout the semester.

1.2 Instructor

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1.3 Text and Web

I am not requiring a text for this course. However, I can recommend [Gotelli and Ellison \(2004\)](#) as an easy to read primer (I've used this book in previous semesters). For an encyclopedia of standard statistics, try [Sokal and Rohlf \(1995\)](#). [Dalgaard \(2002\)](#) will be mostly useful in the lab portion of the course. I'd recommend that you get a copy of this text (though it is also available for free online through the library). Lecture notes should also be available on the web at <http://linum.cofc.edu>. This web-site is password protected.¹ In addition to lecture notes, other course material will be available here.

1.4 Computer software

Two statistical analysis packages are available in the computer room at Grice. The first is 'JMP', produced as a 'point and click' tool by the SAS Institute. The second is R, a freely

¹The username is: bio611 and the password is: fisher

available implementation of the 'S+' statistical language developed at Bell Labs. Class examples and lab exercises will use R. Many of you may have already used SigmaPlot as well. It is a nice graphics program, though R has more flexibility and reproducibility. Finally, both Excel and LibreOffice.org (essentially identical to OpenOffice.org) 'calc' are available on these computers.

If you have your own laptop, I **strongly** encourage you to install the following open-source software:

- R (latest version, currently v3.12) <http://cran.r-project.org>
- RStudio Desktop version (latest version, currently v0.99.491) <http://rstudio.org>². You need both R and R-studio for your platform
- LibreOffice (latest version) libreoffice.org (if you have excel, that will be ok, though)

Finally, I know a bit about computer systems in general, but very little about different flavors of windows and macos. It is your responsibility to make your computer talk to the college's wireless network (instructions available in the Grice computer room). Also it's your responsibility to install software yourself. *Your most important research tool is your brain, bar none. Nowadays, however, your computer is an extremely important research tool as well. If you are considering a career in science, you should quickly become versed in how to manage software and files on the computer, not just for this class, but for your training in general.* I'll help if I can, but I am not a computer support technician.

1.5 Labs

Labs will implement concepts discussed in lecture using concrete examples in R. Every Tuesday and Thursday lab sections will meet from 10:30-1:30. It is important that the class is divided evenly across the two sections. Students will be confirmed in lab sections the first day of class.

1.6 Assignments

1.6.1 Exams

There will be two cumulative exams. Given the type of course that Biometry is by necessity, these will be take-home exams. You are on your honor to work *completely alone* on these exams.

1.6.2 Problem sets

There will be two problem sets assigned this semester. They will require you to take the concepts in class and apply them in a relatively low-pressure, relaxed(!?) environment. I will

²Later versions of rstudio are very important for some of the coursework

provide a series of questions, usually associated with data. Expect these problem sets to be challenging and to require independent thought. They will not consist of regurgitation-type questions. At the same time, I fully intend to provide you with the tools and skills needed to solve these problems. Finally, unlike the exams, I expect and encourage you to collaborate with your peers on these problems. I do expect you to each perform and report the analyses individually, however.

1.6.3 Final Projects

You will be required to take an empirical dataset and (re)analyze the data to address a biological process of their choosing. I expect that most students will derive data from the primary literature, although if you can find a dataset from your advisor, potential advisor, or elsewhere, that would be great. Projects will be presented using suitable visual aids (Powerpoint may seem easiest, but not the only way to go). All students will write critiques of each project presentation. These critiques will comprise 20% of the project total. Due to the size of the class, presentations will be limited to 10 minutes each.

1.6.4 Percent Weights

Assignment	Weight
Problem sets (total)	40
Exams 1 & 2	30
Project	20
Participation	10

1.7 Attendance

It is rather ridiculous that this language has to be included in the syllabus of a graduate class: The difficulty of this class will increase exponentially as you miss classes. Furthermore, if you miss either lecture or lab, please do not expect the instructor to “re-lecture” at your convenience.

2 Lecture Schedule

I reserve the right to deviate from the lecture topic schedule. I’ve included relevant chapters from [Gotelli and Ellison \(2004\)](#) and ?, but remember these are suggested, not required, texts.

Week	Date	Day	Topic	Gotelli.I
1	1/7/2016	th	Intro; Syllabus; Reproducible research; What is Data?	8
2	1/12/2016	tu	What is Data, Computers in Statistics,R	
	1/14/2016	th	Descriptive Statistics	3
3	1/19/2016	tu		
	1/21/2016	th	Probability Distributions	1,2
4	1/26/2016	tu		
	1/28/2016	th	Hypothesis testing; experimental design	4
5	2/2/2016	tu		
	2/4/2016	th	Methods of estimation and model fitting	5
6	2/9/2016	tu	Building a 2-sample MLE	
	2/11/2016	th	Problem set 1 available at 5pm	
	2/16/2016	tu	Exam Help	
	2/18/2016	th		
7	2/23/2016	tu	ANOVA	6,7,10
	2/25/2016	th	Problem set 1 due at 5pm	
8	3/1/2016	tu	ANOVA; Exam 1 available at 5pm	
	3/3/2016	th	Mixed model ANOVA; Non-parametric analogues	10
9	3/8/2016	tu	Spring Break	
	3/10/2016	th	Spring Break	
10	3/15/2016	tu	Regression; non-parametric analogues; Exam 1 Due	9
	3/17/2016	th	Multiple Regression; GLMs	
11	3/22/2016	tu		11
	3/24/2016	th		
12	3/29/2016	tu	Analysis of Frequencies	
	3/31/2016	th		
13	4/5/2016	tu	small introduction into multivariate statistics; Problem set II avail at 2am	
	4/7/2016	th		
14	4/12/2016	tu	Lecture based on popular demand	12
	4/14/2016	th	Presentations (need two days); Exam II available	
15	4/19/2016	tu	Problem set II due	
Exam	4/26/2016		Exam II due	

3 Lab Schedule

Week	Lab.Topic	Daalgard
2	Introduction to Excel, 'R/S+'; import data; Reproducible research	1
3	Description of Data	3
4	Probability distributions	2
5	Determining error rates; hypothesis testing	4
6	OLS; Monte-Carlo; MLEs Final Project Development	
7	Specifying ANOVA models	7; 6.1
8	nlme and non-parametric tests	
10	Specifying regression models	6.2; 6.4
11	Multiple Regression; glms	
13	Contingency Table Analyses	7
14	Multivariate analyses (clustering, how to implement pca)	

References

Dalgaard, P. (2002). *Introductory Statistics with R*, Academic Press, Inc Springer. book goes with R package ISwR.

Gotelli, N. and Ellison, A. (2004). *A Primer of Ecological Statistics*, Sinauer.

Sokal, R. R. and Rohlf, F. J. (1995). *Biometry. The principles and practice of statistics in biological research*, third edn, W. H. Freeman, San Francisco,.