BIOLOGY 9915A
Analytical Methods & Study Design in Biology
Fall 2024

Course Information
Lecture: MW 12:30 - 1:30 pm
Seminar: 1 hour per week time TBD
Lab: (attendance optional) W 2:30 – 5:30

Instructor
Dr. Ben Rubin
Office: BGS 3072
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Pre-requisites

Biology/Statistics 2244A/B or similar introductory undergraduate statistics course.

Anti-requisites

Biology 4259F or Biology 9916. This course is cross-listed with Biol 4259F.

Required Materials
Laptop: Bring your own to lectures and labs.
Software (free):
- R version 4.4.1 (June 2024) (https://cran.r-project.org/)
- RStudio Desktop v2022.07.01 (https://posit.co/download/rstudio-desktop/)

*If you have an earlier version of R and RStudio on your laptop, I recommend that you
uninstall R, RStudio, and all libraries, and then install the most recent versions. You may also use R Studio Cloud, which is hosted online.

Books:
- Hector, A. 2021. The New Statistics with R: An Introduction for Biologists. 2nd edition. Oxford University Press, Oxford, UK. Electronic access via the library.
- Beckerman, A.P., D.Z. Childs, O.L. Petchey. 2017. Getting Started with R: An Introduction for Biologists. 2nd edition. Oxford University Press, Oxford, UK. Electronic access via the library.

Description
This course aims to help you become an informed user and consumer of statistics. Statistical methods allow us to answer questions and learn about the world around us from data. As a biologist, you might apply analysis of variance to learn about the effects of different diseases on plant growth, linear regression to explore the impacts of climate change on species diversity, or logistic regression to understand the factors affecting an animal's presence in the landscape.

In introductory courses, you may have been taught these methods as if they were recipes to follow. My goal is to help you understand these techniques, and more complex procedures, more deeply so that you can choose an appropriate analysis for your study and report your results clearly. Our discussions will focus on understanding the assumptions underlying the methods we study and developing good practices of statistics that you can take forward to new problems.

Learning Outcomes

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

1. Explain the assumptions of the methods studied in class.
2. Decide whether a specified method is appropriate to analyze data from a given study.
3. Implement the methods studied in class in R and interpret the results.
4. Report the results of your analysis in language appropriate for a publication in biology.

Assessment

Your course grade will be calculated based on the following elements:

Lecture attendance and reading reports	10%
Writing assignments (top 3 of 4)	30%
Summary and critique of statistical analysis and reporting in a scientific paper	15%
Data analysis assignments (top 9 of 11)	30%
Seminar leading and participation	15%

Brief description of each element:

Reading report – for each reading assignment you will be asked to state the three to five main points and to rate your own understanding of each point on a scale from 1 to 10. These are due Monday mornings at 8:30 AM. Grading scheme: full credit if submitted, no credit if not submitted

Writing assignments – essays of 500 to 600 words that evaluate the important principles of how statistical inference is conducted and reported. Due dates are on tentative schedule at the end of this course outline.

Summary and critique of statistical analysis and reporting in a scientific paper – essay of 1,000 to 1,200 words that describes and critiques the use of statistical analysis as described in a biological research article of your choosing. The due date will be shortly after we cover the relevant technique in class. There will be a sign-up process near the beginning of the term so that all students have some choice of topic and due date.

Data analysis assignments – The assignments are to be completed using R Studio to apply the techniques of lecture and lab. Due dates are on tentative schedule at the end of this course outline.

Seminar leading – During each seminar meeting, we will discuss a paper about the use of statistical analysis in biology. One or two students will be assigned to lead each discussion. There will be a sign-up process near the beginning of the term so that all students have some choice of topic and due date.

Accessibility

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661- 2111 ext. 82147 if you have questions regarding accommodation.

The policy on Accommodation for Students with Disabilities can be found here:
www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf

The policy on Accommodation for Religious Holidays can be found here:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Accommodation for Medical Illness or Other Serious Circumstances

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or supporting documentation to the Academic Counselling Office of your home faculty as soon as possible. If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in NCB280, and can be contacted at scibmsac@uwo.ca.

For further information, please consult the university's medical illness policy at
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

Plagiarism and Scholastic Offenses

Scholastic offenses are taken seriously and students are directed to read the appropriate policy, specifically the definition of what constitutes a Scholastic Offence, at the following web site:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

"Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar)."

Support Services

Learning-skills counsellors at the Student Development Centre (http://sdc.uwo.ca/learning/) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

If you are in emotional or mental health distress, there are several sources of support (in addition to student health):

The Wellness education centre can be a great first stop: http://wec.uwo.ca/

There is also a resource guide http://studentexperience.uwo.ca/student_experience/wellness_initiatives/mental_health_resource_guide.html, and a dedicated health and wellness page, including crisis contacts https://uwo.ca/health/mental_wellbeing/. USC also runs a peer support centre http://westernusc.ca/peersupport/.

Tentative Course Schedule: Lecture and lab

Week	Lecture topic	Lecture readings	Lab topic	Lab readings	Assignments due
Sept 4	M: No class W: Introduction	None	No lab	None	
Sept 9, 11	Statistical estimation	Hector: Chs. 3, 5	Intro to R, R Studio, R Markdown	Hector: Ch. 4 Beckerman: Chs. 1, 2	
Sept 16, 18	Statistical models	Hector: Ch. 6	Data management	Beckerman: Ch.3	Analysis #1: Sept 20
Sept 23, 25	Regression	Hector: Chs. 7, 8	Graphing	Beckerman: Ch. 4	Writing #1: Sept 24 Analysis #2: Sept 27
Oct 2	M: no class W: Model inference	Hector: Chs. 9. 10	Regression	None	Analysis #3: Oct 4
Oct 7, 9	ANOVA	Hector: Chs. 11, 12	ANOVA	None	Analysis #4: Oct 11
Oct 16	M: no class W: ANCOVA	Hector: Ch. 13	ANCOVA	None	Analysis #5: Oct 18
Oct 21, 23	Linear model complexities	Hector: Ch. 14	Linear model complexities	None	Analysis #6: Oct 25
Oct 28, 30	GLM for binary data	Hector: Chs. 15, 18	GLM for binary data	None	Writing #2: Oct 29 Analysis #7: Nov 1
Reading week: no class					
Nov 11, 13	GLM for count data	Hector: Ch. 16	GLM for count data	None	Analysis #8: Nov 15
Nov 18, 20	GLM for binomial data	Hector: Ch. 16	GLM for binomial data	None	Analysis #9: Nov 22
Nov 25, 27	GAM	TBA	GAM	None	Writing #3: Nov 26 Analysis #10: Nov 29
Dec 2, 4	GLMM	TBA	GLMM	None	Writing #4 & Analysis #11: Dec 5

Tentative Course Schedule: Seminar (TBA)