Analytical Methods for Ecology, Evolution, and Natural Resources

Fall 2021

11:372:369; 11:216:369
Fall (3 credits)

When M-Th 12:10 – 1:30*
Where: Food Science Room 109. Cook Campus

The general format for the class will be lecture on Mondays and hands on application in Excel and R (mostly R) on Thursdays. Due to the shortened first week of school, this format will start in Week 2.

Instructor: John Wiedenmann
Email: john.wiedenmann@rutgers.edu
Office ENR 125
Remote office hours: by appointment

COVID Protocol: Rutgers requires that all students wear masks in the classroom.

Course Objectives: Students in this course will learn concepts related to understanding the collection, processing, analyzing and visualization of data in problems ecology, evolution, and natural resource management. This course is not a comprehensive course in statistics. Rather, students will be exposed to a wide range of analytical tools, providing a foundation of quantitative reasoning skills to be built upon throughout their academic or professional careers.

Course Learning Goals: The overall learning goals for this course are for students to understand an apply basic quantitative

1) Become proficient in dealing with data: learn types of data, data entry, organization, manipulation, summary, and plotting in Excel
2) Demonstrate knowledge of probability and the standard statistical distributions.
3) Demonstrate the ability to test hypotheses using parametric and non parametric statistical tests
4) Demonstrate an understanding of the use and formulation of different models in ecology, evolution and natural resources.

DEENR Learning Goals

Goal 4: Develop a comprehensive understanding of software, hardware, field and laboratory techniques commonly used in the study of ecology, evolution, and natural resources management.

Goal 5: Demonstrate the ability to design experiments and interpret numeric and graphical data.

Goal 7: Communicate effectively orally and through written text and graphics.

Grading
Homework 50%
Comprehensive Exam 30%
Group project 20%

Most of the course grade will be based on ~5 homework assignments (~10%). Homework will be due one week from the date it is given, and there is no credit for late assignments (unless special permission has been given by the instructor). Missing a single homework can mean dropping a whole letter grade. Any evidence of copying or duplication of another's work will result in a 0 for the homework for everyone involved.

The bulk of the remainder of the course grade (30%) will be based on one take home exam that covers a majority of the class material, and one group project that will be 20% of your grade.

Suggested readings
There is no required stats textbook for this course. However, there are a number of good resources for you to explore if you are interested. Note: I am providing the links to Amazon for easy exploration and to look at some reviews. You can purchase the book through the vendor of your choosing.

- The analysis of biological data by Michael Whitlock and Dolph Schluter: https://www.amazon.com/Analysis-Biological-Data-Michael-Whitlock/dp/0981519407
- Ecological models and data and R by Benjamin Bolker: https://www.amazon.com/Ecological-Models-Data-Benjamin-Bolker/dp/0691125228/ref=sr_1_1?crid=3IJHHIVZT1V4U&keywords=ecological+models+and+data+in+r&qid=1567346190&s=books&sprefix=ecological+models%2Cstripbooks%2C126&sr=1-1 Individual chapters of this book are also available on Dr. Bolker's website for free: https://ms.mcmaster.ca/~bolker/emdbook/index.html
- The R book by Michael Crawley: https://www.amazon.com/R-Book-Michael-J-Crawley/dp/0470973927/ref=sr_1_4?keywords=The+R+book&qid=1567346266&s=books&sr=1-4

Tentative schedule, subject to change. Homework due dates will always be 1 week after it is assigned. The actual due dates may shift if we get behind in the material.

Week	Topic
Week 1 (9/8)	Introduction; course objectives
Week 2 (9/12, 9/15)	Understanding data, random sampling, data preparation. Introduction to Excel and R.
Week 3 (9/19, 9/22)	Summary statistics (mean, median, mode, variance, standard error), application in R and Excel
Week 4 (9/26, 9/29)	Plotting, application in R **Homework 1 due by 9/29**
Week 6 (10/3, 10/6)	Randomness in nature – probability, discrete probability distributions (binomial and Poisson), application in R.
Week 7 (10/10, 10/13)	Continuous distributions - the Normal distribution, application in R **Homework 2 due by 10/13**
Week 8 (10/17, 10/20)	Proportion data, Hypothesis testing, Chi-squared tests, application in R and Excel
Week 9 (10/24, 10/27)	Differences in means, t-tests, application in R and Excel **Homework 3 due 10/27**
Week 10 (10/31, 11/3	Analysis of Variance (ANOVA), application in R, introduction to data sets for group projects **Homework 4 due 11/3**
Week 11 (11/7, 11/10)	Correlation, linear regression, application in R and Excel **Homework 5 due 11/3**
Week 12 (11/14, 11/17)	Dealing with violations of assumptions, non-parametric tests, application in R.
Week 13 (11/21,11/22) This is the week of Thanksgiving. Tuesday follows a Thursday schedule	Multiple regression; application in R, time for group project work. **Take home exam due 11/22**
Week 14 (12/5, 12/8)	Simulation models; application in R; Group presentations
Week 15 (12/12)	Group project presentations

For this class we will using R and RStudio. R is a programming language and RStudio is a nice user interface that makes working with R much easier. You must first download and install R, then install RStudio. Follow the steps below

To Install R on a <u>Mac</u>

1. Open an internet browser and go to www.r-project.org.

2. Click the "download R" link in the middle of the page under "Getting Started."

3. Select a CRAN location (a mirror site – I suggest any one in the US) and click the corresponding link.

4. Click on the "Download R for (Mac) OS X" link at the top of the page.

5. Click on the file containing the latest version of R under "Files."

6. Save the .pkg file, double-click it to open, and follow the installation instructions.

7. Now that R is installed, you need to download and install RStudio.

To Install RStudio

1. Go to www.rstudio.com and click on the "Download RStudio" button.

2. Click on "Download RStudio Desktop."

3. Click on the version recommended for your system, or the latest Mac version, save the .dmg file on your computer, double-click it to open, and then drag and drop it to your applications folder.

To Install R on a <u>PC</u>:

1. Open an internet browser and go to www.r-project.org.

2. Click the "download R" link in the middle of the page under "Getting Started."

3. Select a CRAN location (a mirror site – I suggest anyone in the US) and click the corresponding link.

4. Click on the "Download R for Windows" link at the top of the page.

5. Click on the "install R for the first time" link at the top of the page.

6. Click "Download R for Windows" and save the executable file somewhere on your computer. Run the .exe file and follow the installation instructions.

7. Now that R is installed, you need to download and install RStudio.

   To Install RStudio

1. Go to www.rstudio.com and click on the "Download RStudio" button.

2. Click on "Download RStudio Desktop."

3. Click on the version recommended for your system, or the latest Windows version, and save the executable file. Run the .exe file and follow the installation instructions.