

The aim of *Modelling Biological Data* is to move beyond traditional statistical models that assume normally distributed observations and to introduce models better suited to the types of data commonly encountered in the biological sciences. The course is applied in nature with a significant practical component. You will learn to use the R statistical software to fit modern statistical models and to interpret and present results from your data analyses.

Instructor

Dr. Mark Vanderwel (LB 248; mark.vanderwel@uregina.ca; office hours: by appointment)

Prerequisites

STAT 200 (if taken as BIOL 440)

Prior programming experience (e.g., CS 110) is recommended.

Lectures & Labs

Lectures: TR 1:00 – 2:15, CL 417. See table below for lecture dates.

Computer-based lab classes: M 2:30 – 5:15, CL 109.

Recommended texts

There is no required textbook for the course. If you are interested in using a textbook to reinforce your understanding of the course material, I recommend the following:

Zuur A.F., Ieno, E.N., Walker, N.J., Saveliev, A.A., and Smith, G.M. (2009) *Mixed Effects Models and Extensions in Ecology with R*. Springer. The book and individual chapters are available for free through the U of R library's online subscription.

Bolker, B. (2008) *Ecological Models and Data in R*. Princeton University Press. Chapter PDFs freely available from <http://ms.mcmaster.ca/~bolker/emdbook/>.

Zuur A.F., Ieno, E.N., and Smith, G.M. (2007) *Analysing Ecological Data*. Springer. The book and individual chapters are available for free through the U of R library's online subscription.

McElreath R. (2016) *Statistical Rethinking: A Bayesian course with examples in R and Stan*. CRC Press. The book and individual chapters are available for free through the U of R library's online subscription.

Software

It is highly recommended that students download and install the following free software to complete assignments for the course. It is also installed in the U of R computer labs, and will be used regularly during labs.

R: <http://cran.stat.sfu.ca/>

R Studio (Desktop version): <https://posit.co/download/rstudio-desktop/>

Grade Allocation

	BIOL 440	BIOL 810
Participation	10%	10%
Lab assignments	10%	10%
Lab quizzes (×3)	30%	20%
Midterm exam	20%	10%
Final exam	30%	20%
Data analysis project		20%
Presentation		10%

Lab Assignments and Quizzes

Weekly lab assignments will require you to demonstrate an understanding of the data analysis skills developed in the labs and the statistical knowledge covered in lecture. Lab assignments will be due at the start of the following week's lab (Monday at 2:30). Each assignment will be graded on a pass/fail basis.

You may collaborate with other students or use generative AI for assistance on lab assignments, but the work you submit (answers to questions, R scripts) must be your own. Each week a different student will present their solutions to assignment questions from the previous lab.

A 30-minute lab quiz will be held at the start of the lab periods on **Feb 2**, **Mar 9**, and **Apr 6**. The quiz on Feb 2 will cover the three previous labs, and those on Mar 9 and Apr 6 will cover the four previous labs. Questions on the lab quizzes will be drawn from previous lab assignments. Lab quizzes will be closed-book, with no external assistance permitted.

Data Analysis Project (BIOL 810 only)

Students enrolled in BIOL 810 will use the approaches presented in the course to perform a complete independent analysis of a data set. Students are encouraged to use suitable data from

their own research, with the prior approval of the instructor. If such data are not available, a data set will be assigned by the instructor. Further details will be provided during the course.

Students will give a 10-15 min. presentation and submit a written report on their data analysis project near the end of the course.

Exams

There will be an in-class midterm on **Feb 12**.

The final exam is currently scheduled on **Apr. 16, 2:00-5:00** (Subject to change. Please consult the final exam schedule to confirm exam date and time.)

Students are required to write the final exam to pass the course. “Deferred” final exams are granted only by the Assistant Dean, Undergraduate (for Faculty of Science students), or by the Deans and/or Assistant Deans of other Faculties of Federated Colleges of the University Regina. There are no exceptions.

Schedule of Topics

	Tuesday lecture		Thursday lecture		Next Monday lab	
1	Jan 6	Introduction	Jan 8	Simple regression	Jan 12	Mean fitting lab
2	Jan 13	Transformations	Jan 15	Linear models	Jan 19	Simple reg. lab
3	Jan 20	Interactions	Jan 22	PDFs	Jan 26	Linear mod. lab
4	Jan 27	PDFs	Jan 29	GLM	Feb 2	PDFs lab*
5	Feb 3	Overdispersion	Feb 5	Likelihood	Feb 9	GLM lab
6	Feb 10	Likelihood	Feb 12	Midterm exam	Feb 16	Winter break
	Feb 17	Winter break	Feb 19	Winter break	Feb 23	Likelihood lab
7	Feb 24	Optimization	Feb 26	Likelihood fns	Mar 2	Non-linear lab
8	Mar 3	Model eval.	Mar 5	Model selection	Mar 9	Cross-valid. lab*
9	Mar 10	Bayesian models	Mar 12	Simple Bayes	Mar 16	Bayesian lab
10	Mar 17	MCMC	Mar 19	Writing a sampler	Mar 23	MCMC lab
11	Mar 24	Mixed models	Mar 26	Hier. Bayes	Mar 30	Mixed mod. lab
12	Mar 31	Hier. Bayes	Apr 2	Autocorrelation	Apr 6	Hier. Bayes lab*
13	Apr 7	State space mod.	Apr 9	Presentations	Apr 13	

* Lab quiz

Use of AI

Students are permitted to use generative AI tools on assignments for this course as indicated by the instructor and outlined on this syllabus. Without such permission, students are expected to complete all coursework without substantial assistance from others, including automated tools.

Attendance Policy

Students are expected to be on time for class. Students that are chronically absent without a valid reason will receive a zero for the participation portion of their grade. One written warning will be provided to the student before such action is taken.

Student Conduct

Students of the University of Regina are expected to conduct themselves responsibly and with propriety both in their studies and in their general behaviour, and are expected to abide by all policies and regulations of the University of Regina. Misconduct, which may be academic (that is, in academic studies) or non-academic (in general behaviour), is subject to disciplinary action.