

BIOL 343

Advanced Statistics for Biologists

Winter Term (2017/18)

CALENDAR DESCRIPTION

An in-depth exploration of the general linear model and its application to biological problems, with special emphasis on using R software for analysis and reproducible research.

LEARNING HOURS 120 (36L;12T;12O;60P)

PREREQUISITE BIOL 243/3.0 or STAT 269/3.0.

SCHEDULE

Lectures: Monday 08:30-09:20am, Tuesday 10:30-11:20am, Thursday 09:30-10:20 in MAC-CORRY 0216

Tutorials: Thursdays 13:30-14:20 OR 14:30-15:20, in BIOSCI 3311

Instructor	Bob Montgomerie
Instructor Contact	mont@queensu.ca Phone: 613-533-6127
Office Hours	Mon, Tues, Thurs 1400-1600 or any other time by appointment (send me an email)
TAs:	Alyson Van Natto
TA Contact	Aly can be contacted at alysoncvn@gmail.com
TA Office Hours	during tutorials or contact to make appointment

Intended Student Learning Outcomes

The goals of Biology 343 are to provide students with practical experience in the application of the general linear model to the analysis of biological data using R,

to develop general skills in the application and reporting of statistical analysis, and to develop statistical literacy.

To complete this course students will demonstrate their ability to:

1. Perform statistical analyses, manage data and draw graphs using R.
2. Draw graphs that enhance the publication of scientific studies in both the technical literature and popular press
3. Use RMarkdown to document the use of R code to perform analyses and summarize results in a reproducible manner
4. Use the general linear model to analyze continuous and categorical data
5. Interpret the results of statistical analyses in terms of effect sizes and margins of error; understand the concept of false discovery rate
6. Read and evaluate statements about statistics in both the scientific literature and the popular press
7. Understand all of the concepts and principles in the textbook by Motulsky

Learning Hours

<i>Teaching method</i>		<i>Average hours per week</i>	<i>Number of weeks</i>	<i>Total hours</i>
In-class hours	Lecture	3	12	36
	Seminar			
	Laboratory			
	Tutorial	1	12	12
	Practicum			
	Group learning			
	Individual instruction			
Other	Online activity	1	12	12
	Off-campus activity			
	Private study	5	12	60
Total hours on task				120

Course Outline

The main topics to be covered in this course are data visualization and the practical application of the general linear model (anova, regression, categorical data analysis) using R software and a variety of on-line and software tools. This course builds on the foundation provided in BIOL-243 (and equivalent courses) to give students considerable practical experience in the analysis of data and the presentation of results, with a particular emphasis on statistical literacy. Students who are successful in BIOL-343 should be well prepared for the sorts of data analysis required in field courses, honours theses and graduate student research.

Monday classes will introduce ideas and concepts; Tuesday and Thursday classes will be conducted in the form of workshops where we will work through examples based on the Monday class

Approximate weekly schedule

- w1 Intro to course, data visualization, reproducibility, RMarkdown
- w2 data wrangling
- w3 descriptive statistics and statistical literacy
- w4 effect sizes, margins of error P, power, false discovery rate
- w5 general linear models (LMs): regression and correlation
- w6 **in-class 2-part midterm quiz:** Tues multiple choice, Thurs short answer
- w7 LM: multiple regression, diagnostics and graphs
- w8 LM: one way ANOVA
- w9 LM: two way ANOVA and ANCOVA, interactions
- w10 LM: contingency tables
- w11 Generalized Linear Models: binomial and sex ratios
- w12 **in-class 2-part final quiz:** Tues multiple choice, Thurs short answer

Textbooks/Readings

REQUIRED: Motulsky H (2016) *Essential Biostatistics*. Oxford University Press, Oxford

We also recommend: Whitlock M, Schluter D (2015) *The Analysis of Biological Data*, 2nd edition. Roberts and Co, Colorado.

Check the Resources page on the course OnQ site for further readings and online resources.

Grading Scheme

Component	Weight (%)	Date
Assignments (6 marks each) x10	60	One per week in weeks 1-5 and 7-11
Midterm and final @ 20 marks each	40	Weeks 6 and 12

Grading Method

In this course, all assignments and examinations will receive letter grades, which for purposes of calculating your course average will be translated into numerical equivalents using the Faculty of Arts and Science Letter Grade Input Scheme and weighted according to the Grading Scheme above.

The following scale will be employed to translate letter grades into numerical grades for purposes of calculating your course average:

Arts & Science Letter Grade Input Scheme

Assignment mark	Numerical value for calculation of final mark
A+	93
A	87
A-	82
B+	78
B	75
B-	72
C+	68
C	65
C-	62
D+	58
D	55
D-	52
F48 (F+)	48
F24 (F)	24
F0 (0)	0

Your course average will then be converted to a final letter grade according to Queen's Official Grade Conversion Scale:

Queen's Official Grade Conversion Scale

Grade	Numerical Course Average (Range)
A+	90-100
A	85-89
A-	80-84
B+	77-79
B	73-76
B-	70-72
C+	67-69

C	63-66
C-	60-62
D+	57-59
D	53-56
D-	50-52
F	49 and below

Statement on Academic Integrity

Queen's students, faculty, administrators and staff all have responsibilities for supporting and upholding the fundamental values of academic integrity. Academic integrity is constituted by the five core fundamental values of honesty, trust, fairness, respect and responsibility (see www.academicintegrity.org) and by the quality of courage. These values and qualities are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University.

Students are responsible for familiarizing themselves with and adhering to the regulations concerning academic integrity. General information on academic integrity is available at Integrity@Queen's University, along with Faculty- or School-specific information. Departures from academic integrity include, but are not limited to, plagiarism, use of unauthorized materials, facilitation, forgery, and falsification. Actions that contravene the regulation on academic integrity carry sanctions that can range from a warning, to loss of grades on an assignment, to failure of a course, to requirement to withdraw from the university.

Turnitin Statement

Queen's University has partnered with Turnitin to help maintain our standards of excellence in academic integrity. Turnitin is a suite of tools that provide instructors with information about the authenticity of submitted work and facilitates the process of grading.

Submitted files are compared against an extensive database of content, and Turnitin produces a similarity report and a similarity score for each assignment. A similarity score is the percentage of a document that is similar to content held within the database. Turnitin does not determine if an instance of plagiarism has occurred. Instead, it gives instructors the information they need to determine the authenticity of work as a part of a larger process.

Accommodations Statement

Queen's University is committed to achieving full accessibility for persons with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. If you are a student with a disability and think you may need accommodations, you are strongly encouraged to contact Student Wellness Services (SWS) and register as early as possible. For more information, including important deadlines, please visit the Student Wellness website at: <http://www.queensu.ca/studentwellness/accessibility-services/>

Copyright

The material on the course's OnQ site is designed for use in BIOL 343 at Queen's University and is the property of the instructor unless otherwise stated. Third party copyrighted materials (such as book chapters and articles) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law.

Academic Consideration for Students in Extenuating Circumstances

The Senate Policy on Academic Consideration for Students in Extenuating Circumstances (<http://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslclwww/files/files/policies/senateandtrustees/Academic%20Considerations%20for%20Extenuating%20Circumstances%20Policy%20Final.pdf>) was approved in April, 2017. Queen's University is committed to providing academic consideration to students experiencing extenuating circumstances that are beyond their control and which have a direct and substantial impact on their ability to meet essential academic requirements.

Each Faculty has developed a protocol to provide a consistent and equitable approach in dealing with requests for academic consideration for students facing extenuating circumstances. Arts and Science undergraduate students can find the Faculty of Arts and Science protocol and the portal where they submit a request at: <http://www.queensu.ca/artsci/accommodations>. Students in other Faculties and Schools should refer to the protocol for their home Faculty.

Location and Timing of Final Examinations

As noted in Academic Regulation 8.2.1, “the final examination in any class offered in a term or session (including Summer Term) must be written on the campus on which it was taken, at the end of the appropriate term or session at the time scheduled by the Examinations Office.”

The exam period is listed in the key dates prior to the start of the academic year in the Faculty of Arts and Science Academic Calendar and on the Office of the University Registrar’s webpage. A detailed exam schedule for the Fall Term is posted before the Thanksgiving holiday; for the Winter Term it is posted the Friday before Reading Week, and for the Summer Term the window of dates is noted on the Arts and Science Online syllabus prior to the start of the course. Students should delay finalizing any travel plans until after the examination schedule has been posted. Exams will not be moved or deferred to accommodate employment, travel/holiday plans or flight reservations.