

# Analysis of Biological Data Syllabus

## Department of Biology

### BIOL4062 Fall 2024

*Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral, current and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.*

*Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.*

*In BIOL4062 all students are welcome regardless of race/ethnicity, gender identity or expression, sexual orientation, socio-economic status, age, or any other diverse aspect or identity.*

### Course Instructor(s)

Name	Email	Office Hours
Derek Tittensor (instructor)	<a href="mailto:derek.tittensor@dal.ca">derek.tittensor@dal.ca</a>	Mon.Wed 16:00 - 16:30 (LSC 7060), or via email.
Hal Whitehead (instructor)	<a href="mailto:hal.whitehead@dal.ca">hal.whitehead@dal.ca</a>	Mon.Wed 16:00 - 16:30 (LSC 7076), or via email.
Reid Steele (TA)	<a href="mailto:reid.steele@dal.ca">reid.steele@dal.ca</a>	Email for appointment

### Course Description

Biologists are increasingly using quantitative techniques to analyze larger and larger data sets. A command of the available analytical techniques is an important part of the set of skills which are expected of a trained biologist, especially those working in the broad area of ecology. The class will introduce techniques available for the analysis of biological data, including correlation, regression, multivariate, Bayesian and hierarchical methods. Emphasis will be on the practical use and abuse of these techniques rather than derivations or mathematical formulae; the idea being that students will learn a suite of approaches that will enable them to select suitable techniques for multiple data types. Students will explore real and realistic data sets, as well as simulated data, and learn good practices for hands-on application of approaches.

### *Course Prerequisites*

Prerequisites: STAT 2080.03 or ECON 2280.03 or MATH 2080.03, AND BIOL 3872.03. Students should have familiarity with R (strongly preferred), or some other statistical, command-line, programming language (e.g. Python, MATLAB; but support is only in place for R).

### *Course Exclusions*

None.

## **Course Structure**

### *Course Delivery*

Course delivery is hybrid. Most lectures will be in-person with a few pre-recorded and available on the class Brightspace on the day of the lecture. In-class test on 4 Dec will be in person. Students are expected to attend in-person lectures as these will not be recorded for subsequent viewing. Students connecting to online resources from outside Canada are responsible for ensuring awareness and compliance with any applicable laws in the country from which they are connecting.

### *Lectures*

Mon & Wed 14:35 - 15:55, LS OCEANOGRAPHY O3655

## **Course Materials**

Course Brightspace page contains relevant materials and will be used for pre-recorded lectures. No textbook necessary.

## **Assessment**

<b>Assessment</b>	<b>Weight (% of final grade)</b>	<b>Date</b>
<b><i>Assignments</i></b>		
<i>Report of analysis of data set 1a</i>	<i>10%</i>	<i>7 Oct</i>
<i>Report of analysis of data set 1b</i>	<i>10%</i>	<i>15 Oct</i>
<i>Report of analysis of data set 1c</i>	<i>10%</i>	<i>21 Oct</i>

*Report of analysis of data set 1d*      **10%**      **30 Oct**

*Report of analysis of data set 1e*      **10%**      **6 Nov**

*Description of data set 2*

*and proposed analysis*      **5%**      **23 Oct**

*(revised version on 30 Oct)*

*Report of analysis of data set 2*      **30%**      **9 Dec**

*Tests/quizzes*

*In class test (80 min)*      **15%**      **4 Dec**

*Final exam*

No final exam: in-class test on Wednesday 4<sup>th</sup> Dec.

*Other course requirements*

None.

Conversion of numerical grades to final letter grades follows the

[Dalhousie Grade Scale](#)

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (0-49)
A- (80-84)	B- (70-72)	C- (55-59)	

### **Course Policies on Missed or Late Academic Requirements**

Assignments must be sent in through Brightspace by 16:30 on due date.

10% off for each weekday late without medical or other legitimate explanation (use the *Student Declaration of Absence* form; up to 3 times in course)

## Course Policies related to Academic Integrity

This course is tailored towards individual learning, so there is to be no working in groups on assignments. Plagiarism detection software may be used on assignments.

*Generative AI and LLM policy:* Writing for assignments should not use ChatGPT or other generative AI. You are welcome to explore ChatGPT to help you code your statistical analyses, though the final code should be yours; be aware that AI-generated code may not be accurate or may have unanticipated issues, and also be aware that uncritically using AI-generated code will impact your learning.

## Learning Objectives

Developing knowledge of methods for analyzing biological data.

## Course Content

Lecture	Date	In-person / pre-recorded	Assignment given out	Assignment due
Introduction to 4062/5062	Wed 4 Sep	In-person		
R (a refresher)	Mon 9 Sep	In-person (led by TA)		
Inference in Biology	Wed 11 Sep	In-person		
Correlation and linear regression	Mon 16 Sep	In-person		
Introduction to multivariate analysis and multivariate distances, association measures	Wed 18 Sep	In-person		
Principal component analysis	Mon 23 Sep	In-person	Assignment 1a given out	
Multivariate analysis with grouped units or grouped variables	Wed 25 Sep	In-person	Assignment 1b given out	

<i>National day of truth and reconciliation</i>	<i>Mon 30 Sep NATIONAL DAY OF TRUTH AND RECONCILIATION</i>	<i>No class</i>		
Multivariate analysis of association matrices	Wed 2 Oct	In-person		
Cluster analysis, Categorical Data: Contingency Tables and Log-Linear Models	Mon 7 Oct		Assignment 1c given out	<b>Report 1a due</b>
Introduction to likelihood	Wed 9 Oct	In-person		
<i>Thanksgiving</i>	<i>Mon 14 Oct THANKSGIVING</i>	<i>No class</i>		<b>Report 1b due 15<sup>th</sup> August</b>
Multiple linear regression and path analysis	Wed 16 Oct	In-person	Assignment 1d given out	
Generalized linear models	Mon 21 Oct	In-person		<b>Report 1c due  Assignment 2a meetings (around this date)</b>
Logistic regression	Wed 23 Oct	In-person	Assignment 1e given out	<b>Description of data set 2 &amp; proposed analysis due</b>
Bayesian data analysis using STAN	Mon 28 Oct	In-person		
Hierarchical models	Wed 30 Oct	In-person		<b>Report 1d due</b>
Simulating data to check your models and cross-validation	Mon 4 Nov	Pre-recorded		
Diversity analysis, sampling effort, and bootstrapping	Wed 6 Nov	Pre-recorded		<b>Report 1e due</b>

Fall study break	Mon 11 Nov FALL STUDY BREAK	<i>No class</i>		
Fall study break	Wed 13 Nov FALL STUDY BREAK	<i>No class</i>		
Analyzing temporal data	Mon 18 Nov	In-person		
Analyzing spatial data & good modelling practice and tips	Wed 20 Nov	In-person		
Graduate presentations 1 (undergrads to attend)	Mon 25 Nov	In-person		<b>Grad presentations (undergrads to attend)</b>
Graduate presentations 2 (undergrads to attend)	Wed 27 Nov	In-person		<b>Grad presentations (undergrads to attend)</b>
Graduate presentations 3 (undergrads to attend)	Mon 2 Dec	In-person		<b>Grad presentations (undergrads to attend)</b>
Graduate presentations 4 (undergrads to attend)	Tue 3 Dec	In-person		<b>Grad presentations (undergrads to attend)</b>
In-class test for undergrads	Wed 4 Dec	In-person (undergrads only)		<b>In-class test for undergrads</b>
Report on analysis of data set 2 due	Fri 9 Dec	N/A		<b>Report on analysis of data set 2 due</b>

## Student Resources

### Advising

**General Advising** [https://www.dal.ca/campus\\_life/academic-support/advising.html](https://www.dal.ca/campus_life/academic-support/advising.html)

**Science Program Advisors:** <https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html>

**Indigenous Student Centre:** [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

**Black Students Advising Centre:** [https://www.dal.ca/campus\\_life/communities/black-student-advising.html](https://www.dal.ca/campus_life/communities/black-student-advising.html)

**International Centre:** [https://www.dal.ca/campus\\_life/international-centre/current-students.html](https://www.dal.ca/campus_life/international-centre/current-students.html)

### Academic supports

**Library:** <https://libraries.dal.ca/>

**Writing Centre:** [https://www.dal.ca/campus\\_life/academic-support/writing-and-study-skills.html](https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html)

**Studying for Success:** [https://www.dal.ca/campus\\_life/academic-support/study-skills-and-tutoring.html](https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html)

**Copyright Office:** <https://libraries.dal.ca/services/copyright-office.html>

**Fair Dealing Guidelines** <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

### Other supports and services

**Student Health & Wellness Centre:** [https://www.dal.ca/campus\\_life/health-and-wellness.html](https://www.dal.ca/campus_life/health-and-wellness.html)

**Student Advocacy:** <https://dsu.ca/dsas>

**Ombudsperson:** [https://www.dal.ca/campus\\_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html](https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html)

### Safety

**Biosafety:** <https://www.dal.ca/dept/safety/programs-services/biosafety.html>

**Chemical Safety:** <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

**Radiation Safety:** <https://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

**Scent-Free Program:** <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

**Dalhousie COVID-19 information and updates:** <https://www.dal.ca/covid-19-information-and-updates.html>



## University Policies and Statements

### Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or [elders@dal.ca](mailto:elders@dal.ca). Additional information regarding the Indigenous Student Centre can be found at: [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

### Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

### Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: [https://www.dal.ca/dept/university\\_secretariat/academic-integrity.html](https://www.dal.ca/dept/university_secretariat/academic-integrity.html)

### Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre ([https://www.dal.ca/campus\\_life/academic-support/accessibility.html](https://www.dal.ca/campus_life/academic-support/accessibility.html)) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)

### Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

### **Diversity and Inclusion – Culture of Respect**

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.html>

### **Student Code of Conduct**

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at: [https://www.dal.ca/dept/university\\_secretariat/policies/student-life/code-of-student-conduct.html](https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html)

### **Fair Dealing Policy**

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: [https://www.dal.ca/dept/university\\_secretariat/policies/academic/fair-dealing-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html)

### **Originality Checking Software**

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at:

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html)

### **Student Use of Course Materials**

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.