College of Physical and Engineering Science

STAT *2230: Biostatistics for Integrative Biology (0.5 credit)
Course Outline for Winter 2022

****NOTE: Per university policy and COVID-19 restrictions, the first two weeks of lectures and labs (Jan 10-21) will be held online. The location of lectures and labs after January 21st is subject to change is response to evolving university policy and COVID-19 restrictions.****

I. General Information

Calendar description: This course introduces students to the design, completion and interpretation of research projects, including identifying categories of research questions, types of data, data gathering methods, efficient graphic and numeric methods to summarize data, standard statistical analyses involving parameter estimation and hypothesis tests and interpreting results in the context of research goals. Statistical concepts underlying practical aspects of biological research will be emphasized. Computer-intensive laboratory sessions will focus on practical data organization, visualization, statistical analysis using software, and interpretation and communication of statistical results. Department of Mathematics and Statistics and Department of Integrative Biology.

Prerequisite(s):	BIOL*1070, BIOL*1080
Restriction(s):	BIOL*2250, STAT*2040, STAT*2060, STAT*2080, STAT*2120, STAT*2250. Enrollment restricted to the BSC majors in BIOD, ECOL, MFB, WBC, WLB, ZOO and BSES majors in ECOL and ECOLC.
Instructor:	Prof. Christina Caruso, Department of Integrative Biology
E-mail:	carusoc@uoguelph.ca
Office hours:	TBA
Instructor:	Prof. Faisal Khamis, Department of Mathematics & Statistics
E-mail:	fkhamis@uoguelph.ca
Office hours:	Immediately after Monday-Wednesday lectures and by appointment
TAs:	Hannah Brazeau (hbrazeau@uoguelph.ca) Patrick McMillan (pmcmilla@uoguelph.ca) Victoria Silverman (vsilverm@uoguelph.ca)
Lecture:	9:30-10:20 MWF. **Either in person in ROZH 103 or online. See "III. Course content" below for details.**
Labs:	1:30-3:20 Th (*0101), SSC 1306

3:30-5:20 Th (*0102), SSC 1306
10:30-12:20 F (*0103), SSC 1306
12:30-2:20 F (*0104), SSC 1306
2:30-4:20 F (*0105), SSC 1306

Midterm exam: February 18, 2022

Final exam: 2:30-4:30 on April 19, 2022

II. Learning outcomes

This course is designed to give students experience and confidence in the design and analysis of data within realistic biological research contexts. Students will gain basic practical experience in displaying, summarizing, analyzing and interpreting biological data in applied research contexts using standard statistical methods.

At the end of this course students should:

1. Understand the statistical concepts of bias, variability, and sampling distributions.
2. Select the appropriate statistical method for a given data set.
3. Evaluate the quality of data collected from observational and experimental studies.
4. Make and interpret visual summaries of data.
5. Use statistical computer software to explore and analyze data.
6. Understand statistical language as used in the primary biological literature.
7. Interpret statistical results and communicate them to other biologists.

III. Course content

Our schedule of lectures is as follows:

Date	**Topic**	**Readings from Samuels et al.**	**Location**
Week 1 (Jan 10-14)			
Monday Jan 10 (CC)	What is statistics? Sources of variability	None	Online
Wednesday Jan 12 (CC)	Types of evidence Sampling	Chapter 1	Online
Friday Jan 14 (CC)	Types of evidence Sampling	Chapter 1	Online
Week 2 (Jan 17-21)			
Monday Jan 17 (CC)	Description of samples	Chapter 2	Online
Wednesday Jan 19 (CC)	Description of samples	Chapter 2	Online
Friday Jan 21 (CC)	Description of samples	Chapter 2	Online
Week 3 (Jan 24-28)			

Monday Jan 24 (FK)	Normal distribution	Chapter 4	ROZH 103
Wednesday Jan 26 (FK)	Confidence intervals	Chapter 6	Online
Friday Jan 28 (FK)	Confidence intervals	Chapter 6	
Week 4 (Jan 31-Feb 4)			
Monday Jan 31 (FK)	Bias and precision One-sample hypothesis tests	Chapter 6	ROZH 103
Wednesday Feb 2 (FK)	Bias and precision One-sample hypothesis tests	Chapter 6	Online
Friday Feb 4 (FK)	Bias and precision One-sample hypothesis tests	Chapter 6	
Week 5 (Feb 7-11)			
Monday Feb 7 (CC)	Experimental design I Comparison of two independent samples	Chapter 7	ROZH 103
Wednesday Feb 9 (CC)	Experimental design I Comparison of two independent samples	Chapter 7	ROZH 103
Friday Feb 11 (CC)	Comparison of paired samples	Chapter 8	ROZH 103
Week 6 (Feb 14-18)			
Monday Feb 14 (CC)	Review	None	ROZH 103
Wednesday Feb 16 (FK)	Review	None	Online
Friday Feb 18	Midterm exam	None	ROZH 103
BREAK (Feb 21-25)	NO CLASS		
Week 7 (Feb 28-Mar 4)			
Monday Feb 28 (FK)	Chi-square goodness of fit test	Chapter 9	ROZH 103
Wednesday Mar 2 (FK)	Chi-square goodness of fit test	Chapter 9	Online
Friday Mar 4 (FK)	Contingency tables	Chapter 10	
Week 8 (Mar 7-11)			
Monday Mar 7 (CC)	Experimental design II	None	ROZH 103
Wednesday Mar 9 (CC)	Experimental design II One-way ANOVA	Chapter 11	ROZH 103
Friday Mar 11 (CC)	One-way ANOVA	Chapter 11	ROZH 103
Week 9 (Mar 14-18)			
Monday Mar 14 (FK)	Multiple comparisons	Chapter 11	ROZH 103
Wednesday Mar 16 (FK)	ANOVA w/blocks	Chapter 11	Online
Friday Mar 18 (FK)	ANOVA w/blocks	Chapter 11	
Week 10 (Mar 21-25)			
Monday Mar 21 (CC)	Two-way ANOVA	Chapter 11	ROZH 103
Wednesday Mar 23 (CC)	Two-way ANOVA	Chapter 11	ROZH 103
Friday Mar 25 (FK)	Linear regression and correlation	Chapter 12	Online
Week 11 (Mar 28-Apr 1)			
Monday Mar 28 (FK)	Linear regression and correlation	Chapter 12	ROZH 103

Wednesday Mar 30 (FK)	Linear regression and correlation	Chapter 12	Online
Friday Apr 1 (FK)	Linear regression and correlation	Chapter 12	
Week 12 (Apr 4-8)			
Monday April 4 (FK)	Review	None	Online
Wednesday Apr 6 (CC)	What test do I use?	None	ROZH 103
Friday Apr 8 (CC)	Review	None	ROZH 103
Tuesday Apr 19	Final Exam	None	TBA

Our schedule of labs is as follows:

Date	Topic of lab	Due date for lab
Week 1 (Jan 10-14) **Online**	Lab 1: Introduction to R	Jan 17 (lab is ungraded, but still turned in)
Week 2 (Jan 17-21) **Online**	Lab 2: Sampling Description of samples	Jan 24
Week 3 (Jan 24-28)	Lab 3: Confidence intervals	Jan 31
Week 4 (Jan 31-Feb 4)	Lab 4: One-sample hypothesis tests	Feb 7
Week 5 (Feb 7-11)	Lab 5: Experimental design Comparison of independent and paired samples	Feb 14
Week 6 (Feb 15-19)	No lab	N/A
BREAK (Feb 21-25)	BREAK	N/A
Week 7 (Feb 28- Mar 4)	Lab 6: Chi-square tests	Mar 7
Week 8 (Mar 7-11)	Lab 7: Experimental design One-way ANOVA	Mar 14
Week 9 (Mar 14-18)	Lab 8: ANOVA w/blocks Multiple comparisons	Mar 21
Week 10 (Mar 21-25)	Lab 9: Two-way ANOVA	Mar 28
Week 11 (Mar 28-Apr 1)	Lab 10: Regression Correlation	Apr 4
Week 12 (Apr 4-8)	No lab	N/A

Important Dates

Jan. 10	First day of classes
Jan. 10	First lecture
Jan. 13-14	First lab
Feb. 18	Midterm
Feb. 21-25	Reading week
Apr. 8	Last day of classes

Apr. 19 Final Exam

IV. Course Resources

Recommended resources

Textbook: Samuels, M.L., J. A. Witmer, and A. A. Schaffner. 2016. Statistics for the Life Sciences, Fifth Edition. New York, Prentice Hall.

Samuels et al. (2016) is available for purchase at the University and Co-op Bookstores. We will assign readings and practice problems from Samuels et al. (2016). You will also be able to use it during the open-book midterm and final exam.

R statistical software: We will be using the software package RStudio to analyze data in labs. R is freely available. Installing R is a two-step process:

1. Download R (the programming language) at http://cran.r-project.org.
2. Download RStudio (the visual interface) at https://www.rstudio.com/products/rstudio/download/.

To launch R, always click on the RStudio icon and not the R icon.

Guide to using R: Dalgaard, P. 2008. Introductory Statistics with R, Second Edition. New York, Springer.

A PDF of Dalgaard (2008) is available for free download on Courselink.

V. Methods of Assessment

Assessment		**Due Date**
Lab assignments	40%	Weekly (Learning outcomes #1-7)
Midterm Exam	25%	February 18th (Learning outcomes #1, 3, 4, and 7)
Final Exam	35%	April 19th (Learning outcomes #1-5, 7)

Lab assignments: The assignments are designed to give you experience in data management, experimental design, graphical methods, and statistical analysis using R, as well as reinforce concepts presented in lectures. The assignments and any required data sets will be posted on Courselink. Assignments will be due by noon on Mondays. **Late assignments will not be accepted, but your lowest assignment grade will be dropped.**

We encourage you to discuss the assignments with your peers, as this leads to better understanding. However, statistical analysis, data exploration, and the learning of statistical software only comes with experience. Consequently, you will get the best value if you work with your peers to increase your comprehension, rather than to do less work.

Each student must hand in a separate complete assignment, and no part of this should be copied from another student. Academic dishonesty, such as plagiarism (including copying all or part of an assignment) and impersonation is grounds for loss of course credit and dismissal. More information on the subject of academic misconduct can be found at:

http://www.uoguelph.ca/undergrad_calendar/c08/c08-amisconduct.shtml.

You will be submitting completed assignments online using a grading software called Crowdmark. You will receive online submission instructions via your University of Guelph e-mail address for each assignment. It is your responsibility to check for this e-mail and to contact Prof. Caruso if you do not receive the e-mail for a particular assignment. More details regarding this process will be provided on each assignment. Marked assignments will be returned via e-mail.

You are responsible for answering all of the questions on each assignment because they will help prepare you for the course exams. However, only some of the questions on each assignment will be graded each week. You will not know in advance which questions will be subject to grading. Solutions for each assignment will be posted on the course. It is up to you to check the answer sheet to evaluate your performance on the unmarked questions.

Exams: There will be one midterm and one final exam in the course. Students are allowed to use their notes, copies of assignments, a calculator, and the course textbook during the midterm and final. However, they cannot communicate with their peers or any other people during the exam.

If you missed the midterm because of illness or academic consideration, your final exam will be reweighted to make up for the missed test. If you miss the final exam for any reason, you must see your program counsellor. University regulations require specific procedures to be followed regarding the conduct of final exams, including recourse, if any, for missed final examinations. These procedures are out of the course instructors' control.

VI. University Statements

Email Communication: As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

When You Cannot Meet a Course Requirement: When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

Drop Date: Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

Copies of Out-of-class Assignment: Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Accessibility: The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 14 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website
https://www.ridgetownc.com/services/accessibilityservices.cfm

Academic Integrity: The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Recording of Materials: Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Resources: The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars https://www.uoguelph.ca/academics/calendars

Disclaimer: Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (https://news.uoguelph.ca/2019-novel-coronavirus-information/) and circulated by email.

Illness: Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

Covid-19 Safety Protocols: For information on current safety protocols, follow these links:

- https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your- safe-return/
- https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.

VII. Campus Resources

If you are struggling to succeed academically

Learning Commons: There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist.

http://www.learningcommons.uoguelph.ca/

Science Commons: Located in the library, the Science Commons provides support for physics, mathematics/statistics, and chemistry. Details on their hours of operations can be found at:

https://www.uoguelph.ca/uaic/acadsupport-sciencecommons

If you are struggling with personal or health issues

Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance:

https://www.uoguelph.ca/counselling/.

Student Health Services is located on campus and is available to provide medical attention:

https://www.uoguelph.ca/studenthealthservices/clinic.