



# STAT\*2230 Biostatistics for Integrative Biology

Winter 2023

Section(s): C01

Department of Integrative Biology

Credit Weight: 0.50

Version 1.00 - January 06, 2023

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## 1 Course Details

### 1.1 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.

**Pre-Requisites:**

BIOL\*1070

**Restrictions:**

STAT\*2040, STAT\*2060, STAT\*2080, STAT\*2120. Restricted to students in the BSC majors in BIOD, MFB, MFB:C WBC, WLB, and ZOO, and BSES majors in ECOL and ECOL:C.

### 1.2 Timetable

**Lecture:**

Monday, Wednesday, Friday: 9:30-10:20, RICH2520

**Labs:**

STAT\*2230\*0101, Thursday: 1:30-3:20; SSC 1306

STAT\*2230\*0102, Thursday: 3:30-5:20; SSC 1306

STAT\*2230\*0103, Thursday: 5:30-7:20; SSC 1306

STAT\*2230\*0104, Friday: 12:30-2:20; SSC 1304

STAT\*2230\*0105, Friday: 2:30-4:20; SSC 1306

## 1.3 Final Exam

**Midterm exam:** Wednesday February 9:30AM – 10:20AM.

Rooms will be announced on CourseLink.

**Final exam:** April 22<sup>nd</sup> from 7PM - 9PM.

Rooms will be announced on CourseLink.

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## 2 Instructional Support

### 2.1 Instructional Support Team

**Instructor:** Nagham Mohammad  
**Email:** naghamm@uoguelph.ca  
**Telephone:** +1-519-824-4120 x53298  
**Office:** MACN 513

**Instructor:** Dirk Steinke  
**Email:** dsteinke@uoguelph.ca  
**Telephone:** +1-519-824-4120 x53759  
**Office:** CBG 109  
**Office Hours:** By appointment - virtually and in person

### 2.2 Teaching Assistants

**Teaching Assistant (GTA):** Thanuja Fernando  
**Email:** thanuja@uoguelph.ca

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## 3 Learning Resources

### 3.1 Required Resources

## R statistical software (Software)

We will be using the software package RStudio to analyze data in labs. R is freely available. If you wish to download a copy for your personal computer, it is a two-step process. First, you must download R (the programming language) at <http://cran.r-project.org>. Second, you must download RStudio (the visual interface) at <https://www.rstudio.com/products/rstudio/download/>.

## 3.2 Recommended Resources

### Guides to using R (Textbook)

- Nagham's Tutorial-R programming language posted on the CourseLink.
- Dalgaard, P. 2008. *Introductory Statistics with R*, Second Edition. New York, Springer. (pdfs available for free download through University of Guelph library).

### Textbooks (Textbook)

- Samuels, M.L., J. A. Witmer, and A. A. Schaffner. 2016. *Statistics for the Life Sciences*, Fifth Edition. New York, Pearson.
- Whitlock, M. C., and D. Schluter. 2015. *The Analysis of Biological Data*, Third Edition. MacMillan Learning.

## 3.3 Additional Resources

### Statistics Learning Centre (Other)

Drop-in help is available in the Mathematics & Statistics Learning Centre (Science Commons, 3rd floor of the library) for students seeking help with course content and/or assignments. Hours of operation are Monday/Wednesday: 9:30am - 3:30pm, Tuesday/Thursday: 10am - 4pm, Friday: 9:30am - 2:30pm. Students are expected to use the Mathematics & Statistics Learning Centre as a primary resource for help with course material

## 4 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:

## 4.1 Course Learning Outcomes

By the end of this course, you should be able to:

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.

## 5 Teaching and Learning Activities

Our TENTATIVE schedule of lectures and labs is as follows. Chapter numbers currently refer to Samuels et al. 2016, 5<sup>th</sup> edition.

### 5.1 Lecture

Topic			
<b>Table 1: TENTATIVE Schedule of Lectures and Labs</b>			
Monday	Wednesday	Thursday	Friday
January 9	Jan 11 (DS)		January 13 (DS)
Introduction (DS/NM) Why do you need statistics? (DS)	Types of evidence (Chapter 1)	<b>No lab</b>	Sampling & Variables (Chapter 1) <b>No Lab</b>
January 16 (DS)	Jan 18 (DS)		January 20 (DS)
Frequency distributions	Descriptive statistics		Measures of

Topic			
(Chapter 2)	(Chapter 2)	<b>Lab 1: Intro to R</b>	Dispersion (Chapter 2) <b>Lab 1: Intro to R</b>
January 23 (DS)	Jan 25 (NM)		January 27 (NM)
Transformation (Chapter 2)	Normal distribution (Chapter 4)	<b>Lab 2: Sampling, Description of samples</b>	Normal distribution (Chapter 4) <b>Lab 2: Sampling, Description of samples</b>
Jan 30 (NM)	Feb 1 (NM)		Feb 3(NM)
Confidence Intervals (Chapter 6)	Confidence Intervals (Chapter 6)	<b>Lab 3: Confidence Intervals</b>	Bias and precision One-sample hypothesis tests (Chapter 6) <b>Lab 3: Confidence Intervals</b>
February 6 (NM)	Feb 8 (DS)		February 10 (DS)
Bias and precision	Bias and precision		Experimental design I: Comparison of two independent samples (Chapter 7)
One-sample hypothesis tests (Chapter 6)	One-sample hypothesis tests (Chapter 6)	<b>Lab 4: One-sample hypothesis tests</b>	<b>Lab 4: One-sample hypothesis tests</b>
Feb 13 (DS)	Feb 15		Feb 17 (DS)

Topic			
Experimental design I: Comparison of two independent samples (Chapter 7)	Midterm		Comparison of paired samples (Chapter 8)
		<b>No Lab</b>	<b>No Lab</b>
Review			
<b>Feb 20 BREAK</b>	<b>Feb 22 BREAK</b>	<b>Feb 23 BREAK</b>	<b>Feb 24 BREAK</b>
February 27 (NM)	Mar 1 (NM)		Mar 3 (NM)
Chi-square goodness of fit (Chapter 9)	Chi-square goodness of fit (Chapter 9)		Contingency tables (Chapter 10)
		<b>Lab 5:</b> Experimental design; Comparison of independent and paired samples	<b>Lab 5:</b> Experimental design; Comparison of independent and paired samples
March 6 (NM)	Mar 8 (DS)		March 10 (DS)
Contingency tables (Chapter 10)	Experimental design II: One-way ANOVA (Chapter 11)		Experimental design II: One-way ANOVA (Chapter 11)
		<b>Lab 6:</b> Chi-square tests	<b>Lab 6:</b> Chi-square tests
March 13 (NM)	Mar 15 (NM)		March 17 (NM)
Multiple comparisons (Chapter 11)	ANOVA w/blocks (Chapter 11)		ANOVA w/blocks (Chapter 11)
		<b>Lab 7:</b> One-way ANOVA	<b>Lab 7:</b> One-way ANOVA
March 20 (DS)	Mar 22 (DS)		March 24 (NM)

Topic		
Two-way ANOVA (Chapter 11)	Two-way ANOVA (Chapter 11)	Linear regression and correlation (Chapter 12)
	<b>Lab 8:</b> Multiple comparisons; ANOVA with blocks	<b>Lab 8:</b> Multiple comparisons; ANOVA with blocks
March 27 (NM)	Mar 29 (NM)	Mar 31 (NM)
Linear regression and correlation (Chapter 12)	Linear regression and correlation (Chapter 12)	Linear regression and correlation (Chapter 12)
	<b>Lab 9:</b> Linear Regression and Correlation	<b>Lab 9:</b> Linear Regression and Correlation
Apr 3 (NM)	Apr 5(DS)	Apr 7
Linear regression and correlation (Chapter 12)	Case studies	Holiday
	<b>Lab 9:</b> Linear Regression and Correlation	
April 10 (DS) Friday April 7 Schedule		
Review		
<b>Lab 9:</b> Linear Regression and Correlation		

## 5.2 Lab

Topic
<p><b><u>General information on labs:</u></b></p> <ul style="list-style-type: none"> <li>• Labs will be run by TAs who will introduce the lab assignment, lead discussion, and give pointers on using R. While we do not take attendance at labs, we strongly encourage you to attend.</li> <li>• Be sure to save the work you do in the lab (data files, output, word processing) and email it to yourself before you leave. Alternatively, you can save your work on a memory key.</li> </ul>



## 6 Assessments

### **Grading Scheme:**

*Every student is treated the same way according to the grading scheme below. We cannot modify final grades to give you an extra percent – this would be unfair to the other students.* There are 2 grading schemes in order to minimize the impact of a poor performance on either of the 2 exam. The scheme that gives you the best mark will be used **automatically**.

**Table 2: Grading Schemes**

<b><u>Scheme (1)</u></b>		<b><u>Scheme (2)</u></b>	
**Best 7 out of 8 graded Lab Assignments	30%	**Best 7 out of 8 graded Lab Assignments	30%
Midterm Exam	30%	Midterm Exam	40%
Final Exam	40%	Final Exam	30%



Total	100	Total	100

**\*\*The first lab will not be graded. There will be 8 graded assignments in total, but your lowest assignment grade will be dropped.**

**Table 3: Course Assessments Dates (Tentative)**

Assessment	Due Date
Lab assignments	Weekly (Learning outcomes #1-7)  Labs due at 8:00am on:  Jan 23, 30, Feb 6, 13, Mar 6, 13, 20, 27, Apr 10
Midterm Exam	February 15th (Learning outcomes #1, 3, 4, 7)
Final Exam	April 22 <sup>nd</sup> from 7pm- 9pm  (Learning outcomes #1-5, 7)

**\*\*Lab Assignments:**

- The assignments are designed to provide you with you experience in data management, experimental design, graphical methods, and statistical analysis using R, as well as reinforcing concepts presented in lectures. The assignments and any required data sets will be posted on CourseLink. All the assignments will be released on Monday at 12:00pm the same week of the lab and closed the next week on Monday at 8:00am except the Lab Assignment (9) which will close at 8:00pm. **Late**

**assignments will not be accepted!!!!**

**\*Note\* There are no alternate dates nor make-up for missing any Lab Assignment.**

**Dropping the lowest Lab assignment mark is meant to take into account any absences. However, if you missed more than one Lab Assignment due to illness/extenuating circumstances, contact Nagham Mohammad within 48 hours.**

- Because of limited availability of computers, students will work together in pairs. Discussion often leads to better understanding and so we encourage group thinking. However, we urge you to not divide up the work. You will get the best value if you work together to increase your comprehension and not to do less work. Statistical analysis, data exploration, and the learning of statistical software only works through experience. 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 the following website:  
[http://www.uoguelph.ca/undergrad\\_calendar/c08/c08-amisconduct.shtml](http://www.uoguelph.ca/undergrad_calendar/c08/c08-amisconduct.shtml)
- You will be submitting completed assignments online using a grading software called **Gradescope**. 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 Dr. Mohammad 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. We will do our best to return the assignments one-week after the due date.
- You are responsible for answering all of the questions on each assignment because these will help prepare you for the course exams. **However, only some of these assignments 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 CourseLink. 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 this course and both will be written in-person (**NOT ONLINE**).
- A two-hour final examination will be held on Saturday April 22<sup>nd</sup> at 7:00pm. Please do not make any travel arrangements.
- Information regarding midterm test, and final exam (e.g. material covered and locations) will be posted on CourseLink. Students must present a valid Student ID card to write all tests and final exam.

**Out-of-Class Workload:**

As in any university course much of your learning in this course will take place outside of class time. Each week you have 3 hours of lectures. Therefore, you should plan to spend 3-6 hours each week in out-of-class learning. This learning consists mostly of making sure you understand the concepts and steps that were used in class to solve problems and then apply these to practice problems on your own.

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## 7 Course Statements

### 7.1 Course policies

**Missed Lectures:**

If you miss lectures then you are responsible for finding out what you missed. Your instructor will not reteach missed material.

**Remarking of Tests:**

If you have a question regarding the marking of a midterm test/lab assignment you must first check the posted solutions. If you still have a question, then you should follow the procedure posted on the CourseLink. **You have 4 days to appeal a test/assignment grade.**

**Missed Midterm Test:**

- If you miss a midterm test due to illness or extenuating circumstances you must contact your instructor within 48 hours of the missed test.
- If you miss Midterm Test 1 due to illness/extenuating circumstances, the weight from that test will be carried to the Final Exam.

### **Missed Final Exam:**

The final exam (date, time and location) is scheduled by the Registrar's Office. Students who miss the final exam due to a valid, documented reason must contact their program counsellor for advice on University regulations regarding final exams.

### **Obtaining Grades and Feedback:**

Unofficial assessment marks will be available in the **Grades** tool on CourseLink. Your instructor will have grades posted online. Once your assignments/tests are marked you can view your grades on the course website by selecting **Grades** from the menu on the navbar. Your course will remain open to you for seven days following the last day of the final exam period, but the Grades will be hidden to work on the final grade of the course.

University of Guelph degree students can access their final grade by logging into WebAdvisor (using your U of G central ID). <https://www.uoguelph.ca/webadvisor>

### **Calculator Policy:**

For the tests, only non-programmable, non-graphical calculators **are allowed.**

### **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. See the Undergraduate Calendar for information on regulations and procedures for Academic Consideration.

**Drop Date:**

Courses that are one semester long must be dropped by the end of the last day of classes; two-semester courses must be dropped by the last day of classes in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

**Academic Accommodation of Religious Obligations:**

If you are unable to complete a course requirement due to religious obligations, please let the instructor know within the first two weeks of class. See the academic calendar for more information:

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml>

**Technical Support**

If you need any assistance with the software tools or the CourseLink website, contact CourseLink Support.

**CourseLink Support:**

University of Guelph

Day Hall, Room 211

Email: [courselink@uoguelph.ca](mailto:courselink@uoguelph.ca)

Tel: 519-824-4120 ext. 56939

Toll-Free (CAN/USA): 1-866-275-1478

**Walk-In Hours (Eastern Time):**

Monday thru Friday: 8:30 am–4:30 pm

**Phone/Email Hours (Eastern Time):**

Monday thru Friday: 8:30 am–8:30 pm

Saturday: 10:00 am–4:00 pm

Sunday: 12:00 pm–6:00 pm

## 8 Department of Integrative Biology Statements

### 8.1 Academic Advisors

If you are concerned about any aspect of your academic program:

- Make an appointment with a program counsellor in your degree program. [B.Sc. Academic Advising](#) or [Program Counsellors](#)

### 8.2 Academic Support

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, mathematic/statistics, and chemistry. Details on their hours of operations can be found at: <http://www.lib.uoguelph.ca/get-assistance/studying/chemistry-physics-help> and <http://www.lib.uoguelph.ca/get-assistance/studying/math-stats-help>

### 8.3 Wellness

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>
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations.  
<http://www.selfregulationskills.ca/>

### 8.4 Personal information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) <http://www.e-laws.gov.on.ca/index.html>. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes.

For more information regarding the Collection, Use and Disclosure of Personal Information policies please see the Undergraduate Calendar.  
(<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml>)

### 8.5 Course Offering Information Disclaimer

Please note that course delivery format (face-to-face vs online) is subject to change up to the first-class day depending on requirements placed on the University and its employees by public health bodies, and local, provincial and federal governments. Any changes to course format prior to the first class will be posted on WebAdvisor/Student Planning as they become available.

## 9 University Statements

### 9.1 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.

### 9.2 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>

### 9.3 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>

### 9.4 Copies of Out-of-class Assignments

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.



## 9.5 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 make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

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>

## 9.6 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>

## 9.7 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.

## 9.8 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>

## 9.9 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.

## 9.10 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).

## 9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

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

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

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