

Course Outline
Biostatistics for Integrative Biology
STAT*2230
University of Guelph, Winter 2024

I. General Information

| Sec. | Instructor | Office | Email | Lecture Times |
|----------------------|---------------------|---------------|--------------|--|
| 01(LEC) In-person | Dr. Nagham Mohammad | MACN 513 | naghamm | MWF 8:30AM - 9:20AM Room: THRN 1200 |
| 01(LEC) In-person | Dr. Dirk Steinke | CBG109 | dsteinke | MWF 8:30AM - 9:20AM Room: THRN 1200 |

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
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 in ECOL and ECOL:C.

Instructor: Dr. Nagham Mohammad
Office hours: F – 9:30 AM-10:15AM. Room: MacNaughton 513

Instructor: Dr. Dirk Steinke, Department of Integrative Biology
Office hours: By appointment - virtually and in person

Labs:

Table 1: Labs Schedule

| <u>Lab Section</u> | <u>Date</u> |
|--------------------|-------------------------------|
| 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: 10:30-12:20; SSC 1306 |
| STAT*2230*0105 | Friday: 12:30-2:20; SSC 1306 |
| STAT*2230*0106 | Friday: 2:30-4:20; SSC 1306 |
| STAT*2230*0107 | Thursday: 3:30-5:20; SSC 1304 |
| STAT*2230*0108 | Friday: 10:30-12:20; SSC 1304 |

Midterm exam: Wednesday February 14th, 8:30AM – 9:20AM during lecture time.
Room: THRN 1200

Final exam: **Saturday April 20th from 8:30AM – 10:30AM.**
Rooms will be announced on CourseLink.

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

Table 2: TENTATIVE Schedule of Lectures and Labs

| Monday | Wednesday | Thursday | Friday |
|--|---|---|---|
| January 8 Introduction (DS/NM) Why do you need statistics? (DS) | Jan 10 (DS) Types of evidence (Chapter 1) | No lab | January 12 (DS) Sampling and Variables (Chapter 1 and 2) No Lab |
| January 15 (DS) Frequency distributions (Chapter 2) | Jan 17 (DS) Descriptive statistics (Chapter 2) | Lab 1: Intro to R | January 19 (DS) Measures of Dispersion (Chapter 2) Lab 1: Intro to R |
| January 22 (DS) Transformation (Chapter 2) | Jan 24 (NM) Normal distribution (Chapter 4) | *Lab 2: Sampling, Description of samples | January 26 (NM) Normal distribution (Chapter 4) Lab 2: Sampling, Description of samples |
| Jan 29 (NM) Confidence Intervals (Chapter 6) | Jan. 31 (NM) Confidence Intervals (Chapter 6) | Lab 3: Confidence Intervals | Feb 2(NM) Bias and precision One-sample hypothesis tests (Chapter 6) Lab 3: Confidence Intervals |
| February 5 (NM) Bias and precision One-sample hypothesis tests (Chapter 7) | Feb 7 (DS) Bias and precision One-sample hypothesis tests (Chapter 7) | Lab 4: One-sample hypothesis tests | February 9 (DS) Experimental design I: Comparison of two independent samples (Chapter 7) Lab 4: One-sample hypothesis tests |
| Feb 12 (DS) Experimental design I: Comparison of two independent samples (Chapter 7) Review | Feb 14 Midterm Test | No Lab | Feb 16 (DS) Comparison of paired samples (Chapter 8) No Lab |

| Feb 19 BREAK | Feb 21 BREAK | BREAK: No Lab | Feb 23 BREAK |
|---|--|---|--|
| February 26 (NM) Chi-square goodness of fit (Chapter 9) | Feb. 28 (NM) Chi-square goodness of fit (Chapter 9) | *Lab 5: Experimental design; Comparison of independent and paired samples | Mar 1 (NM) Contingency tables (Chapter 10) Lab 5: Experimental design; Comparison of independent and paired samples |
| March 4 (NM) Contingency tables (Chapter 10) | Mar 6 (DS) Experimental design II: One-way ANOVA (Chapter 11) | Lab 6: Chi-square tests | March 8 (DS) Experimental design II: One-way ANOVA (Chapter 11) Lab 6: Chi-square tests |
| March 11 (NM) Multiple comparisons (Chapter 11) | Mar 13 (NM) ANOVA w/blocks (Chapter 11) | *Lab 7: One-way ANOVA | March 15 (NM) ANOVA w/blocks (Chapter 11) Lab 7: One-way ANOVA |
| March 18 (DS) Two-way ANOVA (Chapter 11) | Mar 20 (DS) Two-way ANOVA (Chapter 11) | Lab 8: Multiple comparisons; ANOVA with blocks | March 22 (NM) Linear regression and correlation (Chapter 12) Lab 8: Multiple comparisons; ANOVA with blocks |
| March 25 (NM) Linear regression and correlation (Chapter 12) | Mar 27 (NM) Linear regression and correlation (Chapter 12) | Lab 9: Linear Regression and Correlation | Holiday |
| Apr 1 (NM) Linear regression and correlation (Chapter 12) | Apr 3 (NM) Linear regression and correlation (Chapter 12) | Lab 9: Linear Regression and Correlation | Apr 5(DS) Case studies Lab 9: Linear Regression and Correlation |
| April 8 (DS) Case studies & Review <i>* Dr. Dirk Steinke will prepare these assignments</i> | | | |

General information on lectures:

Supplementary Materials (Instructor's Slides)

This course includes supplementary materials, including fillable PowerPoint slides from the instructors. These materials are meant to supplement the required readings and course content, and to provide study materials for assignments and tests. You can print the PowerPoint slides and bring them with you to class. To access these materials, select **Content** on the navbar to locate **Supplementary Materials** in the table of contents panel.

General information on labs:

- Labs will be run by TAs who will introduce the lab assignments, lead discussions, and give pointers on using R. While we do not take attendance at labs, we strongly encourage you to attend.
- 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.

IV. Course Resources

R statistical 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/>.

Recommended Resources:

Guide to using R

- 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:

- 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.

Statistics Learning Centre:

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

V. Methods of Assessment

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 the midterm exam. The scheme that gives you the best mark will be used **automatically**.

Table 3: Grading Schemes

| <u>Scheme (1)</u> | | <u>Scheme (2)</u> | |
|--|-----|--|-----|
| Top Hat Questions | 5% | Top Hat Questions | 5% |
| **Best 7 out of 8 graded Lab Assignments | 25% | **Best 7 out of 8 graded Lab Assignments | 25% |
| Midterm Exam | 30% | Midterm Exam | 40% |
| Final Exam | 40% | Final Exam | 30% |
| Total | 100 | Total | 100 |

****The first lab will not be graded and not considered in calculating the final grade of the assignments.**

****There will be 8 graded assignments in total, but your lowest graded assignment grade will be dropped.**

Table 4: Course Assessments Dates (Tentative)

| Assessment | Due Date |
|-----------------|---|
| Lab assignments | Weekly (Learning outcomes #1-7) Labs due at 8:00am on: Jan 29, Feb 5, 12, Mar 4, 11, 18, 25, Apr 8 |
| Midterm Exam | February 14th (Learning outcomes #1, 3, 4, 7) |
| Final Exam | April 20th from 8:30AM – 10:30AM. (Learning outcomes #1-5, 7) |

****Lab Assignments:**

- The assignments are designed to provide you with 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 Lab Assignment (9) which will close at 8:00pm. Late assignments will not be accepted!!!!**

***Note* There are no alternate dates nor make-up options 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 completed 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
- You will be submitting completed assignments online using a grading software called **Gradescope**. 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. 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.

Top Hat:

To facilitate discussion and to enhance your learning in and out of class, we will be using an educational software called *Top Hat*. *Top Hat* allows you to answer questions and engage in discussion using your smartphone, tablet or laptop. You will need to purchase the *Top Hat* app. Instructions for purchasing, downloading and setting up the *Top Hat* software will be provided by e-mail. **Answering Top Hat questions for another student is an academic offence.**

For each Top Hat question asked during class, there will be two marks: one for participation (any answer), and another for a correct response.

Notes: Only the best 80% of the Top Hat marks will be used to determine your Top Hat final grade.

***Note* There are no alternate dates nor make-up options for missing any Top Hat questions. Dropping the lowest 20% of Top Hat marks is meant to take into account any absences.**

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 **April 20th from 8:30AM – 10:30AM**. 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.

VI. 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 3 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](https://www.uoguelph.ca/webadvisor) (using your U of G central ID). <https://www.uoguelph.ca/webadvisor>

Calculator Policy:

At both **Midterm Test and Final Exam**, only a non-programmable, non-graphical calculator **is allowed**. You must have a stand-alone calculator for all tests and the final exam. You will **not** be permitted to use a calculator on a laptop computer, smartphone, etc. If you are discovered to be using anything but a stand-alone calculator during a test or the final exam, it will be reported as possible academic misconduct.

Gradescope:

Gradescope is an online testing and assessment software that may be used in this course. Visit the Gradescope website to review the [Get Started videos](#) and [Student Help Centre](#).

https://www.gradescope.com/get_started#student-submission
<https://help.gradescope.com/category/cyk4ij2dwi-student-workflow>

Obtaining Grades and Feedback:

Unofficial assessment marks will be available in the **Grades** tool of the course website. 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>

Course Technology Requirements and Technical Support

CourseLink System Requirements:

You are responsible for ensuring that your computer system meets the necessary system requirements. Use the [browser check](#) tool to ensure your browser settings are compatible and up to date. (Results will be displayed in a new browser window).

<https://courselink.uoguelph.ca/d21/systemCheck>

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

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

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.

Technical Skills:

As part of your learning, you are expected to use a variety of technology:

- Manage files and folders on your computer (e.g., save, name, copy, backup, rename, delete, and check properties);
- Install software, security, and virus protection;
- Use office applications (e.g., Word, PowerPoint, Excel, or similar) to create documents;
- Be comfortable uploading and downloading saved files;
- Communicate using email (e.g., create, receive, reply, print, send, download, and open attachments);
- Navigate the CourseLink learning environment and use the essential tools, such as **Dropbox**, **Quizzes**, and **Grades** (the instructions for this are given in your course);
- Access, navigate, and search the Internet using a web browser (e.g., Firefox, Internet Explorer); and
- Perform online research using various search engines (e.g., Google) and library databases.

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](#).

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.

University Policies

Email Communication:

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

Academic Consideration:

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor in writing, with your name, id#, and e-mail contact. See the academic calendar for information on regulations and procedures for academic consideration:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Academic Misconduct:

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 discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

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. More information: www.uoguelph.ca/sas

Course Evaluation Information (Student Feedback Questionnaires (SFQs))

Please see

<https://uoguelphca.sharepoint.com/sites/ccs/SitePages/services/course-evaluation.aspx>

Copyright Notice:

Content within this course is copyright protected. Third party copyrighted materials (such as book chapters and articles) have either been licensed for use in this course, or have been copied under an exception or limitation in Canadian Copyright law.

The fair dealing exemption in Canada's Copyright Act permits students to reproduce short excerpts from copyright-protected materials for purposes such as research, education, private study, criticism and review, with proper attribution. Any other copying, communicating, or distribution of any content provided in this course, except as permitted by law, may be an infringement of copyright if done without proper license or the consent of the copyright owner. Examples of infringing uses of copyrighted works would include uploading materials to a commercial third-party web site, or making paper or electronic reproductions of all, or a substantial part, of works such as textbooks for commercial purposes.

Students who upload to CourseLink copyrighted materials such as book chapters, journal articles, or materials taken from the Internet, must ensure that they comply with Canadian Copyright law or with the terms of the University's electronic resource licenses.

For more information about students' rights and obligations with respect to copyrighted works, review [Fair Dealing Guidance for Students](#).

http://www.lib.uoguelph.ca/sites/default/files/fair_dealing_policy_0.pdf

Plagiarism Detection Software:

Students should be aware that faculty have the right to use software to aid in the detection of plagiarism or copying and to examine students orally on submitted work. For students found

guilty of academic misconduct, serious penalties, up to and including suspension or expulsion from the University can be imposed.

Recording of Materials:

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate 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 which apply to undergraduate, graduate and diploma programs.

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

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

Mental Health Services:

One out of every five students in Canada experiences some sort of mental health issue at some point in their academic career. If you find yourself facing a mental health crisis, or just need to talk to someone, please consider taking advantage of one of the following resources available to University of Guelph students:

Counselling Services:

Visit the Counselling Services website (<https://wellness.uoguelph.ca/counselling>) to get information on resources available to you, both online and in-person. You can also visit them at Health Services (J.T. Powell Building, ext. 53244) where they offer individual and group counselling sessions by appointment or walk-in.

Student Support Network: is located in the Wellness & Education Promotion Centre in the J.T. Powell Building and offers confidential, peer-based, drop-in support.

Good2Talk: ([1-866-925-5454](tel:1-866-925-5454)) is a free, 24/7 student hotline that provides professional counselling and referrals for mental health, addictions and well-being.

Here 24/7: ([1-844-437-3247](tel:1-844-437-3247)) specializes in assessment, referral and appointment booking and is available 24/7 for crisis support.

You are not alone and you will not be judged for asking for help.