

University of Guelph
College of Engineering and Physical Science
Department of Mathematics and Statistics

STAT*2040 Statistics I
Winter 2022
Credit Weight: 0.5

CALENDAR DESCRIPTION: This course focuses on the practical methods of Statistics and the topics include: descriptive statistics; univariate models such as binomial, Poisson, uniform and normal; the central limit theorem; expected value; the t, F and chi-square models; point and interval estimation; hypothesis testing methods up to two-sample data; simple regression and correlation; introduction to analysis of variance. Assignments will deal with real data from the natural sciences and involve the use of statistical software for computing and visualization.

PREREQUISITES: 1 of 4U Calculus and Vectors, Advanced Functions and Calculus, OAC Calculus, MATH*1080

RESTRICTIONS: STAT*2060, STAT*2080, STAT*2120, STAT*2230.

INSTRUCTOR: Jeremy Balka x54481 **OFFICE:** 550 MacN **EMAIL:** jbalka@uoguelph.ca

LECTURES: Section 1: MWF 1:30–2:20 in MacN 105*

Section 2: MW 5:30–6:50 in ROZH 101*

(*When we're finally back in the classroom. Online at those times until then. See the Courselink announcements for details.)

OFFICE HOURS: I'll be available for at least a half hour after every class (on Zoom when lectures are online, in person when we're in person). Other virtual hours TBA.

LEARNING OUTCOMES: After successful completion of the course, students should be able to:

- Explain the fundamental concepts of samples and populations, statistics and parameters, observational studies and experiments, and sampling bias.
- Create and properly interpret numerical and graphical data summaries.
- Discuss fundamental probability concepts and carry out basic probability calculations.
- Carry out probability calculations for various discrete and continuous probability distributions, and choose the appropriate probability distribution in different scenarios.
- Explain statistical inference concepts and methods, including concepts related to sampling distributions, confidence intervals, and hypothesis tests.
- Choose an appropriate statistical inference procedure in a variety of situations, carry out the procedure, and effectively communicate a proper interpretation of the results.
- Use statistical software to create plots and carry out the calculations for various statistical inference procedures.
- Read published statistical studies and describe the results of their statistical inference procedures.

COURSE TEXT: There is no publisher text and no extra costs in this course. I'll be releasing draft chapters of the 1.11 version of my pdf text (Introductory Statistics Explained) as we progress through the semester. (I've been using the 1.10 version in this course for a number of years, and you can get away with using that if you prefer. But I'm updating to 1.11 and the chapters I release through the semester will be the official course text.) Please let me know if you find any typos or other errors. Suggestions for improvements (areas that require greater clarification, topics for short videos etc.) are welcome.

There is *lots* of video support, in different formats. I have over 100 shorter videos on specific topics and many video solutions to exercises. Links to the supporting videos are found in the text and exercises.

LECTURE CONTENT AND FORMAT:

To a great extent, lectures will be a summary of the text. If my lectures sound similar to the text, it is because my text is based on my lectures (not the other way around).

On Courselink I provide partially completed notes (“lecture outlines”) for each topic in pdf format. I will complete these notes during lectures, and I assume that you have these notes with you. Bringing these notes to lectures will greatly reduce your writing burden. Some students prefer to come to class and take minimal notes, relying instead on the online text. That is a reasonable approach. I will leave it up to you to decide what works best for you.

N.B. Lectures are but a part of the course. From the [undergraduate calendar](#):

A credit weight of [0.50] indicates 10-12 student effort hours, including class time, on academic tasks associated with the course.

Ten to twelve hours. Each week. Let’s round up and call lectures 3 hours per week. As *part* of those other hours, it is expected that students work through the exercises each week.

GRADING SCHEME:

- 25% Data analysis assignments. There will be 2 assignments that require the use of R software, and each of them will be worth 12.5% of your final grade. The assignments will be submitted electronically in pdf format. (Full details will be posted on Courselink.) You may complete the data analysis assignments on your own, or in groups of 2 or 3. N.B. Students in this version of the course (the face-to-face offering) can only submit group work with other students in this offering (and not the DE offering). Deadline dates: Wednesday January 26 and Wednesday March 30.
- There will be 3 online term tests, worth 15% each. They will be carried out via the quizzing tool in Courselink. Each term test will open at 11:59 am ET on a Wednesday, and close 12 hours later at 11:59 pm ET. No extensions will be granted. You may start the test at any time in that window, but once you start the quiz you will have 60 minutes to complete it and it must be completed by 11:59 pm ET. Dates:
 - Wednesday February 2.
 - Wednesday March 2.
 - Wednesday March 23.
- 30% Final exam. Online. April 19. 2:30–4:30.

ASSIGNMENT AND EXAM POLICIES:

- **Any assignment not submitted by the deadline will not be marked and will receive a grade of 0.** Contact me as soon as possible if you run into an issue that prevents you submitting the assignment by the deadline.
- You may submit each assignment individually or as a group of 2 or 3. While you are encouraged discuss approaches to assignment questions with others, your submitted assignment must be your own work. Copying any part of another student’s work is considered academic misconduct. (Please read the section on academic misconduct at the end of this document and in the graduate calendar.)
- The term tests and final exam are to be completed individually.
- If you miss a term test for a valid reason (that you let me know of as soon as possible), your final exam will be reweighted to make up for the missed term test.

STATISTICAL SOFTWARE: We will use R (or R Studio) for our statistical analyses in this course. Use of R will be required on the assignments and tests. R is available in the computer pools on campus, and can be downloaded (for free) from <https://www.r-project.org/>.

EXERCISES: There will be exercises and solutions (including some video solutions) available on Courselink for all topics in the course. Although these do not count for marks directly, they are *required* exercises. It is best to work through these questions after each lecture, in order to consolidate the information we talked about in lecture. It is assumed that students are working through these exercises as we proceed through the course.

OPTIONS FOR GETTING HELP IN THE COURSE:

- Talk to me after class or during my virtual office hours.
- Post on the discussion board on Courselink.
- Use the (virtual) Statistics Learning Centre, available as a Resource page on Courselink. STAT*2040 students are automatically enrolled in the Statistics Learning Centre. Students can interact with a TA via discussion boards, instant message chat rooms, virtual white boards, or live meetings that allow for voice calls. The hours of operation are:
 - Monday and Wednesday: 9:30am - 3:30pm
 - Tuesday and Thursday: 10am - 4pm
 - Friday: 9:30am - 2:30pm
- Attend the R drop-in help, which is a Courselink resource page staffed during the week (hours TBA). It is staffed by graduate student TAs who can help you with any questions you have about R.

TOPIC OUTLINE: For the most part I cover the course material in lecture. But there will be times when I refer you to the text. Some students prefer to base their studies on the text. While we will cover this list quite closely, it is tentative and we may skip the occasional topic here or there.

- Chapter 1: *Introduction to Statistics*.
Descriptive statistics, inferential statistics.
- Chapter 2: *Gathering Data*.
Population, variables, samples, quantitative and qualitative data, bias, simple random samples, experiments, observational studies, lurking variables, confounding.
- Chapter 3: *Descriptive Statistics*.
Bar charts, pie charts, histograms, stem-and-leaf displays, summation notation, numerical measures of central tendency, numerical measures of variability, numerical measures of relative standing, boxplots, methods for detecting outliers, linear transformations.
- Chapter 4: *Probability*.
Simple events, events, Venn diagrams, combinations, unions, intersections, complements, mutually exclusive events, conditional probability, addition rule, multiplication rule, independent events, Bayes' theorem.
- Chapter 5: *Discrete Random Variables and Discrete Probability Distributions*.
Random variables, discrete and continuous random variables, probability distributions, expected value and variance of a discrete random variable, the binomial distribution, the Poisson distribution, the hypergeometric distribution.
- Chapter 6: *Continuous Random Variables and Continuous Probability Distributions*.
Properties of continuous random variables and continuous probability distributions, the uniform distribution, the normal distribution, descriptive methods for assessing normality (normal quantile-quantile plots).
- Chapter 7: *Sampling Distributions*.
The concept of the sampling distribution, the sampling distribution of the sample mean, the central limit theorem.
- Chapter 8: *Confidence Intervals*.
Basic concepts of confidence intervals, confidence intervals for a population mean when sigma is known, confidence intervals for a population mean when sigma is unknown, sample size determination.
- Chapter 9: *Hypothesis Testing*.
Motivation for hypothesis testing, null and alternative hypotheses, significance levels, p -values, Type I and Type II errors, power, tests of hypothesis on a single mean.
- Chapter 10: *Inference for Two Means*.
Confidence intervals and hypothesis tests for the difference between population means, independent sampling, paired difference experiments.
- Chapter 11: *Inference for Proportions*.
Confidence intervals and hypothesis tests for a single proportion, sample size determination, confidence intervals and hypothesis tests for the difference between two population proportions.
- Chapter 12: *Inference for Variances*.
Confidence intervals and hypothesis tests for a single variance, confidence intervals and hypothesis tests for two population variances.
- Chapter 13: *Chi-square tests for count data*.
Chi-square goodness of fit tests. Tests for one-way tables, chi-square tests of independence.
- Chapter 14: *One-Way Analysis of Variance*.
Using one-way ANOVA to test for a difference in population means. (One-way ANOVA extends the two-sample pooled-variance t test to more than two groups.)
- Chapter 15: *Simple Linear Regression and Correlation*.
Least squares regression, model assumptions, inference on the slope, the correlation coefficient, the coefficient of determination, estimation and prediction using the fitted line.

University Policies

Email Communication

As per university regulations, all students are required to check their uoguelph.ca email account regularly: email 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. See the academic calendar for information on regulations and procedures for Academic Consideration:

<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-consideration-appeals-petitions/>

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: <https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/dropping-courses/>.

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.

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:

<https://www.uoguelph.ca/sas>

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.

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.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:

<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-misconduct/>

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: <http://www.uoguelph.ca/registrar/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-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) 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) 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.