

MDSC 407
Statistics and Research Design in Health Sciences

Instructors:

Dr. Na Li
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and Guest Instructor:

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Office Hours/Policy on Answering Student Emails

Dr. Na Li and Dr. Holodinsky will be available for office hours on Mondays and Wednesdays by appointment. Office hours will occur via Zoom.

Student emails will be answered within 24 hours on weekdays. Note: attending office hours or using the D2L discussion board for course questions is preferred.

Teaching Assistants:

Levi Frehlich, MSc
PhD Student, Epidemiology Specialization
Department of Community Health Sciences
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Joshua Quan
MSc Student, IBD Research Group
Department of Medicine
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Time and Location:

Winter Semester: January 10 – April 12

Lectures: Mondays and Wednesdays 09:00 – 10:20; Online via Zoom (January 10 – 28), Health Sciences Centre (HSC) Theatre 1 (January 31st onwards, unless otherwise directed by university policy)

This course is delivered in a flipped format. Some course material will be delivered via online modules (including but not limited to podcast lectures, online readings, and/or online quizzes). **Online modules need to be completed PRIOR to the lecture time on the week indicated in the course schedule** (ex. Lecture 2 online modules are to be completed before scheduled lecture time for Lecture 2 of the course). The online modules to be completed before lecture time are clearly marked on the course schedule. The course schedule and material delivery method are subject to change with adequate notice given to

students. Please check D2L to keep current with the materials. In person lecture time will be highly interactive, and students will be given time to complete exercises in class with their peers (and with assistance from Instructors/TAs if needed). These exercises will form part of the In-Class Activities grade thus it is imperative that students come to class with appropriate online modules completed in order to ensure in class activities can be completed.

Labs: Fridays 09:00 – 10:50, 11:00 – 12:50, 13:00 – 14:50; Online via Zoom (January 10 – 28), HSC O1501 (January 31st onwards, unless otherwise directed by university policy)

To best succeed in the course, students are encouraged to view the weekly lecture videos and participate in the weekly in person lecture learning tasks using the D2L and TopHat learning environments as well as attend the lab sessions.

To account for any necessary transition to remote learning in the Winter 2022 semester due to the uncertainty of COVID-19, courses with in-person lectures and labs may be shifted to remote delivery for a certain period of time. The remote delivery will be offered via Zoom with detailed information provided on D2L. In addition, adjustments may be made to the modality and format of assessments and deadlines, as well as to other course components and/or requirements, so that all coursework tasks are in line with the necessary and evolving health precautions for all involved (students and staff).

Prerequisite/Co-Requisite:

Enrolment in the BHSc Honours Program

Course Description:

This course is an introduction to statistics and research design in health sciences. As a field of study, statistics consists of a set of procedures for organizing, describing, and interpreting data. Accordingly, we will focus on the theory and tools necessary to analyze data, which will be illustrated by relevant applications. The emphasis will be on statistical literacy, which is an important skill for both the analyses of health-related data and understanding and reviewing the health sciences literature.

Overarching Theme

This course is delivered in a flipped format. Lecture material is delivered via video, students are then encouraged to practice this new material via learning tasks on TopHat during in-person lecture time. Students will be able to apply their new learnings in the weekly labs and bi-weekly lab assignments. Finally, course concepts across the semester will be tied together in a final project where students will be able to tie together concepts from across the semester.

Global Objectives

The primary objective is for students to understand formulation of a research question, the data that are collected, the statistical analyses that should be used, and the conclusions that can be drawn.

Course Learning Outcomes

By the end of this course, students will be able to:

1. Distinguish sample level data from population level data
2. Classify data as nominal, ordinal, interval, or ratio
3. Explain the central limit theorem and describe its importance in biostatistics
4. Calculate and interpret confidence intervals for means, proportions, differences in means, and differences in proportions

5. Interpret the meaning of a given p-value
6. Compare and contrast the results of a hypothesis test and a confidence interval
7. Perform (both by hand and using statistical software) various hypothesis tests including t-tests, proportion tests and Chi-square tests, ANOVA, repeated measures ANOVA, and linear regression
8. Interpret the results of various hypothesis tests including t-tests (and non-parametric equivalents), proportion tests and Chi-square tests, ANOVA, repeated measures ANOVA, and linear regression
9. Justify the choice of hypothesis test used based on the attributes of given data
10. Describe the factors that influence power and sample size
11. Calculate power and sample size for various types of data

Learning Resources

There is no required textbook for this course.

Analyses in this course will be performed using Stata Statistical Software. Students will be required to have access to Stata to complete assignments in this course. This software is available in the Bioinformatics Lab (HSC 1501). However, considering the evolving COVID-19 situation students may wish to purchase their own copy of Stata. There are several purchase options through Stata, the most economical being the Student 6-month Stata/IC license (<https://www.stata.com/order/new/edu/profplus/student-pricing/>). If students do not wish to purchase the software, they may utilize the Bioinformatics Lab or Health Sciences Library computer lab (where Stata is also available) based on personal schedules (and respecting other bookings that may occur in these rooms).

Learning activities will also be completed using the TopHat online platform (<https://www.tophat.com>). University of Calgary students can make a free TopHat account linked to their @ucalgary email address. Instructions for joining the MDSC 407 TopHat Online Course will be provided in the first week of the course.

Recommended Textbooks/Readings

There is no required textbook for this course.

The following textbooks are optional references for those wishing to have a reference text. All evaluation, assignments and examples will be given in the lecture and lab notes. Those not wishing to purchase a textbook will have no disadvantage.

- Introduction to the Practice of Statistics (9th Edition), Moore, McCabe & Craig
- Biostatistics: A Foundation for Analysis in the Health Sciences (11th edition), Daniel & Cross

Learning Technology Requirements

Brightspace (by D2L) is located on the University of Calgary server and will be used extensively for communication with students. **It is the student's responsibility to ensure that they receive all posted communications and documents and that they receive emails sent by instructors or fellow students through D2L.**

Only your @ucalgary.ca email address may be linked to D2L. Please ensure that you are regularly checking your @ucalgary.ca account.

In order to successfully engage in learning experiences at the University of Calgary, students taking online, remote, and blended courses are required to have reliable access to the following technology:

- A computer with a supported operating system, as well as the latest security and malware updates;
- A current and updated web browser;
- Webcam (built-in or external);
- Microphone and speaker (built-in or external), or headset with microphone;
- Current antivirus and/or firewall software enabled;
- Broadband internet connection

Most current laptops will have a built-in webcam, speaker, and microphone.

A laptop, desktop, tablet, or mobile device is required for D2L access. If you need help accessing or using D2L, please visit the Desire2Learn resource page for students: <http://elearn.ucalgary.ca/d2l-student/>.

Evaluation

The University policy on grading and related matters is described in section F of the 2021-2022 Calendar.

In determining the overall grade in the course, the following weights will be used:

Description	Percentage of Grade	Due Date
Mid-Term Examination	20%	February 9 th
Mid-Term Examination II	20%	March 23 rd
Lab Assignments	20%	Assignment due dates and times are indicated in course schedule. Submitted online via D2L Dropbox
Online Learning Activities (TopHat)	10%	Due weekly at 11:59pm on Fridays
Final Project (Contains several graded components due throughout the term. See Final Project Outline on D2L for details and marking rubrics)	30%	Projects will be delivered live on April 4 th and April 6 th

**There is no Registrar-scheduled final exam for this course

**A student's final grade for the course is the sum of the separate assignments. It is not necessary to pass each assignment separately in order to pass the course.

- Detailed instructions on assignment completion and format are available on D2L.
- Detailed instructions on exam administration and format are available on D2L
- The final project is broken down into several smaller components due during the course of the term. On D2L detailed instructions on each final project component, including marking rubrics, can be found

A Note regarding Writing Assignments:

Writing skills are important to academic study in all disciplines. In keeping with the University of Calgary's emphasis on the importance of academic writing in student assignments (section E.2 of 2021-22 Calendar), writing is emphasized, and the grading thereof in determining a student's mark in this course. The Bachelor of Health Sciences values excellence in writing. Competence in writing entails skills

in crafting logical, clear, coherent, non-redundant sentences, paragraphs, and broader arguments, as well as skills with the mechanics of writing (grammar, spelling, punctuation). Sources used in research papers must be properly documented. The University of Calgary offers instructional services through the Students' Success Centre's Writing Support Services (<http://www.ucalgary.ca/writingsupport/>) for students seeking feedback on assignments or seeking to improve their general writing skills. Students are **strongly encouraged** to take advantage of these programs.

Grading Scheme:

Letter Grade	Description	Percentage
A+	Outstanding performance	96-100
A	Excellent performance	90-95
A-	Approaching excellent performance	85-89
B+	Exceeding good performance	80-84
B	Good performance	75-79
B-	Approaching good performance	70-74
C+	Exceeding satisfactory performance	65-69
C	Satisfactory performance	60-64
C-	Approaching satisfactory performance	57-59
D+	Marginal pass	54-56
D	Minimal pass	50-53
F	Did not meet course requirements	0-49

Missed Components of Term Work:

Late assignments will not be accepted and will automatically receive a mark of zero, exceptions to this may be made on a case-by-case basis. Students who miss an exam will receive a mark of zero unless the instructor has been previously notified. There will be NO exceptions to this policy.

24-hour Stress Buster Bonus: The stress buster is a one-time 24-hour extension on an individual assignment that students can redeem without penalty. However, the stress buster does not apply to quizzes, exams, and group assignments. Once the stress buster is redeemed, extensions will NOT be granted again on any assignment or other component of the course work. The only exceptions to this are those in keeping with the University Calendar (debilitating illness, religious conviction, or severe domestic affliction) that are received in writing and with supporting documentation. Please note that while absences are permitted for religious reasons, students are responsible for providing advance notice and adhering to other guidelines on this matter, as outlined in the University Calendar (<https://www.ucalgary.ca/pubs/calendar/current/e-4.html>).

Course Evaluations and Student Feedback

Student feedback will be sought at the end of the course through the Universal Student Rating of Instruction (USRI) and a qualitative student evaluation. Students are welcome to discuss the process and content of the course at any time with the instructor. Students may also address any concerns they may have with Dr. Ebba Kurz, Associate Dean (Undergraduate Health and Science Education) in the Cumming School of Medicine (kurz@ucalgary.ca).

Attendance

Students are encouraged to attend all live sessions and to watch all recorded sessions. It should be noted that while attendance is not formally taken nor graded, students absent from live sessions or choosing not to watch recorded sessions will be at a disadvantage in terms of learning important materials.

Conduct During Lectures

The classroom should be respected as a safe place to share ideas without judgement - a community in which we can all learn from one another. Students are expected to frame their comments and questions to lecturers in respectful and appropriate language, always maintaining sensitivity towards the topic. Students, employees, and academic staff are also expected to demonstrate behaviour in class that promotes and maintains a positive and productive learning environment.

As members of the University community, students, employees and academic staff are expected to demonstrate conduct that is consistent with the University of Calgary Calendar, the Code of Conduct and Non-Academic Misconduct policy and procedures, which can be found at <https://www.ucalgary.ca/legal-services/university-policies-procedures>.

Students are expected to take notes during class and should not rely solely on material supplied by the instructors.

Use of Internet and Electronic Communication Devices in Class

The Bachelor of Health Sciences program aims to create a supportive and respectful learning environment for all students. The use of laptop and mobile devices is acceptable when used in a manner appropriate to the course and classroom activities. However, research studies have found that inappropriate/off-topic use of electronic devices in the classroom negatively affects the learning of others during class time.

Students are responsible for being aware of the University's Internet and email use policy, which can be found at <https://www.ucalgary.ca/policies/files/policies/electronic-communications-policy.pdf>.

UNIVERSITY OF CALGARY POLICIES AND SUPPORTS

Copyright

All students are required to reach the University of Calgary policy on Acceptable Use of Material Protected by Copyright (<https://www.ucalgary.ca/policies/files/policies/acceptable-use-of-material-protected-by-copyright-policy.pdf>) and requirements of the Copyright Act (<https://laws-lois.justice.gc.ca/eng/acts/C-42/index.html>) to ensure they are aware of the consequences of unauthorized sharing of course materials (including instructor notes, electronic versions of textbooks, etc.). Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy <https://www.ucalgary.ca/pubs/calendar/current/k.html>.

Instructor Intellectual Property

Course materials created by instructors (including course outlines, presentations and posted notes, labs, case studies, assignments, and exams) remain the intellectual property of the instructor. These materials may **NOT** be reproduced, redistributed, or copied without the explicit consent of the professor. **The posting of course materials to third-party websites such as note-sharing sites without permission is prohibited.** Sharing of extracts of these course materials with other students enrolled in the course **at the same time** may be allowed under fair dealing.

Academic Accommodations

It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The Student Accommodations policy is available at <https://ucalgary.ca/student-services/access/prospective-students/academic-accommodations>. Students needing an accommodation based on disability or medical concerns should contact Student Accessibility Services (SAS) in accordance with the Procedure for Accommodations for Students with Disabilities (<https://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities.pdf>). SAS will process the request and issue letters of accommodations to instructors. For additional information on support services and accommodations for students with disabilities, visit www.ucalgary.ca/access/.

Students who require an accommodation in relation to their coursework based on a protected ground other than disability should communicate this need in writing to Dr. Ebba Kurz, Associate Dean (Undergraduate Health and Science Education) (kurz@ucalgary.ca).

Academic Misconduct

The University of Calgary is committed to the highest standards of academic integrity and honesty. The University of Calgary has created rules to govern all its members regarding the creation of knowledge and the demonstration of knowledge having been learned.

Academic Misconduct refers to student behaviour that compromises proper assessment of a student's academic activities and includes (but is not limited to): cheating, fabrication, falsification, plagiarism, unauthorized assistance, failure to comply with an instructor's expectations regarding conduct required of students completing academic assessments in their courses, and failure to comply with exam regulations applied by the Registrar. **It also includes using of third-party websites/services to access past/current course material, essay/assignment writing services, or real-time assistance in completing assessments, seeking answers to assessment questions and similar, whether paid, bartered, or unpaid.**

For information of the Student Academic Misconduct Policy and Procedures, please visit; <https://ucalgary.ca/policies/files/policies/student-academic-misconduct-policy.pdf>
<https://ucalgary.ca/policies/files/policies/student-academic-misconduct-procedure.pdf>

Additional information is available on the Academic Integrity website at: <https://ucalgary.ca/student-services/student-success/learning/academic-integrity>.

Recording of Lectures

Audio or video recording of lectures (or similar) is **prohibited** except where explicit permission has been received from the instructor or it is an approved accommodation.

Freedom of Information and Protection of Privacy Act

Student information will be collected in accordance with typical (or usual) classroom practice. Students' assignments will be accessible only by the authorized course faculty. Private information related to the individual student is treated with the utmost regard by the faculty at the University of Calgary

Appeals

If there is a concern with the course, academic matter, or a grade, first communicate with the instructor. If these concerns cannot be resolved, students can proceed with an academic appeal, as per Section I of the University Calendar. Students must follow the official reappraisal/appeal process and may contact

the Student Ombuds' Office (<http://www.ucalgary.ca/ombuds>) for assistance with this and with any other academic concerns, including academic and non-academic misconduct. Students should be aware that concerns about graded term work may only be initiated **within 10 business days** of first being notified of the grade. <https://www.ucalgary.ca/pubs/calendar/current/i-2.html>

MEDIA RECORDING

The instructor may use media recordings to capture the delivery of a lecture. These recordings are intended to be used for lecture capture only and will not be used for any other purpose. Although the recording device will be fixed on the Instructor, in the event that incidental student participation is recorded, the instructor will ensure that any identifiable content (video or audio) is masked or will seek consent to include the identifiable student content to making the content available on University approved platforms.

Sexual and Gender-Based Violence Policy

The University recognizes that all members of the University Community should be able to learn, work, teach and live in an environment where they are free from harassment, discrimination, and violence. The University of Calgary's sexual and gender-based violence policy guides us in how we respond to incidents of sexual and gender-based violence, including supports available to those who have experienced or witnessed sexual or gender-based violence, or those who are alleged to have committed sexual or gender-based violence. It provides clear response procedures and timelines, defines complex concepts, and addresses incidents that occur off-campus in certain circumstances. Please see the policy available at <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Sexual-and-Gender-Based-Violence-Policy.pdf>.

Resources for Support of Student Learning, Success, Safety and Wellness

Student Success Centre	http://www.ucalgary.ca/ssc/
Student Wellness Centre	http://www.ucalgary.ca/wellnesscentre/
Distress Centre	http://www.distresscentre.com/
Library Resources	http://library.ucalgary.ca

Wellness and Mental Health Resources

The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness, and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the excellent mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the SU Wellness Centre (<https://www.ucalgary.ca/wellnesscentre/services/mental-health-services>) and the Campus Mental Health Strategy (<http://www.ucalgary.ca/mentalhealth/>).

Student Ombuds' Office

The Student Ombuds' Office supports and provides a safe, neutral space for students. For more information, please visit www.ucalgary.ca/ombuds/ or email ombuds@ucalgary.ca

BHSc Student Faculty Liaison Committee (SFLC)

The BHSc SFLC, with elected representatives from all majors, serves to raise issues of interest to BHSc students to the program administration, including items pertaining to curriculum, scheduling and events. A list of current representatives can be found on the BHSc website.

Student Union (SU) Information

The SU Vice-President Academic can be reached at (403) 220-3911 or suvpaca@ucalgary.ca; the SU representatives for the Cumming School of Medicine can be reached at medrep1@su.ucalgary.ca or medrep2@su.ucalgary.ca.

Student Success Centre

The Student Success Centre provides services and programs to ensure students can make the most of their time at the University of Calgary. Our advisors, learning support staff, and writing support staff assist students in enhancing their skills and achieving their academic goals. They provide tailored learning support and advising programs, as well as one-on-one services, free of charge to all undergraduate and graduate students. For more information visit: <https://www.ucalgary.ca/student-services/student-success>

Emergency Evacuation/Assembly Points

As part of the University of Calgary Emergency Evacuation plan, students, faculty, and staff should locate the closest Assembly Point in case of Fire Alarm. Safety signage is posted throughout the campus showing the locations and the possible route to these locations. All students, faculty, and staff are expected to promptly make their way to the nearest Assembly Point if the Fire Alarm is activated. No one is to return into campus facilities until an all clear is given to the warden in charge of the Assembly Area. For more information, see <https://www.ucalgary.ca/emergencyplan/building-evacuation/assembly-points>

Safewalk

Campus security will escort individuals, day, or night, anywhere on campus (including McMahon Stadium, Health Sciences Centre, Student Family Housing, the Alberta Children's Hospital, and the University LRT station). Call 403-220-5333 or visit <http://www.ucalgary.ca/security/safewalk>. Use any campus phone, emergency phone or the yellow phone located at most parking lot pay booths. Please ensure your personal safety by taking advantage of this service.

Class Schedule

The following is a list of topics for class and assignment / exam due dates. Please note that unforeseen circumstances may cause changes to the schedule with respect to the timing of topics. Students will be notified of all changes in a timely manner by way of email and D2L announcements. The exam dates are firm and will not be altered. Note: TopHat learning activities are not listed here, they are due weekly at 11:59pm on Friday.

Course Schedule Date	Video Lectures (must be viewed prior to lecture date unless otherwise indicated)	Instructor	In-Class Activities (will occur during scheduled lecture time)	Lab Topics	Assignment Due Dates & Times
January 10	Course Overview Live lecture, no prep work required	Dr. Li, Dr. Holodinsky	-	Introduction to Stata	Self-select final project group members by Jan 14 11:59pm
January 12	Introduction to Statistics, types of data, populations, and samples	Dr. Holodinsky	Introduction to Statistics Worksheet		
January 17	Introduction to the Scientific Method	Dr. Holodinsky	Introduction to the Scientific Method Worksheet	Calculating descriptive statistics by hand and in Stata	Group Project Contract due Jan 21 11:59pm
January 19	Descriptive Statistics: Summary Statistics and Graphics	Dr. Holodinsky	Summary Statistics and Graphics Pt Worksheet	Creating graphical displays in Stata	
January 24	Probability: Application of Probability in Diagnostic Studies	Dr. Li	Application of Probability in Diagnostic Studies Worksheet	Worked examples of probability and accuracy of diagnostic tests	Assignment 1 Due Jan 28 09:00am
January 26	Probability: Probability Distributions	Dr. Li	Probability Distributions Worksheet		
January 31	Using Distributions: The Central Limit Theorem	Dr. Li	The Central Limit Theorem and the t-distribution Worksheet	Calculating Z and t-scores by hand and in Stata	
February 2	Interval Estimates: Confidence Intervals for Means and the t-distribution	Dr. Li	Confidence Intervals for Means Worksheet	Calculating confidence intervals by hand and in Stata	

February 7	Hypothesis Testing: Principles of Hypothesis Testing	Dr. Holodinsky	Principles of Hypothesis Testing Worksheet	Calculating confidence intervals for proportions by hand and in Stata	Assignment 2 Due Feb 11 09:00am
February 9	Midterm I (up to and including Feb. 2)				
February 14	Continuous Data: The One Sample t-test	Dr. Li	The One Sample t-test Worksheet	One sample t-test by hand and in Stata	
February 16	Power and Sample Size	Dr. Li	Power and Sample Size Worksheet		
February 21, 23	Reading Days – No Class			Reading Days – No Labs	
February 28	Continuous Data: The Paired t-test & Two Sample t-test	Dr. Li	The Paired t-test & Two Sample t-test Worksheet	The paired and two sample t-tests by hand and in Stata	Final Project Progress Report 1 Due March 4 11:59pm
March 2	Confidence Intervals, Power, and Sample Size for the paired and two-sample t-tests	Dr. Holodinsky	Confidence Intervals, Power, and Sample Size for the paired and two-sample t-tests Worksheet		
March 7	Hypothesis Testing for More than Two Groups: ANOVA Part 1	Dr. Holodinsky	ANOVA Part 1 Worksheet	ANOVA calculations by hand and in Stata	Assignment 3 Due Mar 11 09:00am
March 9	Hypothesis Testing for More than Two Groups: ANOVA Part 2	Dr. Holodinsky	ANOVA Part 2 Worksheet		
March 14	Categorical Data: The Chi-square test, risk ratios, odds ratios	Dr. Li	The Chi-square test, risk ratios, odds ratios Worksheet	Hypothesis Testing for categorical variables by hand and in Stata	Final Project Progress Report 2 Due Mar 18 11:59pm

March 16	Categorical Data: The two-sample test of proportions (including confidence intervals for proportions)	Dr. Li	The two-sample test of proportions Worksheet		
March 21	Categorical Data: The McNemar's Chi-square test	Dr. Holodinsky	McNemar's Chi-square test Worksheet	McNemar's Chi-square test by hand and in Stata	Final Project Rubric Assignment Due Mar 25 11:59pm
March 23	Midterm II (up to and including March 16)				
March 28	Linear Regression: Correlation and the Line of Best Fit	Dr. Holodinsky	Correlation and the Line of Best Fit Worksheet	Interpretation of Correlation and linear regression outputs in Stata	Assignment 4 Due Apr 1 09:00am
March 30	Linear Regression: Linear Regression Diagnostics	Dr. Holodinsky	Linear Regression Diagnostics Worksheet		
April 4	Final Presentations			No Labs	-
April 6	Final Presentations				
April 11	Introduction to R	Dr. Li	-		