

MDSC 407
STATISTICS AND RESEARCH DESIGN IN HEALTH SCIENCES

Instructors:

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Office Hours/Policy on Answering Student Emails

Please note that all course communications must occur through your @ucalgary email.

Dr. Holodinsky and Dr. Li will be available for office hours by appointment.

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 Assistant:

TBD

Time and Location:

Winter Semester: January 12 – April 14

Lectures: Mondays and Wednesdays 09:00 – 10:15. Check D2L for location

This course is delivered in two parts by two different instructors. The first half is more epidemiology-focused, emphasizing conceptual reasoning, study design, and interpretation. The second half is more statistics-focused, with greater emphasis on hands-on computation, mathematical notation, and working through statistical concepts using formulas and applied examples. Please expect different teaching styles across the two halves of the course.

This course is delivered in a flipped format. Some course material will be delivered via online modules (including but not limited to video lectures and online readings). **Online modules are preferred 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 attending the scheduled lecture time for Lecture 2 of the course). The online modules to be completed before lecture time are clearly marked on D2L.

In person lecture will begin at 9:00am with a quiz (administered via D2L) covering material from the previous lecture. Students will have 10 minutes and one attempt to complete the quiz. Promptly at 9:10am instruction for the current lecture material will begin. This will include a brief review of the pre-lecture video and example problems to help solidify key concepts. These examples will help students prepare for exams thus it is imperative that students come to class with appropriate online modules completed and participate in in-class activities. *Watching the online video modules alone will not sufficiently prepare students for exams.*

Labs: Fridays 09:00 – 10:50, 11:00 – 12:50, 13:00 – 14:50.

Prerequisite/Co-Requisite:

Enrolment in the BHSc Honours Program

Course Description:

An introduction to the study of research design and statistical analysis including a broad overview of the variety of methods for research in health sciences. Students will be introduced to a variety of research tools through lecture and tutorial components.

Overarching Theme

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.

Statistics and research design are vital components of scientific inquiry. This course aims to provide students with the necessary skills to formulate and answer research questions using basic study designs as well as appraise the use of basic study designs in the literature. The course will be delivered in two parts. The first half, delivered by Dr. Holodinsky, will focus on research design. The second half, delivered by Dr. Li, will focus on statistics.

This course is delivered in a flipped format. Lecture material is delivered via videos which are preferred to be watched before coming to class. During class students will solidify their understanding of materials through in class quizzes and examples. Students will be able to apply their new learnings in lab assignments. Finally, course concepts across the semester will be tied together in a final project.

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, and linear regression.
8. Interpret the results of various hypothesis tests including t-tests, proportion tests and Chi-square tests, 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.

Transferable Skill Development:

Many of the skills and abilities that you are developing in your coursework are transferable to the workforce, graduate and professional studies and other facets of life. Employers seek applicants with transferable skills because they can be an asset in the workplace, regardless of industry or sector. Transferable skills are core skills for your success in building your future career.

The work that you will do in MDSC 407 will help you build the following transferable skills:

- **Collaboration:** Work respectfully with others from different backgrounds, cultures, and countries.
- **Verbal Communication:** Learn and share information by presenting, listening, and interacting with others.
- **Creativity and Innovation:** Find different and better ways to do things, being curious, and thinking imaginatively.
- **Critical Thinking:** Actively and skillfully conceptualize, apply, analyze, synthesize, and/or evaluate information (data, facts, observable phenomena, and research findings) to make a reasoned judgment or draw a reasonable conclusion.
- **Digital Skills:** Use digital technologies like computers, social media, virtual meeting platforms, and the internet.
- **Information Literacy:** Find, understand, and use information presented through words, symbols, and images
- **Numeracy:** Use mathematical information such as numbers, symbols, words, and graphics to do tasks.
- **Problem solving:** Identify an issue, find and implement a solution, and assess whether the situation has improved.
- **Project Management:** Conceptualize, initiate, plan and execute a plan to achieve a predetermined goal (project) by effectively prioritizing activities and meeting deadlines.
- **Written Communication:** Share ideas and information by using words, images, and symbols.

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) and on some computers in the Health Sciences Library Computer Lab. However, students may wish to purchase their own copy of Stata in the event they need to be away from campus for a certain period of time. 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 based on personal schedules (and respecting other bookings that may occur in these rooms).

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

A Note regarding readings

A list of required pre-lecture video materials will be outlined on D2L. These videos have been crafted carefully to inform you and enhance the lecture material. **Students are REQUIRED to watch the assigned videos BEFORE each lecture.** Instructors will proceed in class on the assumption that students have watched completely the assigned videos. Students should be aware that many of the videos they will be assigned may present materials of an unfamiliar nature and style. Students should allot sufficient time to allow for several viewings of the assigned material.

Supplementary Fees

Optional supplementary costs for this course may include STATA software licensing and poster printing.

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.

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 2025-2026 Calendar.

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

Assessment *	Weight (% of Grade)	Due Date and Time
Mid-Term Examination I	20%	February 25 9:00-10:10 MT This exam will be delivered in person during class time. The exam will be handwritten. A scientific calculator is required; graphic calculators may not be used.
Mid-Term Examination II	20%	March 30 9:00-10:10 MT This exam will be delivered in person during class time. The exam will be handwritten. A scientific calculator is required; graphic calculators may not be used.
Journal Club Facilitation	5%	During the research design portion of the semester, each student will be assigned a journal article to present in small groups. The student will be required to lead a discussion of the article with their peers during an assigned lab session using a discussion guide. After the session the student is responsible for summarizing the discussion including article strengths and weaknesses for grading. Facilitation date will vary depending on study design assigned. The completed discussion guide is due 3 days after the assigned facilitation date. Detailed instructions and a marking guide can be found on D2L.
Lab Assignments	15%	There will be 3 equally weighted Assignments. Assignment due dates and times are indicated in course schedule. Submitted online via D2L Dropbox.
In-Class Quizzes	10%	Every lecture will begin with a quiz covering the material from the previous lecture (please see course schedule below). The quiz will be administered via D2L. The quiz will open at 9:00 am. Once the D2L quiz is opened, students will have only <u>10 minutes and one attempt</u> to complete the quiz. Quizzes are open-book and students may work collaboratively with their peers on the quiz. Scheduled lecture materials will begin promptly at 9:10 am, so it is imperative students are on time to begin their quiz at 9:00. The ability to access the quiz will remain open until 9:30 in the event a student is late or away from class, but we will not delay beginning lecture materials to accommodate late students.
Final Project	30%	Contains several graded components due throughout the term. See Final Project Outline on D2L for details. Final Project Materials Due Apr 7 at 13:00 MT Projects will be presented over two lecture sessions on April 8 & 13, 9:00 – 10:15 MT

**Descriptions and rubrics/marketing guidelines of each assessment item are posted in D2L.

**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.

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 2025-26 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 to complete each assessment must be properly documented, unless otherwise noted by the instructor. 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	90-95.99
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	Does not meet course requirements	0-49

Missed Components of Term Work:

Students will lose 5% per day late past the deadline for all assignments. In this case, assignments will **NOT** be accepted more than 72 hours after the posted deadline and students failing to submit any assignment within this time frame will receive a mark of zero.

As per University Calendar Section G.2.3 **students who are absent from an in-class assessment will receive a mark of zero on the missed component.** Students who are absent are responsible for contacting their instructor to discuss the impact of their missed assessment. Alternative opportunities for completing missed assessments or shifting of the assessment weight **may** be possible but are not guaranteed. Students who are identified as falsifying information related to missed assessments will be subject to investigation for academic misconduct.

Extensions will NOT be granted on any assignment or quizzes in MDSC 407. 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. Traffic jams and late or full buses are common events in Calgary and are NOT acceptable reasons for late arrivals to class, meetings and examinations. 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://calendar.ucalgary.ca/pages/02ffccb6b1a541db880fe4223d122b5e>

Course Evaluations and Student Feedback

Student feedback will be sought at the end of the course through the new UCalgary Course Experience Survey 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. Fabiola Aparicio-Ting, Associate Dean (Undergraduate Health and Science Education) in the Cumming School of Medicine (feaparic@ucalgary.ca).

Attendance

Regular attendance is advised in order to succeed in MDSC 407. Students are expected to take notes during class and should not rely solely on material supplied by the instructors. Instructors may or may not post lectures notes to D2L, at their individual discretion. In-class discussion and all content presented in class, including concepts and examples, can constitute substantial learning and can be considered for assessment.

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://ucalgary.ca/student-services/student-conduct/policy>

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/legal-services/university-policies-procedures/acceptable-use-electronic-resources-and-information-policy>

Use of Artificial Intelligence Tools

Generative Artificial Intelligence (AI), and specifically foundational models that can create writing, computer code, and /or images using minimal human prompting includes not only GPT-4 (and its siblings ChatGPT and Bing), but many writing assistants that are built on this or similar AI technologies.

Students may use artificial intelligence tools, including generative AI, in **MDSC 407**. **However, students are ultimately accountable for the work they submit.** Students may choose to use generative artificial intelligence tools as they work through the assignments in this course; this use must be documented in an appendix for each assignment. The documentation should include what tool(s) were used, how they were used, and how the results from the AI were incorporated into the submitted work. **Failure to cite the use of AI generated content in an assignment/assessment will be considered a breach of academic integrity and subject to Academic Misconduct procedures.** Please see this library guide for how to cite the use of AI tools: <https://libguides.ucalgary.ca/c.php?g=733971&p=5302331>

Students are **not allowed** to upload class slides, assignment instructions, or other course materials to AI tools or platforms, except for the UCalgary account associated version of Copilot. These are the intellectual property of the course instructor (IP); uploading these to an AI platform may breach IP rules since some of these sites may use these as training/output data.

UNIVERSITY OF CALGARY POLICIES AND SUPPORTS

Copyright

All students are required to read the University of Calgary policy on Acceptable Use of Material Protected by Copyright (<https://www.ucalgary.ca/legal-services/university-policies-procedures/acceptable-use-material-protected-copyright-policy>) 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/legal-services/university-policies-procedures/student-non-academic-misconduct-policy>

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/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf>).

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. Fabiola Aparicio-Ting (feaparic@ucalgary.ca), Associate Dean (Undergraduate Health and Science Education).

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://www.ucalgary.ca/legal-services/university-policies-procedures/student-academic-misconduct-policy>.

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) by students is prohibited except where explicit permission has been received from the instructor.

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/student-services/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://calendar.ucalgary.ca/pages/e31a7115dca740ec83579e946d4a4193>

Media Recording

Please refer to the following statement on media recording of students: https://elearn.ucalgary.ca/wp-content/uploads/2020/05/Media-Recording-in-Learning-Environments-OSP_FINAL.pdf

Media recording for lesson capture

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 violence policy guides us in how we respond to incidents of sexual violence, including supports available to those who have experienced or witnessed sexual violence, or those who are alleged to have committed sexual 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/university-policies-procedures/sexual-and-gender-based-violence-policy>

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/
Student Advocacy and Wellness Hub (CSM)	https://cumming.ucalgary.ca/mdprogram/current-students/student-advising-wellness
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/student-services/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/risk/emergency-management/drills/assembly-points-and-evacuation-maps>

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

