

MDSC 407

Statistics and Research Design in Health Sciences

Instructors:

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Office Hours

- **Dr. Sajobi:** Wednesdays 1:00 – 3:00pm or by appointment

Teaching Assistants:

- Anita Brobbey, MSc
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Time and Location:

Winter semester: January 10th (Thursday) to April 12th (Friday)

Lecture: Wednesday 9:00-11:50am (Room: Clara Christie Theatre)

Lab: Friday 9am-10:50 am; 11am-12:50 pm; 1pm- 2:50pm (Room: 1501 Bioinformatics Lab)

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 semi-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. Week 2 online modules are to be completed before scheduled lecture time in Week 2 of the course). These online modules are marked in the course schedule below. As noted, 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. 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 (as outlined below) thus it is imperative that students come to class with appropriate online modules completed in order to ensure in class activities can be completed.

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.

Learning Objectives

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

1. explain basic concepts and terminology used in statistics and applied to health sciences research
2. evaluate the basic assumptions underlying common biostatistical tests used in health sciences research
3. define research hypotheses and evaluate evidence in support or against hypotheses using datasets
4. interpret results from statistical analysis involving the comparison of continuous and categorical variables between two or more groups
5. conduct statistical analyses involving correlations between variables and linear regression
6. conduct statistical analysis of data using STATA software

Required Textbooks

Medical Statistics: A Textbook for the Health Sciences, 4th Edition
Michael J. Campbell; David Machin; Stephen J. Walters

Available at the Medical Bookstore or as a e-textbook

(<http://ca.wiley.com/WileyCDA/WileyTitle/productCd-HEP002315.html>)

3 copies available for short term loan (in library use only) at the Health Sciences Library

Recommended Textbooks/Readings

Biostatistics: A Foundation for Analysis in the Health Sciences, Tenth Edition

Wayne W. Daniel; Chad L. Cross

(<http://ca.wiley.com/WileyCDA/WileyTitle/productCd-EHEP002458.html>)

A Note regarding readings

*A list of required readings will be outlined on D2L and links and documents will be made available, where possible. Required readings have been chosen carefully to inform you and enhance the lecture material. **Students are REQUIRED to complete assigned readings BEFORE each lecture.** Instructors will proceed in class on the assumption that students have read completely the assigned readings. Students should be aware that many of the readings they will be assigned may be of an unfamiliar nature and style. Students should allot sufficient time to allow for several reads of the assigned material.*

Evaluation

The University policy on grading and related matters is described in section F.2 of the 2018-2019 Calendar.

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

Description	Percentage of Grade	Due Date
Mid-Term Examination (Closed Book, calculator permitted)	20%	February 13, 2019 (in-class)
Mid-Term Examination II (Closed book, calculator permitted)	20%	March 20, 2019 (in-class)
Lab Assignments	25%	At the beginning of the lab as per course schedule
In-class activities and quizzes	5%	Completed during each lecture
Capstone Project (Contains several graded components due throughout the term. See Capstone Project Outline on D2L for details)	30%	Project Delivery April 10, 2019 (in class)

**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.

1. All assignments, lab reports, and/or project reports must be "typewritten", at least 1.5 line spaced and written in formal English. Whenever necessary, students should use either one of the following referencing formats: Harvard or Vancouver.
2. In accordance with the Freedom of Information and Protection of Privacy Act (FOIP), students should identify themselves on written assignments (exams, term work, lab reports etc.) by placing their names and ID number on the front page and their ID number on each subsequent page.
3. The two in-class mid-terms will be closed-book exams. The format will include both multiple-choice questions and/or written questions. Any necessary materials (i.e., distribution tables and formula sheets) will be provided during the exam.
4. TopHat will be used during lecture time, 5-7 review questions will be posted for students to work together and answer. Students will need smartphone, tablet or laptop connected to the Internet or a cell-phone with SMS texting capabilities during lecture in order to participate. Details about the TopHat access code will be provided during the first lecture.

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 2018-19 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). The University of Calgary offers a number of 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:

A+ 97-100%	B+ 80-84%	C+ 65-69%	D+ 54-56%
A 90-96%	B 75-79%	C 60-64%	D 50-53%
A- 85-89%	B- 70-74%	C- 57-59%	F 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. **Students who miss a quiz/in-class assignment will receive a mark of zero unless the instructor has been previously notified. There will be NO exceptions to this policy.**

It is the agreement of all teaching staff involved in MDSC407 that **extensions will NOT be granted** on any assignment or quizzes. 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://www.ucalgary.ca/pubs/calendar/current/e-4.html>).

Brightspace by Desire2Learn (D2L)

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.

If you need help accessing or using D2L, please visit the Desire2Learn resource page for students: <http://elearn.ucalgary.ca/d2l-student/>.

Policies Governing the Course:

Attendance

Students are encouraged to attend all sections (lecturers and lab) and it should be noted that while attendance is not formally taken nor graded there will be in-class activities in most sessions, which are graded. Students absent from class without arrangements being made with the instructor prior to class will forfeit the marks for these activities.

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 conduct themselves in a mature and courteous manner during ALL lectures. Students are expected to frame their comments and questions to lecturers in respectful and appropriate language, always maintaining sensitivity towards the topic.

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

Electronic Devices

The Bachelor of Health Sciences program aims to create a supportive and respectful learning environment for all students. Research studies have found that student use of electronic devices (laptops, tablets, etc) in the classroom negatively affects the learning of both the user

and those sitting nearby. Inappropriate use of laptops is also disruptive to your fellow classmates and disrespectful to the lecturer. The use of laptops and other electronic note-taking devices is permitted; however, their use in the classroom should be for course-related work/note-taking only. Please do **NOT to surf the web, check email or do other unrelated work**. Students who use their laptops inappropriately or are otherwise disruptive during lectures will be asked to leave.

Cell phones (or similar devices) should **be turned off** (not merely silent) upon entering the classroom. Sending/receiving text messages or leaving the class to take calls is disruptive to the entire class and will not be tolerated unless absolutely necessary. The only exception to this is the use of cell phones for answering TopHat review questions, when TopHat is not actively being used cell phone use is NOT permitted. Students who disregard this rule during lectures or tutorials will be asked to leave. These items are not permitted under any circumstance during exams/quizzes, etc.

Copyright

It is the responsibility of students and professors to ensure that materials they post or distribute to others comply with the Copyright Act and the University's Fair Dealing Guidance for Students (http://library.ucalgary.ca/files/library/guidance_for_students.pdf). Further information for students is available on the Copyright Office web page (<http://library.ucalgary.ca/copyright>)

A Note Regarding Instructor Intellectual Property

Generally speaking, course materials created by professor(s) (including course outlines, presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the professor(s). 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 Based on Disability or Medical Condition

It is the student's responsibility to register with Student Accessibility Services to be eligible for formal academic accommodation 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_0.pdf). If you are a student who may require academic accommodation and have not registered with Student Accessibility Services, please contact their office at (403) 220-8237; <http://www.ucalgary.ca/access/>. Students will be provided with all necessary accommodations to ensure equal opportunity to succeed in this course. Please provide the instructor your accommodation letter from Student Accessibility Services within 14 days after the start of this course so that all needed arrangements for exams and assignments can be made.

Accommodations on Protected Grounds other than Disability

Students who require an accommodation in relation to their coursework based on a protected

ground other than disability, should communicate this need, preferably in writing, to the designated BHSc program contact, Mrs. Jennifer Logan (jjlogan@ucalgary), or to Dr. Ebba Kurz, Associate Dean, Undergraduate Health and Science Education, Cumming School of Medicine. Students who require an accommodation unrelated to their coursework or the requirements for a graduate degree, based on a protected ground other than disability, should communicate this need, preferably in writing, to the Vice-Provost (Student Experience). For additional information on support services and accommodations for students with disabilities, visit <https://www.ucalgary.ca/access/>.

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. These rules are contained principally in Sections J to L of the *University of Calgary Calendar*. Students are expected to be familiar with these standards and to uphold the policies of the University in this respect. The Calendar also stipulates the penalties for violating these rules. Please know that the University and the Cumming School of Medicine take these rules seriously. **All incidences of academic dishonesty in this course, such as cheating and plagiarism, will be reported to the Associate Dean for investigation;** infractions will be noted on the record of a student found to be guilty.

Recording of Lectures

Audio or video recording and taking photographs during lectures is prohibited except where explicit permission has been received from the instructor.

Other Important Information

Freedom of Information and Protection of Privacy Act

This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIP); students should identify themselves on written assignments (exams and term work) by their name and ID number on the front page and ID on each subsequent page. Work assigned to you by your course instructor will remain confidential unless otherwise stated before submission. The assignment cannot be returned to anyone else without your expressed permission to the instructor. Grades will be made available on an individual basis and students will not have access to other students' grades without expressed consent. Similarly, any information about yourself that you share with your course instructor will not be given to anyone else without your permission. See <https://www.ucalgary.ca/policies/files/policies/privacy-policy-2011.pdf> for more information.

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 15 days** of first being notified of the grade.

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 (Room 370 MacEwan Student 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

Student Union (SU) Information

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

Emergency Evacuation/Assembly Points

Assembly points for emergencies have been identified across campus. Assembly points are designed to establish a location for information updates from the emergency responders to the evacuees; and from the evacuated population to the emergency responders. The primary assembly point for the Health Science Centre is the Health Research Innovation Centre (HRIC) Atrium. The alternate assembly point is Parking Lot 6. For more information, see the University of Calgary's Emergency Management website:

<http://www.ucalgary.ca/emergencyplan/assemblypoints>
<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.

MDSC 407: Winter 2019 Course Schedule

The following is a list of topics for class and assignment due dates. Please note that unforeseen circumstances may cause changes to the schedule with respect to the timing of topics or method of material delivery. 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.

Instructor(s)	Lecture Date	Lecture Part 1 9:00 – 10:30	In Class Exercise 10:30 – 11:15	Lecture Part 2 11:15 – 11:50	Lab
Week 1	There is no formal lecture in Week 1	The below material will be delivered via online modules which should be completed prior to Week 2. — Intro to statistics — Types of data — Populations and samples	Students need to complete ITP Metric Profile online (deadline Jan 11, 11:59pm) Students need to complete Lab Data Collection Survey online by Jan 11, 11:59pm		Introduction to MDSC 407 Instructors Introduction to Stata
Week 2 Jessalyn Holodinsky Dr. Sajobi	Jan 16	Introduction to the Scientific Method and Research Design — Scientific Method — PI(E)COD Questions — Basic research design Summary Statistics & Graphics Pt 1 — Summarizing Categorical Data o Frequencies, percentages o Tables — Displaying Categorical Data — Bar/pie charts	Overview of Final Project — Format, expectations, grading Final Project Group Work — Time to meet with groups and complete group contract. — Group contract due Jan 16, 11:59pm	Summary Statistics & Graphics Pt 2 — Summarizing continuous data o Median, IQR, percentiles o Mean, standard deviation o Mode — Displaying Continuous Data o Boxplots & Histograms o Describing shape of distributions (symmetrical vs. skew)	Calculating descriptive statistics by hand and in Stata. Creating graphical displays in Stata
Week 3 Dr. Sajobi Anita Brobbey	Jan 23	Theory of Probability — What is probability? — Probability terminology — Calculating the probability of an event — Selected probability rules (Addition and Multiplication) — Conditional, Marginal and Joint probability	In class activity: — Calculating probabilities — Using probability rules	Applications of Probability in Diagnostic studies — Diagnostic tests — Sensitivity, specificity — PPVs — NPVs — Likelihood Ratio Tests	Worked examples of probability and accuracy of diagnostic tests Assignment 1 Due

Week 4 Dr. Sajobi	Jan 30	Probability Distributions — Binomial Distribution — Poisson Distribution — Normal Distribution — Standardizing the Normal Distribution	In class activity: — Properties of the normal distribution — Practice calculating Z-scores	Principles of Statistical Inference – Estimation — Sampling distributions — Central Limit Theorem	Calculating Z-scores by hand and in Stata Review of sampling distributions and the CLT
Week 5 Dr. Sajobi Levi Frehlich	Feb 6	Inference for One-Sample and Two-Sample Groups (Continuous Outcomes) — The t distribution — Standard Errors of Means for one-sample — Standard Errors of differences for two independent samples	In class activity:	Confidence Intervals (CI) for Means — CI for a one sample — Confidence Interval for two independent groups — Choice between Z or t critical values — Relationship between sample size and CI	Calculating confidence intervals by hand and in Stata Assignment 2 Due
Week 6	Feb 13	Mid-term Examination (up to and including Week 4)			NO LAB 1st Project Progress Report Due Feb 15 11:59pm
Week 7	Feb 20	Reading Week: No Classes or Labs			
Week 8 Anita Brobbey	Feb 27	Inference for One-Sample and Two-Sample Groups (Proportions) — Standard Errors of Means for one-sample — Standard Errors of differences for two independent samples	In class activity:	Confidence Intervals (CI) for Proportions — CI for a one sample — CI for two independent groups	Calculating confidence intervals for proportions by hand and in Stata
Week 9 Dr. Sajobi Levi Frehlich	Mar 6	Principles of Hypothesis Testing — Types of hypotheses — Test statistic (Z or t) — Use of CI for hypothesis testing — P-values — Interpretation	In class activity: — Interpreting p-values — Relationship between p-values and confidence intervals	Hypothesis Testing for Means — One-Sample — Two-Sample — Paired t-test	Hypothesis testing for means by hand and in Stata Assignment 3 Due

Week 10 Dr Sajobi	Mar 13	Hypothesis Testing for Proportions — One-Sample (online) — Two-Sample (online) Two-Sample Hypothesis Testing for Categorical Outcomes — Chi square test — Fishers Exact Test	In class activity: — Practice with one sample proportion test and two sample test for proportions	Hypothesis Testing for Matched Categorical Outcomes — McNemar’s Chi ² Test Measures of Association for Categorical Outcomes — Odds ratio — Risk ratio	Hypothesis Testing for categorical variables by hand and in Stata 2nd Project Progress Report Due Mar 15 11:59pm
Week 11 Dr. Sajobi	Mar 20	Mid-term Examination (up to and including Week 9)	Break	Statistical Assumptions and Hypothesis Testing for Continuous and Categorical Variables — Normal distributions — Covariance homogeneity — Independence	Examination of Statistical Assumptions in Datasets using Stata Project Rubric Completion Assignment Due Mar 22, 11:59pm
Week 12 Jessalyn Holodinsky	March 27	Hypothesis Testing for more than Two groups — One-way Analysis of Variance (online) — Assessing assumption for ANOVA — One-way Repeated Measures ANOVA	In class activity: — Practice calculating values in ANOVA — Assessing ANOVA assumptions	Final Projects — Time for work on final projects	ANOVA calculations by hand and in Stata Assignment 4 Due
Week 13 Jessalyn Holodinsky	April 3	Correlation and Regression — Interpreting correlation coefficients (online) — Determining the line of best fit (online) — Interpreting regression coefficients — Assumptions for linear regression	In class activity: — Interpreting scatter plots — Calculating correlation coefficients — Generating regression equations	Regression Continued — Regression to the Mean — Regression Diagnostics	Interpretation of Correlation and linear regression outputs in Stata
Week 14	April 10	Final Project Delivery & Presentation			NO LAB
Assignment 5 Due					