The University of Calgary
Bachelor of Health Sciences
Cumming School of Medicine

Academic Year 2019-2020

MDSC 407
Statistics and Research Design in Health Sciences

Instructors:

- Levi Frehlich, MSc
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  Office Hours: By Appointment

Office Hours/Policy on Answering Student Emails
By appointment with any of the Teaching Assistants and Instructor
All attempts will be made to answer emails within 48 hours

Teaching Assistants:

- Oluwaseyi Lawal, MSc
  PhD Student, Biostatistics Specialization
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- Sangmin (Sarah) Lee, MSc
  PhD Candidate, Health Services Research Specialization
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Time and Location:
Winter semester: January 13th (Monday) to April 15th (Wednesday)
Lecture: Monday 9:00-10:15am and Wednesday 9:00-10:15am (Room: Theatre One)
Lab: Friday 9:00 -10:50am; 11:00am-12:50pm; 1:00-2:50pm (Room: 1501 Bioinformatics Lab)

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. 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). As noted, the course schedule and material delivery method is subject to change with adequate notice given to students. **Please check D2L to keep current with the materials.**

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. Students will understand the basic concepts and terminology used in statistics and applied to health sciences research.

2. Students will be able to understand and be able to evaluate the basic assumptions underlying common statistical tests used in health sciences research.

3. Students will be able to understand the basic concepts and assumptions underlying probability, sampling distributions, and hypothesis testing.

4. Students will be able to demonstrate the use of, and be able to interpret, results from statistical analysis involving the comparison of continuous and categorical variables between two or more groups.

5. Students will be able to demonstrate the use of, and be able to interpret, results from statistical analysis involving correlations between variables and linear regression.

6. Students will be able to demonstrate the ability to undertake statistical analysis using Stata.

Required Textbooks
Biostatistics: A Foundation for Analysis in the Health Sciences, 11th Edition
Wayne W. Daniel; Chad L. Cross
Available at the Medical Bookstore or as a e-textbook
(https://www.wiley.com/en-ca/Biostatistics%3A+A+Foundation+for+Analysis+in+the+Health+Sciences%2C+11th+Edition-p-9781119496571)

Recommended Textbooks/Readings
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 (https://www.wiley.com/en-ca/Medical+Statistics%3A+A+Textbook+for+the+Health+Sciences%2C+4th+Edition-p-9781118300619)
3 copies available for short term loan (in library use only) at the Health Sciences Library

Additional readings will be posted through D2L.

A Note regarding readings
A list of required readings for all course sections 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 of the 2019-2020 Calendar. In determining the overall grade in the course, the following weights will be used:

Description	Percentage of Grade	Due Date
Midterm Examination (Closed Book, Calculator Permitted)	20%	February 12, 2020 (in-class)
Midterm Examination II (Closed book, calculator permitted)	25%	March 25, 2020 (in-class)
Lab Assignments	25%	At the beginning of the lab as per course schedule
Capstone Project (Contains several graded components due throughout the term. See Capstone Project Outline on D2L for details)	30%	Project Delivery April 15, 2020 (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. An example template assignment will be posted to D2L.

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.

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 2019-20 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:

Letter Grade	Description	Percentage
A+	Outstanding performance	97-100
A	Excellent performance	90-96
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

We will be using the D2L Dropbox feature for all lab assignment submissions and some components of the final project over the semester. Please be sure you are familiar with this feature. Any grade appeals for lab assignments must be submitted in writing to your TA **no sooner than 24 hours after assignments are returned**. Appeals will only be accepted up to 10 business days after assignment return. Appeals on examination grades must be submitted in writing to an Instructor **no sooner than 24 hours after exam grades are released**. Appeals will only be accepted up to 10 business days after grade release. Reappraisal may cause the grade to go up, down, or remain unchanged.

Missed Components of Term Work:
At the instructor's discretion, students will lose 5% per day late past the deadline for all assignments, including weekends. Without prior arrangement, 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. **There will be NO exceptions to this policy.**

It is the agreement of all Faculty involved in MDSC 407 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.

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/.

Policies Governing the Course:

Attendance

Students are encouraged to attend all lectures and labs.

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 each session and should not rely solely on handout 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. 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 both the user and those sitting nearby. Students are to refrain from accessing websites that may be distracting for fellow learners (i.e. personal email, Facebook, YouTube).

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

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. 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 (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
Students seeking an accommodation based on disability or medical concerns should contact Student Accessibility Services; SAS will process the request and issue letters of accommodation to instructors. For additional information on support services and accommodations for students with disabilities, visit www.ucalgary.ca/access/.

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 their instructor or to the designated BHSc program contact, Mrs. Jennifer Logan (jljlogan@ucalgary.ca), or to Dr. Ebba Kurz, Associate Dean, Undergraduate Health and Science Education, Cumming School of Medicine. The full policy on Student Accommodations is available at
http://www.ucalgary.ca/policies/files/policies/student-accommodation-policy.pdf.

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. For information on academic misconduct and its consequences, please see the University of Calgary Calendar at
http://www.ucalgary.ca/pubs/calendar/current/k.html Students are expected to be familiar with these standards and to uphold the policies of the University in this respect. 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 of lectures is prohibited except where explicit permission has been received from the instructor.

Other Important Information

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

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

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.

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.

MDSC 407: Winter 2020 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.

Monday: Lecture **9:00-10:15am** **Instructor: Anita Brobbey**	**Wednesday: Lecture** **9:00-10:15am** **Instructor: Levi Frehlich**	**Friday: Lab** **Lab 1: 9:00-10:50am** **Lab 2: 11:00am-12:50pm** **Lab 3: 1:00-2:50pm**	**Reading***
Jan 13 **Introduction to MDSC 407** — Course outline — Intro to statistics — Types of data — Populations and samples	**Jan 15** **Introduction to the Scientific Method and Research Design** — Scientific Method — Basic research design	**Jan 17** Introduction to Stata	Chapter 1

Jan 20
Summary Statistics & Graphics Pt. 1
— Summarizing Categorical Data
  ○ Frequencies, percentages
  ○ Tables
— Displaying Categorical Data
— Bar/pie charts
	Jan 22
	Summary Statistics & Graphics Pt. 2
	— Summarizing continuous data
	  ○ Median, IQR, percentiles
	  ○ Mean, standard deviation
	  ○ Mode
	— Displaying Continuous Data
	  ○ Boxplots & Histograms
	  ○ Describing shape of distributions (symmetrical vs. skew)
		Jan 24
		Calculating descriptive statistics by hand and in Stata.
		
		Creating graphical displays in Stata
			Chapter 2

Jan 27 **Theory of Probability** — What is probability? — Probability terminology — Calculating the probability of an event — Selected probability rules (Addition and Multiplication)	**Jan 29** **Applications of Probability in Diagnostic studies** — Diagnostic tests — Sensitivity, specificity — PPVs — NPVs — Likelihood Ratio Tests	**Jan 31** Worked examples of probability and accuracy of diagnostic tests **Assignment 1 Due**	Chapter 3

— Conditional, Marginal and Joint probability			
Feb 3 **Probability Distributions** — Binomial Distribution — Poisson Distribution — Normal Distribution — Standardizing the Normal Distribution	**Feb 5** **Principles of Statistical Inference – Estimation** — Sampling distributions — Central Limit Theorem	**Feb 7** Calculating Z-scores by hand and in Stata Review of sampling distributions and the CLT	Chapter 4 and 5
Feb 10 **Midterm Review**	**Feb 12** **Midterm Examination** **(up to and including Jan 29 material)**	**Feb 14** **Project Lab Day** **Assignment 2 Due**	
Feb 16-22 Reading Week: No Classes or Labs			
Feb 24 **Inference for One-Sample and Two-Sample Groups (Proportions)** — Standard Errors of Means for one-sample — Standard Errors of differences for two independent samples	**Feb 26** **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	**Feb 28** Calculating confidence intervals by hand and in Stata	Chapter 6
Mar 2 **Confidence Intervals (CI) for Proportions** — CI for one sample — CI for two independent groups	**Mar 4** **Confidence Intervals (CI) for Means** — CI for one sample — Confidence Interval for two independent groups — Choice between Z or t critical values — Relationship between sample size and CI	**Mar 6** **Project Lab Day**	Chapter 6
Mar 9 **Principles of Hypothesis Testing** — Types of hypotheses — Test statistic (Z or t) — Use of CI for hypothesis testing	**Mar 11** **Hypothesis Testing for Means** — One-Sample — Two-Sample — Paired t-test	**Mar 13** Hypothesis testing for means by hand and in Stata **Assignment 3 Due**	Chapter 7

— P-values — Interpretation			
Mar 16 **Hypothesis Testing for Proportions** — One-Sample — Two-Sample **Two-Sample Hypothesis Testing for Categorical Outcomes** — Chi square test — Fishers Exact Test	**Mar 18** **Hypothesis Testing for Matched Categorical Outcomes** — McNemar's Chi²Test **Measures of Association for Categorical Outcomes** — Odds ratio — Risk ratio	**Mar 20** Hypothesis testing for categorical outcomes by hand and in Stata	Chapter 7 and 12
Mar 23 **Midterm Review**	**Mar 25** **Midterm Examination (focus on Feb 3 – to Mar 18)**	**Mar 27** **Project Lab day** **Assignment 4 Due**	
Mar 30 **Hypothesis Testing for more than Two groups** — One-way Analysis of Variance — Assessing assumption for ANOVA — One-way Repeated Measures ANOVA	**Apr 1** **Statistical Assumptions and Hypothesis Testing for Continuous and Categorical Variables** — Normal distributions — Covariance homogeneity Independence	**Apr 3** Examination of Statistical Assumptions in Datasets using Stata ANOVA calculations by hand and in Stata	Chapter 8
Apr 6 **Correlation and Regression Pt. 1** — Interpreting correlation coefficients — Determining the line of best fit — Interpreting regression coefficients — Assumptions for linear regression	**Apr 8** **Correlation and Regression Pt. 2** — Regression to the Mean — Regression Diagnostics	**Apr 10** **Final Project Delivery** **Assignment 5 Due**	Chapter 9
Apr 13 **Special Topics Pt 1.**	**Apr 15** **Special Topics Pt 2.**		

*When applicable, additional readings and/or links will be posted on D2L