We recognize and acknowledge that McMaster University meets and learns on the traditional territories of the Mississauga and Haudenosaunee nations, and within the lands protected by the "Dish With One Spoon" wampum, an agreement amongst all allied Nations to peaceably share and care for the resources around the Great Lakes.

Arts and Science 2R03 – Applied Statistical Inference

2021/22 Winter Term

Instructor: Dr. David Lozinski | **E-mail:** lozinski@math.mcmaster.ca | **Tel. Extension:** 23409 | **Office:** HH 315

Office hours: Mo, Th 3:30-4:20 | **Web Page:** The course web page can be found on Avenue to Learn

Lectures: Mo, We, Th 4:30 – 5:20 (in BSB106) |

Tutorials: **T01:** Mo 1:30-2:20 (in JHE 329) | **T02:** Mo 12:30-1:20 (in JHE 329) | **T03:** Mo 12:30-1:20 (in TSH B126)

Teaching Assistants: Quinn Macpherson (macpherq@mcmaster.ca), Jessica Latimer (latimerj@mcmaster.ca) & Catherine Hu (huc27@mcmaster.ca)

Please Note: The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of students to check their McMaster email and course websites weekly during the term and to note any changes.

Announcements will be made in class, on the course web site, and by using the course email distribution list.

COURSE DESCRIPTION

Inferential statistics, with an emphasis on applications. Topics include data description, graphical methods, probability, confidence intervals, hypothesis testing, one-way ANOVA, and analysis of categorical data. The course includes the use of the statistics software package R.

COURSE AND LEARNING OBJECTIVES

Introduction:

The course objectives are to learn, exemplify and train the students on: (a) methods to summarize data numerically and graphically, (b) the most widely used statistical methods to draw inferences from observed data, (c) some of the mathematical details behind the methods, and (d) handling data and carrying out basic statistical analyses using the freeware statistical package R.

REQUIRED MATERIALS/ RESOURCES

Textbook:

- *Introductory Statistics - A Problem-Solving Approach* by Stephen Kokoska, published by Macmillan Education. It is available at the Campus Store. The direct connection to the campus store is: https://campusstore.mcmaster.ca/cgi-mcm/ws/txsub.pl?wsTERMG1=221&wsDEPTG1=ARTSSCI&wsCOURSEG1=2R03&wsSECTIONG1=DAY%20C01&crit_cnt=1

Supporting problems are listed on the web site. Answers to selected problems are in the back of the textbook.

Calculator: Only the standard Casio fx 991 MS or MS Plus calculator is permitted.

COURSE OVERVIEW AND ASSESSMENT

Lectures:

Lectures will be in person. Attendance is required.

Assignments:

There will be 5 assignments to be completed during the term. Assignments will make use of the statistical software R. R is freeware statistical software downloadable for Windows and MacIntosh platforms from The R Project for Statistical Computing. The web page is:
http://www.r-project.org/
The assignments will be due by noon on the Tuesdays of:
Feb 1, Feb 15, March 8, March 22, and April 5.
Late assignments will not be accepted and a grade of zero will be assigned.

Participation:

A portion of the final grade will be computed based on participation in collaborative learning activities done during the tutorials.

Project:

In addition to the above, a project consisting of a statistical analysis of appropriate data will be required. The project due date is Tuesday, April 12. Late assignments will not be accepted and a grade of zero will be assigned. More information on the project will be presented in class.

Mid-Term Tests:

There are 2 midterm tests, each worth 20% of the final grade. The dates for the midterms are tentatively
Wednesday, February 9 during class time (4:30-5:20pm)
Wednesday, March 16 during class time (4:30-5:20pm)
More information, including the topics covered, will be announced in class.

Final Exam: A 2.5-hour final exam will be administered in person during the April Final Examination Period. It will cover all course material.

EVALUATION

Assessment	Weight
1. Two Midterm Tests	40% (20% each)
2. Final Examination	30%
3. Assignments	15% (3% each)
4. Project	10%
5. Participation	5%

The assignments will be due by noon on the Tuesdays of: Feb 1, Feb 15, March 8, March 22, and April 5.
The dates for the midterms are tentatively Wednesday, February 9 and Wednesday, March 16 during class time.
The project will be due on Tuesday, April 12.

SENATE-APPROVED ADVISORY STATEMENTS

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. It is your responsibility to understand what constitutes academic dishonesty.
Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the *Academic Integrity Policy*, located at https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/.
The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.
Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., online search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ONLINE ELEMENT

Some courses may use online elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses online elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, whether in person or online.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

In the event of an absence for medical or other reasons, students should review and follow the *Policy on Requests for Relief for Missed Academic Term Work*.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, including lectures by University instructors. The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done either by the instructor for the

purpose of authorized distribution or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

NOTES FOR ALL ARTS & SCIENCE COURSES

1. Some of the statements above refer to a "Faculty Office"; please note that the Arts & Science Program Office serves in this capacity.
2. It is the responsibility of students to check their McMaster email regularly. Announcements will be made in class, via A2L, and/or via the course email distribution list.
3. For additional information regarding requests for accommodation, relief for missed term work (e.g. MSAF), deferred examinations, etc., students should read carefully the Requests and Resources pages on the Arts & Science Program website.

Approximate lecture schedule

Week 1: Jan 10 to Jan 14
- Intro, graphing data, Intro to R
- Chapters 1 and 2

Week 2: Jan 17 to Jan 21
- Measured statistics (including mean, percentiles, variance and std dev)
- Chapters 2 and 3

Week 3: Jan 24 to Jan 28
- Probability, from counts of equally likely outcomes, 3 axioms and basic laws
- Chapter 4

Week 4: Jan 31 to Feb 4
- Inpendence, conditional probability, discrete probability districutions
- Chapter 4

Week 5: Feb 7 to Feb 11
- Baye's Formula, Binomial and Poisson distributions
- Chapters 4 and 5

TEST 1

Week 6: Feb 14 to Feb 18
- Continuous Random variable, PDFs, normal distribution, exponential
- Chapter 6

READING WEEK: Feb 21 to Feb 25

Week 7: Feb 28 to March 4
- parameters from sample, dist of statistic, C.I. and t distribution
- Chapter 8

Week 8: March 7 to March 11
- Dist of sample proportion and C.I., C.I. for variance and Chi square
- Chapter 8

Week 9: March 14 to March 18
- Hypothesis testing, null alternative, test statistic, decision rule, error types
- Chapter 9

TEST 2

Week 10: March 21 to March 25
- Examples, 1 tail, 2 tail,Hypothesis testing on proportion, 2 sample means
- Chapters 9 and 10

Week 11: March 28 to April 1
- 2 sample means, examples. Categorical data, contingency tables
- Chapters 10 and 13

Week 12: April 4 to April 8
- Chi square test, test for homogeneity, intro to ANOVA
- Chapters 13 and 11

Week 13: April 11 to end of term
- Review.