

STAT 2220  
Contemporary Statistics for Engineers  
Fall 2022

<b>Time</b>	Mondays, Wednesdays & Fridays, 11:30 a.m. – 12:20 p.m.
<b>Location</b>	231 Isbister
<b>CRN</b>	10100
<b>Instructor</b>	Andrew Morris (He/Him) 324 Machray Hall Email: Andrew.Morris@umanitoba.ca Telephone: 204-480-1073
<b>Web Pages</b>	UM Learn: <a href="http://umanitoba.ca/umlearn">http://umanitoba.ca/umlearn</a> R Download (Windows): <a href="https://muug.ca/mirror/cran/bin/windows/">https://muug.ca/mirror/cran/bin/windows/</a> R Download (MacOS): <a href="https://muug.ca/mirror/cran/bin/macosx/">https://muug.ca/mirror/cran/bin/macosx/</a> R Studio: <a href="https://www.rstudio.com/products/rstudio/#download">https://www.rstudio.com/products/rstudio/#download</a> i►clicker Student: <a href="https://app.reef-education.com">https://app.reef-education.com</a>
<b>Office Hours:</b>	<b>Room 312 Machray Hall</b> (If I am not there, check my office.) Tuesday 11:30 a.m. – 12:30 p.m. Wednesday 10:30 a.m. – 11:15 a.m. Thursday 11:30 a.m. – 12:30 p.m.

## Territory Acknowledgment

The University of Manitoba campuses are located on original lands of Anishinaabeg, Cree, Oji-Cree, Dakota and Dene peoples, and on the homeland of the Métis Nation. We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration.

## Calendar Description

(Lab Required) Descriptive statistics, basic probability concepts, special statistical distributions, statistical inference-estimation and hypothesis testing, regression, reliability, statistical process control. May not be held with STAT 1000, STAT 1001 or STAT 1150. Prerequisite: one of MATH 1232, MATH 1690, the former MATH 1680, MATH 1700, MATH 1701, MATH 1710.

# Course Objectives

Upon completion of this course, the student will have an understanding of the fundamental concepts of statistics and an appreciation for the application of statistics in the field of Engineering.

## Evaluation

R Tutorials (best 4 of 5)	5%
i►clicker Tutorials (best 4 of 5)	6%
Assignments (3)	9%
Term Test 1*	15% or 20%
Term Test 2*	15% or 20%
Final Examination	45%

\*Your better term test will be worth 20% of your final grade; the other will be worth 15%.

If you miss a second R tutorial or a second i►clicker tutorial due to illness or another valid reason, and provided that you have submitted a self-declaration form to your instructor within 24 hours of both missed due dates, the weight will be transferred to your final exam. (See Page 12 of the course outline for an explanation and link to the required form.)

The following are the minimum percentage grades required to receive each of the various letter grades: A<sup>+</sup> (90%), A (80%), B<sup>+</sup> (75%), B (70%), C<sup>+</sup> (65%), C (60%), D (50%).

## Textbook

There is **no required textbook** for this course. You will be provided with detailed notes and all the material you need.

## Exam Information

The first term test will be held **Thursday October 20 from 8:30 a.m. – 9:45 a.m.** and will cover Units 1 – 4 in the course notes. The second term test will be held **Thursday November 24 from 8:30 a.m. – 9:45 a.m.** and will cover Units 5 & 6 in the course notes. Students missing a test for a valid reason will be permitted to write a deferred test at a later date. The final exam will be 3 hours in duration and will be scheduled by the Student Records Office. The final exam will cover Units 1 – 8, with emphasis on material covered after the second term test.

Both the term tests and the final examination will contain multiple-choice questions and a written component.

Both the term tests and the final exam are **closed book**. However, for each term test, you will be permitted to prepare **one** page of notes (one regular 8.5" x 11" piece of paper with writing only on one side). For the final exam, you can prepare **two** pages of notes (two regular 8.5" x 11" pieces of paper with writing only on one side, or one regular 8.5" x 11" piece of paper with writing on both sides). You can write notes, formulas, examples, or anything else you want on these pages. Your notes must be hand-written, and must be prepared by you – you are not permitted to use notes written by another student or anyone else.

For tests and exams, you will also need a **non-programmable scientific calculator**.

## Software

This course will make use of the statistical software R and RStudio. Both of these programs are free to use and are available for both Windows and Mac OS systems. R is one of the most popular statistical software programs, and throughout the course, we will utilize R to aid in our data analysis. We will use R through the RStudio environment, which will neatly organize and display your work. Finally, R Markdown (a component of RStudio) will be used to format the documents that you submit (both in the form of lab worksheets and your assignments).

To download R, follow one of the links below (depending on your operating system):

Windows systems: <https://muug.ca/mirror/cran/bin/windows/>

Mac OS systems: <https://muug.ca/mirror/cran/bin/macosx/>

Once you have downloaded and installed R, you may access RStudio through the link below:

<https://www.rstudio.com/products/rstudio/#download>

Detailed installation instructions will be provided on your *UM Learn* page.

# Tutorial

**Thursdays, 8:30 a.m. – 9:45 a.m., Robert Schultz Lecture Theater, 172 St. John's**

Tutorials will begin Thursday September 15. There will be two different types of tutorial:

In the first **R tutorial**, your TA will introduce you to R and RStudio, and show you what the software looks like. However, it is expected that you will have R and RStudio installed prior to your first tutorial, and that you have RMarkdown set up. There will be a detailed installation and setup guide on your *UM Learn* page.

Each R tutorial will have two segments. In the first segment, your TA will demonstrate that day's content with an R demonstration; in the second segment, you will complete a short worksheet based on the material covered that day. For these worksheets, you can work in groups of up to three students (you and two other students). You will complete your worksheet on your computer through RMarkdown and submit it electronically through a Crowdmark link which will be provided to you. The worksheet must be submitted by the end of the tutorial session. Only one submission is required per group.

If you can, you should **bring a laptop to your R tutorials**. Note that whatever machine you bring must be able to run R and RStudio: this means that most tablets and Chromebooks will not be sufficient. If you do not have access to a Windows/MacOS machine, you may work in a group with a classmate who does.

Worksheets will be marked on a pass/fail basis. So long as your group has made a reasonable effort on the worksheet, you will receive a grade of 1/1 for that tutorial. Note that only the best 4 of 5 R tutorial grades will be count towards your final grade (i.e., the lowest grade will be dropped, meaning that you can miss one R tutorial with no penalty).

In the **i►clicker tutorials**, the i►clicker classroom response system will be used in order to enhance your understanding of the material and promote participation. Your T.A. will go through multiple-choice i►clicker questions. Each i►clicker question will be worth three marks; you will be awarded one mark just for answering (a participation mark), and two additional marks if you get the correct answer. Each tutorial will be weighted equally and only the **best 4 of 5 i►clicker tutorial grades** will count towards your final grade (i.e., the lowest grade will be dropped, which means you can miss one i►clicker tutorial with no penalty). **You should bring your cell phone or an internet enabled device that runs a web browser or the i►clicker Student app to each class. You can use a laptop, iPhone/iPad (iOS 10+), or Android (OS 5.0+) device.**

You will need to make a free i►clicker Student account either through their app or their website, <https://app.reef-education.com>. Once registered, you will need to add this class in your app or web profile.

# Assignments

There will be three assignments in the course, which will make use of the R statistical software. Your final submission will be formatted with RMarkdown, and submitted to Crowdmark for grading. See the course schedule for assignment due dates.

## Practice Questions

You will be provided with many practice questions in this course. In the **Practice Problems** folder on *UM Learn*, you will find written-answer questions for each unit, as well as detailed solutions. These problems will help you practice and learn the course material, and to prepare for the long-answer questions on the term tests and final exam.

In the **Practice Multiple Choice Questions** folder on *UM Learn*, you will find many multiple choice questions for each unit. The letter answers for these questions are at the end of each file. These questions will help you practice and learn the course material, and to prepare for the multiple choice questions on the term tests and final exam.

Although they are not for marks, students are strongly encouraged to try these practice problems on a regular basis.

## Statistics Help Centre

In Room 311 Machray Hall (which contains a number of computers), graduate students and senior undergraduate students in statistics are available to help you with any questions you have about the course, as well as the installation and use of R and RStudio. The Help Centre is open at the following times (from September 7 to December 12):

Monday	9:00 a.m. – 2:30 p.m.
Tuesday	9:00 a.m. – 7:00 p.m.
Wednesday	9:00 a.m. – 5:00 p.m.
Thursday	9:00 a.m. – 5:00 p.m.
Friday	9:00 a.m. – 5:00 p.m.

The Help Centre will be closed on holidays and during the Fall term break (Nov. 7 – 10).

## STAT 2220 Course Schedule

<b>Week</b>	<b>Dates</b>	<b>Tutorials</b>	<b>Assignment Due Dates</b>
<b>Week 1</b>	Sep. 7 – Sep. 9	No Tutorial	
<b>Week 2</b>	Sep. 12 – Sep. 16	Tutorial 1	R – Intro/Unit 1
<b>Week 3</b>	Sep. 19 – Sep. 23	Tutorial 2	R – Unit 1
<b>Week 4</b>	Sep. 26 – Sep. 30	Tutorial 3	iClicker Assignment 1 due September 29
<b>Week 5</b>	Oct. 3 – Oct. 7	Tutorial 4	R – Unit 2
<b>Week 6</b>	Oct. 10 – Oct. 14	Tutorial 5	iClicker Assignment 2 due October 14
<b>Week 7</b>	Oct. 17 – Oct. 21	Tutorial 6	Test 1 October 20 Units 1 – 4
<b>Week 8</b>	Oct. 24 – Oct. 28	Tutorial 7	iClicker
<b>Week 9</b>	Oct. 31 – Nov. 4	Tutorial 8	iClicker
<b>Fall Term Break</b>	Nov. 7 – Nov. 11	No Tutorial	
<b>Week 10</b>	Nov. 14 – Nov. 18	Tutorial 9	R – Unit 6
<b>Week 11</b>	Nov. 21 – Nov. 25	Tutorial 10	Test 2 November 24 Units 5 & 6
<b>Week 12</b>	Nov. 28 – Dec. 2	Tutorial 11	R – Unit 7/8
<b>Week 13</b>	Dec. 5 – Dec. 9	Tutorial 12	iClicker Assignment 3 due December 7

# Course Outline

## Unit 1 – Examining Distributions

- types of variables: quantitative, categorical (nominal, ordinal)
- graphs: bar charts, pie charts, frequency distributions, histograms, time plots
- examining distributions, shape (skewed, symmetric)
- describing distributions with numbers: mean, weighted mean, median, quartiles, percentiles, interquartile range, range, variance and standard deviation
- five-number summary and quantile boxplots
- outliers
- the  $1.5 \times \text{IQR}$  rule for suspected outliers, outlier boxplots
- resistant measures

## Unit 2 – Correlation & Regression

- association, explanatory variable, response variable
- examining scatterplots
- correlation
- least squares criterion and least squares regression line, prediction
- slope, intercept,  $r^2$
- residuals
- outliers, influential observations
- association vs. causation, lurking variables
- extrapolation

## **Unit 3 – Sampling & Experimental Design**

- populations and samples
- voluntary response sample, convenience sample
- simple random sample
- stratified random sample
- multistage sample
- systematic sample
- census
- undercoverage, nonresponse
- observational study vs. experiment
- factors, factor levels, treatments
- placebo effect, control group
- principles of experimental design
- completely randomized design
- randomized block design

## **Unit 4 – Probability Theory**

- randomness, definition of probability
- sample space, outcomes, events
- basic probability rules
- mutually exclusive events, exhaustive events, complements
- conditional probability
- independence
- Law of Total Probability, Bayes' Theorem
- system reliability

## **Unit 5 – Random Variables**

- discrete random variables (probability mass function, cumulative distribution function)
- continuous random variables (probability density function, cumulative distribution function)
- expected value and variance of a random variable
- functions of random variables

## **Unit 6 – Common Discrete and Continuous Distributions**

- Bernoulli random variables, binomial distribution
- geometric and negative binomial distribution
- hypergeometric distribution
- Poisson distribution
- continuous uniform distribution
- Exponential distribution (relationship with Poisson distribution, lack-of-memory property)
- normal distribution

## **Unit 7 – Sampling Distribution**

- sampling distribution of a sample mean
- Central Limit Theorem
- sampling distribution of a proportion

## **Unit 8 – Inference for a Single Population**

- estimating with confidence
- confidence interval for a population mean ( $\sigma$  known)
- margin of error
- effect of sample size, confidence level, standard deviation
- effect of population size
- sample size calculation for estimating a population mean
- hypothesis tests for a population mean ( $\sigma$  known)
- hypotheses, test statistic,  $P$ -value, statistical significance
- two-sided tests and confidence intervals
- confidence intervals and hypothesis tests for a population mean ( $\sigma$  unknown)
- confidence intervals and hypothesis tests for a population proportion
- sample size calculation for estimating a population proportion

## Academic Integrity

It is important that you understand what constitutes academic dishonesty and that you are familiar with the very serious consequences. The following link describes various types of academic dishonesty (including plagiarism, cheating, inappropriate collaboration and examination impersonation), and offers several resources to help students understand and avoid academic dishonesty:

<http://umanitoba.ca/student-supports/academic-supports/academic-integrity>

The Student Discipline Bylaw, which describes the potential consequences of academic dishonesty, can be found at the following link:

[http://umanitoba.ca/admin/governance/media/Student\\_Discipline\\_Bylaw\\_-\\_2018-09-01.pdf](http://umanitoba.ca/admin/governance/media/Student_Discipline_Bylaw_-_2018-09-01.pdf)

An academic integrity and student conduct tutorial can be found at the following link. For this course, it is recommended in particular that you view the parts on Tests & Exams and Inappropriate Collaboration.

[http://umanitoba.ca/student/resource/accessibility/files/AI-Student-Conduct-Tutorial/story\\_html5.html](http://umanitoba.ca/student/resource/accessibility/files/AI-Student-Conduct-Tutorial/story_html5.html)

All students are required to complete a short **Academic Integrity quiz** in *UM Learn*. You must receive a score of 100% on this quiz. (You will have multiple attempts if you do not get 100% on your first attempt.) This quiz must be completed by **Monday September 26 at noon**. You cannot receive credit for this course if you do not complete this quiz.

## Voluntary Withdrawal

The voluntary withdrawal date is **November 22** (by which time you will have received your marks for the first term test, your first nine tutorials, and your first two assignments). If you are unlikely to be successful in the course, or are not achieving the grade that you are aiming for, you should consider a VW from the course. Students enrolled in the course after the VW deadline will be assigned a final grade.

### Authorized Withdrawal

In some instances, medical or compassionate circumstances arise in a student's life that prevent them from performing as they would in normal circumstances. If you are in this position, please contact a Faculty academic advisor to discuss your options. Be prepared to provide documentation, which supports your situation.

## Copyrighted Material

All course notes, assignments, tests, exams, practice questions and solutions are the intellectual property of your instructor or the Department of Statistics. **The reproduction, posting or distribution of these materials is strictly forbidden without their consent.** It is **illegal** to upload any course material to any website. For more information, see the University's Copyright Office website at <http://umanitoba.ca/copyright>.

## Recording of Class Lectures

Your instructor holds copyright over the course materials, presentations and lectures which form part of this course. **No audio or video recording of lectures or presentations is allowed in any format** without permission from your instructor.

## Class Communication

The University requires all students to activate an official University email account. Please note that all communication between you and your instructor must comply with the Electronic Communication with Students Policy. Please see

[http://umanitoba.ca/admin/governance/governing\\_documents/community/electronic\\_communication\\_with\\_students\\_policy.html](http://umanitoba.ca/admin/governance/governing_documents/community/electronic_communication_with_students_policy.html)

You are required to obtain and use your U of M email account for all communication between yourself and the university.

## Professional Conduct

Students in the University community can freely express their thoughts, opinions, and beliefs; however, they must observe the Respectful Work and Learning Environment Policy (<https://umanitoba.ca/about-um/respectful-work-and-learning-environment-policy>) and treat each other, staff, and faculty with respect. Students who are alleged to have breached the Respectful Work and Learning Environment Policy will be investigated and disciplined according to the Student Non-Academic Misconduct and Concerning Behaviour Procedure.

# Academic Accommodations

## Student Accessibility Services

Students who have, or think they may have, a disability (e.g., mental illness, learning, medical, hearing, injury-related, visual) are encouraged to contact Student Accessibility Services to arrange a confidential consultation. Instructors are notified by Student Accessibility Services what accommodations their registered students require, which will help the instructor determine fair, feasible and reasonable academic accommodations without compromising academic standards. This takes time and planning, so reach out at the start of term.

SAS students can write their exams and tests in spaces organized by the SAS Exam Centre; however, they must register with the SAS Exam Centre a few weeks in advance. Please be sure to do so to receive the accommodations.

Student Accessibility Services

<http://umanitoba.ca/student-supports/accessibility>

520 University Centre

204-474-7423

[Student\\_accessibility@umanitoba.ca](mailto:Student_accessibility@umanitoba.ca)

## Medical Notes and Other Documentation

The Self-Declaration for Brief and Temporary Absences Procedure and Policy will be effective on September 1, 2022 and therefore students will not be required to present medical or other documentation for absences due to extenuating circumstances of 72 hours or less; however, you must complete the form at the following link:

<https://umanitoba.ca/governance/sites/governance/files/2022-06/self-declaration-for-brief-and-temporary-student-absences-fillable-form-final-for-website.pdf>

You must submit the form to your instructor in lieu of any medical or other documentation. Please note that further documentation may be requested from students who claim multiple temporary absences or absences for more than 72 hours. You only need to submit this form if you miss an assessment. You do **not** need to fill out this form if you are missing a lecture or a tutorial. Note that personal vacations or work obligations are **not** considered valid excuses to miss assessments.

## Final Exams

If you have conflicting scheduled final exams, or if you miss a final exam due to illness or some other valid reason, **you must contact an academic advisor in your home faculty** (<http://umanitoba.ca/academic-advisors/>) as soon as possible to apply for a deferred exam. Deferred final exams are **not** arranged through your instructor or the department. Note that the granting of a deferred exam is not necessarily guaranteed.

# Health and Safety

The University of Manitoba is committed to maintaining a safe learning environment for all students, faculty, and staff. Should campus operations change because of health concerns related to the COVID-19 pandemic or other campus-wide emergency, it is possible that this course will move to a fully remote delivery format. Should the instructor be required to stay at home for an extended period and an alternate instructor not be available, the course may move temporarily to a remote delivery format.

## Mask Wearing

In a face-to-face environment, our commitment to safety requires students to observe all COVID guidelines set by the University (<https://umanitoba.ca/coronavirus>). While on campus and in class, you must wear masks as stipulated in current University policies, procedures, and guidelines. The University highly recommends the use of KN-95 masks; the minimum requirement is a ATSM Level 2 Medical mask. Both mask types are available at many locations on campus. Students who fail to comply are subject to disciplinary action in accordance with the Student Discipline Bylaw and the Non-Academic Misconduct and Concerning Behaviour Procedure. If you do not follow masking requirements, you will be asked to leave the learning space and may only return to the class already in progress when you have complied with this requirement. Repeated issues will result in disciplinary action as previously noted. **Students should not eat or drink during class time.**

## Illness

Remember: **STAY HOME IF YOU HAVE SYMPTOMS OR ARE ILL.** If you received a positive COVID test result, or if you have symptoms without testing, you must follow the instructions at <https://umanitoba.ca/covid-19/health-safety>. Specifically,

- You should **isolate for 5 days** after your symptoms started and until you have no fever and your other symptoms have improved over the past 24 hours.
- If you don't have symptoms and test positive, you should **isolate for 5 days** after your test date.

Recall that only the best 4 of 5 R tutorials and 4 of 5 i►clicker tutorials will count towards your final grade. **The purpose of this policy is that we know you may be unable to attend a tutorial sometime during the term, either due to illness or some other valid reason.**

If you become ill while at the university, you should leave the classroom, lab, or workspace immediately. Once at home, complete the MB self-assessment and follow the directions that are provided. Please remain off-campus until cleared to return in accordance with self-assessment, testing results, and UM recommended isolation procedures.

Complete the COVID-19 case reporting form at <https://umanitoba.ca/covid-19/case-reporting>.

# Mental Health Support

For 24/7 mental health support, you can contact the Mobile Crisis Service at 204-940-1781.

## Student Counselling Centre

Contact SCC if you are concerned about any aspect of your mental health, including anxiety, stress, or depression, or for help with relationships or other life concerns. SCC offers crisis services as well as individual, couple, and group counselling.

*Student Counselling Centre:* <http://umanitoba.ca/student/counselling/index.html>

474 University Centre or S207 Medical Services  
204-474-8592

## Student Support Case Management

Contact the Student Support Case Management team if you are concerned about yourself or another student and don't know where to turn. SSCM helps connect students with on-and off-campus resources, provides safety planning, and offers other supports, including consultation, educational workshops, and referral to the STATIS threat assessment team.

*Student Support Intake Assistant:* <http://umanitoba.ca/student/case-manager/index.html>  
520 University Centre, Fort Garry Campus  
204-474-7423

## University Health Service

Contact UHS for any medical concerns, including mental health problems. UHS offers a full range of medical services to students, including psychiatric consultation.

*University Health Service:* <http://umanitoba.ca/student/health/>  
104 University Centre, Fort Garry Campus  
204-474-8411 (Business hours or after hours/urgent calls)

## Health and Wellness

Contact the university's Health and Wellness Educator if you are interested in peer support from Healthy U or information on a broad range of health topics, including physical and mental health concerns, alcohol and substance use harms, and sexual assault.

*Health and Wellness Educator:*  
<https://umanitoba.ca/student/health-wellness/welcome-about.html>  
[britt.harvey@umanitoba.ca](mailto:britt.harvey@umanitoba.ca)  
469 University Centre, Fort Garry Campus  
204-295-9032

## Live Well @ UofM

For comprehensive information about the full range of health and wellness resources available on campus, visit the Live Well @ UofM site: <http://umanitoba.ca/student/livewell/index.html>.

# Your Rights and Responsibilities

As a student of the University of Manitoba, you have rights and responsibilities. It is important for you to know what you can expect from the University as a student and to understand what the University expects from you. Become familiar with the policies and procedures of the University and the regulations that are specific to your faculty, college or school.

The Academic Calendar (<https://umanitoba.ca/registrar/academic-calendar>) is one important source of information. View the sections of University Policies and Procedures and General Academic Regulations. While all of the information contained in these two sections is important, the following information is highlighted.

- If you have questions about your grades, talk to your instructor. There is a process for term work and final grade appeals. Note that you have the right to access your final examination scripts. See the Registrar's Office website for more information including appeal deadline dates and the appeal form: <http://umanitoba.ca/registrar/>.
- You are expected to view the General Academic Regulation section within the Academic Calendar, and specifically read the **Academic Integrity** regulations. Consult the course syllabus or ask your instructor for additional information about demonstrating academic integrity in your academic work. Visit the Academic Integrity Site for tools and support <http://umanitoba.ca/academicintegrity/>. View the **Student Academic Misconduct** procedure for more information.
- The University is committed to a respectful work and learning environment. You have the right to be treated with respect and you are expected to conduct yourself in an appropriate respectful manner.

For information on regulations that are specific to your academic program, read the section in the Academic Calendar and on the respective faculty/college/school web site <http://umanitoba.ca/faculties/>

Contact an Academic Advisor within **your** registered faculty/college or school for questions about your academic program and regulations.

Contact **Student Advocacy** if you want to know more about your rights and responsibilities as a student, have questions about policies and procedures, and/or want support in dealing with academic or discipline concerns.

<http://umanitoba.ca/student/advocacy/>  
520 University Centre  
204-474-7423  
[student\\_advocacy@umanitoba.ca](mailto:student_advocacy@umanitoba.ca)