

STAT 3000 F22 Section A01

Applied Linear Statistical Models

Time M/W 2:30 - 3:45 p.m.
Location 208 Armes

Instructor Jenna G. Tichon
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Web Pages Statistics: <http://umanitoba.ca/statistics/>
Course Website: <http://umanitoba.ca/umlearn>
R Studio Cloud: <http://rstudio.cloud>

Office Hours Monday: 10:00 - 11:00 a.m.
Tuesday: 1:30 - 2:30 p.m.
Thursday: 10:00 - 11:00 a.m.
(Or by appointment.)

If the above times are not convenient for you, please email or speak to me to arrange an alternate time to meet. I am available for Zoom meetings by appointment but you must use your U of M email address. I will do my best to return all email within 24 hours. While I have listed my office phone, please avoid using it unless there is an emergency and you are aware that I am in my office.

My preferred form of address is Dr. Tichon and my pronouns are she/her.

Calendar Description

Applied Linear regression and analysis of variance for designed experiments. This course is not for use in the Honours or Major degree programs in Statistics. Not to be held with STAT 3470, STAT 3480, the former STAT 3120 or the former STAT 3130. Prerequisite: a "C" or better in one of STAT 1150, STAT 2000 or STAT 2001.

Course Goals

By the end of the course we would like students to be able to:

- identify appropriate basic regression and ANOVA models for common data sets.
- assess model assumptions and make decisions on whether or not methods are useable and suggest transformations where needed.

- use R to conduct common ANOVA and regression tests and be proficient in basic R programming.
- present and summarize data output in a way that is clear, concise and provides practical insight for non-statisticians needing the results.

This course is an introduction to linear modelling where students will take a practical and hands on approach to analysing data sets using R programming. The focus is on developing a clear understanding of the different models for different data types, developing an intuitive understanding for our estimators, making appropriate assessments of the proposed methods, using R to analyse our data and interpreting the computer output in a clear manner. Students are encouraged to step back from the material and consider all of the examples from the standpoint of a practitioner and what considerations would need to be made if they were the actual people conducting the experiment. Beyond the techniques in the course, it is the hope that the students will leave the course with a mind focused on being a responsible data scientist who is ready to perform their own research.

Textbook, Readings, and Course Materials

Required Textbook: The following textbook will be used throughout the course. I will be assigning reading and practice from the text through out the course and may assign some questions on the assignments. Other textbooks may be referenced for additional reading.

STAT2 Modeling with Regression and ANOVA, Second Edition by Cannon, Cobb, et al. W.H. Freeman and Company ISBN 9781319056971

The text is available from the bookstore or as an e-book through <https://www.vitalsource.com/en-ca/products/stat2-modeling-with-regression-and-anova-ann-r-cannon-george-w-cobb-v9>

Supplementary Readings: Occasionally I will assign supplementary readings in the form of short articles or website URLs to complement the lectures. These will be made available through the course website on UMLearn under the course content for the appropriate unit or on the class discussion forum.

Course Notes: All of the course notes will be provided to students on the course website. Note that solutions to many problems will be worked out in class. I will post scanned copies of any notes I make in class but you should consider getting a copy from a classmate if you miss class.

Required Materials: All students will be required to purchase and use a scientific non-programmable calculator or use R Studio for calculations. A scientific non-programmable calculator will also be required for all the midterms, and the final exam.

Using Copyrighted Material

Please be mindful and respect copyright throughout this course. All course notes, assignments, tests, exams, practice exams, and solutions are either my own intellectual property or that of the Department of Statistics. If I use any copyrighted material in my lectures I will properly source and follow copyright guidelines and I expect you to do the same. The copyrighted works are made available for your personal use and study and must not be distributed in any format without express permission.

You do not have permission to upload any course notes, tests, assignments, or handouts to any note sharing websites. Please see the following site for more information: https://umanitoba.ca/student/resource/student_advocacy/media/Message_note_sharing_December_2013.pdf

No video or audio recording of lectures or presentations is allowed in any format, openly or surreptitiously, in whole or in part without my permission.

Course Technology

Respectful Behaviour in an Online Classroom: Please ensure that any technology used in the class is used in a responsible manner that is mindful of the students around you. You may have cell phones on your person as long as they are kept on silent and are not brought above table height. You may use laptops or tablets in class to help with note taking or follow along with any computer demonstrations but please keep only academic matters up on your screen and refrain from distracting the students around you.

R Studio: In this class we will be making use of the statistical software R. You may download R from <http://cran.utstat.utoronto.ca/> and the R Studio program from <https://www.rstudio.com/products/rstudio/download/>. R Studio will also be available from the statistics computer lab. If you require assistance installing R Studio, you may come and see me in my office hours. We will go over the basic installation and use in the first lab of the semester.

Throughout the course I will demonstrate how to carry out the majority of the calculations using R. All assignments will have both a hand calculation component and a component that you are expected to complete using R.

UMLearn: All course material as well as class reflections for marks will be posted on UMLearn. All important dates can be found on the calendar and I will make class announcements through the news feed on the course website. All grades will be posted in the UMLearn Gradebook

In addition, there will also be discussion forums available. For each class I will open up a discussion forum where I will post the material covered that class, any announcements, and suggestions for preparation for the next class. Please be in the habit of checking it after every class. If you have questions about anything during the lecture or any announcements, you can ask directly on the forum for the relevant class. There will also be a discussion forums opened up for general class/technology questions, for questions on assignments/projects, and a student forum.

All discussion will be monitored closely by me. Please be courteous in posing questions and replying to questions on the board. Your best effort should be made to make clear questions in complete English sentences.

Crowdmark: Some assessments will be marked using the Crowdmark software, an online grading tool. These will be written by you on paper or produced as PDFs on a computer/tablet and then scanned and uploaded through a link you will be provided over email. While you may take a photo of your paper, due to the high quality of most camera phones, it is recommended that you use the app Cam Scanner to take the photos of your work. There will be a trial run of the software prior to the first assessment that uses it. Upon completion of the marking, an electronically marked copy of your assessment will be emailed to your UManitoba e-mail address. I will send out an email when the marked copies have been sent. Please check your spam folders if you do not see it in your inbox.

Notice Regarding Collection, Use, and Disclosure of Personal Information by the University: Your personal information is being collected under the authority of the *University of Manitoba Act*. It will be used for the purposes of grading papers and providing feedback to students. Personal information will not be used or disclosed for other purposes, unless permitted by *The Freedom of Information and Protection of Privacy Act* (FIPPA). The University of Manitoba has taken steps to ensure that its agreement with Crowdmark, Inc. for services provided by the Crowdmark application in compliance with FIPPA. Please be aware that information held by Crowdmark Inc. may be transmitted to and stored on servers outside of the University of Manitoba, or Canada. The University of Manitoba cannot and does not guarantee protection against the possible disclosure of your data including, without limitation, against possible secret disclosures of data to a foreign authority in accordance with the laws of another jurisdiction. If you have any questions about the collection of personal information, contact the Access and Privacy Office (tel. 204-474-9462), The University of Manitoba, 233 Elizabeth Dafoe Library, Winnipeg, Manitoba, Canada, R3T 2N2.

Expectations: I Expect You To

In my class I expect you to:

- Attend lectures and listen attentively.
- Participate in small group activities when asked.
- Use technology respectfully as outlined in the syllabus.
- Come prepared the class with paper, writing utensils, a scientific calculator, and any needed statistical tables.
- Arrive to your exams with writing utensils, a scientific calculator, and a ruler if appropriate.
- Do your utmost to arrive on time and be as quiet as possible should you unavoidably need to arrive late or leave early.
- Not talk to your neighbours while I am lecturing.

- Ask questions during my lecture as needed and interrupt me if I write something incorrect on the overhead.
- Be mindful of my time outside of class and allow me sufficient time to answer emails or look in to your concerns.
- Follow all policies in the syllabus and consult it as needed.
- Come to me with any constructive feedback that would improve the running of the course.
- Not come to class when you are feeling ill.
- Look to the class folder on UMLearn and review all material if you miss class, as well as connect with a fellow classmate to get any missed notes.

Academic Dishonesty: It is important that you understand what constitutes academic dishonesty and that you are familiar with the very serious consequences. Links to resources that describe academic dishonesty (including plagiarism, cheating, inappropriate collaboration and examination impersonation, as well as typical penalties) can be found at:

http://www.umanitoba.ca/student/resource/student_advocacy/academicintegrity/students/a-to-i-what-is-academic-integrity.html#cheating-on-exams

http://www.umanitoba.ca/student/resource/student_advocacy/academicintegrity/students/student-academic-misconduct-faq.html

<https://www.sci.umanitoba.ca/students/undergraduate-students/academic-resources/academic-integrity-2/>

I expect students to hold themselves to the highest standards of academic integrity. Impersonation, cheating for hire websites, and using unauthorized materials are very serious offences. I expect you to be honest, conduct yourself with integrity, actively encourage your peers to conduct themselves with integrity, and uphold the value of what a degree from the University of Manitoba means. When you are in doubt, always consult with your instructor. My door is always open for discussions on the boundaries of what is and what is not allowed. I will also clearly state what the ground rules are for collaboration on any assignment. Asking is a sign of integrity, not a signal that you might think of cheating. Always bear in mind that what is considered a violation of academic integrity can vary from course to course (even with the same instructor) so it is always important to ask and clarify. Ignorance is not an acceptable excuse for academic misconduct.

Recording of Class Lectures

Your instructor and the University of Manitoba hold 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, openly or surreptitiously, in whole or in part without permission from your instructor. If you require an audio recording to help you play back and study, I require you to first ask my permission and it must only be used for your personal use. You should take care to pause and not record your classmates when we go into group discussions.

Class Communication: The University requires all students to activate an official University email account. Please note that all communication between your instructor and you as a student 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

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

E-mail: To schedule an appointment outside of office hours or to ask a question that would not be suitable for the discussion forums (it involves personal matters or your private information) you may email me at my university email address. Please note that if your question is answered on the course outline (which will be posted on UMLearn) I will simply direct you to find the answer yourself as I cannot handle the large volume of emails and still productively manage my courses when answering those kinds of emails. The subject line of your emails should contain "STAT 3000". All emails should start with an opening salutation, be written in complete English sentences and be signed with your name and student number. Please note that I will not divulge grades over email. All emails received during the work week will be replied to within 24 hours. While I will generally check my work emails over the weekend in case there is an emergency, you can expect a reply to non-urgent matters received over the weekend by Monday at noon.

Office Hours: My office hours are listed at the top of the course outline. You do not need to make an appointment and may just show up to ask any questions that you may have. This is the perfect time to ask questions about course material, your assignment, review your coursework, or receive help with R. If you can not make my scheduled office hours, please email me to make an appointment. I am also available for meetings over Zoom by prior arrangement.

Student Accessibility Services: If you are a student with a disability, please contact SAS for academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability (e.g. mental illness, learning, medical, hearing, injury-related, visual) are invited to contact SAS to arrange a confidential consultation.

<http://umanitoba.ca/student/saa/accessibility/>

Expectations: You Can Expect Me To

As your instructor you can expect me to:

- Treat you with respect inside and outside of the classroom.
- Arrive 5-10 minutes prior to the start of class and remain for a few minutes afterwards to answer questions after the lecture.
- Come prepared to my lectures.
- Be available during my office hours and make my best attempt to provide sufficient notice if an office hour needs to be moved or canceled.
- Answer your questions thoughtfully and follow up if needed.
- Listen to your feedback/concerns and do my best to take reasonable requests in to account.
- Monitor my markers and ensure assessments are retuned in a reasonable time period.
- Set assessments that are reasonable and contain questions that match the learning objectives for the course.
- Be passionate about my subject and what I teach.
- Be helpful in getting you through any coding issues.

Should I be ill, I will work with my Department to find a substitute to continue teaching the class in-person. In the event a suitable instructor cannot be found, I may give the lecture synchronously or provide asynchronous content through Zoom or UMLearn for up to 5 days. An email will be sent to students? UM email and a posting will be made on UM Learn the night before class, or as soon as possible, if this is the case.

Course Schedule and Evaluation

Please see the course schedule handout for the complete class schedule, including due dates. Please note that all dates for content coverage in these schedules are approximate and subject to minor changes.

Grading:

Assignments (best 3 of 4)	20%
Project	10%
Midterm Exams (2)	30%
Reflections/Participation	5%
Final Exam	35%

Grade Assignment: The following are **guaranteed** minimum requirements to receive a letter grade.

A+	90-100%
A	80-89%
B+	75-79%
B	70-74%
C+	65-69%
C	60-64%
D	50-59%
F	0-49%

Gradebook: All marks will be available through the gradebook on UMLearn. Please check that all of your grades have been entered correctly before the final exam.

Assignments: There will be four assignments to be handed in for marks throughout the term. While you are allowed to work in groups to solve the problems and work on the coding, all assignments must be written up individually. There will be zero tolerance for students found to be copying assignments verbatim. All long answers must be written in your own words; it is academic dishonesty to copy from lecture notes, the internet, or the textbook as well as your fellow classmates. Assignments must conform to the following standards:

- Typeset in R Markdown.
- All code and output must be shown and not suppressed.
- While exact answers may be contained in your code output, you will need to summarize all answers in text below the output. (It is not the responsibility of the marker to interpret your code.)
- Contain the title information that is included in my template file with your own information substituted in.

Marks will be subtracted if it does not meet the above standards. Assignments will be comprised of questions that require hand calculations and that require the use of computer software. Note that I provide the markdown files for all unit notes which contain questions that are similar to your assignment questions if you would like a hint at the coding. For questions with hand calculations, you may type your answers in the space provided by me or take a photo of your work written by hand and insert it in to your document at the appropriate place. I will be very helpful for anyone that comes to see me for help with coding as long as you have demonstrated some effort to try. If there are interesting formatting things you would like to try to improve appearance, I am more than happy to help you with those as well. Assignments are to be submitted as a single pdf file to the Crowdmark link provided in your email. In addition to the regular assignments, there will be one quick test "assignment" where you will have to edit a few lines of a Markdown document I provide, compile it, and submit the PDF to the UMLearn dropbox. This will count towards your one-minute paper mark. The lowest assignment mark will be dropped so there is no need to submit a self declaration form if you miss an assignment, it will automatically be the dropped assessment.

Project: Part of your term mark will be made up of an individual research project that requires identifying a statistical question, collecting data, analyzing, and summarizing the data. Further details on the project will be available in October with clear instructions and a rubric for how they will be graded. You will receive a minimum of one month to complete the project with two small submissions to be made along the way to make sure you are on track. All projects are to be completed independently.

Midterm: There will be two long/short answer midterm tests that will take place during class time on **Wednesday, October 26** and **Monday, November 28** in class. To complete them you will need access to a scientific non-graphing calculator, a writing utensil, possibly a ruler and a booklet of tables. I will provide the booklet of tables. At the test, you may bring with you one single-sided 8.5x11 sheet of paper with anything you would like written on it. If you submit it with your test and I deem that it has a mostly complete formula sheet, you will receive a 5% bonus on your midterm. You may work with a friend on the formula sheet but you will need to

declare the names of anyone you worked with on the study sheet itself.

Should you miss a midterm for an excused reason, 5% will be added to the other midterm and 10% to the final exam. If you miss the midterm due illness, you must complete the self declaration form and hand it in to your professor within 48 hours.

Final Exam: There will be a 3-hour cumulative long answer final exam that will be completed in-person at a time scheduled by the registrar's office. You will also be able to bring with you one double-sided 8.5x11 sheet of paper containing any information you would like.

Participation/Reflection: At the end of most classes you will be expected to complete a "one minute paper" worth 2 participation marks. There will be a prompt question given related to either class material, assigned reading, or feedback on the course in general. You will always have some short activities such as the getting to know you survey and practice R assignment that will count towards your participation grade. If you receive 70% of the available marks, you will receive 5/5. If you receive between 50-69% of the available marks, you will receive 3/5. If you receive less than 50% of the marks, you will receive 0/5. While I will not be "grading" the quality of the papers, you must make an honest effort at answering the question to receive the marks. Answers will generally be 2-3 sentences long.

Practice Questions: Through out the course I will provide extra practice problems in pdf form and suggest questions from the textbook. These are not for marks but you should complete them for the extra practice. The pdf questions in particular will be helpful as they were written by me and will reflect the way I ask questions on the assignments and tests.

Assessment Tokens: For each student in the class, I will maintain a spreadsheet for two assessment tokens. These are used for 48 hour no questions asked extensions on one-minute papers, assignments, or parts of the project. To use a token on an assignment or project part, you must email me **prior** to the due date stating that you are using a token, what you are using it on, your name, and your student ID. To use a token on a one-minute paper, you should email me your response along with the statement that you are using your token within the 48 window (i.e. you do not need to give advance warning). You do not need to justify why you are using the token. You do not need to use your tokens and there is no reward for not using them. **Note: tokens may not be used on assignment 2 so that I can post solutions prior to the midterm.**

Voluntary Withdrawal

The voluntary withdrawal date is **November 22** (by which time you will have received your marks for the first two assignments and the midterm.)

ROASS Schedule A

Schedule A of the Responsibilities of Academic Staff with regards to Students (ROASS) policies of the University of Manitoba lists resources and policies for students. It is important that you familiarize yourself with these resources and policies. Schedule A will be posted on your instructor's UMLearn page in a file labeled as the syllabus appendix

Course Topics

1. Linear Regression

- Review of the Simple Linear Regression
- Assessing Conditions
- Transformations
- Outliers and Influential Points

2. Inference for Simple Linear Regression

- Inference for regression slope
- Partitioning Variability – ANOVA
- Regression and correlation
- Intervals for prediction

3. Multiple Regression

- Multiple linear regression model
- Assessing the a multiple linear regression model
- New predictors from old
- Correlated Predictors
- Testing Subsets of Predictors

4. One-way ANOVA and Randomized Experiments

- Overview of ANOVA
- The One-way Randomized Experiment and Its Observational Sibling
- Fitting the Model
- Formal Inference: Assessing and Using the Model
- Using Plots to Help Choose a Scale for the Response
- Multiple Comparisons and Fisher's Least Significant Difference

5. Blocking and Two-way ANOVA

- Choose: RCB and Its Observational Relatives
- Exploring Data from Block Designs
- Fitting the Model for a Block Design
- Assessing the Model for a Block Design
- Using the Model for a Block Design

6. ANOVA with Interactions and Factorial Designs

- Interaction
- Design: The Two-way Factorial Experiment
- Exploring Two-way Data
- Fitting a Two-way Balanced ANOVA Model
- Assessing Fit: Do We Need a Transformation?
- Using a Two-way ANOVA Model

7. Additional Topics in Analysis of Variance (Time Permitting)

- Randomization F-Test
- Repeated Measures Designs and Datasets
- Designed Experiments
- ANOVA and Regression with Indicators