

# STAT 3000 F20 Section A01

## Applied Linear Statistical Models

**Time** M/W 2:30 - 3:45 p.m.  
**Location** Cisco Web Ex

**Instructor** Jenna G. Tichon  
Email: [jenna.tichon@umanitoba.ca](mailto:jenna.tichon@umanitoba.ca)

**Web Pages**            Statistics: <https://www.sci.umanitoba.ca/statistics/>  
Course Website: <http://umanitoba.ca/umlearn>  
R Studio Cloud: <http://rstudio.cloud>

**Office Hours** Monday 10:00 a.m. – 11:00 a.m.  
Thursday 10:30 a.m. – 11:30 a.m.  
(Or by appointment.)

If the above times are not convenient for you, please email me to arrange an alternate time to meet. I will do my best to return all emails within 24 hours.

## 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 and not available online. You must attend class or watch the recorded video lectures to receive the numerical solutions.

**Required Materials:** All students will be required to purchase and use a scientific non-programmable calculator or use R Studio for calculations. It 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/admin/vp\\_admin/ofp/copyright/media/Note\\_sharing\\_Web\\_sites.pdf](https://umanitoba.ca/admin/vp_admin/ofp/copyright/media/Note_sharing_Web_sites.pdf)

Recordings of the lectures are available for your own personal use only. You may not upload or edit any of the videos or materials I produce.

## Course Technology

**Respectful Behaviour in an Online Classroom:** All live components of this course will be conducted over Cisco WebEx. It is expected that you conduct yourself professionally and do not distract your fellow students with unnecessary or inappropriate chat messages, sounds, or images if you are ever on web camera. If you appear on web camera it is expected that you will be dressed appropriately for a classroom environment and that your background does not contain distracting or offensive materials.

**R Studio:** In this class we will be making some use of the statistical software R. While you may download R from <http://cran.utstat.utoronto.ca/> and the R Studio program from <https://www.rstudio.com/products/rstudio/download/>, in this class we will be making use of R Studio Cloud through a web browser. It is required that you can access the course and files through R Studio Cloud to work on course work and to follow along with live simulation demonstrations that I conduct. I will demonstrate how to register for R Studio Cloud for those that need instruction beyond the syllabus the first time that we use the software in class.

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.

Access to the class recordings and the live lectures will be available through UMLearn under Communications > Cisco WebEx.

**Crowdmark:** Some of the assessments will be marked using the Crowdmark software, an on-line grading tool. These assessments will be written by you on paper 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 as much as you are able and watch the recordings within 24 hours when you are not.
- Make use of the chat function over Cisco WebEx to ask questions of myself and provide answers to class discussions.
- Behave professionally in our online learning environment.
- Have paper, a writing utensil, a computer/tablet and access to a scanner or cell phone capable of taking photos during the allotted midterm and final exam period.
- Ask questions during my lecture as needed and answer questions asked of you.
- Be mindful of my time outside of class and allow me sufficient time to answer emails or look in to your concerns.
- Make use of the discussion forums as much as you are able for your course questions.
- 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.

- Begin your assignments early so that I can provide help and guidance as necessary with the R programming.

**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/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](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/>

While this is a remote learning course, 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 and are no less serious in an online environment. 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. 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.

**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](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. There are hours of dedicated STAT 3000 office hours that will be scheduled over Cisco WebEx as a drop-in session. You do not need to make an appointment and may just show up to ask any questions that you may have. If you can not make my scheduled office hours, please email me to make an appointment. For private appointments I am open to alternative communication methods such as Skype, FaceTime, or Zoom in lieu of WebEx.

**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.
- Begin the class video stream 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 flexible in the face of any technological issues that may arise as we navigate remote learning together.
- Be helpful in getting you through any coding issues.

### **Course Delivery**

The class will be live streamed over Cisco Web Ex which is available through UMLearn under Communication>Cisco Web Ex. While live attendance is not mandatory, it is highly encouraged so that you have the ability to ask questions and participate in discussions. If you are unable to make it to the live lecture, you are expected to watch the video within 24 hours. Everyone will be required to answer a short reflective question for 24 hours on UMLearn following the live lectures. In the latter half of the course, there may be one or two pre-recorded lectures announced in advance for the computationally heavy portion of the ANOVA unit.

## Course Schedule and Evaluation

Week	Content	Notes	Evaluation
Week 1 Sept 7 -11	Mon: No class Wed: First class (CLASS 1)		· Getting to Know You Survey - Due *
Week 2 Sept 14 - 18	Mon: R Intro (CLASS 2) Wed: Unit 1 (CLASS 3)		· Reflection 2 - Due * · Reflection 3 - Due *
Week 3 Sept 21 - 25	Mon: Unit 1 (CLASS 4) Wed: Unit 1 (CLASS 5)	Drop Date Sept 22	· Reflection 4 - Due * · Reflection 5 - Due* · Markdown Test - Due Sun Sept 27 11:59 p.m.
Week 4 Sept 28 - Oct 2	Mon: Unit 1 (CLASS 6) Wed: Unit 2 (CLASS 7)		· Reflection 6 - Due Tues Sept 29 3:45 p.m. · Reflection 7 - Due Thurs Oct 1 3:45 p.m.
Week 5 Oct 5 - 9	Mon: Unit 2 (CLASS 8) Wed: Unit 2 (CLASS 9)		· Reflection 8 - Due Tues Oct 6 3:45 p.m. · Reflection 9 - Due Thurs Oct 8 3:45 p.m. · Assignment 1 - Due Sun Oct 11 11:59 p.m.
Week 6 Oct 12 - 16	Mon: NO CLASS Wed: Unit 2/3 (CLASS 10)	Oct 12 Holiday	· Reflection 10 - Due Thurs Oct 15 3:45 p.m.
Week 7 Oct 19 - 23	Mon: Unit 3 (CLASS 11) Wed: Unit 3 (CLASS 12)		· Reflection 11 - Due Tues Oct 20 3:45 p.m. · Reflection 12 - Due Thurs Oct 22 3:45 p.m. · Assignment 2 - Due Sun Oct 25 11:59 p.m.
Week 8 Oct 26 - 30	Mon: Unit 3 (CLASS 12) Wed: Midterm 1 (CLASS 13)		· Reflection 12 - Due Tues Oct 27 3:45 p.m. · Midterm 1 - Due Wed Oct 28 **
Week 9 Nov 2 - 6	Mon: Unit 4 (CLASS 13) Wed: Unit 4 (CLASS 14)		· Reflection 13 - Due Tues Nov 3 3:45 p.m. · Reflection 14 - Due Thurs Nov 5 3:45 p.m. · Project Approval - Due Mon Nov 2 11:59 p.m.



## Course Schedule and Evaluation

Week	Content	Notes	Evaluation
Week 10 Nov 9 - 13	NO CLASSES	Reading Week	· Project Intro Draft - Due Thurs Nov 12 11:59 p.m.
Week 11 Nov 16 - 20	Mon: Unit 4 (CLASS 15) Wed: Unit 5 (CLASS 16)		· Reflection 15 - Due Tues Nov 17 12:30 p.m. · Reflection 16 - Due Thurs Nov 19 12:30 p.m. · Assignment 3 - Due Mon Nov 16 11:59 p.m.
Week 12 Nov 23 - 27	Mon: Unit 5 (CLASS 17) Wed: Unit 5 (CLASS 18)	Nov 23 VW Deadline	· Reflection 17- Due Tues Nov 24 3:45 p.m. · Reflection 18 - Due Thurs Nov 26 12:30 p.m. · Project - Due Wed Nov 25 11:59 p.m.
Week 13 Nov 30 - Dec 4	Mon: Midterm 2 (CLASS 19) Wed: Unit 6 (CLASS 20)		· Midterm 2 - Due Mon Nov 30 ** · Reflection 20 - Due Thurs Dec 3 3:45 p.m.
Week 14 Dec 7 -11	Mon: Unit 6 (CLASS 21) Wed: Unit 6 (CLASS 22)		· Reflection 21 - Due Tues Dec 8 3:45 p.m. · Reflection 22 - Due Thurs Dec 10 3:45 p.m. · Assignment 4 - Due Fri Dec 11 11:59 p.m.

Please note that all dates for content coverage in these schedules are approximate and subject to minor changes.

\* All assessments due prior to the Add/Drop date are due Friday, September 25 at 11:59 p.m. However, for all of these assessments, the intention is that you would complete them within 24 hours of the corresponding class.

\*\* Midterms will be administered through UMLearn. You will login between 2:25 and 3:15 and have 80 minutes from the time you begin the exam.

**Grading:**

Assignments (4)	25%
Project	10%
Midterm Exams (2)	30%
One Minute Papers/Participation	5%
Final Exam	30%

**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 28** and **Monday, November 30** on UMLearn. At 2:25 pm an assessment will appear on UMLearn under Assessments > Quizzes. You can begin the midterm at any point between 2:25 pm - 2:45 pm and will have 80 minutes to complete the assessment. To complete them you will need access to a scientific non-graphing calculator and a booklet of tables provided on UMLearn. Up until the start of the assessment, you can submit a formula/study guide to a dropbox on UMLearn to receive a bonus 2 marks on your midterm. You may work with a friend on the study guide but you will need to declare the names of anyone you worked with in the comment box when submitting your study guide. Note that the midterms themselves are individual assessments and you are not allowed to consult other people. The only acceptable resource is materials on MyStatLab, your submitted formula sheet/study guide, and materials that I make available through UMLearn. Inappropriate collaboration, plagiarism, or contract cheating of any kind will be dealt with severely and forwarded to the appropriate disciplinary committee.

Should you miss a midterm for an excused reason, 5% will be added to the other midterm and 10% to the final exam. Should you miss both midterms, a cumulative deferred midterm will be scheduled at a time negotiated by the professor and any affected students during the last week of class. If you miss your midterm due to illness, you must complete the university's self declaration form prior to the start of the assessment and email it to the professor within 24 hours of the assessment.

**Final Exam:** There will be a 3-hour cumulative long answer final exam that will be completed over Crowdmark. Five minutes prior to the start of the exam time, as scheduled by the registrar's office, you will receive a link to your UMLearn email from Crowdmark. This will take you a page with the exam questions listed and a place to drag and drop files with your answers for each separate question. Thirty minutes of additional time will be given at the end of the exam for additional time to upload the pictures. Up until the start time of the exam, you will also be able to submit a formula sheet/study to a dropbox on UMLearn for 2 additional marks on your exam.

**One Minute Papers:** After each live lecture, there will be a short reflective question available on UMLearn under Assessments>Quizzes. It will be available from the end of the class period for 24 hours\*. These are meant to be thinking questions about how concepts we talk about in class work or applications of the concepts to real life. These are meant to take approximately 2-5 minutes to complete and should be answered thoughtfully in one or two fully reasoned sentences. For the first class this will be a Getting to Know You Survey but following that it will be a prompt for a short 1-2 sentence written response. Each question will be marked out of 2. A score of 0 is for an entirely irrelevant answer. A score of 1 is for an answer that is relevant but incomplete (e.g. it asks for 2 examples and you give 1 or it asks you to explain why and you give a one word answer.) A score of 2 is for any answer that makes a genuine attempt at giving a complete answer to the question (regardless of whether it is correct or not). You may work with up to one other person and submit the same answer but you both must identify in your answer the full name and student ID number of the person you worked with. The answers must be in your own words (the exception being two people working together and identifying that they are submitting the same answer) and direct copying from the notes, text, or the internet is considered plagiarism and will be submitted for academic dishonesty. (\*For all assessments due before the add/drop deadline, the deadline will be set as 11:59 p.m. on Friday, September 25th. It is, however, the expectation that students registered in the course will still complete the responses for each class within 24 hours.) Your three lowest grades will be dropped so there is no need to submit a declaration form unless you have an extended illness.

**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.

## Voluntary Withdrawal

The voluntary withdrawal date is **November 19** (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.

## 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