

# STAT 3000 Section A01

## Applied Linear Statistical Models

**Time** M/W/F, 12:30 p.m. – 1:20 p.m.  
**Location** 207 Buller

**Instructor** Jenna G. Tichon  
321 Machray Hall  
Telephone: 474-8417  
Email: [jenna.tichon@umanitoba.ca](mailto:jenna.tichon@umanitoba.ca)

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

**Office Hours** Tuesday 10:00 a.m. – 11:00 a.m.  
Wednesday 1:30 p.m. – 2:30 p.m.  
Friday 10:00 a.m. – 11:00 a.m.  
(Or by appointment.)

## 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

**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 to receive the numerical solutions.

**Required Materials:** All students will be required to purchase and bring with them to class a scientific non-programmable calculator. It will also be required for all quizzes, the midterm, 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](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

**Use of Technology in the 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. 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 submit assignments. The second week of term we will have a class in the statistics computer lab and get everyone set up with R Studio Cloud. It is very important that you attend this lab.

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. If you do not have access to a computer at home, the statistics computing lab has copies of R Studio installed on all of the computers that you can use during the open lab hours. Occasionally class will be held in the computer lab for more intensive R demonstrations.

**UMLearn:** All course material will be posted on UMLearn in the Contents section. All important dates can be found on the calendar and I will make class announcements through the news feed on the course website.

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 or about the R programming, you can ask directly on the forum for the relevant class.

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.

**Echo360:** This class is using the Echo360 software and all lectures will be video captured and available for viewing online. The video will capture from about the first row of seats forward. Should you have privacy concerns, please contact the Privacy Office as given in the section on Crowdmark. The videos will be available via a link to the Echo360 portal in Crowdmark. If you are using a smart device to follow the slides, you can view the slides via the portal to mark questions for further study as you go along. When you review the videos and slides after class, you will have the ability to ask questions that are marked to specific times in the video or slides. We will discuss further functionality in class. The videos will not be used for any other purposes than your studying.

**Crowdmark:** The midterm, and the final exam will be marked using the Crowdmark software, an online grading tool. All exams will be written on provided paper and then scanned for grading. Additional instructions will be given prior to the first assessment to ensure the examinations can be scanned correctly. Upon completion of the midterm, an electronically marked copy of your exam 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.

**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/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)

**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 your personal information or the answer would not be of interest to other students) 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. 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.

**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 early to class and remain for a few minutes afterwards to answer questions.
- Come prepared to my lectures.
- Be available during my office 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.
- Return assignments and the midterm within a week.
- 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.

## Course Schedule and Evaluation

Week	Content	Special Notes	Evaluation		
			Type of Assessment	Date	Value of Final Grade
Week 1 Sept. 2-6	Welcome & Intro to R	First day, Sept. 4			
Week 2 Sept. 9-13	Unit 1				
Week 3 Sept. 16-20	Unit 1	Sept. 18, end of revision period			
Week 4 Sept. 23-27	Unit 2				
Week 5 Sept 30 - Oct 4	Unit 2 & 3				
Week 6 Oct. 7 - 11	Unit 3		Assignment 1	Oct 11 In Class	5%
Week 7 Oct. 14 - 18	Unit 3 No Class Oct 14	Thanksgiving			
Week 8 Oct. 21- 25	Unit 4		Midterm In Class	Oct. 23 12:30-1:20	20%
Week 9 Oct. 28- Nov. 1	Unit 4 & 5		Project Approval	Oct 25	5%* *(of project)
Week 10 Nov. 4-8	Unit 5		Assignment 2	Nov. 8 In Class	5%
Week 11 Nov. 11-15	-	Reading Week NO CLASSES			
Week 12 Nov. 18-22	Unit 5 & 6 Nov. 18	VW Date	Project Due	Nov. 20 In Class	10%
Week 13 Nov. 25-29	Unit 6				
Week 14 Dec. 3-7	Unit 7	Last Class, Dec 6	Assignment 3	Dec 2 In Class	5%*

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

### Grading:

Assignments (3)	15%
Project	10%
Midterm Exam	20%
One Minute Papers	5%
Final Exam	50%

**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 three 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 or hand written in blue or black ink.
- Done on one side only of  $8.5 \times 11$  paper.
- Stapled in the top left corner.
- Not contain highlighter.
- All relevant computer output must be attached at the appropriate location in the assignment and not at the end.
- To receive marks on a computing questions you must provide me with all the code used, all the output received, and any hand work or interpretation you did yourself.
- Be accompanied by a title page that includes: assignment number, course number, student name, student ID number, instructor's name.

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. An example of how I expect assignments to be formatted with computer output and code can be found by looking at the solutions for my practice questions at the end of each unit's notes.

**Late Assignments:** Assignments are due at the start of class on their due date. If you are aware that you will not be in class on the due date, please arrange to have it submitted early. Should extenuating circumstances prevent you from making it to class, late assignments will **only** be accepted if you email the instructor pictures or a scanned copy of your completed assignment by class time and promptly hand in an identical hard copy the next working day.

**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 within the first month of class with clear instructions and a rubric for how they will be graded. You will receive a minimum of one month to complete the project. All projects are to be completed independently.

**Midterm:** There will be one long answer midterm exam that will take place during class time on **Wednesday, October 23** in a location that is TBA. Non-graphical calculators are both permitted and necessary to complete the midterm. There will be no makeup midterm. Should you miss for a valid and documented reason, the weight will be transferred to the final exam.

**Final Exam:** There will be a 3-hour cumulative long answer final exam. A practice final will be provided to see the expected length and format. Please check Aurora for the date and time of the exam.

**One Minute Papers:** At the end of most classes you will be expected to complete a “one minute paper”. There will be a prompt question given related to either class material, assigned reading, or feedback on the course in general. Your mark for this portion will be counted as  $(\text{Total Submitted})/(\text{Total Papers} - 3)$ . 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 quizzes and tests.

## Statistics Help Centre

In room 311 Machray Hall there is an open statistical computing lab which you can use for completing assignments, your project, or working through class examples in R. While there are T.A.'s available to help, they are there mainly for the lower level courses. Priority will be given to those students with questions and the T.A.s may not be familiar with your course material. The hours for September 9 to December 6 are:

Monday	9:30 a.m. – 3:30 p.m.
Tuesday	9:30 a.m. – 7:00 p.m.
Wednesday	9:30 a.m. – 2:30 p.m.
Thursday	9:30 a.m. – 4:30 p.m.
Friday	9:30 a.m. – 12:00 p.m.

**Note:** The help centre will be closed on holidays and during the Fall term break (November 11 – 15).

## 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