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Spring 2-1-2019

# STAT 452.01: Statistical Methods II

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**Syllabus**  
**STAT 452, Statistical Methods II**  
**Spring 2019, MWF 10:00-10:50am in Math 103**

**Course Information:**

- **Instructor:** Jon Graham, Math 204, 243-2561, jgraham@mso.umt.edu.
- **Textbook:** *Statistical Methods & Data Analysis, 7<sup>th</sup> ed.*, by Ott & Longnecker
- **Office Hours:** To be announced, By appointment
- **Course Webpage:** Accessed through Moodle
- **Grading:** Homework: 30% Exams 1,2: 40% Final: 30%
- **Prerequisites:** STAT 451 or consent of instructor based on a previous statistics course.

**Homework**

Homework will typically be assigned every Friday, to be handed in at the beginning of class the following Friday. **NO LATE HOMEWORK WILL BE ACCEPTED FOR ANY REASON**, and the lowest homework grade will be dropped. Homework is not only a fairly substantial portion of your grade, but is vital to your success in this class. Working with other students on homework is encouraged, as long as you hand in your own work, and do not simply copy someone else's work. Solutions to all problems will be provided.

**Exams**

Exams 1 & 2 will be cumulative and closed book. More about the exams, including the exact dates of the exams will be given later. If you cannot make it to an exam, you must let me know **BEFORE** the exam is given. No make-up exams will be given without a documentable reason for missing the exam.

**Final Exam**

The **Final exam** is scheduled for 10:10am-12:10pm on Wednesday, May 1. More will be said about the final at a later date.

**Course Material and Objectives**

This course is a continuation of an introduction to statistical methods for analyzing data. The course is intended primarily for students in disciplines outside of mathematics who are seeking statistical tools for data analysis. After discussing chi-square methods and simple linear regression, the course will concentrate on many areas of regression such as inference, multiple regression, logistic regression, etc., and on areas of analysis of variance (ANOVA) such as interpretation of ANOVA tables, experimental designs, and analysis of covariance among others. This course is taught in conjunction with STAT 458 which will use the software package **R** to illustrate statistical techniques and elucidate statistical concepts.

Questions are strongly encouraged, both during class and at office hours. If you are lost and confused, please let me know.

### **Important Dates**

**Friday, January 18:** Last day to add courses by CyberBear.

**Monday, January 21: Martin Luther King Jr. Day holiday**

**Thursday, January 31:** Last day to drop courses/change grading option in Cyberbear.

**Monday, February 18: President's Day holiday**

**Friday, March 15:** Last day to drop courses. Paper form must be signed by advisor and instructor. A W will appear on your transcript. After this date, drops can only be done by with the Dean's signature.

**Monday, March 25 – Friday, March 29: Spring Break**

**Friday, April 26:** Last day to change grading option (letter grade to CR/NCR or vice-versa). Requires paper form signed by advisor and instructor.

**Learning Outcomes:** Upon successful completion of STAT 341, a student will:

1. Understand multiple linear regression, model building, and associated normal-based inference procedures.
2. Understand analysis of variance and to carry out analyses of variance for a variety of experimental designs, including completely randomized and randomized block designs.
3. Understand the assumptions behind standard statistical inference procedures for linear regression and analysis of variance.
4. Understand how statistical methods were used to answer specific scientific questions in a wide variety of applied problems.
5. Carry out analyses of real data sets and communicate the results in written form.

### **Disability Services**

*The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students (DSS). If you think you may have a disability adversely affecting your academic performance, and you have not already registered with DSS, please contact DSS in Lommasson 154. I will work with you and DSS to provide an appropriate accommodation.*

### **Academic Honesty**

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary action by the University. All students need to be familiar with the Student Conduct Code. You can find it in the A-Z index on the UM home page.

## Other Important Course Information

1. **Video Recordings:** Because this class is primarily populated by students in the natural sciences who often have field work/conferences, all lectures will be video-recorded and posted on a YouTube link off of the main Moodle page.
2. **R Software:** As most of you know, the software package used in this course, **R**, is free for download at [www.r-project.org/](http://www.r-project.org/). Instructions for downloading and installing **R** and **R-Studio** can be found at the bottom of the course webpage. I have also included a brief **R** manual as a reference guide. My goal is not to teach you **R** in this course, but to simply use it as a tool for conducting the statistical analyses required. As a result, please feel free to ask me any and all **R** questions you have and when you have specific **R** coding questions, be sure to Email me the **ENTIRE** block of code you are using in “text” form so I can diagnose and help you solve any coding issues.
3. **Communication:** Whenever I forget to post something on the webpage, have information to pass along such as homework hints or corrections, or want to share another student’s question and my response, I will send an Email to the entire class to let them know. As a result, please be sure to regularly check your university Email account for updates. Also, per university policy, I cannot communicate with you at your personal Email address, so please only send me Emails from your university address.
4. **My Role:** While I am the instructor for this course, it is not my intent to make your life miserable. I am here to help you. I try to be accessible and will do my best to help you when you have questions. It is NOT my role to do your homework for you, but I will try to walk you through the course content in an effort to answer whatever questions you have. Mostly, I want you to feel free to ask me anything.

## Tentative Topic Outline

1. Categorical Data (Ch. 10)
  - a. Review of inference for one or two proportions (10.1-10.3)
  - b. Chi-square inferences for multiple proportions, goodness of fit (10.4)
  - c. Chi-square tests for independence and homogeneity (10.5)
2. Linear Regression and Correlation (Ch. 11)
  - a. Least Squares Concepts (11.1-11.2)
  - b. Transformations to Linearize Relationships (11.1)
  - c. Correlation Coefficients (11.6)
  - d. Residual Analysis (11.2)
  - e. Inference in Simple Linear Regression: CIs and tests for  $\beta_0$  and  $\beta_1$  (11.3)
  - f. Inference on  $E(y)$ , predictions of  $y$  (11.4)
  - g. Examining Regression Lack of Fit (F tests) (11.5)
  - h. Bootstrapping in Regression (not in book)

3. Multiple Linear Regression (Ch. 12)
  - a. General Linear Models, Estimation, and Examples (12.1-12.3)
  - b. Inference for Parameter Estimates,  $E(y)$ , and predictions of  $y$  (12.4,12.6)
  - c. Inference for Multiple Parameters Simultaneously (12.5)
  - d. Comparing Slopes of Several Regression Lines (12.7)
  - e. Nonlinear Regression (13.3)
  - f. Logistic Regression (12.8)
4. More on Multiple Regression (Ch. 13)
  - a. Model Formation and Variable Selection Techniques (13.1-13.3)
  - b. Model Diagnostics: Residual Analysis (13.4), Influence Statistics (not in book)
5. Analysis of Variance (ANOVA) (Ch.8-9)
  - a. Assumptions: Normality, Independence, Variance Homogeneity (8.3)
  - b. Testing Equality of Two Population Means (8.1-8.2)
  - c. 1-way ANOVA, 2-way ANOVA (8.2)
  - d. Testing Homogeneity of Variance (Hartley's, Levene's Test) (7.4, 8.4)
  - e. Variance Stabilizing Transformations (8.5)
  - f. Kruskal-Wallis Test (nonparametric alternative) (8.6)
6. Multiple Comparisons of Means (Ch. 9)
  - a. Linear and Orthogonal Contrasts (9.2)
  - b. Procedures (Fisher's LSD, Tukey's W, SNK, Bonferoni, Scheffe's) (9.3-9.7)
  - c. Controlling Type I error rates for Multiple Comparisons (9.3)
7. Experimental Design: The Completely Randomized Design (Ch. 14)
8. ANOVA for Experimental Designs (Ch. 15-19)
  - a. Randomized Complete Block Design and Blocking Issues (15.2)
  - b. Latin Square Design (15.3)
  - c. Factorial Designs and Testing for Interactions (15.4-15.6)
  - d. Analysis of Covariance (16)
  - e. Fixed, Random, Mixed-effects Models (17)
  - f. Other Designs (Split Plot, Nested, Repeated Measures, etc.) (18.2, 17.6, 18.3-18.5)