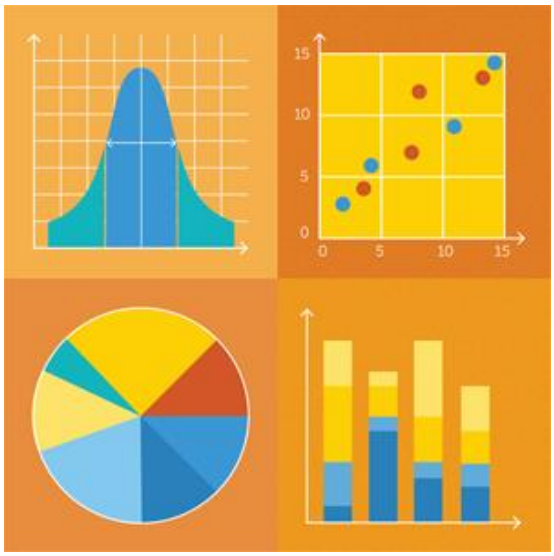
Applied Statistics

MATH 220-02

Spring 2019

M-Tu-W-F 11:30am – 12:20pm Knapp Hall 106



Course Description

Statistics is the science of reasoning from data. This course will introduce the fundamental concepts and methods of statistics, including calculus-based probability. Topics include experimental design, data collection, and the scopes of conclusion, a robust study of probability models and their application to statistical inference, hypothesis testing, and regression analysis.

Instructor

Anthony Bonifonte
Office: Burton Morgan 410
Office Hours: Mon, Tu 1:30-4:00, Wed 1:30 – 3:00
If you are unable to attend these hours, you are encouraged to email questions or schedule an appointment.
Email: bonifontea@denison.edu

Course Goals

At the end of the course, students should be able to:

- Create data visualizations and compute fundamental statistical quantities
- Describe randomness with random variables and different discrete and continuous distributions
- Apply randomization and parametric statistical tests to examine the significance of observed phenomena
- Predict future trends from historical data
- Communicate findings to a diverse, non-technical audience
- Interpret statistics with a critical eye to how they can be manipulated

"It is the mark of a truly intelligent person to be moved by statistics."

-George Bernard Shaw

Course Logistics

Prerequisites: MATH 123 and DA 101
or MATH 124

Textbook: Practicing Statistics, by Kuiper and Sklar

http://www.mypearsonstore.com/bookstore/practicing-statistics-guided-investigations-for-the-9780321586018?xid=PSED

"Processed data is information. Processed information is knowledge. Processed knowledge is wisdom."

- Ankala V. Subbarao

Expectations

Academic Honesty: Academic honesty, the cornerstone of teaching and learning, lays the foundation for lifelong integrity. Academic dishonesty is intellectual theft. It includes, but is not limited to, providing or receiving assistance in a manner not authorized by the instructor in the creation of work to be submitted for evaluation. This standard applies to all work ranging from homework assignments to major exams. I will assume that you are familiar with the Code of Academic Integrity. To learn more about it, please go to http://www.denison.edu/about/integrity.html.

Class communication: All electronic communication will be through announcements using NoteBowl and delivered to your Denison email. You are responsible for checking these messages periodically to stay informed of important dates and potential changes to the syllabus.

I am pleased to reply to questions via email at bonifontea@denison.edu. Please include 'MATH - 220' in the subject line. I check my email frequently, but I reserve the right to a 48-hour response period. This means questions immediately before an assignment due date may not receive a timely response. Please send all emails through your Denison account so it does not get blocked by spam filters.

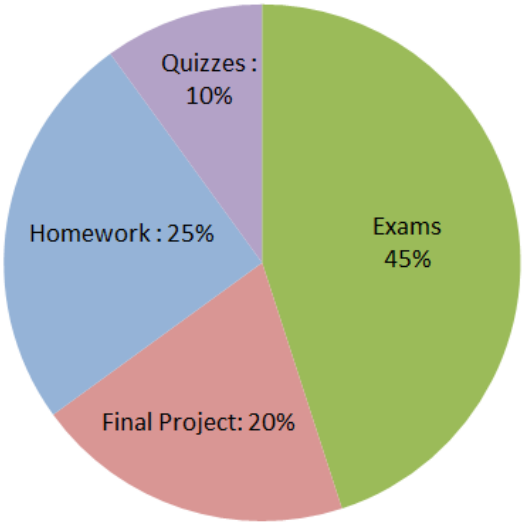
Disability Accomodations: Any student who feels he or she may need an accommodation based on the impact of a disability should contact me privately as soon as possible to discuss his or her specific needs. I rely on the Academic Resource Center (ARC) in 020 Higley to verify the need for reasonable accommodations based on the documentation on file in that office.

Technology Policy: Please be respectful with your use of laptops and technology in class. I request you only use them for class related purposes, as I and others may find them distracting. Cell phones should be kept silent and away, and you can expect the same from me.

Software: All projects in this course will be analyzed using R, an open source data analysis language and environment. R is a powerful free statistics program that you will use throughout the major and your career. A small time investment to learn R will greatly benefit you in the future. No previous experience with R, statistical software packages, or computer programming is assumed.

Class forums: If you have conceptual questions that may benefit others, please post them to Notebowl so peers or myself can respond.

Assignments and Grading



Final Course Grade:

A+:	98%	A:	92%	A-:	90%
B+:	88%	B:	82%	B-:	80%
C+:	78%	C:	72%	C-:	70%
D+:	68%	D:	62%	D-:	60%

Homework 25%

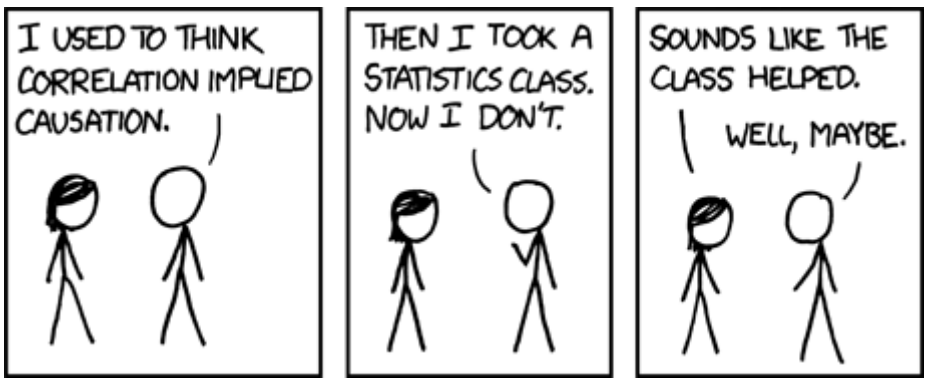
Homework problem sets will be assigned on a weekly basis. You are allowed to work in groups, however, every student needs to submit individually and write up the solution in their own words. Problem sets will test theory and small computational issues. Solutions will be posted online in a timely manner.

Homework will be due at the start of class on the posted date. Please submit a legible hard copy. No late homework will be accepted without an institute approved absence.

Re-grades: In the interest of fairness, re-grades for partial credit on homework will not be accepted. If you believe a mistake on the grading was made, you have one week to submit a written explanation stapled to the original assignment.

Quizzes 10%

Short quizzes will take place during the first 5 minutes of class on various class days. They will contain open response questions that ensure you are keeping up with the readings and class content. Each quiz will be announced at least one class period ahead of time.



Exams (3, 15% each)

Exams: Three exams will take place during the semester**.** The first exam will take place in class on 2/13. Exams two (3/13) and three (4/17) will contain both a sit-down, closed notes portion and a take-home, open-notes computer –use section. The sit-down portion will contain open response questions and pencil-and-paper calculations, and the take-home computer-use section will involve computation and the use of software.

- No resources of any sort may be shared during exams.
- On the take-home portions of the exam, you may use resources such as the textbook, class notes, R scripts you have prepared ahead of time, Google searches, and any websites you find. You may **not** collaborate with others, have others complete the exam on your behalf, or ask exam related questions on peer websites such as stack overflow. Any uncertainties on this policy should be directed to the instructor.

Partial credit opportunities: To offer you an opportunity to learn from your mistakes and demonstrate your mastery of course content, you will have an opportunity to make corrections on sit-down exams. After exams are returned, you can earn back up to 1/3 of missing points by writing a response that for each problem addresses what you did wrong, why you did it wrong, and working out the correct answer. (Example: you had a late night and earned a 70 on the exam. By correcting your work and addressing these 3 criteria, you can earn up to 10 points back, improving your exam score to an 80.) Working out the correct answer may be done with classmates, but addressing what was wrong and why you attempted the problem that way must be completed individually. These corrections will be due no later than 7 days after graded exams are returned. No further re-grades will be considered after this partial credit.

Individual make up exams: Individual make-up exams will only be offered if a student has valid reasons, such as documented illness, severe illness or death in the family, accidents, or court appearances. "I didn't feel well" is insufficient. You must provide documentation prior to the make up.

Final Project 20%

Students will work in groups of 2-3 on a final project that utilizes concepts and methods from the class. Topics are of student choosing and must be approved by the instructor.

Of the project grade, 40% will derive from the written report, 40% from the presentation during last week of class, and 20% from feedback given to fellow student's presentations on standard feedback forms.

"The greatest moments are those when you see the result pop up in a graph or in your statistics analysis – that moment you realise you know something no one else does and you get the pleasure of thinking about how to tell them."

-Emily Oster

Course Schedule

Each course topic will prepare you to answer the quoted question.

Dates	Topics	Textbook Sections	Exam	Assignment Due
1/21 – 1/25	Introduction to Probability – State Spaces and Counting "How do we quantify and measure randomness?"	Supplemental		
1/29 – 2/01	Randomization tests – Hypothesis Testing and Confidence Intervals – Nonparametric "How do we test the difference between populations with few assumptions but abundant computational power?"	1.2 – 1.6		1/30
2/04 – 2/08	Discrete Distributions "How do we model randomness of discrete quantities?"	Supplemental		2/06
2/11 – 2/15	Normal Distributions "Can we describe the distribution of the sample mean from a large sample, regardless of the underlying distribution?"	Supplemental	2/13	2/11
2/18 – 2/22	Hypothesis Testing and Confidence Intervals – Parametric "How do we test the difference between populations with limited computational power but strong assumptions?"	2.2, 2.10, 2.11		2/20
2/25 – 3/01	Categorical data: Chi-square test and Fisher's Test "How do we test for significant differences in categorical data?"	6.1 – 6.6		2/27
3/04 – 3/08	Experimental design: ANOVA "How should we design and analyze an experiment?"	2.4, 4.1 – 4.5		3/06
3/11 – 3/15	Simple Linear Regression "How do we explain the relationship between one predictor and one continuous response variable?"	2.3, 2.10, 2.11	3/13	3/11
3/18 – 3/22	Spring Break			
3/25 – 3/29	Multiple Linear Regression "How do we explain the relationship between multiple predictors and one continuous response variable?"	3.1, 3.2, 3.4, 3.5		3/29
4/01 – 4/05	Multiple Regression : Model Selection "How do we decide which subset of variables gives the best predictions?"	3.3		4/05
4/08 – 4/12	Logistic Regression "How do we explain the relationship between one or more predictors and one binary response variable?"	7.1, 7.3, 7.5		4/12
4/15 – 4/19	Other topics of interest	11.1-11.5	4/17	
4/29 – 5/03	Student Project Presentations			4/29
5/06	Review & Wrap-Up			

"A certain elementary training in statistical method is becoming as necessary for everyone living in this world of today as reading and writing."

-H.G. Wells