Syllabus for Elementary Statistics: MATH 080 Summer 2020

Dr. Jordan Hanson - Whittier College Dept. of Physics and Astronomy

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Abstract

This course will follow the standard methodology of elementary statistics taught regularly during Fall and Spring semesters. Concepts of descriptive statistics will be presented, including descriptive measures, probability concepts, discrete random variables, and the normal distribution. Concepts of inferential statistics will also be presented, including sampling distributions, confidence intervals, hypothesis testing, chi-squared procedures, and linear regression. This version of the course will provide interactive learning techniques designed to augment the online learning experience, and the course textbook will be free. Time-permitting, the use of computer programming tools to help visualize examples will be covered.

***Pre-requisites**: C- or higher in MATH 076 or MATH 079 or 2 or better on the Math Placement Exam*
***Course credits, Liberal Arts Categorization**: 3 Credits, None*
***Regular course hours**: Monday through Friday, 9:00-12:00. Synchronous time: 1.0-1.5 hours, asynchronous time: 1.0-1.5 hours. Synchronous time corresponds to meeting together via Zoom, asynchronous time corresponds to engaging with pre-recorded content and thinking through content that prepares you for the homework.*
***Instructor contact information**: jhanson2@whittier.edu, Zoom ID: 796 092 0745, 667725*
Office hours**: Fridays from 8:00-12:00, online via Zoom ID. Professor on Google Hangouts: **918particle
***Attendance/Absence**: Students are required to log in for the morning Zoom sessions, however the asynchronous content may be digested on the students' individual schedules.*
***Late work policy**: Late work is generally not accepted, but is left to the discretion of the instructor.*
***Text**: Introductory Statistics - `https://openstax.org/details/books/introductory-statistics` The text is open-access, and therefore free online, and via the OpenStax app on iOS and Android. High-quality PDF is available online.*
***Grading**: There will be one midterm, one final exam, and daily warm-up quizzes. There will also be homework from the textbook, submitted via Moodle. Finally, there will be a self-designed project and presentation given at the end of the term. Daily warm-up quizzes are graded for completion, like taking attendance, and are worth 15% of the grade. Homework is worth 25% of the grade, and it is due weekly. The midterm is worth 20% of the grade, and the final is worth 20% of the grade. The final project and presentation are worth 20% of the grade.*

Item	Percentage
Warm ups	15 %
Homework	25 %
Midterm	20 %
Final	20 %
Final Project + Presentation	20%

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Warm ups	20 %
Homework	30 %
Midterm	25 %
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Table 1: (Left) These are the grade settings with the final exam included. (Right) These are the grade settings without the final exam. The final exam is optional.

***Grade Settings**: $\geq 60\%, < 70\% = D$, $\geq 70\%, < 80\% = C$, $\geq 80\%, < 90\% = B$, $\geq 90\%, < 100\% = A$.*
Pluses and minuses: 0-3% minus, 3%-6% straight, 6%-10% plus (e.g. 79% = C+, 91% = A-)

***ADA Statement on Disability Services**: The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services: disabilityservices@whittier.edu, tel. 562.907.4825.*
***Academic Honesty Policy**: `http://www.whittier.edu/academics/academichonesty`*

***Policy due to COVID-19**: Our course is an online summer course, so there is no additional risk of transmission from person-to-person contact. However, we do note some policies that should be helpful:*

1. *Class will meet synchronously for **up to 90 minutes** using the Zoom web-conferencing application, at the normal class time. Class time will be used to work through a daily warm-up quiz together, along with whiteboard solution via Zoom. The warm up will be followed by traditional lecture content and interactive examples and activities. **We will reach consensus in the first days of class as to the exact start time of the daily synchronous portion of the course.** This is to accommodate those who have class conflicts, work, or family obligations at home.*
2. *Group project results will be **presented via Zoom** during the last week of class.*
3. ***Students may opt-out of taking the final exam.** In order to accommodate students' preparation for the Fall semester, the final exam is optional. If one does not take it, the assignment weights for the final grade will be those given in Tab. 1 (right).*

***Course Objectives**:*

- To practice written and oral expression of technical ideas.
- To solve word problems pertaining to statistics.
- To learn to describe data sets and populations with statistical parameters.
- To learn to predict the behavior of data sets and populations with statistical tools.
- To perform experiments and data analysis, and the communication of results.

***Course Outline**:*

1. **Unit 0**: Introductory concepts
   (a) Topics from Chapter 1: 1.1, 1.2, 1.3
      - What is a statistic?
      - Probability examples
      - Data and sampling

   (b) Topics from Chapter 2: 2.1 - 2.4, 2.5 - 2.8
      - Data visualization
      - Location of the data in numerical space

   (c) Topics from Chapter 3: 3.1, 3.2, 3.3
      - Two rules of probability

2. **Unit 1**: Discrete Random Variables and the Normal Distribution
   (a) Topics from Chapter 4: 4.1 - 4.4
      - Discrete random variables, averages and standard deviation
      - Distributions of discrete random variables: binomial and geometric

   (b) Topics from Chapter 6: 6.1 - 6.4
      - The normal and standard normal distributions
      - Using normal distributions

3. **Unit 2:** Applications of descriptive statistics
   (a) Applications to baseball (Moneyball)
   (b) Applications to stock exchanges (Wall Street)
   (c) Applications to COVID-19 (Normal distributions and standard deviations)
   (d) Central limit theorem: Chapters 7.1 and 7.2, with examples

4. **First midterm, July 24th, 2020.** The first midterm will cover units 0, 1, and 2. Emphasis on 0 and 1.

5. **Unit 3:** Confidence intervals and hypothesis testing
   (a) Topics from Chapter 8: 8.1 - 8.4
      - Confidence intervals
      - Data interpretation

   (b) Topics from Chapter 9: 9.1 - 9.3, 9.6

- Rejection of the Null hypothesis
- Types of error
- Underlying distributions

6. **Unit 4:** The Chi-squared test and linear regression
   (a) Topics from Chapter 11: 11.1 - 11.4
   - How to perform Chi-squared tests
   - Testing variables' independence
   - Significance
   - Special topic: a function's fit to time-dependent data

   (b) Topics from Chapter 12: 12.1 - 12.6
   - Linear regression
   - Data linearization and visualization
   - Correlation and the correlation coefficient
   - **Final project:** (1) Location and measurement of data sample (2) Data cleaning and linearization (3) Regression analysis (4) Extrapolation

   (c) **Final project presentations** (last week of class: August 10th through August 14th)

7. **Final exam, August 14th, 2020.** The final exam is optional. If a student feels he or she needs to take it to shore up a grade, then it is recommended.

8. *Final Project and Presentation details:* Students will perform data collection and analysis on a topic of their choice, with the goal of establishing a linear correlation. Often times this portion of the project is more art than science, since many experiments do not turn out a linear dependence. Students must submit a *project summary* by July 31st, 2020 so that the instructor may modify it or make suggestions. The data should be collected, along with statistical errors on the measurements. Students will then perform a linear regression on the data, and attempt to make a sound statistical prediction using the regression. The final presentation should be 7-12 slides in PDF or PowerPoint format, which will be presented remotely to the class via Zoom in the final week of class. In addition to the technical correctness of the conclusions, students will be assessed on the clarity of the presentation. **As such, the instructor will provide practice sessions, training, and advice on presentation of the topic by appointment with the students.**