**Statistics**

**Syllabus**

**Overview**

The purpose of the AP course in statistics is to introduce students to the major concepts and tools for collecting, analyzing, and drawing conclusions from data. Students are exposed to four broad conceptual themes:

1. Exploring Data: Describing patterns and departures from patterns

2. Sampling and Experimentation: Planning and conducting a study

3. Anticipating Patterns: Exploring random phenomena using probability and simulation

4. Statistical Inference: Estimating population parameters and testing hypotheses

Statistics is uniquely different from all other math courses in the area of reading and writing. Students are not just focused on obtaining an answer, but are also focused on how they obtained the answer, why the answer may be correct, the probability that the answer is correct, and must clearly communicate all of these. Justifying one’s position on an answer is more important than the correctness of their answer. The ability to justify a position can make incorrect or simple math errors seemingly disappear and make a wrong answer right. Knowing this fact can at times be frustrating to the students and yet makes the class of statistics exciting and fascinating.

**Class Outline** – Organized by units in primary text

**Unit 1 – Exploring and Understanding Data (6 weeks)**

Construct and interpret graphical displays of distributions of univariate data (dotplots, stemplots, histograms, cumulative frequency plots)

* Describe center and spread
* Describe clusters and gaps
* Note outliers and other unusual features
* Describe the shape of a distribution

Summarize distributions of univariate data

* Measure center and spread using the mean and median
* Measure the spread using the range, interquartile range, and standard deviation
* Measure position using quartiles, percentiles, and z-scores
* Use boxplots to describe a distribution
* Note the effect of changing units of measure

Compare distributions of univariate data

* dotplots
* back to back stemplots
* parallel boxplots
* Compare center and spread
* Compare clusters and gaps
* Compare outliers and other unusual features
* Compare shapes

Explore categorical data

* Create frequency tables and bar charts
* Calculate marginal and joint frequencies for two-way tables
* Calculate relative frequencies
* Compare distributions using bar charts

Investigate the normal distribution

* Understand the properties of the normal distribution
* Use tables of the normal distribution
* Use the normal distribution as a model for measurements

Chapter 1 - Introduction

Chapter 2 - Data

Chapter 3 - Display and Describe Categorical Data

Chapter 4 - Display and Describe Quantitative Data

Chapter 5 - Describe Distributions Numerically

Chapter 6 - The Normal Model and the Standard Deviation

**Unit 2 – Exploring Relationships Between Variables (4 weeks)**

Explore bivariate data

* Analyze patterns in scatterplots
* Calculate correlation and explain its relationship to linearity
* Find the least squares regression line
* Sketch residual plots; identify outliers and influencial points
* Use transformations to achieve linearity
* Find logarithmic and power transformations

Chapter - 7 Scatterplots, Association, and Correlation

Chapter - 8 Linear Regression

Chapter - 9 Regression Wisdom

Chapter - 10 Re-expressing Data: Get it Straight

**Unit 3 – Gathering Data (4 weeks)**

Understand the methods of data collectio

* Recognize the difference between a:
  + Census
  + sample survey
  + experiment
  + observational study

Plan and conduct a survey.

* Understand the characteristics of a well designed survey
* Understand the difference between populations, samples, and random selection
* Identify sources of bias
* Understand how to conduct a simple random sample and a stratified random sample
* Understand cluster sampling

Plan and conduct an experiment.

* Understand the characteristics of a well designed experiment
* Identify
  + Treatments
  + control groups
  + experimental units
  + random assignment
  + replication
* Identify sources of bias and confounding
* Understand the placebo effect and blinding
* Implement completely randomized design
* Understand how to use block design, including matched pairs design

Generalize results and draw conclusions.

Chapter 11 - Understanding Randomness.

Chapter 12 - Sample Surveys

Chapter 13 - Experiments and Observational Studies

**Unit 4 – Randomness and Probability (4 weeks)**

Explore random phenomena using probability and simulation.

* Interpret probability, including long-run relative frequency interpretation
* Understand the law of large numbers
* Apply the addition rule and the multiplication rule
* Understand conditional probability and independence
* Investigate discrete random variables and their probability distributions including binomial and geometric distributions
* Conduct simulations of random behavior
* Find the mean and standard deviation of a random variable

Combine independent random variables.

* Understand the difference between independence and dependence
* Find the means and standard deviations for sums and differences of independent random variables

Chapter 14 - From Randomness to Probability

Chapter 15 - Probability Rules

Chapter 16 - Random Variables

Chapter 17 - Probability Rules

**Unit 5 – Data at Hand to the World at Large (5 weeks)**

Investigate sampling distributions.

* Examine the sampling distribution of a sample proportion
* Understand the central limit theorem
* Examine the sampling distributions of a difference between two independent sample proportions

Estimate population parameters and apply statistical inference

* Estimate margins of error
* Calculate large sample confidence interval for a proportion
* Calculate a large sample confidence interval for a difference between two proportions
* Understand confidence intervals and draw conclusions

Apply tests of significance.

* Understand the logic of significance testing
* Understand the null and alternative hypothesis
* Understand p-values
* Distinguish between one and two sided tests
* Distinguish between Type I and Type II errors
* Understand power
* Apply a large sample test for a proportion
* Apply a large sample test for a difference in proportions

Chapter 18 - Sampling Distribution Models

Chapter 19 - Confidence Intervals for Proportions

Chapter 20 - Testing Hypotheses About Proportions

Chapter 21 - More About Tests

Chapter 22 - Comparing Two Proportions

**Unit 6 – Learning about the world (4 weeks)**

Estimate population parameters and apply statistical inference.

* Estimate margins of error
* Calculate a confidence interval for a mean
* Calculate a confidence interval for a difference between two means

Apply tests of significance.

* Understand the logic of significance testing
* Understand the null and alternative hypothesis
* Understand p-values
* Distinguish between one and two sided tests
* Distinguish between Type I and Type II errors
* Understand power
* Investigate the t-distribution
* Apply a test for a mean
* Apply a test for a difference between two means

Plan and conduct an experiment.

* Plant and analyze the results of an experiment that uses block design, including matched pairs design

Chapter 23 - Inferences About Means

Chapter 24 - Comparing Means

Chapter 25 - Paired Samples and Blocks

**Unit 7 – Inference when Variables are Related (3 weeks)**

Estimate population parameters and apply statistical inference.

* Estimate margins of error and calculate confidence intervals.

Estimate population parameters.

* Calculate a confidence interval for the slope of a least squares regression line.

Apply tests of logic.

* Understand the logic of significance testing
* Understand the null and alternative hypothesis
* Understand p-values
* Distinguish between one and two sided tests
* Distinguish between Type I and Type II errors
* Understand power
* Investigate the chi-square distribution.
* Apply a chi square test for
  + Goodness of fit
  + Homogeneity of proportions
  + Independence (one and two way tables).
* Apply a test for the slope of a least squares regression line.

Chapter 26 Comparing Counts

Chapter 27 Inference for Regression

**AP Review (1 week)**

* Previously release exams

Post AP Test (2 weeks)

* Project

**Assessment**

There will be a unit test after each of the above listed sections. The unit tests focus on exam type questions and complete written responses. Within each unit there will be quizzes, approximately every one and a half weeks. The quizzes are focused on making sure the student has stayed current with the reading recalls the vocabulary and can complete simple problems. There will be a Final Exam for each semester. The fall semester final exam will occur after the Gathering Data topic. The spring semester final exam will occur during the review for the AP exam. Both semester exams will utilize parts of past AP test questions. The unit tests will be comprised of free response type questions, and as the year progresses more AP test questions will be used in these unit tests.

There will be a project each quarter, the last one falling after the AP test. These projects will incorporate data analysis, model assessment, computer use, calculator use and/or simulations to help increase their understanding and ability to communicate statistically. The course is activity based to help students actively increase their understanding of the techniques and concepts in statistics.

**Technology**

This class requires a graphing calculator. A TI 84 Plus or TI N-Spire are recommended.

Computer software (Fathom) will be demonstrated in class, and students will become adept at interpreting the computer output. For projects, students will have access to this software.

A variety of computer applets will be utilized.

Microsoft Excel.

**Course Textbook:**

Brock, D. E., Velleman, P. F., & De Veaux R. D. (2007). Stats: Modeling the World 2rd Edition. Boston, MA: Pearson Addison Wesley.

**Additional Resources:**

Larose, Daniel T. (2013) Discovering Statistics 2nd Edition. New York, NY: W. H. Freeman and Company

Peck, Roxy, & Olsen, Chris (2014) Statistics: Learning from Data, AP\* Edition. Boston, MA: Brooks/Cole Cengage Learning

Starnes D. S., Yates D. S., & Moore D. S. (2012) The Practice of Statistics 4th Edition. New York, NY: W. H. Freeman and Company

AP Statistics Workshop Handbook 2012 – 2013. College Board