AP Statistics Syllabus

Course Design/Pedagogy

AP Statistics is taught as an activity based course (similar to all of our mathematics courses), in which students actively construct their own understanding of the statistical concepts and techniques. This allows the classroom to be a statistics laboratory where students "learn by doing." The two primary objectives of the course are: to learn the fundamental logic and tools of statistics and to learn about the actual practice of statistics in real-world situations. The primary text provides the foundation/general layout for the course. Students are expected to read the appropriate sections of the textbook before class so that class time can be used for discussion and activities, with less time spent on lecturing**. The course emphasizes developing students into competent interpreters and investigators of statistical data and information. The classroom activities of decision-making and validating/justifying statistical hypotheses requires students to demonstrate the critical connections between the design/analysis and conclusions of a statistical experiment.** Class discussion is an integral component and is encouraged by students working in small groups and the discussion questions foster further debate over important issues among the whole class.

The ability to justify and communicate one's results is a critical component to one's understanding of statistics. Students are required to write complete responses on all homework assignments, tests, and write-ups from activities, investigations and experiments. Throughout the course students will learn to effectively communicate how methods, results and interpretations of data for any given experiment are valid. Weekly AP Questions (based on released AP free response questions) are given on Friday, due on Monday and then are graded/discussed in class using the AP grading rubric. These questions require students to write complete responses and to justify all conclusions, emphasizing communication.

At the beginning of the school year, all students receive a copy of the AP Formulas/Tables from the course description book. These handouts are used throughout the school year for homework and all quizzes/tests. Quizzes are usually given on a weekly basis and cover basic statistical skills and techniques. Major exams are given approximately every 3 to 4 weeks covering the major

topics/units in the AP Course Outline (One Variable Data, Two Variable Data, Producing Data, Sampling/Probability Distributions, Inference). These exams consist of two parts, Part I - Multiple Choice and Part II - Free Response (similar to the AP Exam format) and are given over two days.

In keeping with College Board's principle that all students deserve an opportunity to participate in rigorous and academically challenging courses and programs, AP Statistics is open to all students who have successfully completed Algebra 2. AP Statistics offers an interesting and alternative way to keep students involved in mathematics their senior year, who otherwise would not be taking a mathematics class. Students planning on taking an AP science course in their senior year are strongly encouraged to take AP Statistics concurrently with precalculus or AP Calculus.

Technology

Modern technology, in the form of graphing calculators and computers, has redefined how and what we teach in mathematics today compared to 20 years ago. Technology, with a particular emphasis on the TI -83/84 is incorporated on a regular basis into daily class activities. All students are required to have a graphing calculator (we recommend a TI-83/TI-84), and they are expected to have it with them at all times. If they are unable to purchase one, calculators are available for rental for the school. An overhead graphing calculator display, as well as a computer projection unit are used on a daily basis for class demonstrations. The graphing calculator is allowed on all tests, although students must show all their work and statistical formulas to support all calculator answers as well as calculator notation.

Projects

In preparation for the free-response questions/investigative tasks on the AP Exam, students are assigned several projects each semester to strengthen their analytical and organizational skills, as well as their writing and communication skills. **The main purpose of these projects is to provide students with experiences in developing statistical studies and making sound connections and judgments between the design and the results of an experiment. Projects vary in length from a paper analyzing a research article, to designing and conducting a survey or experiment to answer a specific question complete with statistical**

analysis. Possible projects are listed with each topic in the course outline. Two examples are given below:

<u>Example 1</u> (Unit 1/2 – Case Study/ Simulation)

Develop /design a question that can be answered by modeling the problem using a simulation. Collect and interpret the results of the simulation and make a decision/conclusion based on the likeliness of the results of your simulation.

<u>Example 2</u> (Unit 4 – Sampling/Experimentation)

In small groups write up the results of the "Bears in Space/Block Those Bears" experiment. The point of the experiment is for students to clearly be able to describe the experimental design process from design to collection of data to the descriptive report of their results. In the write up students will compare/contrast the differences between the two different experimental designs and the types of variability that arise and how to reduce the variation by choosing the design that is best for the problem at hand.

Course Materials

Primary Text

PoS Starnes, Daren S., Josh Tabor, Daniel S. Yates, and David S. Moore. *The Practice of Statistics*. New York, NY: W. H. Freeman and Company, 2015.

Supplementary Texts

Tabor, Josh, Christine Franklin. *Statistical Reasoning in Sports*. New York, NY: W. H. Freeman and Company, 2013.

Watkins, Ann, Richard Scheaffer, and George W. Cobb. *Statistics in Action: Understanding a World of Data*. Emeryville, CA: Key Curriculum Press, 2008.

Course Outline

Content/Skills *A major assessment will follow each major topic*	**Approx. Time Frame** (50 minutes per block) **Chapter, pages**
Exploration of Data *Graphing and Numerical Distributions* [SC1] The student will: ● Identify the individuals and variables in a set of data ● Identify each variable as categorical or quantitative ● Make and interpret bar graphs, pie charts, dot plots, stem plots, and histograms of distributions of a categorical variable ● Look for overall patterns and skewness in a distribution given in any of the above forms ● Give appropriate numerical measures of central tendency and dispersion ● Recognize outliers ● Compare distributions using graphical methods ● Graphing calculator is used to obtain statistics and to include the 5-number summary [SC8] ● Spreadsheet software is used to create pie charts and histograms [SC10]	PoS: Ch. 1, p. 2 - 81 Time frame: 9 blocks
The Normal Distribution *Density Curves and the Normal Distribution; Standard Normal Calculations* The student will: ● Know that areas under a density curve represent proportions. ● Approximate median and mean on a density curve. ● Recognize the shape and significant characteristics of a normal distribution, including the 68-95-99.7 rule. ● Find and interpret the standardized value (z-score) of an observation. ● Find proportions above or below a stated measurement given relevant measures of central tendency and dispersion or between two measures. ● Determine whether a distribution approaches normality	PoS: Ch. 2, p. 82 - 139 Time frame: 7 blocks

Examining Relationships *Scatter Plots, Correlation; Least-Squares Regression* The student will: ● Identify variables as quantitative or categorical. ● Identify explanatory and response variables. ● Make and analyze scatter plots to assess a relationship between two variables. ● Find and interpret the correlation r between two quantitative variables. ● Find and analyze regression lines. ● Use regression lines to predict values and assess the validity of these predictions. ● Calculate residuals and use their plots to recognize unusual patterns. **Two-Variable Data** *Transformation of Relationships; Cautions About Correlation and Regression; Relations in Categorical Data* The student will: ● Recognize exponential growth and decay. ● Use logarithmic transformations to model a linear pattern, use linear regression to find a prediction equation for the linear data, and transform back to a nonlinear model of the original data. ● Recognize limitations in both r and least-squares regression lines due to extreme values. ● Recognize lurking variables. ● Explain the difference between correlation and causality. ● Find marginal distributions from a two-way table. ● Describe the relationship between two categorical variables using percents. ● Recognize and explain Simpson's paradox.	PoS: Ch. 3, p. 140 - 203 Time frame: 8 blocks
Production of Data *Designing Samples; Designing Experiments; Simulating Experiments* [SC2 & SC3] The student will: ● Identify populations in sampling situations. ● Identify different methods of sampling, strengths and weaknesses of each, and possible bias that might result from sampling issues. ● Recognize the difference between an observational study and an experiment. ● Design randomized experiments.	PoS: Ch. 4, p. 204 - 279 Time frame: 11 blocks

● Recognize confounding of variables and the placebo effect, explaining when double-blind and block design would be appropriate. ● Explain how to design an experiment to support cause-and-effect relationships.	
Probability *Idea of Probability; Probability Models; General Probability Rules* [SC4] The student will: ● Describe and generate sample spaces for random events. ● Apply the basic rules of probability. ● Use multiplication and addition rules of probability appropriately. ● Identify disjointed, complementary, and independent events. ● Use tree diagrams, Venn diagrams, and counting techniques in solving probability problems.	PoS: Ch. 5, p, 280 - 337 Time frame: 8 blocks
Random Variables *Discrete and Continuous Random Variables, Means, and Variances of Random Variables* [SC4] The student will: ● Recognize and define discrete and continuous variables. ● Find probabilities related to normal random variables. ● Calculate mean and variance of discrete random variable. ● Use simulation methods using the graphing calculator and the law of large numbers to approximate the mean of a distribution. [SC9] ● Use rules for means and rules for variances to solve problems involving sums, differences, and linear combinations of random variables. **Binomial and Geometric Distributions** *Binomial Distributions; Geometric Distributions* The student will: ● Verify four conditions of a binomial distribution: two outcomes, fixed number of trials, independent trials, and the same probability of success for each trial. ● Calculate cumulative distribution functions, cumulative distribution tables and histograms, and	PoS: Ch. 6, p. 337 - 411 Time frame: 9 blocks

means and standard deviations of binomial random variables. ● Use a normal approximation to the binomial distribution to compute probabilities. ● Verify four conditions of a geometric distribution: two outcomes, the same probability of success for each trial, independent trials, and the count of interest must be the number of trials required to get the first success. ● Calculate cumulative distribution functions, cumulative distribution tables and histograms, and means and standard deviations of geometric random variables.	
Sampling Distributions *Sampling Distributions; Sample Proportions; Sample Means* [SC4] The student will: ● Identify parameters and statistics in a sample. ● Interpret a sampling distribution, including bias and variability and how to influence each. ● Recognize when a problem involves a sample proportion. ● Analyze problems involving sample proportions, including using the normal approximation to calculate probabilities. ● Recognize when a problem involves sample means. ● Analyze problems involving sample means and understand how to use the central limit theorem to approximate a normal distribution.	PoS: Ch. 7, p. 412 - 464 Time frame: 7 blocks
Introduction to Inference *Estimating with Confidence, Tests of Significance, Interpreting Statistical Significance; Inference as Decision* [SC5] The student will: ● Describe confidence intervals and use them to determine sample size. ● State null and alternative hypotheses in a testing situation involving a population mean. ● Calculate the one-sample z statistics and p-value for both one-sided and two-sided tests about the mean μ using the graphing calculator. [SC8] ● Assess statistical significance by comparing values. ● Analyze the results of significance tests.	PoS: Ch. 8, p. 465 - 525 Time frame: 7 blocks

● Explain Type I error, Type II error, and power in significance testing.	
Testing a Claim *Significance Tests; Tests about a Population Proportion; Tests about a Population Mean* The student will: ● Perform and analyze a one-sample t test to hypothesize a population mean and discuss the possible problems inherent in the test. ● Use the z procedure to test significance of a hypothesis about a population proportion. ● Use the graphing calculator to obtain confidence intervals and test hypotheses. [SC8]	PoS: Ch. 9, p. 526 - 599 Time frame: 8 blocks
Comparing Two Populations or Groups *Comparing Two Proportions; Comparing Two Means* The student will: ● Recognize when inference about a mean or comparison of two means is necessary. ● Perform and analyze a two-sample t test to compare the difference between two means and discuss the possible problems inherent in the test. ● Use the graphing calculator to obtain confidence intervals and test hypotheses. [SC8] ● Recognize whether one-sample, matched pairs, or two-sample procedures are needed. ● Use the two-sample z procedure to test the hypothesis regarding equality of proportions in two distinct populations.	PoS: Ch. 10, p. 600 - 673 Time frame: 8 blocks
Inference for Tables *Test for Goodness of Fit; Inference for Two-Way Tables* [SC5] The student will: ● Choose the appropriate chi-square procedure for a given situation. ● Perform chi-square tests and calculate the various relevant components. ● Interpret chi-square test results obtained from computer output. [SC10]	PoS; Ch. 11, p. 674 - 735 Time frame: 6 blocks
Inference for Regression *Inference About the Model, Predictions, and Conditions* [SC5]	PoS: Ch. 12, p. 736 - 809 Time frame: 7 blocks

The student will: ● Recognize when linear regression inference is appropriate for a set of data. ● Interpret the meaning of a regression for a given set of data. ● Interpret the results of computer output for regression. [SC10]	
AP Exam Review	Time frame: 3 weeks
Final Project See example under Course Projects	Time frame: 3 weeks