

A.P. Statistics Overview and Syllabus

Course overview: The goal of this course is for students to become mathematically proficient with all topics included in a one-semester college Statistics course. The course has four major sections. Students first learn how to present and analyze data sets. The second section involves the design of experiments. An understanding of the laws of probability fills the third section while the fourth (and perhaps most important) has the goal of having students gain a practical understanding of statistical inference procedures.

Textbook: *The Practice of Statistics*, 2nd edition, Yates, Moore and Starnes, W.H. Freeman and Co., 2002

Required Components

Special Problems: The course goals are accomplished by creating a classroom culture in which students work together to investigate, discuss, explain, justify, and reflect on the topics of Statistics. **Most units include a “Special Problem” which requires students to perform an analysis of a data set and draw conclusions based on their analysis. Students gain the ability to use statistics to justify conclusions, and write or verbalize these conclusions and explain their methods of analysis.** In a number of these special problems, students design their methods of acquiring the data.

Communication: Students communicate verbally as they work in groups to investigate new concepts, to solve problems, and to process homework. They also communicate verbally through problem presentations to their peers as well as a final project presentation at the end of the year in which they present a larger experiment and analysis. Students communicate in written form when they write justification for homework problems, when they are asked to explain their work as part of a test questions, and when they complete AP Packets during April. Each unit ends with a test that includes both free-response and multiple-choice problems.

Technology: Almost every lesson involves the incorporation of graphing calculator technology. Our purpose is to use the graphing calculator as a tool to make statistical calculations easier. Because of that, graphing calculator techniques for displaying data, probability and inference procedures are done concurrently to paper and pencil analytical approaches. All tests allow 100% use of a graphing calculator. Computer technology is also incorporated, although on a less frequent basis. Students use various Applets as teaching tools and have the opportunity to use Minitab software.

Content: All AP Statistics topics are covered in this course. This can be seen in the unit and lesson syllabus given on the following pages.

Introduction - The first few days of the school year include an introduction which includes course expectations, a discussion of the AP test (including timing), and a few modeling problems which get students thinking about statistics.

Section 1 - Exploring Data

<u>Unit</u>	<u>Overview / Topics covered</u>	<u>Time</u>
Unit 1	<p>Exploring Data – This unit includes quite a bit of review material for most students. Methods of displaying data both graphically and numerically are covered in this unit.</p> <p>Displaying distributions with graphs Categorical vs Quantitative Shape, Center, Spread, Outliers, Symmetric vs. Skewed, Percentiles Describing distributions with numbers Mean, Median, standard deviation, quartiles, IQR, box plots Changing units of measure Comparing distributions ****Special Problem****</p>	5 days
Ch.2	<p>Normal Distributions – This unit introduces the concept of a density curve. The normal distribution is covered earlier than may be necessary in the year, but as such an important concept, it is good to get to early.</p> <p>Normal distributions, density curve, 68-95-99.5 rule Standard normal calculations (z-scores)</p>	6 days
Ch.3	<p>Examining Relationships – This unit deals with the relationships between to sets of data. Scatterplots, correlation, and regression are the main topics.</p> <p>Scatterplots (explanatory vs response) Form, direction, strength, correlation Least squares regression (many equations) Residuals, outliers, influential observations ****Special Problem****</p>	9 days
Ch.4	<p>More on Two-variable Data – This unit is a catchall for topics that weren't covered in the previous chapter.</p> <p>Transformations (power functions, exponential) Extrapolation, lurking variables, averaging data Categorical data (marginal and conditional distributions) Simpson's paradox.</p>	6 days

Section 2 - Producing Data

- Ch.5 **Producing Data** – This unit has been nicknamed the “food chapter” in previous years by students who enjoyed the taste test experiments that students choose for their projects late in this chapter. This chapter focuses on choosing samples and designing or simulating experiments. There is very little ‘math’ to perform in this chapter 14 days

Observational study, experiment, population, census, sample, bias, undercoverage, non-response

Designing samples: Voluntary response, SRS, stratified random sample

Using tables of random digits to choose samples.

Designing experiments: control, randomization, replication

Comparative experiments, double blind, matched pairs, block design, placebo effect

Simulating experiments

****Special Problem****

****Special Problem****

Section 3 - Probability

- Ch.6 **The Study of Randomness** – This unit begins with a discussion of the idea of random behavior and the fact that it is very predictable in the long run. From there a number of general probability rules and models are covered. We add additional problems from outside the text during this unit. 14 days

What is random?

Sample space, event, probability model, multiplication principle, compliment, disjoint

Venn diagrams, union, intersection

Probability rules

Conditional probability, tree diagrams

****Special Problem****

- Ch.7 **Random Variables** – This unit gets away from general probability and discusses discrete and continuous random variables and the mean and variance formulas for random variables. An investigation of a few games of chance (and why you won’t make money in a casino in the long run) permeates throughout this unit. 10 days

Discrete random variables, probability distributions

Continuous random variables, probability distributions, normal distributions revisited

Mean and variance of random variables. Rules for means and variances.

The law of large numbers, “law of small numbers”

- Ch.8 **Binomial and Geometric Distributions** – This unit covers the rules and applications of the binomial and geometric probability distributions. 12 days

Binomial Random Variables, pdf, cdf, binomial coefficients and probability

Mean and standard deviation of binomial random variables

Geometric Random Variables, pdf, cdf, geometric probabilities.

Mean and standard deviation of geometric random variables

Final exam week – The final week of the semester is dedicated to review for comprehensive final exams in each subject. The final exam in statistics is free-response questions involving the analysis of a data set that the students have access to before the exam.

Ch.9 **Sampling Distributions** – This chapter introduces the concepts that the distributions of sampled data follow predictable patterns (the basis of inference). Both means and proportions are considered and the relationship to the normal distribution is developed through many simulations and examples. Both graphical and numerical representations of the distributions are considered. 8 days

Sampling distributions. Bias and variability.
Mean and standard deviations of sample proportions.
Rules of thumb for using the procedures and equations.
Mean and standard deviations of sample means.
Central Limit Theorem

Section 4 - Inference

Ch.10 **Introduction to Inference** – This unit introduces the one-sample z-intervals and tests. By using z-procedures, we build on our understanding of normal distributions and set a framework for inference procedures that can be used in the next chapters. 14 days

Statistical Inference
Confidence Intervals, confidence level, margin of error
Inference Toolbox (4-step procedure for inference problems)
Tests of significance. Hypotheses, p-values, alpha level, one-sided/two-sided
Making sense of statistical significance
Inference as decision, Type I and Type II errors
****Special Problem****

Ch.11 **Inference for Distributions** – This unit introduces the t-procedures for one and two-sample means. 14 days

t-distributions, degrees of freedom
t-procedures (confidence intervals and significance tests.) Conditions for inference.
Matched pairs t-procedures
Two-sample t-procedures

Ch.12 **Inference for Proportions** – This unit introduces the inference procedures for 1 and 2 proportions. 10 days

Conditions for inference
z-procedures (confidence intervals, and tests of significance)
Choosing sample sizes.
Procedures for comparing two proportions.
****Special Problem****

Ch.13 **Inference for Tables** – This unit introduces the Chi-Squared tests for goodness of fit. 8 days

Chi-squared distributions.

Conditions for using the chi-squared procedures

Inference for two-way tables.

Ch.14 **Inference for Regression** – This unit introduces the procedures for drawing inference about regression lines. 8 days

Conditions for regression inference.

Confidence intervals and significance tests for regression slope

Review - Approximately three weeks are spent going through previous years' tests to review for the AP exam.

Final Project – In the weeks between the AP test and the end of school, a final project involving experimenting and performing the appropriate inference procedure is designed, completed and reported on by each student.