

Course: AP Statistics

Primary Textbook: Stats: Modeling the World, 2nd Ed. (Bock, Velleman, De Veaux, 2007, Pearson Pub.)

Supplementary Materials: Resource Guide for Stats: Modeling the World (to be abbreviated below as TRG); Workshop Statistics, Rossman, 1997, Springer Pub. (to be abbreviated below as WSS), Teacher-created worksheets (to be abbreviated below as TW)

Course Description: Advanced Placement Statistics is a higher level course which requires proficiency in mathematics, critical thinking and effective communication. The minimum prerequisite for this course is Algebra 2. Topics covered in this course include exploratory data analysis, regression, sampling & experimental design, probability and statistical inference. The course is designed to prepare students for the Advanced Placement Examination, which is given in May. Registration for the exam takes place in February. Students who take the exam may receive college credit for a score of 3, 4 or 5 (depending on the university).

A graphing calculator with statistical capabilities is required for this course. The best Texas Instrument calculators for this purpose are the TI83, TI83 Plus, TI84, TI84 Plus or TINspire. Other brand calculators with statistical capabilities (including regression, statistical tests & confidence intervals) are acceptable, but the teacher is less familiar with these and students must be ready to rely heavily on the user's manual. If a student already has a different kind of graphing calculator, they should bring the calculator and user's manual to the teacher to make sure the calculator has all of the necessary functions for the course. Specific uses of this calculator are described in the "Technology Use" sections within each chapter listed below.

Syllabus: The following outline describes the topics we will be covering over the course of the year. The course is divided into seven parts, and each part contains several chapters. An approximate number of days is listed for each chapter. This timeline may be adjusted based on a variety of factors (student needs, school events, etc.).

Notes on items listed below:

- For each textbook chapter listed, assignments involve reading these chapters and completing assigned problems from the chapters.
- Computer output described below comes from several software packages, including Statkey, Minitab, Data Desk and SPSS. Students will use free online packages such as Statkey to analyze data from their own investigations.
- An "activity" listed under supplemental materials is usually a 1-2 day investigation mostly done in class, where students should reach one specific conclusion. A "project" listed in its own category is usually a longer-term assignment done mostly at home, where different students in the class may come up with different responses or solutions and present them to their peers.
- Tests & quizzes are teacher-created or adapted from the TRG. Tests at the end of each "part" of the textbook are half multiple choice and half free response.

PART I: EXPLORING & UNDERSTANDING DATA (21 days)

Chapter 1: Stats Starts Here (1 day)

Topics Covered: Introduction to the course and textbook overview

Textbook: Chapter 1

Supplemental Materials: TRG - Data collected based on a class survey to be used in a variety of later chapters

Chapter 2: Data (1 day)

Topics Covered: Data tables; categorical and quantitative variables; identifying the context of a data set

Technology use: Students will explore the basic capabilities of the graphing calculator and learn how to enter data into lists in the calculator.

Textbook: Chapter 2

Assessment: Chapter 2 Quiz

Chapter 3: Displaying and Describing Categorical Data (3 days)

Topics Covered: Frequency tables; the area principle; bar charts; pie charts; contingency tables; marginal & conditional distributions; independence; Simpson's Paradox

Supplemental Materials: TRG: Smoking & Education activity (students use data tables and segmented bar graphs to explore relationship between two categorical variables)

Project: TRG: Investigative Task – Race and the Death Penalty (students explore the relationship between two categorical variables and write a newspaper article with graphs describing their analysis)

Assessments: Ch. 3 Quiz

Chapter 4: Displaying Quantitative Data (4 days)

Topics Covered: Histograms; stem-and-leaf plots; dotplots; timeplots; center, shape, spread & unusual features (gaps, clusters, outliers); identifying patterns; interpreting displays

Technology Use: Students will use the TI calculator to create histograms & timeplots. They will also examine dotplots, stemplots & other graphs produced by statistical software packages.

Project: TRG: Investigative Task – Dollars for Students (students use a data set to create and interpret a visual display comparing education spending in eastern and western states)

Assessments: Ch. 4 Quiz

Chapter 5: Describing Distributions Numerically (5 days)

Topics Covered: Median; range; quartiles & IQR; 5-number summary; boxplots; outliers; mean; standard deviation; choosing appropriate numerical summaries of symmetric & non-symmetric data sets

Technology Use: Students will learn how to use their TI calculators to find measures of center and spread and to draw boxplots

Supplemental Materials: TRG: Classwork – Mooseburgers v. McTofu (students use data on salaries at two companies to compare mean and median as useful measures of center)

Project: TRG: Investigative Task – Auto Safety (students summarize and compare auto safety ratings on three sizes of cars in a report for an insurance company)

Assesment: Ch. 5 Quiz

Chapter 6: The Standard Deviation as a Ruler and the Normal Model (4 days)

Topics Covered: Shifting & re-scaling data (effect on measures of center and spread); z-scores; normal distributions; the standard normal distribution; using the z-table; the empirical rule; normal probability plots

Technology Use: Students will use the *normalcdf* and *invnorm* functions on their calculators to solve problems involving normal distributions. They will use statistical software packages such as “StatKey” to create quick dotplots to assess the shape of distributions. They will use their calculators and/or software to calculate summary statistics as they explore shifting and rescaling.

Supplemental Materials: TW – Normal Distribution Applications; previous AP Exam problems

Assessment: Ch. 6 Quiz

Part I Review & Part I Test (3 days)

PART II: EXPLORING RELATIONSHIPS BETWEEN VARIABLES (18 days)

Chapter 7: Scatterplots, Association & Correlation (4 days)

Topics Covered: Concept of association between quantitative variables; scatterplots; explanatory & response variables; form, direction & strength of association; finding & interpreting the correlation coefficient; lurking variables

Technology Use: Students will learn how to draw scatterplots on their calculators & using statistical software, including how to identify different data sets by using different symbols, and how to correctly transfer these graphs from their devices to their work, including maintaining scale and labeling the axes. They will also use their calculators and statistical software tools to enter data sets and find the value of the correlation coefficient r .

Supplemental Materials: WSS Topic 9 Activities (Correlation); previous AP Exam problems

Chapter 8: Linear Regression (6 days)

Topics Covered: Least squares regression; finding, interpreting & using linear models; residuals; understanding regression output from statistical software; assessing fit; interpreting r -squared in the regression context

Technology Use: Students will use the graphing calculator & statistical software to find least squares regression lines and to sketch these lines on scatterplots; they will also use these tools to construct residual plots and evaluate numerical summaries of bivariate data sets. They will examine regression output from a variety of software packages.

Supplemental materials: WSS Topic 10 & 11 Activities (Least Squares Regression); previous AP Exam problems

Assessment: Chapter 7-8 Quiz

Chapter 9: Regression Wisdom (2 days)

Topics Covered: influential observations; regression outliers; extrapolation; causation; lurking variables

Technology Use: Students will continue to practice the techniques learned in Chapters 7-8. In addition, they will use Statkey and Desmos.com to explore the effect of outliers and influential points on regression results by entering and manipulating collected data.

Supplemental Materials: TW – Influential Observations

Chapter 10: Re-Expressing Data (3 days)

Topics Covered: Linear vs. nonlinear models; re-expressing data; exponential regression (using linear transformation); other nonlinear models (using calculators and software)

Technology Use: Students will use their calculators and statistical software to explore a variety of re-expressions to create linear models from nonlinear data. They will also explore the various nonlinear regression models available in the graphing calculator & using software tools.

Supplemental Materials: TW: Gypsy Moths (exponential regression with re-expression); TW: Stopping Distance (students try several re-expressions for a nonlinear data set); TW: Size of Alligators (adapted from Texas Instruments activity/AP Stats 1997 Teacher's Guide)

Part II Review & Part II Test (3 days)

PART III: GATHERING DATA (16 days)

Chapter 11: Understanding Randomness (4 days)

Topics Covered: definition of randomness; random selection; random number tables & generators; simulation

Technology Use: Students will use their calculators to generate random numbers.

Supplemental Materials: Previous AP Problems (simulation)

Project: Airline Overbooking Simulation (from teacher's guide for previous textbook – Yates, Moore, McCabe *The Practice of Statistics: Advanced Placement Edition, 1st edition*)

Assessment: Chapter 11 Quiz

Chapter 12: Sample Surveys (5 days)

Topics Covered: Sampling methods (including simple random, stratified, cluster, systematic random, convenience, multistage); census; representative samples; bias (including response bias; nonresponse bias; voluntary response bias; undercoverage); sampling variability; sample statistics; population parameters

Technology Use: Students will use random number generators to aid in selection of samples.

They will also use their calculators and/or statistical software to construct plots & report summary statistics based on samples collected.

Supplemental Materials: Previous AP Exam problems; “Rolling Down the River” Activity from NCSSM

Assessment: Chapter 12 Reading Quiz

Chapter 13: Experiments & Observational Studies (4 days)

Topics Covered: Observational studies; experiments; vocabulary of experiments; principles of experimental design; control; random assignment; blinding; blocking; confounding; statistical significance; placebo effect; the question of causation

Technology Use: Students will use random number generators to assign subjects to treatment groups.

Supplemental Materials: Previous AP Exam problems

Assessment: Chapter 13 Reading Quiz

Part III Review & Part III Test (3 days)

PART IV: RANDOMNESS AND PROBABILITY (19 days)

Chapter 14: From Randomness to Probability (2 days)

Topics Covered: Definition of probability; relative frequency; independent events; law of large numbers; basic probability rules; introduction to discrete probability distributions; complements; disjoint events

Technology Use: Students use their calculators and/or statistical software to analyze probability experiments (with summary calculations & graphs), and to perform basic probability calculations.

Chapter 15: Probability Rules! (5 days)

Topics Covered: Sample spaces; events; general addition rule; general multiplication rule; Venn diagrams; probability tables; marginal probabilities; joint probabilities; conditional probabilities; independence; tree diagrams; Bayes' Rule

Technology Use: Students use calculators to perform probability calculations.

Supplemental Materials: Taxi Problem (from AP workshop 1999 – example of conditional probability using Bayes' Theorem); TW: Bayes' Rule (adapted from Bluman, *Elementary Statistics*)

Assessment: Chapter 14-15 Quiz

Chapter 16: Random Variables (5 days)

Topics Covered: Discrete & continuous random variables; probability models; expected value (mean of a random variable); variance of a random variable; shifting, rescaling & combining random variables (effect on mean and variance); probability using the Normal model

Technology Use: Students use calculators to perform calculations and explore the effect of manipulating the value of random variable on their means and variances. They will also use the *normalpdf* and *invNorm* functions on their calculators to help them solve probability problems involving the Normal probability model.

Supplemental Materials: TW: Chapter 16 Practice; previous AP Exam problems

Assessment: Chapter 16 Quiz

Chapter 17: Probability Models (4 days)

Topics Covered: Bernoulli trials; geometric probability distribution; binomial probability distribution; normal approximation to the binomial distribution

Technology Use: Students will use their calculators to find geometric & binomial probabilities. They will also use a Java applet from Rice University to explore when a normal approximation to the binomial distribution is appropriate.

Supplemental Materials: Previous AP Exam problems

Assessment: Chapter 17 Quiz

Part IV Review & Part IV Test (3 days)

END OF FIRST SEMESTER AND FIRST SEMESTER FINAL EXAM

PART V: FROM THE DATA AT HAND TO THE WORLD AT LARGE (24 days)

Chapter 18: Sampling Distribution Models (6 days)

Topics Covered: Sample proportions; sample means; sampling distributions (for both proportions & means); mean and variance of sampling distributions; standard error; Central Limit Theorem; conditions for use of sampling distribution models; Empirical Rule (68-95-99.7 Rule); probability using sampling distributions

Technology Use: Students will use their calculators and/or statistical software to sketch graphs of simulated sampling distributions. They will use a Rice University Java applet to explore the meaning of the Central Limit Theorem & the effect of population shape & sample size on a sampling distribution.

Project: M&M Introduction to Sampling Distributions (students work in groups using M&M's to explore the characteristics of a sampling distribution for a sample proportion)

Supplemental Materials: TW - Sample Proportions; previous AP Exam problems

Assessment: Chapter 18 Quiz

Chapter 19: Confidence Intervals for Proportions (5 days)

Topics Covered: Point estimates; sampling variability; margin of error; critical values; constructing & interpreting confidence intervals for a single proportion; checking conditions; interpreting confidence levels; relationship between confidence level, sample size & interval width

Technology Use: Students will use calculators and statistical software to find confidence intervals for a single proportion.

Supplemental Materials: TW – Chapter 19 Practice; previous AP Exam problems

Assessment: Chapter 19 Quiz

Chapter 20: Testing Hypotheses About Proportions (3 days)

Topics Covered: Logic of hypothesis testing; null & alternative (1 and 2-sided) hypotheses; one-proportion z-tests (including hypotheses, conditions, mechanics & interpretation)

Technology Use: Students will use calculators & statistical software to find test statistics & p-values for hypothesis tests involving a single proportion.

Supplemental Materials: Previous AP Exam problems; Gender Discrimination Simulation Activity (from AP workshop – students perform a simulation using beads based on a theoretical 'random' firing of male and female employees to see whether they think the company in question discriminated; intro to the idea of significance),

Chapter 21: More About Tests (4 days)

Topics Covered: Significance levels; Type I & Type II error; critical values; relationship between hypothesis tests & confidence intervals; power; relationship between sample size & power; relationship between alpha, beta & power

Technology Use: Students will continue to use calculators & statistical software to find test statistics & p-values for hypothesis tests involving a single proportion.

Supplemental Materials: Previous AP Exam problems; online article at www.intuitor.com/statistics/T1T2errors.html; TW – 1-Proportion z-Tests

Assessment: Chapter 20-21 Quiz

Chapter 22: Comparing Two Proportions (3 days)

Topics Covered: Sampling distribution model for the difference between two proportions; 2-proportion z-tests; 2-proportion z-intervals; conditions for inference for 2 proportions

Technology Use: Students will use calculators & statistical software to find confidence intervals as well as test statistics & p-values for hypothesis tests involving the difference between two proportions.

Supplemental Materials: Previous AP Exam problems; TW – Inference for Proportions (mixed review of Chapters 19-22)

Part V Review & Part V Test (3 days)

PART VI: LEARNING ABOUT THE WORLD (12 days)

Chapter 23: Inferences About Means (4 days)

Topics Covered: Central Limit Theorem (revisited); t-distributions & their characteristics; degrees of freedom; relationship between t and the normal model; conditions for inference for a single mean; assessing normality; 1-sample t-test; 1-sample t-intervals

Technology Use: Students will use calculators & statistical software to verify whether a small data set satisfies the normality condition and find confidence intervals as well as test statistics & p-values for hypothesis tests involving a single mean.

Supplemental Materials: The JellyBlubber Colony (students gather data through an SRS and create a confidence interval for the mean length of the colony; individual confidence intervals from each student are combined in a class chart to reinforce the meaning of a confidence level)

(http://noblestatman.com/AP_Stats_Workshops/Design_files/JellyBlubbers.Activity.pdf);

TW – Chapter 23 Practice; previous AP Exam problems

Assessment: Chapter 23 Quiz

Chapter 24: Comparing Means (3 days)

Topics Covered: Sampling distribution model for the difference between the means of two independent samples; 2-sample t-tests; 2-sample t-intervals; conditions for inference for 2 means (independent samples)

Technology Use: Students will use calculators & statistical software to find confidence intervals as well as test statistics & p-values for hypothesis tests involving the difference between the means of two independent samples.

Project: Paper Towel Lab (students conduct a lab experiment to compare the absorbency of two brands of paper towels and analyze the results using a 2-sample t-test).

Supplemental Materials: Previous AP Exam problems

Chapter 25: Paired Samples and Blocks (2 days)

Topics Covered: Difference between paired data & independent samples; conditions for inference for paired data; paired t-tests; paired t-intervals

Technology Use: Students will use calculators & statistical software to find confidence intervals, test statistics & p-values for hypothesis tests involving the mean difference in paired data.

Supplemental Materials: Previous AP Exam Problems; TW – “Which Procedure?” (students identify which of the inference procedures they have learned is appropriate for each situation)

Part VI Review & Part VI Test (3 days)

PART VII: INFERENCE WHEN VARIABLES ARE RELATED (9 days)

Chapter 26: Comparing Counts (5 days)

Topics Covered: Chi-square distribution; chi-square tests for goodness of fit; homogeneity of proportions & independence; conditions for using chi-square

Technology Use: Students will use their calculators and statistical software to find test statistics & p-values for chi-square tests.

Supplemental Materials: TW – Chi Square Tests; Problem Sets from Bluman, *Elementary Statistics*, 1997; Previous AP Exam problems.

Project: M&M's Goodness of Fit (students sample M&M's to see if their color distribution is significantly different from that claimed by the Mars Co. using a chi-square goodness of fit test).

Assessment: Chapter 26 Quiz

Chapter 27: Inferences for Regression (4 days)

Topics Covered: Idealized regression model; t-tests & t-intervals for the slope of a regression line; focus on reading results from software output

Technology Use: Students will revisit the calculator regression techniques learned in weeks 36. They will also use the calculator to perform hypothesis tests for a null hypothesis of slope=0. They will use online software packages to construct confidence intervals and perform hypothesis tests involving the slope of a regression line. In addition, they will examine computer output from a variety of software packages to pull out the relevant information for performing hypothesis tests and calculating confidence intervals.

Supplemental Materials: TRG – Regression Inference Worksheet; previous AP Exam problems

Assessment: Chapter 27 Quiz

AP EXAM REVIEW (15-20 days)

Students review for the AP Exam in a variety of ways, including:

- Topic-by-topic class review using previous AP Exam problems
- Taking practice exams (both multiple choice and free response parts)
- Self and peer scoring of free response problems using published AP rubrics
- Working through sections of a variety of available AP Statistics prep books

CUMULATIVE FINAL EXAM (2 days)

CULMINATING PROJECT (20 days)

Students, working individually or in groups of 2-4, choose a research question of interest to them which can be examined using the methods of analysis they have learned during the course of the year. They collect data using a well-designed experiment or study which they create based on the principles learned in class. They analyze this data using the methods covered throughout the year, and draw a conclusion which answers their initial question. They may use either their calculator or a statistical software package to assist them in performing this analysis. Finally, they critique their study, citing possible sources of error, potential improvements in their design, implications of their results and possibilities for further investigation of the topic. The project includes a written report and a presentation of results to the class.