AP® STATISTICS

Overview of Advanced Placement Statistics

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Course Design

One of the greatest differences between statistics and other mathematics courses is that statistical instruction takes on a variety of forms. Students in my AP Statistics course often work in groups to gather, analyze, and discuss conclusions drawn from data. Classroom discussion pertaining to statistical topics is encouraged as it is an integral part of developing an understanding of the methodology, practical application, and inferences drawn from the subject.

Teaching materials for this course include a primary textbook, activities, lectures and discussions, readings from other books, journals, magazines, and newspapers, ancillary packets, videos, dynamic software explorations, calculator simulations, and a class website. Students are provided with resources including formula cards, statistical tables, and chapter guides to assist in their studies. Students are expected to have a graphing calculator with statistical capabilities. A limited number of calculators are available for use if the student can not provide one. Fathom2 Statistical Exploration Software is used to illustrate concepts and Minitab statistical output is used to enhance understanding of statistical results in a variety of forms.
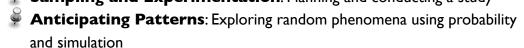
Students complete a final culminating project after the AP Examination. The purpose of this project is to give the students the opportunity to demonstrate their understanding of Statistics by formulating a question, designing a study or experiment, collecting and analyzing data, and performing appropriate inferential procedures to answer the original question. Students begin drafting questions, designing the study, and collecting data as each concept is mastered throughout the year.
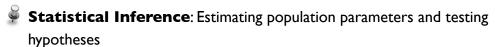
Course Requirements

AP Statistics introduces students to the major concepts and tools for collecting, analyzing, and drawing conclusions from data. Students are exposed to four broad conceptual themes, with appropriate emphasis given to each:

- **Exploring Data**: Describing patterns and departures from patterns
- **Sampling and Experimentation**: Planning and conducting a study
- **Anticipating Patterns**: Exploring random phenomena using probability and simulation
- **Statistical Inference**: Estimating population parameters and testing hypotheses

AP Statistics draws connections between all aspects of the statistical process, including design, analysis, and conclusions.

AP Statistics teaches students how to communicate methods, results, and interpretations using the vocabulary of statistics. Class discussion is encouraged to develop students' ability to communicate statistically.

AP Statistics teaches students how to use graphing calculators and demonstrates the use of computers and/or computer output to enhance the development of statistical understanding through exploring and analyzing data, assessing models, and performing simulations.

Students who successfully complete the course and exam may receive credit, advanced placement, or both for a one-semester introductory college statistics course.

Primary Textbook and Resource Materials

Primary Textbook used in the course:

- Yates, Daniel S., Moore, David S., and Starnes, Daren S. *The Practice of Statistics,* 2nd ed. New York: W.H. Freeman, 2003.

The following texts and resources are used as supplements in the teaching of the course:

- Peck, Olsen, and Devore. *Introduction to Statistics and Data Analysis.* 2nd ed. Pacific Grove, CA: Duxbury, 2004.
- Moore, David S. *Decisions Through Data.* DVD series. COMAP.
- Texas Instruments TI83+/84+ Graphing Calculators.
- Key Curriculum Press. *Fathom 2 Dynamic Data Software.*
- Watkins, Scheaffer, and Cobb. *Statistics in Action: Understanding a World of Data.* Emeryville, CA: Key Curriculum Press, 2006.
- Bohan, James F. *AP Statistics: Preparing for the Advanced Placement Examination*, 2nd ed. New York: AMSCO School Publications, 2006.
- Daily newspaper/magazine articles are used to illustrate concepts currently being discussed in class.
- YMS2e Companion Website. Online quizzes and statistical applets.
- Instructor developed activities to illustrate and develop an understanding of statistical concepts.

Course Content and Outline

The following outline describes this course's content by unit as well as assignments, assessments, activities, and mini-projects. Each row corresponds to one 60 minute class period. The schedule is subject to change based on student needs, class interruptions, teacher absences, etc.

Unit 1: Describing Data		
YMS 2e	**Content**	**Assignment**
	Intro Activity - Westvaco Discrimination Case. Introduction to statistical thinking. Students explore data from the Westvaco age discrimination case and review the concepts of shape, center, and variability of data.	Ch1 "Damned Lies and Statistics"
	What is Statistics - Continue Westvaco activity and explore the concept of inference. Discuss the differences between Statistical thinking and traditional mathematical thinking.	Rd 4-7, Write 1/2 page reaction to Ch1 "Damned Lies..."
1.1	Exploratory Data Analysis - Definition of statistics, variables (categorical vs quantitative), data, displays and numeric descriptions.	Rd 8-10 Do 1-6
1.1	Basic Graphical Displays - Dotplots, stemplots, histograms vs bar graphs and pie charts.	Rd 11-16 Do 8,9,10
1.1	Plots Practice - Construct plots and interpret the Shape, Outliers, Center, and Spread of univariate datasets.	Rd 18-27 Do 15,16,20
Qz	Review and Quiz 1.1	Rd 27-34 Do 23,24,28
1.2	Measures of Center - Calculate and interpret the mean and median of a dataset.	Rd 37-46 Do 31,34,36,39
1.2	Standard Deviation - Calculate and interpret the standard deviation of a dataset.	Rd 49-52 Do 40,41,43
1.2	Center and Spread - Calculate and interpret the 5-number summary of a dataset. Display data using a boxplot.	Rd 53-55 Do 44,45,46
1.2	Comparing - Side by side stemplots, parallel boxplots.	Rd 56-61 Do 48,49
Rev	Decisions Through Data Episode 1	Rd 64-66 Do 60,63,66,67
Rev	Review Chapter 1	Online Quiz 1
Exam	Chapter 1 Exam: Multiple Choice and Free Response Exam. Students demonstrate ability to construct and interpret appropriate displays and numerical descriptions of univariate data sets.	

Mini-Project: Students collect a set of quantitative data (minimum n=30) and analyze it using the techniques from this chapter. Data must be plotted in at least two different ways, and numerical descriptions of center and spread must be provided. Data is to be interpreted in context - Graded on four point rubric similar to AP free response questions.

Unit 2: The Normal Distributions		
YMS 2e	**Content**	**Assignment**
2.1	Normal Dist Activity - Students measure heights and display data using a dotplot. Characteristics of the plot are used to introduce the concepts of density curves and normal distributions.	Read Intro to Ch2
2.1	Density Curves - Describe an idealized mathematical model for distributions of data.	Rd 78-83 Do 1-4
2.1	Normal Distributions - Explore the characteristics of a normal distribution and the Empirical (68-95-99.7) Rule	Rd 85-90 Do 6-9,11-15
2.2	Standardizing, Normal Curves - Calculate the standard normal score and percentile for observations in a normal distribution.	Rd 93-101 Do 19-24
2.2	z-score Calculations - Calculate the % of observations above, below, and between multiple values on a normal distribution.	Rd 101-109 Do 26, 28-34

Unit 2: The Normal Distributions	
Qz	Review/Quiz	
2.2	Assessing Normality - Construct and interpret normal quantile plots as a tool to assess the normality of a set of data.	Normal Dist Practice
Rev	Decisions Through Data Episode	Rd 112 Do 40-42, 44-48
Rev	Review Chapter 2	Chapter 2 Online Quiz
Exam	Chapter 2 Exam : Multiple Choice and Free Response Exam. Students demonstrate ability to assess normality and perform standard normal calculations.	
Mini-Project: Students collect a set of approximately normal quantitative data (minimum n=30) and analyze it using the techniques from this chapter. Normality of the data is to be assessed, the Empirical Rule is to be interpreted, and at least 3 standard normal calculations are to be performed in the context of the data.		

Unit 3: Examining Relationships		
YMS 2e	Content	Assignment
3.1	Scatterplots - Construct and interpret a scatterplot for bivariate data. Analyze strength, direction, and form and identify control and dependent variables.	Rd 121-134 Do 1-4,6-7,15-19, 22
3.2	Correlation - Calculate and interpret the correlation coefficient, r. Discuss properties of r. Cautions about correlation.	Rd 140-145 Do 24-29, 33
3.3	Least Squares - Calculate and interpret the slope and intercept of the "line of best fit" for bivariate data. Discuss prediction vs extrapolation.	Rd 149-156 Do 38-41
3.3	Least Squares Regression - Use LSRL to make predictions from a bivariate set of data. Calculate and interpret residuals.	Rd 157-165 Do 42-43, 45
3.3	Residuals - Construct residual plots as a means to discuss the appropriateness of a linear regression model. Define and interpret r^2 in the context of a LSRL situation. Discuss effects of outliers and influential points on LSRLs.	Rd 167-176, Do 46, 48
Rev	Decisions Through Data Episode - Online Quiz	Rd 181-183 Do 62-65, 67-73
Exam	Chapter 3 Exam: Multiple Choice and Free Response Exam. Students demonstrate ability to construct and interpret appropriate displays and numerical descriptions of univariate data sets.	
Mini-Project: Students collect a set of bivariate quantitative data (minimum n=30) and analyze it using the techniques from this chapter. Data is to be plotted in a scatterplot and analyzed in terms of strength, direction, and form. The LSRL and correlation are to be calculated and interpreted in the context of the data. At least 3 calculations are to be performed using the LSRL, illustrating reasonable predictions as well as the dangers of extrapolation.		

Unit 4: More Bivariate Relationships		
YMS 2e	Content	Assignment
4.1	Transforming Relationships - Use logarithmic transformations to achieve linearity.	Rd 192-205 Do 3-5
4.1	Power and Exponential Models - Calculate LSRL for log-transformed data and use it to find exponential and power models.	Rd 214-219 Do 13-16
4.1	Modeling Nonlinear Data - Calculate and interpret the most appopriate model for nonlinear data.	Nonlinear Modeling Practice
Rev	Review 4.1 - Using technology to find nonlinear models.	Rd 221-222 Do 17, 21, 25
Quiz	Quiz 4.1 - Assignment: Read "How to Lie with Statistics" Chapter 8	
4.2	Cautions about Correlation - Correlation vs Causation	Rd 225-230 Do 27-31

	Unit 4: More Bivariate Relationships	
4.2	The Question of Causation - Discuss lurking variables, common response, causation, and confounding.	Rd 231-237 Do 33-37
4.2	Causation Practice	Rd 238 Do 38-49
4.3	Categorical Relationships - Discuss marginal and conditional distributions for categorical data presented in two-way tables.	Rd 241-245 Do 53-55
4.3	Simpson's - Recognize and identify Simpson's Paradox	Rd 246-250 Do 59-61
Rev	Review - Online Quiz	Do 72-73, 81-83
Exam	Chapter 4 Exam: Multiple Choice and Free Response Exam. Students demonstrate ability to construct and interpret appropriate models for nonlinear data as well as identify possible reasons for correlation. Students interpret relationships in categorical data by analyzing two-way tables.	

Mini-Project: Students collect a set of nonlinear bivariate quantitative data (minimum n=30) and analyze it using the techniques from this chapter. Data is to be plotted in a scatterplot and analyzed in terms of strength, direction, and form. The most appropriate nonlinear model is to to be calculated, justified, and interpreted in the context of the data. At least 3 calculations are to be performed using the model, illustrating reasonable predictions as well as the dangers of extrapolation.

	Unit 5: Producing Data	
YMS 2e	Content	Assignment
5.1	Sampling Methods - Population vs. Sample. Observational Study vs Experiment. Discuss good vs bad methods of collecting a representative sample; Voluntary Response, Convenience, Cluster, Systematic, Simple Random Sample, Stratified Random Sample.	Rd 269-283 Do 1-12
5.1	Sampling and Bias - Designing polls and surveys with an awareness of undercoverage, nonresponse, wording bias, and other potential bias.	Rd 284-285 Do 19-29
5.2	Experimental Design - Basics including subjects, factors, treatments, variables, control, randomization, replication, placebo effect, and blinding.	Rd 290-297 Do 31-39
5.2	Matched Pairs and Blocking - Advanced designs	Rd 299-303 Do 43-48
Rev	Review 5.1- Practice AP Free Response Questions	Rd 305-306 Do 49-53, 56, 58
Quiz	Quiz 5.1-5.2 - Assignment: Read "Damned Lies..." Chapter 2	
5.3	Simulating Experiments - Use Calculator and random numbers to simulate experimental results.	Rd 309-319 Do 59-63, 74-80
Rev	Decisions Through Data Episode - Online Quiz	Do 82-83, 86
Exam	Chapter 5 Exam: Multiple Choice and Free Response Exam. Students demonstrate ability to identify appropriate sampling and experimental procedures as well as potential bias and confounding. Students design an experiment to answer a situational question.	

Mini-Project: Students develop a question that can be answered by collecting data through an observational study or experiment. Students must then develop a study to collect this data. Grading will be based on the appropriateness of the study. If approved, this question and study may be used to begin the post-exam project.

	Unit 6: Probability	
YMS 2e	Content	Assignment
6.1	Flipping Coins - Explore Randomness and discuss probability as a long-term relative frequency. Define sample space, outcomes, and events.	Rd 330-340 Do 11-15, 17-18
6.2	Probability Rules - Basic probability rules, Venn and tree diagrams, union and intersection, multiplication counting principle.	Rd 342-354 Do 19-23, 26-29, 31
6.3	General Probability Rules - Addition and multiplication rules for independent events.	Rd 359-369 Do-53 46

	Unit 6: Probability	
6.3	Conditional Probabilities - Two-way tables, independence.	Rd 366-369 Do 54-61
Quiz	Quiz - Probability - Practice Problems	
6.3	Bayes' Rule - Tree Diagrams and conditional probabilities. Practice	Rd 371-376 Do 62-65
Rev	Decisions Through Data Episode - Online Quiz	Rd 383-383 Do 66-71, 73-74
Exam	Chapter 6 Exam: Multiple Choice and Free Response Exam. Students demonstrate ability to calculate and interpret probabilities using the addition and multiplication rules as well as other strategies including diagrams and simulations.	

	Unit 7: Random Variables	
YMS 2e	**Content**	**Assignment**
7.1	Discrete Random Variables - Introduction to Random Variables, discrete vs continuous, probability distributions, notation.	Rd 391-395 Do 1-5
7.1	Continuous Random Variables - Probability distributions for continuous random variables, review of standard normal calculations.	Rd 397-403 Do 6-12, 14-16
7.2	Mean/Variance of R.V. - Calculation and interpretation of expected value and variance for discrete random variables.	Rd 407-411 Do 22-26, 29
7.2	Rules for Mean/Variance - Exploration of the effects of linear transformations and combinations of random variables.	Rd 418-423 Do 34-39, 41
7.2	Combining Normal Random Variables - Calculations and interpretation of expected value and variability of combinations of normal random variables.	Rd 424-427 Do 42-46, 49-50
Rev	Review - Practice Problems and Online Quiz	Practice Problems
Exam	Chapter 7 Exam: Multiple Choice and Free Response Exam. Students demonstrate ability to identify discrete and random variables. Students calculate and interpret expected value and variability of random variables in context and use them to answer situational questions.	
Mini-Project: Students work through an in-class casino lab, calculating and interpreting answers to probability questions in given situations.		
Statistics in the News: Students identify an article related to the concepts learned in AP Statistics and prepare a one-page response. The response should clearly identify connections to class and student reactions to the information.		

	Unit 8: Binomial and Geometric Distributions	
YMS 2e	**Content**	**Assignment**
8.1	Binomial Distributions - Identify characteristics of the Binomial Setting {Two outcomes, Independence, Fixed number of trials, Equal P(successP}	Rd 439-449 Do 1-5, 9-13
8.1	Binomial Distributions - Calculate and interpret Probabilities in the Binomial Setting, Normal Approximation to the binomial setting	Rd 450-459 Do 27-36
Quiz	Quiz 8.1 - Using technology to calculate binomial probabilities	Rd 464-473 Do 37-40
8.2	Geometric Distributions - Identify characteristics of the Geometric Setting, calculate and interpret geometric probabilities.	Review Worksheet
Rev	Review Chapter 8	Review Worksheet
Exam	Chapter 8 Exam: Multiple Choice and Free Response Exam. Students demonstrate ability to identify binomial and geometric settings. Students calculate and interpret probabilities, expected values, and variability in both binomial and geometric situations. Students demonstrate ability to approximate binomial probabilities using normal calculations.	

Unit 9: Sampling Distributions		
YMS 2e	**Content**	**Assignment**
9.1	Sampling Distributions - Explore the concepts of parameters vs statistics, sampling distributions, bias and variability, and the concept of inference.	Rd 9.1 Do 1-4, 12-15
9.2	Sample Proportions - Calculate and interpret the mean and standard deviation of the sampling distribution of p-hat. Normal approximation and conditions for use.	Rd 9.2 Do 19-23
9.3	Sample Means - Calculate and interpret the mean and standard deviation of the sampling distribution of x-bar. Discuss the Central Limit Theorem and conditions for use.	Rd 9.3 Do 45-52
9.3	Calculations involving Sampling Distributions - Moving towards statistical inference.	Practice Worksheet
Rev	Decisions Through Data Episode - Online Quiz	
Exam	Chapter 9 Exam: Multiple Choice and Free Response Exam. Students demonstrate ability to describe the sampling distributions of means and proportions. Students calculate and interpret probabilities using sampling distributions and make basic inferential arguments.	

Unit 10: The Logic of Statistical Inference		
YMS 2e	**Content**	**Assignment**
10.1	Estimating with Confidence - Activity to explore the concept of estimating an unknown parameter	Rd 535-541 Do 1-4
10.1	Confidence Intervals - Logic behind the construction and interpretation of a confidence interval. Point estimate, margin of error, determining sample size.	Rd 543-554 Do 8-10, 20-21, 24-25
10.2	Tests of Significance - Activity to explore the concept of testing a claim about a parameter.	Rd 559-566 Do 27-32
10.2	Hypotheses - Develop a basic procedure for inference; Hypotheses, conditions, sampling distribution, p-value, conclusion.	Rd 567-581 Do 38-40,46-48
10.3	Using Significance Tests - Significance level, one-sided vs two-sided, statistical vs practical significance	Practice Sheet
Quiz	Quiz 10.1-10.2	Rd 586-592 Do 57-61
10.4	Inference as a Decision - Introduction to Type I and II errors	Rd 593-598 Do 66-68
10.4	TypeI,II Errors - Calculating and interpreting power	Rd 599-602 Do 71-72
Rev	Decisions Through Data Episode - Online Quiz	Rd 606-608 ReviewSheet
Exam	Chapter 10 Exam: Multiple Choice and Free Response Exam. Students demonstrate ability to construct and interpret confidence intervals and carry out basic significance tests.	

Unit 11: Inference for Means		
YMS 2e	**Content**	**Assignment**
11.1	Inference for the Mean - Introduction to Student's t-Distribution, degrees of freedom	Rd 616-619 Do 1-5
11.1	t intervals and tests - Construct and interpret a one-sample t-interval for a mean. Interpret confidence level. Determine sample size. Perform significance tests for a claim about a population mean.	Rd 621-628 Do 7-11
11.1	Matched Pairs t - Construct and interpret a paired t interval. Perform t-interval calculations on the calculator.	Rd 628-640 Do 12-17
11.1	Robustness - Practice constructing and interpreting t intervals and significance tests for a single mean.	Rd 641-642 Do 24-29, 30
Qz	Quiz 11.1	Rd 648-656 Do 37-38

	Unit 11: Inference for Means	
11.2	Comparing Two Means - Construct and interpret t-intervals and perform significance tests for claims about two means.	Rd 658-667 Do 39-43,47, 49
Qz	Quiz 11.2	Rd 667-668 Do 50, 53, 55
Rev	Decisions Through Data Episode - Online Quiz	Rd 673-674 Do 62-65, 72
Exam	Chapter 10 Exam: Multiple Choice and Free Response Exam. Students demonstrate ability to construct and interpret confidence intervals and carry out basic significance tests for one or two population means.	

Unit 12: Inference for Proportions		
YMS 2e	Content	Assignment
12.1	Inference for Proportions - Review sampling distribution for p-hat and introduce concepts of confidence intervals and significance tests.	Rd 682-688, Do 1-5
12.1	z-intervals and tests - Calculate and interpret confidence intervals for a population proportion and perform significance tests on a claim about a proportion.	Rd 689-697, Do 7-9, 11, 15
12.1	Practice - Construct intervals for proportions on the calculator.	Worksheet
Qz	Quiz 12.1	
12.2	Comparing Proportions - Calculate and interpret confidence intervals for the difference between two proportions.	Rd 700-706, Do 22-24
12.2	Significance tests - Perform significance tests to compare two population proportions. Perform proportion tests on the calculator.	Rd 707-717, Do 26,28,30,31
Rev	Decisions Through Data Episode - Online Quiz	Rd 717-719 Do 35, 36, 39, 41, 45
Exam	Chapter 12 Exam: Multiple Choice and Free Response Exam. Students demonstrate ability to construct and interpret confidence intervals and carry out basic significance tests for one or two population proportions.	
AP	Practice AP Free Response Questions involving inference for means or proportions.	

Unit 13: Inference for Distributions		
YMS 2e	Content	Assignment
13.1	Goodness of Fit - Introduction to the Chi-Square distribution, m&m activity to explore comparing distributions of proportions	Rd 727-743 Do 1-4, 10-13
13.2	Test for Homogeneity - Compare independent SRS's or multiple distributions	Rd 744-756 Do 14, 16-18
13.2	Test for Independence - Distinguish between homogeneity and independence questions. Perform Chi-Square tests on the calculator.	Rd 757-766 Do 19, 25-29
Rev	Decisions Through Data Episode - Online Quiz	Do 31-35, 39
Exam	Chapter 13 Exam: Multiple Choice and Free Response Exam. Students demonstrate ability to perform Chi-square tests for distributions.	

Unit 14: Inference About the Model		
YMS 2e	Content	Assignment
14.1	The Linear Regression Model - Population vs Sample regression lines, Confidence Interval for the Slope	Rd 14.1 Do Practice Problems
14.1	Significance Test about the Slope - Interpreting Computer or Calculator Output	Practice Problems
Rev	Decisions Through Data Episode - Online Quiz	

Unit 14: Inference About the Model	
Exam	Chapter 14 Exam: Multiple Choice and Free Response Exam. Students demonstrate ability to construct a confidence interval and perform a t-test about the slope of a regression model.

AP Examination Review (10 Days)
- Chapter Review, Practice Problems
- Mock AP Exam - Multiple Choice and Free Response Final Exam
- Practice Multiple Choice Questions
- Practice Free Response Questions
- Grading and Strategies for Success

AP Statistics Examination

After the AP Examination
Students complete a final project, alone or in pairs, on a topic of their choice. The purpose of the project is for students to demonstrate an understanding of the major conceptual themes of statistics. Students are graded based on the following tasks:
- Topic/Study Design Proposal - Detailed research question, rationale, proposed study design, and method of data analysis.
- Progress Report - Summary of project progress after one week
- Participation - Use of class time, daily effort on completing project
- Written Report - Final report including written descriptions of the research question, rationale, study design, raw data summary, exploratory data analysis, inferential procedure, interpretation, conclusion, obstacles encountered and suggestions for further analysis.
- Oral Presentation - 10-15 minute class presentation of the project utilizing visual aids.

Course Objectives
Upon completion of the coursework, exam, and final project, it is expected that students will be proficient in the following areas:

Statistical Concepts
- Describe the four major conceptual themes of statistics: Describing Data, Producing Data, Anticipating Patterns, and Statistical Inference.

Statistical Skills
- Produce convincing oral and written statistical arguments, using appropriate terminology, in a variety of applied settings.
- Know when and how to use technology to aid them in solving statistical problems

Statistical Knowledge
- Employ techniques for producing data (surveys, experiments, observational studies, simulations), analyzing data (graphical & numerical summaries), modeling data (probability, random variables, sampling distributions), and drawing conclusions from data (inference procedures – confidence intervals and significance tests)

Statistical Habits of mind
- Become critical consumers of published statistical results by heightening awareness of ways in which statistics can be improperly used to mislead, confuse, or distort the truth.