ADVANCED PLACEMENT STATISTICS

**SYLLABUS**

**Course Objective**

This course is to introduce the 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.

This course is recommended for students who plan to major in college in the areas of engineering, psychology, sociology, health science and business. Students completing this course will be able to take the AP Exam in May.

**Teaching Strategy**

In the teaching of AP Statistics, the instructor may vary the teaching procedures in order to present an interesting and stimulating class presentation. Classroom discussion pertaining to topics such as methodology and inferences is supported by students working together in groups. Projects and outside problem sets will be assigned. Students will also be required to learn how to use a graphing calculator and read computer data to perform statistical analysis.

Moreover, students will be instructed to keep eye on the real data from newspapers, journals, medical newsletters, videos, TV news and the internet. By obtaining the background knowledge, students will learn to use statistical methodology to analyze the cases in real life, and even go on further research work.

**Primary Textbook and Resource Materials**

* Daren Starnes, Dan Yates, and David Moore. *The Practice of Statistics*, Fifth Edition (TPS 4e). W. H. Freeman and Company, 2012.
* Martin Sternstein. *Barron's AP Statistics*, 6th Edition (Barron). This book is used for taking exercises at class.
* Jennifer Phan, Jerimi Ann Walker, Divya Balachandran. *5 Steps to a 5 500 AP Statistics Questions to Know by Test Day* (500). Mcgraw-Hill. This book is used for homework assignment.
* Statistics web, [www.stattrek.com](http://www.stattrek.com). Students can access this website for self-tutorial in case they can’t understand the contents at class well.

**Technology**

* All students will need to have a TI-89 or TI-Nspire graphing calculator for use in class, at home, and on the AP Exam. Students will use their graphing calculators extensively throughout the course.

**Evaluation**

Students will be graded based on participation, homework, regular tests, mid-term and final exams.

* Class participation, being on task, having the required materials, taking notes, asking and answering questions, is worth 10% of the grade.
* Homework and projects are worth 20% of the grade.
* Tests and quizzes are worth 20% of the grade. Tests will be issued as frequently as once a month at least. Each test is comprised of a multiple-choice section and a free response section, which requires 90 minutes. There will be occasional quizzes, taking 10 to 15 mins, during the teaching periods.
* Semester exams, mid-term and final exams, are worth 20% and 30% of the grade respectively.

Students will gain extra grade points for score above 3 in AP exam.

**Course Outline**

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| **Topics** | **Contents** | **Textbook** | **Assignment** |
| **Topic One:**  **Exploring Data**  Chapter 1:  Distribution  (4weeks) | Unit 1.1 Graphical Display  Preface: Type of variables  1.1.1 Tabular Method   * Frequency distribution table   1.1.2 Graphical Display   * Bar graph; pie chart; * dotplot; stemplot; histogram; * density curve;   1.1.3 Examine Graphs   * Shape; center; spread; * gap; cluster; outlier | Page 2~6  Introduction:  Page 8~12  Section 1.1  (Bar graphs  and pie charts)  Page 27~42  Section 1.2 | Exercise:  (Barron) P45/1, 2, 7, 8, 9, 10~14  Homework:  (500) Question  21, 22, 23, 26, 41, 42, 43,  69/(a)(b), 70/(a) |
| Unit 1.2 Numerical Display  1.2.1 Measure of Center   * Mean; median   1.2.2 Measure of Spread   * Standard deviation; Interquartile range; range; boxplot; * Effect of linear transformation;   1.2.3 Measure of Position   * Standard score (z-score); * Percentile; empirical rule * Cumulative Frequency Plot * Normal quantile plot | Page 50~69  Section 1.3  Page 85~104  Section 2.1  Page 110~130  Section 2.2  (The 68-95-99.7 Rule; Assessing Normality) | Exercise:  P72/1, 2, 3,  7, 8, 9, 10, 11, 14, 15, 16, 18, 20, 21, 25, 30, 31, 32, 33  Homework:  Question 24,  27~33, 36, 37,  38, 44, 45,  47~53, 55,56,  57, 60~65,  69/(c)(d), 70/(b)(c)(d) |
| Unit 1.3 Compare Distribution  1.3.1 Compare distribution   * compare “SOCS”   1.3.2 Graphs for comparing   * Parallel dotplots; back-to-back stemplots; side by side boxplots; * double bar graphs | Page 27~42  Section 1.2 | Exercise:  P94/1, 3, 4, 5, 6, 7 |
| Chapter 2:  Relationship  (4weeks) | Unit 2.1 Bivariate Data  Preface: Examine the association  2.1.1 Graphical Display   * Scatterplot;   2.1.2 Numerical Display   * Correlation coefficient | Page 143~157  Section 3.1 | Exercise:  P124/4, 5, 8, 9,  10, 19~23  Homework:  Question 71,  72, 77, 82, 89, 93, 108,  117/(b),  119/(a) |
| Unit 2.2 Regression Line  2.2.1 Least-square Regression   * Least-square method; * Equation of regression line; * Interpret the regression line;   2.2.2 Coefficient of Determination   * R-square;   2.2.3 Transformation to achieve  Linearity   * Logarithmic function form; * Exponential function form; * Power function form   2.2.4 Residuals, Outliers and  influential points   * Residual; residual plot * Outliers; influential points | Page 164~190  Section 3.2  Page 765~785  Section 12.2 | Exercise:  P124/2, 3, 6,  11, 12, 13, 14, 15, 18, 25, 26  Homework:  Question 73~76, 80, 81,  84~88, 90, 91,  92, 96, 100,  101, 102, 104,  110, 113,  117/(a), 119/(b)(c) |
| Unit 2.3 Two-way Table  Preface: Examine categorical data  2.3.1 Two-way Table   * Joint distribution; * Marginal distribution; * Conditional distribution; * Segmented bar graph   2.3.2 Simpson’s Paradox | Page 12~21  Section 1.1  (Two-way tables and  marginal distribution)  Page 303~307  Section 5.2  (Two-way tables and  Probability)  Page 312~314  Section 5.3 | Exercise:  P152/3, 4, 5, 7, 8, 9, 10, 11 |
| **Topic Two:**  **Planning a Study**  Chapter 3:  Experiment  (1 week) | Unit 3.1 Experimental Design  Preface: Methods of data collection   * Observational study; experiment   3.1.1 Question of causation   * Lurking variable; * Causation; common response;   Confounding  3.1.2 Parts of an Experiment   * Experiment unit; * Explanatory variable; response variable * Factor; level; treatment   3.1.3 Principles of a well-designed  Experiment   * Control; placebo effect; blinding; blocking; * Randomization; replication   3.1.4 Experimental Design   * Completely randomized design * Randomized block design * Matched pair design | Page 231~252  Section 4.2 | Exercise:  P164/2, 3, 4, 7, 8, 9, 10;  P195/1, 2, 3, 4, 7, 12, 13  Homework:  Question 121~124, 126~129, 131~135, 137,  140, 156~160,  165, 167/(a)(b) |
| Chapter 4:  Sample Survey  (1 week) | Unit 4.1 Sampling Design  Preface: Type of survey   * Census; sample survey   4.1.1 Non-probability sampling   * Voluntary sample; * Convenience sample;   4.1.2 Probability sampling   * Simple random sampling; * Stratified sampling; * Cluster sampling; * Multi-stage sampling; * Systematic random sampling;   4.1.3 Bias in a sample survey   * Selection bias; under-coverage; * non-response bias; * voluntary response bias; * Response bias; wording of the question   4.1.4 Sampling error | Page 207~225  Section 4.1 | Exercise:  P175/1, 2, 3, 4, 5, 6, 7, 10, 12, 13  Homework:  Question 140~147, 149~155, 158,  162, 163, 165,  170/(a)(b)(c) |
| **Topic Three:**  **Anticipating Pattern**  Chapter 5:  Probability  (2 weeks) | Unit 5.1 Probability  5.1.1 Randomness   * Random phenomenon; * Law of large numbers;   5.1.2 Sample Space and Events   * Sample space; event;   5.1.3 Equally Likely Outcomes | Page 283~288  Section 5.1 | Exercise:  P229/2, 9, 11, 12, 13, 16, 27, 28, 29, 34, 35, 42, 43, 45, 46  Homework:  Question 173~180, 191~200, 211,  216, 218, 219,  221/(b)(c) |
| Unit 5.2 Principle Rules  5.2.1 Addition Rule   * Disjoint event; union   5.2.2 Complement Rule   * Complement of event;   5.2.3 Multiplication Rule   * Independent event; intersection | Page 299~308  Section 5.2  Page 312~328  Section 5.3 |
| Unit 5.3 General Rules  5.3.1 General Addition Rule   * Compatible event   5.3.2 General Multiplication Rule   * Dependent event; * Conditional probability   5.3.3 Tree Diagram   * Multi-stage Probability Rule   5.3.4 Bayes’ Rule |
| Chapter 6:  Random Variable and  Distribution  (3 weeks) | Unit 6.1 Random Variable  6.1.1 Concept of Random Variable   * Random variable; * Probability distribution;   6.1.2 Mean and Variance of a Random Variable  6.1.3 Rule for Mean and Variance   * Linear transformed variables * Combined random variables | Page 341~352  Section 6.1  Page 358~377  Section 6.2 | Exercise:  P229/3, 8, 20, 21, 36, 37  P259/5, 6, 7, 3, 4, 8  Homework:  Question 183~186, 189,  190, 213~215,  220/(a)(b) |
| Unit 6.2 Discrete Probability  Distribution  6.2.1 Binomial Distribution   * Binomial setting; * Binomial probability; * Mean and standard deviation for binomial distribution   6.2.2 Geometric Distribution   * Geometric setting * Geometric probability | Page 382~402  Section 6.3 | Exercise:  P229/4, 7, 10,  40, 44  Homework:  Question 226,  227, 230~236,  243, 244,  246~254, 260~263, 273,  275/(a)(b) |
| Unit 6.3 Continuous Probability  Distribution  6.3.1 Uniform Distribution  6.3.2 Normal Distribution   * Normal probability calculation; * Standard normal distribution   6.3.3 Normal Approximation of the  Binomial Distribution   * Continuity correction | Page 110~130  Section 2.2  Page 395~397  Section 6.3  (Normal Approximation for Binomial  Distributions) | Exercise:  P277/1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16;  P240/47  Homework:  Question 201~207, 209,  210, 212,  222/(a)(b)(c)  237~242, 264~269, 271,  272, 279/(a)(b) |
| Unit 6.4 Simulating Random Behavior  6.4.1 Steps to conduct a simulation  6.4.2 Simulating binomial modals  6.4.3 Simulating geometric modals | Page 289~293  Section 5.1  (Simulation) |
| Chapter 7:  Sampling Distribution  (2 weeks) | Unit 7.1 Sampling Distribution  7.1.1 Sampling Distribution of Single Population   * Sampling distribution of sample proportion; * Sampling distribution of sample mean; * Central limit theorem   7.1.2 Sampling Distribution of a  Difference of Two Population   * Sampling distribution of a   difference of two proportions   * Sampling distribution of a   difference of two sample means  7.1.3 t-Distribution  7.1.4 Chi-square Distribution | Page 416~428  Section 7.1  Page 432~439  Section 7.2  Page 442~454  Section 7.3  Page 604~608  Section 10.1  Page 628~632  Section 10.2  Page 505~506  Section 8.3  (t-distribution)  Page 682  Section 11.1  (Chi-square Distributions) | Exercise:  P304/1, 2, 3, 5, 7, 8, 10, 12, 13, 14, 15  Homework:  Question 245,  255~259, 270,  276/(a)(b), 278/(a)(b), 280/(a) |
| **Topic Four:**  **Statistical Inference**  Chapter 8:  Confidence Interval  (3weeks) | Unit 8.1 Confidence Interval  Preface: Statistical Inference  8.1.1 Concept of Confidence Interval   * Estimation; statistic; confidence level; margin of error; * Construct a confidence interval; * Interpret a confidence interval;   8.1.2 Confidence Interval for means and proportions   * CI for One large-sample   proportion;   * CI for Two large-sample   proportions;   * CI for One-sample mean (σ is known); * CI for One-sample mean (σ is unknown); * CI for Two-sample means (σ1, σ2 are known); * CI for Two-sample means (σ1, σ2 are unknown); * CI for pooled two-sample means; * CI for mean difference of paired data;   8.1.3 Sample Size for Confidence  Interval   * Procedure to reduce the margin of error | Page 469~480  Section 8.1  Page 484~495  Section 8.2  Page 499~517  Section 8.3  Page 608~611  Section 10.1  Page 634~637  Section 10.2 | Exercise:  P338/1, 2, 4, 5, 10, 11, 12, 13, 14, 15, 16, 18, 20, 22, 24, 25, 26, 27, 28, 33  Homework:  Question 281~283, 286,  287, 289~302,  305, 307~310,  312~314, 317,  319, 321~324,  327/(b), 328/(a)(b), 330/(b)(c) |
| Chapter 9:  Test of  Significance  (4 weeks) | Unit 9.1 Conduct a Significance Test  9.1.1 Concept of a Significance Test   * Statistical significance;   9.1.2 Procedure for conducting a  Significance Test   * State the hypothesis; * Identify the test and check the assumptions; significance level; * Compute the test statistic and P-value; region of rejection * Make a conclusion and interpret the result; | Page 529~537  Section 9.1 | Exercise:  P378/1, 2, 3, 4, 6, 7, 8, 11, 13, 14, 15, 17, 18, 20, 21, 22, 24, 25  Homework:  Question 284,  285, 303, 304,  315, 318,  331~337, 339~356, 358~385,  386/(b), 387/(b), 388/(a)(b), 389/(b) |
| Unit 9.2 Test for Means and  Proportions  9.2.1 Test for One large-sample  Proportion  9.2.2 Test for Two large-sample  Proportions  9.2.3 Test for One-sample Mean (σ is known)  9.2.4 Test for Two-sample Means (σ1, σ2 are known)  9.2.5 Test for One-sample Mean (σ is unknown)  9.2.6 Test for Two-sample Means (σ1, σ2 are unknown)  9.2.7 Test for Pooled Two-sample  Means  9.2.8 Test for Mean Difference of  Paired data  9.2.9 Confidence Interval and  Two-tailed Significance test | Page 549~561  Section 9.2  Page 565~586  Section 9.3  Page 604~620  Section 10.1  Page 627~650  Section 10.2 |
| Unit 9.3 Two Type of Errors and Power of a Test  9.3.1 Two Type of Errors   * Type I error; Type II error;   9.3.2 Power of a Test   * Factors that affect power; | Page 538~545  Section 9.1 |
| Chapter 10:  Inference for  Regression  (2 weeks) | Unit 10.1 Inference for Regression  Preface: Inference for Slope of a  Regression Line  10.1.1 Simple Linear Regression  10.1.2 Sampling Distribution of Slope of a Regression Line   * Mean and standard deviation of slope of a regression line;   10.1.3 Significance Test for Slope of a Regression Line  10.1.4 Confidence Interval for Slope of a Regression Line | Page 739~758  Section 12.1 | Exercise:  P347/35, 37  P424/11, 12  Homework:  Question 391~396, 399~405, 407,  409~412, 415,  418~420, 422,  423, 425, 427,  428, 431~436,  438, 439,  440/(a)(b), 442/(a)(b) |
| Chapter 11:  Inference for  Categorical Data  (2 weeks) | Unit 11.1 Test of One-way Table  11.1.1 Test for Goodness-of-fit  11.1.2 Conduct a Test of goodness-of- fit   * Expected count; * Chi-square statistic | Page 678~691  Section 11.1 | Exercise:  P420/2, 5, 8  Homework:  Question 446,  449~453, 455,  456, 458, 461,  463, 470~472,  475, 479, 481,  483, 485,  487~490, 496/(a)(b), 497/(a)(b)(c) |
| Unit 11.2 Test of Two-way Table  11.2.1 Test for Independence  11.2.2 Conduct a Test for  Independence   * Expected count; Row total;   column total   * Chi-square statistic   11.2.3 Test for homogeneity  11.2.4 Conduct a Test for  homogeneity | Page 696~723  Section 11.2 | Exercise:  P420/3, 4, 6, 7, 9, 10  Homework:  Question 454,  457, 467~469,  473, 474,  476~478, 491~494, 499/(a)(b) |
| 3 weeks | Review and simulation test |  |  |

**AP Statistics Project Example (Response Bias)**

**The Project:** You will design and conduct an experiment to investigate the effects of response bias in surveys. You may choose the topic for your surveys, but you must design your experiment so that it can answer at least one of the following questions:

* Can the wording of a question create response bias?
* Do the characteristics of the interviewer create response bias?
* Does anonymity change the responses to sensitive questions?
* Does manipulating the answer choices change the response?

**Proposal:** The proposal will be worth 20% of the grade, so don’t treat it casually. If the proposal isn’t approved the first time, you will need to resubmit it for a reduced grade. You must attach the original proposal to any resubmissions.

In your proposal, you should:

* Describe your topic and state which type of bias you are investigating
* Describe how you will obtain your subjects (minimum sample size is 50). This must be practical!! Note: your population does not need to be from Carlmont High School nor should you interrupt any classes.
* Describe what your questions will be and how they will be asked, including how you will incorporate direct control, blocking (if any), and randomization. Convince me that this is a good experiment!

**Four Paragraphs:** These four paragraphs, in addition to your project title and question, should be included on your poster (clearly labeled):

A. Introduction: What form of response bias were you investigating? Why did you choose the topic you chose for the survey?

B. Methodology: Describe how you conducted your experiment and why you think your design was effective. Note: This section should be very similar to your proposal.

C. Results: Present the data in both tables and graphs in such a way that conclusions can be easily made. Make sure to label the graphs/tables clearly and consistently.

D. Conclusions: What conclusions can be drawn from your experiment? Be specific. Did you encounter any problems during your project? Would you do anything different if you were to repeat your experiment? What did you learn from this project?

E. Your original proposal

**Poster:** The poster should completely summarize your project, yet be simple enough to be understood by a freshman. Be sure to include some pictures of your data collection in progress. Do not make it heavy--I want to hang them up!

**Oral Presentation:** Both members need to participate equally. Your poster should be used as a visual aid. Approximately 5 minutes. Be prepared for questions.

**Examples of Successful Projects:**

“Cartoons”, by Sean Wu and Brian Hartzheim

1. “Do you watch cartoons?” (90% yes)

2. “Do you *still* watch cartoons?” (60% yes)

“Milk vs. Orange Juice”, by Angela Chen and Sharon Lai

1. “Which do you prefer, milk or orange juice, as a breakfast drink?” (milk: 14%)

2. “Milk contains high levels of vitamin D and calcium. Do you prefer milk or orange juice as a breakfast drink?” (milk: 64%)

“Cheating”, by Wilson Kurniawidjaja, Oliver Lee, and Charlene Wang

1. “Do you cheat in class?” (anonymous: 47% would)

2. “Do you cheat in class?” (not anonymous: 15% would)

“Make-Up”, by Caryn Suryamega and Trisha Tsuno

(all questions asked to males)

1. “Do you find females who wear makeup attractive?” (wearing makeup: 75% yes)

2. “Do you find females who wear makeup attractive?” (without wearing makeup: 30% yes)

“Time Online”, by Yale Lee and Helen Theung

1. “On average, how many hours do you spend online each week: 0-5, 6-10, 11-16, 17-25, 26- 35, or more?”

2. “On average, how many hours do you spend online each week: 0-5, 6-10, 11-16, or more?”

-For this question, the students anticipated that subjects would be embarrassed to put “more”. In the first question, 50% answered over 17 hours, but in the second question, 0% did.