AP Statistics
Course Syllabus
Updated: 10/26/10

Course Description

AP Statistics is a course of investigation methods. Unlike many other courses, AP Statistics emphasizes classroom discussion and the communication of mathematical concepts in order to gain a better understanding of the world, in particular the parts of the world that cannot be conveniently modeled by conventional mathematics. The classroom itself is set up so that students can participate in both group discussion and individualized work. Desks can easily be moved from rows to clusters of three with no student being unable to see information presented by the instructor or their fellow students.

Our class utilizes a combination of given instruction and investigation, using materials that come from numerous sources, particularly the text book, the internet, and articles both from newspapers and journals. Students have access to TI 83's and the programs Logger Pro and open office spreadsheet. Students have access to all of the formulas provided on the AP exam at any time.

Projects

Our class includes at minimum one major project for every two units, and smaller projects for every unit in the class. Projects are very important to the make-up of the class. Unit projects are generally directed based on the additional classroom materials, while major projects are given broad guidelines, while the students select their subject from anything they can think of that relates to the practice of statistics.

Primary Resources

Moore, David S., and George P. McCabe. *Introduction to the Practice of Statistics*. 4th ed. New York: W.H. Freeman, 2002.

Huff, Daniel. *How to Lie with Statistics.* W.W. Norton & Company, Inc. 1954.

Texas Instruments TI 83 graphing calculators

Open Office Spreadsheet

Logger Pro (graphical analysis program)

Curriculum Units

Unit 1: **Exploratory Data Analysis (4-5 weeks)**

Unit objectives:

1. Students will be able to construct and interpret the following graphical representations:
a. Bar graphs
b. Histograms
c. Box plots
d. Ogives
e. Pie charts
f. Time series plots
g. Dot plots
h. Stem plots

2. Students will be able to calculate and explain the concepts of univariate data, including mean, median, mode, standard deviation, variance, quartiles, interquartile range, maximum and minimum values, and students should be able to determine if any values are to be considered outliers.

3. Students will be able to analyze center and spread of a distribution, and make decisions about which method of analysis above will be most appropriate.

4. TI 83 usage will be practiced throughout this unit.

5. A unit test will be given consisting of AP level multiple choice and free response questions.

6. Homework will be given nightly with a problems from the book meant to extend the concepts seen in class.

7. Students will use univariate data analysis to compare housing prices in the place they would like to live.

Unit 2: Linear Regression (3-4 weeks)

1. Students will be instructed in constructing scatterplots by hand, using computer programs, and using the TI 83 calculators.

2. Students will learn to calculate and correctly explain the correlation coefficient and the correlation squared in the context of real life problems.

3. Students will be able to find a least-squares regression line via the TI 83 calculator and computer software, and they will be able to use the formula to make interpolated predictions about possible values within the data range.

4. Students will be instructed on how to identify influential points, and how to transform data after examining the residual plot in order to linearize data.

5. A unit test will be given consisting of AP level multiple choice and free response questions.

6. Homework will be regularly assigned throughout the unit.

7. Students investigated residuals by comparing the age of celebrities with the age they guessed.

Unit 3 Experimental Design (3 weeks)

1. Students will gain an understanding of when causation can be determined, experiments, and observational studies.

2. Students will be able to identify anecdotal evidence, and determine the role it should play in experimental design.

3. Students will learn how to design and experiment or a study, including sampling techniques such as simple random sampling, stratifying, blocking, and other sampling methods.

4. Students will be able to analyze an experimental design for sampling error, confounding and bias.

5. Students will learn the importance of replication of studies.

6. Other experimental design concepts will be taught here, including census's, cluster sampling, control groups, placebo effect, generalizability of results, observational studies, treatments, experimental units, and blinding.

7. A unit test comprised of multiple choice and free response questions will be given.

8. Homework will be given regularly from Moore.

9. A major project will be assigned where students must use the concepts taught in the unit and in units 1 and 2 in order to design a study or experiment, carry it out, and analyze the results.

Unit 4 Probability (2 weeks)

1. Students will become familiar with basic probability rules.

2. Class activities will be used to demonstrate probability.

3. Students will have a unit quiz based on AP multiple choice problems.

4. The unit project will be to construct a game that will be tested on the class at the end of the unit.

5. Homework will be regularly assigned from the text book.

Unit 5 Sampling Distributions (2-3 weeks)

1. Students will be instructed on random variables.

2. Students will practice constructing and interpreting sampling distributions, as well as making simulations of probability distributions.

3. Students will learn how to calculate and use expected values and the standard deviation of random variables in the context of problem solving.

4. Students will be able to find the mean and standard deviation for sums and differences of random variables that are independent.

5. Multiple computer applets will be used as part of a one day lab exercise to help students gain a better understanding of sampling distributions.

6. TI 83 graphing calculators will be used daily.

7. A unit test will be given that will incorporate both sampling distributions and probability.

Unit 6 Simulating Distributions (3-4 weeks)

1. Students will learn how to calculate binomial probabilities, construct binomial distributions, and learn how to find a normal approximation to the binomial distribution.

2. Students will be introduced to the Law of large numbers.

3. Students will be instructed on the use of PDF and CDF functions on the TI 83 calculator in order to learn how counting principles impact the normal approximation of the binomial distribution.

4. Students will learn the following concepts: binomial probabilities, binomial distribution, normal approximation for counts and proportions, geometric distributions and probabilities of geometric distributions, sampling distribution of a sample mean, and the central limit theorem.

5. Students will complete a class activity intended to communicate the central limit theorem.

6. A test will be given at the end of the unit consisting of AP level multiple choice and free response questions.

7. Homework will be given regularly from Moore.

Unit 7 Confidence Intervals (3 weeks)

1. Students will be able to estimate population means, calculate critical values, margin of error, and sample size.

2. Students will be introduced to the world of hypothesis testing.

3. Students will be able to define and use null and alternative hypotheses, p values, statistical significance, z test for population mean, confidence intervals, and two-sided tests.

4. Type I and Type II errors will be explained by the students, as well as power and power curves. Students will be able to determine statistical significance and practical significance.

5. Students will complete a hypothesis test project including all material previously learned up to the present. The subject of the project will be chosen by the student.

6. A test will be given at the conclusion of the unit.

7. Problems will be assigned as homework from Moore.

Unit 8 Inference for a Single Proportion (2 weeks)

1. Students will be introduced to the concept of inference by use of large-sample inference for a population proportion.

2. Students will be able to find the confidence interval for a population proportion, calculate a necessary sample size, and determine margin of error.

3. Students will be able to compare two proportions and make judgements using statistical methods.

4. Students will be able to construct confidence intervals for the differences between two proportions, as well as

calculate significance tests for comparing the two proportions.

5. A test will be given at the end of the unit, and homework will be assigned regularly from Moore.

Unit 9 Distributions (3 weeks)

1. Students will be able to calculate and interpret standard error.

2. Students will be able to perform one-sample t procedures and matched pairs t procedures.

3. Students will be able to compare two means, find a two-sample t statistic, and a two-sample independent t procedure.

4. Students will be given a choice of research articles for analysis which they must calculate the appropriate p-values for inference.

5. A test will conclude the unit, and homework will be given from Moore.

Unit 10 Contingency and Two-way tables (2 weeks)

1. Students will be able to organize relations in a two-way table, find the chi-square test for goodness of fit, determine the homogeneity of proportions, and determine independence of one and two way tables.

2. Students are assigned the year end review project, where they must make their own review booklet due the week before the AP exam.

3. At the conclusion of this unit, students will be given a quiz, and homework will be assigned throughout.

Unit 11 Inference for Regression (2 weeks)

1. Students will be able to construct a simple linear regression model, estimate regression parameters, find confidence intervals and conduct inference for the slope, and make confidence intervals for future observations.

2. Students will conduct an in class project in order to find confidence intervals for the least square regression line.

3. Unit 11 ends with a test over Units 10 and 11.

Unit 12 AP review (1 week)

1. Students will present their review projects.

2. A sample AP test will be given as the official final exam.

Unit 13 Post-AP Exam (3 weeks)

Students will conduct computer lab experiments in order to complete a final project of their choosing.

Notes:

How to Lie with Statistics is assigned for reading, 1 chapter per weekend. The following class the students conduct an activity based on the lesson of the chapter.

Not all resources are listed above, only the resources that will definitely be used are present.

First Term Project

Personal Investigation: Experimental Design and Exploratory Data Analysis

The world around us leaves much to be discovered. No doubt you have noticed something in your own life that has made you wonder if a legitimate connection exists. In this project, you are going to conduct and observational study or an experiment to see if there may be an association between two of the many variables in your life.

Project Requirements

Your project must include the following:

1. Your project must be the study of two quantitative variables.
2. You are testing for an association between these variables, so you must conduct a linear regression test, determine correlation, r-squared, and make a residual plot.
3. You must conduct an observational study or an experiment.
4. Regardless of which of the above you choose, you must write, in detail, the methods you used to conduct the study or experiment, using correct statistical vocabulary.
5. For this project, you may not use pre-existing data.
6. The final write-up must include the following sections.

Introduction: Your introduction needs to include your reasons for conducting the study and the anecdotal evidence that made you suspect a possible association in the first place.
Methodology: In this section, you must describe, in detail how you conducted your observational study or experiment. You must include the measures you took in order to isolate the two variables you intend to study, and detail any variables that couldn't be feasibly isolated.
Data: In this section, you must describe your data, and list it in table form.
Analysis: This section must include the steps of analysis you took to analyze your data. There must be a scatterplot of the data, a linear regression line, a calculation of correlation and r-squared, and a residual plot. Lastly, all variables must be defined, and using correlation, r-squared, and the residual plot, you must make a brief discussion about any possible association.
Conclusion: State you conclusions about your initial suspicions. Does there seem to be an association? Based on your experimental design, how generalizable are the results? Did anything unexpected or unplanned for occur?

*The final write-up is due the class before December break. It should be about 5 pages (double spaced, including graphs).
*As an intermediate step, the introduction and methodology are due the class before Thanksgiving break, thus ensuring that there will be enough time to conduct the research necessary for the project.

Final Project

Year End Project: Introduction to Statistics in Review

Throughout the course of the year we have seen everything from experimental design to hypothesis testing to inference. In this final project, you will use all the concepts learned throughout the course of the class to design and conduct an observational study or an experiment, present your data graphically and with summation data, and you will use inference to draw conclusions about your hypothesis. All of this will be done on a topic of your choosing.

Project Requirements

1. Your data must be something you can perform statistical inference on.
2. You must have some specific reason to test the topic you pick.
3. If you collect the data yourself, you must have at least 50 data points, if you use pre-existing data, you must have at least 300 data points.
4. All data will be analyzed using the computer software available to you.
5. The project must be typed, double spaced, with an approximate length of 8 to 10 pages (pictures included).
6. You must describe, in detail, your experimental design using appropriate statistical language.
7. You will be graded on how accurately you describe your results using statistical language.
8. The final report must include the following sections

Introduction: Your introduction needs to include your reasons for conducting the study and the anecdotal evidence that made you suspect a possible association in the first place. In addition, you must also include a hypothesis statement expressing both the null and alternate hypothesis.
Methodology: In this section, you must describe, in detail how you conducted your observational study or experiment. You must include the measures you took in order to isolate the two variables you intend to study, and detail any variables that couldn't be feasibly isolated.
Data: In this section, you must describe your data, and list it in table form. In addition, you must also provide summation data, graphical representations of the data, and if you are testing for association, you must also include a linear regression line and a residual plot.
Analysis: The analysis must include the tests for statistical inference that you have conducted, and the meaning of the results of the test.
Conclusion: State you conclusions about your initial suspicions. Does there seem to be an association? Based on your experimental design, how generalizable are the results? Did anything unexpected or unplanned for occur?

The experimental design section is due May 5th for review.

The final project is due May 28th.