AP/KAP Statistics 2012-2013

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Primary Textbook: Starnes, David S., Yates, Daniel S., Moore, David S. The Practice of Statistics. 4th ed. New York: W.H.Freeman and Company, 2012.

Video Resource: Annenberg/CPB. *Against All Odds: Inside Statistics*. 26 thirty-min. Washington, D.C.: The Annenberg/CPB Collection, 1989. Videocassettes. (800) LEARNER. **www.learner.org.**

Technology:
TI-83, TI-83 plus, or TI 84 plus (silver edition preferred) **Graphing Calculator** will be required. We will also, periodically throughout the year, work in the computer lab with **MiniTab**. We will also use online applets to help visualize statistical concepts.

Grading:

Homework: (10%)
Homework will be checked at the start of the class when the assignment is due. It will be collected periodically. All work must be shown in order to receive full credit.

Tests: (40%)
There will be approximately one test given per chapter. Each test will cover the objectives of that chapter, but may also contain important past material. Tests will be announced well in advance.

1st Semester Exam and 2nd Semester Final Project: (20%)
There will be a cumulative final exam at the end of first semester. There will be a final project second semester. The Project will be in the form of a written report. Students will form their own question, design an experiment, analyze the data obtained, and draw conclusions using the inference methods we have learned in class.

AP Problems and Projects: (10%)
About 2 to 3free response AP problems (Frappy's) will be assigned for each chapter. They will be graded by the AP scoring rubrics. They will be done individually or in groups.

Projects are in the form of written reports. Sometimes they will be done individually or in pairs. Expect at least 2 projects each semesters.

In-Class Activities: (20%)
This class involves *active participation*. There will be a variety of activities completed in class, either independently or in groups. Participation in all in-class activities is expected.
Many of these will be collected.

Course Content:
Unit 1: Sampling Procedures and Displaying Data (3-4 weeks)

Objectives:

- ✓ IDENTIFY the population and sample in a sample survey
- ✓ IDENTIFY voluntary response samples and convenience samples
- ✓ DESCRIBE how to use a table of random digits and a calculator to select a simple random sample (SRS)
- ✓ DESCRIBE simple random samples, stratified random samples systematic samples, and cluster samples
- ✓ EXPLAIN how undercoverage, nonresponse, and question wording can lead to bias in a sample survey
- ✓ CLASSIFY variables as categorical or quatitative
- ✓ CONSTRUCT and INTERPRET bar graphs and pie charts
- ✓ RECOGNIZE "good" and "bad" graphs
- ✓ CONSTRUCT and INTERPRET two-way tables
- ✓ DESCRIBE relationships between two categorical variables by computing conditional distributions
- ✓ CONSTRUCT and INTERPRET dotplots, stemplots, and histograms
- ✓ DESCRIBE the shape of a distribution
- ✓ COMPARE distributions
- ✓ USE histograms wisely
- ✓ MEASURE and CALCULATE center with the mean and median
- ✓ MEASURE and CALCULATE spread with standard deviation and interquartile range
- ✓ IDENTIFY outliers
- ✓ CONSTRUCT a boxplot using the five-number summary
- ✓ CALCULATE numerical summaries with technology

Project: Univariate Qualitative Data: collect data, create computer-generated graphs, analyze

Unit 2: Describing Location in a Distribution (2 weeks)
Objectives:

- ✓ MEASURE position using percentiles
- ✓ INTERPRET cumulative relative frequency graphs
- ✓ MEASURE position using *z*-scores
- ✓ TRANSFORM data
- ✓ DESCRIBE the effect of adding subtracting, multiplying y, or diving by a constant on the shape, center, and spread of a distribution
- ✓ DEFINE and DESCRIBE density curves
- ✓ DESCRIBE and APPLY the 68-95-99.7 Rule
- ✓ DESCRIBE the standard Normal Distribution
- ✓ USE the standard Normal distribution to calculate the proportion of values in a specified interval.
- ✓ USE the standard Normal distribution to determine a z-score from a percentile.
- ✓ INTERPRET a Normal probability plot

Unit 3: Describing Relationships (3 weeks)
Objectives:

- ✓ IDENTIFY explanatory and response variables
- ✓ CONSTRUCT scatterplots to display relationships
- ✓ INTERPRET scatterplots
- ✓ MEASURE linear association using correlation
- ✓ INTERPRET correlation
- ✓ INTERPRET a regression line
- ✓ CALCULATE the equation of the least-squares regression line
- ✓ CALCULATE residuals
- ✓ CONSTRUCT and INTERPRET residual plots
- ✓ DETERMINE how well a line fits observed data
- ✓ DETERMINE how well a line fits observed data – r^2
- ✓ INTERPRET computer regression output
- ✓ USE technology to find a least-squares regression line
- ✓ FIND the slop and intercept of the LSRL from the means and standard deviations of x and y and their correlation.
- ✓ EXPLAIN the dangers of extrapolation

Project: Bivariate Qualitative Data: collect data, create computer-generated graphs, analyze

Unit 4: Experiments (2 weeks)
Curricular Requirement(s) Met:

Objectives:

- ✓ DISTINGUISH observational studies from experiments
- ✓ EXPLAIN how a lurking variable in an observation study can lead to confounding.
- ✓ DESCRIBE the language of experiments: experimental units, explanatory variables, factors, treatments, response variables
- ✓ Explain why the three principles of experimental design are important: control, random assignment, and replication.
- ✓ DESIGN comparative experiments utilizing completely randomized designs and randomized block designs, including matched pairs design
- ✓ Describe how to avoid the placebo effect in an experiment through blind or double blind studies.
- ✓ DESCRIBE the challenges of establishing causation
- ✓ DESCRIBE data ethics in designing studies

Discussion: *Real Knife, Fake Surgery*
Videos: *Experimental Design, Blocking and Sampling.*
Cumulative Test Units 1-4

Unit 5: Probability (3 weeks)

Objectives:

- ✓ DESCRIBE the idea of probability
- ✓ DESCRIBE myths about randomness
- ✓ DESIGN and PERFORM simulations
- ✓ DESCRIBE chance behavior with a probability model
- ✓ DEFINE and APPLY basic rules of probability including the addition rule, complement rule and multiplication rule
- ✓ DETERMINE probabilities from two-way tables
- ✓ CONSTRUCT Venn diagrams and DETERMINE probabilities
- ✓ COMPUTE conditional probabilities
- ✓ DESCRIBE chance behavior with a tree diagram
- ✓ DETERMINE whether two events are independent
- ✓ APPLY the general multiplication rule to solve probability questions

Unit 6 – Random Variables (3 weeks)
Objectives:

- ✓ APPLY the concept of discrete random variables to a variety of statistical settings
- ✓ CALCULATE and INTERPRET the mean (expected value) of a discrete random variable
- ✓ CALCULATE and INTERPRET the standard deviation (and variance) of a discrete random variable
- ✓ DESCRIBE continuous random variables
- ✓ DESCRIBE the effect of performing a linear transformation on a random variable
- ✓ COMBINE random variables and CALCULATE the resulting mean and standard deviation
- ✓ CALCULATE and INTERPRET probabilities involving combinations of Normal random variables
- ✓ Use a graphing calculator for a normal random variable to find probabilities of events
- ✓ DETERMINE whether the conditions for a binomial setting are met
- ✓ COMPUTE and INTERPRET probabilities involving binomial random variables
- ✓ CALCULATE the mean and standard deviation of a binomial random variable and INTERPRET these values in context
- ✓ USE a normal approximation to the binomial distribution to compute probabilities
- ✓ CALCULATE probabilities involving geometric random variables
- ✓ USE graphing calculator to determine the probabilities of the binomial and geometric distributions

Video: *Binomial Distributions*

End of Semester 1 – Semester Exam on Units 1-6

Unit 7 - Sampling Distributions (2-3 weeks)
Objectives:

- ✓ DISTINGUISH between a parameter and a statistic
- ✓ DEFINE sampling distribution
- ✓ DISTINGUISH between population distribution, sampling distribution, and the distribution of sample data
- ✓ DETERMINE whether a statistic is an unbiased estimator of a population parameter
- ✓ DESCRIBE the relationship between sample size and the variability of an estimator
- ✓ FIND the mean and standard deviation of the sampling distribution of a sample proportion
- ✓ DETERMINE whether or not it is appropriate to use the Normal approximation to calculate probabilities involving the sample proportion
- ✓ CALCULATE probabilities involving the sample proportion
- ✓ EVALUATE a claim about a population proportion using the sampling distribution of the sample proportion
- ✓ FIND the mean and standard deviation of the sampling distribution of a sample mean
- ✓ CALCULATE probabilities involving a sample mean when the population distribution is Normal
- ✓ EXPLAIN how the shape of the sampling distribution of sample means is related to the shape of the population distribution
- ✓ APPLY the central limit theorem to help find probabilities involving a sample mean

Activity: The Candy Machine Applet
Activity: Rice University Sampling Distribution Applet

Unit 8 – Estimating with Confidence (3 weeks)
Objectives:

- ✓ INTERPRET a confidence level
- ✓ INTERPRET a confidence interval in context
- ✓ DESCRIBE how a confidence interval gives a range of plausible values for the parameter
- ✓ DESCRIBE the inference conditions necessary to construct confidence intervals
- ✓ Understand why each of the three inference conditions—Random, Normal, and Independent—is important
- ✓ EXPLAIN practical issues that can affect the interpretation of a confidence interval
- ✓ CONSTRUCT and INTERPRET a confidence interval for a population proportion

- ✓ DETERMINE the sample size required to obtain a level *C* confidence interval for a population proportion with a specified margin of error
- ✓ DESCRIBE how the margin of error of a confidence interval changes with the sample size and the level of confidence *C*
- ✓ CARRY out the steps in constructing a confidence interval for a population mean: define the parameter; check conditions; perform calculations; interpret results in context.
- ✓ DETERMINE the sample size required to obtain a level *C* confidence interval for a population mean with a specified margin of error
- ✓ DESCRIBE how the margin of error of a confidence interval changes with the sample size and the level of confidence *C*
- ✓ DETERMINE sample statistics from a confidence interval
- ✓ Use calculator as an aid in finding confidence intervals

Unit 9 – Testing a Claim (2-3 weeks)
Objectives:

- ✓ STATE correct hypotheses for a significance test about a population proportion or mean.
- ✓ INTERPRET *P*-values in context.
- ✓ CHECK conditions for carrying out a test about a population proportion.
- ✓ CONDUCT a significance test about a population proportion.
- ✓ CONSTRUCT a confidence interval to draw a conclusion about for a two-sided test about a population proportion.
- ✓ CHECK conditions for carrying out a test about a population mean.
- ✓ CONDUCT a one-sample *t* test about a population mean.
- ✓ CONSTRUCT a confidence interval to draw a conclusion for a two-sided test about a population mean.
- ✓ PERFORM significance tests for paired data.
- ✓ RECOGNIZE paired data and use one-sample *t* procedures to perform significance tests for such data.
- ✓ INTERPRET a Type I error and a Type II error in context, and give the consequences of each.
- ✓ DESCRIBE the relationship between the significance level of a test, *P*(Type II error), and power.

Unit 10 – Comparing Two Populations or Groups (2 weeks)
Objectives:

- ✓ DESCRIBE the characteristics of the sampling distribution of $\hat{p}_1 - \hat{p}_2$
- ✓ CALCULATE probabilities using the sampling distribution of $\hat{p}_1 - \hat{p}_2$
- ✓ DETERMINE whether the conditions for performing inference are met.
- ✓ CONSTRUCT and INTERPRET a confidence interval to compare two proportions.
- ✓ PERFORM a significance test to compare two proportions.

- ✓ INTERPRET the results of inference procedures in a randomized experiment.
- ✓ DESCRIBE the characteristics of the sampling distribution of the difference between two sample means
- ✓ CALCULATE probabilities using the sampling distribution of the difference between two sample means
- ✓ DETERMINE whether the conditions for performing inference are met
- ✓ USE two-sample *t* procedures to compare two means based on summary statistics or raw data
- ✓ INTERPRET computer output for two-sample *t* procedures
- ✓ PERFORM a significance test to compare two means
- ✓ CHECK conditions for using two-sample *t* procedures in a randomized experiment.
- ✓ INTERPRET the results of inference procedures
- ✓ DETERMINE the proper inference procedure to use in a given setting.

Project: Comparing Two Means of Two Treatments or Populations

Unit 11 – Inference for Distributions of Categorical Data (1 -2 weeks)
Objectives:

- ✓ COMPUTE expected counts, conditional distributions, and contributions to the chi-square statistic
- ✓ CHECK the Random, Large sample size, and Independent conditions before performing a chi-square test
- ✓ PERFORM a chi-square goodness-of-fit test to determine whether sample data are consistent with a specified distribution of a categorical variable
- ✓ EXAMINE individual components of the chi-square statistic as part of a follow-up analysis
- ✓ PERFORM a chi-square test for homogeneity to determine whether the distribution of a categorical variable differs for several populations or treatments
- ✓ PERFORM a chi-square test for association/independence to determine whether there is convincing evidence of an association between two categorical variables
- ✓ EXAMINE individual components of the chi-square statistic as part of a follow-up analysis
- ✓ INTERPRET computer output for a chi-square test based on a two-way table
- ✓ Interpret computer output for a chi-square test based on a two-way table.
- ✓ Distinguish between the three types of chi-square tests.
- ✓ USE chi-square table in evaluating goodness of fit tests, tests of association and homogeneity
- ✓ USE calculator as a tool in finding the chi-square value to evaluate goodness of fit tests, test of association, and tests of homogeneity

Activity: M&M color distribution

Unit 12 – Inference for Regression (1 week)
Objectives:

- ✓ CHECK conditions for performing inference about the slope β of the population regression line
- ✓ CONSTRUCT and INTERPRET a confidence interval for the slope β of the population regression line
- ✓ PERFORM a significance test about the slope β of a population regression line
- ✓ INTERPRET computer output from a least-squares regression analysis
- ✓ USE transformations involving powers and roots to achieve linearity for a relationship between two variables
- ✓ MAKE predictions from a least-squares regression line involving transformed data
- ✓ USE transformations involving logarithms to achieve linearity for a relationship between two variables
- ✓ DETERMINE which of several transformations does a better job of producing a linear relationship

Unit 13 - Review for AP Exam (1-2 weeks)

- ❖ Complete previous Multiple-Choice Test
- ❖ Complete AP Problems not used earlier in course
- ❖ Review how to utilize the calculator to assist in success on the exam
- ❖ Review criteria/conditions for inferential statistical analysis

End of Second Semester - Final Project Due