MASCONOMET REGIONAL SCHOOL DISTRICT

Masconomet Regional High School Curriculum Guide

COURSE TITLE: Statistics **COURSE NUMBER:** 1461

DEPARTMENT: Mathematics **GRADE LEVEL(S) & PHASE:** 12, H / AP

LENGTH OF COURSE: Full Year

Course Description:

Citizens in a free society must be able to make informed choices in all areas of their lives. This course will enable students to grasp information that is presented to them, analyze it and make reasoned decisions about it. To accomplish this, students will learn to collect, organize and display relevant data to answer questions that can be addressed with data; use appropriate statistical methods and predictions that are based on data; develop and evaluate inferences and predictions that are based on data; and apply basic concepts of probability. Students will gain insight into the use of trend graphs and measures of spread for analyzing data. They will categorize data by the type of model that best represents them, design surveys to generate data and learn to choose representative samples and identify biases in the samples and survey questions. When determining relationships among variables, students will consider the difference between association and causation.

Central Objectives:

This course contains but is not limited to the AP curriculum as described by the College Board. This can be found at: http://apcentral.collegeboard.com/apc/public/courses/teachers_corner/2151.html .
From the AP course description is the following overview:

The purpose of the AP course in statistics is to introduce 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

These objectives address the Academic Expectations relating to effective communication, mathematical competency and problem solving skills.

Materials and Activities:

Text: Statistics: Modeling the World
By: David E. Bock, Paul F. Velleman, Richard D. DeVeaux
Pearson Addison Wesley; Boston, MA: 2004

Ancillary Materials:

AAO – Annenberg/CPB. Against All Odds: Inside Statistics series. Burlington, VT: thee Annenberg/CPB Collection, 1989. 26 half hour videotapes.

AS – ActivStats software, Velleman, Paul, Addison Wesley, 2004
Note: anytime the AS designation is used, students are in the computer room

Fathom Statistical Software

Ti- 83 Calculators

Reading Comprehension activities – created by teacher. Example in appendix

AP Statistics Teacher's Guide,

Sternstein, Martin. *Barron's How to Prepare for the AP Statistics Advanced Placement Exam*. 2nd ed. Hauppauge, NY: Barron's Educational Series, 2001.

Students are expected to have and use a graphing calculator in class and when doing assignments. Parents may request that their child borrow a school owned calculator for the year.

- Lecture and class discussion to explain concepts and processes.
- Individual and group work to practice skills presented in class, to apply them to various problem-solving situations and to develop the ability to work cooperatively in such situations.
- Student assignments to develop proficiency in those skills and processes presented and practiced in class.
- Group and individual investigations related to understanding and applying the concepts in the central objectives.
- Independent projects such as reports and computer work may be presented by students.

Scope and Sequence:

Content	Time	Resources/ Activities
Part I: Exploring and Understanding Data – 26 days total		
Why Statistics – Overview. The 5 "W"'s, identifying variables as categorical or quantitative. Students review basic statistical studies for 5 "W"'s	2 days	• Initial project- students gather classroom data and present univariate information informally. Opportunity to begin discussion on appropriate, effective graphs, variety of graphs. • AAO - #1- "What is Statistics" • BVD Ch 1,2 portions
Displaying and Describing Categorical Data summarize distribution with frequency tables, contingency tables, marginal and conditional distributions. Concept of independence is introduced	4 days	• Students bring in graphs/charts with categorical data, discuss appropriateness and effectiveness. Students provided with problematic graphs and find the errors. • "Race and Death Penalty" mini-project, using marginal and conditional distributions, graphical displays and using appropriate statistical language • Intro to Activ Stats – Computer Lab • BVD Ch 3
Displaying Quantitative Data histograms, stem-and-leaf, dotplots, timeplots, shape, skew, outliers, describe distribution of a quantitative variable in terms of its shape, center, and spread.	5 days	• Students bring in graphs/charts with quantitative data, discuss appropriateness and effectiveness. Students provided with problematic graphs and find/discuss the errors. • Ti GC capability –univariate data • US births by day of year – uncovering patterns and trends • Data analysis: State-by-state $ per student-public schools. Must produce visual display and well-written comparison of the distribution of expenditures • BVD Ch 4
Describing Distributions Numerically center, spread, five-number summary, boxplots, mean, median, mode, quartiles, percentiles, variance, standard deviation, compare two or more groups by comparing their boxplots	5 days	• AAO - #3- "Describing Distributions" • Computer Lab – AS – Moving points effect on 5 number summary • Computer Lab – AS – Boxplots • BVD Ch 5
The Standard Deviation as Ruler and the Normal Model changing the center, standardizing, normal model, parameter, statistic, 68-95-99.7 rule, normal probability plot, explain how extraordinary a standardized value may be by using a Normal model	6 days	• AAO - #4- "Normal Distributions" • Olympic Decathlon – use standard deviation to come up with a point system for the 10 events. Determine winner and compare to actual • BVD Ch 6
Univariate Data Project: Masconomet MCAS scores:	4 days	In computer lab, students are given Excel data for English and Math MCAS scores for school 10th grade the last 3 years, broken down according to year and gender. Must report on results. Included are appropriate graphs, comparisons and discussion. Must describe distributions - center, shape and spread. Explain decision to use mean/s.d. or 5 number summary. See appendix for complete project. Projects are given to school principal

Part II: Bivariate Data – 25 days total		
Scatterplots, Association, and Correlation explanatory/response variables, correlation and the misinterpretations of correlation.	5 days	• BVD Ch 7 • AS – developing for predicting r, effect of outliers by placing data points
Linear Regression linear models, predicted value, slope, regression to the mean, residuals, least squares, extrapolation, leverage, influential points, lurking variables.	12 days	• Ti GC capability –bivariate data including residual plots. • Investigative Task: Olympic Long Jump- must create linear model and correctly interpret the slope, intercept, and r^2 in the context of the problem. • BVD Ch 8,9
Re-expressing Data understanding the value of re-expressing data to improve symmetry, constant variance, or linearity	3 days	• BVD Ch 10 • Weightlifting vs. weight – Students will analyze data and report on findings in a mini-report.
Bivariate Data Project: Real Estate- What's the Price	5 days	• Students choose town and obtain information for at least 30 houses for sale. See appendix for complete description

Part III: Gathering Data – 16 days total		
Understanding Randomness simulations, trials, discuss the results of a simulation study and draw conclusions about the question being asked	5 days	• BVD Ch 11 • AS – Lesson 12 – students see truly random numbers vs. TI-83 pseudo-random and see mechanism for creating random outcomes so easy to see. • Investigative Task: ESP – students simulate a test of ESP capabilities using a random number chart
Sample Surveys sampling frames, sampling methods, bias, sampling variability, recognize population parameters, understand the value of randomization as a defense against bias	6 days	• BVD Ch 12 • Politics and Bias – Students look at surveys by different politically affiliated organizations. Students must site different examples of bias. Students must then devise questions on the topic that contain no bias. • Students must design a survey to find student opinion on a certain topic of their choosing. The focus is on the survey itself. By administering their surveys to one another, they uncover issues regarding potential bias, misinterpreting questions, and writing precise and clear questions that gives them the information they desire • NY Times article on the impact of cell phone usage and unbiased samples
Planning and Conducting Experiments observational studies, experiments, treatment, designs, confounding variables, lurking variables	5 days	• BVD Ch 13 and associated reading comprehension worksheets – lots of new vocabulary. Difference between lurking variables and confounding • AAO – Parts of #12 Experimental design and #13 Blocking and Sampling. • Block design – Students are given the task of setting up an experiment for an improved engine treatment for farm/industrial equipment, specifically tractors and backhoes. The students explain in writing method for proper randomization, clear explanation of treatment, as well as blocking.

Part IV: Randomness and Probability – 15 days total

From Randomness to Probability – Terms defined for basic probability - events, independence probability, complement, mutually exclusive, addition/multiplication rules,	4 days	• BVD Ch 14 – with reading comprehension activities for example- see appendix • Coin flipping experiment – Law of Large Numbers (as opposed to Law of Averages) as students combine results • Formal probability –Basic rules
Rules of Probability – Additional terms and multiple event probability -sample space, conditional probability, tree diagram, know when and how to apply the General Multiplication Rule	5 days	• BVD Ch 15 • Do 3-event coin flip and go from simulation to probability • Two dice – P(at least one six) addition rule demo
Random Variables discrete/continuous, expected value, show a probability model for a random variable. Particular attention is paid to the effect on standard deviation of adding/subtracting/multiplying random variables	5 days	• Greedy Pig – warm up – students stand up and receive the number of points each time a die is rolled until they decide to sit down. However, a "5" results in all still standing to receive a "zero". Strategy discussed and refined • Expected Value challenge- Students decide where to put tickets for a drawing to maximize the expected value. See Appendix • Run a contest – Students use probability and expected value to develop strategy for an original game that they present to class • BVD Ch 16
Probability Models Characteristics of Bernoulli trials, geometric/binomial probability, be able to interpret means, standard deviations, and probabilities in the Bernoulli trial context.	5 days	• Geometric and Binomial Models and connection with Normal model – various examples – students must state assumptions and determine if requirements are met for using model • BVD Ch 17 • AAO #17 – Binomial distributions

Part V : From the Data at Hand to the World at Large – 23 Days		
Sampling Distribution Models central limit theorem, standard error, interpreting a sampling distribution model. This is a confusing concept so extra time and examples is required	5 days	• BVD Ch 18 • Simulated Coins Activity – TI random number generator used to simulate twenty sample proportions for 25 and 100 events. Reinforces student understanding of CLT • AS- Lesson 16 – helps students visualize sampling distributions for means and proportions. Simulations for CLT confirmation.
Confidence Intervals for Proportions one-proportional z-interval, margin of error, critical value, be able to interpret a one-proportion z-interval in a simple sentence or two. Overall focus on modeling, assumptions and conditions, and statistical significance.	5 days	• BVD Ch 19 • AS- Lesson 19– simulation activities for students to discover how confidence intervals work for themselves, interactive tool for working Normal model • Students must communicate more than numerical answer. They must communicate what being 95% confident means in the context of the problem and relative to sampling distribution • TI-83 –confidence Intervals
Testing Hypotheses About Proportions alternative and null hypotheses, one-proportional z-test, p-value, be able to interpret the meaning of a P-value in nontechnical language	3 days	• Introduce 4-step process for all hypothesis testing – Hypothesis, Plan, Mechanics, Conclusion based on College Board rubric • AS – Lesson 20 – Inference for Proportions • Ti 83 – Hypothesis testing • BVD Ch 20

More About Tests: alpha level, significance level, type 1/type 2 errors, power, know how to complete a hypothesis test for a population proportion.	4 days	• Investigative Task: Life after High School – students determine a sample size needed, then must obtain a confidence interval and test a hypothesis, and interpret Type I and II errors, and make a conclusion. Must demonstrate 4 step process • BVD Ch 21 • AAO Session #23 -portions
Comparing Two Proportions: two-proportional z-interval/test, pooling, know how to find a confidence interval for the difference between two proportions	3 days	• BVD Ch 22 • TI-83 – methods for two proportions • AAO Session #23 –portions • AS – Lesson 22-4
Project: MCAS Revisited-	3 days	• Students use the data sets from the first quarter project. Statistical inference replaces the limited ability to make conclusions such as "the females scored significantly higher than the males".

Part VI: Learning About the World – 8 Days		
Inferences about Means: student's t-distribution, degrees of freedom, one-sample t-interval and test for the mean, be able to compute and interpret a t-test for the population mean using a statistics package or working from summary statistics for a sample	5 days	• BVD Ch 23 • AAO #21 – "Inference for one mean" • Ti 83 Demo • Investigative Task – Is this engine safe? – Real life example of engineers (the teacher, in his previous career) using hypothesis testing to determine if a set of bolts has sufficient strength to be substituted for the design bolts
Comparing Means: two-sample t-interval/test, pooled t-test, be able to perform a two-sample t-test using a statistics package or calculator	3 days	• BVD Ch 24 • AAO #22 – " Comparing Two means"

Part VII: Inference when Variables are Related – 10 days		
Comparing Counts: two-way table, chi-square test, be able to recognize when to use a test of goodness-of-fit, a test of homogeneity, or a test of independence.	6 days	• BVD Ch 26 • TI 83- Creating matrices, Chi testing • AS- "Cross tabulation and Chi-Square" • AAO - #24 – "Inference for Two-Way Tables" • Investigative Task – The AP scores for Masconomet in Calculus the last few years vs. the national average. Students must use correct process and state conclusions in an appropriate way.
Inferences for Regression: confidence interval for slope of least squares regression	4 days	• BVD Ch 27 • Investigative Task #1 – Using data for electricity usage and average monthly temperature to create a confidence interval for the slope and hypothesis testing for the association.

Part VIII Final Project: Inference – 9 days

Students start with an essential question. Some in the past have been:

1. Is the cell phone use of our students different from those of the average American high school student?
2. Is there a gender difference in how many "safety" and "reach" colleges that our students apply to?
3. Is there a difference in video game usage by grade at our school?

Students will collect data either by survey or by research or both. They will conduct their surveys using the methods previously learned in Part III. They will analyze their data and use inference where appropriate. They must show their assumptions and demonstrate the 4 step approach to hypothesis testing. The conclusions must be statistically sound. While purposefully open-ended, students must demonstrate a clear understanding of inferential analysis.

Part IX – Preparation for AP Test – 10 days
AP curriculum is reviewed via the Sternstein text. Problems from previous tests are reviewed. Practice tests are taken from released exams

Assessment:

- Daily assignments to be evaluated in light of completeness, care of presentation and the student's ability to explain the results. Late or incomplete assignments can earn at most half credit. Generally, no credit will be given for any assignment not completed within one day of the time it was due.
- Individual and group classwork/investigations to be evaluated in light of their completeness, care of presentation, student participation in the process and the student's ability to discuss the results/conclusions.
- Frequent quizzes to assess the student's progress in achieving course objectives on a short-term basis.
- Chapter tests to assess the student's ability to synthesize several classes and achieve course objectives on a long-term basis.
- Semester exams given in January and June.
- Assessments designed to determine how the student has met the Academic Expectations relating to effective communication, mathematical competency and problem solving skills.

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