Course Title: Advanced Placement Statistics (Online)

Meeting Times: This course meets for 36 weeks. Since this is an online course, student schedules vary depending on their local school schedule. They either meet for 90 minutes every other day or for 45 minutes every day. Students are also expected to spend additional time outside of class on activities such as reading material and reviewing feedback as well as completing assignments.

Course Description:

AP Statistics provides a systematic development of the concepts, principles, and tools of statistics with an emphasis on inquiry and critical-thinking skills associated with the collection, representation, analysis, and drawing conclusions from authentic data. Topics of study include data investigation, designing and conducting studies, anticipating patterns using probability and simulations, and statistical inference. Technology is a central component of the course and includes the use of graphing calculators, computers, and data analysis software. On a regular basis, graphing calculators and computers are used to explore, discover, and reinforce concepts of statistics and probability.

Though our system has an open enrollment policy, students should understand that this course is designed to be a fourth-year mathematics course, and the equivalent of an introductory, one-semester, non-calculus-based, college-level statistics course. The course requires a working knowledge of Algebra II, and quantitative reasoning. The breadth, pace, and depth of material covered exceeds the standard high school mathematics course, as does the college-level textbook, and time and effort required of students. This course provides the statistics foundation for college majors in social sciences, health sciences, and business, and serves as the preparation for an upper-level, calculus-based statistics course for majors in the sciences, engineering, and mathematics. Students are expected to take the AP Statistics Exam at the end of this course.

Course Purpose and Goals:

<u>Philosophy</u>

Understanding statistics as the science of data is the basis of this course. Statistics is the formal study of data as numbers in a context. Students build an understanding of statistical concepts as they construct relationships and make connections among the various representations of data and how data is interpreted. The course is more than a collection of topics; it is a coherent, focused curriculum that develops a broad range of statistical and probabilistic thinking, and a variety of statistical methods and applications. Although the development of techniques and fluency with graphic and numeric representations to represent problems is important, it is not the only focus of the course. Rather, the course emphasizes a conceptual development of statistical thinking through the use of an exploratory analysis of real data often using technology, planning and implementing well-designed studies, and engaging students in active learning. According to the National Council of Teachers of Mathematics (2000), "The amount of data available to help make decisions in business, politics, research, and everyday life is staggering… Statistics are often misused to sway public opinion on issues or to misrepresent the quality and effectiveness of commercial products. Students need to know about data analysis and related aspects of probability in order to reason statistically—skills necessary to becoming informed citizens and intelligent consumers" (p. 48).

To support students' development of statistical thinking, technology is used to enhance their understanding of major concepts and tools for working with data. The College Board requires the use of graphing calculators for this course. Mathematical problem solving, investigations, and projects require adequate and timely access to technology including graphing calculators, databases, spreadsheets, Internet and on-line resources, and data

analysis software packages. In this course, technology is introduced in the context of real-world problems, incorporates multiple graphical representations, uses a simulation approach for studying probability, and facilitates connections to other disciplines. Students actively participate in the process of statistical investigations by using estimation, mental math, calculators, computers, and paper-and-pencil techniques.

The standards support the unifying themes of exploring data, sampling and experimentation, anticipating patterns, and statistical inference. Instruction is designed and sequenced to provide students with learning opportunities in appropriate settings. Teaching strategies include collaborative small-group work, pairs engaged in data analysis, whole-group presentations, peer-to-peer discussions, and an integration of technology when appropriate. In this course, students are often actively engaged in statistical investigations that enable them to collaborate with peers in fitting mathematical models to the data and interpret how well the model fits the data. It is a cyclic process in which the data suggest refinements in original questions and mathematical models used. Based on the data, relationships among variables are evaluated through appropriate methods of analysis. Students are encouraged to discuss the mathematics of statistical analysis and inferences, to use the language and tools of statistics to communicate, and to discuss problems and methods of solution. As this course is delivered in an online format, group discussions and projects require the students to participate in asynchronous and synchronous activities to interact collaboratively with their teacher and peers. Tools used to engage students in interactive activities include web-conferencing, Instant Messaging and Web 2.0 tools.

Goals

Students should be able to:

1. Develop statistical thinking based on a conceptual understanding of major topics and tools of data collection, representation, analysis, inference, and conclusions.
2. Analyze and interpret data from graphical displays and numerical distribution summaries, and justify conclusions.
3. Employ the language and symbols of statistics, and effectively communicate the formulation of questions, data collection methods and displays, interpretation of statistical analysis, and evaluation of inferences and predictions based on the data.
4. Use probability as a tool to predict how the distribution of data is related to an appropriate mathematical model.
5. Develop an understanding of statistical inference through the use of confidence intervals and tests of significance.
6. Use graphing calculators and computers in the exploration, statistical analysis, simulation, and modeling of data.
7. Make sense of and evaluate the reasonableness of conclusions based on data.
8. Develop an appreciation for an historical perspective of statistics.

Conceptual Organization

The content and level of depth of the material for this course is equivalent to a college-level course. The course content is organized to emphasize major topics in the course to include the following: (1) exploring data, (2) sampling and experimentation, (3) anticipating patterns, and (4) statistical inference. Building on most students' prior knowledge, the course begins with a review of graphical and numerical data displays. Technology enhances students' constructing an understanding of mathematical relationships among these different representations used in solving problems. This supports and leads to students' visualization and discussion of distribution summaries including measures of center, spread, and position. Information from

distributions of univariate data are compared and interpreted in the context of real-world problems. Normal distributions are examined prior to moving to the study of bivariate data.

Students are provided with opportunities to generate and collect bivariate data, and they analyze relationships between variables using scatter plots, linear correlations, and least squares regression lines. Outliers, influential points, residual plots, and transformations to achieve linearity are examined. This is followed with a focus on the concept of cause and effect, confounding variables, and relationships found in categorical data. In quarter 2, students investigate the purpose and process of a statistical investigation. The concept of randomness is studied and a variety of data collection methods that are used to support the design of a well-planned study. This naturally leads to an examination of sampling error and sources of bias. Probability is introduced as a method for exploring random phenomena, used to analyze simulations, and viewed as predictable patterns in sampling distributions. Specifically, students begin to work with binomial and geometric distributions and probabilities near the end of the first semester.

During the second semester of the course, students broaden their understanding of statistical concepts and techniques to include more sampling distributions, the Central Limit Theorem, and statistical inference. Confidence intervals and tests of significance are emphasized through a wide-range of appropriate models dependent upon the conditions of particular real-world problems. This order of topics within the course, not only provides a logical and systemic study to calculus, but also accommodates the frequent transfer of students within the schools of the system, so that transfer students can maintain a consistent flow of learning.

Course Format and Policies:

Materials and Organization

The online courses have the same level of rigor and adhere to the same standards set forth by the school system and the College Board. To access all courses, students need access to a computer and the Internet via a web browser. All classes are offered via the Blackboard Learning Management System. The online course also offers the flexibility for students to have access to the class 24/7 from school and home.

This course has been designed with a "hands-on" approach in distance learning. The student's active participation in this course is essential. A great deal of learning in an online environment occurs as a result of learners being engaged via collaborative interactions facilitated via web conferencing, Instant Messaging, discussion boards and collaborative group projects. When learners share their knowledge experiences, and understanding of the course materials, the learning process is facilitated and advanced. In discussions, they are expected to post substantive contributions. Examples of this include; supporting a position, beginning a new topic of discussion or adding to an ongoing discussion.

Homework

Homework is assigned daily. It is meant to reinforce the instruction by providing practice of varying difficulty. Homework is graded based on completion not on accuracy. Every assignment will count and every problem should be attempted.

Expectations

In any college-level course keeping pace with the class is essential to the success of the students. In an online course this is particularly true. Thus, the students are expected to exhibit a great deal of self-motivation in their interaction with course content and assignments.

Each student is expected to have these Successful Behaviors:

- ✓ Engage routinely and be prepared for class.
- ✓ Focus on work.
- ✓ Treat classmates, computers, and classroom with respect.
- ✓ Follow all directions from the teacher.
- ✓ Request help when needed.

Grading:

Quarter Grades	Semester Grades
Test: 60%	Quarter 1: 35%
Quizzes and Projects: 30%	Quarter 2: 35%
Classwork: 5%	Semester Exam: 30%
Homework: 5%	

Late assignments will not be accepted.

Weighted grades are calculated for students completing and taking the requisite exam of an AP Course.

Unweighted Scale A=4	Weighted Scale A=5
Unweighted Scale B=3	Weighted Scale B=4
Unweighted Scale C=2	Weighted Scale C=3
Unweighted Scale D=1	Weighted Scale D=2
Unweighted Scale F=0	Weighted Scale F=0

Textbook, Materials and Other Resources:

Required Textbook

- Yates, D. S., Moore, D.S., and Starnes, D.S. (2002). *The Practice of Statistics*, 2nd edition, New York: W.H. Freeman and Company.

Supplemental Textbooks and Readings

- Peck, Olsen, and Devore (2004). *Introduction to Statistics and Data Analysis*. 2nd ed. Pacific Grove, CA: Duxbury.
- Sternstein, Martin. (2007) *Barron's AP Statistics*, 4th ed. Hauppauge, NY: Barron's.
- Levine-Wissing, Robin and Thiel, David (2007). *The Best Test Preparation for the AP Statistics Exam*. 3rd ed. New Jersey: Research & Education Association.
- Agresti and Franklin (2007). *Statistics, The Art and Science of Learning from Data*. 2nd ed. New Jersey: Pearson Prentice Hall.

Other Resources

- Computers: Each student has access to a computer with internet access at their local school during their scheduled class period. Most also have use of a computer at home. The entire course is conducted online. Most students also have access to a scanner or digital sender for submitting work, but a fax machine can be used if one is not available.
- Software: Students use the Microsoft Office programs for projects and for accessing lectures. QuickTime Video is used to run Flash presentations and activities. Adobe Connect Pro and Jabber Moment IM are also used for real-time communications. Windows Media is required for watching video presentations and demonstrations. Other software programs utilized are:
    - Key Curriculum Press. *Fathom 2 Dynamic Data Software*.
    - Minitab Inc. *Minitab Statistical Software*.
- Graphing calculators: Students are required to have a graphing calculator for AP Statisitcs. TI-83+ or TI-84+ (Silver Edition, optional) calculators are suggested for this class. The TI-89 will be supported as well. Other makes/models are acceptable but assistance may not be available
- Internet access and online resources.
    - Mrs. Smart's AP Statistics Page Website: http://www.lhs.logan.k12.ut.us/~jsmart/stats.htm
    - Internet Projects for Elementary Statistics Website: http://www.awl.com/weiss/e_iprojects/
    - Stat Trek: http://stattrek.com/AP-Statistics-1/AP-Statistics-Intro.aspx?Tutorial=ap
    - Mr. Derksen's Website: http://www.mrderksen.com/faq.htm
    - College Board: http://apcentral.collegeboard.com/apc/Controller.jpf
    - W. H. Freeman Website: http://bcs.whfreeman.com/yates2e/

Course Content Outline:

Unit	Quarter	Week	Topics	Assessments
1 Introduction to Statistics: Exploring Graphical Displays of Univariate Data	1	**1**	**Variables: Categorical and Numerical data;** **Types of graphical representations: bar graphs, circle graphs, dot plots, stem plots, histograms, cumulative frequency plot;** **Characteristics of distributions: shape and clusters;** **Comparing graphical distributions**	
Exploring Numerical Displays of Univariate Data	1	**2-3**	**Averages: Measures of center;** **Five-number summary & box plots, and standard deviation: Measures of spread (dispersion);** **Comparing numerical distributions**	**Quiz 1: Graphical distributions**
2 Normal Distributions	1	**4-5**	**Density curves and measures of center;** **Z-score: Measures of position;** **Standard normal distribution**	**Test 1 and 2: Units 1-2** **Multiple Choice and Constructed Response**
3 Bivariate Data: Relationships between Variables	1	**6-7**	**Independent and dependent variables;** **Characteristics of scatter plots;** **Correlations: Strength of linear relationships (slopes and intercepts);** **Mathematical model: Least-Squares Regression line**	**Quiz 2: Scatter plots and correlations**
4 Bivariate Data: More Relationships	1	**8-9**	**Monotonic transformations: linear, positive and negative powers, and logarithms;** **Exponential growth;** **Concept of cause and effect: Lurking and confounding variables;** **Relationships for categorical data;** **Conditional distributions and Simpson's Paradox**	**Test 3: Units 3** **Multiple Choice and Constructed Response**
5 Designing a Data Investigation	2	**9-10**	**Purpose and process of a statistical investigation;** **Populations & random samples;** **Understanding randomness;** **Data collection methods: surveys, experiments, and observational studies;** **Characteristics of well-designed surveys and experiments;** **Sampling error and sources of bias;** **Experimental design;** **Simulations: Random phenomena;** **Results and conclusions**	**Test 4: Unit 4** **Multiple Choice and Constructed Response** **Design Lab/Project** **Quiz 3: FRQ Design Quiz** **Test 5: Unit 5** **Multiple Choice and Constructed Response**

6 Probability Concepts	2	**11-12**	**Probability models: sample space, outcomes, events;** **Empirical & theoretical probabilities;** **Probability rules and operations;** **Fundamental counting principle;** **Independence & multiplication rule;** **Conditional probabilities and Bayes' Theorem;** **Techniques: counting, Venn and tree diagrams**	**Quiz 4: probability models and techniques** **Empirical Probability Lab** **Test 6: Unit 6** **Multiple Choice and Constructed Response**
7 Random Variables and Sampling Distributions	2	**13-14**	**Random variables: discrete and continuous;** **Properties of normal distributions;** **Means and variances;** **Standard deviations;** **Law of Large Numbers and other misconceptions**	**Test 7: Unit 7** **Multiple Choice and Constructed Response**
8 Sampling Distributions: Binomial and Geometric Random Variables	2	**15-17**	**Binomial probabilities and distributions;** **Mean (Expected Value) and standard deviation: binomial random variable;** **Normal approximation to the binomial distribution;** **Geometric distributions and probabilities;** **Geometric simulations**	**Test 8: Unit 8** **Multiple Choice and Constructed Response**
	2	**18**	**Review for Semester Exam**	**Semester 1 Assessment** **Multiple Choice and Constructed Response**
9 Sampling Distributions	3	**19-20**	**Parameter versus statistic;** **Sampling variability and bias;** **Sampling distribution of a sample mean;** **Central Limit Theorem**	**Test 9: Unit 9** **Multiple Choice and Constructed Response**
10 Concept of Statistical Inference	3	**21-23**	**Estimating population means;** **Margin of Error and selecting sample size;** **Confidence Intervals;** **Tests of Significance: stating hypotheses and p-values;** **Concepts of Type I, Type II error and power;** **Statistical significance and practical significance**	**Test 10: Unit 10** **Multiple Choice and Constructed Response**
11 Statistical Inference: Single Mean and Comparing Means	4	**24-25**	**t-test procedures: one-sample, matched pairs, or two-sample;** **Confidence interval for population mean;** **Confidence intervals for the difference between two means;** **Significance tests for comparing two means (unpaired and paired);**	**Test 11: Unit 11** **Multiple Choice and Constructed Response** **Oreo Lab**

12 Inference for Proportions	4	**26-27**	**Large-sample inference for a population proportion; Confidence interval for a population proportion; Sample size and margin of error; Confidence intervals for the difference between two proportions; Significance tests for comparing two proportions; Pooled estimate of p; Techniques: one-sample, matched pairs, or two-sample**	**Quiz 5: FRQ Confidence intervals and significance tests** **M&M Lab** **Test 12: Unit 12** **Multiple Choice and Constructed Response**
13 Inference for Tables: Using Chi-square	4	**28-29**	**Chi-square: Test for goodness of fit problems; Properties of chi-square distribution; Organize categorical data and inference for one- and two-way tables; Chi-square test: homogeneity of proportions and association /independence**	**Test 13: Unit 13** **Multiple Choice and Constructed Response**
14 Inference for Regression	4	**30-31**	**Simple linear regression model; Estimating regression parameters; Confidence intervals and inference for slope of regression line; Prediction and confidence interval for future observations**	**Test 14: Unit 14** **Multiple Choice and Constructed Response** **Test 15: Practice AP Exam**
	4	**32**	**Review for Semester Exam**	**Semester 2 Assessment** **Capstone Project**
	4	**33-36**	**Review and AP Exam**	**AP Exam**

Assessment:

Assessment and evaluation are essential to learning and teaching. Ongoing assessment and evaluation are significant in supporting student achievement, motivating student performance and providing the basis upon which teachers make meaningful instructional decisions. All aspects of progress in mathematics are measured using multiple methods such as authentic, performance, observational, and formative assessments; group and individual projects, student presentations, and conventional summative assessments. Student understanding is evaluated using an assessment cycle that includes pre-, formative, and summative assessments. Pre-assessments are used to determine where the student understanding level is, as the unit is begun. The pre-assessment is used by a teacher to plan instruction. Formative assessments are used to check student understanding while learning is occurring, and provide students and teachers with learning progress information. Pre- and formative assessments are not used to determine grades. Summative assessments, such as unit and semester tests, evaluate student achievement, and along with other measures such as student presentations and project work are data points used to determine the level of student performance.

Assessment Type	Goal	Description
Chapter/Unit Tests	To assess understanding of concepts, principles, applications, and techniques of statistics.	35-45 minute tests containing multiple-choice and free response questions.
Quizzes	To assess understanding of concepts, applications, and techniques of statistics for a given topic.	10-20 minute quizzes that are constructed response items.
Semester Exam	To assess understanding of concepts, principles, applications, and techniques in a cumulative manor.	70-90 minute exam containing multiple choice and free response questions.
Student Projects/Labs	To provide students with an opportunity to apply a statistics or probability topic in-depth and demonstrate the processes and skills of a well-designed statistical investigation.	Both short- and long-term projects, in which students work in a small group or individually, to research a statistics or probability topic. A formal lab report will be turned submitted in which students clearly describe the entire process of their statistical investigation.
Capstone Project	To assess understanding of all components of Statistics using a topic of the students choice.	A long-term project, in which students work in small groups, to research a statistics topic, design a study, and apply all appropriate concepts. A formal paper and presentation will be made describing the entire process of their statistical investigation.

Supporting Services:

To help students maintain successful participation, each student has a designated local facilitator who serves as the liaison between the teacher, the student, parents and school administrators. Students are given access to fax machines, scanners, or digital senders to facilitate turning in assignments.

The goal of the online class is to provide the same level of assistance as is available for brick and mortar instruction. Web-conferencing may be used to organize students into collaborative or study throughout the year. Student may also engage in Web 2.0 activities asynchronously with class mates students in many different time zones around the world. Phone access is provided at each school so that the student can call the teacher for immediate help, and the teacher will contact the student at home in the evenings or weekends whenever requested. Students are also provided access via Instant Messaging and e-mail.

Students are also encouraged to utilize several AVID strategies in the AP Statistics classroom. Organizing all material in one binder, notetaking, and learning logs are a few examples of these strategies. The most important AVID strategy is the use of peer tutorials through well developed questioning.