Mehlville School District

Advanced Placement Statistics

BOE Approval Required to Change

General Course Information

Course Name: Advanced Placement Statistics	
Department: Math	Grade Level(s) 11th and 12th
Duration/Credits: 1 year/ 1.0 Credit	Prerequisites: Students who are successful in AP Statistics must be strong, independent readers and organized writers. Students must be motivated and able to complete college-level course work. Students must have in-depth understanding of Algebra 2 content including Radical Expressions, Linear Functions, and Logarithmic functions.
BOE Approval Date: 12/19/19	Course Code: H2365 W

Course Description:

This course is equivalent to a one-semester, introductory, non-calculus-based college course in statistics. The course introduces students to the concepts and tools for collecting, analyzing, and drawing conclusions from data. There are four main themes for the course: exploring data, sampling and experimentation, anticipating patterns, anAd statistical inference. Students use technology, investigations, problem solving, and writing as they build conceptual understanding. Each student is required to have a scientific calculator (TI-84+ recommended). Advanced Placement credit offered.

Course Rationale:

This AP Statistics course is a rigorous, college-level class that provides an opportunity to gain the skills and experience colleges recognize. Students are provided the opportunity to develop analytical and critical thinking skills as they learn to describe data patterns and departures from patterns, plan and conduct studies, use probability and simulation to explore random phenomena, estimate population parameters, test hypotheses, and make statistical inferences.

Course Objectives:

1. The student will read scenarios and explore data by analyzing shape, center, and spread. (A+ Reading)
2. The student will describe patterns and departures from patterns both verbally and in written form. (A+ Speaking and Listening).
3. The student will conduct sampling and experimentations.
4. The student will plan and conduct a study.
5. The student will anticipate patterns.
6. The student will explore random phenomena using probability and simulation.

7. The student will read scenarios and perform statistical inferences.
8. The student will conduct research to estimate population parameters based on experimentation. (A+ Research)
9. The student will test hypotheses and write a report of their findings. (A+ Writing)

Standards Alignment:

US: AP Statistics (2019)
https://apcentral.collegeboard.org/pdf/ap-statistics-course-and-exam-description.pdf?course=ap-statistics

Power Standards

List Standards -
I. Summarizing distributions of univariate data (I.B)
II. Exploring bivariate data (I.D)
Iii. Planning and conducting surveys (II.B)
IV. Planning and conducting experiments (II.C)
V. Interpreting probability, including long-run relative frequency interpretation (III.A)
VI Estimating population parameters and margins of error (IV.A)
VII. Tests of significance (IV.B)

Unit I: Exploring and Understanding Data	**Duration:** 5-6 Weeks
Unit Description: Exploratory analysis of categorical and quantitative data. Use graphical and numerical techniques to study patterns and departures from patterns. Emphasis to be placed on interpreting information from graphical and numerical displays and summaries with emphasis on the normal model.	
Unit Standards	**Key Learning Targets**
I.A Constructing and interpreting graphical displays of distributions of univariate data (dotplot, stemplot, histogram, cumulative frequency plot) I.B Summarizing distributions of univariate data 1. Measuring center: median, mean 2. Measuring spread: range, interquartile range, standard deviation 3. Measuring position: quartiles, percentiles, standardized scores (z-scores) 4. Using boxplots 5. The effect of changing units on summary measures I.C Comparing distributions of univariate data (dotplots, back-to-back stemplots, parallel boxplots) 1. Comparing center and spread: within group, between group variation 2. Comparing clusters and gaps 3. Comparing outliers and other unusual features 4. Comparing shapes	I can: 1) recognize categorical variables and choose appropriate displays. 2) summarize the distribution of a categorical variable with a frequency table. 3) display the distributions of categorical variables with a bar chart or pie graph. 4) interpret a contingency table. 5) identify an appropriate display for quantitative variables. 6) analyze the shape, center, and spread for a set of data. 7) use technology to create a histogram. 8) compare distributions. 9) identify and describe the effects of an outlier on the data. 10) create a box plot 11) Understand how adding, subtracting, multiplying, dividing a constant will change the center/spread of data. 12) Standardize variables to compare values. 13) Recognize when to apply a normal model.

I.E Exploring categorical data 1. Frequency tables and bar charts 2. Marginal and joint frequencies for two-way tables 3. Conditional relative frequencies and association 4. Comparing distributions using bar charts	14) Compare values using z-scores. 15) Apply the 68-95-99.7 rule. 16) Use technology to find percentages between values in a normal model.
Essential Questions	**Enduring Understandings**
What is data? How do we understand and communicate data? What assumptions can be made from data? How can graphical displays be manipulated to present misleading information? Why is the normal distribution essential to the study of statistics? How does the normal distribution apply to the real world?	The Who, What, Where, Why, and How of the data are important information that must be depicted in each given data set. The shape, center, and spread should be described for every distribution. The normal distribution is used to model the spread of data.
Resources: BVD 3rd ed. 2007, TI 84 or TI NSpire Graphing Calculator	
Previous knowledge and skills needed: Understanding of percents, means, graphing	
Key Unit Vocabulary: mean, median, mode, standard deviation, IQR, skew, symmetric, normal distribution, z-score, boxplot, categorical, quantitative, histogram	
Additional Information:	

Unit II: Exploring Relationships Between Variables	**Duration:** **3-4 Weeks**
Unit Description: Exploratory analysis of bivariate data. Using technology to create and analyze scatterplots, with residuals plots to perform linear regression analysis to make inferences. When necessary with the appropriate data, re-expressing the data will be applied.	
Unit Standards	**Key Learning Targets**
I.D Exploring bivariate data 1. Analyzing patterns in scatterplots 2. Correlation and linearity 3. Least-squares regression line 4. Residual plots, outliers and influential points 5. Transformations to achieve linearity: logarithmic and power transformations	I can: 1) understand correlation. 2) understand correlation does not equal causation. 3) compute correlation. 4) interpret a correlation coefficient. 5) find the direction, form, and strength of a scatterplot. 6) identify the response and explanatory variables. 7) examine data for the straight enough condition. 8) find a regression equation. 9) predict a value for y given x. 10) Understand how influential points can change a regression model. 11) Understand how large residuals and high leverage points influence regression. 12) Graph plots of residuals. 13) Re-express data

Essential Questions	Enduring Understandings
● What is association? What is correlation? ● How are they connected? ● Does association imply causation? How can modeling data help us to understand patterns? ● When is it appropriate to use extrapolation to predict the future?	● Correlations does not imply causation. ● A linear model can be used to represent relationships between bivariate data.
Resources: BVD 3rd ed. 2007, TI 84 or TI NSpire Graphing Calculator	
Previous knowledge and skills needed: graphing points, logarithms, evaluating functions	
Key Unit Vocabulary: association, correlation, form, strength, direction, correlation coefficient, R-squared, residual, slope, y-intercept, model	
Additional Information:	

Unit III: Gathering Data	**Duration:** **3-4 Weeks**
Unit Description: Data must be collected according to a well-developed plan if valid information is to be obtained. Collecting data in a reasonable way, through either sampling or experimentation, is an essential step in the data analysis process.	
Unit Standards	**Key Learning Targets**
II.A Overview of methods of data collection 1. Census 2. Sample survey 3. Experiment 4. Observational study II.B Planning and conducting surveys 1. Characteristics of a well-designed and well-conducted survey 2. Populations, samples and random selection 3. Sources of bias in sampling and surveys 4. Sampling methods, including simple random sampling, stratified random sampling and cluster sampling II.C Planning and conducting experiments 1. Characteristics of a well-designed and well-conducted experiment 2. Treatments, control groups, experimental units, random assignments and replication 3. Sources of bias and	I can: 1) recognize outcomes in a real-world situation. 2) describe a simulation so that others can repeat it. 3) discuss the results of a simulation study and draw conclusions about the question being investigated. 4) perform a simulation. 5) recognize parameters and statistics. 6) understand bias. 7) how to gather a sample from a population. 8) report possible sources of bias. 9) recognize when to use different types of studies. 10) describe basic principles of sound experimental design. 11) recognize factors, treatments and response variable in an experiment.

confounding, including placebo effect and blinding 4. Completely randomized design 5. Randomized block design, including matched pairs design II.D Generalizability of results and types of conclusions that can be drawn from observational studies, experiments and surveys	
Essential Questions	**Enduring Understandings**
● How do we obtain data? ● Why is it important? ● How can bias be identified and prevented? ● To what extent does data collection methodology affect results?	● Careful planning is essential to obtaining valid data. ● Clarifying the question leads to the appropriate methodology. ● The analysis is only as good as the data. ● Well-designed experiments can allow us to reach appropriate cause-and-effect conclusions
Resources: BVD 3rd ed. 2007, TI 84 or TI NSpire Graphing Calculator	
Previous knowledge and skills needed: none	
Key Unit Vocabulary: random number, experiment, simulation, survey, sampling, SRS, stratified, cluster, census, systematic, voluntary response, bias, response bias, convenience sampling, prospective, retrospective, block, randomized block, treatment, control	
Additional Information:	

Unit IV: Randomness and Probability	**Duration:**

	3-4 weeks
Unit Description: Probability is the tool used for anticipating what the distribution of data should look like under a given model. Understanding the basic rules of probability, conditional probability, and specific probability models.	
Unit Standards	**Key Learning Targets**
III.A Probability 1. Interpreting probability, including long-run relative frequency interpretation 2. "Law of Large Numbers" concept 3. Addition rule, multiplication rule, conditional probability and independence 4. Discrete random variables and their probability distributions, including binomial and geometric 5. Simulation of random behavior and probability distributions 6. Mean (expected value) and standard deviation of a random variable, and linear transformation of a random variable III.B Combining independent random variables 1. Notion of independence versus dependence 2. Mean and standard deviation for sums and differences of independent random variables III.C The normal distribution	I can: 1) understand that random phenomena are unpredictable in the short term but show long-run regularity. 2) recognize disjoint and independent events. 3) use facts about probability to determine whether an assignment of probabilities is legitimate. 4) know how and when to apply the Addition Rule. 5) know how and when to apply the Multiplication Rule. 6) use the Complement Rule. 7) make statements about probability in describing a random phenomenon. 8) understand independence. 9) know how and when to apply the Addition Rule. 10) calculate probabilities for compound events. 11) know how and when to apply the Multiplication Rule. 12) find the probability model for a discrete random variable. 13) find the expected value and variance of a

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1. Properties of the normal distribution
2. Using tables of the normal distribution
3. The normal distribution as a model for measurements

III.D Sampling distributions
1. Sampling distribution of a sample proportion
2. Sampling distribution of a sample mean
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random variable.
14) calculate a new mean and standard deviation after adding/multiplying a constant or adding/subtracting two independent random variables.
15) tell if a situation involves Bernoulli trials.
16) choose whether to use a Geometric or a Binomial model.
17) state the appropriate conditions for using a Geometric, Binomial or Normal model.
18) find the expected value of a Geometric model.
19) find the mean and standard deviation of a Binomial model.
20) calculate Binomial probabilities.
21) interpret means, standard deviations and probabilities in Bernoulli trials.
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<td>Essential Questions</td>
<td>Enduring Understandings</td>
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● How can we base decisions on chance?
● How can probability be used to simulate events and to predict future happenings?
● What are the benefits of simulating events as opposed to gathering real data?
● How can modeling predict the future?
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● Probability models are useful tools for making decisions and predictions.
● Probability is the basis of statistical inference.
● The notion and behavior of a random variable is foundational to understanding probability distributions.
● The Law of Large Numbers is an important concept when simulating probability experiments.
● Probability models are useful tools for making decisions and predictions.
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<td colspan="2">Resources: BVD 3rd ed. 2007, TI 84 or TI NSpire Graphing Calculator</td>
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<td colspan="2">Previous knowledge and skills needed: basic probability, percentages, venn diagrams</td>
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Key Unit Vocabulary: Addition rule, multiplication rule, independent, disjoint, mutually exclusive, law of large numbers, normal distribution
Additional Information:

Unit V: From the Data at Hand to the World at Large	**Duration:** **6-8 weeks**
Unit Description: Statistical inference based upon the sampling distribution model. Inferences for the proportion of a population from different real life situations including confidence intervals and testing for one proportion and the difference of two proportions.	
Unit Standards	**Key Learning Targets**
III.D Central Limit Theorem IV.A Estimation (point estimators and confidence intervals) 1. Estimating population parameters and margins of error 2. Properties of point estimators, including unbiasedness and variability 3. Logic of confidence intervals, meaning of confidence level and confidence intervals, and properties of confidence intervals 4. Large sample confidence interval for a proportion 5. Confidence interval for a mean IV.B Tests of significance 1. Logic of significance testing, null and alternative hypotheses; p-values; one- and two-sided tests; concepts of Type I and Type II errors; concept of power 2. Large sample test for a proportion	I can: 1. understand the Central Limit Theorem. 2. demonstrate a sampling distribution by simulation. 3. Calculate probabilities from a sampling distribution. 4. understand a confidence interval. 5. interpret the results of a confidence interval. 6. construct a one-proportion z-interval. 7. interpret a one-proportion z-interval. 8. state the null and alternative hypotheses for a one prop Z test. 9. state the conditions for a one prop Z test. 10. identify a one-sided and two-sided alternative hypothesis. 11. perform a one prop Z test. 12. interpret results of a one prop Z test. 13. interpret a P-value. 14. understand assumptions and their

3. Test for a mean	paired conditions. 15. state how the critical value is related to the alpha level. 16. Determine possible Type 1 and Type 2 errors. 17. interpret the Power of a test. 18. state a null and alternative hypothesis for testing the difference between two proportions. 19. calculate and interpret a confidence interval for the difference between two proportions. 20. interpret a p-value. 21. understand the difference between a t distribution and a z distribution. 22. Perform a t hypothesis test. 23. construct and interpret a t confidence interval.
Essential Questions	**Enduring Understandings**
● How can modeling predict the future? ● How much evidence do you need before you are able to make a reasonable conjecture? ● How is statistical inference used to draw conclusions from data? ● How is probability used to express the strength of our conclusions? ● How do you determine if there is a statistically significant difference between two claims? ● What does it mean to make an inference?	● Variation can be expected in the results of random samples and is affected by the design of the sample or experiment. ● Tests of significance and confidence intervals drive decision making in our world. ● Error analysis is a critical component of significance testing. ● Significance tests determine the likelihood of a sample. ● Confidence intervals are effective tools for estimating the proportion or the mean of a population. ● Inference is a tool for validating a

	claim about a population parameter. ● Inference is a tool for estimating an unknown population parameter.
Resources: BVD 3rd ed. 2007, TI 84 or TI NSpire Graphing Calculator	
Previous knowledge and skills needed: square roots	
Key Unit Vocabulary: inference, p-value, hypotheses, assumptions, conditions, critical value, normal distribution, means, proportions, confidence intervals, margin of error, standard error, two-proportion z test, pooling, two proportion z interval, variance of independent variables	
Additional Information:	

Unit VI: Learning About the World	**Duration:** **3-4 weeks**
Unit Description: Statistical inference for quantitative variables for different real life situations including inferences of the mean, comparing two means, paired samples, and blocked variables.	
Unit Standards	**Key Learning Targets**
IV.A Estimation (point estimators and confidence intervals) 1. Large sample confidence interval for a difference between two proportions 2. Confidence interval for a difference between two means (unpaired and paired) IV.B Tests of significance 1. Large sample test for a difference between two proportions 2. Test for a difference between two means (unpaired and paired)	I can: 1. recognize when to do inference for the difference of means between two groups. 2. know how to examine data for violations of conditions. 3. recognize when to pool data. 4. perform a two sample t test. 5. interpret results of a two sample t test. 6. recognize when groups are paired. 7. find a paired confidence interval. 8. perform a paired t-test. 9. interpret results of a paired t- test.
Essential Questions	**Enduring Understandings**
● How do you determine if there is a statistically significant difference between two claims? ● What does it mean to make an inference?	● Significance tests determine the likelihood of a sample. ● Confidence intervals are effective tools for estimating the proportion or the mean of a population. ● Inference is a tool for validating a claim about a population parameter. ● Inference is a tool for estimating an unknown population parameter.
Resources: BVD 3rd ed. 2007, TI 84 or TI NSpire Graphing Calculator	

Previous knowledge and skills needed: hypothesis testing and confidence intervals for one sample
Key Unit Vocabulary: Student's t degree of freedom, one sample t-interval, one-sample t-test for the the mean, Two sample t method, Two sample t-interval for difference of two means, Two-sample t-test for the difference of two means, pooling, pooled t-methods , Paired data, Paired t-test, Paired t confidence interval
Additional Information:

Unit VII: Inference When Variables Are Related	**Duration:** **3-4 weeks**
Unit Description: Statistical inference for categorical variables using Chi Square testing for different real life situations including independence, homogeneity, and goodness of fit.. Inferences for regression using technology to determine whether bivariate data have an association.	
Unit Standards	**Key Learning Targets**
IV.A Estimation (point estimators and confidence intervals) 1. Confidence interval for the slope of a least-squares regression line IV.B Tests of significance 1. Chi-square test for goodness of fit, homogeneity of proportions, and independence (one- and two-way tables) 2. Test for the slope of a least-squares regression line	I can: 1. Distinguish between tests for independence, homogeneity and goodness-of-fit. 2. Perform chi-square tests. 3. Interpret results of chi-square tests. 4. Test the significance of regression models. 5. Find a confidence interval for the slope of a regression. 6. Summarize a regression in words. 7. Interpret the P-value for the slope. 8. Interpret a confidence interval for the slope of a regression. 9. Check conditions necessary for regression.
Essential Questions	**Enduring Understandings**
● How do you find critical values for a chi-square test? ● How can we verify that two variables are independent? ● Significance tests can also determine the likelihood of a sample from a	● Confidence intervals can estimate the variation in a bivariate sample's slope. ● Significance tests can also determine whether two variables are independent.

series of proportions.	
Resources: BVD 3rd ed. 2007, TI 84 or TI NSpire Graphing Calculator	
Previous knowledge and skills needed: hypothesis testing and confidence intervals for two samples	
Key Unit Vocabulary: Chi Square model, cell, Chi Square Statistic, Chi Square test Goodness-of-fit, Chi Square test Homogeneity, Chi Square test Independence, t-test for the regression slope	
Additional Information:	