# SPRING GROVE AREA SCHOOL DISTRICT

## PLANNED COURSE OVERVIEW

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| **Course Title:** Basic Introductory Statistics | **Length of Course:** 30 cycles |
| **Grade Level(s):** 11 - 12 | **Periods Per Cycle:** 6 |
| **Units of Credit:** 1 | **Length of Period:** 43 minutes |
| **Classification:** Elective | **Total Instructional Time:** 129 hours |

## Course Description

This course is designed to provide the students with important concepts in statistics including: descriptive statistics, probability, estimation, hypothesis testing, and linear regression.

Prerequisites: Successful completion of any algebra and any geometry courses

## Instructional Strategies, Learning Practices, Activities, and Experiences

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| Anticipatory Sets | Graphic Organizers | Survey Project |
| Assessments | Guided Practice | Teacher Demonstrations |
| Class Discussions | High-Level Questioning | Technology Integration |
| Closure | Homework | Videos |
| Critical Thinking | Posted Objectives | Warm-ups |
| Flexible Groups | | |

## Assessments

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| Assessments (Teacher-Created; Open- and closed-book versions) | Higher-Level Questioning<br>Survey Project | Classwork |

## Materials/Resources

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| *Understanding Basic Statistics*: Eighth Edition (Brase, Brase) | Internet Resources |

**Adopted:** 9/17/03
**Revised:** 8/17/09; 5/19/14; 5/20/2019

**Introduction to Statistics**

**The Standards of Mathematical Practices**

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| **Make sense of problems and persevere in solving them.** | **Reason abstractly and quantitatively.** |
| **Construct viable arguments and critique the reasoning of others.** | **Model with mathematics.** |
| **Use appropriate tools strategically.** | **Attend to precision.** |
| **Look for and make use of structure.** | **Look for and express regularity in repeated reasoning.** |

| CONTENT/KEY CONCEPTS | OBJECTIVES/STANDARDS |
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| **A. What is Statistics?**<br>• Define basic vocabulary for statistics including individuals, population, sample, quantitative and qualitative variables<br>• Four levels of measurement – nominal, ordinal, interval and ratio<br>• Descriptive and inferential statistics<br><br>**B. Random Samples**<br>• Identify a simple-random sample<br>• Create simple-random samples with random number chart<br>• Sampling methods – stratified, systematic, cluster, convenience and simple random<br><br>**C. Introduction to Experimental Design**<br>• Basic guidelines of planning statistical study<br>• Define census, sample, simulation, observational study, experiment, randomized two-treatment experiment, and control group<br>• Creation of surveys and the positive and negative aspects of using survey to gather data | • Determine level of measurement for a statistic.<br>• Identify qualitative and quantitative variables.<br>• Compare and contrast descriptive and inferential statistics.<br>• Construct a simple random sample using a random number table or generator.<br>• Classify real-life situations as one of the five major types of sampling methods.<br>• Define and discuss census and samples.<br>• Identify differences between simulations, observational studies, and experiments.<br>• Define and identify control groups, placebo effect, and randomized two-treatment design in real-life situations.<br><br>**CC.2.4.8.B.2** - Understand patterns of association can be seen in bivariate data utilizing frequencies.<br>**CC.2.4.HS.B.2** - Summarize, represent, and interpret data on two categorical and quantitative variables.<br>**CC.2.4.HS.B.4** - Recognize and evaluate random processes underlying statistical experiments. |

| **Organizing Data** | |
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| **CONTENT/KEY CONCEPTS** | **OBJECTIVES/STANDARDS** |
| **A. Frequency Histograms and Distributions**<br>• Find class width and use in creation of frequency tables and histograms<br>• Calculate relative frequency as additional part of a frequency table<br>• Interpret histograms<br><br>**B. Bar Graphs**<br>• Create and interpret dot plot<br>• Create and interpret bar graph and Pareto charts, with and without changing scale<br><br>**C. Circle Graphs**<br>• Create and interpret circle graph, converting percents to degrees<br><br>**D. Time Series Graphs**<br>• Create and interpret time-series graph<br><br>**E. Stem-and-leaf Displays**<br>• Create and interpret stem-and-leaf displays<br>• Understand when to use each of the graphs based on provided data | • Organize data into a frequency table.<br>• Construct histograms and relative frequency histograms.<br>• Identify the basic shapes of distributions.<br>• Create and interpret variety of picture representations of data including dot plots, bar graphs, Pareto charts, circle graphs, time-series graphs, and stem-and-leaf displays.<br>• Understand which representation is used when provided a set of data.<br><br>**CC.2.4.8.B.2** - Understand patterns of association can be seen in bivariate data utilizing frequencies.<br>**CC.2.4.HS.B.1** - Summarize, represent, and interpret data on a single count or measurement variable. |

| **Averages and Variation** | |
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| **CONTENT/KEY CONCEPTS** | **OBJECTIVES/STANDARDS** |
| **A. Measures of Central Tendency**<br>• Mean, median, and mode<br>• Trimmed mean<br><br>**B. Measures of Variation**<br>• Variance, standard deviation and range<br>• Coefficient of variation<br>• Chebyshev's theorem<br><br>**C. Percentiles**<br>• Interpret percentile scores<br><br>**D. Boxplots (Box-and-Whisker Plots)**<br>• Five-number summary of a set of data<br>• Box-and-whisker plots (boxplots) | • Explain differences between measures of central tendency and measures of variation.<br>• Compute mean, mode, mode and trimmed mean.<br>• Identify best situations to use individual measures of tendency.<br>• Compute variance, standard deviation and range.<br>• Compute the coefficient of variation and interpret result.<br>• Apply Chebyshev's theorem and interpret resulting interval.<br>• Interpret percentile scores.<br>• Find quartiles.<br>• Apply five-number summary to create box-and-whisker plot (boxplot).<br><br>**CC.2.4.HS.B.1** - Summarize, represent, and interpret data on a single count or measurement variable. |

| **Correlation and Regression** | |
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| **CONTENT/KEY CONCEPTS** | **OBJECTIVES/STANDARDS** |
| **A. Scatter Diagrams**<br>• Explanatory and response variables<br>• Create and label scatter diagram, providing a 'best-fit' line using given data points<br>• Estimate correlation from pattern in scatter diagram<br><br>**B. Linear Correlation**<br>• Calculate sample correlation coefficient, r<br>• Interpret sample correlation coefficient, r, as it relates to provided situations<br><br>**C. Linear Regression**<br>• Find and graph the equation of the least-squares line<br>• Find the coefficient of determination, $r^2$<br>• Interpolation vs. extrapolation | • Create a scatter diagram.<br>• Estimate a 'best-fit' line for a scatter diagram.<br>• Compute and interpret the sample correlation coefficient, r.<br>• Find and graph the equation of the least-squares line.<br>• Make a prediction of a response variable using the least-squares line.<br>• Explain the difference between interpolation and extrapolation.<br><br>**CC.2.4.8.B.2** - Understand patterns of association can be seen in bivariate data utilizing frequencies.<br><br>**CC.2.2.8.B.3** - Analyze and solve linear equations and pairs of simultaneous linear equations.<br><br>**CC.2.4.HS.B.1** - Summarize, represent, and interpret data on a single count or measurement variable.<br>**CC.2.4.HS.B.3** - Analyze linear models to make interpretations based on the data. |

| **Elementary Probability** | |
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| **CONTENT/KEY CONCEPTS** | **OBJECTIVES/STANDARDS** |
| **A. Probability Basics**<br>• Define probability<br>• Law of large numbers<br>• Complements<br><br>**B. General Probability Rules**<br>• Independent vs. dependent<br>• Multiplication rule for independent events<br>• General multiplication rules for any events<br>• Venn Diagrams for probabilities<br>• Addition rule for mutually exclusive events<br>• General addition rule for any two events<br>• Two-way tables<br>• Tree diagrams<br>• Factorial notation<br>• Counting rules for permutations and combinations | • Assign probabilities to events.<br>• Apply the law of large numbers.<br>• Apply basic probability rules.<br>• Compute probability involving independent events or mutually exclusive events.<br>• Create a tree diagram to show a sample space and the assigned probabilities.<br>• Explain the difference between combination and permutation.<br>• Calculate combinations and permutations.<br>• Find probabilities from a two-way table.<br><br>**CC.2.4.HS.B.7** - Apply rules of probability to compute probabilities of compound events in a uniform probability model.<br>**CC.2.4.HS.B.6** - Use the concepts of independence and conditional probability to interpret data.<br>**CC2.4.7.B.3** - Investigate chance processes and develop, use, and evaluate probability models. |

| **Binomial Probability Distribution** | |
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| **CONTENT/KEY CONCEPTS** | **OBJECTIVES/STANDARDS** |
| **A. Random Variables and Probability Distributions**<br>• Discrete and continuous variables<br>• Probability distribution for discrete random variables<br>• Mean and standard deviation for discrete population probability distribution<br><br>**B. Binomial Probabilities**<br>• Features of a binomial experiment<br>• Formula for binomial probability distribution<br>• Table for binomial probability distribution<br>• Graph binomial distribution<br>• Mean and standard deviation for binomial probability distribution | • Identify difference between discrete and continuous variables.<br>• Classify variables as either discrete or continuous.<br>• Create a histogram of a discrete probability distribution.<br>• Compute the mean and standard deviation of a discrete probability distribution.<br>• List defining features of a binomial experiment.<br>• Compute binomial probabilities using the formula and the table of probabilities.<br>• Create a histogram for a binomial distribution.<br>• Compute the mean and standard deviation of a binomial probability distribution.<br><br>**CC.2.4.HS.B.7** - Apply rules of probability to compute probabilities of compound events in a uniform probability model.<br>**CC.2.4.HS.B.6** - Use the concepts of independence and conditional probability to interpret data. |

| **Normal Curves and Sampling Distributions** | |
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| **CONTENT/KEY CONCEPTS** | **OBJECTIVES/STANDARDS** |
| **A. Graphs of Normal Probability Distributions**<br>• Graph of normal curve including four main characteristics<br>• Empirical rule of 68-95-99.7<br>• Formula for z-score<br>• Convert raw scores to z-score and vice versa<br><br>**B. Standard Units and Areas Under the Standard Normal Distribution**<br>• Standard normal distribution<br>• Use table of standard normal distribution<br>• Area under curve as probabilities<br>• Inverse normal distribution<br>• Sample distributions<br>• The central limit theorem (CLT)<br>• Standard error and its impact on z-scores<br>• Make continuity corrections on graph of normal approximation to binomial distribution | • List the features of a normal curve.<br>• Graph a normal curve.<br>• Apply the empirical rule to real-world problems.<br>• Convert raw scores to standardized scores and standardized scores to raw scores.<br>• Graph the standard normal curve.<br>• Find areas under the standard normal curve.<br>• Compute the probability of standardized events.<br>• Find a z score from a given normal probability (inverse normal).<br>• Apply inverse normal to find guarantee periods.<br>• Apply the central limit theorem.<br>• Compute the mean and standard deviation for the normal approximation.<br>• Convert raw values to range of z scores to find desired probabilities.<br><br>**CC.2.4.HS.B.1** - Summarize, represent, and interpret data on a single count or measurement variable. |

| **Estimation** | |
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| **CONTENT/KEY CONCEPTS** | **OBJECTIVES/STANDARDS** |
| **A. Estimating μ When σ is Known**<br>• Assumptions made about any random variable x<br>• Point estimate and margin of error<br>• Critical values and how they relate to confidence intervals<br>• Find confidence intervals and interpret their meaning<br>• Appropriate sample sizes<br><br>**B. Estimating μ When σ is Unknown**<br>• Properties of a Student's t distribution and its application<br>• Use degrees of freedom to find areas/probabilities from a Student's t table<br>• Find confidence intervals and interpret their meaning<br><br>**C. Estimating p in the Binomial Distribution**<br>• Point estimates for population proportions<br>• Maximal margin of error and how it relates to confidence intervals for proportions<br>• Interpretation of poll results<br>• Appropriate sample sizes both with and without a preliminary estimate | • Explain a confidence interval and how the error of estimation relates to it.<br>• Compute confidence interval for μ when σ is known.<br>• Compute the sample size to be used for estimating a mean μ.<br>• Find critical values using degrees of freedom and confidence level.<br>• Compute confidence intervals for μ when σ is unknown.<br>• Compute confidence intervals for proportions.<br>• Compute sample size to be used for estimating a proportion with and without a preliminary estimate for the proportion.<br><br>**CC.2.4.HS.B.5** - Make inferences and justify conclusions based on sample surveys, experiments, and observational studies. |

| **Hypothesis Testing** | |
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| **CONTENT/KEY CONCEPTS** | **OBJECTIVES/STANDARDS** |
| **A. Introduction to Statistical Tests**<br>• Null and alternate hypotheses – writing and interpretation<br>• Types of statistical tests (left-tail, right-tail and 2-tail)<br>• Test statistics and p-values<br>• Type I and II errors with applications<br>• Level of significance and its impact on a statistical test<br>• Basic components of a statistical test<br><br>**B. Testing the Mean μ**<br>• Test when μ is known and unknown<br><br>**C. Testing a Proportion**<br>• Test proportion using basic components of statistical test | • Identify the null and alternate hypotheses in statistical test.<br>• Use a test statistic to find a P-value.<br>• Identify types of errors.<br>• Identify the meaning and risks of rejecting or not rejecting a null hypothesis.<br>• Test μ when σ is known using normal distribution and Student's t distribution.<br>• Identify the conditions needed for testing a proportion.<br>• Compute the sample test statistic.<br>• Find the P-value and make a conclusion for a test.<br><br>**CC.2.4.HS.B.5** - Make inferences and justify conclusions based on sample surveys, experiments, and observational studies. |

| **Inferences about Differences** | |
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| **CONTENT/KEY CONCEPTS** | **OBJECTIVES/STANDARDS** |
| **A. Tests Involving Paired Differences**<br>• Paired data<br>• Test paired differences using Student's t distribution<br><br>**B. Inferences About the Difference Between Two Means**<br>• Independent samples<br>• Hypothesis test and confidence intervals for difference of means (standard deviations are known)<br>• Hypothesis test and confidence intervals for difference of means (standard deviations are unknown)<br>• Interpret confidence intervals for differences<br><br>**C. Inferences About the Difference Between Two Proportions**<br>• Pooled estimate<br>• Hypothesis test and confidence interval of difference between two proportions | • Identify paired data and dependent samples.<br>• Compute the differences and the sample test statistic.<br>• Estimate a P-value and conclude a test for difference in means.<br>• Compute and interpret confidence interval for difference in means.<br>• Compute the sample test statistic and P-value for a difference in proportions.<br>• Compute confidence interval for a difference in proportions.<br><br>**CC.2.4.HS.B.5** - Make inferences and justify conclusions based on sample surveys, experiments, and observational studies. |