

K – 12 MATHEMATICS UNIFYING STANDARDS

- 1.0 Number Sense and Operations** – Students understand ways of representing numbers, relationships among numbers, and number systems. They understand the meaning of and relationships between operations and strategies, and they can estimate appropriately.
- 2.0 Patterns, Functions, and Algebra** – Students know and understand various types of patterns and functional relationships. They use symbolic forms and models to represent and analyze mathematical structures in both real and abstract contexts.
- 3.0 Measurement** – Students know and understand attributes, units and systems of measurement. They apply a variety of techniques, tools, and formulas for determining measurements.
- 4.0 Geometry and Spatial Sense** – Students know how to analyze characteristics and properties of two- and three- dimensional objects. They select and use different representational systems, including coordinate and graph theory. They understand the usefulness of transformations and symmetry in analyzing mathematical situations. They know how to visualize and to use spatial reasoning to solve problems that cross disciplines.
- 5.0 Data Analysis, Statistics, and Probability** – Students know how to pose questions and collect, organize, represent and interpret data in order to answer those questions. They use methods of exploratory data analysis to develop and evaluate inferences, predictions, and arguments that are based on data. They understand and know how to apply the notions of chance and probability.
- 6.0 Problem Solving** – Students know that they learn basic skills and concepts in order to use them to solve problems in and out of school. They solve routine and complex problems by drawing from a variety of strategies, including technology, while demonstrating an attitude of persistence and reflection in their approaches.
- 7.0 Processes: Reasoning, Communication, and Connections** – Students use reasoning to develop, analyze, draw conclusions, and validate conjectures and arguments. As they reason, they recognize and understand multiple representations of the same concept. They see the interconnections among math ideas, as well as in other disciplines. They know how to communicate their math thinking clearly and coherently to others, orally, graphically, and in writing, using precise language and symbols.

FOCUS GOALS
ADVANCED PLACEMENT STATISTICS

1.0 Number Sense and Operations

- 1.1 Demonstrate understanding of a discrete and continuous random variable.
- 1.2 Determine the mean and standard deviation of a distribution of data.
- 1.3 Combine independent random variables to form a new distribution.
- 1.4 Perform operations on sampling distributions using the Central Limit Theorem.

2.0 Patterns, Functions, and Algebra

- 2.1 Interpret graphical displays of distributions of univariate data.
- 2.2 Understand the properties of the normal distribution and the sampling distribution.
- 2.3 Use the t-distribution in place of the normal distribution when appropriate.
- 2.4 Understand and apply the properties of the binomial, exponential, and geometric distributions.
- 2.5 Use the normal approximation for the binomial distribution.

3.0 Measurement

- 3.1 Select and use appropriate units and scales of measurements.
- 3.2 Summarize distributions of univariate data by computing measures of center, spread, and position.
- 3.3 Explain parameter and variability of a statistic.
- 3.4 Determine the sample size required for a given margin of error.
- 3.5 Understand the differences between a census and a sample survey. (cb)

4.0 Geometry and Spatial Sense

- 4.1 Organize and describe distributions of data using dotplots, stemplots, boxplots, frequency tables, histograms, and line graphs.
- 4.2 Compare data represented from a variety of sources.
- 4.3 Compute and interpret the correlation coefficient and the coefficient of determination.

5.0 Data Analysis, Statistics, and Probability

- 5.1 Explore categorical data with frequency tables and two-way tables.
- 5.2 Compute expected value and variance of a discrete random variable.
- 5.3 Solve probability problems with finite sample spaces using the rules for addition, multiplication, complementation, and independence.
- 5.4 Understand conditional probabilities and use them to solve probability problems.
- 5.5 Understand the concept of the Law of Large Numbers.
- 5.6 Collect data for observational studies and experiments.

6.0 Problem Solving

- 6.1 Make decisions about how to approach problems.
- 6.2 Plan and conduct a survey using various random sampling techniques.
- 6.3 Design and conduct observational studies and experiments.
- 6.4 Understand and identify sources of bias and confounding and how to control them.
- 6.5 Design and conduct simulations of probability distributions and sampling distributions.

7.0 Processes: Reasoning, Communications, and Connections

- 7.1 Communicate math thinking and conclusions using words, graphs, and charts.
- 7.2 Construct confidence intervals for the mean, proportion, or slope.
- 7.3 Conduct tests of significance using z-tests, t-tests, and chi-square tests.
- 7.4 Understand and explain the logic of significance testing and the interpretation of the p-value.
- 7.5 Understand and explain the concept of Type I and Type II errors and the concept of power.
- 7.6 Apply literacy skills when making mathematical connections.

**MATH STANDARDS
ADVANCED PLACEMENT STATISTICS**

1.0 Number Sense and Operations - Students understand ways of representing numbers relationships among numbers, and number systems. They understand the meaning of and relationships between operations and strategies, and they can estimate appropriately.

1.1 Demonstrate understanding of a discrete and continuous random variable. (c3-4)

- θ Determine the values a discrete random variable can assume.
- θ Determine whether a discrete or continuous variable applies to a given situation.

1.2 Determine the mean and standard deviation of a distribution of data. (c8)

- θ Find the mean and standard deviation of a frequency distribution
- θ Find the mean and standard deviation of a probability distribution.

1.3 Combine independent random variables to form a new distribution. (cb)

- θ Know the rules for combining means and variances.
- θ Determine probabilities for the sum or difference of two or more variables.

1.4 Perform operations on sampling distributions using the Central Limit Theorem. (c9)

- θ Find probabilities for values of the sample mean and sample proportion. (cb)
- θ Find probabilities for values of the difference of sample means and the difference of sample proportions, assuming independence. (cb)

2.0 Patterns, Functions, and Algebra - Students know and understand various types of patterns and functional relationships. They use symbolic forms and models to represent and analyze mathematical structures in both real and abstract contexts.

2.1 Interpret graphical displays of distributions of univariate data. (cb)

- θ Determine the relative position of the mean, median, and mode in a distribution. (c10/s)
- θ Determine the skew of a distribution.
- θ Identify patterns such as clusters, gaps, and spikes in a distribution. (cb)

2.2 Understand the properties of the normal distribution and the sampling distribution. (c16)

- θ Apply the Empirical Rule to a normal distribution.
- θ Know the properties of the Central Limit Theorem.

2.3 Use the t-distribution in place of the normal distribution when appropriate. (cb)

- θ Know the conditions and assumptions for using the t-distribution.

2.4 Understand and apply the properties of the binomial, exponential, and geometric distributions. (c7-8)

- θ Find the probability of a given number of successes for a binomial random variable.
- θ Find probability of a given number of trials for a geometric distribution.
- θ Find the expected value for each distribution.

2.5 Use the normal approximation for the binomial distribution.

- θ Determine if the normal approximation can be used.
- θ Use continuity correction in probability statements.
- θ Find the mean and standard deviation of a binomial distribution.
- θ Compute probabilities for a binomial variable using the normal distribution.

3.0 Measurement - Students know and understand attributes, units and systems of measurement. They apply a variety of techniques, tools, and formulas for determining measurements.

3.1 Select and use appropriate units and scales of measurements. (p/s)

- θ Understand the effect of changing class width for univariate graphs. (*)
- θ Understand the effect of changing scale for bivariate graphs. (cb)

3.2 Summarize distributions of univariate data by computing measures of center, spread, and position. (c6)

- θ Understand the effect of extreme data values on the mean and median.
- θ Understand the difference between percents and percentiles.

3.3 Explain parameter (*) and variability of a statistic. (c6)

- θ Explain the meaning of sampling error.

3.4 Determine the sample size required for a given margin of error. (c7)

- θ Determine the effect of the confidence level and standard deviation on sample size.

3.5 Understand the differences between a census and a sample survey. (cb)

4.0 Geometry and Spatial Sense - Students know how to analyze characteristics and properties of two- and three- dimensional objects. They select and use different representational systems, including coordinate and graph theory. They understand the usefulness of transformations and symmetry in analyzing mathematical situations. They know how to visualize and to use spatial reasoning to solve problems that cross disciplines.

4.1 Organize and describe distributions of data using dotplots, stemplots, boxplots, frequency tables, histograms, and line graphs. (c14/s)

- θ Understand why the number of classes should be from 5 to 20.
- θ Split stems when appropriate.
- θ Determine the 5-number summary of data.
- θ Understand the concept of an outlier.

- θ Identify qualitative and quantitative variables. (cb)
- θ Determine the boundaries of a number or of a class. (cb)
- θ Know the difference between class limits and class boundaries. (cb)
- θ Define categorical, grouped, and ungrouped classes. (cb)
- θ Determine class width given the required number of classes. (cb)
- θ Determine relative frequency and cumulative frequency. (cb)
- θ Construct a histogram, cumulative frequency graph, relative frequency graph, stem plot, box plot, or compound time-series graph from a given set of data. (cb)
- θ Understand what is meant by interquartile range. (cb)
- θ Determine the 5-number summary of a set of data. (cb)

4.2 Compare data represented from a variety of sources. (cb/c)

- θ Analyze distribution of univariate data using dotplots, back-to-back stemplots, and parallel boxplots.
- θ Examine univariate data explore bivariate data with scatterplots, least squares regression, residual plots, and transformations to achieve linearity. (cb/c12-13)

4.3 Compute and interpret the correlation coefficient and the coefficient of determination. (cb/c13)

5.0 Data Analysis, Statistics and Probability - Students know how to pose questions and collect, organize, represent and interpret data in order to answer those questions. They use methods of exploratory data analysis to develop and evaluate inferences, predictions, and arguments that are based on data. They understand and know how to apply the notions of chance and probability.

5.1 Explore categorical data with frequency tables and two-way tables. (cb)

- θ Complete the marginal distributions.
- θ Determine conditional probabilities.
- θ Use the chi-square statistic to determine goodness of fit, independence, or homogeneity of proportions.

5.2 Compute expected value and variance of a discrete random variable. (c3)

- θ Understand what is meant by the variance of a set of numbers. (cb)
- θ Determine the expected value and variance of a probability distribution. (cb)
- θ Compute the mean and variance of a binomial distribution. (cb)

5.3 Solve probability problems with finite sample spaces using the rules for addition, multiplication, complementation, and independence. (cb)

- θ Understand the meaning of an event and a compound event. (cb)
- θ Determine the sample space of an experiment. (cb)
- θ Make a tree diagram for a sequence of events and list all possible outcomes. (cb)
- θ Understand equally likely, and mutually exclusive events. (cb)
- θ Define empirical, theoretical, and classical probabilities. (cb)
- θ Find the probability of a simple event or compound events. (cb)
- θ Apply the rules of complement of an event. (cb)

- θ Simplify probabilities using at least complements. (cb)
- θ Understand the requirements for a probability distribution. (cb)
- θ Construct a probability distribution table and graph a probability distribution. (cb)
- θ Understand differences between independent and dependent events. (cb)

5.4 Understand conditional probabilities and use them to solve probability problems.
(c2)

- θ Find the conditional probability B given event A has occurred. (cb)
- θ Find conditional probabilities when using two-way tables.*

5.5 Understand the concept of the Law of Large Numbers. (cb)

- θ Define the law of large numbers. (cb)
- θ Understand the effects of the law of large numbers. (cb)

5.6 Collect data for observational studies and experiments. (cb)

- θ Know the meaning of descriptive and inferential statistics.
- θ Distinguish between a population and a sample.
- θ Compare and contrast the terms parameter and statistic.

6.0 Problem Solving - Students know that they learn basic skills and concepts in order to use them to solve problems in and out of school. They solve routine and complex problems by drawing from a variety of strategies, including technology, while demonstrating an attitude of persistence and reflection in their approaches.

6.1 Make decisions about how to approach problems. (p9-12)

- θ Analyze problems by identifying relationships, discriminating relevant from irrelevant information, identifying missing information, sequencing and prioritizing information, and observing patterns.
- θ Identify and utilize appropriate tools.
- θ Make generalizations based on prior knowledge and related examples.

6.2 Plan and conduct a survey using various random sampling techniques. (cb)

- θ Understand how to use a random number table.
- θ Use random, stratified, systematic, and cluster samples.

6.3 Design and conduct observational studies and experiments. (cb)

- θ Know the characteristics of a well-designed and conducted survey. (cb)
- θ Understand the use of blocking and completely randomized design. (cb)
- θ Understand the logic of using a control group to show causation.
- θ Use matched pairs design when appropriate.
- θ Generalize results from the sample to the population.
- θ Use a graphing calculator to represent the data and to conduct simulations. *

6.4 Understand and identify sources of bias and confounding and how to control them.
(cb)

6.5 Design and conduct simulations of probability distributions and sampling distributions. (cb)

- θ Understand how to use a random number table.
- θ Establish a correspondence between the probabilities of an event and random numbers.

7.0 Processes: Reasoning, Communications, and Connections - Students use reasoning to develop, analyze, draw conclusions, and validate conjectures and arguments. As they reason, they recognize and understand multiple representations of the same concept. They see the interconnections among math ideas, as well as in other disciplines. They know how to communicate their math thinking clearly and coherently to others, orally, graphically, and in writing, using precise language and symbols.

7.1 Communicate math thinking and conclusions using words, graphs, and charts. (p)**7.2 Construct confidence intervals for the mean, proportion, or slope.** (c17)

- θ Interpret the meaning of the confidence level and the confidence interval.
- θ Construct confidence intervals for the difference in two means or two proportions. (cb)

7.3 Conduct tests of significance using z-tests, t-tests, and chi-square tests. (c19)

- θ Justify that the test used meets the appropriate conditions and/or assumptions.
- θ Write the null and alternative hypotheses both symbolically and worded in the context of the problem.
- θ Determine if a test is one-tailed or two-tailed.
- θ Test for the mean, proportion, difference of two means (paired or unpaired), or difference of two proportions. (cb)
- θ Test for the slope of the true regression line. (cb)

7.4 Understand and explain the logic of significance testing and the interpretation of the p-value. (cb)**7.5 Understand and explain the concept of Type I and Type II errors and the concept of power.** (cb)**7.6 Apply literacy skills when making mathematical connections.** (p-language arts)

- θ Learn and use mathematics vocabulary encountered through reading. (R1.0)
- θ Use strategies to comprehend, analyze, and evaluate mathematics reading materials. (R2.0)
- θ Employ technology to organize and record mathematics information. (R3.0)
- θ Write about mathematics to convey ideas logically and correctly. (W2.0)