

# Statistics Modules

Unit 1 - Methods of Data Collection

Unit 2 - Analyzing Categorical Data

Unit 3 - Displaying, Summarize, and Comparing Quantitative Data

Unit 4 - Scatter Plot & Regression

Unit 5 - Probability

Unit 6 - Data Analysis: Random Variables & Binomial Distribution

Unit 7 - Normal Distribution

## **Purpose & Rationale**

Studying Statistics provides tools for describing variability in data and for making informed decisions. Decisions or predictions are often based on data—numbers in context. These decisions or predictions would be easy if the data always sent a clear message, but the message is often obscured by variability.

Statistics is a highly applicable subject for students considering any post-secondary education (business, engineering, nursing, sciences, etc.). The challenge comes in meeting students where they are when they enter the course. The pace and depth of this course may vary depending on the skills and knowledge of the students.

Consider using the *Statistics & Probability* course or *High School Statistics* mission in Khan Academy.

For open text resources, consider OpenStax CNX [Intro to Statistics](#) or [Intro to Statistics for Business](#).

**KPBSD MATH CURRICULUM  
STATISTICS  
UNIT 1 – METHODS OF DATA COLLECTION**

**Desired Results**

<p style="text-align: center;"><b>Priority Standards</b></p> <p><b>S.IC.1.</b> Understand statistics as a process for making inferences about population parameters based on a random sample from that population.</p> <p><b>S.IC.3.</b> Recognize the purposes of and differences among sample surveys, experiments, and observational studies.</p> <p style="text-align: center;"><b>Supporting Standards</b></p> <p><b>S.IC.5.</b> Use data randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.</p>	<b>Transfer</b>	
	<p>Students will be able to independently use their learning to... Determine appropriate tools for gathering data and communicate the purpose and value of statistics in understanding our world.</p>	
	<b>Meaning</b>	
	<b>ENDURING UNDERSTANDINGS</b>	<b>ESSENTIAL QUESTIONS</b>
	<p>Students will understand that...</p> <ul style="list-style-type: none"> <li>• Statistics provides tools for describing variability in data and for making informed decisions that take it into account.</li> <li>• Data is categorized qualitatively and quantitatively.</li> </ul>	<p>Students will keep considering...</p> <ul style="list-style-type: none"> <li>• What is statistics and how is data categorized?</li> <li>• What is data?</li> <li>• How do I communicate and understand data?</li> <li>• How can data analysis be used to predict future happenings?</li> </ul>
	<b>Acquisition</b>	
<p>Students will know...</p> <ul style="list-style-type: none"> <li>• Concepts of subject, variable, population, sample, parameter, statistic, qualitative, quantitative, placebo effect.</li> </ul>	<p>Students will be skilled at...</p> <ul style="list-style-type: none"> <li>• I can recognize and differentiate between key terms.</li> <li>• I can apply various types of sampling methods to data collection.</li> <li>• I can determine statistical questions.</li> <li>• I can follow guidelines for statistical studies.</li> <li>• I can determine control and treatment groups.</li> </ul>	

**KPBSD MATH CURRICULUM  
STATISTICS  
UNIT 1 – METHODS OF DATA COLLECTION**

**Evidence**

<b>Evaluative Criteria</b>	<b>Assessment Evidence</b>
Rubrics Course Assignments Performance Tasks Teacher made assessments Observation Journals and Self-Reflection Technology-Based Assessments Other...	<b>PERFORMANCE TASK(S):</b> Unit exam (or) Khan Academy: Unit on Study Design, Take unit test as pre-test and then post. Student project demonstrating understanding of standards and spreadsheets.

**KPBSD MATH CURRICULUM  
STATISTICS  
UNIT 2 – ANALYZING CATEGORICAL DATA**

**Desired Results**

<p style="text-align: center;"><b>Priority Standards</b></p> <p><b>S.ID.1.</b> Represent data with plots on the real number line (dot plots, histograms, and box plots).</p> <p><b>S.ID.5.</b> Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.</p> <p style="text-align: center;"><b>Supporting Standards</b></p> <p><b>S.CP.4.</b> Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.</p>	<b>Transfer</b>	
	Students will be able to independently use their learning to... Organize, interpret, and communicate categorical data.	
	<b>Meaning</b>	
	<p style="text-align: center;"><b>ENDURING UNDERSTANDINGS</b></p> <p>Students will understand that...</p> <ul style="list-style-type: none"> <li>• Dot plots, histograms, and box plots are graphical ways to display information.</li> <li>• The shape of the display plays an important role in comparing two data sets.</li> </ul>	<p style="text-align: center;"><b>ESSENTIAL QUESTIONS</b></p> <p>Students will keep considering...</p> <ul style="list-style-type: none"> <li>• What are appropriate visuals to display information about data?</li> <li>• What are common distribution shapes?</li> </ul>
	<b>Acquisition</b>	
<p>Students will know...</p> <ul style="list-style-type: none"> <li>• Bar graph, pictograph, stem-and-leaf plot, histogram, two-way tables, relative, marginal, frequency, relative frequency.</li> </ul>	<p>Students will be skilled at...</p> <ul style="list-style-type: none"> <li>• I can create and interpret frequency tables.</li> <li>• I can display data graphically and interpret graphs: stem plots, histograms, and box plots.</li> </ul>	

**Evidence**

<b>Evaluative Criteria</b>	<b>Assessment Evidence</b>
<p>Rubrics</p> <p>Course Assignments</p> <p>Performance Tasks</p> <p>Teacher made assessments</p> <p>Observation</p> <p>Journals and Self-Reflection</p> <p>Technology-Based Assessments</p> <p>Other...</p>	<p>PERFORMANCE TASK(S):</p> <p>Unit exam (or) Khan Academy: Unit on Analyzing Categorical Data</p> <p>Student project demonstrating understanding of standards and spreadsheets.</p>

# KPBSD MATH CURRICULUM STATISTICS

## UNIT 3 – DISPLAYING, SUMMARIZE, AND COMPARING QUANTITATIVE DATA

### Desired Results

<p style="text-align: center;"><b>Priority Standards</b></p> <p><b>S.ID.2.</b> Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.</p> <p><b>S.ID.3.</b> Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). <i>For example, Justify why median price of homes or income is used instead of the mean.</i></p> <p style="text-align: center;"><b>Supporting Standards</b></p> <p><b>S.ID.4.</b> Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.</p>	<b>Transfer</b>	
	<p>Students will be able to independently use their learning to...</p> <p>Determine the statistical measurement(s) that best represent or compare data sets by conducting graphical and numerical analysis.</p>	
	<b>Meaning</b>	
	<p style="text-align: center;"><b>ENDURING UNDERSTANDINGS</b></p> <p>Students will understand that...</p> <ul style="list-style-type: none"> <li>• Interpretation of data is dependent upon the graphical displays and numerical summaries.</li> <li>• The shape, center, and spread are important characteristics of a distribution.</li> <li>• The question to be answered determines the data to be collected and how best to collect it.</li> </ul>	<p style="text-align: center;"><b>ESSENTIAL QUESTIONS</b></p> <p>Students will keep considering...</p> <ul style="list-style-type: none"> <li>• What is data?</li> <li>• How can data analysis be used to predict future happenings?</li> <li>• Does the data always lead to the truth?</li> </ul>
	<b>Acquisition</b>	
	<p>Students will know...</p> <ul style="list-style-type: none"> <li>• Median, mean, interquartile range, standard deviation, and normal distribution.</li> </ul>	<p>Students will be skilled at...</p> <ul style="list-style-type: none"> <li>• I can use technology to display and interpret data.</li> <li>• I can calculate measures of center, spread, and can use technology to estimate population percentages.</li> </ul>

# KPBSD MATH CURRICULUM STATISTICS

## UNIT 3 – DISPLAYING, SUMMARIZE, AND COMPARING QUANTITATIVE DATA

### Evidence

Evaluative Criteria	Assessment Evidence
Rubrics Course Assignments Performance Tasks Teacher made assessments Observation Journals and Self-Reflection Technology-Based Assessments Other...	PERFORMANCE TASK(S): Unit exam (or) Khan Academy: Units on Display and Comparing Quantitative Data and Summarizing Quantitative Data Student project demonstrating understanding of standards and spreadsheets.

**KPBSD MATH CURRICULUM  
STATISTICS  
UNIT 4 – SCATTER PLOT AND REGRESSION**

**Desired Results**

<p style="text-align: center;"><b>Priority Standards</b></p> <p><b>S-ID.6.</b> Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.</p> <p>a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.</p> <p>b. Informally assess the fit of a function by plotting and analyzing residuals. <i>For example, Describe solutions to problems that require interpolation and extrapolation.</i></p> <p>c. Fit a linear function for a scatter plot that suggests a linear association.</p> <p><b>S-ID.9.</b> Distinguish between correlation and causation.</p> <p style="text-align: center;"><b>Supporting Standards</b></p> <p><b>S-ID.7.</b> Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.</p> <p><b>S-ID.8.</b> Compute (using technology) and interpret the correlation coefficient of a linear fit.</p>	<b>Transfer</b>	
	Students will be able to independently use their learning and knowledge of scatterplots, correlations, and regressions to determine the relationship between data in two variables.	
	<b>Meaning</b>	
	<b>ENDURING UNDERSTANDINGS</b>	<b>ESSENTIAL QUESTIONS</b>
	<p>Students will understand that...</p> <ul style="list-style-type: none"> <li>• Regression is an effective model for prediction.</li> <li>• There is a difference between causation and correlation.</li> <li>• Scatterplots and other graphs are used to illustrate solutions and solve problems.</li> <li>• Data is analyzed to verify the truth.</li> </ul>	<p>Students will keep considering...</p> <ul style="list-style-type: none"> <li>• What does it mean to regress?</li> <li>• What is association? What is correlation? How are they connected?</li> <li>• Does association imply causation?</li> <li>• How can modeling data help me to understand patterns?</li> <li>• Can I use extrapolation to predict the future?</li> <li>• Is it possible to test for lack of correlation?</li> </ul>
<b>Acquisition</b>		
<p>Students will know...</p> <ul style="list-style-type: none"> <li>• Regression, residuals, correlation, and causation.</li> </ul>	<p>Students will be skilled at...</p> <ul style="list-style-type: none"> <li>• I can construct and describe scatter plots in two variables.</li> <li>• I can fit a function to a variety of models: linear, quadratic, and exponential, and interpret the fit of the data to the model.</li> </ul>	

**KPBSD MATH CURRICULUM**  
**STATISTICS**  
**UNIT 4 – SCATTER PLOT AND REGRESSION**

**Evidence**

<b>Evaluative Criteria</b>	<b>Assessment Evidence</b>
Rubrics Course Assignments Performance Tasks Teacher made assessments Observation Journals and Self-Reflection Technology-Based Assessments Other...	<b>PERFORMANCE TASK(S):</b> Unit exam (or) Khan Academy: Units on Exploring bivariate numerical data Student project demonstrating understanding of standards and spreadsheets.

**KPBSD MATH CURRICULUM  
STATISTICS  
UNIT 5 – PROBABILITY**

**Desired Results**

<p style="text-align: center;"><b>Priority Standards</b></p> <p><b>S.CP.2.</b> Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.</p> <p><b>S.CP.3.</b> Understand the conditional probability of A given B as <math>P(A \text{ and } B)/P(B)</math>, and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.</p> <p><b>S.CP.5.</b> Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.</p> <p><b>S.CP.6.</b> Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.</p> <p style="text-align: center;"><b>Supporting Standards</b></p> <p><b>S.CP.1.</b> Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).</p> <p><b>S.CP.4.</b> Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample</p>	<b>Transfer</b>	
	Students will be able to independently use their learning <i>of randomness, conditional probability, and independence to understand and quantify natural phenomena and operational decision-making.</i>	
	<b>Meaning</b>	
	<b>ENDURING UNDERSTANDINGS</b>	<b>ESSENTIAL QUESTIONS</b>
	<p>Students will understand that...</p> <ul style="list-style-type: none"> <li>• Probability models are useful tools for making decisions and predictions.</li> <li>• The notion and behavior of a random variable is foundational to understanding probability distributions.</li> <li>• Probability is based on relative frequencies.</li> <li>• The Law of Large Numbers is an important concept when simulating probability experiments but should be interpreted carefully.</li> </ul>	<p>Students will keep considering...</p> <ul style="list-style-type: none"> <li>• How can I verify that two variables are independent?</li> <li>• How can I base decisions on chance?</li> <li>• 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?</li> <li>• Is independence desirable?</li> </ul>
<b>Acquisition</b>		
<p>Students will know...</p> <ul style="list-style-type: none"> <li>• Independent, mutually exclusive, probability, and conditional probability,</li> </ul>	<p>Students will be skilled at...</p> <ul style="list-style-type: none"> <li>• I can determine whether two events are mutually exclusive and whether two events are independent.</li> <li>• I can calculate probabilities using the Addition Rules and Multiplication Rules.</li> <li>• I can construct and interpret Contingency Tables.</li> <li>• I can construct and interpret Venn Diagrams.</li> <li>• I can construct and interpret Tree Diagrams.</li> <li>• I can calculate probabilities with permutations and combinations.</li> </ul>	

# KPBSD MATH CURRICULUM

## STATISTICS

### UNIT 5 – PROBABILITY

<p>space to decide if events are independent and to approximate conditional probabilities.</p> <p><b>S.CP.7.</b> Apply the Addition Rule, <math>P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)</math>, and interpret the answer in terms of the model.</p> <p><b>S.CP.8.</b> (+) Apply the general Multiplication Rule in a uniform probability model, <math>P(A \text{ and } B) = P(A)P(B A) = P(B)P(A B)</math>, and interpret the answer in terms of the model.</p> <p><b>S.CP.9.</b> (+) Use permutations and combinations to compute probabilities of compound events and solve problems.</p>		
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#### Evidence

Evaluative Criteria	Assessment Evidence
Rubrics Course Assignments Performance Tasks Teacher made assessments Observation Journals and Self-Reflection Technology-Based Assessments Other...	<b>PERFORMANCE TASK(S):</b> Unit exam (or) Khan Academy: Units on Probability and Counting, Combinations, and Permutations. Student project demonstrating understanding of standards and spreadsheets.

# KPBSD MATH CURRICULUM STATISTICS

## UNIT 6 – DATA ANALYSIS: RANDOM VARIABLES AND BINOMIAL DISTRIBUTION

### Desired Results

<p><b>Priority Standards</b></p> <p><b>S.IC.4.</b> Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.</p> <p><b>S.IC.6.</b> Evaluate reports based on data.</p> <p><b>S.MD.2. (+)</b> Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.</p> <p><b>S.MD.3. (+)</b> Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value.</p> <p><b>S.MD.4. (+)</b> Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value.</p> <p><b>S.MD.6. (+)</b> Use probabilities to make fair decisions (e.g., drawing by lots, using random number generator).</p> <p><b>S.MD.7. (+)</b> Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).</p> <p><b>Supporting Standards</b></p> <p><b>S.IC.2.</b> Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. <i>For example, a model says a spinning coin falls heads up with probability 0.5. Would a result</i></p>	<b>Transfer</b>	
	Students will be able to independently use their learning of discrete and continuous random variables to be able to analyze test results.	
	<b>Meaning</b>	
	<b>ENDURING UNDERSTANDINGS</b>	<b>ESSENTIAL QUESTIONS</b>
	<p>Students will understand that...</p> <ul style="list-style-type: none"> <li>• Randomness and probability are the theoretical bases of statistical theory.</li> <li>• Probability models are useful tools for making decisions and predictions.</li> <li>• Probability is the basis of statistical inference.</li> <li>• The notion and behavior of a random variable is foundational to understanding probability distributions.</li> </ul>	<p>Students will keep considering...</p> <ul style="list-style-type: none"> <li>• What is randomness?</li> <li>• How can modeling predict the future?</li> <li>• To what extent does our world exhibit binomial and geometric phenomena?</li> <li>• When is probability a sure thing?</li> <li>• How can we base decisions on chance?</li> <li>• Is anything in nature truly random?</li> </ul>
<b>Acquisition</b>		
<p>Students will know...</p> <ul style="list-style-type: none"> <li>• Random variables, discrete, continuous, expected value, probability distribution,</li> </ul>	<p>Students will be skilled at...</p> <ul style="list-style-type: none"> <li>• I can recognize and understand discrete probability distribution functions, in general.</li> <li>• I can calculate and interpret expected values.</li> <li>• I can recognize the binomial probability distribution and apply it appropriately.</li> <li>• I can recognize the hypergeometric probability distribution and apply it appropriately.</li> <li>• I can classify discrete word problems by their distributions.</li> </ul>	

# KPBSD MATH CURRICULUM STATISTICS

## UNIT 6 – DATA ANALYSIS: RANDOM VARIABLES AND BINOMIAL DISTRIBUTION

<p><i>of 5 tails in a row cause you to question the model?</i></p> <p><b>S.MD.1.</b> (+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.</p> <p><b>S.MD.5.</b> (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.</p>		
<b>Evidence</b>		
<b>Evaluative Criteria</b>	<b>Assessment Evidence</b>	
Rubrics Course Assignments Performance Tasks Teacher made assessments Observation Journals and Self-Reflection Technology-Based Assessments Other...	<b>PERFORMANCE TASK(S):</b> Unit exam (or) Khan Academy: Unit on Random Variables Student project demonstrating understanding of standards and spreadsheets.	

# KPBSD MATH CURRICULUM STATISTICS

## UNIT 7 – NORMAL DISTRIBUTION (OPTIONAL EXTENSION)

### Desired Results

<p style="text-align: center;"><b>Priority Standards</b></p> <p><b>S.ID.4.</b> Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.</p> <p style="text-align: center;"><b>Supporting Standards</b></p> <p><b>S.IC.1.</b> Understand statistics as a process for making inferences about population parameters based on a random sample from that population.</p> <p><b>S.IC.2.</b> Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. <i>For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?</i></p> <p><b>S.IC.4.</b> Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.</p>	<b>Transfer</b>	
	Students will be able to independently use their learning of <i>data exploration, planning studies and probability to estimate endangered species populations from sample data.</i>	
	<b>Meaning</b>	
	<b>ENDURING UNDERSTANDINGS</b>	<b>ESSENTIAL QUESTIONS</b>
<p>Students will understand that...</p> <ul style="list-style-type: none"> <li>• Many discrete phenomena may be described and thus predicted by binomial and geometric models.</li> <li>• The normal distribution and central limit theorem are essential to analyzing samples of data.</li> <li>• Variation can be expected in the results of random samples and is affected by the design of the sample or experiment.</li> </ul>	<p>Students will keep considering...</p> <ul style="list-style-type: none"> <li>• How can modeling predict the future?</li> <li>• How does the normal distribution apply to the real world?</li> <li>• Is all data “created equal”?</li> </ul>	
<b>Acquisition</b>		
<p>Students will know...</p> <ul style="list-style-type: none"> <li>• Normal distribution, central limits theorem, sample mean.</li> </ul>	<p>Students will be skilled at...</p> <ul style="list-style-type: none"> <li>• I can recognize the normal probability distribution and apply it appropriately.</li> <li>• I can recognize the standard normal probability distribution and apply it appropriately.</li> <li>• I can compare normal probabilities by converting to the standard normal distribution.</li> </ul>	

**KPBSD MATH CURRICULUM  
STATISTICS  
UNIT 7 – NORMAL DISTRIBUTION (OPTIONAL EXTENSION)**

**Evidence**

<b>Evaluative Criteria</b>	<b>Assessment Evidence</b>
Rubrics Course Assignments Performance Tasks Teacher made assessments Observation Journals and Self-Reflection Technology-Based Assessments Other...	<b>PERFORMANCE TASK(S):</b> Unit exam (or) Khan Academy: Unit on Random Variables Student project demonstrating understanding of standards and spreadsheets.