Ohio Mathematics - Extended Learning Standards

Statistics & Probability

Interpreting Categorical and Quantitative Data

Summarize, represent, and interpret data on a single count or measurement variable.

1 Represent data with plots on the real number line (dot plots, histograms, and box plots) in the context of real-world applications using the GAISE model. S.ID.1

Complexity a

a Collect data in real-world context to create a dot plot, histogram, or box plot to represent collected data. S.ID.1.A

Complexity b

b Create a dot plot, histogram, or a box plot to represent given or collected data. S.ID.1.B

Complexity c

c Match given data to a given dot plot, histogram, or box plot. S.ID.1.C

Learning Progression

- [Between level c and b: S.ID.1.LP.A
- Identify a missing whole number value on a number line marked with whole number up to 10.] S.ID.1.LP.B
- Sort representations of different data displays. S.ID.1.LP.C
- Recognize different data representations, table, dot plot, histogram and box plot. S.ID.1.LP.D
- Gather data, e.g., the height of the people in the classroom (at least 11 heights) and organize the same data in table, histogram, and box plot. S.ID.1.LP.E
- Recognize that on a number line the spaces need to be counted not the grid lines, assuming a scale of 1. S.ID.1.LP.F
- Understand that 2 is the distance from 0 to 2 and 3 is the distance from 0 to 3 using standard units for all lengths from 1 to 10. S.ID.1.LP.G
- Identify 0 on a number line. S.ID.1.LP.H
- Recognize a point on a number line. S.ID.1.LP.I
- Know what a number line is. S.ID.1.LP.J
- Know the order of the numbers from 0 to 10. S.ID.1.LP.K
- Engagement Statements (demonstration of engaged in the topic) S.ID.1.LP.L
- Interact with a variety of data representations, i.e. dot plot, histogram or box plot. S.ID.1.LP.M
- Engage with graphing technology. S.ID.1.LP.N
- Engage with a group of students to gather real-world data and observe the data being organized into different displays. S.ID.1.LP.O

2 In the context of real-world applications by using the GAISE model, use statistics appropriate to the shape of the data distribution to compare center (median and

mean) and spread (mean absolute deviation, interquartile range, and standard deviation) of two or more different data sets. S.ID.2

Complexity a

a Compare mean, median, and mode of 2 or more given graphs or collected data sets. S.ID.2.A

Complexity b

b Compute mean, median, or mode of a given graph or collected data set involving numbers less than 100. S.ID.2.B

Complexity c

c Identify the median and mode of a graph or a given data set involving numbers less than 50. S.ID.2.C

Learning Progression

- Order a set of an odd quantity of numbers, e.g., 11 data points, from least to greatest. S.ID.2.LP.A
- Gather real-world data points. S.ID.2.LP.B
- Interact with arithmetic operations. S.ID.2.LP.C
- Recognize the symbols for addition (+), subtraction, (–), multiplication (×), division (÷), and equals (=). S.ID.2.LP.D
- Count up to 50. S.ID.2.LP.E
- Engagement Statements (demonstration of engaged in the topic) S.ID.2.LP.F
- Interact with technology S.ID.2.LP.G
- Engage with a group of students to gather real-world data and observe the data being organized into different displays. S.ID.2.LP.H

3 In the context of realworld applications by using the GAISE model, interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). S.ID.3

Complexity a

a Interpret a dot plot. S.ID.3.A

Complexity b

b Interpret a histogram. S.ID.3.B

Complexity c

c Complete an incomplete dot plot, box plot, or histogram (e.g., adding missing labels and missing data points). S.ID.3.C

Learning Progression

- S.ID.1b: Create a dot plot, histogram, or a box plot to represent given or collected data. S.ID.3.LP.A
- Match the vocabulary to the correct display. S.ID.3.LP.B
- Understand the labels on a data display. S.ID.3.LP.C

- Recognize a point on a number line. S.ID.3.LP.D
- Engagement Statements (demonstration of engaged in the topic) S.ID.3.LP.E

f. Interact with a variety of data representations, i.e. dot plot, histogram or box plot S.ID.3.LP.F

- Engage with a group of students to gather real-world data and observe the data being organized into different displays. S.ID.3.LP.G

4 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. S.ID.4

Complexity a

a Organize given data into a normal distribution graph. S.ID.4.A

Complexity b

b Formulate the mean of given data for the normal distribution. S.ID.4.B

Learning Progression

Not on BP

Summarize, represent, and interpret data on two categorical and quantitative variables.

5 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. S.ID.5

Complexity a

a Determine the missing value in a two-way frequency table using the given context. S.ID.5.A

Complexity b

b Given a two-way frequency table, within a context, determine the missing value(s). S.ID.5.B

Complexity c

c Identify the “most” or “least” value in a two-way frequency table. S.ID.5.C

Learning Progression

- [Between levels c and b: S.ID.5.LP.A
- Enter the data numerically in the two - way table S.ID.5.LP.B
- Create a table with labels for columns and rows S.ID.5.LP.C
- Sort cards with data into 4 cells of the table S.ID.5.LP.D
- Gather the data on e.g. index cards. S.ID.5.LP.E
- Recognize a question that involves two categories (e.g. gender/music style, gender/pet ownership.)] S.ID.5.LP.F
- Relate “ greater than” and “less than” to “most” and “least”. S.ID.5.LP.G
- Determine between two numbers which is “greater than” or “less than”. S.ID.5.LP.H
- Order ten different numbers from 1 to 50. S.ID.5.LP.I
- Demonstrate the counting order of numbers up to 50. • Count up to 50 S.ID.5.LP.J
- Engagement Statements (demonstration of engaged in the topic) S.ID.5.LP.K
- Interact with a two-way frequency table. S.ID.5.LP.L
- Engage with a group of students to gather real-world data and observe the data being organized into a two-way table. S.ID.5.LP.M
- Interact with situations involving greater than, equal to, or less than. S.ID.5.LP.N

6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. 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. (A2,

M3) b. Informally assess the fit of a function by discussing residuals. (A2, M3) c. Fit a linear function for scatterplot that suggests a linear association. (A1, M1) S.ID.6

Complexity a

a Create a scatter plot to represent given or collected data and interpret the relation between the two variables as positive, negative, or no correlation. S.ID.6.A

Complexity b

b Create a scatter plot for a given data set. (Limited to 8 data points.) S.ID.6.B

Complexity c

c Interpret the relation between two variables in a scatter plot as positive, negative, or no correlation. S.ID.6.C

Learning Progression

- S.ID.1b: Create a dot plot to represent given or collected data. S.ID.6.LP.A
- Correctly select one answer choice from three options, with the correct answer not always being in the last position. S.ID.6.LP.B
- Recognize an ordered pair (x, y) as a point on the coordinate plane. S.ID.6.LP.C
- Recognize a point on a coordinate plane. S.ID.6.LP.D
- Identify the x- and y- axes in the coordinate plane. S.ID.6.LP.E
- Recognize that on a number line the spaces need to be counted not the grid lines, assuming a scale of 1 S.ID.6.LP.F
- Recognize that the x- and y- axes are number lines S.ID.6.LP.G
- Engagement Statements (demonstration of engaged in the topic) S.ID.6.LP.H
- Interact with two categorical quantitative data within context (e.g., shoe size /age, age/number of hot dogs eaten) S.ID.6.LP.K
- Interact with a scatter plot. S.ID.6.LP.L
- Engage with a group of students to gather real-world data and observe the data being organized into a scatter plot. S.ID.6.LP.M
- Interact with no more than 3 answer choices be able to select 1 from different positions. S.ID.6.LP.N
- Interpret linear models. S.ID.6.LP.O

7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. S.ID.7

Complexity a

a Interpret in a real-world context a line of best fit with a given slope and y-intercept for a scatter plot. S.ID.7.A

Complexity b

b Identify the y-intercept and slope of a line of best fit for a scatter plot. S.ID.7.B

Complexity c

c Match a line graph with a given data set. S.ID.7.C

Learning Progression

- [Between level c and b: S.ID.7.LP.A
- Create a graph to a story.] S.ID.7.LP.B
- Tell stories of a given graph in context. S.ID.7.LP.C
- Experience the creation of graphs using science probes. S.ID.7.LP.D
- Recognize a line on a coordinate plane. S.ID.7.LP.E
- Understand the labels on a coordinate plane. S.ID.7.LP.F
- Recognize that the x- and y- axes are number lines. S.ID.7.LP.G
- Identify the x- and y- axis. S.ID.7.LP.H
- Recognize patterns of the line going up or down, or staying at the same level. S.ID.7.LP.I
- Read the graph from left to right. S.ID.7.LP.J
- Engagement Statements (demonstration of engaged in the topic) S.ID.7.LP.K
- Interact with two categorical quantitative data within context (e.g., purchasing items and relating an increasing cost, or relating a decreasing amount of money left in the wallet/purse with number of items bought). S.ID.7.LP.L
- Interact with a line graph. S.ID.7.LP.M
- Engage with a group of students to gather real-world data and observe the data being organized into a line graph. S.ID.7.LP.N
- Interact with no more than 3 answer choices be able to select 1 from different positions. S.ID.7.LP.O

8 Compute (using technology) and interpret the correlation coefficient of a linear fit. S.ID.8

Complexity a

a Construct data plots to identify strong and weak correlations of given data. S.ID.8.A

Complexity b

b Identify the strongest and weakest correlations given visual representation of data. S.ID.8.B

Complexity c

c Identify the strongest correlation given a visual representation of data. S.ID.8.C

Learning Progression

Not on BP

9 Distinguish between correlation and causation. S.ID.9

Complexity a

a Describe realworld situations that illustrate correlation and/or causation (e.g., rain = umbrella). S.ID.9.A

Complexity b

b Name correlation in realworld example. S.ID.9.B

Complexity c

c Identify correlation and causation in realworld examples (e.g., shoe size vs. height). S.ID.9.C

Learning Progression

Not on BP

Making Inferences and Justifying Conclusions

Understand and evaluate random processes underlying statistical experiments.

1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population. S.IC.1

Complexity a

a Determine if the given data could come from a specific datagenerating device (spinner, coin, number cube). S.IC.1.A

Complexity b

b Determine the likelihood (likely, impossible, unlikely, and certain) of outcomes from a data-generating device. S.IC.1.B

Complexity c

c Determine the likelihood (certain or impossible) of an outcome from a data-generating device. S.IC.1.C

Learning Progression

Not on BP. This standard is taught in Algebra 2. See http://education.ohio.gov/Topics/Learning-in-Ohio/ Mathematics/Ohio-s-Learning-Standards-in-Mathematics/ Transitioning-to-the-2017-Learning-Standards-in-Ma

2 Decide if a specified model is consistent with results from a given datagenerating process, e.g., using simulation. 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? S.IC.2

Complexity a

a Understand a probability of 0 as impossible, a probability of 1 as certain, a probability near 0 as unlikely, near 1 as likely, and near 1/2 as equally likely. S.IC.2.A

Complexity b

b Understand a probability near 0 as unlikely and near 1 as likely. S.IC.2.B

Complexity c

c Understand a probability near 0 as unlikely and near 1 as likely using a number line. S.IC.2.C

Learning Progression

Not on BP. This standard is taught in Algebra 2.

Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. S.IC.3

Complexity a

a Identify sample surveys, experiments, and observational studies. S.IC.3.A

Complexity b

b Identify a sample survey and an experiment. S.IC.3.B

Complexity c

c Identify a sample survey. S.IC.3.C

Learning Progression

Not on BP. This standard is taught in Algebra 2.

4 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. S.IC.4

Complexity a

a Estimate the mean of data given in a sample survey. S.IC.4.A

Complexity b

b Determine the mean of data given in a sample survey. S.IC.4.B

Complexity c

c Match the mean of data given in a sample survey. S.IC.4.C

Learning Progression

Not on BP. This standard is taught in Algebra 2.

5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between sample statistics are statistically significant. S.IC.5

Complexity a

a Compare data of a randomized experiments to determine outcome differences. S.IC.5.A

Complexity b

b Determine if a given treatment changed the outcome of an experiment. S.IC.5.B

Complexity c

c Match the given treatment that changed the outcome (e.g., bleach changed the stain, water did not). S.IC.5.C

Learning Progression

Not on BP. This standard is taught in Algebra 2.

6 Evaluate reports based on data. S.IC.6

Complexity a

a Evaluate if data supports the claim/results. Evaluate given data to determine results. S.IC.6.A

Complexity b

b Determine if data supports the results/claim. S.IC.6.B

Complexity c

c Match the data to the given results. S.IC.6.C

Learning Progression

Not on BP. This standard is taught in Algebra 2.

Conditional Probability and The Rules of Probability

Understand independence and conditional probability, and use them to interpret data.

1 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”). S.CP.1

Complexity a

a Calculate the probability of given event. S.CP.1.A

Complexity b

b List all possible outcomes of an event. S.CP.1.B

Complexity c

c Choose the possible outcomes of an event (e.g., 4 possible colors spun on a 4-section spinner). S.CP.1.C

Learning Progression

- Play games involving probability with or without technology. S.CP.1.LP.A
- In a given context identify the number of likely outcomes to be able to choose a fitting simulation, e.g., Will it be a boy or a girl? - I can use a penny (heads/tails) to simulate the situation. There are four colors of a candy in a bag, what is the probability of picking a red candy? S.CP.1.LP.B
- Know what an outcome is. S.CP.1.LP.C
- Know the language of “likely” and “not likely”. S.CP.1.LP.D
- Engagement Statements (demonstration of engaged in the topic) S.CP.1.LP.E
- Observe and engage with demonstrations of equal probability situations. S.CP.1.LP.F
- Engage with a group of students and interact with e.g., spinners and number cubes, to experience outcomes. S.CP.1.LP.G
- Interact with 2, 4 or 6 outcomes with equal probability from real-world situations. S.CP.1.LP.H

2 Understand that two events A and B are independent if and only 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. S.CP.2

Complexity a

a Create a Venn Diagram given categorical data. S.CP.2.A

Complexity b

b Calculate probabilities based on a Venn Diagram. S.CP.2.B

Complexity c

c Arrange given data into a Venn Diagram (e.g., sports teams). S.CP.2.C

Learning Progression

Not on BP

3 Understand the conditional probability of A given B as P(A and B)/P(B), 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. S.CP.3

Complexity a

a Calculate conditional probabilities of events from Venn Diagrams using the addition rule (e.g., the probability of students who like horror or comedy movies who also like pizza). S.CP.3.A

Complexity b

b Calculate conditional probabilities of events. (e.g., chance of drawing an ace or face card). S.CP.3.B

Complexity c

c Arrange given data into a Venn Diagram. S.CP.3.C

Learning Progression

Not on BP

4 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. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in 10th grade. Do the same for other subjects and compare the results. S.CP.4

Complexity a

a Create a two-way frequency table when given data and calculate the probability of an event. S.CP.4.A

Complexity b

b Given a two-way frequency table, calculate the probability of an event. S.CP.4.B

Complexity c

c Complete a two-way frequency table given data. S.CP.4.C

Learning Progression

- Should be worked on in conjunction with S.ID.5. S.CP.4.LP.A
- Enter the data numerically in the two - way table. S.CP.4.LP.B
- Create a table with labels for columns and rows. S.CP.4.LP.C
- Sort cards with data into 4 cells of the table S.CP.4.LP.D
- Gather the data on e.g. index cards. S.CP.4.LP.E
- Recognize a question that involves two categories (e.g. gender/music style, gender/pet ownership.) S.CP.4.LP.F

- Engagement Statements (demonstration of engaged in the topic) S.CP.4.LP.G
- Interact with a two-way frequency table. S.CP.4.LP.H
- Engage with a group of students to gather real-world data and observe the data being organized into a two-way table. S.CP.4.LP.I
- Interact with situations involving greater than, equal to, or less than. S.CP.4.LP.J

5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer. S.CP.5

Complexity a

a Given a real-world scenario, student will name the conditional probabilities and their effects. S.CP.5.A

Complexity b

b Given a real-world scenario, student will name the conditional probabilities. S.CP.5.B

Complexity c

c Given a real-world scenario, student will determine if the situation or event is conditional or independent. S.CP.5.C

Learning Progression

- Should be worked on in conjunction with S.CP.1. S.CP.5.LP.A
- Experience and engage in a context where the two events have conditional probability as well as in a context where the two events are independent, e.g., What is the chance of receiving a reward if you follow the rules? (dependent) and What is the chance of not getting homework if you compliment the teacher's attire? (independent) S.CP.5.LP.B
- In a familiar context identify the number of possible outcomes. S.CP.5.LP.C
- Engagement Statements (demonstration of engaged in the topic) S.CP.5.LP.D
- Observe and engage with demonstrations of equal probability situations. S.CP.5.LP.E
- Engage with a group of students and interact with e.g., spinners and number cubes, to experience outcomes. S.CP.5.LP.F

Use the rules of probability to compute probabilities of compound events in a uniform probability model.

6 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. S.CP.6

Complexity a

a Given a Venn Diagram or a table with "a given b" statement, identify "a" and "b". S.CP.6.A

Complexity b

b Given a Venn Diagram or a table, distinguish dependent and independent events. S.CP.6.B

Complexity c

c Given a Venn Diagram or a table and data, correctly input missing data on the table. S.CP.6.C

Learning Progression

Not on BP

7 Apply the Addition Rule, P(A or B) = P(A) + P(B) − P(A and B), and interpret the answer in terms of the model. S.CP.7

Complexity a

a Write the Addition Rule equation given a complete two-way table. S.CP.7.A

Complexity b

b Name/ identify 2 missing condition variables and input into equation. S.CP.7.B

Complexity c

c Given a two-way table and the Addition Rule with missing condition, student will identify one missing variable. S.CP.7.C

Learning Progression

Not on BP