NEW MEXICO
Public Education Department

HS: STATISTICS & PROBABILITY – INTERPRETING CATEGORICAL & QUANTITATIVE DATA

Cluster Statement: B: Summarize, represent, and interpret data on two categorical and quantitative variables

Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:**
HSS.ID.B.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. *Note: Algebra 1 focuses on Linear, discuss general principle*	SMP 2: Students can reason abstractly and quantitatively by completing two-way tables and interpreting frequencies found in them based on the context of the data. SMP 6: Students can attend to precision by identifying and finding the relative frequency from a two-way table based on what's asked.	• Summarize data by creating a two-way frequency table for two categories of data. • Calculate relative frequencies in the context of data. • Identify and describe correlations in relative frequencies that could signify possible causation. **Webb's Depth of Knowledge:** 1-2 **Bloom's Taxonomy:** Understand, Apply, Analyze
Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:**
HSS.ID.B.6: Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. • **HSS.ID.B.6.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.** • **HSS.ID.B.6.B: Informally assess the fit of a function by plotting and analyzing residuals.** • **HSS.ID. B.6.C: Fit a linear function for a**	SMP 4: Students can model with mathematics by writing functions that represent data in various contexts. SMP 5: Students use tools strategically by using technology to create scatter-plots, calculate a best-fit function, and establish its reasonableness based on a residual plot.	• Summarize data by creating a scatter plot for two quantitative variables. • Identify and describe how these two variables are related (e.g., positive, negative or no correlation). • Explain how strongly or negatively correlated two variables are. • Determine what type of curve is most appropriate to represent a given set of data. • Create a residual graph. • Determine if a curve is an appropriate model based on the residual graph. • Estimate a line of best fit for a scatterplot of data that is linearly related. **Webb's Depth of Knowledge:** 1-2 **Bloom's Taxonomy:** Understand, Apply, Analyze

scatter plot that suggests a linear association. *Note: Algebra 1 focuses on Linear, discuss general principle*		
Previous Learning Connections • Connect to constructing and interpreting two-way tables using frequencies and relative frequencies. **(8.SP.4)** • Connect to using relative frequencies to describe a possible association between two variables. **(8.SP.4)** • Connect to constructing and interpreting scatterplots. **(8.SP.1)** • Connect to constructing an equation or a function to model a linear relationship and determine/interpret the slope and y-intercept. **(8.F.4)**	**Current Learning Connections** • Connect to writing functions for linear, quadratic, and exponential representations. **(HSA.CED.1-3)** • Connect to **i**dentifying representations as linear, quadratic and exponential models. **(HSF.B.4)** • Connect to constructing and comparing linear and exponential functions to solve problems. **(HSF.LE.1)**	**Future Learning Connections** • Connect to constructing and interpreting two-way frequency tables to determine independence. **(HSS.CP.4)** • Connect to constructing and interpreting two-way frequency tables to calculate conditional probabilities. **(HSS.CP.4)**
Clarification Statement • HSS.ID.B.5: Students will develop an understanding and analyze the vocabulary of **two-way frequency tables**. Students will learn the table entries are the **joint frequencies**, **row** and **column totals** constitute the **marginal frequencies**, and dividing joint or marginal frequencies by the total number of subjects define **relative frequencies**, respectively. Students will also know **conditional relative frequencies** are determined by focusing on a specific row or column of the table and are particularly useful in determining any associations between the two **variables**. Students are flexible in identifying and interpreting the information from a two-way frequency table. They complete **calculations** to determine frequencies and use those frequencies to describe and compare variables. • HSS.ID.B.6: Students represent **data** on two **quantitative variables** on a **scatter plot**, and describe how the variables are related. Students will **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. (Emphasis is on **linear and quadratic models**.) Students will also informally assess the **fit of a function** by **plotting** and **analyzin**g r**esiduals** and fit a linear function for a scatter plot that suggests a **linear association**.		
Common Misconceptions • Students may not consider outliers when analyzing data and determining the best fit of a function. • Students often have difficult separating causation and association with contextual data sets.		

Multi-Layered System of Supports (MLSS)/Suggested Instructional Strategies

Pre-Teach

Pre-teach (targeted): *What pre-teaching will prepare students to productively struggle with the mathematics for this cluster within your HQIM?*

- For example, some learners may benefit from targeted pre-teaching that rehearses prior learning when describing possible associations between bi-variate data. Students may benefit from min-lesson on the types of outcomes and examples of data (hot chocolate sales and temperature). Students may also benefit from a mini lesson on how to construct and analyze a two-way frequency table and how the frequency table can help determine possible associations.

Pre-teach (intensive): *What critical understandings will prepare students to access the mathematics for this cluster?*

- 8.SP.4 provides a foundation for work with understanding patterns of association of bivariate data by displaying frequencies and relative frequencies in a two-way table. If students have unfinished learning with this standard providing opportunities for students to analyze and discuss possible associations will provide them with the opportunity for on grade level learning. Also discussing the difference between causation and correlation will benefit students before attempting on grade level work for this standard.

Core Instruction

Access

Interest: *How will the learning for students provide multiple options for recruiting student interest?*

- For example, learners engaging with summarizing, representing and interpreting data of 2 categorical or quantitative variables benefit when learning experiences include ways to recruit interest such as providing contextualized examples to their lives because students make meaningful connections to real-life data of 2 quantities. By using real-life examples, students understand and interpret the different data sets in the context of the problems based on their prior experience.

Build

Effort and Persistence: *How will the learning for students provide options for sustaining effort and persistence?*

- For example, learners engaging with informally assessing the fit of function by plotting and analyzing residuals benefit when learning experiences attend to students attention and affect to support sustained effort and concentration such as engaging learners in assessment discussions of what constitutes excellence because students discuss the features of the functions and how the function best match the data sets. Students justify the best fit function to the given data set with viable arguments and evidence.

Language and Symbols: *How will the learning for students provide alternative representations to ensure accessibility, clarity and comprehensibility for all learners? (e.g., a graph illustrating the relationship between two variables may be informative to one learner and inaccessible or puzzling to another; picture or image may carry very different meanings for learners from differing cultural or familial backgrounds)*

- For example, learners engaging with representing the data sets with mathematical model using functions benefit when learning experiences attend to the linguistic and nonlinguistic representations of mathematics to ensure clarity can comprehensibility

for all learners such as highlighting how complex terms, expressions, or equations are composed of simpler words or symbols by attending to the structure because students represent the 2 quantities in the data sets using the variables and model relationship of the quantities using variables and functions. Students interpret and describe the mathematical model used in the context of the data verbally and symbolically.

Expression and Communication: *How will the learning provide multiple modalities for students to easily express knowledge, ideas, and concepts in the learning environment?*

- For example, learners engaging with using functions fitted to data to solve problems in the context of the data benefit when learning experiences attend to the multiple ways students can express knowledge, ideas, and concepts such as providing different approaches to motivate, guide, feedback or inform students of progress towards fluency because students receive frequent feedback to guide their mathematical thinking of justifying which function fit the data sets. Students will test the data set and analyze the tread to check for the best fit to make sense of their mathematical thinking.

Internalize

Comprehension: *How will the learning for students support transforming accessible information into usable knowledge, knowledge that is accessible for future learning and decision-making?*

- For example, learners engaging with representing and interpreting the quantities of the data sets using function benefit when learning experiences attend to students by intentionally building connections to prior understandings and experiences; relating important information to the learning goals; providing a process for meaning making of new learning; and, applying learning to new contexts such as providing explicit, supported opportunities to generalize learning to new situations because students interpret and predict the correlation of the 2 quantities in the data sets using function. Students may make generalization and prediction of the quantities in the context of the problems with evidence and viable arguments.

Re-teach

Re-teach (targeted): *What formative assessment data (e.g., tasks, exit tickets, observations) will help identify content needing to be revisiting during a unit?*

- For example, students may benefit from re-engaging with content during a unit on modeling the relation of the 2 variables with the appropriate mathematical model by revisiting student thinking through a short mini-lesson because students need to explain the features of the data sets or the graphs/plots. Students connect those features to the features of different functions.

Re-teach (intensive): *What assessment data will help identify content needing to be revisited for intensive interventions?*

- For example, some students may benefit from intensive extra time during and after a unit choosing the appropriate functions to model the 2 quantitative variables of the data by confronting student misconceptions because students need to use the functions model to make prediction and implication of the data. Students need to justify if the prediction and the implication make sense in the context of the data.

Extension

What type of extension will offer additional challenges to 'broaden' your student's knowledge of the mathematics developed within your HQIM?

- For example, some learners may benefit from an extension such as the application of and development of abstract thinking skills when studying representing the data with a function model because students explain the interval(s) when the function model fits the scatter plot. Students describe the possible situation when the function model does not fit the scatter plot and possible explanation.

Culturally and Linguistically Responsive Instruction:

Validate/Affirm: How can you design your mathematics classroom to intentionally and purposefully legitimize the home culture and languages of students and reverse the negative stereotypes regarding the mathematical abilities of students of marginalized cultures and languages?
Build/Bridge: How can you create connections between the cultural and linguistic behaviors of your students' home culture and language the culture and language of school mathematics to support students in creating mathematical identities as capable mathematicians that can use mathematics within school and society?

Supporting Productive Struggle in Learning Mathematics: The standard for mathematical practice, makes sense of mathematics and persevere in solving them is the foundation for supporting productive struggle in the mathematics classroom. "Too frequently, historically marginalized students are overrepresented in classes that focus on memorizing and practicing procedures and rarely provide opportunities for students to think and figure things out for themselves. When students in these classes struggle, the teacher often tells them what to do without building their capacity for persistence." Teachers need to provide tasks that challenge students and maintain that challenge while encouraging them to persist. This encouragement or "warm-demander" requires a strong relationship with students and an understanding of the culture of the students. For example, when studying data on two variables supporting productive struggle is critical because students may explore multiple ways of representing and interpreting two variables data sets. Students explore different functions to model the data set and defend their choice. When the function is not the best fit for the domain, students need to develop flexible solutions and define underlying assumptions about the math model used.

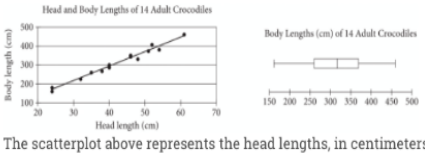
Standards Aligned Instructionally Embedded Formative Assessment Resources:
Source: https://satsuitequestionbank.collegeboard.org/

Question ID 4170271

Assessment	Test	Cross-Test and Subscore	Difficulty	Primary Dimension	Secondary Dimension	Tertiary Dimension	Calculator
SAT	Math	Problem Solving and Data Analysis	■□□	Problem Solving and Data Analysis	Two-variable data: Models and scatterplots	1. Using a model that fits the data in a scatterplot, compare values predicted by the model to values given in the data set.	Calculator

4170271

Questions 3-5 refer to the following information.



The scatterplot above represents the head lengths, in centimeters (cm), and body lengths, in cm, of 14 adult crocodiles. The line of best fit for the data is also shown. The box plot above summarizes the body lengths of the 14 crocodiles.

For an adult crocodile with a head length of 30 cm, which of the following is closest to the body length, in cm, predicted by the line of best fit?

For an adult crocodile with a head length of 30 cm, which of the following is closest to the body length, in cm, predicted by the line of best fit?

A. 180

B. 215

C. 250

D. 275

Rationale

Choice B is correct. It's given that the adult crocodile has a head length of 30 cm. Based on the line of best fit shown in the scatterplot, an adult crocodile that has a head length of 30 cm is predicted to have a body length that falls between 200 cm and 250 cm. Only choice B gives a body length that is between 200 cm and 250 cm.
Choice A is incorrect. This is approximately the minimum body length predicted by the line of best fit. Choices C and D are incorrect and may result from misinterpreting the scatterplot.

https://tasks.illustrativemathematics.org/content-standards/tasks/1887

Relevance to families and communities:	**Cross-Curricular Connections:**
During a unit focused on summarizing, representing and interpreting data on two variables, consider options for learning from your families and communities the cultural and linguistic ways this mathematics exists outside of school to create stronger home to school connections for students, for example, using data that is relevant to the community and the summary of the data provides useful information to students regarding to their families, culture and community.	Social Studies: In high school the New Mexico Social Studies Standards state students should "explain how to use technological tools to research data, verify facts and information, and communicate findings." Consider providing a connection for students to determine the best fit of a function for a set of data and explain their choice.