NEW MEXICO
Public Education Department

HS: STATISTICS & PROBABILITY- INTERPRETING CATEGORICAL & QUANTITATIVE DATA

Cluster Statement: A: Summarize, represent, and interpret data on a single count or measurement variable

Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:**
HSS.ID.A.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.**	SMP2: Students can reason abstractly and quantitatively by expressing relationships between different measures by finding the measures of center and dispersion using quantitative reasoning. SMP3: Students can construct viable arguments and critique the reasoning of others by justifying their reason for using a specific measure of center based on the data dispersion. SMP 7: Students can look for and make use of structure by learning to see visually the relationship between probability of a population and a normal curve. SMP 8: Students can look for and express regularity in repeated reasoning by determinin the effects of skewed data sets and extreme values on their measures of center.	• Explain data distributions: when the data is normal, mean and standard deviation are used to represent the data; when data is skewed, median and Interquartile Range (IQR) are used to represent the data. • Explain why normal distribution can be used to estimate population percentages. • Estimate areas under a normal curve. • Calculate mean, median (Q2), standard deviation, IQR (Q1 & Q3). • Calculate z- score based on mean and standard deviation. • Use the empirical rule to understand area under the distribution • Apply this knowledge to estimate population percentages. • Use real world data to determine distributions. **Webb's Depth Of Knowledge:** 1-4 **Bloom's Taxonomy:** remember, understand, apply, analyze, evaluate

Previous Learning Connections	**Current Learning Connections**	**Future Learning Connections**
• Connect to work in previous math courses: when students learned to determine mean, median, mode, range, IQR, minimum, maximum. Students also learned how to graph data distributions (e.g., histograms, box plots).	• Connect students using this information to make inferences and justify conclusions from sample survey, experiments and observational studies.	• Connect to future work students may do in subsequent statistics course (AP or college level).

Clarification Statement

At this level, students are not expected to fit **normal curves** to data. (In fact, it is rather complicated to rescale data plots to be **density plots** and then find the best fitting curve.) Instead, the aim is to look for broad **approximations**, with application of the rather rough "**empirical rule**" (also called the 68%–95% Rule) for distributions that are somewhat **bell-shaped**. The better the bell, the better the approximation. Using such approximations is partial justification for the introduction of the **standard deviation**.

Common Misconceptions

Students may believe all data follows a normal distribution because of prior work with a sampling distribution of means.

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 analyzes common misconceptions when studying Summarize, Represent, And Interpret Data On A Single Count Or Measurement Variable because there are common misconceptions which learners often encounter. Addressing these misconceptions will often resolve issues that would otherwise have to be addressed in more time consuming one-on-one instruction.
- For example: Learners often misunderstand the meaning of range and standard deviation. Directly targeting this misconception can often allow students to move forward without time-consuming one-on-one instruction.

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

- 6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots.: This standard provides a foundation for work with Interpreting Categorical And Quantitative Data because learners which don't understand the meaning and use of different types of data graphs will have difficulty interpreting them for meaning when solving problems. If students have unfinished learning within this standard, based on assessment data, consider ways to provide intensive pre-teaching support prior to the start of the unit to ensure students are ready to access grade level instruction and assignments.

Core Instruction

Access

Physical Action: *How will the learning for students provide a variety of methods for navigation to support access?*

- For example, learners engaging with Interpreting Data benefit when learning experiences ensure information is accessible to learners through a variety of methods for navigation, such as varying how statistical data and analytical results are displayed or presented because insight into a problem is often gained by viewing the data using different perspectives.

Build

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

- For example, learners engaging with Interpreting Data benefit when learning experiences attend to students attention and affect to support sustained effort and concentration such as creating expectations for group work (e.g., rubrics, norms, etc.)s because students are more likely to fully engage in an activity when they are being held accountable within their peers.

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 Interpreting Data benefit when learning experiences attend to the linguistic and nonlinguistic representations of mathematics to ensure clarity can comprehensibility for all learners such as embedding support for unfamiliar references within the text (e.g., domain specific notation, lesser known properties and theorems, idioms, academic language, figurative language, mathematical language, jargon, archaic language, colloquialism, and dialect) because Interpreting Data requires a good understanding of a large number of concepts that some students have trouble processing at one time, producing cognitive overload. Reducing the cognitive load enables learners to process at a higher level since less energy and time is spent on remembering concepts.

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 Interpreting 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 insightful interpretation of data requires a high level of conceptual understanding and processing that is honed through practice, trial and error and feedback.

Internalize

Self-Regulation: *How will the design of the learning strategically support students to effectively cope and engage with the environment?*

- For example, learners engaging with Interpretation of data benefit when learning experiences set personal goals that increase ownership of learning goals and support healthy responses and interactions (e.g., learning from mistakes), such as using activities that include a means by which learners get feedback and have access to alternative scaffolds (e.g., charts, templates, feedback displays) that support understanding progress in a manner that is understandable and timely because learners often benefit from guiding questions and other feedback which help them overcome conceptual and reasoning errors and help them develop reasoning strategies that are useful in solving similar problems.

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 summarize, represent, and interpret data on a single Count or measurement variable by providing specific feedback to students on their work through a short mini-lesson because learners often get hung up on a single misconception or step. Clearing that step will often enable the learner to progress in solving the problem.

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 in the Summarize, Represent, And Interpret Data On A Single Count Or Measurement Variable cluster by helping students move from specific answers to generalizations for certain types of problems because learners sometimes have difficulties with recall or have difficulty with the cognitive load of recalling and processing information spread out over one or more days. This is especially true when instruction is spread over weekends or breaks. Intensive Reteaching eases this cognitive load and empowers learners to accomplish the task.

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 opportunity to understand concepts more quickly and explore them in greater depth than other students when studying how to summarize, represent, and interpret data on a single count or measurement variable, such as non-Gaussian distributions because there may be learners that need additional challenges beyond the curriculum.

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?

Goal Setting: Setting challenging but attainable goals with students can communicate the belief and expectation that all students can engage with interesting and rigorous mathematical content and achieve in mathematics. Unfortunately, the reverse is also true, when students encounter low expectations through their interactions with adults and the media, they may see little reason to persist in mathematics, which can create a vicious cycle of low expectations and low achievement. For example, when studying HS.ID.A: Summarize, represent, and interpret data on a single count or measurement variable cluster, goal setting is critical because statistics are often used to help describe how a specific ethnic or cultural group is doing and what needs they may need. The census is the largest statistical tool the United States uses to help with this objective.

Standards Aligned Instructionally Embedded Formative Assessment Resources:
http://tasks.illustrativemathematics.org/content-standards/HSS/ID/A/4/tasks/1020

This type of assessment question requires students to analyze a scenario approximately modeled by a normal distribution with given mean and standard deviation to make and support a statistical claim. Students will engage with SMP 3 by making and supporting statistical claims. If students share their solutions with others, SMP 3 can be further targeted by critiquing the solutions of peers.

Relevance to families and communities:	**Cross-Curricular Connections:**
During a unit focused on analyzing data, 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, learning about the different data	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

analytical techniques helps provide a robust set of results which provide differing points of view. For example, mean and median of a data set can be used to estimate the symmetry of a curve, providing insight into the number of people that might be affected at the extremes of the population.	providing a connection for students to write a report describing and analyzing a specific set of data.