NEW MEXICO
Public Education Department

<table>
<tr><td colspan="3">

7.SP: STATISTICS & PROBABILITY

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<tr><td colspan="3">Cluster Statement: B: Draw informal comparative inferences about two populations.

Additional Cluster (Students should spend the large majority of their time (65-85%) on the major work of the grade/course. Supporting work and, where appropriate, additional work should be connected to and engage students in the major work of the grade.)</td></tr>
<tr>
<td rowspan="3">Standard Text

7.SP.B.3: Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.</td>
<td rowspan="3">Standard for Mathematical Practices

SMP 5: Students choose appropriate mathematical and visual representations, including technology-based tools, to represent the data distributions.

SMP 8: Students look for and express regularity in repeated reasoning. Students look to make generalized comparisons between situations that involve bias using specific criteria.</td>
<td>Students who demonstrate understanding can:
• Find measures of center and measures of variation for two or more data sets.
• Compare two data sets for variability by comparing graphs.
• Make inferences about data sets by comparing their statistical measures.
• Model and compare two real-world data sets by measuring the difference between centers and expressing it multiple of a measure of variability</td>
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<tr><td>Webb's Depth of Knowledge: 1-2</td></tr>
<tr><td>Bloom's Taxonomy:
Understand, Evaluate</td></tr>
<tr>
<td rowspan="3">Standard Text

7.SP.B.4: Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.</td>
<td rowspan="3">Standard for Mathematical Practices

SMP 1: Students make sense of problems and persevere in solving them. Students make sense of information by connecting visual, tabular, and symbolic representations of sample populations in real-life contexts.

SMP 6: Students attend to precision to collect accurate measurement information from sample populations and precise language when generating and interpreting data.</td>
<td>Students who demonstrate understanding can:
• Draw valid comparative inferences about two populations.
• Select the appropriate measure(s) of center (mean and median) or variability (MAD and IQR) when comparing two sets of data and justify that selection.</td>
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<tr><td>Webb's Depth of Knowledge: 1-2</td></tr>
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Understand, Evaluate</td></tr>
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Previous Learning Connections	Current Learning Connections	Future Learning Connections
• In 6th grade, learners develop an understanding of graphs, mean, median, mode, Mean Absolute Deviation (M.A.D.) and interquartile range (IQR). In 6th grade, learners recognize there will be variability in the data of a statistical question and will account for it in the answers. In 6th grade, learners understand a data set has a distribution which can be described by its center, spread, and overall shape and can summarize numerical data sets by reporting the number of observations along with describing the nature of the attribute under investigation and how it was measured and its units.	• This is an additional cluster, so the connections between this cluster and other grade level clusters is limited to 7.SP.A and 7.SP.C that examine different aspects of Statistics & Probability.	• In future courses, learners will represent data with plots on the real number line (dot plots, histograms, and box plots). In future courses, learners will use statistics appropriate to the shape and context of the data distribution to compare center (median, mean) and spread (IQR, standard deviation) of two or more different data sets. In future courses, learners will interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points.

Clarification Statement:
In this cluster students draw valid comparable inferences about two populations using measures of center (mean, median) and measures of variability (mean absolute deviation, interquartile range).

Common Misconceptions
Students may struggle with the key vocabulary utilized within in this cluster. It will be important to emphasize vocabulary acquisition.

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 provides additional time for confusion to happen with new mathematical ideas when studying; Drawing informal comparative inferences about two populations because in previous clusters, students worked with one population.

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

- 7.SP.A.2: This standard provides a foundation for work with Drawing informal comparative inferences about two populations because why and how inferences and generalizations are made helps to justify reasoning. 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

Perception: *How will the learning for students provide multiple formats to reduce barriers to learning, such as providing the same information through different modalities (e.g., through vision, hearing, or touch) and providing information in a format that will allow for adjustability by the user?*

- For example, learners engaging with using random sampling to draw inferences about a population benefit when learning experiences ensure information is accessible to learners with sensory and perceptual disabilities, but also easier to access and comprehend for many others such as displaying information from a random sample in a flexible format to vary perceptual features such as providing a variety of representations including visuals, contexts, tables, graphs, and symbols because students are analyzing data from a sample to draw overall inferences for an entire population and students will benefit from having the information presented in multiple forms.

Build

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

- For example, learners engaging with using random sampling to draw inferences about a population benefit when learning experiences attend to students attention and affect to support sustained effort and concentration such as encouraging and supporting opportunities for peer interactions and supports because students can question or convince each other of the inferences they were able to make based on the data from the random sample.

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 using random sampling to draw inferences about a population benefit when learning experiences attend to the linguistic and nonlinguistic representations of mathematics to ensure clarity can comprehensibility for all learners such as pre-teaching vocabulary and symbols, especially in ways that promote connection to the learners' experience and prior knowledge because students need to have an established understanding of a random sample before they can be expected to make inferences.

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 random sampling to draw inferences about a population benefit when learning experiences attend to the multiple ways students can express knowledge, ideas, and concepts such as providing sentence starters or sentence strips because this will give students examples of inferences they should be able to draw from the random sample.

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 using random sampling to draw inferences about a population 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 will be expected to draw their own inferences based on random samples and these explicit practice opportunities will support their learning.

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?*

- Examine assessments for evidence of lingering misconceptions (see common misconceptions). If students exhibit one more of these misconceptions, consider addressing the misconception by re-engaging with content during a unit on drawing informal comparative inferences about two populations by clarifying mathematical ideas and/or concepts through a short mini-lesson because students may not understand why it may be necessary to conduct multiple samples of the same size

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

- Examine assessments for evidence of students still developing the underlying ideas drawing informal comparative inferences about two populations by offering opportunities to understand and explore different strategies because students can organize by using lists, tables, tree diagrams, and simulations.

Extension

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

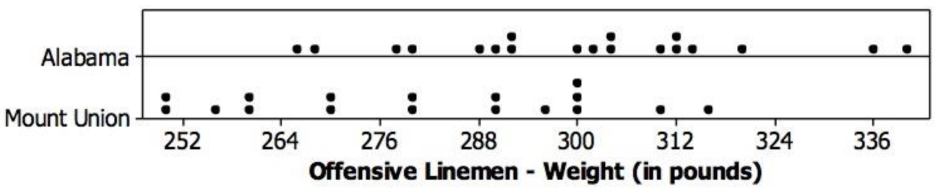
- To extend students learning about an opportunity to explore links between various topics when studying drawing informal comparative inferences about two populations because students can apply probabilities to real-life scenarios that link science disciplines for example, genetics and a Punnett square.

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?

Building Procedural Fluency from Conceptual Understanding: Instruction should build from conceptual understanding to allow students opportunities to make meaning of mathematics before focusing on procedures. When new learning begins with procedures it privileges those with strong prior familiarity with school mathematics procedures for solving problems and does not allow learning to build for more methods for solving tasks that occur outside of school mathematics. For example, when studying drawing informal comparative inferences about two populations the types of mathematical tasks are critical because in this cluster of standards many of the ideas are new to students. We need to create learning opportunities that are focused on conceptual understanding as the entry point. We can build connections with students' cultures and languages as we purposefully work with students to use data that is relevant as they explore probability and develop models. This will also allow us to create opportunities for students to practice the situational appropriateness in the use of these mathematical principles in a variety of real-world situations.

Standards Aligned Instructionally Embedded Formative Assessment Resources:
Source: http://tasks.illustrativemathematics.org/content-standards/7/SP/B/3/tasks/1341
Offensive Linemen
College football teams are grouped with similar teams into "divisions" (and in some cases, "subdivisions") based on many factors such as game attendance, level of competition, athletic department resources, and so on. Schools from the Football Bowl Subdivision (FBS, formerly known as Division 1-A) are typically much larger schools than schools of any other division in terms of enrollment and revenue. "Division III" is a division of schools with typically smaller enrollment and resources.
One particular position on a football team is called "offensive lineman," and it is generally believed that the offensive linemen of FBS schools are heavier on average than the offensive linemen of Division III schools.
For the 2012 season, the University of Mount Union Purple Raiders football team won the Division III National Football Championship while the University of Alabama Crimson Tide football team won the FBS National Championship. Below are the weights of the offensive linemen for both teams from that season.



a. Based on visual inspection of the dotplots, which group appears to have the larger average weight? Does one group seem to have greater variability in its weights than the other, or do the two groups look similar in that regard?

b. Compute the mean and mean absolute deviation (MAD) for each group. Do your measures support your answers in part (a)?

c. Choose from the following to fill in the blank: "The average Alabama offensive lineman's weight is about _________ than the average Mount Union offensive lineman's weight."

   i. 20 pounds lighter

   ii. 15 pounds lighter

   iii. 15 pounds heavier

   iv. 20 pounds heavier

2. "This difference in average weights is approximately ___________ of either team."

   i. About half of the MAD

   ii. Slightly more than 1 MAD

   iii. Twice the MAD

d. The offensive linemen on the Alabama team are not a random sample from all FBS offensive linemen. Similarly, the offensive linemen on the Mount Union Team are not a random sample from all Division III offensive linemen. However, for purposes of this task, suppose that these two groups can be regarded as random samples of offensive linemen from their respective divisions/subdivisions. If these were random samples, would you think that offensive linemen from FBS schools are typically heavier than offensive linemen from Division III schools? Explain your decision using answers to the previous questions and/or additional analysis.

In this task, students are able to conjecture about the differences and similarities in the two groups from a strictly visual perspective and then support their comparisons with appropriate measures of center and variability. This will reinforce that much can be gleaned simply from visual comparison of appropriate graphs, particularly those of similar scale. Since the two distributions have similar variability and almost identical MADs, students are able to express the difference in mean values with reference to the MAD of either group. As a possible extension, students can investigate if these distributions are in fact similar to the distributions of offensive lineman weights at similar schools (such as schools in the same respective divisions or conferences).

Relevance to families and communities:	**Cross-Curricular Connections:**[1]
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? During a unit focused on investigating chance processes and developing, using, and evaluating probability models, 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 about how probability is connected to games that families enjoy playing. Discussing how probability makes the games more or less interesting.	*Science and Technology:* Science and math are intimately connected, particularly in fields such as chemistry, astronomy and physics. Students who can't master basic arithmetic skills will struggle to read scientific charts and graphs. More complex math, such as geometry, algebra and calculus, can help students solve chemistry problems, understand the movements of the planets and analyze scientific studies. Math is also important in practical sciences, such as engineering and computer science. Students may have to solve equations when writing computer programs and figuring out algorithms. Nursing majors may have great bedside manner. but they also need to know how to precisely calculate dosages to pass their courses. *Social Studies:* Social studies classes, such as history, often require students to review charts and graphs that provide historical data or information on ethnic groups. In geography classes, students might need to understand how the elevation of an area affects its population or chart the extent to which different populations have different average life spans. Knowledge of basic mathematical terms and formulas makes statistical information accessible *Literature and Writing:* Literature might seem like a far cry from math but mastering basic arithmetic can enable students to better understand poetry. The meter of

[1] Thompson, Van. (2020, June 24). How Is Mathematics Used in Other Subjects?. *sciencing.com*. Retrieved from https://sciencing.com/how-is-mathematics-used-in-other-subjects-9861185.html

	poetry, the number of words to include in a line and the effect that certain rhythms have on the reader are all products of mathematical calculations. At a more mundane level, math can help students plan reading assignments in literature classes by discerning their average reading time and estimating how long it will take them to read a particular work. The linear, logical thinking used in mathematical problems can also help students write more clearly and logically. *Art/Music:* Students interested in pursuing careers in theater, music, dance or art can benefit from basic mathematical knowledge. Musical rhythm often follows complex mathematical series, and math can help students learn the basic rhythms of dances used in ballet and theater performances. Art thrives on geometry, and students who understand basic geometric formulas can craft impressive art pieces. Photographers use math to calculate shutter speed, focal length, lighting angles and exposure time.