NEW MEXICO
Public Education Department

7.SP: STATISTICS & PROBABILITY

Cluster Statement: A: Use random sampling to draw inferences about a population.

Supporting 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.)

Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:**
7.SP.A.1: Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.	SMP 2: Students can reason abstractly and quantitatively by making generalizations and predictions based on random samples. SMP 3: Students can construct viable arguments by using statistical methods as justification for predictions inferences. SMP 4: Students can model with mathematics by developing probability models and use them to find probabilities of events. SMP 5: Students can use tools by using organized lists, tables, tree diagrams, and simulation tools.	• Critique examples of sampling as statistical tools using precise mathematical vocabulary; random sampling, population, and valid generalization. • Design random samplings to collect the data given statistical questions. • Defend the samplings as random. **Webb's Depth of Knowledge:** 1-2 **Bloom's Taxonomy:** Understand, Apply
Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:**
7.SP.A.2: Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. *For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.*	SMP 2: Students can reason abstractly and quantitatively by making generalizations and predictions based on random samples. SMP 3: Students can construct viable arguments by using statistical methods as justification for predictions inferences. SMP 4: Students can model with mathematics by developing probability models and use them to find probabilities of events.	• Draw valid inferences and generalizations from random samplings of populations • Justify their inferences and generalizations as valid using appropriate vocabulary • Explain the variability in multiple random samples and gauge how far off an estimate may be. **Webb's Depth of Knowledge:** 1-2 **Bloom's Taxonomy:** Understand, Apply

	SMP 5: Students can use tools by using organized lists, tables, tree diagrams, and simulation tools.	
Previous Learning Connections • In 6th grade, learners summarize quantitative data using quantitative measures of center and variability.	**Current Learning Connections** • In 7th grade, learners focus on the process of selecting a random sample, and the value of doing so.	**Future Learning Connections** • In high school, students make inferences and justify conclusions from sample surveys, experiments, and observational studies.

Clarification Statement:
Students learn about sampling populations and that a sampling must be representative of the population in order to make valid inferences and generalizations. To measure variation and estimates or predictions about a characteristic, students must conduct multiple samples of the same size from populations with unknown characteristics.

Common Misconceptions

- Use random sampling to draw inferences about a population
- The concept of random is difficult for some students. It may be necessary to physically demonstrate a random vs a non-random sampling to eliminate misconceptions. For example, a non-random sampling would be to ask all girls to stand up to answer a question about video game preferences. A random sample would be to ask every third student to answer the same question. Ask student to compare and contrast answers for each example.

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 introduces new representations when studying using random sampling to draw inferences about a population because the idea of a random sample is a new concept for students. They need time to understand what a random sample is and what it isn't before they are expected to make inferences based on one.

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

- 6.SP.A.1 This standard provides a foundation for work with using random sampling to draw inferences about a population because this standard is when students are introduced to a statistical question and the variability in data. 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 in a flexible format to vary perceptual features because by providing descriptions (text or spoken) for all images, graphics, video, or animations; allowing use of touch equivalents (tactile graphics or objects of reference) for key visuals that represent concepts; providing physical objects and spatial models to convey perspective or interaction, and/or providing auditory cues for key concepts and transitions in visual information ensures that all learners have equal access to information, in formats that encourages student to seek what is familiar and to explore additional options.

Build

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

- For example, learners engaging with drawing informal comparative inferences about two populations 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 when students can evaluate their strengths and limitations, they can become more fluent in identifying their shortcomings and understanding the benefits of solid, relevant assessments. Instructions and vested interest are better aligned with intended outcomes.

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 drawing informal comparative inferences about two populations 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 one of the key factors in learners losing motivation is their inability to recognize their own progress. It is important, moreover that learners have multiple models and scaffolds of different self-assessment techniques so that they can identify, and choose, ones that are optimal. Rubrics, examples and non-examples, timely feedback, and reflection encourages perseverance, recognition of progress and creates a less competitive environment conducive to further risk taking and exploration.

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 using random sampling to draw inferences about a population by providing specific feedback to students on their work through a short mini-lesson because students need to make sure that the random sample is in fact a random representation of a population before any inferences can be made about the population.

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 as some students may benefit from intensive extra time during and after a unit using random sampling to draw inferences about a population by confronting student misconceptions because there is variability in estimations and predictions and how to gauge the difference. Also, the need for multiple random samples.

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, 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 using random sampling to draw inferences about a population because the concept of random sampling and applying it to make inferences about a population is a large concept. Being able to provide extra time for students to explore the samples, and the variability will help students in other clusters.

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 use of random sampling to draw inferences about a population, goal setting is critical because it provides students opportunities to use mathematics to understand and investigate meaningful situations.

Standards Aligned Instructionally Embedded Formative Assessment Resources:
Source: http://tasks.illustrativemathematics.org/content-standards/7/SP/A/tasks/235
Election Poll, Variation 1
Members of the seventh-grade math group have nominated a member of their group to be class president. Every student in seventh grade will cast a vote. There are 2 candidates in the race and a candidate needs at least 50% of the votes to be elected. The math group wants to conduct a survey to assess their candidate's prospects. There are almost 500 students in the seventh grade at their school. They do not have the resources to interview all seventh graders so they have decided to interview a sample of 40 seventh graders. They will obtain the seventh-grade list of names from their school principal's office and select the sample from this list. They plan to ask each student in the sample whether they plan to vote for their candidate or the other candidate.

a. How should the students select the sample of 40 to have the best chance of obtaining a representative sample? Describe clearly how they could use the random number table provided below to select the sample of 40 students. "Clearly" means that someone other than you could duplicate the sampling process by following your description.

Random Number Table Generated in Excel				
196	14	57	441	219
459	284	356	306	119
358	241	406	122	390
238	98	392	433	256
335	189	24	260	452
468	106	28	294	46
20	385	37	109	4
437	70	464	471	432
454	474	1	280	117
492	390	154	115	336
460	377	101	312	350
115	126	64	333	291
445	297	449	171	234
438	224	357	13	500
288	284	254	86	173
449	340	11	9	387
359	133	494	31	458
217	174	343	3	350
171	195	127	141	276
299	246	394	164	294

b. Suppose that all 40 students selected from the list of seventh graders in the school respond to the survey, and the results showed that 18 students would vote for the math group's candidate. In order to get elected, a candidate must receive at least 50% of the votes. Some members of the math group believe that on the basis of this sample outcome it is unreasonable to think that their candidate can win. Others in the group believe that it is possible that their candidate might win. Based on the initial survey results, should the math group students be discouraged, or is it reasonable to think their candidate might win? Justify your response

- This type of assessment question requires students to discover the fundamental statistical ideas of using data summaries (statistics) from random samples to draw inferences (reasoned conclusions) about population characteristics (parameters). In the task built around an election poll scenario, the population is the entire seventh grade class, the unknown characteristic (parameter) of interest is the proportion of the class members voting for a specific candidate, and the sample summary (statistic) is the observed proportion of voters favoring the candidate in a random sample of class members.
- There are two important goals in this task: seeing the need for random sampling and using randomization to investigate the behavior of a sample statistic. These introduce the basic ideas of statistical inference and can be accomplished with minimal knowledge of probability.
- Random sampling (like mixing names in a hat and drawing out a sample) is not a new idea to most students, although the terminology is likely to be new. Most students readily grasp this as a fair way to select the sample because everyone gets an equal chance of being selected. Standard 1 uses the term "representative," which has no technical definition in statistics and might be interpreted in terms of fairness. Students should understand that most samples, even if randomly selected, would not have exactly the same characteristics as the population from which they came.
- Using simulation to repeatedly select random samples from a population with a specified proportion of successes will be a new idea to most students. Some discussion should revolve around this seemingly backward statistical notion of first specifying a population and then seeing if it could have produced the observed result as a reasonably likely outcome. Specifying the population structure allows the use of probability to determine the likelihood of the observed sample, and that is the basis of drawing statistical conclusions.

Relevance to families and communities:	**Cross-Curricular Connections:**
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	Science: Examining biological characteristics of a sample Social Studies: Population Sampling and Data Analysis

capable mathematicians that can use mathematics within school and society? For example, when studying use of random sampling to draw inferences about a population the types of mathematical tasks are critical because students come to our classrooms with Informal Knowledge/Funds of Knowledge.	