New Mexico Instructional Scope

Algebra 2 Making Inferences and Justifying Conclusions Guide

The purpose of this tool is to help educators understand each of the grade level standards and how those standards connect to the students' overall preparation for college and career readiness.

The NMIS is a teacher-influenced tool, designed to provide instructional planning support at the programmatic level for districts and instructional level for teachers. Its foundation stems from the vision and mission of the PED and came into existence to assure that students in NM will be engaged in a culturally and linguistically responsive educational system that meets the social, emotional, and academic needs of ALL students. This is also rooted in the belief that all students must have access to on-grade-level standards, focusing on acceleration. The purpose of this tool is to help educators understand each of the grade level standards and how those standards connect to the students' overall preparation for college and career readiness.

Standards are defined as the most critical prerequisite skills and knowledge. This document is color-coded to reflect both anchor and priority standards. Though previous emphasis was placed on priority standards to address lost learning due to COVID-19, New Mexico teachers should note that moving forward, while priority standards allow for acceleration of learning, **all** standards should be addressed in instruction throughout the school year.

In this guide you will find:

- A breakdown of each of the grade level standards within the cluster, including:
    - Standards of Mathematical Practice
    - Common Misconceptions
    - Identification of Priority Standards, as identified by NMPED.
    - Level of Rigor Identification
- Sample aligned assessment items
- Suggested Student Discourse Guide
- A multilayered system of supports (MLSS) and culturally and linguistically responsive instruction (CLR) guide

Key		
	Priority Standard	Priority standards, as identified by NMPED, are denoted with red highlighting. Priority standards are the most critical prerequisite skills and knowledge a student needs. This does not mean that these are only standards required to be taught, just these are the standards that will allow for the acceleration the students of New Mexico need during this time.
	Conceptual Understanding	Conceptual Understanding standards help students build a deep understanding of the **how** and **why** of mathematics.
	Application	Application standards help students identify the appropriate concepts and skills to tackle **novel real-world problems.**
	Procedural Skill and Fluency	Procedural standards help students develop **efficiency** and **accuracy** in computations.

Standards Breakdown

- Understand and evaluate random processes underlying statistical experiments
  - HSS.IC.A.1
  - HSS.IC.A.2
- Make inferences and justify conclusions from sample surveys, experiments, and observational studies
  - HSS.IC.B.3
  - HSS.IC.B.4
  - HSS.IC.B.5
  - HSS.IC.B.6

Grade	*CCSS Domain*	*CCSS Cluster*
A2	**Making Inferences & Justifying Conclusions**	**Understand and evaluate random processes underlying statistical experiments**

Cluster Standard: HSS.IC.A.1

Standard	Standards for Mathematical Practice
Understand statistics as a process for making inferences about population parameters based on a random sample from that population.	• **SMP 2:** Reason abstractly and quantitatively. • **SMP 3:** Construct viable arguments and critique the reasoning of others. • **SMP 4:** Model with mathematics.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students move beyond analyzing data to making sound statistical decisions based on probability models. The reasoning process is as follows: develop a statistical question in the form of a hypothesis (supposition) about a population parameter; choose a probability model for collecting data relevant to that parameter; collect data; compare the results seen in the data with what is expected under the hypothesis.	• Explain the difference between bias and unbiased sampling. • Explain why the statistical measures of a random sample should be roughly the same as the statistical measures of the population. • Make inferences about a population based on a random sample.
DOK	**Blooms**
2-3	Understand, Analyze

Grade	CCSS Domain	CCSS Cluster
A2	Making Inferences & Justifying Conclusions	Understand and evaluate random processes underlying statistical experiments

Cluster Standard: HSS.IC.A.2

Standard	Standards for Mathematical Practice
Decide if a specified model is consistent with results from a given data-generating 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*?	• **SMP 2:** Reason abstractly and quantitatively. • **SMP 5:** Use appropriate tools strategically. • **SMP 8:** Look for and express regularity in repeated reasoning.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students move beyond analyzing data to making sound statistical decisions based on probability models. The reasoning process is as follows: develop a statistical question in the form of a hypothesis (supposition) about a population parameter; choose a probability model for collecting data relevant to that parameter; collect data; compare the results seen in the data with what is expected under the hypothesis.	• Explain the difference between a rare event and an ordinary event. • Use tools to analyze results from data-generating processes, i.e., create a simulation. • Make inferences about a model to decide if a model is consistent with the result given.
DOK	**Blooms**
3-4	Analyze, Evaluate

Common Misconceptions

- Students may struggle with the difference between rare and impossible.
- Students may struggle with recognizing the difference between random and non-repeating events. Humans tend to believe random means an outcome will not repeat but in large data sets of random outcomes it's common to have strings of the same outcome (i.e., flipping a coin 100 times and finding a string of 5 heads in a row).

Grade	*CCSS Domain*	*CCSS Cluster*
A2	**Making Inferences & Justifying Conclusions**	**Make inferences and justify conclusions from sample surveys, experiments, and observational studies**

Cluster Standard: HSS.IC.B.3

Standard	Standards for Mathematical Practice
Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.	• **SMP 3:** Construct viable arguments and critique the reasoning of others.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Once students see how **probability** intertwines with data collection and analysis, students use this knowledge to make **statistical inferences** from data collected in **sample surveys** and in **designed experiments**, aided by **simulation** and the technology that affords it.	• Recognize that randomization is necessary to making accurate statistical inferences. • Compare and contrast the differences between a sample survey, experiment, and observational study and the advantages to their uses. • Explain how to use random sampling techniques and the importance of random sampling.
DOK	**Blooms**
3	Understand, Apply

Grade	*CCSS Domain*	*CCSS Cluster*
A2	**Making Inferences & Justifying Conclusions**	**Make inferences and justify conclusions from sample surveys, experiments, and observational studies**

Cluster Standard: HSS.IC.B.4

Standard	Standards for Mathematical Practice
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.	• **SMP3:** Construct viable arguments and critique the reasoning of others. • **SMP5:** Use appropriate tools strategically. • **SMP8:** Look for and express regularity in repeated reasoning.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students should be able to explain the reasoning in a **statistical decision** and the nature of the error that may have been made.	• Estimate a population mean and calculate margin of error given a simulation. • Use real world data to determine the population mean and margin of error.
DOK	**Blooms**
3	Understand, Apply

Grade	*CCSS Domain*	*CCSS Cluster*
A2	**Making Inferences & Justifying Conclusions**	**Make inferences and justify conclusions from sample surveys, experiments, and observational studies**

Cluster Standard: HSS.IC.B.5

Standard	Standards for Mathematical Practice
Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.	• **SMP3:** Construct viable arguments and critique the reasoning of others. • **SMP5:** Use appropriate tools strategically. • **SMP8:** Look for and express regularity in repeated reasoning.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students should be able to explain the reasoning in a **statistical decision** and the nature of the error that may have been made.	• Identify differences between parameters. • Compare two treatment groups in an experiment and decide if the difference in parameters is significant.
DOK	**Blooms**
1-3	Analyze, Evaluate

Grade	CCSS Domain	CCSS Cluster
A2	Making Inferences & Justifying Conclusions	Make inferences and justify conclusions from sample surveys, experiments, and observational studies

Cluster Standard: HSS.IC.B.6

Standard	Standards for Mathematical Practice
Evaluate reports based on data.	• **SMP 6:** Attend to precision. • **SMP 7:** Look for and make use of structure. • **SMP 8:** Look for and express regularity in repeated reasoning.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Student will look at the quality of a statistical question to be answered, question clarity, quantization of responses and error calculations, as absolute value of difference of the sample values from the mean.	• Explain the parameters of data and their significance • Define the characteristics of experimental design (control, randomization, and replication). • Evaluate the experimental study design, how the data was gathered, what analysis (numerical or graphical) was used. • Draw conclusions based on graphical and numerical summaries. • Evaluate reports based on data.
DOK	**Blooms**
3	Analyze, Evaluate

Common Misconceptions

- Students may struggle with distinguishing between the difference between estimates for means and proportions.
- Students may have difficulty in relating the margin of error from a simulation model to the inference about a population.
- Students may have the misconception that when the margin of error increases that the statistic does not contain the true population parameter.
- Students may struggle with using statistical language that includes the possibility of error in measurement rather than absolute language such as always, never, guaranteed.

ASSESSMENT GUIDE

- Understand and evaluate random processes underlying statistical experiments.
- Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

Grade	*CCSS Domain*	*CCSS Strand*
A2	Making Inferences & Justifying Conclusions	Understand and evaluate random processes underlying statistical experiments

Sample Task #1 (Constructed Response)

CollegeBoard Question ID 4169753

Assessment	Test	Cross-Test and Subscore	Difficulty	Primary Dimension	Secondary Dimension	Tertiary Dimension	Calculator
SAT	Math	Problem Solving and Data Analysis	Medium	Problem Solving and Data Analysis	Evaluating statistical claims: Observational studies and experiments	1. With random samples, describe which population the results can be extended to.	Calculator

A sample of 40 fourth-grade students was selected at random from a certain school. The 40 students completed a survey about the morning announcements, and 32 thought the announcements were helpful. Which of the following is the largest population to which the results of the survey can be applied?

Question Difficulty: Medium

A. The 40 students who were surveyed

B. All fourth-grade students at the school

C. All students at the school

D. All fourth-grade students in the county in which the school is located

Choice B is correct. Selecting a sample of a reasonable size at random to use for a survey allows the results from that survey to be applied to the population from which the sample was selected, but not beyond this population. In this case, the population from which the sample was selected is all fourth-grade students at a certain school. Therefore, the results of the survey can be applied to all fourth-grade students at the school.

Choice A is incorrect. The results of the survey can be applied to the 40 students who were surveyed. However, this isn't the largest group to which the results of the survey can be applied. Choices C and D are incorrect. Since the sample was selected at random from among the fourth-grade students at a certain school, the results of the survey can't be applied to other students at the school or to other fourth-grade students who weren't represented in the survey results. Students in other grades in the school or other fourth-grade students in the country may feel differently about announcements than the fourth-grade students at the school.

Grade	CCSS Domain	CCSS Strand
A2	Making Inferences & Justifying Conclusions	Make inferences and justify conclusions from sample surveys, experiments, and observational studies

Sample Task #1 (Constructed Response)

CollegeBoard **Question ID 4789744**

Assessment	Test	Cross-Test and Subscore	Difficulty	Primary Dimension	Secondary Dimension	Tertiary Dimension	Calculator
SAT	Math	Problem Solving and Data Analysis	Medium	Problem Solving and Data Analysis	Inference from sample statistics and margin of error	1. Use sample mean and sample proportion to estimate population mean and population proportion. Utilize, but do not calculate, margin of error.	Calculator

A bag containing 10,000 beads of assorted colors is purchased from a craft store. To estimate the percent of red beads in the bag, a sample of beads is selected at random. The percent of red beads in the bag was estimated to be 15%, with an associated margin of error of 2%. If r is the actual number of red beads in the bag, which of the following is most plausible?

Question Difficulty: Medium

A. $r > 1{,}700$

B. $1{,}300 < r < 1{,}700$

C. $200 < r < 1{,}500$

D. $r < 1{,}300$

Choice B is correct. It was estimated that 15% of the beads in the bag are red. Since the bag contains 10,000 beads, it follows that there are an estimated $10{,}000 \times 0.15 = 1{,}500$ red beads. It's given that the margin of error is 2%, or $10{,}000 \times 0.02 = 200$ beads. If the estimate is too high, there could plausibly be $1{,}500 - 200 = 1{,}300$ red beads. If the estimate is too low, there could plausibly be $1{,}500 + 200 = 1{,}700$ red beads. Therefore, the most plausible statement of the actual number of red beads in the bag is $1{,}300 < r < 1{,}700$.

Choices A and D are incorrect and may result from misinterpreting the margin of error. It's unlikely that more than 1,700 beads or fewer than 1,300 beads in the bag are red. Choice C is incorrect because 200 is the margin of error for the number of red beads, not the lower bound of the range of red beads.

MLSS AND CLR GUIDE

- Understand and evaluate random processes underlying statistical experiments.
- Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

CCSS Domain	*CCSS Cluster*
Making Inferences and Justifying Conclusions	Understand and evaluate random processes underlying statistical experiments

Culturally and Linguistically Responsive Instruction

Relevance to Families and Communities	During a unit focused on evaluating random processes underlying statistical experiments, consider options for learning from your families and communities the cultural and linguistic ways mathematics exists outside of school to create stronger home to school connections for students. For example, how statistics are used to describe the risk of different cultural and ethnic groups for developing breast cancer and how this might affect medical breast cancer screening frequency recommendations.	
Cross-Curricular Connections	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.	
Validate/Affirm/Build/Bridge	• *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?* • *How can you create connections between the cultural and linguistic behaviors of*	• 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.IC.B 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. Knowing how to interpret and present data in meaningful ways helps develop a more robust model of the community. The 10-year Census is the largest statistical tool the United States uses to help with this objective.

	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?	

Planning for Multi-Layered System of Supports

Vertical Alignment

Previous Learning	***Current Learning***	***Future Learning***
• Connect to the work students have done to determine mean, median, mode, range, IQR, minimum, maximum.	• Connect to work throughout the Statistics and Probability domain around interpreting and making inferences about populations based upon sample quantitative data.	• Connect to future work with Statistics and Probability in college level courses and careers.

Suggested Instructional Strategies

Pre-Teach

Level of Intensity	***Essential Question***	***Examples***
Targeted	*What pre-teaching will prepare students to productively struggle with the mathematics for this cluster within your HQIM?*	Some learners may benefit from targeted pre-teaching that previews new contexts for tasks regarding understanding and evaluating random processes underlying statistical experiments because a preview often piques learner curiosity and knows that there is a reason for learning this material.
Intensive	*What critical understandings will*	7.SP.C.7: This standard focuses on developing a probability model and using it to find probabilities of

	prepare students to access the mathematics for this cluster?	events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. This standard provides a foundation for work with units in Understand and Evaluate Random Processes Underlying Statistical Experiments cluster because misconceptions with probabilities will impact a learner's ability to evaluate random processes. 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.

Re-Teach

Level of Intensity	***Essential Question***	***Examples***
Targeted	What formative assessment data (e.g., tasks, exit tickets, observations) will help identify content needing to be revisited during a unit?	For example, students may benefit from re-engaging with content during a unit on understanding and evaluating random processes underlying statistical experiments by critiquing student approaches/solutions to make connections through a short mini-lesson because misconceptions about the nature of random events is common and may lead to incorrect conclusions. For example, many people believe that luck is real and can affect the outcome of random events.
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 understanding and evaluating random processes underlying statistical experiments by addressing conceptual understanding because small subtle misconceptions about random processes can lead to invalid or inaccurate decisions. For example, many people believe that if they get cancer once, they are less likely to get it again.

Extension

Essential Question	***Examples***
What type of extension will offer additional challenges to 'broaden' your student's knowledge of the mathematics developed within your HQIM?	Some learners may benefit from an extension such as open-ended tasks linking multiple disciplines when evaluating random processes underlying statistical experiments because many learners want or need to

	know how this cluster will relate to future career or college interests.

CCSS Domain	*CCSS Cluster*
Making Inferences and Justifying Conclusions	Make inferences and justify conclusions from sample surveys, experiments, and observational studies

Culturally and Linguistically Responsive Instruction

Relevance to Families and Communities	During a unit focused on making inferences and justifying conclusions, consider options for learning from your families and communities the cultural and linguistic ways mathematics exists outside of school to create stronger home to school connections for students. For example, how statistics are used to describe the risk of different cultural and ethnic groups for developing breast cancer and how this might affect medical breast cancer screening frequency recommendations. Another option to consider is students learning about how data might allow us to infer how an infection might be slowed in a large extended family living in one house.	
Cross-Curricular Connections	Social Studies: Connection to the difference between correlation versus causation when reading data.	
Validate/Affirm/Build/Bridge	• *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?* • *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*	• 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.IC: Making Inferences & Justifying Conclusions cluster goal setting is critical because interpreting statistical results are often used to infer 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.

	identities as capable mathematicians that can use mathematics within school and society?	

Planning for Multi-Layered System of Supports

Vertical Alignment

Previous Learning	***Current Learning***	***Future Learning***
• Connect to work in previous math courses, where students have learned to determine mean, median, mode, range, IQR, minimum, maximum. Students have also learned how to graph data distributions (e.g., histograms, box plots).	• Connect to students work with evaluating the randomness of a sample and use this to determine if a specified model is consistent with the results. **(HSS.IC.A)**	• Connect to work in subsequent statistics course (AP or college level).

Suggested Instructional Strategies

Pre-Teach

Level of Intensity	***Essential Question***	***Examples***
Targeted	*What pre-teaching will prepare students to productively struggle with the mathematics for this cluster within your HQIM?*	Some learners may benefit from targeted pre-teaching that provides additional time for confusion to happen with new mathematical ideas when making Inferences and justifying conclusions because learners are often more ready to engage the material at a deeper level when they feel frustrated and confused just enough to have questions that need answered during the upcoming units.
Intensive	*What critical understandings will prepare students to access the mathematics for this cluster?*	7.SP.A: This cluster of standards provides a foundation for work with the units in the HS.S-IC.B: Making Inferences And Justifying Conclusions Cluster because the 7th grade standard provides a foundation for valid random sampling techniques, providing validity for conclusions based on the 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.
Re-Teach		
Level of Intensity	***Essential Question***	***Examples***
Targeted	What formative assessment data (e.g., tasks, exit tickets, observations) will help identify content needing to be revisited during a unit?	For example, students may benefit from re-engaging with content during a unit on HS.S-IC.B: Making Inferences and Justifying Conclusions cluster by revisiting student thinking through a short mini-lesson because this conversation can serve as a diagnostic tool so the teacher can prescribe the needed review needed to get the learner moving.
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 HS.S-IC.B: Making Inferences And Justifying Conclusions cluster by helping students move from specific answers to generalizations for certain types of problems because learners often benefit from seeing the work of more experienced problem solvers.

Extension	
Essential Question	***Examples***
What type of extension will offer additional challenges to 'broaden' your student's knowledge of the mathematics developed within your HQIM?	Some learners may benefit from an extension such as in-depth, self-directed exploration of self-selected topics because advanced or gifted learners often need or want to explore more into how data is used. For example, a learner could look at how Big Data is being used to make life better but not without potential risks.