

**Just in Time Quick Check**  
**Standard of Learning A2.ST.1**  
**Strand: Statistics**

**Standard of Learning A2.ST.1**

**The student will apply the data cycle (formulate questions; collect or acquire data; organize and represent data; and analyze data and communicate results) with a focus on univariate quantitative data represented by a smooth curve, including a normal curve.**

*Students will demonstrate the following Knowledge and Skills:*

- a) Formulate investigative questions that require the collection or acquisition of a large set of univariate quantitative data or summary statistics of a large set of univariate quantitative data and investigate questions using a data cycle.
- b) Collect or acquire univariate data through research, or using surveys, observations, scientific experiments, polls, or questionnaires.
- c) Examine the shape of a data set (skewed versus symmetric) that can be represented by a histogram and sketch a smooth curve to model the distribution.
- d) Identify the properties of a normal distribution.
- e) Describe and interpret a data distribution represented by a smooth curve by analyzing measures of center, measures of spread, and shape of the curve.
- f) Calculate and interpret the z-score for a value in a data set.
- g) Compare two data points from two different distributions using z-scores.
- h) Determine the solution to problems involving the relationship of the mean, standard deviation, and z-score of a data set represented by a smooth or normal curve.
- i) Apply the Empirical Rule to answer investigative questions.
- j) Compare multiple data distributions using measures of center, measures of spread, and shape of the distributions.

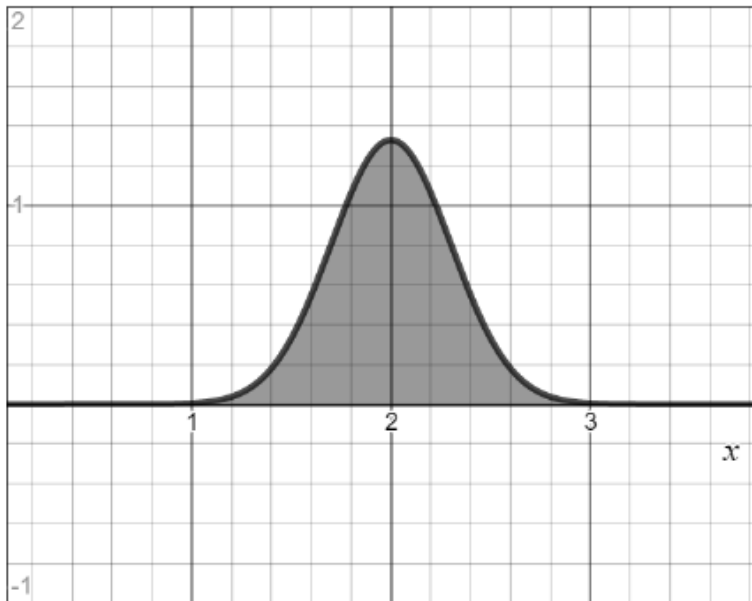
**Just in Time Quick Check**

**Just in Time Quick Check Teacher Notes**

**Supporting and Prerequisite SOL: A.ST.1, A2.ST.2**

**Just in Time Quick Check A2.ST.1**

1. The value of the mode of a normally distributed set of data is: (circle one)
  - a) Always greater than the value of the mean
  - b) Approximately the same as the value of the mean
  - c) Always less than the value of the mean
  
2. The value of the median of a normally distributed set of data is: (circle one)
  - a) Always greater than the value of the mean
  - b) Approximately the same as the value of the mean
  - c) Always less than the value of the mean
  
3. What appears to be the total area under the curve of the normal distribution shown below?



4. Data representing the grades of all the students on a recent test in Ann’s class have a normal distribution. The z-score of Ann’s test grade is 0.75. Explain what this z-score represents in relation to the mean of the class grades.

5. The mean of a normally distributed set of data is 125. A data value of 100 has a z-score of -1.40. Determine the standard deviation of this distribution.
6. The standard deviation of a normally distributed set of data is 5. If a data value of 27 has a corresponding z-score of 1.22, what is the mean of this distribution?
7. A data set of values has a mean of 45 and standard deviation of 5. The z-score for a point A is 0. The z-score for a point B is 0.2. What are the values of point A and point B?
8. Data on the grades of a morning math class and an afternoon math class were collected. The grades in the morning math class were normally distributed with a mean of 82 and a standard deviation of 3.
- Student A earned a grade of 80.
  - Student B earned a grade of 78.
- The grades in the afternoon math class were normally distributed with a mean of 80 and a standard deviation of 5.
- Student C earned a grade of 78.
  - Student D earned a grade of 76.
- Which student was in the lowest 16% of their class?
9. Jose's teacher announced that the scores on their most recent Algebra test were normally distributed. The mean score was 72 and the standard deviation was 8. Jose scored a 75 on the test. What percentage of students scored lower than Jose?

10. The number of hours a certain type of battery will last is distributed normally with a mean of 500 minutes. The standard deviation is 50 minutes. Out of 240 batteries tested, how many batteries would be expected to still work after 580 minutes?
11. The principal of a high school is interested in the exercise habits of students in her school. Write an investigative question that focuses on one measurable variable and would require collecting a large amount of data. Explain why your question is appropriate and how it can be answered using the steps of the data cycle.
12. Explain how you would use the data cycle to study the distribution of quiz scores in your Algebra 2 class. Describe each step from posing the question to interpreting the results.
13. For your Algebra 2 project on univariate data, you decide to study how many hours students sleep on school nights. How would you collect univariate data to study the number of hours students sleep on school nights? Explain your plan by including the method you would use and the type of data you would collect.

14. Which of the following methods can be used to collect univariate quantitative data? Circle all that apply.

- Scientific experiment
- Survey
- Observation
- Measurement
- Researching published journals
- Interview with open-ended questions

15. Which of the following characteristics describe a distribution that is skewed left? Circle all that apply.

- Long tail on the left
- Long tail on the right
- Mean is less than median
- Mean is greater than median
- Symmetric shape
- Non-symmetric shape
- Most data values are high
- Most data values are low

16. Explain what it means if the shape of a histogram of test scores is skewed to the right. Describe the characteristics of this distribution and draw a smooth curve that represents the shape.

17. Explain why the median may be a better measure of center than the mean for a skewed distribution.

18. A student scored an 85 on a geometry test where the class mean was 75 and had a standard deviation of 5. Find the z-score for this student's score and explain what the z-score represents as it relates to the student's performance compared to the class.
19. If two distributions have the same mean but different standard deviations, which distribution shows greater variability?
- a) The distribution with lower standard deviation
  - b) The distribution with higher standard deviation
  - c) Both distributions have the same variability
  - d) It cannot be determined
20. Cell phone covers are shipped from warehouses where the shipping costs over the past year are normally distributed with a mean of \$5.00 and a standard deviation of \$0.20.
- a) Using the Empirical Rule, determine the range of shipping costs that fall within one standard deviation of the mean.
  - b) What percentage of shipping costs does this range represent?
  - c) Explain what this means in the context of shipping costs for the warehouse.

## A2.ST.1 Just in Time Quick Check Teacher Notes

### Common Errors/Misconceptions and their Possible Indications

1. The value of the mode of a normally distributed set of data is: (circle one)
  - a) Always greater than the value of the mean
  - b) Approximately the same as the value of the mean
  - c) Always less than the value of the mean

*A common error that some students may make is to assume that the values of the mode, median, and mean of a data set must always be different. In a normally distributed data set, this is not the case. A defining property of a normal distribution is that it is perfectly symmetric, which causes the mean, median, and mode to occur at the same value at the center of the distribution.*

*Students may incorrectly select options indicating that the mode is always greater than or less than the mean, which may indicate confusion between normal distributions and skewed distributions, where these measures of center differ. Because students often work with small or irregular data sets in earlier grades/courses, they may not yet recognize how increasing the number of data values can produce the smooth, symmetric shape that is characteristic of a normal curve. It may be helpful to provide students with visual examples (e.g., histograms, smooth curves generated from large data sets) to reinforce the idea that, in a normal distribution, the mode aligns with the mean.*

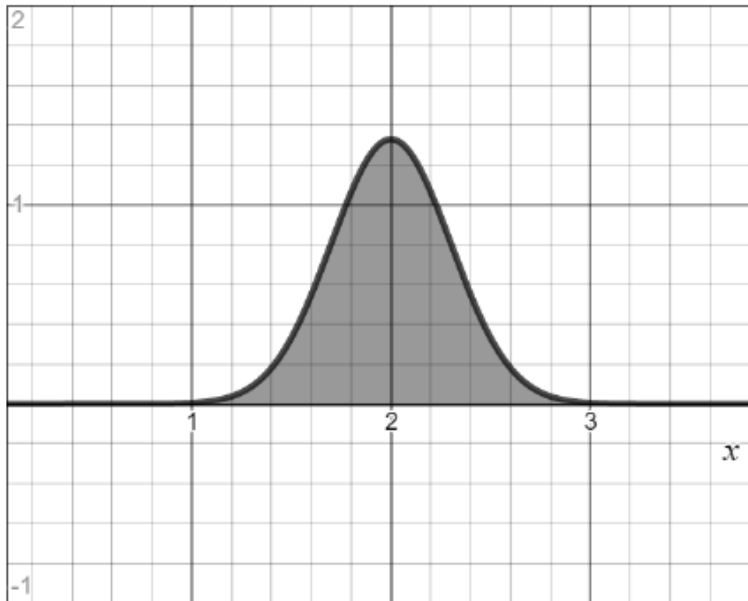
2. The value of the median of a normally distributed set of data is: (circle one)
  - a) Always greater than the value of the mean
  - b) Approximately the same as the value of the mean
  - c) Always less than the value of the mean

*A common error that some students may make is to assume that the values of the mode, median, and mean of a data set must always be different. In a normally distributed data set, this is not the case. A defining property of a normal distribution is that it is perfectly symmetric, which causes the mean, median, and mode to occur at the same value at the center of the distribution.*

*Students may incorrectly select options indicating that the median is always greater than or less than the mean, which may indicate confusion between normal distributions and skewed distributions, where these measures of center differ. Because students often work with small or irregular data sets in earlier grades/courses, they may not yet recognize how increasing the number of data values can produce the smooth, symmetric shape that is characteristic of a normal curve. It may be helpful to provide students with visual examples (e.g., histograms,*

*smooth curves generated from large data sets) to reinforce the idea that, in a normal distribution, the median aligns with the mean.*

3. What appears to be the total area under the curve of the normal distribution shown below?



*A common misconception is that students believe they must use the units or scale shown on the graph's axes to calculate the total area under the curve of a normal distribution. This may indicate that students do not recognize that the normal curve represents a probability distribution, not a geometric region measured in square units. In a normal distribution, the total area under the curve is always equal to 1. The axes and units of the graph do not change this total area.*

*It may be helpful to use the Table of Standard Normal Probabilities to reinforce the idea that probabilities correspond to areas under the curve. Teachers can emphasize how symmetry about the mean allows probabilities on either side of the center to be interpreted consistently and how partial areas (such as those within one, two, or three standard deviations) combine to make the total area of 1.*

4. Data representing the grades of all the students on a recent test in Ann's class have a normal distribution. The z-score of Ann's test grade is 0.75. Explain what this z-score represents in relation to the mean of the class grades.

*A common misconception that some students may demonstrate is to interpret the z-score as a percentage or as a direct statement of how many points Ann scored on the test. This may indicate that students do not understand how the z-score describes a value's relative position within a distribution. A z-score represents the number of standard deviations a value is from the mean. In this case, Ann's z-score of 0.75 indicates that Ann's test grade is 0.75 standard deviations above the*

*mean, indicating that she performed better than average. It may be helpful to emphasize that z-scores do not have units and are based on the mean and standard deviation, which may help students distinguish them from percentages and deepen students' understanding of the roles of z-scores in a normal distribution.*

5. The mean of a normally distributed set of data is 125. A data value of 100 has a z-score of -1.40. Determine the standard deviation of this distribution.

*A common error that some students may make is incorrectly manipulating the z-score formula, such as multiplying instead of dividing the z-score, when solving for the standard deviation. This will lead to a standard deviation that is positive but is unrealistically large and may indicate that students do not fully understand that a z-score describes how many standard deviations a data value is above or below the mean, rather than representing a standalone quantity.*

*It may be helpful to have students sketch a normal curve and label the mean at 125 and the data value at 100. Since the z-score is -1.40, students should recognize that the value 100 lies 1.4 standard deviations below the mean. Because the distance from the mean to the value is 25 points, each standard deviation must be less than 25 points, not greater than 25 points. Students should be encouraged to estimate reasonable values for one standard deviation before calculating them to help students assess whether their final answer makes sense. This will also support students' conceptual understanding of the relationship among the mean, standard deviation, and z-scores.*

6. The standard deviation of a normally distributed set of data is 5. If a data value of 27 has a corresponding z-score of 1.22, what is the mean of this distribution?

*A common error some students make is they reverse the subtraction in the z-score formula by writing  $\frac{\mu-27}{5}$  instead of  $\frac{27-\mu}{5}$ , which leads to a mean that is too large and contradicts the meaning of a positive z-score. Another common error students make is they treat the z-score as a raw data value. For example, subtracting 1.22 directly from 27 rather than first multiplying by the standard deviation. Students may also incorrectly solve for the wrong variable or stop solving too early, by finding  $27 - \mu = 6.1$  but then adding instead of subtracting to isolate the mean. Teachers can help by emphasizing the meaning of each variable in the formula  $z = \frac{x-\mu}{\sigma}$  and requiring students to identify the unknown and known values before substituting in numbers. Teachers may use visual models such as a normal curve to locate data values relative to the mean to help students understand why a positive z-score indicates that the mean must be less than the given value. Teachers can also model correct steps and incorrect steps students make when substituting in values and encourage students to check the reasonableness of their final answer.*

7. A data set of values has a mean of 45 and standard deviation of 5. The z-score for a point A is 0. The z-score for a point B is 0.2. What are the values of point A and point B?

*A common misconception is that students may misinterpret the meaning of a z-score, thinking it is a raw value or a percentage rather than a measure of how many standard deviations a data point is from the mean.*

*It may be helpful to have students draw a normal curve and label the mean at 45 in the center. Then using the standard deviation (5), label values at the multiples above and below the mean (i.e., 30, 35, 40, 45, 50, 55, 60), and then assign z-scores to these points (e.g., 30 would be a z-score of -3, 35 would be a z-score of -2, 40 would be a z-score of -1). Finally, ask students to predict the value of points with non-integer z-scores like 0.2 before calculating. This approach helps students reason about the relationship between z-scores and actual data values, understand the scale of the standard deviation, and verify whether their calculations are reasonable.*

8. Data on the grades of a morning math class and an afternoon math class were collected. The grades in the morning math class were normally distributed with a mean of 82 and a standard deviation of 3.

- Student A earned a grade of 80.
- Student B earned a grade of 78.

The grades in the afternoon math class were normally distributed with a mean of 80 and a standard deviation of 5.

- Student C earned a grade of 78.
- Student D earned a grade of 76.

Which student was in the lowest 16% of their class?

*A common error that some students may make is to choose Student D simply because they had the lowest raw grade, rather than consider the student's position relative to their class mean and standard deviation. This may indicate that students do not understand that z-scores normalize data values across different distributions.*

*It may be helpful to have students sketch normal curves for each class, labeling the mean, each standard deviation value above and below the mean, and the student data values. This visual may make it easier for students to see how far each student's score is from the mean in terms of standard deviations. Then, students can use the z-score formula to calculate the standardized position of each student and identify which student falls below  $z = -1$ , which corresponds to the lowest 16% of a normal distribution. This will help solidify the connections between z-scores, relative position, and probability in a normal distribution.*

9. Jose’s teacher announced that the scores on their most recent Algebra test were normally distributed. The mean score was 72 and the standard deviation was 8. Jose scored a 75 on the test. What percentage of students scored lower than Jose?

*A common error that some students may make is interpreting the z-score as a percentage and assuming that a z-score of 0.375 means that 37.5% of students scored lower than Jose. This error indicates that students may not understand that z-scores must be converted to probabilities using the area under the normal curve.*

*It may be helpful to have students explain in context what a z-score represents and to have them practice using the Standard Normal Distribution table (or a calculator) to find the area to the left of the z-score, connecting the z-score to the cumulative probability. It would also be beneficial to emphasize that z-scores are unitless and are not probabilities. It may also help to show students examples where the z-score is out of the possible range of probability values (which range from 0 to 1).*

10. The number of hours a certain type of battery will last is distributed normally with a mean of 500 minutes. The standard deviation is 50 minutes. Out of 240 batteries tested, how many batteries would be expected to still work after 580 minutes?

*A common error that some students may make is to calculate the percentage of batteries that last 580 minutes but fail to convert that percentage to the number of batteries in the sample. This may indicate that students understand how to use a z-score and the standard normal table but do not understand what the problem is asking in context. It may be helpful to encourage students to think about what the final answer should represent (a number of batteries, rather than a percentage or probability), and have students break the problem down into parts (e.g., first find the percentage of batteries to last 580 minutes, then determine how many of the 240 batteries represent that percentage).*

11. The principal of a high school is interested in the exercise habits of students at her school. Write an investigative question that focuses on one measurable variable and would require collecting a large amount of data. Explain why your question is appropriate and how it can be answered using the steps of the data cycle.

*A common error students make is writing a bivariate investigative question (e.g., “How does a student’s grade level affect the number of hours they exercise?”), which involves two variables and results in paired data rather than a univariate data set. Students may also vaguely describe the steps of the data cycle, such as stating, “We collected and analyzed the data,” without clearly explaining each step. It may be helpful to model univariate questions that focus on one measurable variable, such as “How many hours a week do students exercise?” This leads naturally to a single numerical data set. It may also be beneficial to provide students with a graphic organizer that helps them explicitly identify and address each step of the data cycle.*

12. Explain how you would use the data cycle to study the distribution of quiz scores in your Algebra 2 class. Describe each step from posing the question to interpreting the results.

*A common error students make is confusing a conclusion with a statistical question by jumping directly to a statement about student performance without first posing a clear, measurable investigative question. For example, students may state something like, "Most students did a great job on the quiz," instead of asking a measurable question like, "What is the average quiz score of students taking Algebra 2 quizzes?" Students may also incorrectly apply statistical formulas or confuse measures of center, such as incorrectly calculating the mean of quiz scores {72, 75, 82, 95} as  $\left(\frac{72+75+82}{4}\right)$  and failing to include all data values. It may be helpful to model how to pose clear, measurable questions that align with the data cycle, such as "What is the mean quiz score and how far do scores deviate from the mean?" Teachers can also provide additional practice with calculations by reinforcing the formula  $Mean = \frac{\Sigma x}{n}$  and requiring students to justify each step.*

13. For your Algebra 2 project on univariate data, you decide to study how many hours students sleep on school nights. How would you collect univariate data to study the number of hours students sleep on school nights? Explain your plan by including the method you would use and the type of data you would collect.

*A common error is that students collect categorical data instead of numerical data when investigating a univariate data set. For example, students may ask questions such as "Are you tired?" or "How tired are you?", which do not produce numerical values that can be analyzed statistically. Additionally, students may misrepresent the data by creating a bivariate table or graph, such as pairing hours of sleep with grade level, instead of focusing on a single variable. It may be helpful to model how to clearly define variables using algebraic notation (e.g.,  $x =$  hours of sleep on a school night) and to reinforce that the project must focus on one measurable variable to maintain a univariate data set.*

14. Which of the following methods can be used to collect univariate quantitative data? Circle all that apply.

- Scientific experiment
- Survey
- Observation
- Measurement
- Researching published journals
- Interview with open-ended questions

*A common misconception is that all data collected through surveys or interviews are quantitative. Students may not recognize that it is the type of response requested, not the collection method itself, that determines whether the data are univariate quantitative. Univariate quantitative data consists*

*of numerical values measured for a single variable. For example, interview or survey questions such as “How many hours do you sleep per night?” generate univariate quantitative data, whereas open-ended questions such as “How do you feel about math?” produce qualitative data and cannot be analyzed numerically.*

*Some students may be inconsistent in selecting surveys as a correct method because they confuse the method of collection with the nature of the data collected. Surveys can be used to collect univariate quantitative data only when questions require numerical responses, such as test scores, hours studied, or number of practices per week. Surveys that ask preference-based or opinion questions such as “How do you feel about math?” or “Which subject is your favorite?” produce qualitative or categorical data rather than quantitative data. Similarly, students may incorrectly assume that scientific experiments, observations, or measurements always produce univariate data. While these models can generate univariate data, they may also produce multivariate or qualitative data if more than one variable is measured or if the results are recorded descriptively rather than numerically.*

*Teachers can support student understanding by emphasizing that the question asks which methods can be used to collect univariate quantitative data, not which methods always do so. It may be helpful to focus on how the design of the question determines the type of data collected. Providing clear examples and non-examples may be beneficial for students. Examples of univariate data could include test scores, time spent studying, or number of siblings. Non-examples of univariate data could include yes/no responses, favorite subjects, or written opinions or explanations. It may also be helpful to have students compare different survey and interview formats. Surveys or interviews that require numerical responses produce quantitative data; those that use yes/no options or other choices produce categorical data; and those that use open-ended prompts produce qualitative data. This distinction helps students correctly identify valid methods for collecting univariate data.*

15. Which of the following characteristics describe a distribution that is skewed left? Circle all that apply.

- Long tail on the left
- Long tail on the right
- Mean is less than median
- Mean is greater than median
- Symmetric shape
- Non-symmetric shape
- Most data values are high
- Most data values are low

*Students may be able to identify characteristics of a left-skewed distribution without understanding how they are connected. For example, students may correctly select “most data values are high,” but be unable to explain that this is because the tail of the distribution extends to the left, pulling the mean toward the lower values. Another common error is selecting “mean is greater than median,” which is true for right-skewed distributions. In a left-skewed distribution, the mean is less than the median because the lower outliers in the left tail reduce the mean more than they affect the median.*

*Additionally, students may incorrectly select “symmetric shape,” which may indicate difficulty connecting characteristics with distribution shape.*

*It may be helpful for teachers to model examples using both numerical and graphical representations. For instance, using the data set: {40, 70, 75, 78, 80}, students can calculate the mean as  $\frac{343}{5} = 68.6$  and compare it to the median 75, demonstrating that the mean is less than the median, consistent with a left-skewed distribution. Histograms can further reinforce this idea by showing that most values cluster on the higher end, while a small number of lower values form the long tail to the left.*

16. Explain what it means if the shape of a histogram of test scores is skewed to the right. Describe the characteristics of this distribution and draw a smooth curve that represents the shape.

*A common error students may make is to confuse the direction of skew with where most data values are located, believing that a right-skewed distribution means most values are large, however, a right-skewed distribution is defined by a long tail extending to the right, not by the location of most data values. Another common error is stating that the mean is less than the median for a right-skewed distribution. This indicates that students may not understand that large values in the right tail pull the mean to the right, making the mean greater than the median.*

*It may be helpful to use numerical examples to connect algebraic reasoning with distribution shape. For example, given the data set: {61, 65, 70, 75, 95}, students can calculate the mean as  $\frac{366}{5} = 73.2$  and compare it to the median of 70. This demonstrates that the mean is greater than the median, which is consistent with right-skewed distributions. Teachers can also use visual models such as histograms and smooth curves to help students understand why the mean is greater than the median in a right-skewed distribution and provide students with practice drawing smooth curves from data to reinforce the connection between algebraic calculations and graphical models.*

17. Explain why the median may be a better measure of center than the mean for a skewed distribution.

*A common misconception is that students may believe that the mean always represents the center of a data set, regardless of the distribution’s shape. This may lead to students relying on the mean even when a few extreme values pull it away from where most of the data are located. However, the median is often a better measure of center than the mean for a skewed distribution because it is resistant to extreme values (outliers), while the mean is more sensitive to outliers. For example, given the data set: {3, 4, 4, 5, 25}, students may fail to recognize how the outlier 25 increases the mean from 4 to 8.2, making it a less representative measure of center. It may be helpful to use this data set, and other data sets with outliers, to explicitly compare the mean and median and facilitating discussions about how the outlier affects each measure. Demonstrating algebraically how the mean,  $\frac{\sum x}{n}$ , changes when an extreme value is included may help students see why the mean shifts in the direction of the skew, while the median remains unchanged. Using dot plots, histograms, and*

*numerical summaries together reinforces why the median is often the more appropriate measure of center for skewed data.*

18. A student scored an 85 on a geometry test where the class mean was 75 and had a standard deviation of 5. Find the z-score for this student's score and explain what the z-score represents as it relates to the student's performance compared to the class.

*A common error students may make is misusing the z-score formula, often reversing the subtraction in the numerator and writing  $z = \frac{\mu - x}{\sigma}$  instead of using the correct formula  $z = \frac{x - \mu}{\sigma}$ . This reversal leads to incorrect signs and misinterpretation of whether a score is above or below the mean. Students may also make arithmetic errors when computing the z-score. For example, after correctly finding  $85 - 75 = 10$ , students may incorrectly state that  $z = 10$ , instead of dividing by the standard deviation and concluding that  $z = 2$ . Students may also misinterpret the z-score by describing it as percentage or a raw point difference, such as stating, "The student scored 2% higher than the class average." This error may indicate confusion between standardized units and percentages.*

*Teachers can support student learning by modeling the correct use of the z-score formula,  $z = \frac{x - \mu}{\sigma}$ . Additionally, it may be helpful to reinforce the concept that z-scores measure distance from the mean in units of standard deviation. Emphasizing that a z-score of 2 means "two standard deviations above the mean" may help students connect algebraic computation to meaningful statistical interpretation of the student's performance relative to the class.*

19. If two distributions have the same mean but different standard deviations, which distribution shows greater variability?
- The distribution with lower standard deviation
  - The distribution with higher standard deviation
  - Both distributions have the same variability
  - It cannot be determined

*A common error students may make is to confuse center with spread, leading them to conclude that two distributions with the same mean must also have the same variability. For example, students may reason that if  $\mu_1 = 60$ ,  $\mu_2 = 60$ , then the distributions must have the same variability, even when  $\sigma_1 \neq \sigma_2$ . Some students may incorrectly think that a smaller standard deviation indicates more variability, believing that a value such as  $\sigma = 3$  indicates more spread than a value such as  $\sigma = 8$ . This misconception often stems from misunderstanding what standard deviation measures. Other students may think that variability cannot be determined without raw data, selecting "It cannot be determined."*

*Teachers can address these misconceptions by explicitly connecting standard deviation to distance from the mean, using expressions such as  $|x - \mu|$  and explaining that a larger average distance results in a larger standard deviation. Visual or numerical comparisons such as  $70 \pm 5$  versus  $70 \pm 15$  can be used to help students see that the distribution with the larger standard deviation is more*

*spread out. It may also be helpful to reinforce the definition of variance,  $\sigma^2 = \frac{\Sigma(x-\mu)^2}{n}$ , to show algebraically that larger deviations from the mean produce a larger standard deviation, and therefore greater variability.*

20. Cell phone covers are shipped from warehouses where the shipping costs over the past year are normally distributed with a mean of \$5.00 and a standard deviation of \$0.20.
- Using the Empirical Rule, determine the range of shipping costs that fall within one standard deviation of the mean.
  - What percentage of shipping costs does this range represent?
  - Explain what this means in the context of shipping costs for the warehouse.

*A common error students may make is to treat one standard deviation as a single value rather than an interval, calculating  $5.00 + 0.20 = 5.20$  and stopping, instead of recognizing the full range  $5.00 \pm 0.20$ . Students also frequently misapply the Empirical Rule by using the wrong interval for the percentage. For example, they might claim  $5.00 \pm 2(0.20)$  represents 68% of the data, when in fact 68% corresponds to one standard deviation,  $5.00 \pm 1(0.20)$ , while 95% corresponds to two standard deviations,  $5.00 \pm 2(0.20)$ . Another common error occurs when students assume the data are evenly distributed and try to find quartiles by dividing the standard deviation by four (e.g.,  $5.00 - \frac{0.20}{4} = 4.95$ ). This ignores the bell-shaped nature of a normal distribution, where data are more concentrated near the mean.*

*It may be helpful to emphasize interval notation by modeling calculations such as  $5.00 \pm 0.20$  and explicitly writing the range as  $4.80 \leq x \leq 5.20$ . Teachers can also reinforce the correct use of the Empirical Rule by consistently connecting each percentage to its algebraic form. As an extension, teachers may also wish to provide counter-reasoning by introducing z-scores such as  $z = \frac{x-5.00}{0.20}$ , to explain why percentiles like the lowest 25% are not found by simply dividing the standard deviation and instead depend on the area under the normal curve.*