Chapter 2: Modeling Distributions of Data

1. The cumulative relative frequency graph below describe the distribution of weights (in grams) of tomatoes grown in a laboratory experiment.



Which of the following weights is closest to the median of the distribution?

A. 120 grams.

AR. Incorrect. According to the graph, a 120-gram tomato is roughly the 35th percentile.

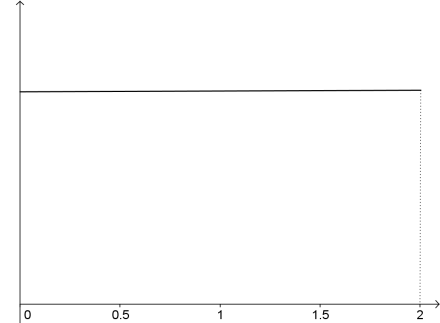
\*B. 140 grams.

BR. Correct. The cumulative relative frequency for a tomato weighing 140 grams is about 0.5, which makes it the median weight.

C. 170 grams.

CR. Incorrect. According to the graph, a 170-gram tomato is roughly the 80th percentile.

2. For the density curve shown, which of the following statements is true?



A. The mean is larger than the median.

AR. Incorrect. Because the density curve is symmetric, the mean and median must be equal.

B. The proportion of outcomes between 0.2 and 0.5 is equal to 0.3.

BR. Incorrect. The proportion that we seek is the area under the density curve between 0.2 and 0.5. The length of this interval is 0.3, but because the interval on which the variable is defined has length 2, the height of the density curve is only 0.5, so the desired proportion is (0.3)(0.5) = 0.15.

\*C. The proportion of outcomes greater than 1.5 is equal to 0.25.

CR. Correct. The proportion that we seek is the area under the density curve between 1.5 and 2. The length of this interval is 0.5, and the height of the density curve is 0.5, so the desired proportion is (0.5)(0.5) = 0.25.

3. An office uses two brands of fluorescent light bulbs in its overhead light fixtures. From past experience, it is known that Brand A bulbs have a mean life length of 3000 hours and a standard deviation of 200 hours, while Brand B bulbs have a mean life length of 2700 hours and a standard deviation of 250 hours. Which bulb has a longer life relative to all bulbs of its brand, a Brand A bulb that lasts 3150 hours or a Brand B bulb that lasts 2850 hours?

\*A. The Brand A bulb has a longer life relative to its brand.

AR. Correct. We compare the two measurements using *z*-scores. The *z*-score for the Brand A bulb is , while the *z*-score for the Brand B bulb is . This means that the Brand A bulb lies 0.75 standard deviations above its group’s mean, while the Brand B bulb lies 0.60 standard deviations above its group’s mean. Since the *z*-score is larger for the Brand A bulb, the Brand A bulb has a longer relative life.



B. The Brand B bulb has a longer life relative to its brand.

BR. Incorrect. Compare the two bulbs by calculating their *z*-scores.

C. The two bulbs have equally long lives.

CR. Incorrect. Compare the two bulbs by calculating their *z*-scores.

4. Javier’s school bus is always late. Below are data on how many minutes late the bus was for 15 days in February.

1 2 2 2 3 3 4 4 4 5 6 7 8 10 12

What is the 60th percentile of this distribution?

A. 9

AR. Incorrect. Recall that the *n*th percentile is the score that is higher than *n* percent of the scores in the distribution.

\*B. 5

BR. Correct. Sixty percent (nine) of the scores in this distribution are less than 5.

C. 3

CR. Incorrect. Recall that the *n*th percentile is the score that is higher than *n* percent of the scores in the distribution.

5. The weights of cockroaches living in a university dormitory follow a Normal distribution with mean 80 grams and standard deviation 5 grams. The percentage of cockroaches having weights between 72 grams and 88 grams must be

A. less than 68%.

AR. Incorrect. The interval 72 to 88 contains all values within 1.6 standard deviations (= 8/5) of the mean. Since 68% of all values lie within 1 standard deviation of the mean, the percentage of all values lying within 1.6 standard deviations of the mean must be larger than 68%.

\*B. between 68% and 95%.

BR. Correct. The interval 72 to 88 contains all values within 1.6 standard deviations (= 8/5) of the mean. Since 68% of all values lie within 1 standard deviation of the mean and 95% of all values lie within 2 standard deviations of the mean, the percentage of observations within 1.6 standard deviations of the mean must be between 68% and 95%.

C. between 95% and 99.7%.

CR. Incorrect. The interval 72 to 88 contains all values within 1.6 standard deviations (= 8/5) of the mean. Since 95% of all values lie within 2 standard deviation of the mean, the percentage of observations within 1.6 standard deviations of the mean must be less than 95%.

6. Scores on the American College Testing (ACT) college entrance exam follow a Normal distribution with mean 18 and standard deviation 6. Lisa’s standardized score on the ACT was *z* = −0.7. What was her actual ACT score?

A. 4.2.

AR. Incorrect. Check the formula you used for the *z*-score.

\*B. 13.8.

BR. Correct. Solving for *x* yields *x* = 13.8.

C. 22.2.

CR. Incorrect. Check the value you used for *z.*

7. What is the 25th percentile of the standard Normal distribution?

A. 1.00

AR. Incorrect. Use the table of standard Normal probabilities to find the *z*-score corresponding to a probability of 0.25.

B. 0.5987

BR. Incorrect. Use the table of standard Normal probabilities to find the *z*-score corresponding to a probability of 0.25. You may be confusing the Normal *z*-score with the percentile.

\*C. –0.67

CR. Correct. The *z*-score corresponding to a probability (area under the Normal curve) of 0.25 is –0.67.

8. The lifetime of a 2-volt battery in constant use has a Normal distribution with a mean of 516 hours and a standard deviation of 20 hours. The proportion of batteries with lifetimes that exceed 520 hours is approximately

A. 0.2000.

AR. Incorrect. The *z*-score corresponding to 520 is (520 – 516)/20 = 0.20. The *z*-score is *not* the same as the proportion we seek.

B. 0.5793.

BR. Incorrect. The *z*-score corresponding to 520 is (520 – 516)/20 = 0.20. The area to the left of z = 0.20 is 0.5793, which corresponds to the proportion with lifetimes below 520 hours.

\*C. 0.4207.

CR. Correct. The *z*-score corresponding to 520 is (520 – 516)/20 = 0.20. The area to the right of *z* = 0.20 is 1 – 0.5793 = 0.4207, which corresponds to the proportion with lifetimes greater than 520.

9. The lifetime of a 9-volt battery in constant use has an approximately Normal distribution with a mean of 516 hours and a standard deviation of 20 hours. Which of the following is the approximate lifetime of a battery that lasts longer than 90% of all batteries?

\*A. 541.6 hours

AR. Correct. The *z*-score corresponding to the 90th percentile of the lifetime distribution is 1.28. If we add 1.28 standard deviations or (1.28)(20) = 25.6 hours to the mean of 516 hours, we get 541.6 hours.

B. 517.28 hours

BR. Incorrect. The *z*-score corresponding to the 90th percentile is 1.28. We have to multiply this *z*-score by the standard deviation and add the product to the mean. Just adding the *z*-score itself to the mean is not sufficient.

C. 490.4 hours

CR. Incorrect. The *z*-score corresponding to the 90th percentile is 1.28. In this case, you have found the *z*-score corresponding to the 10th percentile, that is, −1.28.

10. The lifetime of 9-volt battery in constant use has an approximately Normal distribution with a mean of 516 hours and a standard deviation of 20 hours. Which of the following best describes the distribution of standard scores for the lifetimes of such batteries?

A. Exactly Normal, with mean 0 and standard deviation 1.

AR. Incorrect. Standardizing the values in a distribution does not alter the distribution’s shape, so if the original distribution was only approximately Normal, the same is true of the standardized values.

\*B. Approximately Normal, with mean 0 and standard deviation 1.

BR. Correct. Standardizing the values in a distribution subtracts the mean from each value, which re-centers the distribution at zero. It also divides each value by the standard deviation, so that the new standard deviation is 1.

C. Approximately Normal, with mean 1 and standard deviation 1.

CR. Incorrect. Standardizing the values in a distribution does divide each value by the standard deviation, so that the new standard deviation is 1. But the standardized mean is not 1. Review the formula for calculating *z* scores!

11. Fuji apples grown at a certain orchard have a mean weight of 5.2 ounces with a standard deviation of 0.8 ounces. Suppose the scale the orchard owner uses systematically underweighs apples by 0.2 ounces and also weighs the apples in grams, rather than ounces. What would the mean and standard deviation of these apples’ weights be as determined by this scale? (Note: 1 ounce ≈ 28 grams).

A. Mean 145.6 grams, standard deviation 0.8 grams.

AR. Incorrect. This is a linear transformation, both mean and standard deviation should be altered appropriately.

B. Mean 140 grams, standard deviation 22.4 grams.

BR. Correct. Since , the new mean is Note that we have to express the 0.2 ounce underestimate in grams before subtracting. , the new standard deviation is .

C. Mean 140 grams, standard deviation 16.8.

CR. Incorreect. Since , the new mean is indeed Note that we had to express the 0.2 ounce underestimate in grams before subtracting. But only multiplying something to a variable alters the standard deviation, not adding.

12. The graph below is a Normal probability plot of test scores for students in Mr. Olivier’s precalculus classes. Based on this plot, which of the following is the best description of the shape of the distribution of test scores?



A. approximately Normal

AR. Incorrect. A bell-shaped distribution of data would have an approximately linear Normal probability plot. In this case, the plot is clearly nonlinear. The highest test scores fall systematically above a line drawn through the main body of points, and the lowest test scores fall above this line.

\*B. skewed to the left

BR. Correct. The highest test scores fall systematically above a line drawn through the main body of points—these test scores would have to be higher to fall in a line drawn through the main body of points. Similarly, the lowest test scores would have to be higher. Thus there is a longer “tail” on the left side of the distribution.

C. skewed to the right

CR. Incorrect. The highest test scores fall systematically above a line drawn through the main body of points—these test scores would have to be higher to fall in a line drawn through the main body of points. Similarly, the lowest test scores would have to be higher. Thus there is a longer “tail” on the left side of the distribution.