7.2 Case Study 2: Normal Distribution Cases

7.2.1 BMI for 10-Year-Old-Boys

Body mass index (BMI) is a reliable indicator of body fat for most children and teens. BMI is calculated from a child's weight and height and is used as an easy-to-perform method of screening for weight categories that may lead to health problems. For children and teens, BMI is age- and sex-specific and is often referred to as BMI-for-age.

The Centers for Disease Control and Prevention (CDC) reports BMI-for-age growth charts for girls as well as boys to obtain a percentile ranking. Percentiles are the most commonly used indicator to assess the size and growth patterns of individual children in the United States.

The following table provides weight status categories and the corresponding percentiles and BMI ranges for 10-year-old boys in the United States.

Weight Status Category	Percentile Range	BMI Range
Underweight	Less than 5th	Less than 14.2
Healthy Weight	Between 5th and 85th	Between 14.2 and 19.4
Overweight	Between 85th and 95th	Between 19.4 and 22.2
Obese	More than 95th	More than 22.2

Health officials of a Midwestern town are concerned about the weight of children in their town. They believe that the BMI of their 10-year-old boys is normally distributed with mean 19.2 and standard deviation 2.6.

In a report, use the sample information to:

1. Compute the proportion of 10-year-old boys in this town that are in the various weight status categories given the BMI ranges.
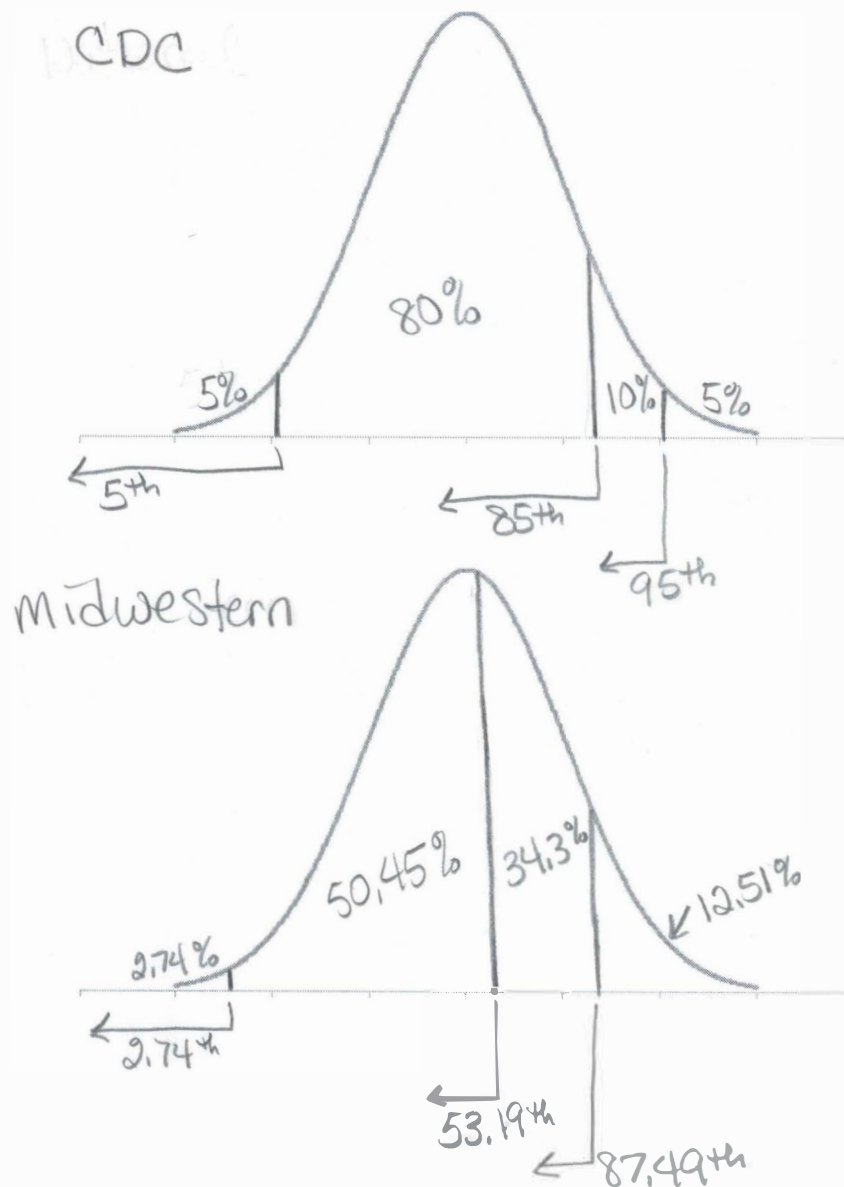
Weight Status Category	Percentile Range	BMI Range
Underweight	Less than 2.74^{th}	Less than 14.2
Healthy Weight	Between 2.74^{th} and 53.19^{th}	Between 14.2 and 19.4
Overweight	Between 53.19^{th} and 87.49^{th}	Between 19.4 and 22.2
Obese	More than 87.49^{th}	More than 22.2

Find z-score for 14.2, 19.4, and 22.2 using Midwestern town mean and standard deviation. $\mu = 19.2$ $\sigma = 2.6$

$$Z = \frac{14.2 - 19.2}{2.6} = -1.92$$

$$Z = \frac{19.4 - 19.2}{2.6} = 0.08$$

$$Z = \frac{22.2 - 19.2}{2.6} = 1.15$$

CDC

80%

5%   10%   5%

5th

85th

95th

Midwestern

50.45%   34.3%

2.74%   12.51%

2.74th

53.19th

87.49th

2. Discuss whether the concern of health officials is justified.

More than 12% of the boys in this Midwestern town are classified as Obese compared to only 5% specified by the CDC. More than 35% are classified as Overweight compared to only 10% specified by the CDC.

CDC
5% obese vs. 12.51%

CDC
10% overweight
vs. 34.3%

CDC
80% healthy vs.
only 50.45%