Lesson 11: How does shifting and rescaling data affect measures of position and spread?

Q: Enter the following data into your calculator.

14 14 17 14 13 14 19
18 18 9 14 15 11 14
11 15 18 13 11 9 14
16 10 13 16 15 19 13
19 12 12 17

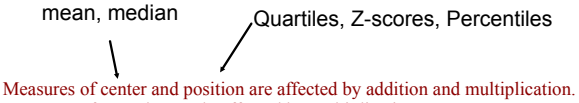
and

Calculate 1-Var Statistics

Suppose the class took a 20-point quiz. Results show a mean score of _____, median ____, IQR _____,SD ____, min _____, and Q1 ____. (Suppose YOU got a 17.) What happens to each of the statistics if…

1. I decide to weight the quiz as 30 points, and will add 10 points to every score. Your score is now 27.
2. I decide to weight the quiz as 40 points, and double each score. Your score is now 34.
3. I decide to count the quiz as 100 points; I'll quadruple each score and add 20 points. Your score is now 88.

Statistic	original (y)	$y+10$	$2y$	$2y+20$
mean				
median				
IQR				
SD				
minimum				
Q1				
your score				



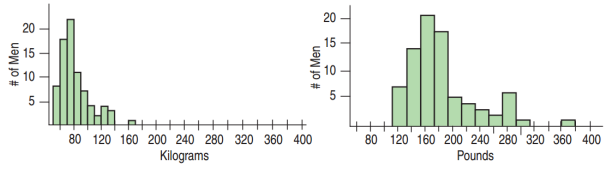
Measures of center and position are affected by addition and multiplication.
Measures of spread are only affected by multiplication.

Adding (or subtracting) a constant to every data value adds (or subtracts) the same constant to measures of position (center, min, max) but leaves measures of spread (range, IQR, standard deviation) unchanged.

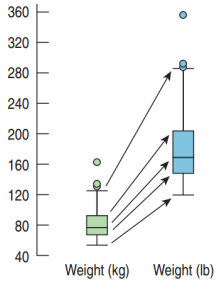
Rescaling Data

Not everyone thinks naturally in metric units. Suppose we want to look at the weights in pounds instead. We'd have to rescale the data.

1	=	2.20462
Kilogram		Pound



What happens to the spread? How much larger is it?



	Weight (kg)	Weight (lb)
Min	54.3	119.46
Q1	67.3	148.06
Median	76.85	169.07
Q3	92.3	203.06
Max	161.5	355.30
IQR	25	55
SD	22.27	48.99

When we multiply (or divide) all the data values by any constant, all measures of position (such as the mean, median, and percentiles) and measures of spread (such as the range, the IQR, and the standard deviation) are multiplied (or divided) by that same constant.

Cattle. The Virginia Cooperative Extension reports that the mean weight of yearling Angus steers is 1152 pounds. Suppose that weights of all such animals can be described by a Normal model with a standard deviation of 84 pounds.

a) How many standard deviations from the mean would a steer weighing 1000 pounds be?

b) Which would be more unusual, a steer weighing 1000 pounds or one weighing 1250 pounds?

MP3s. Two companies market new batteries targeted at owners of personal music players. DuraTunes claims a mean battery life of 11 hours, while RockReady advertises 12 hours.

a) Explain why you would also like to know the standard deviations of the battery lifespans before deciding which brand to buy.

b) Suppose those standard deviations are 2 hours for DuraTunes and 1.5 hours for RockReady. You are headed for 8 hours at the beach. Which battery is most likely to last all day? Explain.

c) If your beach trip is all weekend, and you probably will have the music on for 16 hours, which battery is most likely to last? Explain.