

Rescaling and shifting

- A fancy way of changing one variable to another
- Main concepts involve:
 - Adding or subtracting a number (shifting)
 - Multiplying or dividing by a number (rescaling)

Where have you seen this before?

- Going from Fahrenheit to Celsius
 - $C = (5/9)*(F-32)$
- Going from Celsius to Fahrenheit
 - $F = [(9/5)*C]+32$
- Going from pounds to kilograms
 - $1 \text{ lb} = 0.45359237 \text{ kg}$
- Going from kilograms to pounds
 - $1 \text{ kg} = 2.204622622 \text{ lbs}$

What does adding a constant do to data?

- All measures of position (5 number summary, mean) will increase (if adding) or decrease (if subtracting) by the constant
- All measures of spread (range, IQR, standard deviation) STAY THE SAME

Example

- Say we have the following temperatures (in Fahrenheit): 32, 34, 33, 36, 38, 38, 21
 - 5 number summary:
 - Min: 21
 - Q1: 32
 - Median: 34
 - Q3: 38
 - Max: 38
 - IQR= 6
 - $s = 5.84$

Distributions		
Column 1		
Quantiles		
100.0%	maximum	38.000
99.5%		38.000
97.5%		38.000
90.0%		38.000
75.0%	quartile	38.000
50.0%	median	34.000
25.0%	quartile	32.000
10.0%		21.000
2.5%		21.000
0.5%		21.000
0.0%	minimum	21.000
Moments		
Mean		33.142857
Std Dev		5.843189
Std Err Mean		2.2085178
upper 95% Mean		38.546906
lower 95% Mean		27.738809
N		7

Example (con't)

- Now say we subtract 32 from each data value
- Temperatures become: 0,2,1,4,6,6,8
 - 5 number summary:
 - Min: -11
 - Q1: 0
 - Median: 2
 - Q3: 6
 - Max: 6
 - IQR= 6
 - $s = 5.84$

Distributions		
Column 2		
Quantiles		
100.0%	maximum	6.00
99.5%		6.00
97.5%		6.00
90.0%		6.00
75.0%	quartile	6.00
50.0%	median	2.00
25.0%	quartile	0.00
10.0%		-11.00
2.5%		-11.00
0.5%		-11.00
0.0%	minimum	-11.00
Moments		
Mean		1.1428571
Std Dev		5.843189
Std Err Mean		2.2085178
upper 95% Mean		6.5469056
lower 95% Mean		-4.261191
N		7

Example (con't)

- Can see comparing the two that IQR and s didn't change by subtracting 32 from each temperature
- The 5 number summary changed by subtracting 32 from each element
- Bottom line: shifting data DOES NOT change the spread

What does multiplying or dividing by a number do to data?

- Changes the:
 - position
 - spread
- If we multiply all the data by a number, measures of position and measures of spread are multiplied by that number
- If we divide all the data by a number, measures of position and measures of spread are divided by that number

Example (con't)

- Say we multiply the previous temperatures by $(5/9)$
- The temperatures of the original data are now in degrees Celsius : 1.11, 0.55, 2.22, 3.33, 3.33, -6.11

Example (con't)

- For the Celsius data:
 - 5 number summary:
 - Min: -6.11
 - Q1: 0
 - Median: 1.11
 - Q3: 3.33
 - Max: 3.33
 - IQR = 3.33
 - $s = 3.246$

Distributions		
Column 3		
Quantiles		
100.0%	maximum	3.333
99.5%		3.333
97.5%		3.333
90.0%		3.333
75.0%	quartile	3.333
50.0%	median	1.111
25.0%	quartile	0.000
10.0%		-6.111
2.5%		-6.111
0.5%		-6.111
0.0%	minimum	-6.111
Moments		
Mean		0.6349206
Std Dev		3.2462161
Std Err Mean		1.2269544
upper 95% Mean		3.6371698
lower 95% Mean		-2.367329
N		7

Example (con't)

- We can see both measures of position and measures of spread change
- All measures of position and spread were multiplied by $(5/9)$
- Bottom line: rescaling data DOES change spread