

Stat 101L: Lecture 7

The Standard Deviation as a Ruler

- ◆ A student got a 67/75 on the first exam and a 64/75 on the second exam. She was disappointed that she did not score as well on the second exam.
- ◆ To her surprise, the professor said she actually did better on the second exam, relative to the rest of the class.

1

The Standard Deviation as a Ruler

- ◆ How can this be?
- ◆ Both exams exhibit variation in the scores.
- ◆ However, that variation may be different from one exam to the next.
- ◆ The standard deviation provides a ruler for comparing the two exam scores.

2

Summarizing Exam Scores

- | | |
|------------------|------------------|
| ◆ Exam 1 | ◆ Exam 2 |
| – Score: 67 | – Score: 64 |
| – Mean: | – Mean: |
| $\bar{y} = 59.5$ | $\bar{y} = 50.1$ |
| – Standard | – Standard |
| Deviation: | Deviation: |
| $s = 8.61$ | $s = 11.86$ |

3

Stat 101L: Lecture 7

Standardizing

Look at the number of standard deviations the score is from the mean.

$$z = \frac{y - \bar{y}}{s}$$

4

Standardized Exam Scores

♦ Exam 1

– Score: 67

$$z = \frac{67 - 59.5}{8.61}$$

$$z = 0.87$$

♦ Exam 2

– Score: 64

$$z = \frac{64 - 50.1}{11.86}$$

$$z = 1.17$$

5

Standardized Exam Scores

- ♦ On exam 1, the 67 was 0.87 standard deviations better than the mean.
- ♦ On exam 2, the 64 was 1.17 standard deviations better than the mean.

6

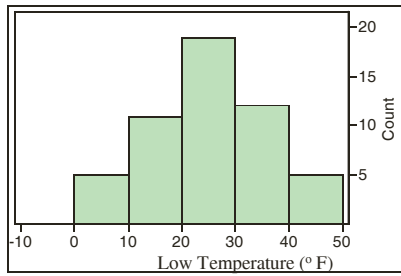
Stat 101L: Lecture 7

Standardizing

- ◆ Shifts the distribution by subtracting off the mean.
- ◆ Rescales the distribution by dividing by the standard deviation.

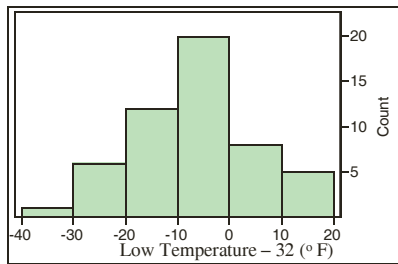
7

Distribution of Low Temps



8

Shifting the Distribution



9

Stat 101L: Lecture 7

Shifting

- ◆ Temperature ($^{\circ}$ F)
 - Median: 24.0° F
 - Mean: 24.4° F
 - IQR: 16.0° F
 - Std Dev: 11.22° F
- ◆ Temp – 32 ($^{\circ}$ F)
 - Median: -8° F
 - Mean: -7.6° F
 - IQR: 16.0° F
 - Std Dev: 11.22° F

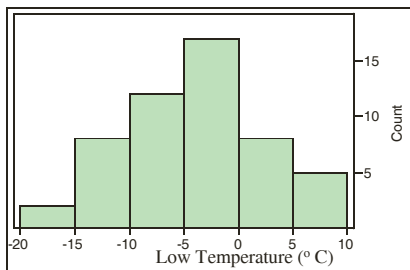
10

Shifting

- ◆ When adding (or subtracting) a constant:
 - Measures of position and center increase (or decrease) by that constant.
 - Measures of spread do not change.

11

Rescaling



12

Stat 101L: Lecture 7

Rescaling

- ◆ Temp – 32 (° F)
- Median: –8° F
- Mean: –7.6° F
- IQR: 16.0° F
- Std Dev: 11.22° F
- ◆ Temperature (° C)
- Median: –4.4° F
- Mean: –4.2° F
- IQR: 8.9° F
- Std Dev: 6.24° F

13

Rescaling

- ◆ When multiplying (or dividing) by a constant:
 - All measures of position, center and spread are multiplied (or divided) by that constant.

14

Standardizing

- ◆ Standardizing does not change the shape of the distribution.
- ◆ Standardizing changes the center by making the mean 0.
- ◆ Standardizing changes the spread by making the standard deviation 1.

15
