

# Stat 101: Lecture 8

## 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.

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## 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.

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## Summarizing Exam Scores

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

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# Stat 101: Lecture 8

## Standardizing

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

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

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## Standardized Exam Scores

- Exam 1

– Score: 67

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

$$z = 0.87$$

- Exam 2

– Score: 64

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

$$z = 1.17$$

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## 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.

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# Stat 101: Lecture 8

## Standardizing

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

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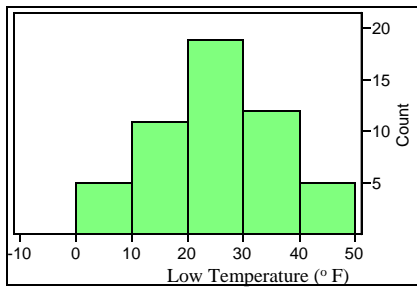
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## Distribution of Low Temps



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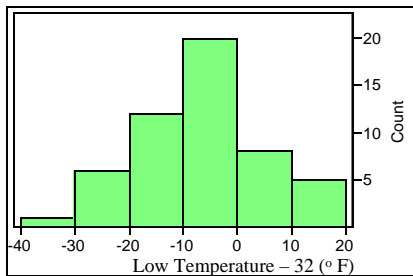
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## Shifting the Distribution



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# Stat 101: Lecture 8

## Shifting

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

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## Shifting

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

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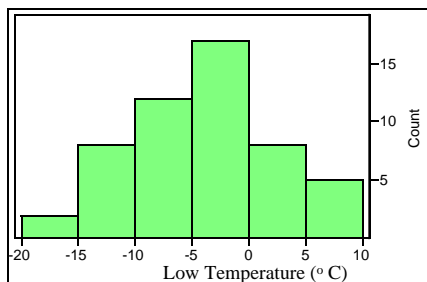
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## Rescaling



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# Stat 101: Lecture 8

## Rescaling

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

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## Rescaling

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

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## 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.

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