

Chapter 5: Exploring Data: Distributions

For All Practical
Purposes



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Section 5.7 Describing Variability: The Standard Deviation

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- Standard Deviation s

- “Standard” or average amount that the observed data values deviate from the mean
- Calculated by taking the square root of the mean of the squared deviations except dividing by $n-1$ instead of n
- The standard deviation of n observations $x_1, x_2, x_3, \dots, x_n$ is

$$s = \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + (x_3 - \bar{x})^2 + \dots + (x_n - \bar{x})^2}{n - 1}}$$

- Standard deviation example

- 7 purchase prices for Radiohead “In Rainbows” download:

- 3 4 5 7 10 12 15 (in dollars) The mean is

$$\bar{x} = \frac{3+4+5+7+10+12+15}{7} = 8 \text{ dollars}$$

- The standard deviation is

$$\begin{aligned} s &= \sqrt{\frac{(3-8)^2 + (4-8)^2 + (5-8)^2 + (7-8)^2 + (10-8)^2 + (12-8)^2 + (15-8)^2}{7-1}} \\ &= \sqrt{\frac{(-5)^2 + (-4)^2 + (-3)^2 + (-1)^2 + (2)^2 + (4)^2 + (7)^2}{6}} \\ &= \sqrt{\frac{25+16+9+1+4+16+49}{6}} = \sqrt{\frac{120}{6}} = \sqrt{20} = 4.47 \text{ dollars} \end{aligned}$$

- *Properties of the standard deviation s :*
 - *s measures spread about the mean*
 - *$s=0$ only when there is no spread, otherwise $s>0$*
 - *s has the same units of measurement as the original observations*
 - *s is sensitive to extreme observations or outliers*

Choosing a Summary

The five-number summary is usually better than the mean and standard deviation for describing a skewed distribution or a distribution with outliers. Use the mean and standard deviation only for reasonably symmetric distributions with no outliers.

Many calculators and computer programs can easily calculate the standard deviation.