

# HSCC 470 Research Methods and Data Analysis in Health Sciences

## Descriptive Statistics II: Measures of Dispersion



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## Unit Objectives

Upon completion of this unit, the student will be able to:

- List the uses of measures of variability.
- Describe the derivation and use of the sample range.
- Describe the derivation and use of the sample variance.
- Describe the derivation and use of the sample standard deviation.
- Describe the interpretation of the sample standard deviation for a bell-shaped distribution.



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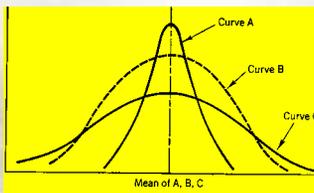
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## Measures of Variability

- It is possible for different data sets to have the same mean but different variability.



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## Measures of Variability (Dispersion)

- Sample Range
- Sample Variance
- Sample Standard Deviation

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## Uses of Variability Measures

- Provides estimate of reliability of measures of central tendency.
- May wish to compare dispersions of different data sets.
- Used in statistical tests.

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## Range

- Range = value of highest observation - value of lowest observation
- Easy to calculate
- Heavily influenced by outliers
- Ignores all other data
- Likely to change drastically from one sample to the next

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## Range continued

- Example

– Annual incomes

Paramedic Annual Salaries		
County	Sample 1	Sample 2
A	\$22,000	\$20,000
B	\$22,000	\$22,000
C	\$25,000	\$25,000
D	\$28,000	\$28,000
E	\$28,000	\$28,000
F	\$31,000	\$31,000
G	\$33,000	\$35,000
Mean	\$27,000	\$27,000
Range	\$11,000	\$15,000

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## Sample Variance

- Sample variance

$$s^2 = \frac{\sum (Y_i - \bar{Y})^2}{n - 1}$$

County	Yi	(Yi-Ybar)	(Yi-Ybar) <sup>2</sup>
A	\$22,000	-\$5,000	\$25,000,000.00
B	\$22,000	-\$5,000	\$25,000,000.00
C	\$25,000	-\$2,000	\$4,000,000.00
D	\$28,000	\$1,000	\$1,000,000.00
E	\$28,000	\$1,000	\$1,000,000.00
F	\$31,000	\$4,000	\$16,000,000.00
G	\$33,000	\$6,000	\$36,000,000.00
			<b>\$108,000,000.00</b>
Mean (Ybar)	<b>\$27,000</b>		
Sample Variance	\$18,000,000		

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## Sample Standard Deviation

- Sample standard deviation =

(population standard deviation =  $\sigma$ )

$$s = \sqrt{\frac{\sum (Y_i - \bar{Y})^2}{n - 1}}$$

County	Yi	(Yi-Ybar)	(Yi-Ybar) <sup>2</sup>
A	\$22,000	-\$5,000	\$25,000,000.00
B	\$22,000	-\$5,000	\$25,000,000.00
C	\$25,000	-\$2,000	\$4,000,000.00
D	\$28,000	\$1,000	\$1,000,000.00
E	\$28,000	\$1,000	\$1,000,000.00
F	\$31,000	\$4,000	\$16,000,000.00
G	\$33,000	\$6,000	\$36,000,000.00
			<b>\$108,000,000.00</b>
Mean (Ybar)	<b>\$27,000</b>		
Sample Variance	\$18,000,000		

$$s = \sqrt{s^2} = \sqrt{\$18,000,000} = \$4,242$$

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## Properties of the Standard Deviation

- $S = 0$  only when all of the values are identical
- The greater the dispersion about the mean, the larger will be the value of  $S$ .

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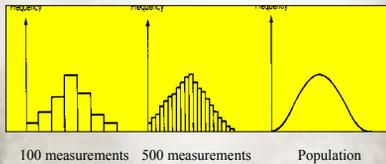
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## Frequency Distribution Reviewed

- Sample and population distributions



100 measurements    500 measurements    Population

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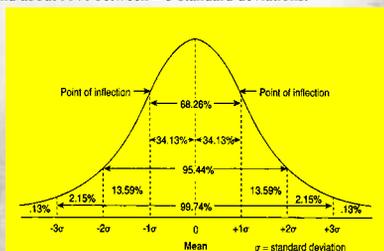
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## Interpreting the Std. Deviation

- If the histogram of a collection of measurements is approximately bell-shaped, then:
  - About 68% of the measurements lie between  $\pm 1$  standard deviation of the mean, about 95% between  $\pm 2$  standard deviations, and about 99% between  $\pm 3$  standard deviations.




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