

## Lecture 4 Summary (Chapter 2)

## 3) Measures of Variation

A measure of center cannot give a complete summary of data.

## (A) Sample Variance and Standard Deviation

$$\text{Sample variance: } s^2 = \sum_{i=1}^n (x_i - \bar{x})^2 / (n - 1)$$

$$\text{An alternative formula: } s^2 = \frac{1}{n - 1} \left[ \sum_{i=1}^n x_i^2 - \frac{(\sum_{i=1}^n x_i)^2}{n} \right]$$

$$\text{Sample standard deviation: } s = \sqrt{s^2}$$

## (B) Population Variance and Standard Deviation

$$\text{Population variance: } \sigma^2 = \sum_{i=1}^N (x_i - \mu)^2 / N$$

$$\text{Population standard deviation: } \sigma = \sqrt{\sigma^2}$$

Empirical guidelines for symmetric bell-shaped distributions:
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Approximately 68% of the data lie within $\bar{x} \pm s$ .
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Approximately 95% of the data lie within $\bar{x} \pm 2s$ .
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Approximately 99.7% of the data lie within $\bar{x} \pm 3s$ .
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$$z\text{-score: } \frac{x - \mu}{\sigma}$$