Psy 331 Inferential Statistics

Measures of Variability

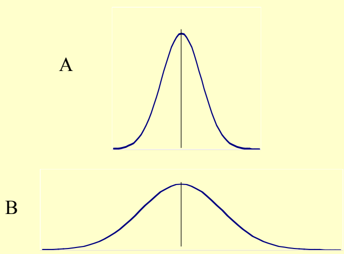
What We Will Cover in This Section

- What variability is.
- Range.
- Variance and Standard deviation.

Overview

The Mean describes the ‘typical’ score; measures of variability show how much the rest of the scores in the distribution are spread out around the mean.

Two Normal Distributions with the Same Mean



Range

- The distance between the lowest and highest score.
- Formula

  Highest Score
  − Lowest Score
  Range

- Example

1	3	4	6	8	12	15	16	18	19
1	3	4	6	8	12	15	16	18	79

Properties of the Range

1. Gross descriptive statistic.
2. Highly sensitive to extreme scores.
3. Relatively unstable.
4. Insensitive to the shape of the distribution between the two scores.

Range Assumptions

1. Scores represent interval or ratio scales.

Deviation Scores

	Score	$X - \bar{X}$	$(X - \bar{X})^2$
	5	-2.50	6.25
	6	-1.50	2.25
	7	-.50	.25
	8	.50	.25
	9	1.50	2.25
	10	2.50	6.25
Sum	45	0	**17.50**
Mean	7.5		**2.92**

Sum of Squares (17.50)

Variance (2.92)

Sum of Squares

Sum of the squared deviation scores around the mean.

$$SS = \sum (X - \overline{X})^2$$

Variance and Standard Deviation

- The Variance (S^2) is expressed in squared units.
- We need to convert the variability measure back to unsquared units.
- To do this we take the square root of the variance.
- This number is called the standard deviation (s).

$$S = \sqrt{S^2}$$

The Key Measures of Variability

Term	Formula	Computation
Sum of Squares	$\sum (X - \overline{X})^2$	17.50
Variance	$\frac{\Sigma (X - \overline{X})^2}{N}$	2.92
Standard Deviation	$\sqrt{\frac{\Sigma (X - \overline{X})^2}{N}}$	1.71

Variance

Mean squared deviation score.

Sample Formula **Population Formula**

$$S_X^2 = \frac{\Sigma\left(X - \overline{X}\right)^2}{N} \Rightarrow \hat{s}_X^2 = \frac{\Sigma\left(X - \overline{X}\right)^2}{N - 1}$$

Degrees of freedom (df)

Standard Deviation

Square root of the variance.

Sample Formula **Population Formula**

$$S_X = \sqrt{\frac{\Sigma\left(X - \overline{X}\right)^2}{N}} \Rightarrow \hat{S}_X = \sqrt{\frac{\Sigma\left(X - \overline{X}\right)^2}{N - 1}}$$

Another Example

Population Parameters

Statistic	Sample Description	Sample (used to estimate the population)	Population symbol
Variance	S^2	$\hat{S}^2$ or s^2	σ^2
Standard Deviation	S	$\hat{S}$ or s	σ

Properties of the Variance and Standard Deviation

1. Sensitive to the location of each score in the distribution.
2. Sensitive to extreme scores.
3. Resistant to sampling fluctuation.
4. Is used in most higher order statistical computations.

Assumptions

1. The variables are measured on an interval or ratio scale.
2. There are no outliers in the distribution.

Interpretation and Use

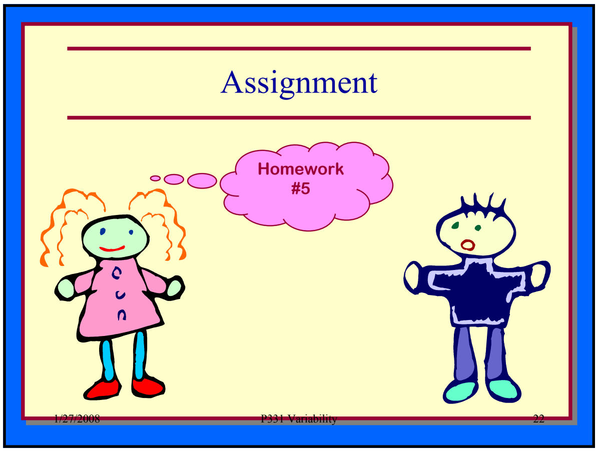
- How much difference is there in a set of scores.
  - Are the scores similar?
- Provides input to other statistical procedures.

Key Learning Points, Part 1

1. The *Range* is a rough estimate of variability.
2. The *Variance* represents the mean squared deviation score.
3. The *Standard Deviation* is the square root of the variance.
4. The higher the *Standard Deviation* the more spread out the scores will be.

Key Learning Points, Part 2

5. S is the symbol used to represent the sample standard deviation.
6. $\hat{S}^2$, or s^2, is the unbiased estimate of the population variance σ^2.
7. $\hat{S}$, or s, is the unbiased estimate of the population standard deviation σ.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THE END
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