Graduate Statistics

Measures of Variability

What We Will Cover in This Section

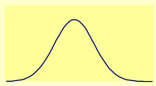
- What variability is.
- Range.
- Interquartile range.
- Variance and Standard deviation.

Overview

The Mean describes the 'typical' score; measures of variability give an index of how much the rest of the scores in the distribution are spread out around the mean.

Two Normal Distributions with the Same Mean

A



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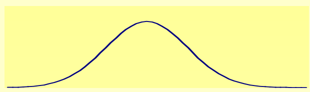


Range

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

  Range = Highest Score – Lowest Score
- 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.

Semi-Interquartile Range

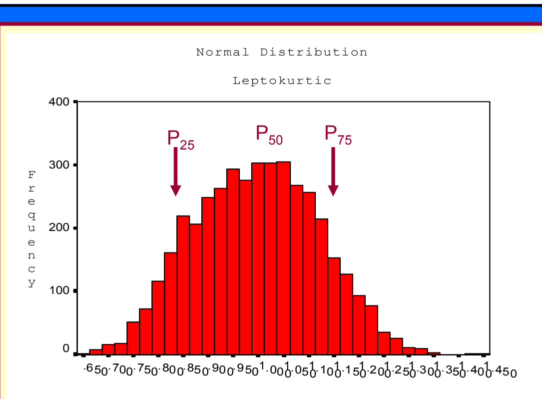
- Computation

$$Interquartile\ Range\ (IQ) = P_{75} - P_{25}$$

$$Semi-Interquartile\ Range\ (SIQ) = \frac{P_{75} - P_{25}}{2}$$

- Interpretation

  The distance between the middle 50% of the scores.



Interquartile Range: Properties

1. Not sensitive to extreme scores.
2. Relatively stable.
3. Does not consider the shape of the distribution.
4. Ignores all but two of the scores.

Interquartile Range Assumptions

1. Scores represent interval or ratio scales.

Deviation Score

	Score	X - M_x	$(X - M_x)^2$
	5	-2.5	6.25
	6	-1.5	2.25
	7	-.5	.25
	8	.5	.25
	9	1.5	2.25
	10	2.5	6.25
Sum	45	0	**17.50**
Mean	7.5	0	**2.92**

Sum of Squares

Mean Square

Sum of Squares

Sum of the squared deviation scores around the mean.

$$SS = \sum (X - \mu)^2$$

$$SS = \sum (X - M_X)^2$$

Variance

Mean squared deviation score

Sample Formula
(used when describing the properties of a sample)

$$S_X^2 = \frac{SS}{N}$$

Population Formula
(used when making and ***inference*** about a population)

$$s_X^2 = \frac{SS}{N-1}$$

Degrees of freedom (df)

Degrees of Freedom (df)

- Number of independent scores.
- Why use it?
  - The sample variance is a biased estimate of the population variance.
  - It tends to underestimate the population variance.
  - To correct, we reduce the N by 1. These are the degrees of freedom.

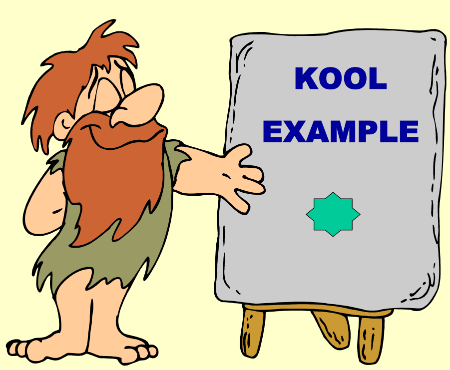
Standard Deviation

Square root of the variance.

Sample Formula	Population Formula
$S_X = \sqrt{\frac{SS}{N}}$	$s_X = \sqrt{\frac{SS}{N-1}}$
$S_X = \sqrt{S_X^2}$	$s_X = \sqrt{s_X^2}$

Population Parameters

Statistic	Sample	Sample (used to estimate the population)	Population symbol
Variance	S^2	s^2	σ^2
Standard Deviation	S	s	σ



Properties of the Standard Deviation

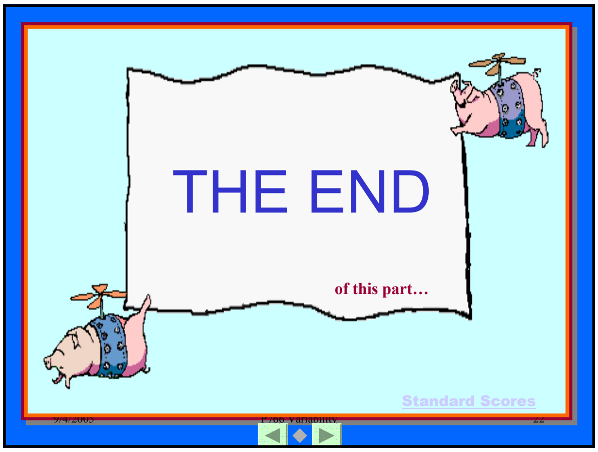
1. Sensitive to the location of each score in the distribution.
2. Sensitive to extreme scores.
3. Resistant to sampling fluctuation.
4. Is used in most higher order statistical computations.

Assumptions

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

Interpretation and Use

- Useful to compare two groups when there are widely differing scores.
- Useful to assess the amount of variability in two groups of scores.
- Provides input to other statistical procedures.



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Standard Scores
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