

Measure of Variation (Dispersion)

Course: Statistics 1

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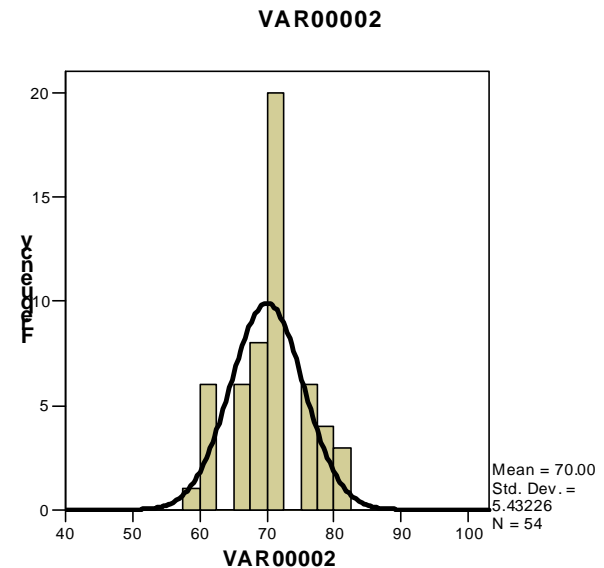
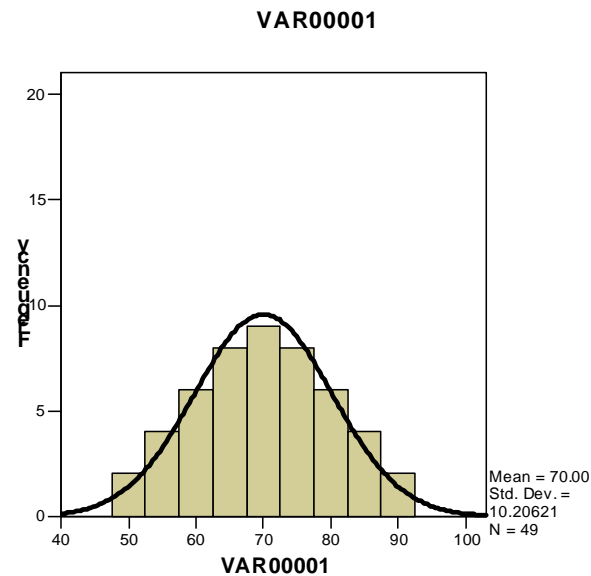


Variability

- **Central Tendency** yields a single value that best describe a group of data
- **Variability** is a measure of the fluctuation of scores about a measure of central tendency
 - Range
 - Variance
 - Standard Deviation

Two Distributions

- Same central tendency but different variability



Range

- Maximum score – Minimum score

$$90 - 82 = 8$$

- Easily affected by extreme scores
- Tells us nothing about *pattern* of the distribution

82	83	84	85	85	86	86	87	89	90
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Deviations and Sum of Squares

- The algebraic sum of deviations of each data point from the mean is always **0**
- **Squared Deviation** is just the square of difference from mean
- Sum of Square, **SS**

$$SS = \sum(X - \bar{X})^2 = 56.1$$

- Variance is the Average Sum of Square Deviations from the mean

$$\text{Variance} = \frac{SS}{N} = \frac{\sum(X - \bar{X})^2}{N} = \frac{56.1}{10} = 5.61$$

X	$(X - \bar{X})$	$(X - \bar{X})^2$
86	0.3	0.09
83	-2.7	7.29
90	4.3	18.49
87	1.3	1.69
89	3.3	10.89
82	-3.7	13.69
84	-1.7	2.89
85	-0.7	0.49
86	0.3	0.09
85	-0.7	0.49
	$\sum(X - \bar{X}) = 0$	56.1

Variance

- The Average Sum of Square Deviations from the mean: **SS/N**

$$\text{Variance} = \frac{SS}{N} = \frac{\Sigma(X - \bar{X})^2}{N} = \frac{56.1}{10} = 5.61$$

Population - Sample Variance

- Population Variance: **SS/N**

$$\sigma^2 = \frac{SS}{N} = \frac{\Sigma(X - \mu)^2}{N} = \frac{56.1}{10} = 5.61$$

- Sample Variance: **$SS/(N-1)$**

$$s^2 = \frac{SS}{N-1} = \frac{\Sigma(X - \bar{X})^2}{N-1} = \frac{56.1}{9} = 6.23$$

Standard Deviation

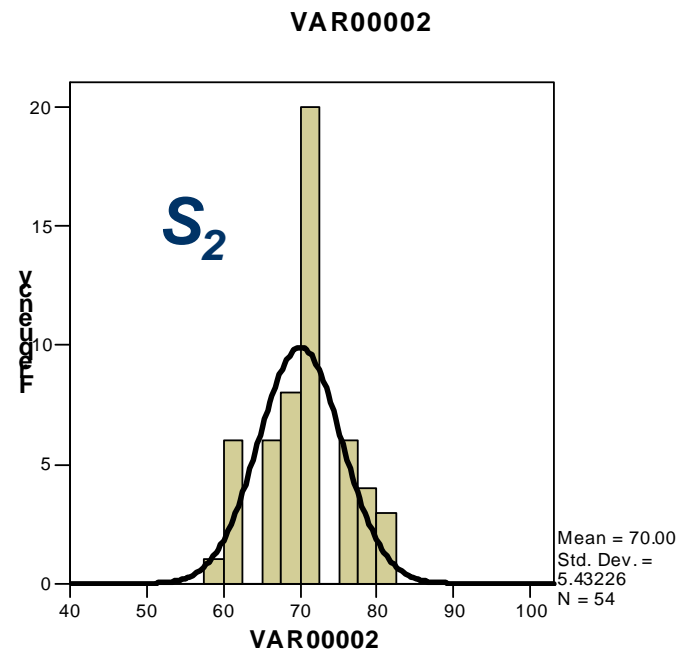
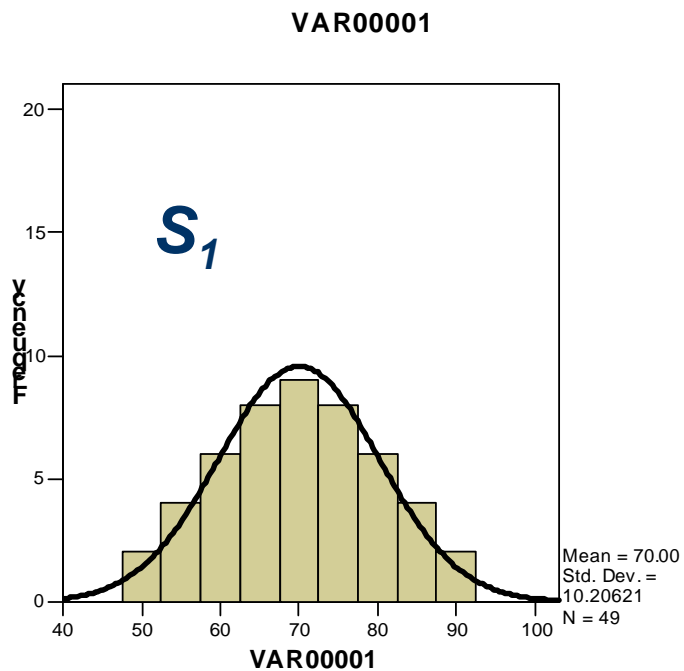
- Most widely used measure of variability
- It's the square root of the variance
- It is a measure of the spread of data about the mean

$$S = \sqrt{\frac{\sum(X - \bar{X})^2}{N}}$$

$$\text{Standard Deviation} = \sqrt{\text{Variance}}$$

Standard Deviation - Spread

- $S_1 > S_2$



Population - Sample Standard Deviations

- Population

$$\sigma \text{ (sigma)} = \sqrt{\sigma^2} = \sqrt{5.61} = 2.37$$

- Sample

$$S = \sqrt{S^2} = \sqrt{6.23} = 2.50$$

SPSS Variability Measures

Statistics

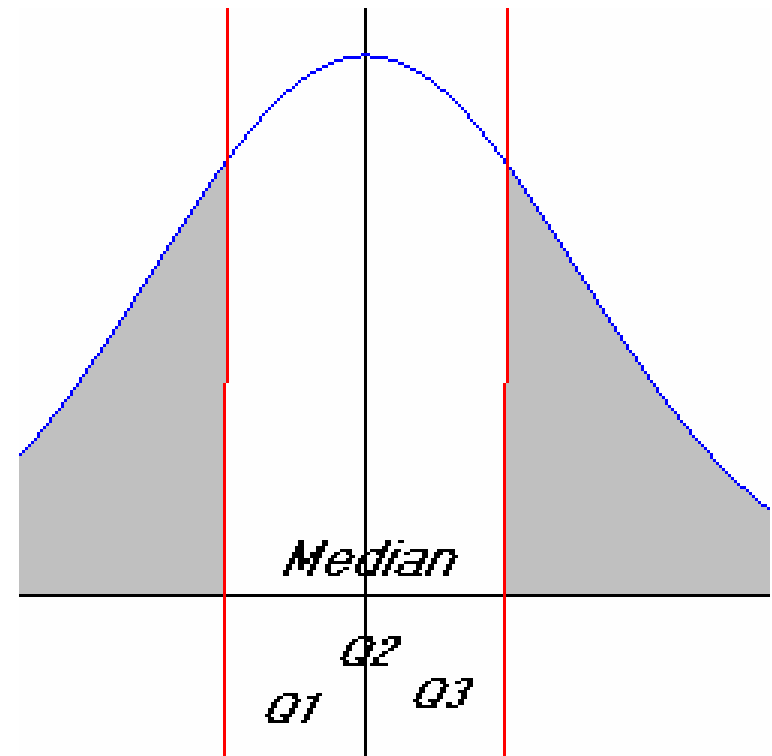
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N	Valid	10
Std. Deviation		2.49666
Variance		6.233
Range		8.00

82	83	84	85	85	86	86	87	89	90
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Interquartile Range (IQR)

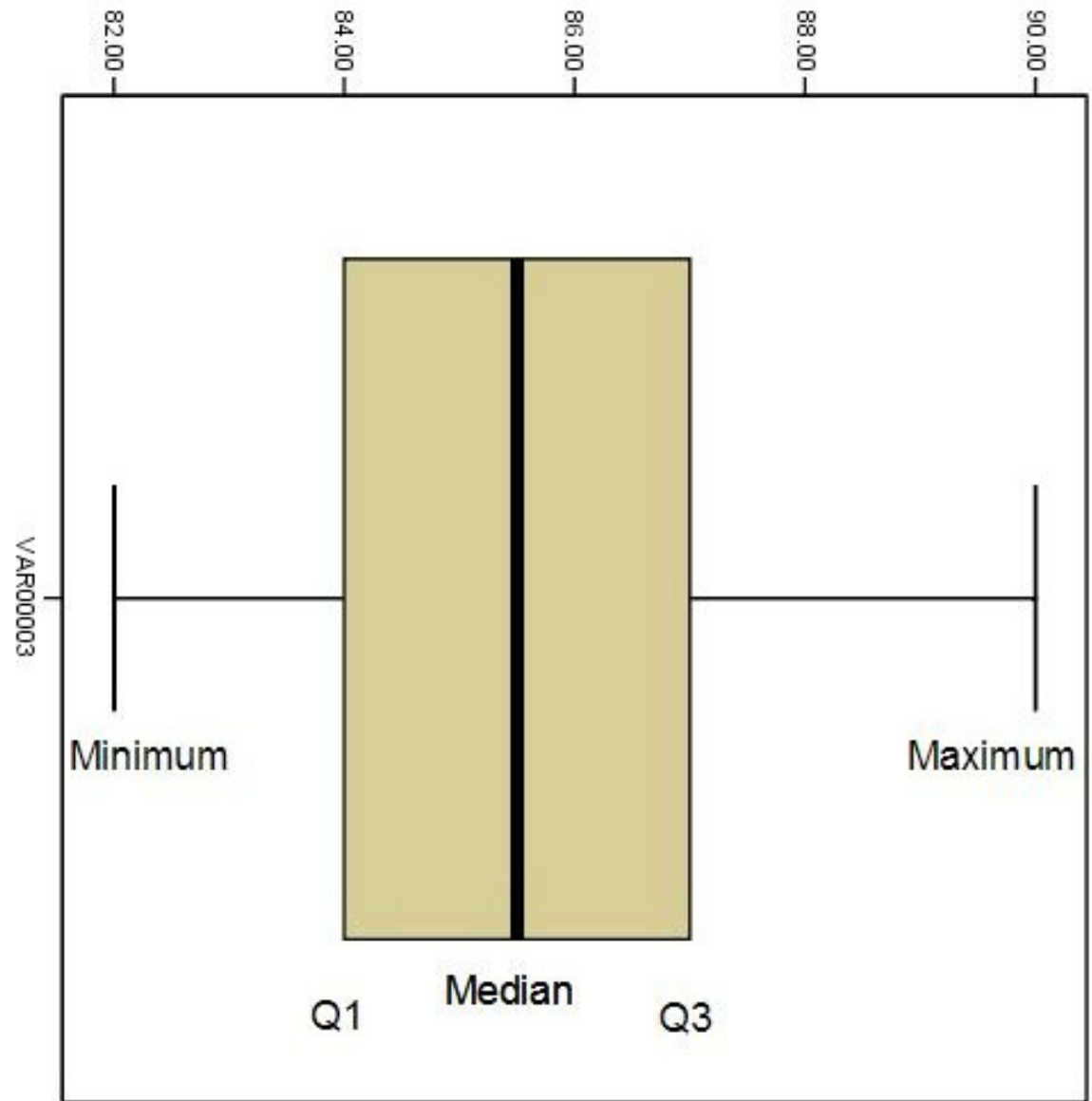
- Q2 is Median, 50 percentile
- Q1 is the 25 percentile
- Q3 is the 75 percentile
- ***IQR*** is the ***Interquartile*** range:
$$IQR = Q3 - Q1$$
- The *IQR* is more stable than the range of often is used instead of it



Box Plot

- A graphical illustration of both central tendency and dispersion
- Outliers are values some distance outside the values of the Box Plot
- Show:
 - Minimum,
 - Q1: 25 percentile,
 - Median,
 - Q3: 75 percentile and
 - Maximum

Box Plot Example



82

83

84

85

85

86

86

87

89

90