

2.7 Measures of the Spread of the Data

Learning Objectives

In this section, you will:

- Measure the spread of data, including standard deviation and variance

An important characteristic of any set of data is the variation in the data. In some data sets, the data values are concentrated closely near the mean; in other data sets, the data values are more widely spread out from the mean. The most common measure of variation, or spread, is the standard deviation.

Standard Deviation: is a number that measures how far data values are from their mean.

- Standard deviation is always positive or zero
- The standard deviation is small when the data are concentrated close to the mean, exhibiting little variation or spread
- The standard deviation is larger when the data values are more spread out from the mean, exhibiting more variation.
- Standard deviation is zero if all data is the same number
- Outliers can have a strong effect on the standard deviation

- $s = \sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$ sample
- $\sigma = \sqrt{\frac{\sum(x-\mu)^2}{N}}$ population

Range: Highest data value minus lowest data value

Round off rule: Carry one more decimal place than the original data

Example 1

Data set #1: 5, 6, 6, 10, 10, 11 \bar{x} = Range = s =

Data set #2: - 2, 4, 6, 10, 12, 18 \bar{x} = Range = s =

To find values that are a certain number of standard deviations above or below the mean.

Value = mean \pm (# of standard deviations)*(standard deviation)

$x = \bar{x} \pm (\# \text{ of } STDEV) * (s)$

Variance: is the square of the standard deviation (s^2 or σ^2)

Using the graphing calculator to find variance

- First find standard deviation
- Press VARS
- Press 5:Statistics
- Press 3:Sx
- Press x2
- Press ENTER

Example 2

For data set #1 find s^2

For data set #2 find s^2

Example 3

In a fifth grade class, the teacher was interested in the average age and the sample standard deviation of the ages of her students. The following data are the ages for a SAMPLE of $n = 20$ fifth grade students. The ages are rounded to the nearest half year:

9; 9.5; 9.5; 10; 10; 10; 10; 10.5; 10.5; 10.5; 10.5; 11; 11; 11; 11; 11; 11; 11.5; 11.5; 11.5;

- Find the mean and standard deviation on your calculator.
- Find the value that is one standard deviation above the mean.
- Find the value that is two standard deviations below the mean.
- Find the values that are 1.5 standard deviations from the mean.

Example 4

Find the standard deviation and variance of the frequency table

Class	Frequency
0-2	1
3-5	6
6-8	10
9-11	7
12-14	0
15-17	2

Comparing Values from Different Data Sets

Z-score (standardized value) – the number of standard deviations a given value of x is above or below the mean.

$$\text{Sample, } z = \frac{x - \bar{x}}{s} \quad \text{or} \quad \text{Population, } z = \frac{x - \mu}{\sigma}$$

Example 5

Which is a better score? A score of 76 on a quiz where the mean score was 64 and the standard deviation was 6.7, or a score of 12 on a quiz with a mean of 10 and a standard deviation of 1.1?

Example 6

Two students, John and Ali, from different high schools, wanted to find out who had the highest GPA when compared to his school. Which student had the highest GPA when compared to his school?

Student	GPA	School Mean GPA	School Standard Deviation
John	2.85	3.0	0.7
Ali	77	80	10

For more information and examples see online textbook OpenStax Introductory Statistics pages 110 - 120.

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