Section 5.3 Standard Deviation

Standard Deviation

- a measure of dispersion or scatter of data values in relation to the mean.
- The Greek letter sigma, σ, is often used to represent it.
- A low standard deviation indicates that most data values are close to the mean.
- A high standard deviation indicates that most data values are scattered farther from the mean.
- The standard deviation is helpful when comparing two or more sets of data.

Example 1:

A teacher has two chemistry classes. She gives the same tests to both classes.

a) Calculate the mean mark for each of the first five tests given to both classes.

Test	Class A (%)	Class B (%)
1	94	84
2	56	77
3	89	76
4	67	81
5	84	74

b) Calculate the range of the mean test scores for Class A and Class B. What additional information does this give us about the two classes?

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Note:
Range only tells us how spread out the two extreme measures are - it does not provide any information about the variation within the data values themselves.

To learn more about the dispersion of these test scores let's look at a second measure of dispersion called standard deviation.

To calculate standard deviation we will use the formula:

$$\sigma = \sqrt{\frac{\sum(x-\bar{x})^2}{n}}$$

where:

σ is the standard deviation

$\sum$ tells us to calculate the sum of the following

x is each individual data value

$\bar{x}$ is the mean in the sample of data

n is the number of values in the data set

Tip:
To calculate the standard deviation requires multiple steps. Therefore, it is a good idea to be organized with your workings. A table will help!

Test	Class A (%)	Class B (%)
1	94	84
2	56	77
3	89	76
4	67	81
5	84	74

Mean for Class A: ________

Mean for Class B: ________

Table to help calculate standard deviation for Class A.

Class A's Test Scores	$(x - \overline{x})$	$(x - \overline{x})^2$
94		
56		
89		
67		
84		

The sum of column 3 is:

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

Now complete the formula:

$$\sigma = \sqrt{\frac{\sum(x-\bar{x})^2}{n}}$$

Table to help calculate standard deviation for Class B.

Class B's Test Scores	$(x - \overline{x})$	$(x - \overline{x})^2$
84		
77		
76		
81		
74		

The sum of column 3 is:

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

Now complete the formula:

$$\sigma = \sqrt{\frac{\sum(x-\bar{x})^2}{n}}$$

c) What additional information does the standard deviation tell us about the dispersion in the test scores of the two classes?

Example 2:

Remember Tim and Luke, both enrolled in Mathematics 2201 and scored the following marks on the last five unit tests.

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Tim	60	65	70	75	80
Luke	68	69	70	71	72

Previously calculated in Sec 5.1:
From Tim's marks: mean = 70 median = 70
From Luke's marks: mean = 70 median = 70

a) Whose marks are more dispersed?

b) What does this mean in terms of a high or low standard deviation?

c) If the data is clustered around the mean, what does this tell us about the value of the standard deviation?

d) Who was more consistent over the five unit tests?

e) Who's standard deviation should be smaller? Why?

f) Calculate the standard deviation for each student.
Explain your results.

Tim's Standard Deviation:

Tim's Test Scores	$(x - \bar{x})$	$(x - \bar{x})^2$
60		
65		
70		
75		
80		

The sum of column 3 is:

$\sum(x - \bar{x})^2 =$

Now complete the formula: $\sigma = \sqrt{\frac{\sum(x-\bar{x})^2}{n}}$

Luke's Standard Deviation:

Luke's Test Scores	$(x - \bar{x})$	$(x - \bar{x})^2$
68		
69		
70		
71		
72		

The sum of column 3 is:

$\sum(x - \bar{x})^2 =$

Now complete the formula: $\sigma = \sqrt{\frac{\sum(x-\bar{x})^2}{n}}$

Example 3:

a) Is it possible for a data set to have a standard deviation of 0? Provide an example.

b) Can the standard deviation ever be negative? Explain why or why not?

Example 4:

Two obedience schools for dogs monitor the number of trials required for 20 puppies to learn to "sit and stay".

True Companion Dog School		Top Dog School	
Number of trials	Number of puppies	Number of trials	Number of puppies
7	1	7	4
8	2	8	3
9	5	9	2
10	4	10	3
11	4	11	4
12	4	12	4

a) How many dogs at each school?

True Companion Dog School

Top Dog School

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b) Determine the mean of the number of trials required to learn to "sit and stay" at each dog school.

True Companion Dog School

Top Dog School

Note:
We will calculate the standard deviation by hand, for very small sets of data to understand how the value is determined. However, for large data sets like this, it is much easier to use technology!

Technology Options:

Websites

http://easycalculation.com/statistics/standard-deviation.php

http://www.mathsisfun.com/data/standard-deviation-calculator.html

http://easycalculation.com/statistics/mean-median-mode.php

Microsoft Excel or Microsoft Works Spreadsheet

c) Determine the standard deviation of the number of trials required to learn to "sit and stay" at each dog school.

True Companion Dog School

Top Dog School

d) Which school is more consistent in teaching puppies to "sit and stay"? Explain!

p.261 #2, 4, 6 and 7

Attachments

pm5s3-p8.tns

5s3e1.mp4

5s3e2.mp4