Lesson 5: Measuring Variability for Symmetrical Distributions

Classwork

Example 1: Calculating the Standard Deviation

Here’s a dot plot of the lives of the Brand A batteries from Lesson 4.



How do you measure variability of this data set?

One way is by calculating **standard deviation.**

* Find each deviation from the mean.

 Difference between values and the mean

 $ x-\overbar{x}$

* Then, square the deviations from the mean. For example, when the deviation from the mean is −18 the squared deviation from the mean is $\left(-18\right)^{2}=324$.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Life (Hours) | 83 | 94 | 96 | 106 | 113 | 114 |
| Deviation from the Mean | −18 | −7 | −5 | 5 | 12 | 13 |
| Squared Deviations from the Mean | 324 | 49 | 25 | 25 | 144 | 169 |

* Add up the squared deviations:

$324+49+25+25+144+169=736$.

This result is the *sum* of the squared deviations.

The number of values in the data set is denoted by *n*. In this example *n* is 6.

* You divide the sum of the squared deviations by *n* $-1$, which here is $6-1=5$:

$$\frac{736 }{5}=147.2$$

* Finally, you take the square root of 147.2, or to the nearest hundredth is $12.13$.

We conclude that a typical deviation of a Brand A lifetime from the mean lifetime for Brand A is 12.13 hours. The unit of standard deviation is always the same as the unit of the original data set. So, here the standard deviation to the nearest hundredth, with the unit, is 12.13 hours. How close is the answer to the typical deviation that you estimated at the beginning of the lesson?

**Standard Deviation** shows how the data deviate from the mean.

**A low standard deviation** indicates that the data tend to be very close to the mean.

**A high standard deviation** indicates that the data are spread out over a larger range of values

Exercises 1–5

Now you can calculate the standard deviation of the lifetimes for the eight Brand B batteries. The mean was 100.5. We already have the deviations from the mean:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Life (Hours) | 73 | 76 | 92 | 94 | 110 | 117 | 118 | 124 |
| Deviation from the Mean | −27.5 | −24.5 | −8.5 | −6.5 | 9.5 | 16.5 | 17.5 | 23.5 |
| Squared Deviation from the Mean |  |  |  |  |  |  |  |  |

1. Write the squared deviations in the table.
2. Add up the squared deviations. What result do you get?
3. What is the value of *n* for this data set? Divide the sum of the squared deviations by $n – 1$, and write your answer below. Round your answer to the nearest thousandth.
4. Take the square root to find the standard deviation. Record your answer to the nearest hundredth.
5. How would you interpret the standard deviation that you found in Exercise 4? (Remember to give your answer in the context of this question. Interpret your answer to the nearest hundredth.)

Exercises 6–7

Jenna has bought a new hybrid car. Each week for a period seven weeks she has noted the fuel efficiency (in miles per gallon) of her car. The results are shown below.

45 44 43 44 45 44 43

1. Calculate the standard deviation of these results to the nearest hundredth. Be sure to show your work.
* Find the mean of the data set
* Calculate the deviations from the mean
* Square the deviations from the mean
* Add up the squared deviations
* Divide by n – 1 (if you are working with a data from a sample, which is the most common case)
* Take the square root
1. What is the meaning of the standard deviation you found in Exercise 6?

**Lesson Summary:**

* The standard deviation measures a typical deviation from the mean.
* The unit of the standard deviation is always the same as the unit of the original data set.
* The larger the standard deviation, the greater the spread (variability) of the data set.

Problem Set

1. A small car dealership has 12 sedan cars on its lot. The fuel efficiency (mpg) values of the cars are given in the table below. Complete the table as directed below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Fuel Efficiency (miles per gallon) | 29 | 35 | 24 | 25 | 21 | 21 | 18 | 28 | 31 | 26 | 26 | 22 |
| Deviation from the Mean |  |  |  |  |  |  |  |  |  |  |  |  |
| Squared Deviation from the Mean |  |  |  |  |  |  |  |  |  |  |  |  |

* 1. Calculate the mean fuel efficiency for these cars.
	2. Calculate the deviations from the mean, and write your answers in the second row of the table.
	3. Square the deviations from the mean, and write the squared deviations in the third row of the table.
	4. Find the sum of the squared deviations.
	5. What is the value of $n$ for this data set? Divide the sum of the squared deviations by $n – 1$.
	6. Take the square root of your answer to (e) to find the standard deviation of the fuel efficiencies of these cars. Round your answer to the nearest hundredth.
1. The same dealership has six SUVs on its lot. The fuel efficiencies (in miles per gallon) of these cars are shown below.

21 21 21 30 28 24

Calculate the mean and the standard deviation of these values. Be sure to show your work, and include a unit in your answer.

1. Consider the following questions regarding the cars described in questions 1 and 2.
	1. What was the standard deviation of the fuel efficiencies of the cars in Question (1)? Explain what this value tells you.
	2. You also calculated the standard deviation of the fuel efficiencies for the cars in Question (2). Which of the two data sets (Question (1) or Question (2)) has the larger standard deviation? What does this tell you about the two types of cars (sedans and SUVs)?

4. Solve the system of equations graphically and state the solution.

 y = -3x + 2

 3y – x = 6