Statistics Support Activity: Introduction to Standard Deviation

Notes about Standard Deviation (s) :

- The standard deviation is a measure of spread or variability the measures how far typical numbers in the data are from the mean average.

- The sample standard deviation is usually denoted by the letter "s".

- The standard deviation (s) is only accurate if the data is bell shaped (normally distributed).

- Do NOT use the standard deviation if the data has a skewed or non-normal shape.

- If the data is bell shaped (normally distributed), then typical values in the data will be within one standard deviation from the mean. Typical values will be between the sample mean minus the standard deviation $(\bar{x} - s)$ and the sample mean plus the standard deviation $(\bar{x} + s)$.

- Calculating standard deviation is very time consuming. It is best to use a statistics software to calculate it.

- To calculate standard deviation, we start by calculating the "sum of squares" of the differences between each number in the data set (x) and the mean average $(\bar{x})$. We take each number (x) and subtract the mean $(\bar{x})$ from them. Some of the differences come out positive and some come out negative. To deal with this, we square all the differences. This eliminates the negative numbers. Then we add up the squares ("sum of squares"). The square button on most calculators is x^2.

$$\text{Sum of Squares} = \sum(x - \bar{x})^2$$

- After calculating the sum of squares, we divide the sum of squares by the "Degrees of Freedom" (n – 1). Degrees of freedom for one quantitative data set is usually equal to one less than the sample size (n). *(The answer to this calculation is called the "Variance" of the data.)*

$$\frac{\sum(x - \bar{x})^2}{(n - 1)}$$

- Now we can calculate the standard deviation. We take the square root of the answer we got in the previous calculation. The square root button on most calculators is $\sqrt[2]{x}$ or $\sqrt{\ }$. If you use the calculator on your cell phone, you will need to open the calculator and then turn your phone sidewise to see the full calculator menu.

$$s = \sqrt{\left(\frac{\sum(x-\bar{x})^2}{(n-1)}\right)}$$

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Problems

1.

Look at the following dollar amounts spent on gas for one trip to the gas station. The sample mean average for this data is $\bar{x}$ = 74 dollars.

60 , 64, 66, 70, 72, 73, 79, 80, 85, 91

a) Fill out the following table. Subtract each number in the data minus the mean (74). Notice that for numbers below the mean (below 74), you will get a negative difference. For numbers above the mean (above 74), you will get a positive difference. If you add these negative and positive numbers what do you get? This is why we need to square the differences before adding (sum of squares).

#'s in data	# – 74	$(\# - 74)^2$
60		
64		
66		
70		
72		
73		
79		
80		
85		
91		
	Sum of Difference =	Sum of Squares =

b) How many numbers are in the data set? This is called the sample size (n).

n = ?

c) Calculate the degrees of freedom (df) by subtracting one from the sample size (n).

degrees of freedom = n – 1 = ?

d) Now divide the sum of squares in part (a) by the degrees of freedom in part (c). (This is called the "variance"). Keep as many decimal places as you can. It is always best not to round till the last calculation is done.

Variance = $\frac{\sum(x-\bar{x})^2}{(n-1)} = \frac{Sum\ of\ Squares}{Degrees\ of\ freedom}$ = ?

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e) Now we can calculate the standard deviation (s) by taking the square root of your answer in part (d). Round your answer to the tenths place (one place to the right of the decimal). Notice this is one place value to the right more than the original data.

Standard Deviation (s) = $\sqrt{\left(\frac{\sum(x-\bar{x})^2}{(n-1)}\right)}$ = ?

f) It is important to be able to explain statistics like standard deviation in sentence form. Fill out the blank in the following sentence to explain the standard deviation meaning. The first blank is the standard deviation and the second blank is the mean (74).

"Typical amounts of dollars spent at one visit to the gas station in our sample data are _____ dollars from the mean average of _____ dollars."

g) Another way to explain standard deviation is that typical values in the data will be between the sample mean minus the standard deviation $(\bar{x} - s)$ and the sample mean plus the standard deviation $(\bar{x} + s)$. Calculate these. Then fill in the blanks of the sentence. The first blank is $\bar{x} - s$ and the second blank is $\bar{x} + s$.

sample mean minus the standard deviation $(\bar{x} - s)$ = ?

sample mean plus the standard deviation $(\bar{x} + s)$ = ?

"Typical amounts of dollars spent at one visit to the gas station in our sample data are between _____ dollars and _____ dollars."