UNIT 6: BUSINESS DECISION MAKING

WEEK SIX

LECTURER: N. QUARRIE

Learning Outcome Two (2)

- LO2 Understand a range of techniques to analyse data effectively for business purposes

Objective

- By the end of this lesson you should be able to:

- 2.3 analyse data using measures of dispersion to
- inform a given business scenario

Overview

- Last week's session focused on how to use the results that are derived form the calculation of mean, mode etc to make conclusions. This week we want to look at how to calculate measures of dispersion and how to use the results from such a calculation to make valid conclusion within the context of the business being analysed.
- The measure of dispersion that we will focus on is standard deviation.

Standard Deviation

- According to (Mathsisfun.com, 2016) "The **Standard Deviation** is a measure of how spread out numbers are. Its symbol is σ (the greek letter sigma) The formula is easy: it is the square root of the Variance."

- Basically, the standard deviation tells how "far" each variable in the data set is from each other.

Standard Deviation: Formula for sample and population

(Taylor and Taylor, 2016)

For samples:

$$\text{variance} = s^2 = \frac{\Sigma(x-\bar{x})^2}{n-1}$$

$$\text{standard deviation} = s = \sqrt{s^2}$$

Calculating Formula

$$s^2 = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}$$

For populations:

$$\text{variance} = \sigma^2 = \frac{\Sigma(x-\bar{x})^2}{n}$$

$$\text{standard deviation} = \sigma = \sqrt{\sigma^2}$$

Calculating Formula

$$\sigma^2 = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n}$$

Steps for calculating sample standard deviation

Source: (Flylib.com, 2016)

- Step-by-step procedure
- STEP 1 First, collected scores are sequenced from the lowest to the highest score and placed into a table. See example Calculating the Standard Deviation—Test Scores.
- STEP 2 Calculate the mean and subtract from all scores.
- STEP 3 Check that the sum of - and + deviation scores (x) = 0.
- STEP 4 Square deviation scores and total.
- STEP 5 Calculate the variance (S2). Remember, use n-1 is total scores are less than 30.
- STEP 6 Take the square root of the variance to get the standard deviation.

Example: Calculating sample standard deviation

Training class test scores (10 students)
(100 possible points = 100%)

X	$-$	$\bar{X}$	$=$	x	x^2
60	−	82	=	−22	484
66	−	82	=	−16	256
67	−	82	=	−15	225
78	−	82	=	−4	16
82	−	82	=	0	0
84	−	82	=	+2	4
90	−	82	=	+8	64
95	−	82	=	+13	169
98	−	82	=	+16	256
100	−	82	=	+18	324
820				0	$\Sigma x^2 = 1798$

$$s = \sqrt{\frac{\Sigma(X - \bar{X})^2}{n - 1}}$$

$$s = \sqrt{\frac{1798}{9}} \quad (10 - 1)$$

$$s = \sqrt{199.77}$$

$$\boxed{s = 14.13}$$

The standard deviation = 14.13 for this data set of scores.

$$\bar{x} = \frac{\Sigma X}{n}$$

$$\bar{X} = 82$$

$$s^2 = \frac{\Sigma(X - \bar{X})^2}{n - 1}$$

$$s^2 = 1798$$

Note: For additional information, refer to tool 66, descriptive statistics, in this handbook.

Example: Population Standard deviation

Source: (Ci.columbia.edu, 2016)

Name	Tenure in years (x)
Rachel	2
John	15
Stacy	8
Bob	7
Mary	2

Example: Population Standard deviation

Source: (Ci.columbia.edu, 2016)

Note that you would need to calculate the mean first

$$\sigma_x^2 = \frac{\sum_{i=1}^{N}(x_i - \mu_x)^2}{N}$$

$$\sigma_x^2 = \frac{(2-6.8)^2 + (15-6.8)^2 + \ldots + (2-6.8)^2}{5}$$

$$= \frac{(-4.8)^2 + (8.2)^2 + \ldots + (-4.8)^2}{5}$$

$$= \frac{23.04 + 67.24 + \ldots + 23.04}{5}$$

$$= \frac{114.8}{5}$$

$$= 22.96$$

Interpreting Standard deviation

- According to (Set, 2016) “ a small standard deviation means that the values in a statistical data set are close to the mean of the data set, on average, and a large standard deviation means that the values in the data set are farther away from the mean, on average.”

- Example of interpretation:

Example of interpretation:

- According to (Set, 2016): “A small standard deviation can be a goal in certain situations where the results are restricted, for example, in product manufacturing and quality control. A particular type of car part that has to be 2 centimeters in diameter to fit properly had better not have a very big standard deviation during the manufacturing process. A big standard deviation in this case would mean that lots of parts end up in the trash because they don’t fit right; either that or the cars will have problems down the road.”

Example of interpretation:

- According to (Set, 2016): “in situations where you just observe and record data, a large standard deviation isn’t necessarily a bad thing; it just reflects a large amount of variation in the group that is being studied. For example, if you look at salaries for everyone in a certain company, including everyone from the student intern to the CEO, the standard deviation may be very large. On the other hand, if you narrow the group down by looking only at the student interns, the standard deviation is smaller, because the individuals within this group have salaries that are less variable. The second data set isn’t better, it’s just less variable.”

Videos

Interpreting Standard deviation:
https://www.youtube.com/watch?v=_hFrXUGgDf8

Calculating and Interpreting Standard Deviation; Computation and Interpretation:
https://www.youtube.com/watch?v=-_JI4_6LErI

Review Questions

1. Explain the steps that should be followed whenever you are calculating standard deviation.

2. Assume that you collected data from students regarding their age and that it is represented in the table below. Calculate the standard deviation.

X (age)
23
19
30
27
29
50

2b. Interpret the results from part "a"

References/Additional Reading List

1. Ci.columbia.edu, (2016). *PreMBA Analytical Methods*. [online] Available at: http://ci.columbia.edu/ci/premba_test/c0331/s7/s7_3.html [Accessed 5 Feb. 2016].
2. Flylib.com, (2016). *Tool 184: Standard Deviation - Six Sigma Tool Navigator: The Master Guide for Teams*. [online] Available at: http://flylib.com/books/en/2.890.1.270/1/ [Accessed 5 Feb. 2016].
3. Mathsisfun.com, (2016). *Standard Deviation and Variance*. [online] Available at: http://www.mathsisfun.com/data/standard-deviation.html [Accessed 5 Feb. 2016].

References/Additional Reading List

- 4. Set, H. (2016). *How to Interpret Standard Deviation in a Statistical Data Set - For Dummies*. [online] Dummies.com. Available at: http://www.dummies.com/how-to/content/how-to-interpret-standard-deviation-in-a-statistic.html [Accessed 5 Feb. 2016].

- 5. Taylor, C. and Taylor, C. (2016). *How to Calculate a Sample Standard Deviation*. [online] About.com Education. Available at: http://statistics.about.com/od/HelpandTutorials/a/How-To-Calculate-A-Standard-Deviation.htm [Accessed 5 Feb. 2016].