



جامعة المستقبل  
AL MUSTAQBAL UNIVERSITY

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قسم التقنيات الاحيائية

LECTURE: (3)

**Subject: Measures of Position**

**Level: First**

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Measures of Position

In addition to measures of central tendency and measures of variation, there are measures of position or location. These measures include:

- 1-standard scores.
- 2- percentiles.
- 3- deciles, and quartiles.

**z score or standard score:** it represents the number of standard deviations that a data value falls above or below the mean.

For samples, the formula is:  $z = (x - \bar{x})/s$   
For populations, the formula is:  $z = (x - \mu)/\sigma$

**Ex:** A student scored 65 on a calculus test that had a mean of 50 and a standard deviation of 10; she scored 30 on a history test with a mean of 25 and a standard deviation of 5. Compare her relative positions on the two tests.

**Sol:**  
 $z_1 = (x - \bar{x})/s = 65 - 50 / 10 = 1.5$   
 $z_2 = (x - \bar{x})/s = 30 - 25 / 5 = 1$

Since the z score for calculus is larger, her relative position in the calculus class is higher than her relative position in the history class.

\*\*\* Note that if the z score is positive, the score is above the mean. If the z score is 0, the score is the same as the mean. And if the z score is negative, the score is below the mean.

As the name implies, quartiles divide the data set into four equal parts. Therefore, the first quartile, Q<sub>1</sub>, is the 25<sup>th</sup> percentile, the second quartile, Q<sub>2</sub> is the 50<sup>th</sup> percentile (or the median), and the third quartile, Q<sub>3</sub>, is the 75<sup>th</sup> percentile. The difference between the third and first quartiles is interred quartile range (IQR).

$IQR = Q3 - Q1$

25% of data	25% of data	25% of data	25% of data
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Min. value    Q1    Q2    Q3    Max. value    median



**Ex:** The following are the ages of nine employees of an insurance company

47 28 39 51 33 37 59 24 33

- a- Find the values of three quartiles
- b- When does the age 28 fall in relation to the ages of these employees.
- c- Find the inter quartile range (IQR).

**Sol:**

Arrange the data in increasing order:

24, 28, 33, 33, 37, 39, 47, 51, 59

$Q_2$  is the median of all values  $\rightarrow Q_2 = 37$

$Q_1$  is the median of values ( 24, 28, 33, 33)  $\rightarrow Q_1 = (28 + 33)/2 = 30.5$ .

$Q_3$  is the median of values (39, 47, 51, 59)  $\rightarrow Q_3 = (47 + 51)/2 = 49$ .

- d- The age 28 fall in the first 25% of the ages.
- e- The inter quartile range ( $IQR$ )  $= Q_3 - Q_1 = 49 - 30.5 = 18.5$  years.

### **Percentiles:**

divide the data set into 100 equal groups. Each data set has 99 percentiles, data must be ranked in increasing order to compute percentiles. The  $k^{\text{th}}$  percentile is denoted by  $P_k$ , where  $k$  is an integer range from (1 –99). For example, the 25<sup>th</sup> percentile which is denoted by  $P_{25}$ , is defined to be that numerical value such that at most 25% of the values are smaller than it and at most 75% are larger than it in an ordered data set.

### **For ungrouped data,**

The percentile corresponding to a given value ( $x$ ) is computed by using the formula:

$$\text{Percentile} = \frac{\text{No.of values below } x+0.5}{\text{Total No.of values}} * 100$$

**Ex.** A teacher gives a 20-point test to 10 students. Find the percentile rank of a score of 12.  
Scores: 18, 15, 12, 6, 8, 2, 3, 5, 20, 10.

**Sol:**

Ordered set: 2, 3, 5, 6, 8, 10, 12, 15, 18, 20.

$$\text{Percentile} = \frac{\text{No. of values below } x+0.5}{\text{Total No. of values}} * 100$$

..... (H.W)

To Finding the value Corresponding to a Given Percentile:

- Let  $p$  be the percentile and  $n$  the sample size.
- Arrange the data in order.
- Compute  $c = (n \times p)/100$ .
- If  $c$  is not a whole number, round up to the next whole number. If  $c$  is a whole number, use the value halfway between  $c$  and  $c + 1$ .
- The value of  $c$  is the position value of the required percentile.

**Ex:** For the following data set: 2, 3, 5, 6, 8, 10, 12, 15, 18, 20. Find the values of the 25th and 80th percentile.

**Sol:**

a.  $n = 10, \quad p = 25 \quad c = (10 \times 25)/100 = 2.5.$

Hence round up to  $c = 3$ . Thus, the value of the 25th percentile is the value  $x = 5$ .

b.  $n = 10, \quad p = 80 \quad c = (10 \times 80)/100 = 8.$

Thus the value of the 80th percentile is the average of the 8th and 9th values.

$$x = (15 + 18)/2 = 16.5.$$

#### QUESTIONS:

- 1- Calculate the range for the following data set: 12, 5, 11, 9, 7, 4, 8
- 2- Mathematical law of sample variance is .....
- 3- The standard deviation divided by the mean is called  
a- Range                      b- standard score                      c- Coefficient of Variation
- 4- Mathematical law of Standard deviation is .....