Measures of Central Tendency:

Mean, Median, Mode

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Measures of Central Tendency

- Measure of central tendency provides a very convenient way of describing a set of scores with a single number that describes the PERFORMANCE of the group.

- It is also defined as a single value that is used to describe the "center" of the data.

- There are three commonly used measures of central tendency. These are the following:
  - MEAN
  - MEDIAN
  - MODE

MEAN

- It is the most commonly used measure of the center of data
- It is also referred as the "arithmetic average"

Sample Mean	Population Mean
$\bar{x} = \dfrac{\Sigma x}{n}$	$\mu = \dfrac{\Sigma x}{N}$

where Σx is sum of all data values

N is number of data items in population

n is number of data items in sample

MEAN

Example:

Scores of 15 students in Mathematics I quiz consist of 25 items. The highest score is 25 and the lowest score is 10. Here are the scores: 25, 20, 18, 18, 17, 15, 15, 15, 14, 14, 13, 12, 12, 10, 10. Find the mean in the following scores.

x (scores)	
25	**14**
20	**14**
18	**13**
18	**12**
17	**12**
15	**10**
15	**10**
15	

$$\bar{x} = \frac{\sum x}{n}$$

$$\bar{x} = \frac{228}{15}$$

$$= 15.2$$

MEAN

$$\bar{X} = 15.2$$

Analysis:

The average performance of 15 students who participated in mathematics quiz consisting of 25 items is 15.20. The implication of this is that student who got scores below 15.2 did not perform well in the said examination. Students who got scores higher than 15.2 performed well in the examination compared to the performance of the whole class.

MEAN

Example:

Find the Grade Point Average (GPA) of Paolo Adade for the first semester of the school year 2013-2014. Use the table below:

Subjects	Grade (X_i)	Units (w_i)	(X_i) (w_i)
BM 112	1.25	3	3.75
BM 101	1.00	3	3.00
AC 103	1.25	6	7.50
EC 111	1.00	3	3.00
MG 101	1.50	3	4.50
MK 101	1.25	3	3.75
FM 111	1.50	3	4.50
PE 2	1.00	2	2.00
		$\Sigma(w_i) = 26$	$\Sigma(X_i)w_i)=32.00$

MEAN

$$\bar{X} = \frac{\Sigma(X_i)w_i}{\Sigma(w_i)}$$

$$= \frac{32}{26}$$

$$= 1.23$$

The Grade Point Average of Paolo Adade for the first semester SY 2013-2014 Is 1.23.

MEAN

Mean for Grouped Data

Grouped data are the data or scores that are arranged in a frequency distribution.

Frequency distribution is the arrangement of scores according to category of classes including the frequency.

Frequency is the number of observations falling in a category.

MEAN

Steps in Solving Mean for Grouped Data

1. Find the midpoint or class mark (*M*) of each class or category using the formula $M = \frac{LL + LU}{2}$.
2. Multiply the frequency and the corresponding class mark $f\ M$.
3. Find the sum of the results in step
4. Solve the mean using the formula

a. Midpoint formula

b. Deviation formula

$$a.\quad \bar{x} = \frac{\sum fM}{n}$$

$$b.\quad \bar{x} = AM + \left(\frac{\sum fd}{n}\right)i$$

MEAN

Example:

Scores of 40 students in a science class consist of 60 items and they are tabulated below.

Class Interval	*f*	M	*f* M
10 – 14	5	12	60
15 – 19	2	17	34
20 – 24	3	22	66
25 – 29	5	27	135
30 – 34	2	32	64
35 – 39	9	37	333
40 – 44	6	42	252
45 – 49	3	47	141
50 – 54	5	52	260
	n = 40		Σ *f* M = 1 345

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

$$= \frac{1\,345}{40}$$

$$= 33.63$$

Class Interval	f	d	f d	M
10 – 14	5	-5	-25	12
15 – 19	2	-4	-8	17
20 – 24	3	-3	-9	22
25 – 29	5	-2	-10	27
30 – 34	2	-1	-2	32
35 – 39	9	0	0	37
40 – 44	6	1	6	42
45 – 49	3	2	6	47
50 – 54	5	3	15	52
	n = 40		Σ f d = -27	

$$\bar{x} = AM + \left(\frac{\sum fd}{n}\right) i$$

$$\bar{x} = 37 + \left(\frac{-27}{40}\right) 5$$

$$= 33.63$$

MEAN

Analysis:

The mean performance of 40 students in science quiz is 33.63. Those students who got scores below 33.63 did not perform well in the said examination while those students who got scores above 33.63 performed well.

MEAN

Properties of the Mean

- It measures stability. Mean is the most stable among other measures of central tendency because every score contributes to the value of the mean.
- The sum of each score's distance from the mean is zero.
- It may easily affected by the extreme scores.
- It can be applied to interval level of measurement.
- It may not be an actual score in the distribution.
- It is very easy to compute.

MEAN

When to Use the Mean

- Sampling stability is desired.
- Other measures are to be computed such as standard deviation, coefficient of variation and skewness.

MEDIAN

- Median is what divides the scores in the distribution into two equal parts.

- Fifty percent (50%) lies below the median value and 50% lies above the median value.

- It is also known as the middle score or the 50th percentile.

MEDIAN

Median of Ungrouped Data

1. Arrange the scores (from lowest to highest or highest to lowest).

2. Determine the middle most score in a distribution if *n* is an *odd number* and get the *average* of the two middle most scores if *n* is an *even number.*

Example 1: Find the median score of 7 students in an English class.

x (score)
19
17
16
<u>15</u>
10
5
2

MEDIAN

Example: Find the median score of 8 students in an English class.

x (score)
30
19
17
16
15
10
5
2

$$\tilde{x} = \frac{16+15}{2}$$

$$\tilde{x} = 15.5$$

MEDIAN

Median of Grouped Data

Formula:

$$\tilde{x} = ll + \left(\frac{\frac{n}{2} - cf <}{f\tilde{x}} \right) i$$

$ll \quad = exact\ lower\ limit$

$\frac{n}{2} \quad = 50\%\ of\ the\ frequencies$

$cf < = cumulative\ frequency\ below\ the\ median$

$i \quad = interval$

$f\tilde{x} \quad = frequency\ where\ the\ median\ lies$

MEDIAN

Steps in Solving Median for Grouped Data

1. Complete the table for cf<.

2. Get $\frac{n}{2}$ of the scores in the distribution so that you can identify MC.

3. Determine *ll*, $f\tilde{x}$, cf<, and *i* .

4. Solve the median using the formula.

MEDIAN

Example: Scores of 40 students in a science class consist of 60 items and they are tabulated below. The highest score is 54 and the lowest score is 10.

X	f	cf<
10 – 14	5	5
15 – 19	2	7
20 – 24	3	10
25 – 29	5	15
30 – 34	2	**17 (cfp)**
35 – 39	**9 (fm)**	26
40 – 44	6	32
45 – 49	3	35
50 – 54	5	40
	n = 40	

MEDIAN

Solution:

$$\tilde{x} = ll + \left(\frac{\frac{n}{2} - cf <}{f\tilde{x}} \right) i$$

$$\tilde{x} = 34.5 + \left(\frac{\frac{40}{2} - 17}{9} \right) 5$$

$$= \ 36.17$$

MEDIAN

Properties of the Median

- It may not be an actual observation in the data set.
- It can be applied in ordinal level.
- It is not affected by extreme values because median is a positional measure.

When to Use the Median

- The exact midpoint of the score distribution is desired.
- There are extreme scores in the distribution.

MODE

The *mode* or the *modal score* is a score or scores that occurred most in the distribution.

It is classified as unimodal, bimodal, trimodal or mulitimodal.

Unimodal is a distribution of scores that consists of only one mode.

Bimodal is a distribution of scores that consists of two modes.

Trimodal is a distribution of scores that consists of three modes or *multimodal* is a distribution of scores that consists of more than two modes.

MODE

The score that appeared most in Section A is 20, hence, the mode of Section A is *20.* There is only one mode, therefore, score distribution is called ***unimodal***.

The modes of Section B are *18* and *24,* since both 18 and 24 appeared twice. There are two modes in Section B, hence, the distribution is a ***bimodal distribution***.

The modes for Section C are *18, 21,* and *25.* There are three modes for Section C, therefore, it is called a ***trimodal*** or ***multimodal distribution.***

MODE

Example: Scores of 10 students in Section A, Section B and Section C.

Scores of Section A	Scores of Section B	Scores of Section C
25	25	25
24	24	25
24	24	25
20	20	22
20	18	21
20	18	21
16	17	21
12	10	18
10	9	18
7	7	18

MODE

Mode for Grouped Data

In solving the mode value in grouped data, use the formula:

$$\text{Mode} = \text{LB} + \left(\frac{d1}{d1+d2}\right)i$$

L_B= lower boundary of the modal class

Modal Class (MC) = is a category containing the highest frequency

d_1 = difference between the frequency of the modal class and the frequency above it, when the scores are arranged from lowest to highest.

d_2 = difference between the frequency of the modal class and the frequency below it, when the scores are arranged from lowest to highest.

c.i = size of the class interval

MODE

Example: Scores of 40 students in a science class consist of 60 items and they are tabulated below.

x	f
10 – 14	5
15 – 19	2
20 – 24	3
25 – 29	5
30 – 34	2
35 – 39	9
40 – 44	6
45 – 49	3
50 – 54	5
	n = 40

MODE

Modal Class = 35 –39

LL of MC = 35

L_B = 34.5

d_1 = 9 – 2 = 7

d_2 = 9 – 6 = 3

c.i = 5

$$\hat{X} = L_B + \frac{d_1}{d_1 + d_2} \times c.i$$

$$= 34.5 + \frac{7}{7 + 3} \times 5$$

$$= 34.5 + 35/10$$

$$\hat{X} = 38$$

The mode of the score distribution that consists of 40 students is 38, because 38 occurred several times.

MODE

Properties of the Mode

- It can be used when the data are qualitative as well as quantitative.
- It may not be unique.
- It is affected by extreme values.
- It may not exist.

When to Use the Mode

- When the "typical" value is desired.
- When the data set is measured on a nominal scale.


Thank
You