

# **LAB. METEOROLOGICAL STATISTICS ..... FOURTH STAGE**

**(First Semester)**

**Department of Atmospheric Sciences**

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Measures of Central Tendency:

A- *The arithmetic mean*: is defined as the ratio of the sum of values to their total number and is commonly used in many applications. The arithmetic mean falls under the so-called measures of central tendency, and the arithmetic mean is divided according to the type of data into two types:

Calculate the arithmetic mean of the ungrouped data:

**1- Calculation of the arithmetic mean for unclassified data(Direct method):**

$$\bar{x} = \frac{\sum X_i}{n} \dots\dots\dots (1)$$

*For example*\\ calculate The arithmetic mean of the following data?

$$X_i = 4,8,2,4,6,9,5,1$$

**First:** We write the values and then define the function to calculate the arithmetic mean

Mean = average (select the first cell : Select the last cell) then **enter**

Mean = 4.875 ..... Arithmetic mean

**\*Calculation of the arithmetic mean of the classified data :**

$$\bar{x} = \frac{\sum f_i X_i}{\sum f_i} \dots\dots\dots (2)$$

*For example*\\ calculate The arithmetic mean of the following data?

$X_i$	$f_i$
3	2
5	5
7	3
9	6
11	2
13	4
15	7
17	9

Solve\|

First Multiply numbers  $f_i x_i$  Then we calculate the sum, then calculate the sum of  $f_i$  Then we divide

$X_i$	$f_i$	$X_i f_i$
3	2	6
5	5	25
7	3	21
9	6	54
11	2	22
13	4	52
15	7	105
17	9	153
	$\sum f_i=38$	$\sum x_i f_i=435$

$$\text{mean} = \frac{\sum f_i X_i}{\sum f_i} = \frac{438}{38} = 11.526$$

2- Calculating the arithmetic mean for unclassified data (the indirect method)

$$\bar{x} = A + \frac{\sum u_i}{n} \quad \text{whereas} \quad u_i = X_i - A \quad n = \text{Data number}$$

A : default element (any number)

$X_i$	$A$	$u_i = (X_i - A)$
4	4	0
8	4	4
2	4	-2
4	4	0
6	4	2
9	4	5
5	4	1
1	4	-3

$$\bar{x} = 4 + \frac{\sum u_i}{8}$$

**H.W\**

**1- Calculate the arithmetic mean, the monthly averages of the values of rain falling on the city of Baghdad for the year 2007**

jan	Feb	Mar	Apr	Nov	Der
60	112	75	129	88	101
62	68	89	85	75	60
116	83	85	127	127	80
68	65	99	78	68	92
100	60	78	97	83	91
85	104	98	88	77	97
92	78	62	60	85	62
68	97	63	80	61	63

**2- calculate The arithmetic mean of the following data?**

Class	Fi
31-40	1
41-50	2
51-60	5
61-70	15
71-80	25

B- **Median**: It is known in mathematics or statistics, and it is one of the measures of central tendency, which is the middle numerical value. It separates the higher value from the sample or the population from the lower half so that the number of values on its side is equal after being arranged in ascending or descending order.

The methods of calculating the median differ according to the different values whose median is to be known. The odd numerical values differ from the even ones. To know the method of calculating it, we must

### 1-Calculation of the median for Unclassified data odd numbers

*For example* \\ calculate the median of the following data?

[ 5,6,9,2,1 ]

*Solve* \\

- Arrange in ascending or descending order [1,2,5,6,9 ]

- Because the values are individual, we choose the median value, which represents the **median =5**

### 2-Calculation of the median for Unclassified even numbers

*For example* \\ calculate the median of the following data?

53	47	49	53	52	50
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*Solve* \\

- Arrange in ascending or descending order

53	53	52	50	49	47
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-To find the median of the even values, by finding the average of the two average values, i.e.

$$(50+52)\div 2= 51 \longrightarrow \text{Median}=51$$

**3-Calculating the median for the classified data:** to find the median for the classified values, we apply the following equation:

$$\text{Median} = L1 + \left( \frac{\frac{N}{2} - F}{f_{\text{median}}} \right) * c$$

**Whereas:** L1= Minimum middle class, N= Total repetitions, C= Category length

$\frac{N}{2}$  = The value that falls within or below it and rounds up the result

F = Cumulative pre-intermediate class frequency

F= Cumulative mean class frequency

**For example** \\ Calculate the median for the following data:

**Solve** \\

<u>Class</u>	<u>frequency</u>	<u>cumulative f</u>
20-29	6	6
30 – 39	8	14
40 – 49	12	26
50 – 59	10	36
60- 69	14	50

$\sum f = n = 50 \longrightarrow \frac{N}{2} = \frac{50}{2} = 25$

C =Category length  $\longrightarrow$  C= 10; mediator class=(40-49)  $\longrightarrow$  L1=40; F=14;

f (median)=12

**Median = L1 +  $\left( \frac{\frac{N}{2} - F}{f_{\text{median}}} \right) * c$**   $\longrightarrow$  = 40+  $\left( \frac{25-14}{12} \right) * 10$   $\longrightarrow$  =40+9.17  $\longrightarrow$

med=49.17

*For example* \\ Calculate the median for the following data:

*Solve* \\

<u>Class</u>	<u>frequency</u>	<u>cumulative f</u>
50-59	3	3
60-69	7	10
70-79	18	28
80-89	12	40
90-99	8	48
100-109	2	50

$$\sum f = n = 50$$

$$N/2 = 50/2 = 25$$

$$L1 = 70; F = 10; f = 18; C = 10$$

$$\text{Median} = L1 + \left( \frac{\frac{N}{2} - F}{f_{\text{median}}} \right) * c \implies = 40 + \left( \frac{25 - 10}{18} \right) * 10 \implies = 40 + 8.33 \implies$$

med = 48.17

H.W \\

1- If you know that the city of Baghdad recorded the highest monthly average temperatures during the past year (33,20,54,56,50,48,58,28,50,31,24,19). Calculate the median value of the temperature data.

2- Calculate the median for the data listed in the table below:

<u>Class</u>	<u>frequency</u>
120 - 129	5
130 - 139	7
140 - 149	10
150 - 159	8
160 - 169	6
170 - 179	4

**Mode :** Mode is one of the measures of central tendency of data analysis in statistics, which are values by which the central value of a set of data can be described. The central value of a set of data, where the mode is expressed by the number of repeats in the data set, and it depends mainly on the frequency in the sample.

**1- Calculation of the Mode for unclassified data:**

It is the value that is described as the greatest frequency.

**For example \\ calculate The mode of the following data?**

(5,2,5,10,2,2)      Mode = 2

**2- Calculation of the mode of the classified data:**

$$\text{Mode} = L_1 + \left( \frac{d_1}{d_1 + d_2} \right) * C$$

Whereas:

L1= Minimum modal class ,C= Category length

$d_1$  = It is the result of subtracting the frequency of the modal class from the frequency of the class before it

$d_2$  = It is the result of subtracting the frequency of the modal class from the frequency of the class after it

Class	f
150 – 159	8
160 – 169	12
170 – 179	15
180 – 189	9
190 – 199	6

← The modal class has the highest frequency

**L = 170 ,d1= 15-12 ,d2= 15 – 9 , C = 10**  
**Mode = 173.33**

**H.W\****1- Calculate the mode for the weights of the following a group of rice sacks:**

<b>the weight (kg)</b>	<b>number of bags</b>
<b>45</b>	<b>8</b>
<b>50</b>	<b>11</b>
<b>55</b>	<b>7</b>
<b>60</b>	<b>10</b>
<b>65</b>	<b>12</b>
<b>70</b>	<b>9</b>
<b>75</b>	<b>8</b>

**2- Calculate the measures of central tendency (mean, median, mode) for the following data?**

<b>Class</b>	<b>f</b>
<b>60-62</b>	<b>5</b>
<b>63-65</b>	<b>15</b>
<b>66-68</b>	<b>45</b>
<b>69-71</b>	<b>27</b>
<b>72-74</b>	<b>8</b>