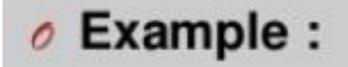# BIOSTATISTICS - UNIT - II
MEASURES OF CENTRAL TENDENCY – MEAN, MEDIAN AND MODE

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- The mean (average) of a data set is found by adding all numbers in the data set and then dividing by the number of values in the set.
- The median is the middle value when a data set is ordered from least to greatest.
- The mode is the number that occurs most often in a data set.

mean: regular meaning of "average"

median: middle value

mode: most often

o **Example :**

o Data Set = 2, 5, 9, 3, 5, 4, 7

o Number of Elements in Data Set = 7

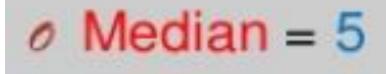o Mean = (2 + 5 + 9 + 7 + 5 + 4 + 3) / 7 = 5

o **Median :** (middle)

o The "Median" of a data set is dependent on whether the number of elements in the data set is odd or even.

o First reorder the data set from the smallest to the largest

o Mark off high and low values until you reach the **middle**.

o If there 2 middles, add them and **divide** by 2.

o **Examples : Odd Number of Elements**

o Data Set = 2, 5, 9, 3, 5, 4, 7

o Reordered = 2, 3, 4, 5, 5, 7, 9

          ^

o Median = 5

o **Examples : Even Number of Elements**

o Data Set = 2, 5, 9, 3, 5, 4

o Reordered = 2, 3, 4, 5, 5, 9

                             ^ ^

Median = (4 + 5) / 2 = 4.5

o **Mode : (most often)**

o The "Mode" for a data set is the element that occurs the most often.

o It is not uncommon for a data set to have more than one mode.

o This happens when two or more elements occur with equal frequency in the data set.

o **Example :**

o Data Set = 2, 5, 9, 3, 5, 4, 7

o Mode = 5

o **Example:**

o Data Set = 2, 5, 2, 3, 5, 4, 7

o Modes = 2 and 5

- **Range :**

- The "Range" for a data set is the difference between the largest value and smallest value contained in the data set.

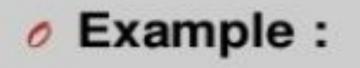- First **reorder** the data set from smallest to largest then **subtract** the first element from the last element.

Examples :

o Data Set = 2, 5, 9, 3, 5, 4, 7

o Reordered = 2, 3, 4, 5, 5, 7, 9

o Range = (9 - 2) = 7

MEAN

o **Example :**

o Data Set = 2, 5, 9, 3, 5, 4, 7

o Number of Elements in Data Set = 7

o Mean = (2 + 5 + 9 + 7 + 5 + 4 + 3) / 7 = 5

MEDIAN

o **Examples : Odd Number of Elements**

o Data Set = 2, 5, 9, 3, 5, 4, 7

o Reordered = 2, 3, 4, 5, 5, 7, 9
               ^

o Median = 5

MEDIAN

o **Examples : Even Number of Elements**

o Data Set = 2, 5, 9, 3, 5, 4

o Reordered = 2, 3, 4, 5, 5, 9
                      ^ ^

   Median = (4 + 5) / 2 = 4.5

MODE

o **Example :**

o Data Set = 2, 5, 9, 3, 5, 4, 7

o Mode = 5

o **Example:**

o Data Set = 2, 5, 2, 3, 5, 4, 7

o Modes = 2 and 5

RANGE

Examples :

- Data Set = 2, 5, 9, 3, 5, 4, 7

- Reordered = 2, 3, 4, 5, 5, 7, 9

- Range = (9 - 2) = 7

- **Find the mean, median, mode, and range for the following list of values:**

    13, 18, 13, 14, 13, 16, 14, 21, 13

The mean is the usual average, so I'll add and then divide:

$(13 + 18 + 13 + 14 + 13 + 16 + 14 + 21 + 13) \div 9 = 15$

Note that the mean, in this case, isn't a value from the original list. This is a common result. You should not assume that your mean will be one of your original numbers.

The median is the middle value, so first I'll have to rewrite the list in numerical order:

13, 13, 13, 13, 14, 14, 16, 18, 21

There are nine numbers in the list, so the middle one will be the $(9 + 1) \div 2 = 10 \div 2 = 5$th number:

13, 13, 13, 13, 14, 14, 16, 18, 21

So the median is 14.

The mode is the number that is repeated more often than any other, so 13 is the mode.

The largest value in the list is 21, and the smallest is 13, so the range is $21 - 13 = 8$.

    mean: 15

    median: 14

    mode: 13

    range: 8

Note: The formula for the place to find the median is "([the number of data points] + 1) ÷ 2", but you don't have to use this formula. You can just count in from both ends of the list until you meet in the middle, if you prefer, especially if your list is short.

- **Find the mean, median, mode, and range for the following list of values:**

  1, 2, 4, 7

  The mean is the usual average:

  $(1 + 2 + 4 + 7) \div 4 = 14 \div 4 = 3.5$

  The median is the middle number. In this example, the numbers are already listed in numerical order, so I don't have to rewrite the list. But there is no "middle" number, because there are an even number of numbers. Because of this, the median of the list will be the mean (that is, the usual average) of the middle two values within the list. The middle two numbers are 2 and 4, so:

  $(2 + 4) \div 2 = 6 \div 2 = 3$

  So the median of this list is 3, a value that isn't in the list at all.

The mode is the number that is repeated most often, but all the numbers in this list appear only once, so there is no mode.

The largest value in the list is 7, the smallest is 1, and their difference is 6, so the range is 6.

mean: 3.5

median: 3

mode: none

range: 6

The values in the list above were all whole numbers, but the mean of the list was a decimal value. Getting a decimal value for the mean (or for the median, if you have an even number of data points) is perfectly okay; don't round your answers to try to match the format of the other numbers.

- **Find the mean, median, mode, and range for the following list of values:**

  8, 9, 10, 10, 10, 11, 11, 11, 12, 13

The mean is the usual average, so I'll add up and then divide:

$(8 + 9 + 10 + 10 + 10 + 11 + 11 + 11 + 12 + 13) \div 10 = 105 \div 10 = 10.5$

The median is the middle value. In a list of ten values, that will be the $(10 + 1) \div 2$ = 5.5-th value; the formula is reminding me, with that "point-five", that I'll need to average the fifth and sixth numbers to find the median. The fifth and sixth numbers are the last 10 and the first 11, so:

$(10 + 11) \div 2 = 21 \div 2 = 10.5$

The mode is the number repeated most often. This list has two values that are repeated three times; namely, 10 and 11, each repeated three times.

The largest value is 13 and the smallest is 8, so the range is 13 – 8 = 5.

mean: 10.5

median: 10.5

modes: 10 and 11

range: 5

As you can see, it is possible for two of the averages (the mean and the median, in this case) to have the same value. But this is *not* usual, and you should *not* expect it.