ST. LAWRENCE HIGH SCHOOL
A JESUIT CHRISTIAN MINORITY INSTITUTION

STUDY MATERIAL-8

SUBJECT – STATISTICS

First term

Chapter: Central tendency   Class: XI

Topic: Median   Date: 13.07.2020

CENTRAL TENDENCY

PART 4

Median is defined as the middle most value of a set of observations when arranged in monotonic order.

Case 1: Discrete raw data.

Observations: $x_1 , x_2 , \ldots \ldots \ldots \ldots , x_n$

Type 1: When the number of observations is odd. Take n= 2m + 1.

The median $\tilde{x} = x_{(2m+1)}$

Type 2: When the number of observations is even. Take n= 2m.

The median $\tilde{x} = \frac{1}{2} (x_{(m)} + x_{(m+1)})$

Case 2: Discrete grouped data.

Observations: $x_1 , x_2 , \ldots \ldots \ldots \ldots , x_n$

Frequency: $f_1 , f_2 , \ldots \ldots . \ldots \ldots , f_n$

➢ Step 1: Calculate the cumulative frequencies of the observations.
➢ Step 2: Check from which cumulative frequency $\frac{N}{2}$ is just smaller.
➢ Step 3: The corresponding observation of the cumulative frequency found in step 2 , is the median.

If in step 2, the value of $\frac{N}{2}$ becomes equal to any cumulative frequency, the the average of the corresponding observation and the next observation will be the median.

Case 3: Continuous grouped data

Define:

x_l : lower class boundary of median class

x_u : upper class boundary of median class

F_{-1}: Cummulative frequency(less than type) of the preceding class

F_0: Cummulative frequency (less than type) of the media class

F_1: Cummulative frequency (less than type) of the next class

F'_{-1}: Cummulative frequency(more than type) of the preceding class

F'_0: Cummulative frequency(more than type) of the median class

F'_{-1}: Cummulative frequency(more than type) of the next class

c_0 : width of the class

N: total frequency

<u>Type 1</u> (using less than type cumulative frequency)

- ➢ Step 1: Observations to be expressed in class boundaries and frequencies.
- ➢ Step 2: Calculate the cumulative frequencies of the classes.
- ➢ Step 3: Check from which cumulative frequency $\frac{N}{2}$ is just smaller.
- ➢ Step 4: The corresponding class is known as median class.

$$\tilde{x} = x_l + \frac{\frac{N}{2} - F_{-1}}{f_0} \, c_0$$

$$\tilde{x} = x_u - \frac{F_0 - \frac{N}{2}}{f_0} \, c_0$$

Type 2 (using greater than type cumulative frequency)

- ➢ Step 1: Observations to be expressed in class boundaries and frequencies.
- ➢ Step 2: Calculate the cumulative frequencies of the classes.
- ➢ Step 3: Check from which cumulative frequency $\frac{N}{2}$ is just smaller.
- ➢ Step 4: The corresponding class is known as median class.

$$\tilde{x} = x_l + \frac{F'_0 - \frac{N}{2}}{f_0} \, c_0$$

$$\tilde{x} = x_u - \frac{\frac{N}{2} - F'_1}{f_0} \, c_0$$

Property:

Change of base or origin and scale

If $y_i = a + b \, x_i$, then $\tilde{y} = a + b \, \tilde{x} \; \forall \, i = 1(1)n$

Proof:

By definition $\tilde{y} = y_l + \frac{\frac{N}{2} - F_{-1}}{f_0} \, (y_u - y_l)$

$$= a + bx_l + \frac{\frac{N}{2} - F_{-1}}{f_0} \, (a + bx_u - a - b \, x_l)$$

$$= a + b\{ x_l + \frac{\frac{N}{2} - F_{-1}}{f_0} \, (x_u - x_l)$$

$$= a + b\,\tilde{x}$$

Uses: Median is being used as a measure of central tendency when

- ✓ atleast one of the extreme class is open
- ✓ presence of an outlier.

Prepared by

Sanjay Bhattacharya