Aloha International Journal of Multidisciplinary Advancement (AIJMU)
ISSN 2622-3252
Volume 3 Number 4, April 2021
http://journal.aloha.academy/index.php/aijmu
RESEARCH
DOI: http://dx.doi.org/10.33846/aijmu30403

Relationships between Mean, Median and Mode

Sri Rejeki Dwi Putranti[1] (corresponding author)
[1]Faculty of Engineering, Universitas Yos Soedarso Surabaya, Indonesia; dwiputranti626@gmail.com

Submitted: March 30, 2021 - Revised: April 15, 2021 - Accepted: April 17, 2021 - Published: April 30, 2021

ABSTRACT

Statistics as an analysis technique can not only be used to make descriptions, but also to make estimates and generalizations. To be able to know and deepen knowledge about statistics, knowledge of research methodology must be possessed. In this study will discuss the arithmetic mean, median and mode for single data and group data, and the related relationship between arithmetic mean, median and mode. So it will be proved that the mode plus the average of the count is equal to three times the median.
Keywords: mean; median; mode

INTRODUCTION

Background

In this twenty-first century, statistics have experienced a fairly rapid development. Almost all branches of science have participated in using statistics. Statistics is an auxiliary science, all kinds of research in this century are carried out in order to develop science, statistics can play an important role. The position of statistics in science, statistics can be a vital tool that can provide descriptions, symptoms, estimate events, and can provide control over conditions. Statistics is a branch of mathematics, namely the science of data collection, data testing, analysis and drawing conclusions.

Basically, statistics are the results of processing data which are numbers that are easier to understand, generally arranged in diagrams. In order to develop knowledge, research activities are very vital activities. Through this research activity it is possible to make estimates and generalizations. Meanwhile, statistics as one of the analytical techniques in research are able to carry out the above tasks, namely making estimates and generalizations.

Literature Review

According to Djarwanto [(1)], one of the main requirements of a good sample is that the sample must contain or represent population characteristics. In other terms, it is said that a good sample is a sample that is representative or that reflects the population. In studies, people often do not examine all individuals or all existing objects. Due to technical reasons, for example, there are limitations in the field of cost, energy and time, then one only examines part of the object. Even in many cases, researching all objects can be an inefficient measure.

According to Budiyuwono [(2)], the arithmetic mean for a single data is the sum of all sizes divided by the number of sizes, formulated by:

$$\bar{x} = \sum_{i=1}^{n} x_i$$

$\bar{x}$ = average count
x = data
n = lots of data

For group data, it is formulated by:

$$\bar{x} = \frac{\sum_{i=1}^{n} fi\ xi}{\sum_{i=1}^{n} fi}$$

Average using the mean while for the data, is formulated by:

$$\bar{x} = x_s + \frac{\sum_{i=1}^{n} di}{n}$$

di = $x_i - x_s$
$\bar{x}$ = average count
x_s = mean while
d_i = deviation
n = lots of data

For group data, it is formulated by:

$$\bar{x} = x_s + \frac{\sum_{i=1}^{n} f_i\ di}{\sum_{i=1}^{n} f_i}$$

Aloha International Journal of Multidisciplinary Advancement (AIJMU)
ISSN 2622-3252
Volume 3 Number 4, April 2021
http://journal.aloha.academy/index.php/aijmu
RESEARCH
DOI: http://dx.doi.org/10.33846/aijmu30403

According to Supranto [3], the size of concentration for the quartile:
Quartiles for single data

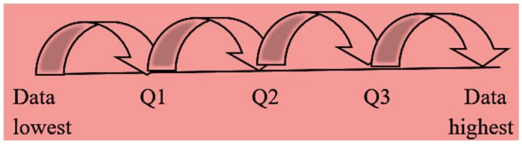


Figure 1. Quartiles for single data

Initially determine:
Q_2 = second quartile (median), then
Q_1 = first quartile (bottom), and
Q_3 = third quartile (top)
Quartiles for group data

$$Q_1 = Tb + \left(\frac{\frac{1}{4}n - fk}{fQ_1}\right).i$$

$$Q_2 = Tb + \left(\frac{\frac{1}{2}n - fk}{fQ_2}\right).i$$

$$Q_3 = Tb + \left(\frac{\frac{3}{4}n - fk}{fQ_3}\right).i$$

For group data, the median (M_e) is written:

$$M_e = Q_2 = Tb + \left(\frac{\frac{1}{2}n - fk}{fM_e}\right)$$

Information: M_e = median
n = lots of data
fk = cumulative frequency
fM_e = median class frequency
i = the length of the interval class

According to Dajan [4], mode is the data that appears the most or data that has the highest requency of a data group.

There are several mode:

a. Single mode is from a data group that has only one data high frequency, called the "capital union".
b. Double mode is from a group of data having two data frequencies high, called "bi capital"
c. Multi-mode is from a group of data that has more than two modes, called "multimodal"

For group data, it is formulated by:

$$M_0 = Tb + \left(\frac{d_1}{d_1 + d_2}\right).i$$

M_0 = Mode
Tb = Bottom edge of mode class
d_1 = Difference in mode class frequency with the previous frequency
d_2 = Difference in mode class frequency with the frequency afterward
i = the length of the interval class

According to Sudjana [5], data presentation can be illustrated by diagrams.
Several kinds of diagrams, namely:

a. Line Chart
Line diagram to show the progress of a continuous event, for example, the height of a growing tree, the weight of a baby after give birth.

Give birth. Age in months	0	1	2	3	4	5	6	7	8
Weight in kg	3	3.4	4	4.5	5	5.4	5.8	6.2	6.5

Aloha International Journal of Multidisciplinary Advancement (AIJMU)
ISSN 2622-3252
Volume 3 Number 4, April 2021
http://journal.aloha.academy/index.php/aijmu
RESEARCH
DOI: http://dx.doi.org/10.33846/aijmu30403

Figure 2. Line diagram

b. Bar Diagram

Type of school	Number of schools
Elementary	10
Secondary	6
High school	4

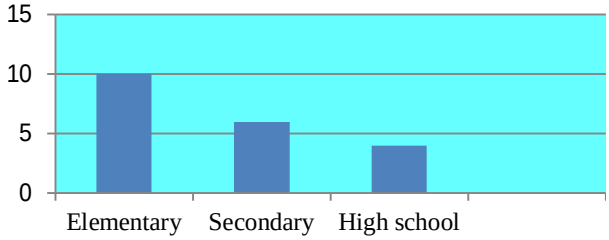


Figure 3. Bar diagram

c. Pie Chart

To show a comparison of the number of activities, many products are generated etc., within a certain period of time can be described with a pie chart.

Profession	Total
Civil Servant	100
Soldier	50
Private	250
Entrepreneur	300
Famers	250
Miscellaneous	250

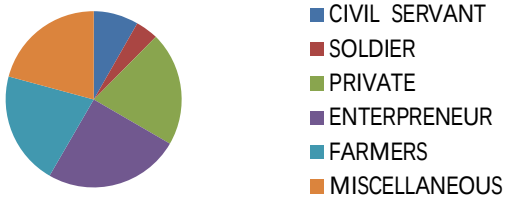


Figure 4. Pie diagram

METHODS

Use of Statistics

1. In the Research Field to be able to know and deepen knowledge about statistics, knowledge about research methodology must be mastered as well. Therefore, the systematics and presentation methods are made in such a way form, so it is very easy to be implemented by everyone inside conduct research.
2. In Economics and Management.

Aloha International Journal of Multidisciplinary Advancement (AIJMU)
ISSN 2622-3252
Volume 3 Number 4, April 2021
RESEARCH
http://journal.aloha.academy/index.php/aijmu DOI: http://dx.doi.org/10.33846/aijmu30403

a. To establish company policies in the production sector by looking at the relationship between wages and the amount of production.
b. To define a company based marketing strategy the relationship between promotional costs and sales turnover.
c. To establish company management activities.

Presentation of Data in Table

1. Group data frequency distribution table
   If the number of data is more than or equal to 30 ($n \geq 30$), then the data these can be presented in groups.
   The steps for creating a frequency distribution table are:
   a. Determine the range
      Range is the difference between the largest data and the smallest data.
   b. Determine the number of class intervals (k)
      Can use rules:

      $$k = 1 + 3.3 \log n$$

      k = the number of class intervals
      n = a lot of power
   c. Determine the length of the class interval (i)

      $$i = \frac{\text{Range}}{\text{Number of class intervals}}$$

      $$i = \frac{R}{k}$$

2. Histogram and polygon frequency
   a. Histogram
      The histogram is a picture (graph) of the frequency distribution of the data is organized in interval classes. If the class length is a the intervals are equal, which is a rectangle with the same basis with the length of the class, while the height is the same as the frequency from each class.
   b. Polygon Frequency
      The frequency polygon is the line connecting the midpoints of each box is distributed over on the histogram.
3. Ogive
   Ogive is a curve connecting the cumulative frequency values is called the cumulative frequency curve.
   There are 2 kinds of ogive, namely:
   a. Positive Ogives
      Positive ogives are made based on cumulative frequency distribution data " less than".
   b. Negative Ogive
      Negative ogives are created based on the data of the “over” frequency distribution.

The Relationship Between Calculated Mean, Median and Mode

The calculated average, median and mode values have a related relationship, namely:
1. If mean = median = mode, the shape of the curve will be normal

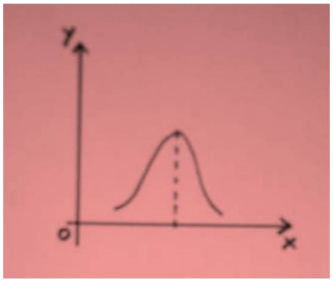


Figure 5. Mean = median = mode

2. If the mean ≠ median ≠ mode, the shape of the curve may be positive or negative.

Aloha International Journal of Multidisciplinary Advancement (AIJMU)
ISSN 2622-3252
Volume 3 Number 4, April 2021
http://journal.aloha.academy/index.php/aijmu
RESEARCH
DOI: http://dx.doi.org/10.33846/aijmu30403

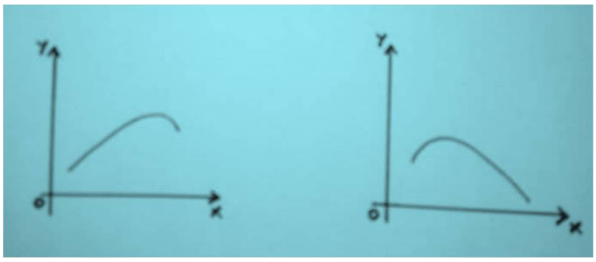


Figure 6. Mean ≠ median ≠ mode

ANALYSIS AND DISCUSSION

The data on the scores of mathematics tests from 100 high school students in Surabaya, Indonesia are as follows:

94 83 68 52 48 100 85 77 72 34
31 40 46 51 41 93 91 70 65 66
61 73 71 44 50 90 100 98 52 45
82 72 78 86 81 61 69 67 43 38
36 33 95 83 63 63 54 97 88 82
47 55 76 75 62 84 78 80 64 68
66 53 75 64 57 66 56 72 85 74
42 96 64 68 53 70 54 82 77 92
53 59 68 72 86 38 61 79 67 65
64 75 90 84 35 42 68 60 54 58

The steps to create a frequency distribution table are:

1. Finding range
   R = 100 - 31 = 69
2. Determine the number of class intervals (k)
   k = 1 + 3.3 log n = 1 + 3.3 log 100 = 7
3. Determine the length of the class interval (i)
   I = R / k = 69 / 7.6 = 10 (rounded)

The distribution table of the frequency distribution of the math test scores of 100 students in Surabaya Indonesia.

Score	Frequency
31- 40	8
41 - 50	10
51 - 60	15
61 - 70	25
71 - 80	17
81 - 90	15
91- 100	10

$$Q_1 = Tb + \left(\frac{\frac{1}{4}n - fk}{fQ_1}\right) \text{ i}$$

$$= 50.5 + \left(\frac{\frac{1}{4}.100 - 18}{15}\right) . 10$$

$$= 50.5 + 4{,}7$$

$$= 55.2$$

$$Q_2 = \text{Tb} + \left(\frac{\frac{1}{2}n - fk}{fQ_2}\right) . i$$

$$= 60.5 + \left(\frac{\frac{1}{2}.100 - 33}{17}\right) . 10$$

$$= 60.5 + 10$$

$$= 70.5$$

Aloha International Journal of Multidisciplinary Advancement (AIJMU)
ISSN 2622-3252
Volume 3 Number 4, April 2021
http://journal.aloha.academy/index.php/aijmu
RESEARCH
DOI: http://dx.doi.org/10.33846/aijmu30403

Q_3= Tb + $(\frac{\frac{3}{4}n-fk}{fQ_3})\,.\,i$

= 70.5 + $(\frac{\frac{3}{4}.100-58}{17})\,.\,10$

= 70.5 + 10

= 80.5

LIST

SCORE	x_i	f_i	d_i	$f_i\,.\,d_i$
31- 40	35.5	8	-40	- 320
41- 50	45.5	10	-30	- 300
51- 60	55.5	15	-20	- 300
61-70	65.5	25	-10	- 250
71- 80	75.5	17	0	0
81- 90	85.5	15	10	150
91-100	95.5	10	20	200
		$\sum f_i$ = 100		$\sum f_i\,.\,d_{i=-220}$

Mean = $\bar{x} = x_s + \frac{\sum_{i=1}^{n} f_i\,.d_i}{\sum_{i=1}^{n} f_i}$

= 75.5 + $(\frac{-820}{100})$

= 75.5 – 8.2

= 67.3

d_1= 25 – 15 = 10

d_2 = 25 – 17 = 8

$M_o = Tb + \left(\frac{d_i}{d_1+d_2}\right).i$

= 70.5 + $(\frac{10}{10+8})$.10

= 70.5 + 5.6

= 76.1

Histogram and Frequency Polygon

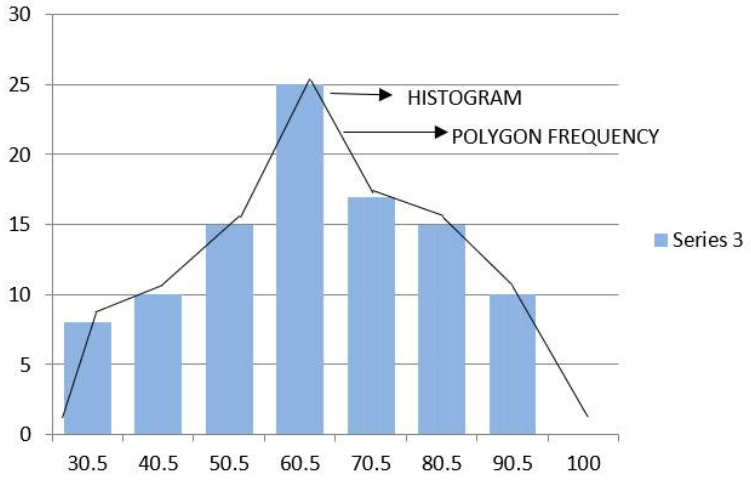


Figure 7. Histogram and polygon

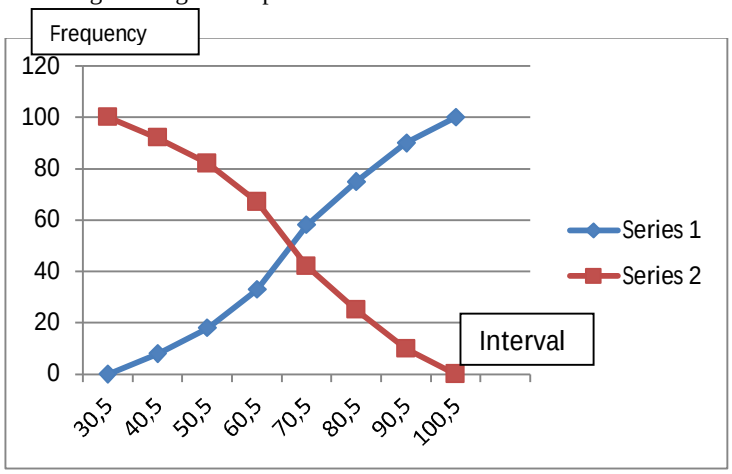
Aloha International Journal of Multidisciplinary Advancement (AIJMU)
ISSN 2622-3252
Volume 3 Number 4, April 2021
http://journal.aloha.academy/index.php/aijmu
RESEARCH
DOI: http://dx.doi.org/10.33846/aijmu30403

The "less than" Cumulative Frequency Distribution Table and Frequency

Cumulative "more than"

Interval	Cumulative frequency intervals less than		Cumulative frequency more than	
	≤ 30,5	0	≥ 30,5	100
31 - 40	≤ 40,5	8	≥ 40,5	98
41 - 50	≤ 50,5	18	≥ 50,5	82
51 - 60	≤ 60,5	33	≥ 60,5	67
61 - 70	≤ 70,5	58	≥ 70,5	42
71 - 80	≤ 80,5	75	≥ 80,5	25
81 - 90	≤ 90,5	90	≥ 90,5	10
91 - 100	≤ 100,5	`100	≥ 100,5	0

Positive Ogive and Negative Ogive Graphs



Information: Blue = Cumulative Frequency more than
Brown = Cumulative Frequency Intervals less than

Figure 7. Positive ogive and negative ogive graphs

Relationship between calculated mean, median and mode from the results of the above calculations there are:

$\bar{x}$ = 67,3
M_0= 76,1
M_e = 70,5
$\bar{x}$ - M_0 = 67,3 - 76,1 = - 8,8
$\bar{x}$ - M_e = 67,5 - 70,5 = - 3,4
$\bar{x}$ - M_0 = 3 ($\bar{x}$ − M_e)
$\bar{x}$ − 3$\bar{x}$ - M_0 = - 3M_e
− 2$\bar{x}$ − M_0 = −3M_e
M_0 + 2$\bar{x}$ = 3M_e

So from the conclusion above, the relationship applies:
M_0 + 2$\bar{x}$ = 3M_e

⟺ Modus + 2 Mean = 3 Median

Thus it is evident, that mode + 2 means = 3 median

Aloha International Journal of Multidisciplinary Advancement (AIJMU)
ISSN 2622-3252
Volume 3 Number 4, April 2021
RESEARCH
http://journal.aloha.academy/index.php/aijmu DOI: http://dx.doi.org/10.33846/aijmu30403

CONCLUSION

If the mean = median = mode, then the curve is normal, if the arithmetic mean is not equal to the median and is not the same as the mode, hence the form curve may be positive or negative. It has been proven that in both the single data and the group data the relationship between the calculated mean, median and mode is the mode plus two times the counting mean is equal to three times the median.

REFERENCES

1. Djarwanto. Pokok-pokok Metode Riset dan Bimbingan Teknis Penulisan Skripsi. Yogyakarta: Liberty; 1994.
2. Budiyuwono N. Pengantar Statistik Ekonomi dan Perusahaan. Yogyakarta: UPP AMP YKPN; 1996.
3. Supranto J. Ekonometrika. Jakarta: LPFE-UI; 1995.
4. Anto Dajan. 1996, Pengantar Metode Statistik, Jilid Kedua, LP3ES, Jakarta.
5. Sudjana. Statistika Untuk Ekonomi dan Niaga II. Bandung: Tarsito; 2004.