

How to Calculate the Quartile Deviation?

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The Quartile Deviation (QD) is the product of half of the difference between the upper and lower quartiles. Mathematically we can define as:

$$\text{Quartile Deviation} = (Q3 - Q1) / 2$$

Quartile Deviation defines the absolute measure of dispersion. Whereas the relative measure corresponding to QD, is known as the coefficient of QD, which is obtained by applying the certain set of the formula:

$$\text{Coefficient of Quartile Deviation} = (Q3 - Q1) / (Q3 + Q1)$$

A Coefficient of QD is used to study & compare the degree of variation in different situations.

First Quartile (Q1) is calculated using the formula given below

First Quartile (Q1)

$$Q_i = [i * (n + 1) / 4] \text{ th observation}$$

$$Q_1 = [1 * (10 + 1) / 4] \text{ th observation}$$

$$Q_1 = [1 * (10 + 1) / 4] \text{ th observation}$$

$$Q_1 = 2.75 \text{ th observation}$$

So, 2.75th observation lies between the 2nd and 3rd value in the ordered group, or midways between 12 & 14 therefore

First Quartile (Q1) is calculated as

Calculation of First Quartile -1.3

$$Q_1 = 2 \text{nd observation} + 0.75 * (3 \text{rd observation} - 2 \text{nd observation})$$

$$Q_1 = 12 + 0.75 * (14 - 12)$$

$$Q_1 = 12 + 1.50$$

$$Q_1 = 13.50$$

Third Quartile (Q3) is calculated using the formula given below

Third Quartile (Q3)

$$Q_i = [i * (n + 1) / 4] \text{ th observation}$$

$$Q_3 = [3 * (10 + 1) / 4] \text{ th observation}$$

$$Q_3 = [(10 + 1) / 4] \text{ th observation}$$

Q3 = 8.25th observation

So, 8.25th observation lies between the 8th and 9th value in the ordered group, or midways between 30 & 35 therefore

Third Quartile (Q3) is calculated as

Calculation of Third Quartile-1.4

$$Q3 = 8\text{th observation} + 0.25 * (9\text{th observation} - 8\text{th observation})$$

$$Q3 = 30 + 0.25 * (35 - 30)$$

$$Q3 = 31.25$$

Now using the Quartile values Q1 & Q3, we will calculate its Quartile deviation & its coefficient as follows –

Quartile Deviation is calculated using the formula given below

$$\text{Quartile Deviation} = (Q3 - Q1) / 2$$

Quartile Deviation Formula-1.5

$$\text{Quartile Deviation} = (31.25 - 13.50) / 2$$

$$\text{Quartile Deviation} = 8.875$$

Coefficient of Quartile Deviation is calculated using the formula given below

$$\text{Coefficient of Quartile Deviation} = (Q3 - Q1) / (Q3 + Q1)$$

Coefficient of Q.D Formula-2.6

$$\text{Coefficient of Quartile Deviation} = (31.25 - 13.50) / (31.25 + 13.50)$$

$$\text{Coefficient of Quartile Deviation} = 0.397$$

Example #2

Following are the observations shows the one-day sales of a shopping mall, where we determine the frequency of the first 50 customers of different age group. Now, we need to Calculate the quartile deviation and coefficient of quartile deviation.

Quartile Deviation Formula-2.1

Solution:

In the case of Frequency Distribution, Quartiles can be calculated by using the formula:

$$Q_i = l + (h / f) * (i * (N/4) - c) ; i = 1,2,3$$

Where,

l = Lower Boundary of Quartile Group

h = Width of Quartile Group

f = Frequency of Quartile Group

N = Total Number of Observations

c = Cumulative Frequency

First, we have to calculate the cumulative frequency table

cumulative frequency table -2.2

First Quartile (Q1) is calculated using the formula given below

First Quartile (Q1)

$$Q_i = [i * (N) / 4] \text{th observation}$$

$$Q_1 = [1 * (50) / 4] \text{th observation}$$

$$Q_1 = 12.50 \text{ th observation}$$

Since 12.50th value is in the interval 44.5 – 49.5

Therefore Group of Q1 is (44.5 – 49.5)

$$Q_i = 1 + (h / f) * (i * (N/4) - c)$$

Q.D Formula-2.3

$$Q_1 = (44.5 + (5 / 8) * (1 * (50 / 4) - 5))$$

$$Q_1 = 44.5 + 4.6875$$

$$Q_1 = 49.19$$

Third Quartile (Q3) is calculated using the formula given below

Third Quartile (Q3)

$$Q_i = [i * (N) / 4] \text{th observation}$$

$$Q_3 = [3 * (N) / 4] \text{th observation}$$

$$Q_3 = [3 * (50) / 4] \text{th observation}$$

$$Q_3 = 37.50 \text{ th observation}$$

Since 37.50th value is in the interval (59.5 – 64.5)

Therefore Group of Q3 is (59.5 – 64.5)

$$Q_i = 1 + (h / f) * (i * (N/4) - c)$$

Quartile Deviation Formula-2.4

$$Q_3 = 59.5 + (5 / 9) * (3 * (50/4) - 34)$$

$$Q_3 = 59.5 + 1.944$$

$$Q_3 = 61.44$$

By putting the values into the formulas of quartile deviation and coefficient of quartile deviation we get:

Quartile Deviation is calculated using the formula given below

$$\text{Quartile Deviation} = (Q3 - Q1) / 2$$

Quartile Deviation Formula-2.5

$$\text{Quartile Deviation} = (61.44 - 49.19) / 2$$

$$\text{Quartile Deviation} = 6.13$$

Coefficient of Quartile Deviation is calculated using the formula given below

$$\text{Coefficient of Quartile Deviation} = (Q3 - Q1) / (Q3 + Q1)$$

Quartile Deviation Formula-2.6

$$\text{Coefficient of Quartile Deviation} = (61.44 - 49.19) / (61.44 + 49.19)$$

$$\text{Coefficient of Quartile Deviation} = 12.25 / 110.63$$

$$\text{Coefficient of Quartile Deviation} = 0.11$$

Explanation

Quartile deviation is the dispersion in the middle of the data where it defines the spread of the data. As we know that the difference between the Third Quartiles and First Quartiles is called the Interquartile range and half of the Interquartile Range is called Semi-Interquartile which is also known as Quartile deviation. Now, we can calculate quartile deviation for both grouped and ungrouped data by using a formula given below.

$$\text{Quartile Deviation} = (\text{Third Quartile} - \text{First Quartile}) / 2$$

$$\text{Quartile Deviation} = (Q3 - Q1) / 2$$

While the coefficient of quartile deviation is used to compare the variation between two data sets. Moreover, quartile deviation is not affected by the extreme values where it contains extreme values. A Coefficient of Quartile deviation can be calculated in such a fashion.

$$\text{Coefficient of Quartile Deviation} = (Q3 - Q1) / (Q3 + Q1)$$

The concept of quartile deviation and coefficient of quartile can be explained with the help of an example in a definite set of steps.

Step 1: Obtain a set of Ungrouped data

In the problem statement, we have considered runs scored by a batsman in last 20 test matches:

96, 70, 100, 89, 78, 56, 45, 78, 68, 42, 66, 89, 90, 54, 44, 67, 87, 90, 97, and 98

Step 2: Arrange the data in ascending order:

42, 44, 45, 54, 56, 66, 67, 68, 70, 78, 78, 87, 89, 89, 90, 92, 96, 97, 98, 100

First Quartile(Q1)

Calculate the first quartile

$$Q_i = i * (n+1) / 4 \text{th observation}$$

$$Q_1 = 1 * (20 + 1) / 4 \text{th observation}$$

$$Q_1 = 5.25 \text{th observation}$$

So, 5.25th observation lies between the 5th and 6th value in the ordered group, or midway between 55 & 66 therefore

$$Q1 = 55 + 0.25 * (66 - 55)$$

$$Q1 = 55 + 2.75$$

$$Q1 = 57.25$$

Third Quartile (Q3)

The calculate the third Quartile is given as:

$$Q_i = i * (n+1) / 4 \text{ th observation}$$

$$Q3 = 3 * (n+1) / 4$$

$$Q3 = 3 * (20 + 1) / 4 \text{th observation}$$

$$Q3 = 15.75 \text{th observation}$$

Where 15.75th lies between 15th and 16th value in the ordered group

$$15 \text{th observation} = 90$$

$$16 \text{th observation} = 96$$

$$Q3 = 90 + 0.75 * (96 - 90)$$

$$Q3 = 90 + 4.5$$

$$Q3 = 94.5$$

Step 3: Calculate the Quartile Deviation & Coefficient of Quartile Deviation on the basis of the respective outcome.

$$\text{Quartile Deviation} = (Q3 - Q1) / 2$$

$$\text{Quartile Deviation} = (94.5 - 57.25) / 2$$

$$\text{Quartile Deviation} = 18.625$$

$$\text{Coefficient of Quartile Deviation} = (Q3 - Q1) / (Q3 + Q1)$$

$$\text{Coefficient of Quartile Deviation} = (94.5 - 57.25) / (94.5 + 57.25)$$

$$\text{Coefficient of Quartile Deviation} = 0.2454$$

“If any Doubt & Question Contact During Class Time”
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