Quartile Deviation

Quartile deviation is the difference between the first and third quartiles. Quartile deviation is half the interquartile range. The interquartile range is the 75th percentile minus the 25th percentile. The 75th percentile is the number such that no more than 75% of the observations (or distribution mass) is less than it, and no more than 25% of the observations are greater than it (if a range of numbers satisfy this criterion, there are various conventions for picking a single number). The 25th percentile is defined in parallel fashion.

Why do quartiles matter?

Quartiles let us quickly divide a set of data into four groups, making it easy to see which of the four groups a particular data point is in.

For example, a professor has graded an exam from 0-100 points. Say that professor wants to give bonus points to the top 25% of students, remedial instruction to the bottom 25% of students, and a chance for extra credit to the middle 50% of students. If the professor knows the quartiles are 55, 62, 75, 88, and 95, then it makes it easier to see where the dividing lines are. Got a 73? You're in the middle 50%. Got an 89? Congrats, you're in the top 25% of the class!

The middle 50% of the data can useful to know about, especially if the data set has outliers. If the minimum or maximum values are far away from the central 50%, then there are probably some outliers in the data set.

Merits of Quartile Deviation

(i) It can be easily calculated and simply understood.

(ii) It does not involve much mathematical difficulties.

(iii) As it takes middle 50% terms hence it is a measure better than Range and Percentile Range.

(iv) It is not affected by extreme terms as 25% of upper and 25% of lower terms are left out.

(v) Quartile Deviation also provides a short cut method to calculate Standard Deviation using the formula 6 Q.D. = 5 M.D. = 4 S.D.

(vi) In case we are to deal with the center half of a series this is the best measure to use.

Demerits or Limitation Quartile Deviation

(i) As Q1 and Q3 are both positional measures hence are not capable of further algebraic treatment.

(ii) Calculation are much more, but the result obtained is not of much importance.

(iii) It is too much affected by fluctuations of samples.

(iv) 50% terms play no role; first and last 25% items ignored may not give reliable result.

(v) If the values are irregular, then result is affected badly.

(vi)We can’t call it a measure of dispersion as it does not show the scatterness around any average.

(vii) The value of Quartile may be same for two or more series or Q.D. is not affected by the distribution of terms between Q1 and Q3 or outside these positions.

So going through the merits and demerits, we conclude that Quartile Deviation cannot be relied on blindly. In the case of distributions with high degree of variation, quartile deviation has less reliability.

Here are some solved numerical of quartile deviation-

Quartile Deviation (QD)

Individual Series

Q. Here are marks of some students. Calculate QD.

Marks
20
28
40
12
30
15
50

Formula of QD

$$QD = \frac{Q_3 - Q_1}{2}$$

$$Q_1 = \frac{N+1}{4} \qquad Q_3 = 3\left(\frac{N+1}{4}\right)$$

Solution - Firstly arrange the series in ascending order.

	Marks
	12
$Q_1 =$	15
	20
	28
	30
$Q_3 =$	40
	50

$$Q_1 = \frac{N+1}{4} = \frac{7+1}{4} = \frac{8}{4} = 2$$

$$Q_3 = 3\left(\frac{7+1}{4}\right) = \frac{3 \times 8}{4} = \frac{24}{4} = 6$$

$$QD = \frac{Q_3 - Q_1}{2} = \frac{40-15}{2} = \frac{25}{2} = 12.5$$

$$\boxed{QD = 12.5}$$

Discrete Series

Question →

Marks	No. of students (f)
10	4
20	7
30	15
40	8
50	7
60	2

Formula →

$$QD = \frac{Q_3 - Q_1}{2}$$

Here N = Total of f

$N = \Sigma f$

Solution →

Marks	f	c.f
10	4	4
$Q_1 = \boxed{20}$	7	11 Q_1
30	15	26
$Q_3 = \boxed{40}$	8	34
50	7	41
60	2	43
	N = 43	

$Q_1 = \left(\frac{N+1}{4}\right) = \left(\frac{43+1}{4}\right) = \frac{44}{4} = 11^{th}$ item (fall under cf 11)

$Q_3 = 3\left(\frac{N+1}{4}\right) = \frac{3 \times 44}{4} = 33^{rd}$ item (falls under cf 34)

$$QD = \frac{40-20}{2} = 10$$

$\boxed{QD = 10}$

Frequency Distribution Series

Q.

Class	f
0-10	3
10-20	5
20-30	7
30-40	10
40-50	12
50-60	15
60-70	12
70-80	6
80-90	2
90-100	8

Formula $= \frac{Q_3 - Q_1}{2}$

$Q_1 = \frac{N}{4}$ Q

L_1 = lower limit of Q class.

i = class interval

Solution -

	Class	f	cf
	0-10	3	3
	10-20	5	8
	20-30	7	15
Q_1 class =	$\boxed{30-40}$	10	25
	40-50	12	37
	50-60	15	52
Q_3 class =	60-70	12	64
	70-80	6	70
	80-90	2	72
	90-100	8	80
		$\Sigma f = 80$	

$Q_1 = \frac{N}{4} = \frac{80}{4} = 20^{th}$ item

$Q_1 = L_1 + \frac{\frac{N}{4} - cf}{f} \times i$

Here cf of preceding class will be taken.

$= 30 + \frac{20 - 15}{10} \times 10$

$= 30 + \frac{5}{10} \times 10 = 35$

$\boxed{Q_1 = 35}$

$Q_3 = \frac{3N}{4} = \frac{3 \times 80}{4} = 60^{th}$ item

$Q_3 = L_1 + \frac{\frac{3N}{4} - c.f}{f} \times i$

$= 60 + \frac{60 - 52}{12} \times 10$

$= 60 + \frac{8}{12} \times 10 = 66.66$

$\boxed{Q_3 = 66.66}$

$QD = \frac{Q_3 - Q_1}{2} = \frac{66.66 - 35}{2}$

$\boxed{QD = 15.83}$