

Measures of Variability :

Quartile Deviation and Standard Deviation

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Measures of Variability (विचलनशीलतेची परिमाणे)

A measure of variability is a summary statistic that represents the amount of dispersion in a dataset. *How spread out are the values?* While a measure of central tendency describes the typical value, measures of variability define how far away the data points tend to fall from the centre. We talk about variability in the context of a distribution of values.

Variability refers to how spread out a group of data is. In other words, variability measures how much your scores differ from each other. Variability is also referred to as dispersion or spread.

एखाद्या गटातील प्राप्तांक हे केंद्रीय प्रवृत्तीच्या वर व खाली कसे पसरलेले आहेत. हे दर्शविणाऱ्या बाबीस विचलनशीलता असे म्हणतात. ही परिवर्तनशीलता दर्शविणाऱ्या परीमानांना परिवर्तनशीलतेची परिमाणे म्हणतात.

Measures of Variability : विचलनशीलतेची परिमाणे

- 1. Range : विस्तार*
- 2. Quartile Deviation : चतुर्थक विचलन / चतुर्थक विस्तार*
- 3. Average/Mean Deviation : सरासरी विचलन*
- 4. Standard Deviation : प्रमाण विचलन*

Quartile Deviation : चतुर्थक विचलन

- A median divides a given dataset into *two equal halves*. similarly, *the quartiles are used to divide a given dataset into four equal halves*. Therefore, logically there should be three quartiles for a given distribution, but if you think about it, the second quartile is equal to the median itself! We'll deal with the other two quartiles,
- दिलेल्या प्राप्तांकाना उतरत्या क्रमाने लिहून श्रेणीचे चार समान भाग करणारे बिंदू म्हणजे चतुर्थक होय.

First Quartile (Q1)

- The first quartile or the lower quartile or the 25th percentile, also denoted by Q_1 , corresponds to the value *that lies halfway between the median and the lowest value in the distribution* (when it is already sorted in the ascending order). Hence, it marks the region which encloses 25% of the initial data.
- श्रेणीतील प्राप्तांक हे उतरत्या क्रमाने लिहिले असता सर्वात खालच्या प्राप्तांकापासून सुरुवात करून श्रेणीतील ज्या बिंदूखाली एकूण प्राप्तांकाच्या २५% प्राप्तांक राहतील त्या बिंदूस प्रथम चतुर्थक म्हणतात.

Second Quartile (Q2) means median

Third Quartile (Q3) :

The *third quartile* or the *upper quartile* or *75th percentile*, also denoted by **Q3**, corresponds to the *value that lies halfway between the median and the highest value in the distribution* (when it is already sorted in the ascending order). *It, therefore, marks the region which encloses the 75% of the initial data or 25% of the end data.*

श्रेणीतील प्राप्तांक हे उतरत्या क्रमाने लिहिले असता सर्वात खालच्या प्राप्तांकापासून सुरुवात करून श्रेणीतील ज्या बिंदुखाली एकूण प्राप्तांकाच्या 75% प्राप्तांक राहतील त्या बिंदुस प्रथम चतुर्थक म्हणतात.

Quartile Deviation (Q):

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

$$\text{Quartile Deviation (Q)} = (Q_3 - Q_1) / 2.$$

- *Quartile deviation is based on the difference between the first quartile (Q1) and the third quartile (Q3) in the frequency distribution and the difference is also known as the inter quartile range, the difference divided by two is known as quartile deviation or semi inter quartile range.*

वारंवारिता वितरणाच्या ७५ वे शततमक आणि २५ वे शततमक यांच्या अंतराच्या निम्म्या भागास चतुर्थक विचलन म्हणतात.

$$Q = \frac{Q_3 - Q_1}{2} \quad (Q = \text{Quartile Deviation, } Q_3 = \text{Third Quartile, } Q_1 = \text{First Quartile})$$

Calculate Quartile Deviation when Frequency Distribution Table is given

C.I	f	Cf
70-74	1	50
65-69	3	49
60-64	4	46
55-59	7 fm	42
50-54	8	35 F
45-49	12	27
40-44	5 fm	15
35-39	7	10 F
30-34	2	3
25-29	1	1
	N=50	

Calculation of Q1	Calculation of Q3
$Q1 = L + \frac{(N/4 - F)}{fm} \times i$	$Q3 = L + \frac{(3N/4 - F)}{fm} \times i$
<p>$N/4 = 50/4 = 12.5$ = वारंवारितेचा N/4भाग i.e. Find out in which Cf N/4 is included L= Lowest Limit of Q1 C.I= 39.5 (ज्या वर्गन्तरात Q1 आहे त्या वर्गान्तराची खालची प्रत्येक्ष मर्यादा) F= Cf of CI which is below the Q1 CI=10 (Q1 वर्गांताराच्या खालील वर्गान्तराची संचित वारंवारिता) fm = Frequency of Q1 CI=</p>	<p>$3N/4 = (3 \times 50) / 4 = 37.5$ = वारंवारितेचा 3N/4 भाग i.e. Find out in which Cf 3N/4 is included L= Lowest Limit of Q3 C.I= 54.5 (ज्या वर्गन्तरात Q3 आहे त्या वर्गान्तराची खालची प्रत्येक्ष मर्यादा) F= Cf of CI which is below the Q3 CI=35 (Q3 वर्गांताराच्या खालील वर्गान्तराची संचित वारंवारिता) fm = Frequency of Q1 CI=</p>
असलेल्या वर्गान्तराची	असलेल्या वर्गान्तराची

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

$$Q = \frac{56.28 - 42}{2} = 7.14$$

Home work : *Calculate quartile Deviation from given frequency distribution table*

Ex-1

C.I	f
90-99	5
80-89	7
70-79	11
60-69	13
50-59	15
40-49	10
30-39	8
20-29	5
10-19	1

Ex-2

C.I	f
65-69	2
60-64	1
55-59	7
50-54	19
45-49	14
40-44	9
35-39	6
30-34	2

Ex-3

C.I	f
42-46	4
37-41	2
32-36	7
27-31	8
22-26	4
17-21	5
12-16	3
7-11	2

Ex-4

C.I	f
42-45	1
38-41	1
34-37	1
30-33	0
26-29	5
22-25	4
18-21	8
14-17	7
10-13	9
6-9	2

Standard Deviation : SD or σ

Standard deviation is the measure of dispersion of a set of data from its mean.

It measures the absolute variability of a distribution; the higher the dispersion or variability, the greater is the standard deviation and greater will be the magnitude of the deviation of the value from their mean.

The sum of the squares of the deviations of the scores in a collection from the mean of the collection is given by the difference between the sum of the squares of the scores divided by their number.

Standard Deviation is the square root of the arithmetic mean of the squared deviations of measurements from their mean.

प्रमाण विचलन : SD or σ

प्रत्येक प्राप्तांकाचे मध्यामानापासून विचलन काढून त्या विचलानांचा वर्ग करून बेरीज करा .या बेरजेला एकूण प्राप्तांकांच्या संख्येने भागून येणाऱ्या वर्गाच्या सरासरीचे वर्गमूळ काढा. अशा तऱ्हेने येणाऱ्या मुल्यास प्रमाण विचलन असे म्हणतात .

थोडक्यात श्रेणीतील प्राप्तांकांच्या मध्यामानापासूनच्या विचलानांच्या वर्गमूळास प्रमाण विचलन असे म्हणतात.

Calculate Standard Deviation by using Assumed Mean (Short Method)

C.I	X _m	f	X'	fx'	Fx' ²
70-74	72	1	+5	+ 5	25
65-69	67	3	+4	+ 12	48
60-64	62	4	+3	+ 12	36
55-59	57	7	+2	+ 14	28
50-54	52	8	+1	+ 8	8
45-49	47	12	0	0	0
40-44	42	5	-1	-5	5
35-39	37	7	-2	-14	28
30-34	32	2	-3	-6	18
25-29	27	1	- 4	- 4	16
		N=50		∑fx' = 22	∑fx' ² = 212

x' = deviation of X_m from A.M, f- frequency,
 N= No.of Students
 ∑fx' = Sum of multiplication of f and x'

$$SD = i \sqrt{\frac{\sum fx'^2}{N} - \left[\frac{\sum fx'}{N} \right]^2}$$

$$SD = 5 \sqrt{\frac{212}{50} - \left[\frac{22}{50} \right]^2}$$

$$SD = 5 \times 2.01$$

$$SD = 10.05$$

∑fx'² = Sum of multiplication of f and square of deviations

Home work : *Calculate Standard deviation from given frequency distribution table*

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90-99	5
80-89	7
70-79	11
60-69	13
50-59	15
40-49	10
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Ex-2

C.I	f
65-69	2
60-64	1
55-59	7
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