Quest Journals
Journal of Research in Applied Mathematics
Volume 12 ~ Issue 6 (June 2026) pp: 34-44
ISSN (Online): 2394-0743 ISSN (Print): 2394-0735
www.questjournals.org

Research Paper

A Systematic Approach to Statistical Computation: A Comparative Guide to Measures of Central Tendency and Dispersion

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Abstract
Data literacy forms the backbone of contemporary professional fields, ranging from healthcare to technology. However, a persistent challenge in statistics education is that learners often grasp the conceptual purpose of measures of central tendency and dispersion but struggle with the mathematical execution. Assuming that students already possess the necessary foundational theoretical background, this paper serves as a comparative guide focused entirely on moving from concept to computation. It demonstrates the application of formulas for these key metrics—mean, median, mode, mean deviation, and standard deviation—by tracing all calculations through a single, consistent baseline dataset, appropriately modified for Individual, Discrete, and Continuous series.

Keywords: *Mean, Median, Mode, Mean deviation, and Standard deviation*

Received 14 June., 2026; Revised 25 June, 2026; Accepted 27 June, 2026
Published with open access at ***www.questjournals.org***

I. INTRODUCTION

Statistics is the language of modern problem-solving, and proficiency in calculating measures of central tendency and dispersion is a foundational requirement for data analysis across various academic and professional disciplines. However, a pedagogical challenge persists: students often develop strong conceptual understandings but lack procedural fluency. The transition from theoretical knowledge to accurate formula application frequently devolves into rote memorization rather than analytical problem-solving. This paper focuses on moving from concept to computation, emphasizing the precise understanding and comparative application of specific formulas required for different types of numerical problems. To facilitate clear comparative insight, a single, consistent dataset is utilized as a running example, appropriately adapted across Individual, Discrete, and Continuous series. By applying formulas for central tendency (mean, median, and mode) and dispersion (mean deviation and standard deviation), the methodology highlights the logical, sequential flow of the calculations. The goal is to shift the student's mindset from memorizing isolated formulas to executing logical, step-by-step procedures, ultimately fostering true competence in statistical computation.

II. ARITHMETIC MEAN

Notation and terminology used

X	the series
x	the terms of the series X
$\overline{X}$	Arithmetic mean of the series X
$\boldsymbol{n}$	number of terms of the series X
A	the assumed mean of the series X,
d	the deviation from assumed mean $d = X - A$ for individual series and discrete series
c	the common factor of the series d and $d' = \frac{X-A}{c}$
d'	$d' = \frac{X-A}{c}$
f	the frequency of the series X

$N = \sum f$	The sum of frequencies, where f is the frequency
m	the mid-values of the class interval of a continuous series
$d = m - A,\ d' = \frac{m-A}{c}$	In case of a continuous series, deviation of the mid values are taken from the assumed mean
$\overline{X_w}$	Weighted Arithmetic Mean
$d = X - A_w\ ,\ d' = \frac{X-A_w}{c}$	deviation of the mid values are taken from the Assumed Weighted Arithmetic Mean

Arithmetic Mean in case of an Individual Series		
Direct Method $\overline{X} = \frac{\sum x}{n}$	Short-Cut Method $\overline{X} = A + \frac{\sum d}{n}$	Step Deviation Method $\overline{X} = A + \frac{\sum d'}{n} \times c$
Arithmetic Mean in case of Discrete Series		
Direct Method $\overline{X} = \frac{\sum fx}{N}$	Short-Cut Method $\overline{X} = A + \frac{\sum fd}{N}$	Step Deviation Method $\overline{X} = A + \frac{\sum fd'}{N} \times c$
Arithmetic Mean in case of Continuous Series		
Direct Method $\overline{X} = \frac{\sum fm}{N}$	Short-Cut Method $\overline{X} = A + \frac{\sum fd}{N}$	Step Deviation Method $\overline{X} = A + \frac{\sum fd'}{N} \times c$
Weighted Arithmetic Mean		
Direct Method $\overline{X_w} = \frac{\sum wx}{\sum w}$	Short-Cut Method $\overline{X_w} = A_w + \frac{\sum wd}{\sum w}$	Step Deviation Method $\overline{X} = A_w + \frac{\sum wd'}{\sum w} \times c$
Combined Arithmetic Mean		
In case of two series $X_{12} = \frac{N_1\overline{X}_1 + N_2\overline{X}_2}{N_1 + N_2}$	In case of three series $X_{123} = \frac{N_1\overline{X}_1 + N_2\overline{X}_2 + N_3\overline{X}_3}{N_1 + N_2 + N_3}$	In case of n series $X_{123\ldots n} = \frac{N_1\overline{X}_1 + N_2\overline{X}_2 + N_3\overline{X}_3 \ldots + N_n\overline{X}_n}{N_1 + N_2 + N_3 + \cdots + N_n}$
Corrected Arithmetic Mean		
Corrected $\sum x$ = incorrect $\sum x$–incorrect values x + corrected values x		
Apply the formula $\overline{X} = \frac{corrected\ \sum x}{n}$		

Note : Observe that the foundational approach to computing the arithmetic mean remains consistent across Individual, Discrete, and Continuous series. The primary distinction lies in how the specific components namely n, N, d, d' are derived for each data type. Furthermore, while the Individual series lacks frequencies, both Discrete and Continuous series require multiplying values by their respective frequencies. Lastly, a notational difference exists in the direct method: the Continuous series employs $\sum fm$, whereas the Discrete series relies on $\sum fx$

2.1 Example: Individual series

X	$A = 25$ $d = m - A$	$c = 10$ $d' = \frac{m-A}{c}$	Direct Method $\overline{X} = \frac{\sum x}{n}$ $\overline{X} = \frac{180}{6} = 30$	Short-Cut Method $\overline{X} = A + \frac{\sum d}{n}$ $\overline{X} = 25 + \frac{30}{6}$ $= 25 + 5 = 30$	Step Deviation Method $\overline{X} = A + \frac{\sum d'}{n} \times c$ $\overline{X} = 25 + \frac{3}{6} \times 10$ $= 25 + 5 = 30$
5	-20	-2			
15	-10	-1			

25	0	0			
35	10	1			
45	20	2			
55	30	3			
$\sum x$=180	$\sum d$=30	$\sum fd'$=3			

2.2 Example: Discrete series

X	Frequency (f)	Xf	$A = 25$ $d = X - A$	fd	$c = 10'$ $d = \frac{x-A}{c}$	fd'
5	5	25	-20	-100	-2	-10
15	4	60	-10	-40	-1	-4
25	3	75	0	0	0	0
35	2	70	10	20	1	2
45	7	315	20	140	2	14
55	9	495	30	270	3	27
	$\sum f$=30	$\sum fm$=1040		$\sum fd$=290		$\sum fd'$ =29

Arithmetic Mean by Direct Method	Arithmetic Mean by Short-Cut Method	Arithmetic Mean by Step Deviation Method
$\overline{X} = \frac{\sum fx}{N} = \frac{1040}{30} = 34.67$	$\overline{X} = A + \frac{\sum fd}{N} = 25 + \frac{290}{30} = 25 + 9.67 = 34.67$	$\overline{X} = A + \frac{\sum fd'}{N} \times c = 25 + \frac{29}{30} \times 10 = 25 + 9.67 = 34.67$

2.3 Example: Continuous series covering mean only by applying all the three methods Direct, Short Cut and Step Deviation method

2.4 in the above example if the series X is replaced by the class intervals and value x is replaced by the mid- points m then the new series so obtained will represent continuous series and same results will hold true for the continuous series obtained so

III. QUARTILES, DECILES AND PERCENTILES

Notation and terminology used

Quartiles, Deciles, Percentiles are represented by Q_i , D_i and P_i respectively, rest are same as that of Arithmetic Mean. Q_2 is also known as Median represented as M

Quartiles Q_i where $1 \leq i \leq 3$	Deciles D_i where $1 \leq i \leq 10$	Percentile P_i where $1 \leq i \leq 100$
Quartiles, Deciles and percentiles in case of Individual series		
In all cases first of all arrange data in ascending or descending order		
$Q_i =$ value of $\frac{i(n+1)}{4} th$ term When $\frac{i(n+1)}{4}$ is whole number say a then Q_i is equal to the value of a^{th} term of the series If $\frac{i(n+1)}{4}$ is in decimal say $a.b$ then $Q_i = a^{th}\ term\ + 0.b((a+1)^{th} - a^{th}\ term)$ If $\frac{i(n+1)}{4}$ is in decimal say $a.5$ then $Q_i = \frac{a^{th}\ term\ + (a+1)^{th} term}{2}$	$D_i =$ value of $\frac{i(n+1)}{10} th$ term When $\frac{i(n+1)}{10}$ is whole number say a then D_i is equal to the value of a^{th} term If $\frac{i(n+1)}{10}$ is in decimal say $a.b$ then $D_i = a^{th}\ term\ + 0.b((a+1)^{th} - a^{th}\ term)$ If $\frac{i(n+1)}{10}$ is in decimal say $a.5$ then $D_i = \frac{a^{th}\ term\ + (a+1)^{th} term}{2}$	$P_i =$ value of $\frac{i(n+1)}{100} th$ term When $\frac{i(n+1)}{100}$ is whole number say a then P_i is equal to the value of a^{th} term If $\frac{i(n+1)}{100}$ is in decimal say $a.b$ then $P_i = a^{th}\ term\ + 0.b((a+1)^{th} - a^{th}\ term)$ If $\frac{i(n+1)}{100}$ is in decimal say $a.5$ then $P_i = \frac{a^{th}\ term\ + (a+1)^{th} term}{2}$

Quartiles, Deciles and percentiles in case of Discrete series

In all cases first of all arrange data in ascending or descending order

$\boldsymbol{Q_i}=$ value of $\frac{i(N+1)}{4}th$ term, $\boldsymbol{D_i}=$ value of $\frac{i(N+1)}{10}th$ term, $\boldsymbol{P_i}=$ value of $\frac{i(N+1)}{100}th$ term

Locate the cumulative frequency which is equal to or next higher to value of $\frac{i(N+1)}{4}th/\ \frac{i(N+1)}{10}th$ term $/\frac{i(N+1)}{100}th$ term. Corresponding to this, locate the Quartile/Decile/percentile in the given series

Quartiles, Deciles and percentiles in case of continuous series

In all cases first of all arrange data in ascending or descending order

$\boldsymbol{Q_i}=$ value of $\frac{iN}{4}th$ term, $\boldsymbol{D_i}=$ value of $\frac{iN}{10}th$ term, $\boldsymbol{P_i}=$ value of $\frac{iN}{100}th$ term

Locate the cumulative frequency which is equal to or next higher to value of $\frac{iN}{4}th/\ \frac{iN}{10}th$ term $/\frac{iN}{100}th$ term. Corresponding to this, locate the Quartile/Decile/percentile class and apply the corresponding following formula

$Q_i = L + \frac{\frac{iN}{4} - cf}{f} \times h$	$D_i = L + \frac{\frac{iN}{10} - cf}{f} \times h$	$\boldsymbol{P_i} = L + \frac{\frac{iN}{100} - cf}{f} \times h$

L is the lower limi of Quartile/Decile/percentile class interval
h is the length of the Quartile/Decile/percentile class interval
f is the frequency of the Quartile/Decile/percentile class interval
cf is the cumulative frequency of the class interval proceeding the Quartile/Decile/percentile class

Note: In all cases Individual series and discrete series Quartiles, Deciles and percentiles is equal to $\boldsymbol{Q_i}=$ value of $\frac{i(N+1)}{4}th$ term, $\boldsymbol{D_i}=$ value of $\frac{i(N+1)}{10}th$ term, $\boldsymbol{P_i}=$ value of $\frac{i(N+1)}{100}th$ term respectively

And in case of continuous series Quartiles, Deciles and percentiles is equal to $Q_i=$ value of $\frac{iN}{4}th$ term, $\boldsymbol{D_i}=$ value of $\frac{iN}{10}th$ term, $\boldsymbol{P_i}=$ value of $\frac{iN}{100}th$ term respectively

3.1 Example: Individual series

$\boldsymbol{X}$	5	15	25	35	45	55

$\boldsymbol{Q_i}=$ value of $\frac{i(n+1)}{4}th$ term where $1 \le i \le 3$	$\boldsymbol{D_i}=$ value of $\frac{i(n+1)}{10}th$ term where $1 \le i \le 10$	$\boldsymbol{P_i}=$ value of $\frac{i(n+1)}{100}th$ term where $1 \le i \le 100$
Q_1 $=$ value of $\frac{(6+1)}{4}th$ term $=$ value of $\frac{7}{4}th$ term $=$ value of $1.75th$ term $Q_1 = 1st\ term + 0.75(2nd\ term - 1st\ term)$ $= 5 + 0.75(15-5)$ $= 5 + 7.5 = 12.5$	$D_5=$ value of $\frac{5(6+1)}{10}th$ term $=$ value of $\frac{35}{10}th$ term $=$ value of $3.5\ th$ term $D_5 = \frac{3rd\ term + 4th\ term}{2}$ $= \frac{25+35}{2} = 30$	P_{75} $=$ value of $\frac{75(6+1)}{100}th$ term $=$ value of $\frac{525}{100}th$ term $=$ value of $5.25\ th$ term P_{75} $= 5th\ term + 0.25(6th\ term - 5th\ term)$ $= 45 + 0.25(55-45)$ $= 45 + 2.5 = 47.5$

3.2 Example: Discrete series

X	5	15	25	35	45	55	
Frequency (f)	5	4	3	2	7	9	$\sum f$=30
Cumulative frequency(cf)	5	9	12	14	21	30	

$Q_i=$ value of $\frac{i(N+1)}{4}th$ term where $1 \le i \le 3$	$D_i=$ value of $\frac{i(N+1)}{10}th$ term where $1 \le i \le 10$	$P_i=$ value of $\frac{i(N+1)}{100}th$ term where $1 \le i \le 100$

$Median = Q_2$ $=$ value of $\frac{2(30+1)}{4} th$ term $=$ value of $\frac{31}{2} th$ term $=$ value of $15.5\ th$ term The Cumulative frequency next higher to 15.5 is 21 So $Q_2 = 45$	$D_3 =$ value of $\frac{3(30+1)}{10} th$ term $=$ value of $\frac{93}{10} th$ term $=$ value of $9.3th$ term The Cumulative frequency next higher to 9.3 is 12 So $D_3 = 25$	$P_{50} =$ value of $\frac{50(30+1)}{100} th$ term $=$ value of $\frac{1550}{100} th$ term $=$ value of $15.5\ th$ term The Cumulative frequency next higher to 15.5 is 21 So $P_{50} = 45$

3.3 Example: Continuous series

Same table will be the for Continuous series on replacing X with the class intervals

Class Intervals	0-10	10-20	20-30	30-40	40-50	50-60	
Frequency (f)	5	4	3	2	7	9	$\sum f$=30
Cumulative frequency(cf)	5	9	12	14	21	30	

$Q_i =$ value of $\frac{iN}{4} th$ term $Q_i = L + \frac{\frac{iN}{4} - cf}{f} \times h$ where $1 \le i \le 3$	$D_i =$ value of $\frac{iN}{10} th$ term $D_i = L + \frac{\frac{iN}{10} - cf}{f} \times h$ where $1 \le i \le 10$	$P_i =$ value of $\frac{iN}{100} th$ term , $P_i = L + \frac{\frac{iN}{100} - cf}{f} \times h$ where $1 \le i \le 100$
Q_3 $=$ value of $\frac{3N}{4} th$ term= value of $\frac{90}{4} th$ term $=$ value of $22.5\ th$ term The Cumulative frequency next higher to 22.5 is 30 So 50-60 is Q_3 class interval $Q_3 = 50 + \frac{22.5 - 21}{9} \times 10$ $= 50 + \frac{15}{9} = 50 + 1.67$ $= 51.67$	$D_7 =$ value of $\frac{7N}{10} th$ term $=$ value of $\frac{7 \times 30}{10} th$ term $=$ value of $21st$ term The Cumulative frequency is 21 So 40-50 is D_7 class interval $D_7 = 40 + \frac{21 - 14}{7} \times 10$ $= 40 + 10 = 50$	$P_{25} =$ value of $\frac{25N}{100} th$ term $=$ value of $\frac{25 \times 30}{100} th$ term $=$ value of $7.5\ th$ term The Cumulative frequency next higher to 7.5 is 9 So 10-20 is P_{25} class interval $P_{25} = 10 + \frac{7.5 - 5}{4} \times 10$ $= 10 + \frac{25}{4}$ $= 10 + 6.25 = 16.25$

IV. MODE

Notation and terminology used

Mode is generally denoted by symbol 'Z', Rest are same as that of Arithmetic Mean etc.

Mode is that value which occurs most frequently in a statistical distribution.
No mode: if in a distribution each item occurs equal number of times.
Multi-mode: If a few items occur same number of times say twice, thrice called Bi-mode, Tri-mode respectively

Individual series

Arrange the items in the ascending or descending order of magnitude. The value with the highest repetition is known as Mode.

Discrete series

a. Inspection Method: Find the term with highest frequency and the value of the variable corresponding to the term is the mode. The method may not suitable for determination of mode if

the highest frequency is repeated	the gap between the highest frequency and the frequencies proceeding it or succeeding it is very small	the highest frequency occurs in the beginning or at the end of the series	the frequencies of the variable increase or decrease in an erratic or haphazard way

b. Grouping Method: is applied when the frequencies are not regular in nature that is there is rise and fall in the values of the frequencies and not possible to locate the value of the mode by inspection properly.

Formation of Grouping Table

X	**Col I**	**Col II**	**Col III**	**Col IV**	**Col V**	**Col VI**	
Write given series	Write given frequencies	Write total of frequencies taking two frequencies at a time	Ignore first frequency and take total of frequencies taking two frequencies at a time	Write total of frequencies taking three frequencies at a time	Ignore first frequency and take total of frequencies taking three frequencies at a time	Ignore first two frequencies and take total of frequencies taking three frequencies at a time	

Mark the maximum values in all the columns

Formation of Analysis Table

X	**Col I**	**Col II**	**Col III**	**Col IV**	**Col V**	**Col VI**	**Total of tick Marks row wise**

Tick the rows containing the variable values that produce the highest totals in each column of the grouping table. Afterward, sun the total number of ticks for each row

The value of the variable which gets the maximum ticks is declared to be the mode of the distribution

Continuous Series

a. Inspection Method: Find the term with highest frequency and the value of the variable corresponding to the term is the mode. The method is not suitable for determination of mode if

the highest frequency is repeated	the gap between the highest frequency and the frequencies of the adjoining classes is very small	the highest frequency occurs in the beginning or at the end of the series	the frequencies of the variable increase or decrease in an erratic or haphazard way

b. Grouping Method: Same as that of in case of discrete series the only difference is that discrete values are replaced by class interval and by this modal class located not the mode , to find mode formula is applied

First of all locate the modal class by inspection method or Grouping method. Apply the formula

$$Mode = L + \frac{f - f_0}{2f - f_0 - f_1} \times h$$

L is the lower limit of the modal class
f is the frequency of modal class
f_o is the frequency preceding the modal class
$f_1$is the frequency following the modal class
h is the length of the modal class

if above formula gives non valid results or $2f - f_0 - f_1 = 0$
then apply

$$Mode = L + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times h$$

Where $\Delta_1 = |f - f_1|$ and $\Delta_2 = |f - f_2|$

When upper limit of the modal class is used to find the mode

$$Mode = U - \frac{f - f_1}{2f - f_0 - f_1} \times h$$

U is the upper limit of the modal class

if above formula gives non valid results or $2f - f_0 - f_1 = 0$

$$Mode = U - \frac{\Delta_2}{\Delta_1 + \Delta_2} \times h$$

Where $\Delta_1 = |f - f_1|$ and $\Delta_2 = |f - f_2|$

Empirical relation is applicable when mode cannot be calculated in usual way
Mode=3 median -2 mean applicable for Multi Modal series

4.1 Example: Individual series

Four series after arranging the data in ascending order

X	Arranged data in ascending order	Mode
1st	2, 2, 3, 3, 3, 4, 5, 5, 5, 5, 5, 5, 6, 6, 7	Uni -Modal series with mode 5
2nd	2, 2, 3, 4, 4, 5, 5, 5, 5, 6, 6, 6, 6, 7, 7	Bi-Modal series with two modes 5 and 6
3rd	2, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 6, 6, 6, 6	Tri modal series with three modes 4,5 and6
4th	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	Mode is ill defined

4.2 Example: Discrete Series

X	5	15	25	35	45	55
Frequency (f)	5	4	3	2	7	9

Max frequency is 9 so mode is 55

4.3 Example: Continuous series

Same table will be the for Continuous series on replacing X with the class intervals

Class Intervals	0-10	10-20	20-30	30-40	40-50	50-60
Frequency (f)	5	4	3	2	7	9 max

Max frequency is 9 so mode class is 50-60

$$Mode = L + \frac{f - f_0}{2f - f_0 - f_1} \times h = 50 + \frac{9 - 7}{2 \times 9 - 7 - 0} \times 10 = 50 + \frac{20}{11} = 50 + 1.82 = 51.82$$

4.4 Example: Discrete series

X	Frequency (f) Col I	Col II	Col III	Col IV	Col V	Col VI	**Col I**	**Col II**	**Col III**	**Col IV**	**Col V**	**Col VI**	**Total of ■**
5	4	10		30									nil
15	6		26		48 max						■		01
25	20	42 max				65 max		■			■	■	03
35	22		45 max	62 max				■	■	■	■	■	05 max
45	23 max	40					■		■	■		■	04
55	17									■			01
	$N = \sum f$=30												

Maximum number of ■ is 5, so mode is 35

4.5 Example: Continuous series

Same table will be the for Continuous series on replacing X with the class intervals

Class Intervals	0-10	10-20	20-30	30-40	40-50	50-60

Maximum number of ■ is 5 , So Modal class is 30-40

$Mode = L + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times h$ Where $\Delta_1 = |f - f_1|$ and $\Delta_2 = |f - f_2|$

Here $\Delta_1 = |22 - 20| = 2$ and $\Delta_2 = |23 - 22| = 1$

$$Mode = 30 + \frac{2}{2 + 1} \times 10 = 30 + \frac{20}{3} = 30 + 6.67 = 36.67$$

Key note for calculation of Mean, Median/ Other positional Measures and Mode			
Cases/ Type of series/class Interval	**Mean**	**Median/ Other positional Measures**	**Mode**
To arrange data in ascending order or descending order	Not Necessary	Necessary	Necessary
To convert inclusive series into the exclusive series	Not Necessary	Necessary	Necessary
To convert unequal class intervals into equal class intervals	Not Necessary	Not Necessary	Necessary
To convert cumulative frequency distribution 'more than' or 'less than' form, into simple frequency	Necessary	Necessary	Necessary
To complete the class intervals in Open end series	Necessary	Not Necessary	Necessary
To construct the class interval in case of mid value series	Not Necessary	Necessary	Necessary

4.6 Example covering Cases/ Type of series/class Interval

Case I	Converted Class Interval of Case I	Case II	Case III	Case IV		Case V		Converted Class Interval For Case II to V
Inclusive Class intervals	Exclusive Class intervals	Open end series	Mid values	Class intervals	Cumulative frequency	Class intervals	Cumulative frequency	Class Interval
0-9	0-9.5	Below 10	5	Less than 10	5	More than 0	30	0-10
10-19	9.5-19.5	10-20	15	20	9	10	25	10-20
20-29	19.5-29.5	20-30	25	30	12	20	21	20-30

30-39	29.5-39.5	30-40	35	40	14	30	18	30-40
40-49	39.5-49.5	40-50	45	50	21	40	16	40-50
50-59	49.5-59.5	Above 50	55	60	30	50	9	50-60

V. RANGE, QUARTILE RANGE, DECILE RANGE, PERCENTILE RANGE

Notation and terminology used

Same as that of used in case of Quartile, Decile and Percentile

For all the three Individual Series, Discrete Series and Continuous Series			
Range =largest value-smallest value= $L-S$	Quartile Range $= Q_3 - Q_1$	Decile Range $= D_9 - D_1$	Percentile Range $= P_{90} - P_{10}$
Coefficient of Range $= \frac{L-S}{L+S}$	Coefficient of Quartile Deviation= $\frac{Q_3-Q_1}{Q_3+Q_1}$	Coefficient of Quartile Deviation= $\frac{D_9-D_1}{D_9+D_1}$	Coefficient of Quartile Deviation= $\frac{P_{90}-P_{10}}{P_{90}+P_{10}}$
	Semi Inter Quartile Range or Quartile Deviation= $\frac{Q_3-Q_1}{2}$		
All of these can be easily calculated			

VI. MEAN DEVIATIONS FROM MEAN, MEDIAN AND MODE

Notations and Terminology used

Mean Deviations from Mean, Median and Mode are represented by $MD_{\overline{X}},\ MD_M\ and\ MD_Z$ respectively, Rest are the same as used in case of Mean Median and Mode

Individual Series	$MD_{\overline{X}} = \sum \frac{\lvert X-\overline{X}\rvert}{N}$	$MD_M = \sum \frac{\lvert X-M\rvert}{N}$	$MD_Z = \sum \frac{\lvert X-Z\rvert}{N}$
Discrete Series	$MD_{\overline{X}} = \sum \frac{f\lvert X-\overline{X}\rvert}{N}$	$MD_M = \sum \frac{f\lvert X-M\rvert}{N}$	$MD_Z = \sum \frac{f\lvert X-Z\rvert}{N}$
Continuous Series	$MD_{\overline{X}} = \sum \frac{f\lvert m-\overline{X}\rvert}{N}$	$MD_M = \sum \frac{f\lvert m-M\rvert}{N}$	$MD_Z = \sum \frac{f\lvert m-Z\rvert}{N}$
Coefficient of mean deviations For all the three Individual Series, Discrete Series and Continuous Series			
	Coefficient of Mean Deviations from mean, $= \frac{MD_{\overline{X}}}{\overline{X}}$	Coefficient of Mean Deviations from median $= \frac{MD_M}{M}$	Coefficient of Mean Deviations from mode $= \frac{MD_Z}{Z}$

6.1 Example: Individual Series

	$X \rightarrow$	5	15	25	35	45	55	Total↓		
$\overline{X} = 30$	$\lvert X-\overline{X}\rvert \rightarrow$	25	15	5	5	15	25	90	$MD_{\overline{X}} = \sum \frac{\lvert X-\overline{X}\rvert}{n} = \frac{90}{6} = 30$	Coefficient of $MD_{\overline{X}} = \frac{MD_{\overline{X}}}{\overline{X}} = \frac{30}{30} = 1$
$M = 30$	$\lvert X-M\rvert \rightarrow$	25	15	5	5	15	25	90	$MD_M = \sum \frac{\lvert X-M\rvert}{n} = \frac{90}{6} = 30$	Coefficient of $MD_M = \frac{MD_M}{M} = \frac{30}{30} = 1$
Here Mode is not defined										

6.2 Example: Discrete series

		$\overline{X} = 34.67$		$M = 45$		$Z = 55$	
X	f	$\lvert X-\overline{X}\rvert$	$f\lvert X-\overline{X}\rvert$	$\lvert X-M\rvert$	$f\lvert X-M\rvert$	$\lvert X-Z\rvert$	$f\lvert X-Z\rvert$
5	5	29.67	148.35	40	200	50	250
15	4	19.67	78.68	30	120	40	160
25	3	9.67	29.01	20	60	30	90

35	2	0.33	0.66	10	20	20	40
45	7	10.33	72.31	0	0	10	70
55	9	20.33	182.97	10	90	0	0
	$N = \sum f$=30		$\sum f\lvert X - \overline{X}\rvert = 511.98$		$\sum f\lvert X - M\rvert = 490$		$\sum f\lvert X - Z\rvert = 610$
		$MD_{\overline{X}} = \sum \frac{f\lvert X - \overline{X}\rvert}{N} = \frac{511.98}{30} = 17.06$		$MD_M = \sum \frac{f\lvert X - M\rvert}{N} = \frac{490}{30} = 16.33$		$MD_Z = \sum \frac{f\lvert X - Z\rvert}{N} = \frac{610}{30} = 20.33$	
		Coefficient of $MD_{\overline{X}} = \frac{MD_{\overline{X}}}{\overline{X}} = \frac{17.06}{334.67} = 0.49$		Coefficient of $MD_M = \frac{MD_M}{M} = \frac{16.33}{45} = 0.36$		Coefficient of $MD_Z = \frac{MD_Z}{Z} = \frac{20.33}{55} = 0.37$	

6.3 Example: Continuous Series

			$\overline{X} = 34.67$		$M = 41.43$		$Z = 51.82$	
Class Intervals	m	f	$\lvert m - \overline{X}\rvert$	$f\lvert m - \overline{X}\rvert$	$\lvert m - M\rvert$	$f\lvert m - M\rvert$	$\lvert m - Z\rvert$	$f\lvert m - Z\rvert$
0-10	5	5	29.67	148.35	36.43	182.15	46.82	243.1
10-20	15	4	19.67	78.68	26.43	105.72	36.82	147.28
20-30	25	3	9.67	29.01	16.43	49.29	26.82	80.46
30-40	35	2	0.33	0.66	6.43	12.86	16.82	33.64
40-50	45	7	10.33	72.31	3.57	24.99	6.82	47.74
50-60	55	9	20.33	182.97	13.57	122.13	3.18	28.62
		$N = \sum f$=30		$\sum f\lvert m - \overline{X}\rvert =$		$\sum f\lvert m - M\rvert = 497.14$		$\sum f\lvert m - Z\rvert = 571.84$
			$MD_{\overline{X}} = \sum \frac{f\lvert m - \overline{X}\rvert}{N} = \frac{511.98}{30} = 17.06$		$MD_M = \sum \frac{f\lvert m - M\rvert}{N} = \frac{497.14}{30} = 16.57$		$MD_Z = \sum \frac{f\lvert m - Z\rvert}{N} = \frac{571.84}{30} = 19.06$	
			Coefficient of $MD_{\overline{X}} = \frac{MD_{\overline{X}}}{\overline{X}} = \frac{17.06}{334.67} = 0.49$		Coefficient of $MD_M = \frac{MD_M}{M} = \frac{16.57}{41.43} = 0.40 =$		Coefficient of $MD_Z = \frac{MD_Z}{Z} \frac{19.06}{51.82} = 0.37$	

VII. STANDARD DEVIATION

Notation and terminology used

Standard Deviation is represented by σ. Rest are the same as used in case of Arithmetic Mean

Standard Deviation in case of Individual series		
Direct Method $\sigma = \sqrt{\frac{\sum X^2}{n} - \left(\frac{\sum X}{n}\right)^2}$	Short-Cut Method $\sigma = \sqrt{\frac{\sum d^2}{n} - \left(\frac{\sum d}{n}\right)^2}$	Step Deviation Method $\sigma = \sqrt{\frac{\sum d'^2}{n} - \left(\frac{\sum d'}{n}\right)^2} \times c$
Standard Deviation in case of Discrete series		
Direct Method $\sigma = \sqrt{\frac{\sum fX^2}{N} - \left(\frac{\sum fX}{N}\right)^2}$	Short-Cut Method $\sigma = \sqrt{\frac{\sum fd^2}{N} - \left(\frac{\sum fd}{N}\right)^2}$	Step Deviation Method $\sigma = \sqrt{\frac{\sum fd'^2}{N} - \left(\frac{\sum fd'}{N}\right)^2} \times c$
Standard Deviation in case of Continuous series		
Direct Method $\sigma = \sqrt{\frac{\sum fm^2}{N} - \left(\frac{\sum fm}{N}\right)^2}$	Short-Cut Method $\sigma = \sqrt{\frac{\sum fd^2}{N} - \left(\frac{\sum fd}{N}\right)^2}$	Step Deviation Method $\sigma = \sqrt{\frac{\sum fd'^2}{N} - \left(\frac{\sum fd'}{N}\right)^2} \times c$
Coefficient of Standard Deviation and Coefficient of Variation		
Coefficient of Standard Deviation $= \frac{\sigma}{\overline{X}}$	**Coefficient of Variation** $= \frac{\sigma}{\overline{X}} \times 100$	

Note : 1. Similar to the arithmetic mean , the foundational approach for calculating standard deviation remains same across Individual, Discrete, and Continuous series, the primary distinction lies in computing the n, N, d, d'' for each type of series. Furthermore, because the Individual series contains no frequencies, frequency multiplication is entirely omitted across all three methods. However, multiplying by frequency (f) remains a mandatory step for both Discrete and Continuous series."

2. The Coefficient of Variation is obtained when the Coefficient of Standard Deviation is represented as a percentage.

7.1 Example: Discrete Series

X	$A = 25$ $d = m - A$	$c = 10$ $d' = \frac{m-A}{c}$	X^2	d^2	d'^2
5	-20	-2	25	400	4
15	-10	-1	225	100	1
25	0	0	625	0	0
35	10	1	1225	100	1
45	20	2	2025	400	4
55	30	3	3025	900	9
$\sum x$=180	$\sum d$=30	$\sum d'$=3	$\sum$ 7150	$\sum$ 1900	$\sum$ 19

Short-Cut Method

$$\sigma = \sqrt{\frac{\sum d^2}{n} - \left(\frac{\sum d}{n}\right)^2}$$

$$= \sqrt{\frac{1900}{6} - \left(\frac{30}{6}\right)^2} = \sqrt{\frac{1900 \times 6 - 900}{36}} = \sqrt{\frac{11400 - 900}{36}}$$

$$= \sqrt{\frac{10500}{36}} = \sqrt{291.67} = 17.07$$

Step Deviation Method

$$\sigma = \sqrt{\frac{\sum d'^2}{n} - \left(\frac{\sum d'}{n}\right)^2} \times c$$

$$= \sqrt{\frac{19}{6} - \left(\frac{3}{6}\right)^2} \times 10$$

$$= \sqrt{\frac{19 \times 6 - 9}{36}} \times 10$$

$$= \sqrt{\frac{114 - 9}{36}} \times 10$$

$$= \sqrt{\frac{105}{36}} \times 10 = \sqrt{2.9167} \times 10$$

$$= 17.07$$

7.2 Example: Continuous Series

Class Intervals	Frequency (f)	(m)	$A = 25$ $d = m - A$	fd	d^2	fd^2	$c = 10'$ $d = \frac{m-A}{c}$	fd'	d'^2	fd'^2
0-10	5	5	-20	-100	400	2000	-2	-10	4	20
10-20	4	15	-10	-40	100	400	-1	-4	1	4
20-30	3	25	0	0	0	0	0	0	0	0
30-40	2	35	10	20	100	200	1	2	1	2
40-50	7	45	20	140	400	2800	2	14	4	28
50-60	9	55	30	270	900	8100	3	27	9	81
	$\sum f$=30			$\sum fd$= 290		$\sum fd^2$ = 13500		$\sum fd'$ =29		$\sum fd'^2$ =135

Short Cut Method

$$\sigma = \sqrt{\frac{\sum fd^2}{N} - \left(\frac{\sum fd}{N}\right)^2} = \sqrt{\frac{13500}{30} - \left(\frac{290}{30}\right)^2}$$

$$= \sqrt{\frac{40500 - 84100}{900}}$$

$$= \sqrt{\frac{320900}{900}} = \sqrt{356.55} = 18.88$$

Step Deviation method

$$\sigma = \sqrt{\frac{\sum fd'^2}{N} - \left(\frac{\sum fd'}{N}\right)^2} \times c$$

$$= \sqrt{\frac{135}{30} - \left(\frac{29}{30}\right)^2} \times 10 = \sqrt{\frac{405 - 841}{900}} \times 10$$

$$= \sqrt{\frac{3209}{900}} \times 10 = \sqrt{3.5655} \times 10 = 1.888 \times 10 = 18.88$$

Coefficient of Standard Deviation $= \frac{\sigma}{\bar{X}} = \frac{18.88}{34.67}$ $=0.54456$	Coefficient of Variation $= \frac{\sigma}{\bar{X}} \times 100 = \frac{18.88}{34.67} \times 100$ $= 0.54456 \times 100 = 54.456$

VII. CONCLUSION

Ultimately, this comparative guide demonstrates that procedural fluency in measures of central tendency and dispersion is best achieved through structured, side-by-side computation. By tracing a single baseline dataset through the Individual, Discrete, and Continuous series frameworks, this paper demystifies the mathematical execution of the mean, median, mode, mean deviation, and standard deviation. This methodological approach directly facilitates the transition from concept to computation. When students observe the logical progression and comparative adaptation of formulas across different data structures, the calculations transition from isolated, intimidating equations into intuitive, step-by-step procedures. By shifting the learner's focus from rote memorization to analytical execution, this guide equips them with the foundational competence and confidence necessary to tackle advanced, real-world data analysis

ACKNOWLEDGEMENT

I would like to express my gratitude to GLM5 for assisting me in drafting this English text. Any book on statistical methods consists of standard content; however, in the paper focus is on a highly logical sequencing of topics.

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