

13

STATISTICS

MEASURES OF CENTRAL TENDENCY

It is that single value which may be taken as the most suitable representative of the data. This single value is known as the average. Average are generally, the central part of the distribution and therefore, they are also called the measures of Central Tendency.

It can be divided into two groups :

Mathematical average :

(i) Arithmetic mean or mean

(ii) Geometric mean

(iii) Harmonic mean

Positional average :

(i) Medium

(ii) Mode or positional average

ARITHMETIC MEAN

Individual observation or unclassified data :

If x_1, x_2, \ldots, x_n be n observations, then their arithmetic

mean is given by
$$
\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n}
$$
 or

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

Example 1 :

Financial average:

Elementric mean or mean

decometric mean

darmonic mean

darmonic mean

data average:

ELEOMEAN is quited

ELEOMEAN is qu If the heights of 5 persons are 144 cm, 153 cm, 150 cm, 158 cm and 155 cm respectively, then find mean height.

Sol. Mean Height =
$$
\frac{144 + 153 + 150 + 158 + 155}{5} = \frac{760}{5} = 152
$$

cm.

Arithmetic mean of discrete frequency distribution :

Let x_1, x_2 x_n be n observation and let f_1, f_2 ,...... f_n be their corresponding frequencies, then their mean

in is given by
$$
\overline{x} = \frac{x_1 + x_2 + + x_n}{n}
$$
 or $\overline{x} = A + \frac{b + 1 + b + 1}{b + 1}$
\n $\frac{1}{n}$
\n

Example 2 :

Find the arithmetic mean of the following frequency distribution :

Equality and a straighted at the values of x or (and) fare large the
 Equality of the state of the values of x or (and) fare large the
 Example 13.81
 Example in the contribution of antiffered calculation of arithmet Solonted Material Theorem and the tect metallical control in the substitution of $\frac{2+\ldots + x_n}{n}$ or

Electric mean by the previous formula used,

the deviation of mathematic mean by the previous formula used,

is quite te and a verage
 $\overline{x} = \frac{\sum f_i x_i}{\sum f_i} = \frac{1478}{107} = 13.81$

and a verage

on or unclassified data :

and a verage

on or unclassified data :

and a verage

on the methr arithmetic

is quite tedious and time consuming. In su **Short cut method :** If the values of x or (and) f are large the calculation of arithmetic mean by the previous formula used, is quite tedious and time consuming. In such case we take the deviation from an arbitrary point A **Solution** of and the values of x or (and) fare large the evaluation of arithmetic mean by the previous formula used, unite tedious and time consuming. In such case we take deviation from an arbitrary point A
 $\overline{x} = A + \frac$ 570
 $\Sigma f_i x_i = 1478$

r (and) f are large the

evious formula used,

In such case we take
 λ

umed mean

umed mean

umed mean

an, the deviation d_i

aay). In such case the

taken by
 $\overline{x} = A + h \left(\frac{\Sigma f_i u_i}{\Sigma f_i} \right)$

2 1478

re large the

mula used,

se we take

an

n

pplication

d_i ch case the
 $\left(\frac{\sum f_i u_i}{\sum f_i}\right)$
 w_n are the

spectively,

$$
\frac{F_{11}}{R} \text{ or } \frac{\overline{x}}{R} = A + \frac{\sum f_i d_i}{\sum f_i}, \text{ where, } A = \text{Assumed mean}
$$
\n
$$
d_i = x_i - A = \text{deviation for each term}
$$

 $\sum_{i=1}^{n} x_i$ Step deviation method:
 $= \frac{i-1}{n}$ Step deviation method: f x **Step deviation method:** Sometimes during the application of shortcut method of finding the mean, the deviation d. are divisible by a common number h (say). In such case the arithmetic is reduced to a great extent taken by $d_i = x_i - A =$ deviation for each term

Step deviation method: Sometimes during the application

of shortcut method of finding the mean, the deviation d_i

are divisible by a common number h (say). In such case the

arithmet A = deviation for each term

viation method: Sometimes during the application

cut method of finding the mean, the deviation d_i

iible by a common number h (say). In such case the

ic is reduced to a great extent taken quite tedious and time consuming. In such case we take

deviation from an arbitrary point A
 $\overline{x} = A + \frac{\sum f_i d_i}{\sum f_i}$, where, A = Assumed mean
 $= x_i - A =$ deviation for each term

po deviation method: Sometimes during the a viation from an arbitrary point A

= A + $\frac{\sum f_i d_i}{\sum f_i}$, where, A = Assumed mean

-A = deviation for each term

eviation method: Sometimes during the application

frout method of finding the mean, the deviation d_i

si It mentod : 1 the values of x or (and) I are large the
on of arithmetic mean by the previous formula used,
eledious and time consuming. In such case we take
ation from an arbitrary point A
 $A + \frac{\sum f_i d_i}{\sum f_i}$, where, A = A or antimized meaning in such case we take

dious and time consuming. In such case we take

in from an arbitrary point A
 $+\frac{\sum f_i d_i}{\sum f_i}$, where, A = Assumed mean

= deviation for each term

ation method: Sometimes during e application
deviation d_i
such case the
y
h $\left(\frac{\sum f_i u_i}{\sum f_i}\right)$
..., w_n are the
respectively,
i x_i
 $\frac{x_i}{x_i}$ ing the application

the deviation d_i

the deviation d_i

the sen by
 $= A + h \left(\frac{\sum f_i u_i}{\sum f_i} \right)$
 $w_3 \dots w_n$ are the
 $\dots x_n$ respectively,
 $\sum_{i=1}^n w_i x_i$
 $\sum_{i=1}^n w_i$
 $\sum_{i=1}^n w_i$

ber if their weight g the application
the deviation d_i
In such case the
en by
 $A + h\left(\frac{\sum f_i u_i}{\sum f_i}\right)$
3, w_n are the
x_n respectively,
 $\sum_{i=1}^{n} w_i x_i$
 $\sum_{i=1}^{n} w_i$
er if their weight s formula used,

the application

de deviation d_i

n such case the

by
 $+ h\left(\frac{\sum f_i u_i}{\sum f_i}\right)$, w_n are the

n respectively,
 $w_i x_i$
 $\frac{w_i x_i}{\sum w_i}$ Step deviation method: Sometimes during the application
of shortcut method of Simple mean, the deviation d_i
of shortcut method of finding the man, the deviation d_i
are divisible by a common number h (say). In such cas s during the application
mean, the deviation d_i
1(say). In such case the
ent taken by
 $\ln \overline{x} = A + h \left(\frac{\sum f_i u_i}{\sum f_i} \right)$
 w_2, w_3, \dots, w_n are the
 x_1, x_3, \dots, x_n respectively,
 x_3 as -
 $\sum_{i=1}^{n} w_i x_i$
 $\overline{x} = \frac{\sum_{i=1}^{$

$$
u_i = \frac{x_i - A}{h}, i = 1, 2, \dots n \quad \therefore \quad \text{mean } \overline{x} = A + h \left(\frac{\sum f_i u_i}{\sum f_i} \right)
$$

Weighted arithmetic mean : If w_1 , w_2 , w_3 ,, w_n are the weight assigned to the values $x_1, x_2, x_3, \dots, x_n$ respectively, then the weighted average is defined as - Weighted A.M. metic is reduced to a great extent taken by
 $=\frac{x_i - A}{h}$, $i = 1, 2, \dots, n$ \therefore mean $\overline{x} = A + h\left(\frac{\sum f_i u_i}{\sum f_i}\right)$

ighted arithmetic mean : If $w_1, w_2, w_3, \dots, w_n$ are the

ght assigned to the values $x_1, x_2, x_3, \dots, x_n$ re

of shortcut method of finding the mean, the deviation d_i
\nare divisible by a common number h (say). In such case the
\narithmetic is reduced to a great extent taken by
\n150 cm, 158
\n
$$
u_i = \frac{x_i - A}{h}
$$
, $i = 1, 2, \dots, n$ \therefore mean $\overline{x} = A + h\left(\frac{\sum f_i u_i}{\sum f_i}\right)$
\neight.
\n**Weighted arithmetic mean**: If $w_1, w_2, w_3, \dots, w_n$ are the
\nweight assigned to the values $x_1, x_2, x_3, \dots, x_n$ respectively,
\nthen the weighted average is defined as -
\nWeighted A.M.
\n**ibution**:
\n $\begin{aligned}\n & \text{subjected } A.M.\n \end{aligned}$ \n $\begin{aligned}\n & \text{subjected } A.M.\n \end{aligned}$ \n $\begin{aligned}\n & \text{subjected } A.M.\n \end{aligned}$ \n $\begin{aligned}\n & \text{subjected } B \text{ is defined as -}\\
 & \text{Weighted } A.M.\n \end{aligned}$ \n $\begin{aligned}\n & \text{subjected } B \text{ is defined as -}\\
 & \text{Weighted } B \text{ is defined as -}\\
 & \text{Weighted } B \text{ is given by -}\\
 & \text{Matrix} \end{aligned}$ \n $\begin{aligned}\n & \text{Example 3: } \\
 & \text{The weighted mean of first } n \text{ natural number if their weight} \\
 & \text{are same as the number is -}\\
 & \text{Matrix} \end{aligned}$ \n $\begin{aligned}\n & \text{Example 3: } \\
 & \text{The number is -}\\
 & \text{Matrix} \end{aligned}$ \n $\begin{aligned}\n & \text{Example 4: } \\
 & \text{Matrix} \end{aligned}$ \n $\begin{aligned}\n & \text{Example 3: } \\
 & \text{Matrix} \end{aligned}$ \n $\begin{aligned}\n & \text{Example 4: } \\
 & \text{Matrix} \end{aligned}$ \n $\begin{aligned}\n & \text{Example 3: } \\
 & \text{Matrix} \end{aligned}$ \n $\begin{aligned}\n & \text{Example 4: } \\
 & \text{Matrix} \end{aligned}$ \n $\begin{aligned}\n & \text{Example 5: } \\
 & \text{Matrix} \end{aligned}$ \n $\begin{aligned}\n & \text{Example 6: } \\
 & \text{Matrix}$

Example 3 :

 $=\frac{\sum f_i x_i}{\sum_{i=1}^{n} f_i}$ Example 3:
The weighted mean of first n natural number if their weight
are same as the number is -
(1) $\frac{n(n+1)}{n}$ (2) $\frac{n+1}{n}$ The weighted mean of first n natural number if their weight are same as the number is -

$$
\sum_{i=1}^{n} f_i
$$
 (1) $\frac{n(n+1)}{2}$ (2) $\frac{n+1}{2}$

$$
(3) \frac{2n+1}{3}
$$
 (4) None of these

Sol. (3). Here the numbers are 1,2, 3,......, n and their weights

also are respectively 1, 2, 3......n so weighted mean = $\frac{1}{\sum w}$

SUDY MATERIAL: MATH
\n**(3).** Here the numbers are 1,2, 3,......, n and their weights
\nalso are respectively 1, 2, 3,......, n so weighted mean =
$$
\frac{\sum wx}{\sum w}
$$

\n= $\frac{1.1+2.2+3.3+....+n}{1+2+3+....+n} = \frac{1^2+2^2+3^2+....n^2}{1+2+3+....+n}$
\n= $\frac{n(n+1)(2n+1)}{6} \times \frac{2}{n(n+1)} = \frac{2n+1}{3}$
\n**COMDIAI** The mean of a set of number is \overline{x} if each number is
\n $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2$

of sizes n_1, n_2, \dots, n_k respectively then the mean \bar{x} if the (ii) composite series is given by

$$
\overline{\mathbf{x}} = \frac{\mathbf{n}_1 \overline{\mathbf{x}}_1 + \mathbf{n}_2 \overline{\mathbf{x}}_2 + \dots + \mathbf{n}_k \overline{\mathbf{x}}_k}{\mathbf{n}_1 + \mathbf{n}_2 + \dots + \mathbf{n}_k}
$$

Example 4 :

The mean income of a group of persons is Rs. 400. Another group of persons has mean income Rs. 480. If the mean income of all the persons in the two groups together is Rs.
430, then find the ratio of the number of persons in the (i) 430, then find the ratio of the number of persons in the groups.

Sol. 1 1 2 2 1 2 n x n x x n n 1 2 x 400, x 480, x 430 1 2 1 2 n (400) n (480) ⁴³⁰ n n 30n1= 50n² ¹ 2 n 5 n 3 i 1 (x x) = 0 or ⁿ i 1 x nx or ⁿ x nx = 0 ⁱ ^x

Properties of Arithmetic mean:

1. In a statistical data, the sum of the deviation of items from A.M. is always zero.

i.e.
$$
\sum_{i=1}^{n} (x_i - \overline{x}) = 0
$$
 or $\sum_{i=1}^{n} x_i - n\overline{x}$
\nor $n\overline{x} - n\overline{x} = 0$ $(\because \overline{x} = \frac{\sum x_i}{n})$
\nGeometric Mean of grouped data :
\nLet x_1, x_2, \dots, x_n be n observation and let f_1, f_2 their corresponding frequency then their Geon

2. In a statistical data, the sum of squares of the deviation of

items from A.M. is least i.e.
$$
\sum_{i=1}^{n} (x_i - \overline{x})^2
$$
 is least.

- **3.** If each of the n given observation be doubled, then their mean is doubled.
- **4.** If \bar{x} is the mean of x_1, x_2, \dots, x_n , The mean of ax_1 , ax_2, \dots, ax_n is a \bar{x} where a is any number different from zero.
- **5.** Arithmetic mean is independent of origin i.e. it is not effected by any change in origin.

STUDY MATERIAL : MATHEMATICS

Example 5 :

 $\overline{\Sigma_{\text{W}}}$ by λ , then find the mean of the new set. Σ w x The mean of a set of number is \bar{x} if each number is increased

STUDY MATERIAL: MATHEMATICS
\nnumbers are 1,2, 3,......, n and their weights
\ntrively 1, 2, 3,......, n so weighted mean =
$$
\frac{\sum wx}{\sum w}
$$

\n $\frac{2+3.3+......+n}{2+3+......+n} = \frac{1^2 + 2^2 + 3^2 +.....+n}{1 + 2 + 3 + + n}$
\n**Sol.** $\overline{x} = \frac{x_1 + x_2 + + x_n}{n} = \frac{\sum x_i}{n}$ $\therefore \sum x_i = n \overline{x}$
\n $\frac{(2n+1)}{6} \times \frac{2}{n(n+1)} = \frac{2n+1}{3}$
\n**NERTISAND DEMENTISOFARITHMETIC MEAN**
\n**MeRTISAND DEMENTSOFARITHMETIC MEAN**
\n**MeRTISAND DEMENTSOFARITHMETIC MEAN**
\n**MeRTISAND DEMENTSOFARITHMETIC MEAN**
\n**Merits of Arithmetic Mean :**
\n**Meck**
\

MERITSAND DEMERITS OFARITHMETIC MEAN Merits of Arithmetic Mean :

- (i) It is rigidly defined.
- (ii) It is based on all the observation taken.
- (iii) It is calculated with reasonable ease and rapidity.
- (iv) It is least affected by fluctuations in sampling.
- (v) It is based on each observation and so it is a better representative of the data.
- (vi) It is relatively reliable
- (vii) Mathematical analysis of mean is possible.

Demerits of Arithmetic Mean :

- It is severely affected by the extreme values.
- (ii) It cannot be represented in the actual data since the mean does not coincide with any of the observed value.
- (iii) It cannot be computed unless all the items are known.
- (iv) It cannot be calculated for qualitative data incapable of numerical measurements.
- (v) It cannot be used in the study of ratios, rates etc.

GEOMETRIC MEAN

(x) It cannot be used in the study of ratios, rates etc.
 $\frac{1}{2}$ ⇒ 30n₁ = 50n₂

(x) It cannot be used in the study of ratios, rates etc.

Individual data : If $x_1, x_2, x_3, \ldots, x_n$ are n values of a v

x, none of t **Individual data :** If $x_1, x_2, x_3, \ldots, x_n$ are n values of a variate x, none of them being zero, then the geometric mean G is defined as $G = (x_1 x_2 x_3....x_n)^{1/n}$ It is least affected by fluctuations in sampling.
It is based on each observation and so it is a better
representative of the data.
It is relatively reliable
Mathematical analysis of mean is possible.
Demerits of Arithme I the observation taken.

with reasonable ease and rapidity.

del by fluctuations in sampling.

each observation and so it is a better

f the data.

liable

each observation and so it is a better

f the data.

liable

eac with reasonable ease and rapidity.

Evalty fluctuations in sampling.

Evalty fluctuations in sampling.

Find data.

Find data.

Individuals of mean is possible.
 thmetic Mean :

Evalted in the actual data since the mean ith any of the observed value.

ed unless all the items are known.

tted for qualitative data incapable of

tents.

the study of ratios, rates etc.
 $x_1, x_2, x_3, \dots, x_n$ are n values of a variate

ng zero, then the geometr of mean is possible.
 CMean:

y the extreme values.

d in the actual data since the mean

any of the observed value.

unless all the items are known.

I for qualitative data incapable of

ts.

study of ratios, rates etc Example 10 the data.

The data.

The data.

In the data.

also so fream is possible.
 hmetic Mean :

existed in the actual data since the mean

exith any of the observed value.

exit any of the observed value.

culated The diameteric Mean is possible.

also lie alysis of mean is possible.
 hmetic Mean :

exerted by the extreme values.

esented in the actual data since the mean

pputed unless all the items are known.

culated for quali data : If $x_1, x_2, x_3, \dots, x_n$ are n values of a variate
them being zero, then the geometric mean G is
 $J = (x_1 x_2 x_3 \dots x_n)^{1/n}$
ilog $\left(\frac{\log x_1 + \log x_2 + \dots + \log x_n}{n}\right)$
iilog $\left(\frac{1}{n} \sum_{i=1}^n \log x_i\right)$
Mean of grouped data :
 Ineasurements.

be used in the study of ratios, rates etc.
 MEAN
 Idata: If $x_1, x_2, x_3, \dots, x_n$ are n values of a variate

f them being zero, then the geometric mean G is
 $G = (x_1 x_2 x_3 \dots x_n)^{1/n}$

trilog $\left(\frac{\log x_1 + \$ 1, x₂, x₃,........, x_n are n values of a variate
g zero, then the geometric mean G is
x₃....x_n^{1/n}
x₁ + log x₂ + + log x_n
n
n
m
monded data :
m observation and let f₁, f₂,......,f_n be
frequen $\left\{\n\begin{aligned}\n&\text{If } x_1, x_2, x_3, \dots, x_n \text{ are n values of a variate} \\
&\text{being zero, then the geometric mean } G \text{ is} \\
&\left\{\n\frac{x_2 x_3 \dots x_n}{n}\n\right\}^{1/n}\n\end{aligned}\n\right.\n\left(\n\frac{\log x_1 + \log x_2 + \dots + \log x_n}{n}\n\right)\n\left(\n\frac{1}{n} \sum_{i=1}^{n} \log x_i\n\right)\n\text{or of grouped data:}\n\frac{1}{n} \text{or observed then their Geometric Mean}\n\dots\n\frac{x_n^{f_n}}{n}\n\right)^{1/N}$ f

If $x_1, x_2, x_3, \dots, x_n$ are n values of a variate

being zero, then the geometric mean G is
 $\frac{x_1 x_2 x_3 \dots x_n}{\left(\frac{\log x_1 + \log x_2 + \dots + \log x_n}{n}\right)}$
 $\left(\frac{1}{n} \sum_{i=1}^n \log x_i\right)$
 n of grouped data :
 $\frac{1}{n}$ be n observation

or
$$
G = \text{antilog } \left(\frac{\log x_1 + \log x_2 + \dots + \log x_n}{n} \right)
$$

or
$$
G = \text{antilog}\left(\frac{1}{n}\sum_{i=1}^{n} \log x_i\right)
$$

Geometric Mean of grouped data :

n their corresponding frequency then their Geometric Mean Let x_1, x_2, \dots, x_n be n observation and let f_1, f_2, \dots, f_n be is metric mean G is
 $\frac{\log x_n}{x_n}$
 $\left(\frac{f_1}{f_1}, \frac{f_2}{f_2}, \dots, \frac{f_n}{f_n}\right)$ be

Geometric Mean
 $\sum_{i=1}^n f_i$ $\left(\frac{1}{n}\right)^{1}$ is $\left(\frac{1}{n}\right)^{1}$ is $\left(\frac{1}{n}\right)^{1}$ is $\left(\frac{1}{n}\right)^{1}$ is $\left(\frac{1}{n}\right)^{1}$ is $\left(\frac{1}{n}\right)^{1}$ is $\left(\frac{1}{n}\right)^{1/N}$ where $N = \sum_{i=1}^{n} f_i$
 $\left(\frac{1}{n}\right)^{1/N}$ where $N = \sum_{i=1}^{n} f_i$
 $\left(\frac{1}{n}\right)^{1}$ is $\frac{1}{n} \sum_{i=1}^{n} \log x_i$

of grouped data :

be n observation and let $f_1, f_2,......, f_n$ be

g frequency then their Geometric Mean
 $......x_n^{f_n}\Big)^{1/N}$ where $N = \sum_{i=1}^{n} f_i$
 $\sum_{i=1}^{n} f_i \log x_i$
 $\sum_{i=1}^{n} f_i$ $\sum_{i=1}^{n} \log x_i$

(rouped data:

in observation and let $f_1, f_2,......, f_n$ be

frequency then their Geometric Mean
 $x_{n}^{f_n}\Big)^{1/N}$ where $N = \sum_{i=1}^{n} f_i$
 $f_i \log x_i$
 $\sum_{i=1}^{n} f_i$ $\begin{aligned}\n\mathbf{x}_1 \mathbf{x}_2 \mathbf{x}_3 \dots \mathbf{x}_n\end{aligned}\n\left(\frac{\log x_1 + \log x_2 + \dots + \log x_n}{n}\right) \\
\left(\frac{1}{n} \sum_{i=1}^n \log x_i\right) \\
\mathbf{n} \text{ of grouped data:} \\
\frac{n}{n} \text{ be no observation and let } \mathbf{f}_1, \mathbf{f}_2, \dots, \mathbf{f}_n \text{ be } \text{no observation,} \\
\text{where } \mathbf{N} = \sum_{i=1}^n \mathbf{f}_i \\
\dots\n\left(\sum_{i=1}^n \mathbf{f}_i \log x_i\right) \\
\$

$$
G = \left(x_1^{f_1} x_2^{f_2} \dots x_n^{f_n} \right)^{1/N} \text{ where } N = \sum_{i=1}^n f_i
$$

$$
\lim_{\text{defineed as } G = (x_1 x_2 x_3....x_n)^{1/n}}
$$
\n
$$
\text{or } G = \text{antilog}\left(\frac{\log x_1 + \log x_2 + + \log x_n}{n}\right)
$$
\n
$$
\text{or } G = \text{antilog}\left(\frac{1}{n}\sum_{i=1}^{n} \log x_i\right)
$$
\n
$$
\text{or } G = \text{antilog}\left(\frac{1}{n}\sum_{i=1}^{n} \log x_i\right)
$$
\n
$$
\text{cometric Mean of grouped data:}
$$
\n
$$
\frac{\sum x_i}{n}\right)
$$
\n
$$
\text{f squares of the deviation of}
$$
\n
$$
\text{f squares of the deviation of}
$$
\n
$$
\sum_{i=1}^{n} (x_1 - \overline{x})^2
$$
\nis least.\n
$$
\sum_{i=1}^{n} (x_1 - \overline{x})^2
$$
\nis least.\n
$$
\sum_{i=1}^{n} \left(\sum_{i=1}^{n} x_1^2 \cdot \dots \cdot x_n^2\right)^{1/N}
$$
\n
$$
\text{where } N = \sum_{i=1}^{n} f_i
$$
\n
$$
\text{aation be doubled, then their}
$$
\n
$$
\text{aation of } \sum_{i=1}^{n} f_i
$$

Example 6 :

Find the geometric mean of numbers $7, 7^2, 7^3, \ldots, 7^n$.

Sol. Geometric mean of number 7, 7² , 7³ ,.......,7ⁿ = (7. 7² . 7³7ⁿ)1/n = (71 + 2 + 3 ++n)1/n

$$
= \left[7 \frac{n(n+1)}{2} \right]^{1/n} = 7 \frac{(n+1)}{2}
$$

HARMONIC MEAN

Harmonic mean is reciprocal of mean of reciprocal. **Individual observation :**

The H.M. of x_1, x_2, \ldots, x_n of n observation is given by

STICS	(b) If n is even then	100
6:	(b) If n is even then	
6:	(c) If n is even then	
6:	(d) If n is even then	
6:	(e) If n is even then	
6:	(f) $\frac{n}{2}$	
7:	$\frac{n}{2}$	
8:	100	
9:	100	
100	100	
110	100	
12:	100	
13:	100	
14:	100	
15:	100	
16:	17	
17:	18	
18:	19	
19:	100	
100	100	
1100	100	
12:	100	
13:	100	
14:	100	
15:	100	
16:	100	
17:	100	
18:	100	
19:	110	
100	100	

H.M. of grouped data :

Let x_1, x_2, \dots, x_n be n observation and let f_1, f_2, \dots, f_n be their corresponding frequency then H.M. is

$$
H = \frac{\sum_{i=1}^{n} f_i}{\sum_{i=1}^{n} \left(\frac{f_i}{x_i}\right)}
$$

Example 7 :

Find the harmonic mean of 2, 4, 5 is Sol. The harmonic mean of 2,4 and 5 is

$$
=\frac{3}{\frac{1}{2} + \frac{1}{4} + \frac{1}{5}} = \frac{60}{19} = 3.16
$$

Note: Relation between A.M., G.M. and H.M.

 $A.M. \geq G.M. \geq H.M.$

Equality sign holds only when all the observations in the series are same.

MEDIAN

Median is the middle most or the central value of the variate in a set of observations, when the observations are arranged either in ascending or in descending order of their magnitudes. It divides the arranged series in two equal parts.

Median of an individual series :

Let n be the number of observations-

- (i) arrange the data in ascending or descending order.
- (ii) **(a) if n is odd then -**

Median (M) = value of
$$
\left(\frac{n+1}{2}\right)^{th}
$$
 observation

(b) If n is even then

Median (M) = mean of
$$
\left(\frac{n}{2}\right)^{th}
$$
 and $\left(\frac{n}{2} + 1\right)^{th}$ observation

⁼ 1/n n (n 1) (n 1) 2 2 7 7 1 1 1 i 1 and i.e. th th n n observation 1 observation 2 2 ^M 2 th n 1 value =

Example 8 :

The number of runs scored by 11 players of a cricket team of India are 5, 19, 42, 11, 50, 30, 21, 0, 52, 36, 27. Find the median. Manuva NCED LEARNING

and $\left(\frac{n}{2}+1\right)^{th}$ observation

1 players of a cricket team

21, 0, 52, 36, 27. Find the

mding order

50, 52
 $\frac{11+1}{2}$ th value = 6th value

ex y distribution : **SPONS AND ANALYZING**
 EDENTADYANGED LEARNING

and $\left(\frac{n}{2}+1\right)^{th}$ observation
 $\left(\frac{n}{2}+1\right)^{th}$ observation

11 players of a cricket team

11, 21, 0, 52, 36, 27. Find the

ending order

2, 50, 52
 $\left(\frac{11+1}{2}\right)^{$ **SPONTADVANCED LEARNING**

and $\left(\frac{n}{2}+1\right)^{th}$ observation
 $\left(\frac{n}{2}+1\right)^{th}$ observation

11 players of a cricket team

1, 21, 0, 52, 36, 27. Find the

ending order

2, 50, 52
 $\left(\frac{11+1}{2}\right)^{th}$ value = 6th value

Sol. Let us arrange the value in ascending order

of India are 5, 19, 42, 11, 50, 30, 21, 0, 52, 36, 27. Find the median.

\n1. e.
$$
H = \frac{n}{\sum_{i=1}^{n} \frac{1}{x_i}}
$$

\n1. b. Let us arrange the value in ascending order 0, 5, 11, 19, 21, 27, 30, 36, 42, 50, 52

\n2. The total number of values in the original value of the value in the original value of the value of the square.

\n3. The total number of values are labeled as $I = \left(\frac{n+1}{2}\right)^{th}$ value of $\left(\frac{n+1}{2}\right)^{th}$ value of \left

Now 6th value in data is 27

 \therefore Median = 27 runs

Median of the discrete frequency distribution :

 $\sum f_i$ Algorithm to find the median : **Step-I :** Find the cumulative frequency (C.F.)

Step-II : Find
$$
\frac{N}{2}
$$
, where N = $\sum_{i=1}^{n} f_i$

Step-III : See the cumulative frequency (C.F.) just greater

than $\frac{N}{2}$ and determine the corresponding value of the $\frac{1}{2}$ and determine the corresponding value of the

variable.

Step-IV The value obtained in step III is the median.

Example 9 :

Find the median for the following distribution :

$$
N = 120 = \sum f_i
$$
 $\therefore \frac{N}{2} = 60$

We find that the C.F. just greater than $\frac{N}{2}$ is 65 and the $\frac{1}{2}$ is 65 and the value of x corresponding to 65 is 5, therefore median is 5.

Median of ground data or continuous series :

- Let the no. of observations be n
- (i) Prepare the cumulative frequency table
- (ii) Find the median class i.e. the class in which the

$$
\left(\frac{N}{2}\right)^n
$$

observation lies.

(iii) The median value is given by the formula

Median (M) =
$$
\ell + \left[\frac{\left(\frac{N}{2}\right) - F}{f}\right] \times h
$$

\n**Product:** ℓ
\n**Property**

N = total limit frequency = \sum f_i

- ℓ = lower of median class
- $f = frequency of the median class$
- $F =$ cumulative frequency of the class preceding the median class
- $h =$ class interval (width) of the median class

Properties of Median :

- (1) The sum of the absolute value of deviations of the items from median is minimum.
- (2) It is a positional average and it is not influenced by the position of the items.

MODE

Mode is that value in a series which occurs most frequently. In a frequency distribution, mode is that variable which has the maximum frequency.

Computation of Mode :

Mode for individual series : In the case of individual series, the value which is repeated maximum number of times is the mode of the series -

Example 10 :

Find the mode of the data 3, 2, 5, 2, 3, 5, 6, 6, 5, 3, 5, 2, 5.

Sol. Since 5 is repeated maximum number of times, therefore mode of the given data is 5.

Mode for grouped data (discrete frequency distribution series) : In the case of discrete frequency distribution, mode is the value of the variate corresponding to the maximum frequency. **uple 10:**
 Solution the mode of the data 3, 2, 5, 2, 3, 5, 6, 6, 5, 3, 5, 2, 5.

Since 5 is repeated maximum number of times, therefore

Since 5 is repeated maximum number of times, therefore

distribution is positivel of the data 3, 2, 5, 2, 3, 5, 6, 6, 5, 3, 5, 2, 5.

ated maximum number of times, therefore

the median reflecting the fact

ven data is 5.

ated maximum number of times, therefore

the median reflecting the fact

cach sc

Mode for continuous frequency distribution :

- (i) First find the model class i.e. the class which has maximum frequency. The model class can be determined either by inspecting or with the help of grouping data.
- (ii) The mode is given by the formula

Mode =
$$
\ell + \frac{f_m - f_{m-1}}{2f_m - f_{m-1} - f_{m+1}} \times h
$$

where, $\ell \rightarrow$ lower limit of the model class

 $h \rightarrow$ width of the model class

 $f_m \rightarrow$ frequency of the model class

 $f_{m-1} \rightarrow$ frequency of the class preceding model class

 f_{m+1} \rightarrow frequency of the class succeeding model class

 2^j (iii) In case the model value lies in a class other than the one **STUDY MATERIAL: MATHEMATICS**
 $h \rightarrow$ width of the model class
 $f_m \rightarrow$ frequency of the model class
 $f_{m-1} \rightarrow$ frequency of the class preceding model class
 $f_{m+1} \rightarrow$ frequency of the class succeeding model class

(ii) I **STUDY MATERIAL: MATH**
 STUDY MATERIAL: MATH

a or continuous series :

tions be n
 $f_m \rightarrow$ width of the model class
 $f_{m-1} \rightarrow$ frequency of the class preceding mode

ass i.e. the class in which the $\left(\frac{N}{2}\right)^{th}$
 f **EXECT AND SET UDY MATERIAL: MATHE

ata or continuous series :

ata or continuous series :

ata or continuous series :
 \begin{array}{ccc}\n & h \rightarrow \text{width of the model class} \\
 & f_m \rightarrow \text{frequency of the model class} \\
 & f_{m-1} \rightarrow \text{frequency of the class preceding model} \\
 \text{class i.e. the class in which the } \left(\frac{N}{2}\right)^{\text{th}} \\
 \text{(ii) } \text{In case the model STUDY MATERIAL: MATH**
 STUDY MATERIAL: MATH

a or continuous series :

tions be n
 $f_m \rightarrow$ frequency of the model class
 $f_{m-1} \rightarrow$ frequency of the class preceding mode

ass i.e. the class in which the $\left(\frac{N}{2}\right)^{th}$ containing maximum frequency (model class) then we use the following formula : **STUDY MATERIAL: MATHEMATICS**
 $h \rightarrow$ width of the model class
 $f_m \rightarrow$ frequency of the model class
 $f_{m-1} \rightarrow$ frequency of the class preceding model class
 $f_{m+1} \rightarrow$ frequency of the class succeeding model class

In cas **STUDY MATERIAL: MATHEMATICS**
of the model class
mcy of the model class
nency of the class preceding model class
uency of the class succeeding model class
nodel value lies in a class other than the one
naximum frequency (**STUDY MATERIAL: MATHEMATICS**
of the model class
ency of the model class
uency of the class preceding model class
quency of the class succeeding model class
model value lies in a class other than the one
maximum frequency **STUDY MATERIAL: MATHEMATICS**
th of the model class
quency of the model class
equency of the class preceding model class
requency of the class succeeding model class
be model value lies in a class other than the one
g max

$$
\left[\frac{\text{N}}{2}\right] - \text{F}\left[\right] \qquad \qquad \text{Mode}: \ \ell + \frac{f_{m+1}}{f_{m-1} + f_{m+1}} \times \text{h}
$$

Properties of Mode : It is not effected by presence of extremely large or small items.

Symmetric distribution :

A distribution is a symmetric distribution if the values of mean, mode and median coincide. In a symmetric distribution frequencies are symmetrically distributed on both sides of the centre point of the frequency curve.

A distribution which is not symmetric is called a skewed distribution. In a moderately asymmetric distribution, the interval between the mean and the median is approximately one-third of the interval between the mean and the mode i.e., when have the following empirical relation between them,

 $Mean - Mode = 3 (Mean - Median)$

 \implies Mode = 3 Median – 2 Mean.

It is known as Empirical relation.

Positively skewed :

Lual series : In the case of individual series,

is repeated maximum number of times is

is repeated maximum number of times is
 Positively skewed

the data 3, 2, 5, 2, 3, 3, 5, 6, 6, 5, 3, 5, 2, 5.
 Positively skewe ich is repeated maximum number of times is

the series contributed the series of the data 3, 2, 5, 2, 3, 5, 6, 6, 5, 3, 5, 2, 5.

Le of the data 3, 2, 5, 2, 3, 5, 6, 6, 5, 3, 5, 2, 5.

Le of the data 3, 2, 5, 2, 3, 5, 6, data 3, 2, 5, 2, 3, 5, 6, 6, 5, 3, 5, 2, 5.

maximum number of times, therefore

distribution is positively ske

the median reflecting the fact

distribution is positively ske

the median reflecting the fact

cach score i lon of Mode :

Mode = 3 Median – 2 **Figure 1.1**
 Example 1.1
 Example 1.1
 Example 1.2
 Example 1.2 A distribution is positively skewed when is has a tail extending out to the right (larger numbers) When a distribution is positively skewed, the mean is greater than the median reflecting the fact that the mean is sensitive to each score in the distribution and is subject to large shifts when the sample is small and contains extreme scores.

Mean > Median > Mode

Negatively skewed :

A negatively skewed distribution has an extended tail pointing to the left (smaller numbers) and reflects bunching of numbers in the upper part of the distribution with fewer scores at the lower end of the measurement scale.

Mean < Median < Mode.

In a moderately asymmetric distribution, the interval between the mean and the median is approximately onethird of the interval between the mean and the mode i.e., when have the following empirical relation between them, Empirical formula : mode $=$ 3 median $-$ 2 mean

Coefficient of skewness = $\frac{\text{Mean} - \text{Mode}}{\sigma}$

Limitations of central values :

An average, such as the mean or the median only locates the centre of the data and does not tell us anything about the spread of the data.

Example 11 :

If the value of mode and mean is 60 and 66 respectively, then find the value of median.

Sol. Mode = 3 Median -2 Mean

$$
\therefore \text{ Median} = \frac{1}{3} \text{ (mode} + 2 \text{ mean)} = \frac{1}{3} \text{ (60 + 2 × 66)} = 64
$$

MEASURES OF DISPERSION

Dispersion is the measure of the variations. The degree to which numerical data tend to spread about an average value is called the dispersion of the data.

The measures of dispersion commonly used are -

- (i) Range
- (ii) Quartile deviation or the semi-interquartile range
- (iii) Mean Deviation
- (iv) Standard Deviation

Range : The difference between the greatest and the least values of variate of a distribution, is called the range of that distribution. If the distribution is continuous grouped distribution, then its

Range = upper limit of the maximum class – lower limit of the minimum class.

Also the coefficient of the range

$$
= \frac{\text{difference of extreme values}}{\text{sum of extreme values}} \qquad \qquad \text{the given centr.}
$$

Quartile deviation : Quartile deviation Q = $\frac{Q_3 - Q_1}{2}$;

Coefficient of Quartile deviation = $\frac{Q_3 - Q_1}{Q_3 + Q_1}$

Note : If the distribution is symmetrical, then $Q = M - Q_1 = Q_3 - M$ where M is the median.

Mean Deviation : Mean deviation is defined as the arithmetic mean of the absolute deviations of all the values taken about any central value. **EXECUTE ARRIVATE CONSTRAINERT CONSTRAINERT CONSTRAINERT CONSTRAINERT (1)**
 $\begin{bmatrix}\n1 & 0 & 0 \\
1 & 0 & 0\n\end{bmatrix}\n= Q_3 - M$ where M is the median.
 iation : Mean deviation is defined as the arithmetic

he absolute deviations of **EDIMADVANGED LEARNING**

SUBMADVANGED LEARNING

SIXTIDUTION IS symmetrical, then
 $Q_3 - M$ where M is the median.
 on : Mean deviation is defined as the arithmetic

absolute deviations of all the values taken

tral value

(i) Mean deviation of individual observations :

If x_1, x_2, \dots, x_n are n values of a variable x, then the mean deviation from an average A (median or AM) is given by

M.D. =
$$
\frac{1}{n} \sum_{i=1}^{n} |x_i - A| = \frac{1}{n} \sum |d_i|
$$
, where $d_i = x_i - A$

Example 12 :

Find the mean deviation about median from the following data : 340, 150, 210, 240, 300, 310, 320.

SEXECUTE:

Mode: If the distribution is symmetrical, then
 $Q = M - Q_1 = Q_3 - M$ where M is the median.

Mean Deviation : Mean deviation is defined as the are

mean of the absolute deviations of all the value

about any centr **Sol.** Arranging the observations in ascending order of magnitude, we have 150, 210, 240, 300, 310, 320, 340 clearly, the middle observation is 300. So, median = 300 Calculation of Mean deviation

Mean deviation =
$$
\frac{1}{n} \sum |d_i| = \frac{1}{7} \sum |x_i - 300| = \frac{370}{7} = 52.8
$$

(ii) Mean deviation of a discrete frequency distribution : If x_1, x_2, \ldots, x_n are n observation with frequencies f_1, f_2, \ldots, f_n , then mean deviation from an average A is given by -

Mean Deviation =
$$
\frac{1}{n} \sum f_i |x_i - A|
$$
, where $N = \sum_{i=1}^{n} f_i$

 $=\frac{\text{difference of extreme values}}{\text{time of frequency}}$ the given central value (median or mean) **Dreamble the deviation of the detail on the deviation of the deviation is the deviation of a great of deviation of a discrete frequency distribution :
 Example 19 13** Mean Deviation = $\frac{1}{n} \sum f_i |x_i - A|$, where a detained the range of that

similar distribution : For calculating mean

class – lower limit of **a** since distribution is for a ground or continuous frequency greatest and the least

alled the range of that

continuous grouped (iii) Mean deviation of a ground or continuous

class – lower limit of

as for a discrete frequency distribution. The

is that here we have to obtain the mly used are **(ii) Mean deviation of a discrete frequency distribution :**

If $x_1x_2,...,x_n$ are n observation with frequencies f_1, f_2

then mean deviation for an average A is given by -

Mean Deviation f_2 are If $x_1, x_2, ..., x_n$ are n observation with frequencies $f_1, f_2, ..., f_n$ are n observation with frequencies $f_1, f_2, ..., f_n$ are n mean deviation from an average A is given by

Mean Deviation $= \frac{1}{n} \sum f_i |x_i - A|$, where $N = \sum_{i=1}^{$ $\frac{70}{7}$ = 52.8

ion:

1, f₂ f_n,

by -
 $\sum_{i=1}^{n} f_i$

requency

ion of a

e is same 300

= $\frac{370}{7}$ = 52.8

ribution :

ies f_1, f_2 f_n ,

ven by -

N = $\sum_{i=1}^{n} f_i$

us frequency

eviation of a

edure is same

mly difference **(iii) Mean deviation of a ground or continuous frequency distribution :** For calculating mean deviation of a continuous frequency distribution the procedure is same as for a discrete frequency distribution. The only difference is that here we have to obtain the mid-point of the various classes and take the deviations of these mid points from

VARIANCE AND STANDARD DEVIATION

 $\frac{-Q_1}{2}$; The variance of a variate x is the arithmetic mean of the squares of all deviations of x from the arithmetic mean of the shoemations and is denoted by seen (c) or π^2 . $-Q_1$ The positive square root of the variance of a variate x is $\overline{+Q_1}$ known as standard deviation i.e. standard deviation The variance of a variate x is the arithmetic mean of the the observations and is denoted by var (x) or σ^2 .

$$
=+\sqrt{\text{var}(x)}
$$

265

The variance is a measure in squared units and has little meaning with respect to the data. Thus, the standard deviation is a measure of variability expressed in the same units as the data. The standard deviation is very much like a mean or an "average" of these deviations. **STUDY MATI**

The in squared units and has
 $\therefore d_1 = x_i - A; i = 1, 2, n$

dect to the data. Thus, the

a measure of variability

its as the data. The standard

its as the data. The standard

its as the data. The standard

its s a measure in squared units and has $\therefore d_1 = x_i - A; i$

with respect to the data. Thus, the

attion is a measure of variability

e same units as the data. The standard

ry much like a mean or an "average"

where $N = \sum_{i=1}^{$ **STUDY MATERIAL:**

measure in squared units and has

ith respect to the data. Thus, the

ith respect to the data. Thus, the

ion is a measure of variability

ame units as the data. The standard

much like a mean or an "av **STUDY MATERIAL:** MA

is a measure in squared units and has
 $\therefore d_1 = x_i - A; i = 1, 2, ..., n$

idion is a measure of variability

the same units as the data. Thus, the

he same units as the data. The standard

ery much like a mea **STUDY MATERIAL: MATE**

is a measure in squared units and has
 $\therefore d_1 = x_i - A; i = 1, 2, n$

g with respect to the data. Thus, the

viation is a measure of variability

he same units as the data. The standard

ery much like a **STUDY MATERIAL: MA**

is a measure in squared units and has
 $\therefore d_1 = x_i - A_1 i = 1, 2, n$

g with respect to the data. Thus, the

viation is a measure of variability

the same units as the data. The standard

ery much like a measure in squared units and has $\therefore d_1 = x_i - A; i = 1, 2, ...$

th respect to the data. Thus, the

on is a measure of variability

me units as the data. The standard

s. Var (x) = $\frac{1}{N} \left(\sum_{i=1}^{n} f_i d_i^2 \right)$

me units as th is a measure in squared units and has
 \therefore $u_1 - x_1 - x_2$
 $u_2 - x_1 - x_2 = 0$

in the respect to the data. Thus, the

intion is a measure of variability
 \therefore Var $(x) = \frac{1}{N} \begin{cases} x_1 - x_2 + x_1 \\ y_1 + y_2 + z_2 \\ z_2 + z_3 + z_4 \end{cases}$
 STUDY MATERIAL

in reasure in squared units and has
 $\therefore d_1 = x_i - A; i = 1, 2, n$

ith respect to the data. Thus, the

ion is a measure of variability
 $\therefore \text{Var}(x) = \frac{1}{N} \left(\sum_{i=1}^n f_i d_i^2 \right) - \left(\frac{1}{N} \sum_{i=1}^n f_i d_i \right)^2$

(i) Variance of individual observations :

If x_1, x_2, \ldots, x_n are n values of a variable s, then by definition h

var (x) =
$$
\frac{1}{n} \left[\sum_{i=1}^{n} (x_i - \overline{x})^2 \right] = \sigma^2
$$
(i)

or
$$
var(x) = \frac{1}{n} \sum_{i=1}^{n} x_i^2 - \overline{x}^2
$$
(ii) then $var(x) = h^2 \left[\frac{1}{N} \sum_{i=1}^{n} f_i u_i^2 - \left(\frac{1}{N} \sum_{i=1}^{N} f_i u_i^2 \right) \right]$

If the values of variable x are large, the calculation of variance from the above formulae is quite tedious and time consuming. In that case we taken deviation from an arbitrary

point A (say) then var (x) =
$$
\frac{1}{n} \sum_{i=1}^{n} d_i^2 - \left(\frac{1}{n} \sum_{i=1}^{n} d_i\right)^2
$$
 (iii)

Example 13 :

Marks of 5 students of a group are 8, 12, 13, 15, 22 then find the variance.

Sol.
$$
\overline{x} = \frac{8+12+13+15+22}{5} = 14
$$

Calculation of variance

2 var (x) = 1 n 2 5 = 21.2 i i i 1 i i i 1

(ii) Variance of a discrete frequency distribution :

If x_1, x_2, \dots, x_n are n observations with frequencies f_1, f_2, \dots, f_n

then var (x) =
$$
\frac{1}{N} \left\{ \sum_{i=1}^{n} f_i (x_i - \overline{x})^2 \right\}
$$
(i)

or
$$
var(x) = \frac{1}{N} \sum_{i=1}^{n} f_i x_i - \overline{x}^2
$$
 (ii)

If the values of x or f are large, we take the deviations of the values of variable x from an arbitrary point A. (say)

STUDY MATERIAL: MATHEMATICS
\n
$$
\therefore d_1 = x_i - A; i = 1, 2, \dots n
$$
\n
$$
\therefore Var(x) = \frac{1}{N} \left(\sum_{i=1}^{n} f_i d_i^2 \right) - \left(\frac{1}{N} \sum_{i=1}^{n} f_i d_i \right)^2 \qquad \qquad \dots \dots \dots \text{(iii)}
$$
\nwhere $N = \sum_{i=1}^{n} f_i$
\nSometimes $d_i = x_i - A$ are divisible by a common number
\nh (say) then
\n
$$
u_i = \frac{x_i - A}{h} = \frac{d_i}{h}, 1, 2, \dots, n
$$

where $N = \sum_{i=1}^{n} f_i$ i **i** and in the set of f_i $\sum_{i=1} f_i$

Sometime $d_i = x_i - A$ are divisible by a common number h (say) then

SALC
\nThe variance is a measure in squared units and has
\n
$$
\therefore d_1 = x_i - A_1i = 1, 2, ..., n
$$
\nstrubY **MATERIAL: MATHEMATICS**
\nstandard deviation is set as the data. The standard
\neavisation is very much like a mean or an "average"
\nof these deviations.
\n
$$
\text{Var}(x) = \frac{1}{n} \left[\sum_{i=1}^{n} (x_i - \overline{x})^2 \right] = \sigma^2 \qquad \text{......} \quad (i)
$$
\n
$$
\text{Var}(x) = \frac{1}{n} \left[\sum_{i=1}^{n} f_i d_i^2 \right] - \left(\frac{1}{N} \sum_{i=1}^{n} f_i d_i \right)^2 \qquad \text{......} \quad (ii)
$$
\n
$$
\text{Var}(x) = \frac{1}{n} \left[\sum_{i=1}^{n} (x_i - \overline{x})^2 \right] = \sigma^2 \qquad \text{......} \quad (i)
$$
\n
$$
\text{Var}(x) = \frac{1}{n} \left[\sum_{i=1}^{n} (x_i - \overline{x})^2 \right] = \sigma^2 \qquad \text{......} \quad (i)
$$
\n
$$
\text{Var}(x) = \frac{1}{n} \left[\sum_{i=1}^{n} (x_i - \overline{x})^2 \right] = \sigma^2 \qquad \text{......} \quad (i)
$$
\n
$$
\text{or } \text{var}(x) = \frac{1}{n} \left[\sum_{i=1}^{n} (x_i - \overline{x})^2 \right] = \sigma^2 \qquad \text{......} \quad (i)
$$
\n
$$
\text{or } \text{var}(x) = \frac{1}{n} \left[\sum_{i=1}^{n} f_i u_i^2 - \left(\frac{1}{N} \sum_{i=1}^{n} f_i u_i \right)^2 \right] \qquad \text{......} \quad (ii)
$$
\n
$$
\text{or } \text{var}(x) = \frac{1}{n} \sum_{i=1}^{n} x_i^2 - \overline{x}^2 \qquad \text{......} \quad (iii)
$$
\n
$$
\text{or a factor of the data. Thus, a product of
$$

2 distribution any of the formulae discussed in discrete(ii) then var $(x) = h^2 \left[\frac{1}{N} \sum_{i=1}^{n} f_i u_i^2 - \left(\frac{1}{N} \sum_{i=1}^{n} f_i u_i \right)^2 \right]$ (iv)

it the calculation of

it is detections and three (iii) Variance of a grouped or continuous frequency

tion from **(iii) Variance of a grouped or continuous frequency distribution:** In a grouped or continuous frequency frequency distribution can be used .

Mathematical properties of variance :

- (a) If all values of the variate in a distribution are added (subtracted) by the same quantity (say λ), then the variance of the distribution remains unchanged. Hence Var $(X + \lambda) = Var(X)$
- (b) If all values of the variate in a distribution are multiplied by a constant number k, then the variance of the distribution is multiplied by k^2 . Hence Var $(kX) = k^2 \text{ var } (X)$
- 2 Var $(aX + b) = a^2 Var(X)$ (c) From above results (i) and (ii) it is obvious that
	- (d) For a continuous distribution standard deviation is not less than the mean deviation with respect to AM.
	- (e) Relationship between measure of dispersion are $9 (Q.D.) = 7.5 (M.D.) = 6 (S.D.)$

i.e. (i) Q.D. =
$$
\frac{5}{6}
$$
 (M.D.) (ii) QD = $\frac{2}{3}$ (S.D.) (iii) M.D. = $\frac{4}{5}$ (S.D.)

 $\left(\frac{1}{n}\sum_{i=1}^{n} d_i\right)^2$ (iii)

frequency distribution can be used .

(a) If values of the variance discussed in discrete

(a) If values of the variance is of variance in a distribution are added

(subtracted) b If all values of the variate in a dist

(a) If all values of the variate in a dist

(a) If all values of the variate in a dist

(a) If all values of the variate in a dist

time condition is multiplied by R².

Then the 22

22

e

e
 $x_1 - \overline{x}$
 $(x_1 - \overline{x})^2$
 $(x_2 - \overline{x})^2$
 $(x_3 - \overline{x})^2$

(c) From above results (i) and (ii) it is obvious
 $x_1 - \overline{x}$
 $(x_2 - \overline{x})^2$

(a) For a continuous distribution standard dd
 $x_1 - \overline{x}$
 $x_2 - \overline{x}$ Example the value of the v 15+22
 $\frac{15+22}{2} = 14$

by a constant number k, then the varian

innce
 $x_1 - \overline{x}$
 -6
 -2
 -1

1

1

1

1

1

1

(c) From above results (i) and (ii) it is obvious
 -2

4

(d) For a continuous distribution st x_i = \overline{x}
 $x_1 = \overline{x}$
 $x_2 = \frac{106}{5} = 21.2$
 $x_1 = \overline{x}$)
 $x_2 = \frac{106}{5} = 21.2$
 $x_3 = \frac{1}{2}$
 $x_4 = \overline{x}$
 $x_5 = \frac{106}{5} = 21.2$
 $x_6 = \frac{106}{5} = 21.2$
 $x_7 = \frac{106}{5} = 21.2$
 $x_8 = \frac{106}{5} = 21.2$
 $x_9 = \frac{106}{$ (f) If AM's of two series containing n_1 , n_2 values are Hency ustanton can be used.

Hematical properties of variance :

If all values of the variate in a distribution are added

(subtracted) by the same quantity (say λ), then the

variance of the distribution remains unchang scussed in discrete

:

stribution are added

ty (say λ), then the

ins unchanged.

ibution are multiplied

the variance of the

s obvious that

dard deviation is not

in respect to AM.

dispersion are

(iii) M.D. = $\$ and combined mean is \bar{x} then the variance of their combined series is given by is multiplied by k².

kX) = k² var (X)

results (i) and (ii) it is obvious that
 $= a^2$ Var (X)

ucous distribution standard deviation is not

be mean deviation with respect to AM.

between measure of dispersion are
 ence Var (kX) = k² var (X)

om above results (i) and (ii) it is obvious that

ar (aX + b) = a² Var (X)

or a continuous distribution standard deviation is not

ss than the mean deviation with respect to AM.

leationsh It is (i) and (ii) it is obvious that

Var (X)

distribution standard deviation is not

n deviation with respect to AM.

Neen measure of dispersion are

D.)=6 (S.D.)

QD= $\frac{2}{3}$ (S.D.) (iii) M.D. = $\frac{4}{5}$ (S.D.)

eri Var $(X + \lambda) = \text{Var}(X)$

Var $(X + \lambda) = \text{Var}(X)$

alues of the variate in a distribution are multiplied

constant number k, then the variance of the

uttion is multiplied by k^2 .

Var $(K\lambda) = k^2$ var (X)

showe results (i) and ie variate in a distribution are multiplied
number k, then the variance of the
ultiplied by k².
= k² var (X)
dults (i) and (ii) it is obvious that
2 Var (X)
sa distribution standard deviation is not
san deviation with d) by the same quantity (say λ), then the

of the distribution remains unchanged.
 $(X + \lambda) = Var(X)$

so fthe variate in a distribution are multiplied

stant number k, then the variance of the

in is multiplied by k².
 $(kX$ variance of the distribution remains unchanged.
Hence Var $(X + \lambda) = \text{Var}(X)$
Hence Var $(X + \lambda) = \text{Var}(X)$
Fall values of the variate in a distribution are multiplied
by a constant number k, then the variance of the
distribution If all values of the variate in a distribution are multiplied
by a constant number k, then the variance of the
distribution is multiplied by k^2 .
Hence Var (kX) = k^2 var (X)
From above results (i) and (ii) it is obvi mean deviation with respect to AM.
between measure of dispersion are
(M.D.)=6 (S.D.)
) (ii) QD = $\frac{2}{3}$ (S.D.) (iii) M.D. = $\frac{4}{5}$ (S.D.)
wo series containing n₁, n₂ values are
heir variance's are σ_1^2 , $\sigma_$ ionship between measure of dispersion are

2.)=7.5 (M.D.) = 6 (S.D.)
 $\frac{5}{6}$ (M.D.) (ii) QD = $\frac{2}{3}$ (S.D.) (iii) M.D. = $\frac{4}{5}$ (S.D.)

1's of two series containing n_1 , n_2 values are

2 and their variance's ili) M.D. = $\frac{4}{5}$ (S.D.)

n₁, n₂ values are
 $\frac{2}{1}$, σ_2^2 respectively

e variance of their
 $\frac{2}{2}(\overline{x}_1 - \overline{x}_2)^2$ (M.D.)=6 (S.D.)

(ii) QD = $\frac{2}{3}$ (S.D.) (iii) M.D. = $\frac{4}{5}$ (S.D.)

wo series containing n₁, n₂ values are

neir variance's are σ_1^2 , σ_2^2 respectively

d mean is \overline{x} then the variance of their

ies (KA) = k va (A)

(e results (i) and (ii) it is obvious that

b) = a^2 Var (X)

tinuous distribution standard deviation is not

the mean deviation with respect to AM.

hip between measure of dispersion are

7.5 (M.D.) = $h = a^2 \text{Var}(X)$
 $= a^2 \text{Var}(X)$

muous distribution standard deviation is not

p between measure of dispersion are
 $5 \text{ (M.D.)} = 6 \text{ (S.D.)}$

D.) (ii) QD = $\frac{2}{3}$ (S.D.) (iii) M.D. = $\frac{4}{5}$ (S.D.)

two series containing is multiplied by k².
 kX) = k² var (X)

results (i) and (ii) it is obvious that

u cous distribution standard deviation is not

u cous distribution standard deviation is not

p hetween measure of dispersion are

5 (becombandwind or a strained or

to Car Var (kX) = k^2 var (X)

m above results (i) and (ii) it is obvious that

(aX + b) = a^2 Var (X)

than the mean deviation with respect to AM.

than the mean deviation with respect

$$
\sigma^{2} = \frac{n_{1}(\sigma_{1}^{2} + d_{1}^{2}) + n_{2}(\sigma_{2}^{2} + d_{2}^{2})}{(n_{1} + n_{2})}
$$

i.e.
$$
\sigma^2 = \frac{n_1 \sigma_1^2 + n_2 \sigma_2^2}{(n_1 + n_2)} + \frac{n_1 n_2}{(n_1 + n_2)^2} (\overline{x}_1 - \overline{x}_2)^2
$$

STATISTICS

Example 14 :

Calculate the mean and standard deviation of first n natural numbers.

Sol. Here $x_i = i = i = 1, 2, \dots, n$. Let \overline{X} be the mean and σ be the S.D. Then,

ATISTICS
uple 14:
Calculate the mean and standard deviation of first n natural numbers.
Here $x_i = i = i = 1, 2, \dots, n$. Let \overline{X} be the mean and σ be the
S.D. Then,
$\overline{X} = \frac{1}{n} \sum_{i=1}^{n} x_i = \frac{1}{n} \sum_{i=1}^{n} i = \frac{1}{n} (1 + 2 + 3 + \dots + n)$
$\Rightarrow \overline{X} = \frac{n(n+1)}{2n} = \frac{n+1}{2}$
$\Rightarrow \overline{X} = \frac{n(n+1)}{2n} = \frac{n+1}{2}$

TESTICS
\n**det 4:**
\nale 14:
\naleulate the mean and standard deviation of first n natural
\nnumbers.
\n
$$
\overline{x} = \frac{1}{n} \sum_{i=1}^{n} x_i = \frac{1}{n} \sum_{i=1}^{n} i = \frac{1}{n} (1 + 2 + 3 + \dots + n)
$$
\n
$$
\overline{x} = \frac{n(n+1)}{2n} = \frac{n+1}{2n}
$$
\n
$$
\overline{X} = \frac{n(n+1)}{2n} = \frac{n+1}{2}
$$
\n
$$
\overline{X} = \frac{n(n+1)}{2n} = \frac{n+1}{2}
$$
\n
$$
\overline{X} = \frac{n(n+1)}{2n} = \frac{n+1}{2}
$$
\n
$$
\overline{X} = \frac{n(n+1)(2n+1)}{6n} - \left(\frac{n+1}{2}\right)^2
$$
\n
$$
\Rightarrow \sigma^2 = \frac{(n+1)(2n+1)}{6n} - \left(\frac{n+1}{2}\right)^2
$$
\n
$$
\Rightarrow \sigma^2 = \frac{(n+1)(2n+1)}{6n} - \frac{(n+1)^2}{4} = \frac{n^2-1}{12}
$$
\n
$$
\Rightarrow \sigma^2 = \frac{(n+1)(2n+1)}{6n} - \frac{(n+1)^2}{4} = \frac{n^2-1}{12}
$$
\n
$$
\Rightarrow \sigma^2 = \frac{(n+1)(2n+1)}{6n} - \frac{(n+1)^2}{4} = \frac{n^2-1}{12}
$$
\n
$$
\Rightarrow \sigma^2 = \frac{(n+1)(2n+1)}{6n} - \frac{(n+1)^2}{4} = \frac{n^2-1}{12}
$$
\n
$$
\Rightarrow \sigma^2 = \frac{(n+1)(2n+1)}{6n} - \frac{(n+1)^2}{4} = \frac{n^2-1}{12}
$$
\n
$$
\Rightarrow \sigma^2 = \frac{(n+1)(2n+1)}{6n} - \frac{(n+1)^2}{4} = \frac{n^2-1}{12}
$$
\n
$$
\Rightarrow \sigma^2 = \frac{(n+1)(2n+1)}{6n} - \frac{(n+1)^2}{4} = \frac{n^2-1}{12}
$$
\n
$$
\Rightarrow \sigma^2 = \frac{(n+1)(2n+1)}{6
$$

Example 15 :

Find the variance and standard deviation for the following distribution:

Classes				$30-40$ $40-50$ $50-60$ $60-70$ $70-80$ $80-90$ $90-100$
Frequency				

Sol. Calculation of Variance and Standard Deviation

Therefore
$$
\overline{x} = A + \frac{\sum f_i y_i}{50} \times h = 65 - \frac{15}{50} \times 10 = 62
$$

\n
$$
\text{Variance } \sigma^2 = \frac{h^2}{50} \left[N \sum f_i y_i^2 - (\sum f_i y_i)^2 \right]
$$
\n
$$
\text{Variance } \sigma^2 = \frac{h^2}{50} \left[N \sum f_i y_i^2 - (\sum f_i y_i)^2 \right]
$$
\n
$$
\text{Sol. Here } np = 6, npq = 4
$$

$$
N^2 L \longrightarrow N^2 L \longrightarrow N^2 L
$$
\n
$$
\Rightarrow q =
$$
\n
$$
= \frac{(10)^2}{(50)^2} [50 \times 105 - (-15)^2] = \frac{1}{25} [5250 - 225] = 201
$$

and standard deviation (σ) = $\sqrt{201}$ = 14.18

MEAN AND VARIANCE OF BINOMIAL DISTRIBUTION

If the frequencies of the values 0, 1, 2,, n of a variate are represented by the following coefficients of a binomial : q^n , nC_1 $q^{n-1}p$, ${}^nC_2q^{n-2}p^2$, ..., p^n

where P is the probability of the success of the experiment (variate), q is the probability of its failure and $p + q = 1$ i.e. distribution is a binomial distribution : then

$$
P (x = r) = {}^{n}C_{r}q^{n-r} p^{r}
$$
; mean $\bar{x} = \sum p_{i}x_{i} = np$
Variance $\sigma^{2} = npq = \bar{x}q$

Example 16 :

15 The mean and variance of a variate X having a binomial distribution are 6 and 4 respectively. Find the number of values of the variate in the distribution.

Sol. Here $np = 6$, $npq = 4$

$$
\Rightarrow q = \frac{2}{3}, p = 1 - \frac{2}{3} = \frac{1}{3} \therefore np = 6 \Rightarrow n = 18
$$

Analysis of Frequency Distributions :

Example 16:
 $\sum f_1y_1^2 \times h = 65 - \frac{15}{50} \times 10 = 62$
 $\sum f_1y_1^2 - (\sum f_1y_1)^2$
 $\sum f_1y_1^2 - (\sum f_1y_1)^2$

Sol. Here np = 6, npq = 4
 $\sum f_1y_1^2 - (\sum f_1y_1)^2$

Sol. Here np = 6, npq = 4
 $\Rightarrow q = \frac{2}{3}, p = 1 - \frac{2}{3} = \frac{1}{3}$ \therefore Measures of dispersion are unable to compare two or more series which are measured in different units even if they have the same mean. Thus, we require those measures which are independent of the units. The measure of variability which is independent of units is called coefficient of variation (C.V.). The coefficient of variation is defined as

$$
C.V. = \frac{\sigma}{\overline{X}} \times 100
$$

where σ and \overline{X} are the standard deviation and mean of the data.

For comparing the variability of two series, we calculate Q.6 the coefficient of variation for each series. The series having greater C.V. is said to be more variable or conversely less consistent, less uniform less stable or less homogeneous than the other and the series having lesser C.V. is said to be $Q.7$ more consistent (or homogeneous) than the other.

Example 17 :

The following values are calculated in respect of heights and weights of the students of a section of Class XI :

Height Weight Mean 162.6 cm 52.36 Variance 127.69 cm^2 23.1361 kg²

Can we say that the weights show greater variation than the heights ?

Sol. To compare the variability, we have to calculate their coefficients of variation

Given Variance of height = 127.69 cm²

Therefore, Standard deviation of height

$$
\sqrt{127.69}
$$
 cm = 11.3 cm

Also, Variance of weight =
$$
23.1361 \text{ kg}^2
$$

Standard deviation of weight = $\sqrt{23.1361}$ kg = 4.81 kg Now, the coefficient of variations (C.V.) are given by

(C.V.) in heights =
$$
\frac{\text{Standard Deviation}}{\text{Mean}} \times 100
$$
 (A) 81
\n
$$
= \frac{11.3}{162.6} \times 100 = 6.95
$$
 (B) 233
\nand (C.V.) in weight = $\frac{4.81}{52.36} \times 1000 = 9.18$ (C) 40
\n(d) 64.1
\n23.3

Clearly C.V. in weights is greater than the C.V. in heights Therefore, we can say that weights show more variability than heights.

TRY IT YOURSELF

Q.1 Find the mean deviation about the median for the data 13, 17, 16, 14, 11, 13, 10, 16, 11, 18, 12, 17

Q.2 Find the mean deviation about the median for the data xⁱ 5 7 9 10 12 15

 f_i 8 $\frac{1}{1}$ 8 6 2 2 2 6 **Q.3** Find the mean and variance for the data 6, 7, 10, 12, 13, 4, 8, 12

Q.4 Find the mean and standard deviation

Q.5 The mean and variance of 7 observations are 8 and 16, respectively. If five of the observations are 2, 4, 10, 12, 14. Find the remaining two observations.

Q.6 The standard deviation of the data 6, 5, 9, 13, 12, 8, 10 is

$$
(C) \sqrt{6} \qquad (D) 6
$$

STUDY MATERIAL: MATHEMATICS

The standard deviation of the data 6, 5, 9, 13, 12, 8, 10 is

(A) $\sqrt{52/7}$ (B) 52/7

(C) $\sqrt{6}$ (D) 6

Let a, b, c, d, e be the observations with mean m and

standard deviation s. The sta Let a, b, c, d, e be the observations with mean m and standard deviation s. The standard deviation of the observations $a + k$, $b + k$, $c + k$, $d + k$, $e + k$ is (A) s (B) k s $(C) s + k$ (D) s/k

Q.8 Let x_1 , x_2 , ... x_n be n observations. Let $w_i = lx_i + k$ for $i = 1$, 2, ...n, where *l* and k are constants. If the mean of x_i 's is 48 and their standard deviation is 12, the mean of w_i 's is 55 and standard deviation of w_i 's is 15, the values of *l* and *k* should be

(A)
$$
l=1.25
$$
, $k=-5$
\n(B) $l=-1.25$, $k=5$
\n(C) $l=2.5$, $k=-5$
\n(D) $l=2.5$, $k=5$

Q.9 Consider the first 10 positive integers. If we multiply each number by –1 and then add 1 to each number, the variance of the numbers so obtained is

(A) 8.25 (B) 6.5 (C) 3.87 (D) 2.87

Q.10 The standard deviation of some temperature data in °C is 5. If the data were converted into ºF, the variance would be

ADDITIONAL EXAMPLES

Example 1 :

Mean of 25 observations was found to be 78.4. But later on it was found that 96 was misread 69. Find the correct mean.

Sol. Mean
$$
\overline{x} = \frac{\sum x}{n}
$$
 or $\sum x = n \overline{x}$; $\sum x = 25 \times 78.4 = 1960$
But this $\sum x$ is incorrect as 06 was mirrored as 60.

But this Σx is incorrect as 96 was misread as 69. correct $\sum x = 1960 + (96 - 69) = 1987$

$$
1007
$$

$$
\therefore \quad \text{correct mean} = \frac{1987}{25} = 79.47
$$

Example 2 :

Find the mean wage from the following data

STATISTICS

Sol. Let the assumed mean be, $A = 900$. The given data can be written as under :

$$
N = \sum f_i = 100
$$

Here A = 900, h = 20

$$
\sum f_i u_i = -44
$$

$$
\therefore \text{ Mean} = \overline{X} = A + h \left(\frac{1}{N} \Sigma f_i u_i \right) = 900 + 20 \left(-\frac{44}{100} \right) = 891.2
$$

Mean deviation = M.1

Hence, mean wage = $Rs. 891.2$

Example 3 :

Find the median from the following distribution

	Class	$5-10$ $10-15$ $15-20$ $20-25$ $25-30$			S
	frequency				3
	Class	$30-35$ $35-40$ $40-45$			f
	frequency				$\mathbf{3}$
Sol.	Class			Frequency Cumulative frequency	
	$5 - 10$				
	$10 - 15$				Si

Here N=49.
$$
\therefore \frac{N}{2} = \frac{49}{2} = 24.
$$

The cumulative frequency just greater than N/2 is 26 and corresponding class is $15-20$. Thus $15-20$ is the median class such that $\ell = 15$, $f = 15$, $F = 11$, $h = 5$

:. Medium =
$$
\ell + \frac{N/2 - F}{f} \times h
$$

\n= 15 + $\frac{24.5 - 11}{15} \times 5$
\n= 15 + $\frac{13.5}{3}$ = 19.5

Example 4 :

Find the mean deviation about mean from the following data

$x_i: 3$ 9 17 23 27			
f_i : 8 10 12 9 5			

Sol. Calculation of mean deviation about mean.

Mean =
$$
\overline{X}
$$
 = $\frac{1}{N} (\Sigma f_i x_i) = \frac{660}{44} = 15$

$$
\frac{1}{100} = 891.2
$$
 Mean deviation = M. D. = $\frac{1}{N} \sum f_i |x_i - 15| = \frac{312}{44} = 7.09$

Example 5 :

Example 6 :

The mean and standard deviation of 20 observations are found to be 10 and 2 respectively. On rechecking, it was found that an observation 8 was incorrect. Calculate the correct mean and standard deviation in each of the following cases: (i) If the wrong item is omitted. (ii) When 8 is omitted from the data.

Sol. (i) If the wrong item is omitted.

We have , $n = 20$, $\overline{X} = 10$ and $\sigma = 2$

$$
\therefore \quad \overline{\mathbf{X}} = \frac{1}{n} \Sigma \mathbf{x}_i \implies \quad \Sigma \mathbf{x}_i = \mathbf{n} \overline{\mathbf{X}} = 20 \times 10 = 200
$$

 \Rightarrow Incorrect $\Sigma x_i = 200$

and,
$$
\sigma = 2 \implies \sigma^2 = 4 \implies \frac{1}{n} \Sigma x_i^2 - (Mean)^2 = 4 \implies C \infty
$$

$$
\Rightarrow \frac{1}{20} \Sigma x_i^2 - 100 = 4 \Rightarrow \Sigma x_i^2 = 104 \times 20
$$

 \Rightarrow Incorrect $\Sigma x_i^2 = 2080$

(ii)When 8 is omitted from the data.

If 8 is omitted from the data, then 19 observations are left.

Now, Incorrect
$$
\Sigma x_i = 200 \Rightarrow
$$
 Correct $\Sigma x_i + 8 = 200$

 \Rightarrow Correct $\Sigma x_i = 192$

STUDY MATERIAL: MATHEMATICS
\nand Incorrect
$$
\Sigma x_i^2 = 2080
$$

\n⇒ Correct $\Sigma x_i^2 + 8^2 = 2080$
\n⇒ Correct $\Sigma x_i^2 = 2016$
\n∴ Correct mean = $\frac{192}{19} = 10.10$
\n⇒ Correct variance = $\frac{1}{19}$ (Correct Σx_i^2) – (Correct mean)²
\n⇒ Correct variance = $\frac{2016}{19} - (\frac{192}{19})^2$
\nCorrect variance = $\frac{38304 - 36864}{361} = \frac{1440}{361}$
\n∴ Correct standard deviation = $\sqrt{\frac{1440}{361}} = \frac{12\sqrt{10}}{19} = 1.997$

$$
\Rightarrow \text{Correct variance} = \frac{1}{19} \text{ (Correct Exi}^2) - (\text{Correct mean})^2
$$

$$
\Rightarrow \text{Correct variance} = \frac{2016}{19} - \left(\frac{192}{19}\right)^2
$$

$$
Correct variance = \frac{38304 - 36864}{361} = \frac{1440}{361}
$$

$$
\therefore \quad \text{Correct standard deviation} = \sqrt{\frac{1440}{361}} = \frac{12\sqrt{10}}{19} = 1.997
$$

STATISTICS QUESTION BANK

 (B) 4 and 9

(C) 5 and 7 (D) 5 and 9

(C) $\left(\frac{3}{4} + \frac{1}{4}\right)^{12}$

- **Q.35** The mean and S.D. of the marks of 200 candidates were found to be 40 and 15 respectively. Later, it was discovered that a score of 40 was wrongly read as 50. The correct mean and S.D. respectively are (A) 14.98, 39.95 (B) 39.95, 14.98 (C) 39.95, 224.5 (D) None of these
- **Q.36** The mean of 100 observations is 50 and their standard deviation is 5. The sum of all squares of all the observations is – (A) 50000 (B) 250000

Q.37 Let x_1, x_2, x_3, x_4, x_5 be the observations with mean m and Q.47 standard deviation s. The standard deviation of the observations kx_1 , kx_2 , kx_3 , kx_4 , kx_5 is – (A) $k + s$ (B) s/k mean of 100 observations is 50 and their standard

value of $(a + b + c)$ $\left(\frac{1}{a} +$

value of $(a + b + c)$ $\left(\frac{1}{a} +$

value of $(a + b + c)$ $\left(\frac{1}{a} +$

value of $(a + b + c)$ $\left(\frac{1}{a} +$

value of $(a + b + c)$ $\left(\frac{1}{a} +$

value of 5025000

250200 (B) 250000 (A) 3

25020 (D) 255000 (C) 9

16025500 (D) 255000 (C) 9

47 The A.M. of the observations in the constraints with mean m and Q-47 The A.M. of the observations kx₁, kx₂, kx₃, kx₃, kx₃,

$$
\begin{array}{ll}\n\text{(C)k s} & \text{(D) s} \\
\text{S}' & \text{L} \text{L} \text{L} & \text{S} \text{C} & \text{L} \text{L} \text{R} & \text{L} \text{L} \\
\end{array}
$$

- **Q.38** Standard deviations for first 10 natural numbers is $(A) 5.5$ (B) 3.87 (C) 2.97 (D) 2.87
- **Q.39** The mean deviation from the median is (A) Greater than that measured from any other value (B) Less than that measured from any other value (C) Equal to that measured from any other value
	- (D) Maximum if all observations are positive
- **Q.40** The variance of the first n natural numbers is

(A)
$$
\frac{n^2 - 1}{12}
$$
 \t\t (B) $\frac{n^2 - 1}{6}$
(C) $\frac{n^2 + 1}{6}$ \t\t (D) $\frac{n^2 + 1}{12}$

Q.41 The means of five observations is 4 and their variance is 5.2. If three of these observations are 1, 2 and 6, then the other two are (A) 2 and 9 (B) 3 and 8

PART 3 : MISCELLANEOUS

- **Q.42** The monthly sales for the first 11 months of the year of a certain salesman were Rs. 12000 but due to his illness during the last month the average sales for the whole year came down to Rs. 11,375. The value of the sale during the last month was – (A) Rs. 4500 (B) Rs. 6000 (C) Rs. 10000 (D) Rs. 8000
- **Q.43** Product of n positive numbers is unity. The sum of these numbers cannot be less than –

 $(A) 1$ (B) n (C) n^2

- (D) None of these
- **Q.44** The average age of a group of men and women is 30 years. If average age of men is 32 and that of women is 27, then the percentage of women in the group is – $(A) 60$ (B) 50 (C) 40 (D) 30
- **Q.45** When tested, the lives (in hours) of 5 bulbs were noted as follows: 1357, 1090, 1666, 1494, 1623 The mean deviations (in hours) from their mean is (A) 178 (B) 179 (C) 220 (D) 356 **EDIMADVANCED LEARNING**
 ESS (in hours) of 5 bulbs were noted

(in hours) from their mean is

(B) 179

(D) 356

ee positive numbers, then the least
 $\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$ is

(B) 6

(D) None of these

rvations 1.3.5 **EDENTADY ANGELERATION**
 ESS (in hours) of 5 bulbs were noted

1, 1666, 1494, 1623

(in hours) from their mean is

(B) 179

(D) 356

ee positive numbers, then the least
 $\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$ is

(B) 6

(D) None of **EDENEARABLE SET AT A REAL PROPERTY.**

Ves (in hours) of 5 bulbs were noted

00, 1666, 1494, 1623

is (in hours) from their mean is

(B) 179

(D) 356

inter positive numbers, then the least
 $\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right)$ When tested, the lives (in hours) of 5 bulbs were noted
as follows: 1357, 1090, 1666, 1494, 1623
The mean deviations (in hours) from their mean is
(A) 178
(2220 (B) 356
If a, b, c are any three positive numbers, then the When tested, the lives (in hours) of 5 bulbs were noted
as follows: 1357, 1090, 1666, 1494, 1623
The mean deviations (in hours) from their mean is
The mean deviations (in hours) from their mean is
(A) 178
(C) 220 (D) 356
 urs) of 5 bulbs were noted
494, 1623
s) from their mean is
(B) 179
(D) 356
ve numbers, then the least
 $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 &$ wws: 1357, 1090, 1666, 1494, 1623
ean deviations (in hours) from their mean is

8 (B) 179

2 (D) 356

9 (D) 356

1 (D) 356

(D) None of these

M. of the observations 1.3.5, 3.5.7, 5.7.9,....,

(D) None of these

M. of the
- **Q.46** If a , b, c are any three positive numbers, then the least

value of
$$
(a + b + c) \left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c} \right)
$$
 is
(A) 3 (B) 6

- (D) None of these
- **Q.47** The A.M. of the observations 1.3.5, 3.5.7, 5.7.9,....., $(2n-1)(2n+1)(2n+3)$ is – (A) 2n³ + 6n² + 7n – $+7n-2$ (B) $n^3 + 8n^2 + 7n - 2$ (C) 2n³ + 5n² + 6n – $+ 6n - 1$ (D) $2n^3 + 8n^2 + 7n - 2$ The mean deviations (in hours).

The mean deviations (in hours) from their mean is

178 (B) 179

220 (D) 356

b, c are any three positive numbers, then the least

e of $(a + b + c)$ $\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right)$ is

3

3

(B)
- **Q.48** If \overline{X}_1 and \overline{X}_2 are the means of two distribution such
	- distribution, then –

(A)
$$
\overline{X} < \overline{X}_1
$$
 (B) $\overline{X} > \overline{X}_2$

$$
(C) \ \overline{X} = \frac{\overline{X}_1 + \overline{X}_2}{2} \qquad \qquad (D) \ \overline{X}_1 < \overline{X} < \overline{X}_2
$$

Q.49 The mean deviation from the mean for the set of observations -1 , 0, 4 is

- ² n 1 50000

50000 (A) 3

5000 (C) (C)

5000 (C) (D) None of these

tions with mean m and Q.47 The A.M. of the observations 1.3.5, 3.5, 7, 5, 7, 9,.....,

and deviation of the

(A) $2n^3 + 6n^2 + 7n - 2$ (B) $n^3 + 8n^2 + 7n - 2$

(C 12 female employees are respectively Rs. 510 and Rs. 460. $+1$ factory is Rs. 500. The mean monthly salaries of male and value of $(a + b + c)$ $\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right)$ is

(A) 3 (B) 6

(C) 9 (D) None of these

The A.M. of the observations 13.5, 3.5.7, 5.7.9,.....,

(A) $2n^3 + 6n^2 + 7n - 2$ (B) $n^3 + 8n^2 + 7n - 2$

(C) $2n^3 + 5n^2 + 6n - 1$ (D) **Q.50** The mean monthly salary of the employees in a certain The percentage of male employees in the factory is $(A) 60$ (B) 70 $(C) 80$ $(D) 90$ distribution, then $-\lambda$

(C) $\overline{X} = \frac{\overline{X}_1 + \overline{X}_2}{2}$ (D) $\overline{X}_1 < \overline{X} < \overline{X}_2$

The mean deviation from the mean for the set of

observations -1, 0, 4 is

(A) $\sqrt{14/3}$ (B) 2

(C) 2/3 (D) None of these

factory (B) $\overline{X} > \overline{X}_2$

(D) $\overline{X}_1 < \overline{X} < \overline{X}_2$

the mean for the set of

(B)2

(D) None of these

the employees in a certain

nonthly salaries of male and

ively Rs. 510 and Rs. 460.

oyees in the factory is

(B) 70
 1 2 (14/3 (B)

(D) None of these

mean monthly salary of the employees in a certain

y is Rs. 500. The mean monthly salaries of male and

e employees are respectively Rs. 510 and Rs. 460.

D) (B) 70

(D) 90

completes the fir $\overline{x} = \frac{\overline{X}_1 + \overline{X}_2}{2}$ (D) $\overline{X}_1 < \overline{X} < \overline{X}_2$

mean deviation from the mean for the set of

rvations -1, 0, 4 is

(1923 (D) None of these

mean monthly salary of the employees in a certain

my is Rs. 500. The $\overline{X} = \frac{x_1 + x_2}{2}$ (D) $\overline{X}_1 < \overline{X} < \overline{X}_2$

mean deviation from the mean for the set of

rvations -1, 0, 4 is
 $\sqrt{14/3}$ (B) 2

(D) None of these

mean monthly salary of the employees in a certain

my is Rs. 500.
	- **Q.51** A car completes the first half of its journey with a velocity v_1 and the rest half with a velocity v_2 . Then the average velocity of the car for the whole journey is

(A)
$$
\frac{v_1 + v_2}{2}
$$
 (B)
$$
\sqrt{v_1 v_2}
$$

(C)
$$
\frac{2v_1 v_2}{v_1 + v_2}
$$
 (D) None of these

- **Q.52** A school has four sections of chemistry in class XII having 40, 35, 45 and 42 students. The mean marks obtained in chemistry test are 50, 60, 55 and 45 respectively for the four sections, the over all average of marks per students is
- $(A) 53$ (B) 45 (C) 55.3 (D) 52.25 **Q.53** The total expenditure incurred by an industry under different heads is best presented as a (A) Bar diagram (B) Pie diagram (C) Histogram (D) Frequency polygon **Q.54** The mean deviation of the numbers 3, 4, 5, 6, 7 is $(A) 0$ (B) 1.2 $(D) 25$

EXERCISE - 2 (NUMERICAL VALUE BASED QUESTIONS)

NOTE : The answer to each question is a NUMERICAL VALUE.

- **Q.1** Find the mean deviation about the mean for the data : 4, 7, 8, 9, 10, 12, 13, 17
- **Q.2** Find the mean deviation about the median for the data: 36, 72, 46, 42, 60, 45, 53, 46, 51, 49
- **Q.3** Find the mean deviation about the mean for the data : x_i 10 30 50 70 90

f: 4 24 28 16 8

$$
f_i
$$
 4 24 28 16 8

Q.4 The variance for the data : 6, 7, 10, 12, 13, 4, 8, 12

is $\frac{592}{y}$. Find the value of X. $\frac{1}{X}$. Find the value of X.

Q.5 The variance for the data :

The variance for the data :

is
$$
\frac{320}{X}
$$
. Find the value of X.

Q.7 The standard deviation for the data :

is X. Find the integer nearest to the 10 X.

Q.8 Find the variance for the following frequency distributions :

EXERCISE - 2 (NUMERICAL VALUE BASED QUESTIONS)

The answer to each question is a NUMERICAL VALUE BASED QUESTIONS)

ind the mean deviation about the mean for the data :

7,8,9, 10, 12, 13, 17

and the mean deviation abou **EXERCISE - 2 (NUMERICAL VALUE BASED QUESTIONS)**
 EXERCISE - 2 (NUMERICAL VALUE BASED QUESTIONS)

The answer to each question is a NUMERICAL VALUE BASED QUESTIONS)

The strained for mean deviation about the mean for the **STUDY MATERIAL: MATHEMATICS**
 CASED QUESTIONS)

Evariance for the data :
 $\frac{1}{3}$ 2 2 3 97 98 102 104 109
 $\frac{3}{3}$ 2 3 2 6 3 3
 $\frac{320}{X}$. Find the value of X.

External deviation for the data :
 $\frac{1}{12}$ 60 61 **EXECTIONS**
 Q.9 The mean and standard deviation of six observations are 8 and 4, respectively. If each observation is multiplied by 3, find the new standard deviation of the resulting observations.

 $(C) \log(G_1, G_2)$ (D) $\log G_1 - \log G_2$ **Q.2** The median of a set of 9 distinct observations is 20.5 If each of the largest 4 observations of the set is increased by 2, then the median of the new set - **[AIEEE 2003]** (A) remains the same as that of the original set (B) is increased by 2 (A) $\frac{G_1}{G_2}$ (B) $\frac{G_2}{G_2}$ (B) $\frac{G_3}{G_2}$ (D) $\frac{G_4}{G_2}$ (D) $\frac{G_5}{G_2}$ (D) $\frac{G_6}{G_2}$ (D) $\frac{G_7}{G_2}$ (D) $\frac{G_8}{G_1 - \log G_2}$ (D) $\frac{G_9}{G_3}$ (D) $\frac{G_9}{G_2}$ (D) $\frac{G_9}{G_3}$ (D) $\frac{G_9}{G_3}$

1 2 $log C$

Q.1 If G_1 , G_2 are the geometric means of two series of θ observations and G is the geometric means of two series of $Q.8$
observations and G is the geometric mean of the ratios of

the corresponding observations, then the value of G-

 G_1 $\log G_1$ $\overline{G_2}$ (B) $\overline{\log G_2}$

- (C) is decreased by 2
- (D) is two times the original median
- **Q.3** The mean and variance of a random variable X having binomial distribution are 4 and 2 respectively, then $P(X = 1)$ is – [AIEEE 2003]
	- (A) 1/4 (B) 1/32 (C) 1/16 (D) 1/8
- **Q.4** In an experiment with 15 observations on x, the following

One observation that was 20 was found to be wrong and was replaced by the correct value 30. Then the corrected variance is **[AIEEE 2003]** (A) 8.33 (B) 78.00 (C) 188.66 (D) 177.33

- **Q.5** Consider the following statements: **[AIEEE 2004]** (a) Mode can be computed from histogram (b) Median is not independent of change of scale (c) Variance is independent of change of origin and scale. Which of these is/ are correct ? (A) only (a) (B) only (b) (C) only (a) and (b) (D) (a), (b) and (c)
- **Q.6** In a series of 2n observations, half of them equal a and remaining half equal – a. If the standard deviation of the observations is 2, then |a| equals- **[AIEEE 2004]**

(A)
$$
1/n
$$
 \t\t (B) $\sqrt{2}$

(C) 2 is
$$
\frac{\sqrt{2}}{n}
$$

Q.7 If in a frequency distribution, the mean and median are 21 and 22 respectively, then its mode is approximately

[AIEEE-2005]

and $\sum x_i = 80$. Then a possible value of n among the following is **[AIEEE-2005]**

- $\frac{1}{1}$ (A) 15 (B) 18 $(C)9$ **EVIOUS YEARS AIEEE / JEE MAIN QUESTIONS)**

REVIOUS YEARS AIEEE / JEE MAIN QUESTIONS)

anns of two series of

ic mean of the ratios of

then the value of G-

[AIEEE-2002]

log G₁ (A) 15 (B) 18

log G₁ (A) 15 (B) 18

l **EVIOUS YEARS AIEEE / JEE MAIN QUESTIONS)**

REVIOUS YEARS AIEEE / JEE MAIN QUESTIONS)

and Sommation such that $\sum x_i^2 = \epsilon$

tion and of G-

(AIEEE-2002)

and $\sum x_i = 80$. Then a possible value of n among

following is [AIE (D) 12 **Q.9** Suppose a population A has 100 observations 101, 102,....
	- 200, and another population B has 100 observations 151, 152,.....250. If V_A and V_B represent the variances of the

two populations, respectively, then $\frac{V_A}{I}$ is-B $V_{\rm B}$

[AIEEE 2006]

- $(A) \frac{9}{4}$ (B) 4/9 (C) 2 (D) 1
- **Q.10** The average marks of boys in a class is 52 and that of girls is 42. The average marks of boys and girls combined is 50. The percentage of boys in the class is-

Q.11 The mean of the numbers a, b, 8, 5, 10 is 6 and the variance is 6.80. Then which one of the following gives possible values of a and b ? **[AIEEE 2008]** $(A) a = 5, b = 2$ (B) $a = 1, b = 6$

(C)
$$
a = 3, b = 4
$$
 (D) $a = 0, b = 7$

Q.12 If the mean deviation of the numbers $1, 1 + d, 1 + 2d, \ldots$ 1 + 100d from their mean is 255, then the d is equal to - **[AIEEE 2009]** $(A) 10.0$ (B) 20.0 (C) 10.1 (D) 20.2 2 narks of boys in a class is 52 and that of

the average marks of boys and girls combined

ercentage of boys in the class is-

[AIEEE 2007]

(B) 20

(D) 60

(D) 60

(D) 60

the numbers a, b, 8, 5, 10 is 6 and the varianc A) 40 (B) 20

(D) 60

C) 80 (D) 60

The mean of the numbers a, b, 8, 5, 10 is 6 and the variance

s 6.80. Then which one of the following gives possible

ratures of a and b?

A) a = 5, b = 2

(B) a = 1, b = 6

C) a = 3, b The mean of the numbers a, b, 8, 5, 10 is 6 and the variance

is 6.80. Then which one of the following gives possible

values of a and b ?

(A) a = 5, b = 2 (B) a = 1, b = 6

(The mean deviation of the numbers

1, 1+d, 1+ (B) 20

(B) 20

an of the numbers a, b, 8, 5, 10 is 6 and the variance

Then which one of the following gives possible

of a and b?

[AIEEE 2008]

5, b = 2

(B) a = 1, b = 6

(D) a = 0, b = 7

1, 1+2d,.....1+100d from the

Q.13 Statement 1 : The variance of first n even natural

numbers is
$$
\frac{n^2 - 1}{4}
$$
. [AIEEE 2009]

Statement 2 : The sum of first n natural numbers is

$$
\frac{n(n+1)}{2}
$$
 and the sum of squares of first n natural numbers

$$
\frac{n(n+1)(2n+1)}{6}
$$

- n and the contract of the cont (A) Statement -1 is true, Statement -2 is true; Statement- 2 is a correct explanation for Statement -1
	- (B) Statement -1 is true, Statement -2 is true; Statement- 2 is not a correct explanation for Statement -1.
	- (C) Statement -1 is true, Statement -2 is false.
	- (D) Statement -1 is false, Statement -2 is ture.

Q.8 Let x_1, x_2, \dots, x_n be n observations such that $\sum x_i^2 = 400$

(A) $\frac{G_1}{G_2}$

EXERCISE - 3 (PREVIOUS YEARS AIEEE / JEE MAIN QUESTIONS)

[AIEEE-2002]

Q.14 For two data sets, each of size 5, the variances are given to be 4 and 5 and the corresponding means are given to be 2 and 4, respectively. The variance of the combined data set is – **[AIEEE 2010]** (A) 11/2 (B) 6

 (C) 13/2 (D) 5/2

- **Q.15** If the mean deviation about the median of the numbers a, 2a,, 50a is 50, then | a | equals – **[AIEEE 2011]** $(A) 2$ (B) 3 (C) 4 (D) 5
- **Q.16** Let x_1, x_2, \dots, x_n be n observations, and let x be their arithmetic mean and σ^2 be the variance. [AIEEE 2012] σ^2 **Statement-1 :** Variance of $2x_1$, $2x_2$,, $2x_n$ is $4\sigma^2$. .

Statement-2 : Arithmetic mean $2x_1, 2x_2, ..., 2x_n$ is $4\overline{x}$.

- (A) Statement-1 is false, Statement-2 is true.
- (B) Statement-1 is true, statement-2 is true; statement-2 is a correct explanation for Statement-1.
- (C) Statement-1 is true, statement-2 is true; statement-2 is not a correct explanation for Statement-1.
- (D) Statement-1 is true, statement-2 is false.
- **Q.17** All the students of a class performed poorly in Mathematics. The teacher decided to give gracemarks of 10 to each of the students. Which of the following statistical measures will not change even after the grace marks were given ? **[JEE MAIN 2013]** (A) mean (B) median (C) mode (D) variance
- **Q.18** The variance of first 50 even natural numbers is **[JEE MAIN 2014]**

Q.19 The mean of the data set comprising of 16 observations is 16. If one of the observation valued 16 is deleted and three new observations valued 3, 4 and 5 are added to the data, then the mean of the resultant data, is

Q.20 If the standard deviation of the numbers 2, 3, a and 11 is 3.5, then which of the following is true :**[JEE MAIN 2016]** $24a + 91 = 0$

- **Q.21** If $\sum (x 1)^2$ 9 $i - 3j = 9$ and 2 437 (D) 437/4 bte

in mean of the data set comprising of 16 observations

6. If one of the observation valued 16 is deleted and

ee new observations valued 3, 4 and 5 are added to

data, then the mean of the resultant dat (B) median and 35 respectively, then y/x is

(B) variance

(B) (2) variance

(B) 833

(B) 833

(B) 833

(C) 7/2

(B) 833

(C) 7/2

(B) 833

(D) 437/4

(D) 437/4

(C) 163

(B) 15.8

(B) 15.8

(C) 16.8

(C) 16.8

(C) 16.8
 EXERCISE ANIX 2013

The mode

(B) median

(B) variance of first 50 even natural numbers is -

(B) variance

(B) and and 35 respectively, then y/x is

variance of first 50 even natural numbers is -

(A) 773

16.0

(B) 33 $\sum_{i=1}^{9} (x_i - 5)^2 = 45$, then the of standard deviation of the 9 items $x_1, x_2, ..., x_9$ is : (A) 2 (B) 3 **[JEE MAIN 2018]** $(C) 9$ (D) 4
- **Q.22** 5 students of a class have an average height 150cm and variance 18 cm². A new student, whose height is 156 cm, joined them. The variance (in cm^2) of the height of these six students is : *[JEE MAIN 2019 (JAN)]* $(A) 22$ (B) 20 **STUDY MATERIAL: MATHEMATICS**

5 students of a class have an average height 150cm and

variance 18 cm². A new student, whose height of these

six students is :
 IDEE MAIN 2019 (JAN)

(A) 22

(C) 16 (B) 20

(C) 16 (B) of a class have an average height 150cm and

scm². A new student, whose height is 156 cm,

n. The variance (in cm²) of the height of these

is :
 SECUMAN2019 (JAN)

(B)20

(D) 18

(B)20

(D) 18

e product of the obs
- (C) 16 (D) 18 **Q.23** The mean and variance of seven observations are 8 and 16, respectively. If 5 of the observations are 2, 4, 10, 12, 14, then the product of the remaining two observations is : **[JEE MAIN 2019 (APRIL)]** (A) 40 (B) 49
- is $4\bar{x}$. the mean score is 48 in the six tests, then the standard (C) 48 (D) 45 **Q.24** A student scores the following marks in five tests : 45,54,41,57,43. His score is not known for the sixth test. If deviation of the marks in six tests is 40 (B) 49

44 (B) (D) 45

tutedent scores the following marks in five tests :

44,41,57,43. His score is not known for the sixth test. If

mean score is 48 in the six tests, then the standard

[JEE MAIN 2019 (APRIL)]

10/ 3.3 The mean sole is the following marks in five tests :
student scores the following marks in five tests :
student scores the following marks in five tests :
for the sixth test. If
the mean score is 48 in the sixt tests

[JEE MAIN 2019 (APRIL)]

Q.25 If the standard deviation of the numbers –1, 0, 1, k is $\sqrt{5}$ where $k > 0$, then k is equal to $[JEE \text{ MAIN } 2019 \text{ (APRIL)}]$

(A)
$$
2\sqrt{\frac{10}{3}}
$$
 (B) $2\sqrt{6}$ (C) $4\sqrt{\frac{5}{3}}$ (D) $\sqrt{6}$

Q.26 The mean and the median of the following ten numbers in increasing order 10, 22, 26, 29, 34, x 42, 67, 70, y are 42 and 35 respectively, then y/x is equal to : **[JEE MAIN 2019 (APRIL)]**

(B) $100/\sqrt{3}$

(D) $10/3$

tion of the numbers -1, 0, 1, k is $\sqrt{5}$

equal to [JEE MAIN 2019 (APRIL)]
 $2\sqrt{6}$ (C) $4\sqrt{\frac{5}{3}}$ (D) $\sqrt{6}$

nedian of the following ten numbers

0, 22, 26, 2

Q.27 If for some $x \in R$, the frequency distribution of the marks obtained by 20 students in a test is :

Q.28 If both the mean and the standard deviation of 50 observations $x_1, x_2, ..., x_{50}$ are equal to 16, then the mean of $(x_1-4)^2$, $(x_2-4)^2$,..... $(x_{50}-4)^2$ is :

(D) 437/4

comprising of 16 observations

ation valued 16 is deleted and

alued 3, 4 and 5 are added to

f the resultant data, is
 IDEEMAIN 2015

(B) 15.8

(B) 15.8

(D) 16.8

(D) 16.8

(D) 16.8

(D) 16.8

(D) 16.8

(D) (B) median

(B) median and 35 respectively, then y/x is equal to :

(DV variance

(A) 7/3

(B) 9/4

(B) 833

(B) 833

(B) 833

(B) 437/4

(B) 833

(B) 437/4

(B) 437/4

(B) 437/4

(B) 437/4

(B) 437/4

(B) 437/4

(B) 437/ **IJEE MAIN 2013**

(B) median

(B) mincreasing order 10, 22, 26, 29, 34, x42, 67, 70, y are

(D) variance

(D) variance

(D) 4774

(B) 4833

(D) 4374

(B) 4934

(D) 4374

(B) 4933

(D) 4374

(D) 4374

(D) 4374

(D) 4833

(**Q.29** If the data $x_1, x_2, ..., x_{10}$ is such that the mean of first four of these is 11, the mean of the remaining six is 16 and the sum of squares of all of these is 2,000; then the standard deviation of this data is : **[JEE MAIN 2019 (APRIL)]** (A) 4 (B) 2 and 35 respectively, then y/x is equal to :

(A) 7/3 (BE MAIN 2019 (APRIL)]

(C) 7/2 (D) 8/3

(C) 7/2 (D) 8/3

obtained by 20 students in a test is :
 $\frac{\text{Marks}}{\text{Frequency}}$ ($x + 1$)² 2x-5 $x^2 - 3x$ x

then the mean of the mar

 $(A) 525$ (C) 480

Q.30 If variance of first n natural numbers is 10 and variance of first m even natural numbers is 16 then the value of $m + n$ is **[JEE MAIN 2020 (JAN)]**

Q.31 If the mean and variance of eight numbers 3, 7, 9, 12, 13, 20, x and y be 10 and 25 respectively, then x·y is equal to_____ **[JEE MAIN 2020 (JAN)]**

Q.32 Mean and standard deviations of 10 observations are 20 and 2 respectively. If $p (p \neq 0)$ is multiplied to each observation and then q (q \neq 0) is subtracted then new mean and standard deviation becomes half of original value . Then find q. **[JEE MAIN 2020 (JAN)**] $(A) -10$ (B) –20

 (C) –5 (D) 10

Q.33 Mean and variance of 20 observation are 10 and 4. It was found, that in place of 11, 9 was taken by mistake find correct variance. **[JEE MAIN 2020 (JAN)]** (A) 3.99 (B) 3.98 (C) 4.01 (D) 4.02 Mean and variance of 20 observation are 10 and 4. It was

found, that in place of 11, 9 was taken by mistake find

correct variance. [JEE MAIN 2020 (JAN)]

(A) 3.99 (B) 3.98

C) 4.01 (D) 4.02

Let the observations x_i (1 **EXECUTE ARNING**
 EXECUTE ARNING
 EXECUTE ARNING
 EXECUTE ARNING
 EXECUTE ARNIN 2020 (JAN)
 EXECUTE MAIN 2020 (JAN)

(B) 3.98

(D) 4.02
 EXECUTE MAIN 2020 (JAN)
 EXECUTE ARNIN 2020
 EXECUTE ARNIN 2020
 EX Mean and variance of 20 observation are 10 and 4. It was
found, that in place of 11, 9 was taken by mistake find
correct variance. [JEE MAIN 2020 (JAN)]
(A) 3.99 (B) 3.98
C) 4.01 (D) 4.02
Let the observations x_i (1 ≤ i Mean and variance of 20 observation are 10 and 4. It was
found, that in place of 11, 9 was taken by mistake find
correct variance. [JEE MAIN 2020 (JAN)]
(A) 3.99 (B) 3.98
Let the observations x_i (1 $\le i \le 10$) satisfy t

Q.34 Let the observations x_i ($1 \le i \le 10$) satisfy the equations,

$$
\sum_{i=1}^{10} (x_i - 5) = 10 \text{ and } \sum_{i=1}^{10} (x_i - 5)^2 = 40.
$$
 If μ and λ are the

mean and the variance of the observations, $x_1 - 3$, $x_2 - 3$, ..., $x_{10} - 3$, then the ordered pair (μ , λ) is equal to :

[JEE MAIN 2020 (JAN)]

ANSWER KEY

CHAPTER- 13 : STATISTICS SOLUTIONS TO TRY IT YOURSELF TRY IT YOURSELF

(1) Arranging the data in ascending order, we have 10, 11, 11, 12, 13, 13, 14, 16, 16, 17, 17, 18 Hence, $n = 12$ (which is even) So, median is average of 6th and 7th observations

$$
\frac{N}{2} = \frac{26}{2} = 1
$$

(2)

The C.f. just greater than 13 is 14 and corresponding value of x is 7. \therefore Median = 7

M.D. about median =
$$
\frac{1}{N} \sum f_i |x_i - M| = \frac{1}{26} \times 84 = 3.23
$$

(3) Here x = 6, 7, 10, 12, 13, 4, 8, 12

$$
\therefore \quad \Sigma x = 6 + 7 + 10 + 12 + 13 + 4 + 8 + 12 = 72
$$

$$
n = 8 \quad \therefore \quad \overline{x} = \frac{72}{8} = 9
$$
\n
$$
\Sigma x^2 = (6)^2 + (7)^2 + (10)^2 + (12)^2 + (13)^2 + (4)^2 + (8)^2 + (12)^2 = 722
$$
\n
$$
\text{Variance} = \sigma^2 = \frac{N \Sigma x^2 - (\Sigma x)^2}{N^2} = \frac{8 \times 722 - (72)^2}{(8)^2}
$$
\n
$$
= \frac{5776 - 5184}{64} = \frac{592}{64} = 9.25
$$

(4) We have,

Now,
$$
\overline{x} = A + \frac{\Sigma f_i d_i}{\Sigma f_i} = 64 + \frac{0}{100} = 64
$$

Variance,
$$
\sigma^2 = \frac{1}{N} \{ \Sigma f_i d_i^2 \} - \left\{ \frac{1}{N} \Sigma f_i d_i \right\}^2
$$

$$
= \left[\frac{1}{100} \times 286 - \left(\frac{1}{100} \times 0 \right)^2 \right] = 2.86
$$

(5) Let x and y be remaining two observations.

Hence, n = 12 (which is even)
\nHence, n = 12 (which is even)
\nSo, median is average of 6th and 7th observations
\nSo, median is average of 6th and 7th observations
\nSo, median is average of 6th and 7th observations
\n
$$
\frac{x_1}{2} \left[\frac{13+14}{2} \right] = \frac{27}{2} = 13.5
$$
\n
$$
\frac{x_2}{8} \left[\frac{|x_2 - M|}{2} \right] = 13.5
$$
\n
$$
\frac{x_3}{8} \left[\frac{|x_3 - M|}{2} \right] = \frac{66}{2} = 13.5
$$
\nNow, $\overline{x} = A + \frac{\sum f_1 d_1}{2} = 64 + \frac{0}{100} = 64$
\n
$$
\frac{134}{100} \frac{135}{100} = 64
$$
\n
$$
\frac{134}{100} \frac{135}{100} = 2.86
$$
\n
$$
\frac{x_1}{f_1} = \frac{f_1}{16} \left[\frac{f_1}{18} \left[\frac{x_1 - 7}{11} \right] \frac{f_1}{18} \left|
$$

$$
(9) (A) (10) (A)
$$

278

 \therefore

CHAPTER- 13 : STATISTICS EXERCISE-1

STATEICS
\n**CHAPTER 13: STATISTICS**
\n**CHAPTER 13:STATISTICS**
\n**EXERCISE-1**
\n(1) (B)
$$
\therefore \frac{\Sigma x_1}{n} = \overline{x}
$$

\nLet $y_1 = x_1 + 2i$, $i = 1, 2, ...n$
\nRequired mean
\n $= \frac{\Sigma y_1}{n} = \frac{1}{n} \sum (x_1 + 2i) = \frac{\Sigma x_1}{n} + \frac{2}{n} \cdot \frac{n(n+1)}{n} = \frac{x_1 + n}{n} + \frac{n(n+1)}{n} = \frac{x_1 + 1}{n}$
\n(2) (B) \therefore Sum of the 50 observations is divided by 10 then let new observations
\n(3) **1**(A) $\therefore \frac{1^2 + 2^2 + 3^2 + \dots + n^2}{n} = \frac{46n}{11}$
\n(3) (A) $\therefore \frac{1^2 + 2^2 + 3^2 + \dots + n^2}{n} = \frac{46n}{11}$
\n $\Rightarrow \frac{n(n+1)(2n+1)}{n} = \frac{46n}{11}$
\n $\Rightarrow 11 (n+1)(2n+1) = 267n$
\n(4) (A) An average between $\frac{1}{2} \sum x_i - 2 \cdot \frac{1}{2} = \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{2} \cdot \frac{1}{2} \$

(2) (B). \because Sum of the 50 observations = $36 \times 50 = 1800$ Two observations 30 and 42 are deleted Sum of the remaining 48 observation

$$
= 1800 - [30 + 42] = 1728
$$

Req. mean = $1728/48 = 36$

(3) (A).
$$
\therefore \frac{1^2 + 2^2 + 3^2 + \dots + n^2}{n} = \frac{46n}{11}
$$

Required mean
\n
$$
\frac{\Sigma y_i}{n} = \frac{1}{n} \Sigma (x_i + 2i) = \frac{\Sigma x_i}{n} + \frac{2}{n} \cdot \frac{n(n+1)}{2} = \frac{n}{x + n + 1}
$$
\n(B). \because Sum of the 50 observations
\nTwo observations 30 and 42 are deleted
\nSum of the remaining 48 observations
\nBeq. mean = 1728/48 = 36
\nReq. mean = 1728/48 = 36
\nA(1) \because $\frac{1^2 + 2^2 + 3^2 + \dots + n^2}{n} = \frac{46n}{11}$
\n $\Rightarrow \frac{n(n+1)(2n+1)}{6n} = \frac{46n}{11}$
\n $\Rightarrow 22n^2 - 243n + 11 = 0 \Rightarrow (n-11)(22n-1) = 0$
\n(A). \because $\frac{1^2 + 2^2 + 3^2 + \dots + n^2}{n} = \frac{46n}{11}$
\n $\Rightarrow 11 (n+1)(2n+1) = 267n$
\n $\Rightarrow 22n^2 - 243n + 11 = 0 \Rightarrow (n-11)(22n-1) = 0$
\n $\Rightarrow 22n^2 - 243n + 11 = 0 \Rightarrow (n-11)(22n-1) = 0$
\n $\Rightarrow 22n^2 - 243n + 11 = 0 \Rightarrow (n-11)(22n-1) = 0$
\n $\Rightarrow 22n^2 - 243n + 11 = 0 \Rightarrow (n-11)(22n-1) = 0$
\n $\Rightarrow 2\frac{7}{1} \times x_i + i, i = 1, 2, \dots, n$
\n $\alpha - \frac{7}{2}, \alpha - 3, \alpha - \frac{5}{2}, \alpha - 2, \alpha - \frac{1}{2}, \alpha + \frac{1}{2}, \alpha + 4, \alpha + 5$
\n $\alpha - \frac{7}{2}, \alpha - 3, \alpha - \frac{5}{2}, \alpha - 2, \alpha - \frac{1}{2}, \alpha + \frac{1}{2}, \alpha + 4, \alpha + 5$
\n $= \frac{1}{x} \sum_{i=1$

(4) (A). On arranging the values in the ascending order

$$
\alpha - \frac{7}{2}, \alpha - 3, \alpha - \frac{3}{2}, \alpha - 2, \alpha - \frac{1}{2}, \alpha + \frac{1}{2}, \alpha + 4, \alpha + 5
$$

($\because \alpha > 0$)

Here number of observations $n = 8$ (even)

Median =
$$
\frac{1}{2} \left[\left(\frac{n}{2} \right)
$$
 th observer. + $\left(\frac{n}{2} + 1 \right)$ th observer.
= $\frac{1}{2} \left[(\alpha - 2) + \left(\alpha - \frac{1}{2} \right) \right] = \alpha - \frac{5}{4}$

⁼ 1 1 5 (2) 2 2 4 **(5) (D).** N = fi = 1 + ⁿC¹ ⁺ ⁿC² + + ⁿCⁿ = 2ⁿ fixi = 1 × 0 + ⁿC¹ × 1 + ⁿC² × 2 + + n × ⁿCⁿ ⁼ n(n 1) n(n 1) (n 2) n 1 2 ... n 1 2! 3! = n [n–1C⁰ ⁺ n–1C¹ ⁺ n–1C² + + n–1Cn–1] = n . 2n–1 Reqd. A.M. = n 1 i i ⁿ f x n.2 n N 2 ² **(6) (D).** 1 2 3 n x x x x 1 3 n x x x ⁼ 1 2 3 n 2 (x x x x) x ⁼ ² nX x

(6) **(D).**
$$
\frac{x_1 + x_2 + x_3 + \dots + x_n}{n} = \overline{x}
$$
(i)

when x_2 is replaced by λ then

$$
\frac{x_1 + \lambda + x_3 + \dots + x_n}{n}
$$
\n
$$
= \frac{(x_1 + x_2 + x_3 + \dots + x_n) + \lambda - x_2}{n} = \frac{n\bar{X} + \lambda - x_2}{n}
$$
\n(13)\nby (i)\n(14)

(7) (A). Let the mean of remaining 4 observations is \bar{x} the sum of remaining 4 observations = $4 \overline{x}$.

$$
M = \frac{a + 4\overline{x}}{(n-4) + 4} = \frac{a + 4\overline{x}}{n} \quad \therefore \quad \overline{x} = \frac{nM - a}{4}
$$

(c) Let set of n observations $x_1, x_2, ... x_n$ and their mean \overline{x} .

$$
\frac{\sum x_i}{n} = \overline{x} \qquad \qquad(i)
$$

(8) (C). Let set of n observations $x_1, x_2, ...x_n$ and their mean \bar{x} .

$$
\therefore \frac{\sum x_i}{n} = \overline{x}
$$
(i)

(n 4) 4 n Each observations is divided by α ($\alpha \neq 0$) and then increased by 10 then let new observations

$$
y_i = \frac{x_i}{\alpha} + 10
$$
, i = 1, 2,n

Req. mean of new observations

Q.B. SOLUTIONS
\n**CHAPTER 13: STATISTICS**
\n**EXERCISE-1**
\n
$$
\therefore M = \frac{a+4\overline{x}}{(n-4)+4} = \frac{a+4\overline{x}}{n}, \quad \overline{x} = \frac{nM-a}{4}
$$
\n
$$
\therefore \overline{X} = \frac{1M-a}{n}
$$
\n
$$
\therefore \overline{X} = \frac{1}{n}
$$
\n
$$
\Rightarrow \
$$

 $=\frac{40 \text{ m}}{11}$ (9) (C). Let n values of distribution are x_1, x_2, \dots, x_n and

$$
\overline{x} = \frac{\Sigma x_i}{n}
$$

Let new observations of that distribution

$$
y_i = x_i + i, \quad i = 1, 2, \dots, n
$$

$$
Req. \text{ mean} = \frac{1}{n} \Sigma y_i = \frac{1}{n} \Sigma (n_i + i) = \frac{\Sigma x_i}{n} + \frac{\Sigma i}{n}
$$

$$
= \overline{x} + \frac{n(n+1)}{2n} = \overline{x} + \frac{n+1}{2}
$$

(10) (A). $n = 21$ (odd), median = 40

Median =
$$
\left(\frac{21+1}{2}\right)
$$
th observation = 11th;

observation= 40

Since observations which greater than median are increased. $\bar{x} = \frac{2x_1}{n}$

Let new observations of that distribution
 $y_1 = x_1 + i$, $i = 1, 2, \dots, n$

Req. mean = $\frac{1}{n} \Sigma y_1 = \frac{1}{n} \Sigma (\mathbf{n}_1 + \mathbf{i}) = \frac{\Sigma x_1}{n} + \frac{\Sigma \mathbf{i}}{n}$
 $= \overline{x} + \frac{\mathbf{n}(\mathbf{n} + \mathbf{i})}{2n} = \overline{x} + \frac{\mathbf{n} + \mathbf{i}}{2}$
 3. Let n values of distribution are x_1, x_2, \dots, x_n and
 $\bar{x} = \frac{\sum x_i}{n}$

t new observations of that distribution
 $y_i = x_i + i$, $i = 1, 2, \dots, n$
 $x_i = x_i + i$, $i = 1, 2, \dots, n$
 $x_i = \frac{1}{n} \sum_i \frac{1}{n} \sum_i (n_i + i) = \frac{\sum x_i}{n} + \frac{\sum i}{n}$ $\overline{x} = \frac{\sum x_i}{n}$
 $x_i = x_i + i, \quad i = 1, 2, \dots, n$
 $x_i = x_i + i, \quad i = 1, 2, \dots, n$
 $x_i = n \text{ and } n = \frac{1}{n} \sum y_i = \frac{1}{n} \sum (n_i + i) = \frac{\sum x_i}{n} + \frac{\sum i}{n}$
 $= \overline{x} + \frac{n(n+1)}{2n} = \overline{x} + \frac{n+1}{2}$
 $\int \text{Area} = \left(\frac{21+1}{2}\right) \text{th} \text{ observation} = 40$
 $\int \text{Area} = \left(\$ 11th;
than median are
remains unchanged.
ing order median
servation = 30
ude after arranging
r n = 21 (odd)
servation = 30
is computed by the
 $\frac{f_m - f_1}{m - f_1 - f_2} \times i$
5 times) than any
 $e = 6$.
5 = 8. ter than median are

ch remains unchanged.

mding order median

observation = 30

aclude after arranging

rder n = 21 (odd)

observation = 30

de is computed by the
 $\frac{f_m - f_1}{2f_m - f_1 - f_2} \times i$

.e., 5 times) than any

od th_;
han median are
mains unchanged.
g order median
rvation = 30
le after arranging
n = 21 (odd)
rvation = 30
s computed by the
 $\frac{n-f_1}{-f_1-f_2} \times i$
i times) than any
= 6.

But median is 11th observation which remains unchanged. **(11) (B).** $n = 19$ (odd), Median = 30

On arranging observations in ascending order median

$$
=\left(\frac{n+1}{2}\right)th\text{ observation}=(10)^{th}\text{ observation}=30
$$

Since two observations 8, 32 are include after arranging that 21 observation in ascending order $n = 21$ (odd)

$$
= 0
$$

\n
$$
y_1 = 0
$$

\n
$$
y_2 = \frac{1}{n} \sum (n_1 + i) = \frac{\sum x_i}{n} + \frac{\sum i}{n}
$$

\n
$$
= \overline{x} + \frac{n(n+1)}{2n} = \overline{x} + \frac{n+1}{2}
$$

\n
$$
= \overline{x} + \frac{n(n+1)}{2n} = \overline{x} + \frac{n+1}{2}
$$

\n
$$
= \frac{21+1}{2} \text{ th observation} = 40
$$

\n
$$
\text{Median} = \left(\frac{21+1}{2}\right) \text{ th observation} = 11^{\text{th}};
$$

\n
$$
\text{observation} = 40
$$

\n
$$
\text{Since observations which greater than median are increased.}
$$

\n
$$
n_0
$$

\n
$$
n_1
$$

\n
$$
= \frac{(11) (B). n = 19 (odd), Median = 30}{Dn \text{ arranging observations in ascending order median}}
$$

\n
$$
n_2
$$

\n
$$
= 12
$$

\n
$$
11n_1
$$

\n
$$
= \left(\frac{n+1}{2}\right) \text{th observation} = (10)^{\text{th}} \text{ observation} = 30
$$

\n
$$
12n - 1
$$

\n
$$
= \frac{n+1}{2} \text{th observation in ascending order} = 21 (odd)
$$

\n
$$
New median = \left(\frac{n+1}{2}\right) \text{th} = (11)^{\text{th}} \text{ observation} = 30
$$

\n
$$
\therefore (8 < 30 < 32)
$$

\n
$$
= (12) (C). For a continuous series the mode is computed by the formula:\n
$$
t + \frac{f_m - f_{m-1}}{2f_m - f_{m-1} - f_{m+1}} \times C \text{ or } \ell + \frac{f_m - f_1}{2f_m - f_1 - f_2} \times i
$$

\n
$$
= \frac{13}{2}
$$

\n
$$
= \frac{1}{2}
$$

\n
$$
t + \frac{1}{2f_m
$$
$$

$$
\because (8<30<32)
$$

(12) (C). For a continuous series the mode is computed by the formula :

$$
\ell + \frac{f_m - f_{m-1}}{2f_m - f_{m-1} - f_{m+1}} \times C \text{ or } \ell + \frac{f_m - f_1}{2f_m - f_1 - f_2} \times i
$$

n

other 15 observations. \therefore Mode = 6. remains unchanged.

ing order median

servation = 30

lude after arranging

er n = 21 (odd)

sservation = 30

e is computed by the
 $\frac{f_m - f_1}{m - f_1 - f_2} \times i$

5 times) than any

e = 6.

(5) = 8. **(13) (C).** Since 6 occurs most times (i.e., 5 times) than any

(14) (D). We know that,

Mode = 3Median – 2Mean =
$$
3(6) - 2(5) = 8
$$
.

(15) (C). We know that, Mean *n i ⁱ ⁿ i i i f f x* 1 1 i.e., ⁴ ⁵ ¹ ² 1 4 2 5 3 4 1 5 2 2.6 *y y* or 31.2 2.6*y* 28 3*y* or 0.4*y* 3.2 *y* 8 . **(16) (B).** Since frequency is maximum for 6. Mode = 6. **(17) (A).** For a moderately Skewed distribution, Mode = 3 median – 2 mean 6 = 3 median – 18 median = 8. **(18) (B). (19) (C).** 1 0 4 x 1 3 ; ⁱ | x x | 2 1 3 6 Mean deviation = i 1 1 | x x | 6 2 n 3 **(20) (A).** ³⁰ x 6 ⁵ Variance = (S.D.)² = ² i 1 | x x | n ⁼ 2 2 i ⁼ ¹ 2 2 2 2 2 2 [2 4 6 8 10] (6) ⁵ ⁼ ²⁰ 36 8 **(21) (B).** Since mean deviation is minimum when it is taken by median of distribution so here K is median of given observations. K = median = n 1 th 2 observation = 51th observation K = x⁵¹ **(22) (D).** Let xi/fi, i = 1, 2, n be a frequency distribution i i f (x x) ^N and M.D. = i i f | x x | ^N Let i i | x x | y then,

$$
Variance = (S.D.)2 = 1/n Σ[x] = 1/n Σx2 = 2/n Σx2 = 2n Ωx2 = 2n Ωx2 = 2n ∴ $σ2 = \overline{xq} \Rightarrow 2 = 3 \times q \Rightarrow q = \frac{2}{3}$ ∴ $p = 1 - q = \frac{1}{3}$
\n**(21) (B)** Since mean deviation is minimum when it is taken by median of a distribution so here K is median of given
\n $K = median = \left(\frac{n+1}{2}\right)$ th observation = 51th observation
\n $K = max_{51}$
\n**(22) (D)** Let $x_i f_i$, i = 1, 2, n be a frequency distribution
\nthen its S.D. = $\sqrt{\frac{1}{N}} Σf_i(x_i - \overline{x})^2$ and
\n $MD = \frac{1}{N} Σf_i | x_i = \overline{x}|$
\n $LC = \frac{1}{N} Σf_i (x_i - \overline{x})^2$
\n $LC = \frac{1}{N} Ωf_i \times \frac{1}{N} = \frac{1}{\sqrt{N}} Ωf_i (x_i - \overline{x})^2$
\nLet $|x_i - \overline{x}| = y_i$ then,
\n $SD = \frac{1}{\sqrt{N}} Σf_i y_i^2$ and $MD = \frac{1}{\sqrt{N}} Σf_i y_i$
\n SO , corrected $Yy = \overline{x}x - 170$, $Σx^2 = 2830$
\nSince once observation 20 was found be wrong an
\nreplaced by its correct value 30.
\n SO , corrected $Yy = \overline{x}x - 20$ + 30 = 180
\n SO , corrected $Yy = \overline{x}x - 20$ + 30 = 180
\n SO , corrected $Yy = \overline{x}x - 20$ + 30 =
$$

Mean
$$
(\overline{x}) = np \Rightarrow n \times \frac{1}{4} = 3 \Rightarrow n = 12
$$

Hence binomial distribution is given by

$$
(q+p)^n = \left(\frac{3}{4} + \frac{1}{4}\right)^{12}
$$

UTIONS

\n**STUDY MATERIAL: MATHEMATICS**

\nMean
$$
(\overline{x}) = np \Rightarrow n \times \frac{1}{4} = 3 \Rightarrow n = 12
$$

\nHence binomial distribution is given by

\n
$$
(q + p)^n = \left(\frac{3}{4} + \frac{1}{4}\right)^{12}
$$

\n**(25) (C).** \because
$$
(S.D.)^2 = \frac{1}{n} \sum (x_i - \overline{x})^2 = \frac{1}{n} \sum x_i^2 - \left(\frac{1}{n} \sum x_i\right)^2
$$

\nSo S.D. of first n natural numbers

\n
$$
= \sqrt{\frac{1}{n} \sum n^2 - \left(\frac{1}{n} \sum n\right)^2}
$$

So S.D. of first n natural numbers

x x i i i 1 1 1 (x x) x x n n n ⁼ ² 1 1 ² n n n n ⁼ ² 1 n(n 1)(2n 1) 1 n(n 1) n 6 n 2 ⁼ ² n(n 1)(2n 1) (n 1) (n 1)(n 1) 6 4 12 ⁼ ² n 1 12 **(26) (C).** Mean (x) 3 , Variance (xq 2 3 q q p 1 q ³ x np 3 n n 9 n n r r P (x r) C q p ^r

1

(26) (C). Mean
$$
(\overline{x}) = 3
$$
, Variance $(\sigma^2) = 2$

$$
\therefore \quad \sigma^2 = \overline{x}q \Rightarrow 2 = 3 \times q \Rightarrow q = \frac{2}{3} \quad \therefore \quad p = 1 - q = \frac{1}{3}
$$

ximum for 6. : Mode = 6.
\nSo S.D. of first natural numbers
\nmedian = 82.
\n
$$
\frac{1}{n} \sum R^2 - (\frac{1}{n} \sum R)^2
$$
\n
$$
= \sqrt{\frac{1}{n} \sum R^2 - (\frac{1}{n} \sum R)^2}
$$
\n
$$
= \sqrt{\frac{n(n+1)(2n+1)}{6} - (\frac{1}{n} \frac{n(n+1)}{2})^2}
$$
\n
$$
= \sqrt{\frac{n(n+1)(2n+1)}{6} - (\frac{1}{n} \frac{n(n+1)}{2})^2}
$$
\n
$$
= \sqrt{\frac{n(n+1)(2n+1)}{6} - (\frac{1}{n} \frac{n(n+1)}{2})^2}
$$
\n
$$
= \sqrt{\frac{n^2-1}{12}}
$$
\n(26) (C). Mean (x) = 3, Variance (c²) = 2
\n
$$
\therefore \quad \alpha^2 = \overline{x}q \Rightarrow 2 = 3 \times q \Rightarrow q = \frac{2}{3} \therefore p = 1 - q = \frac{1}{3}
$$
\n
$$
10^2 \bigg] - (6)^2 = \frac{220}{5} \Rightarrow 36 = 8
$$
\nis minimum when it is taken by
\n
$$
\therefore \quad P(x = r) = {}^nC_r q^{n-r} p^r
$$
\n
$$
= {}^nC_1 (\frac{2}{3}) (\frac{1}{3})^8 + {}^pC_0 (\frac{2}{3})^9 + (\frac{1}{3})^9
$$
\n
$$
= 9 \times \frac{2}{3} \times \frac{1}{3} + 1 \times 1 \times \frac{1}{3} = \frac{19}{3^9}
$$
\n
$$
= 9 \times \frac{2}{3} \times \frac{1}{3} + 1 \times 1 \times \frac{1}{3} = \frac{19}{3^9}
$$
\n(27) (B). Given $n = 15, \Sigma \times 170, \Sigma \times 2 = 2830$
\nSince one observe that 30.
\nD. = $\frac{1}{N} \Sigma f_1 y_1$
\n
$$
= \frac{1}{N} \Sigma f_1 y_1
$$

\n
$$
= \frac{1}{N} \Sigma f_1 y_1
$$

\n<math display="</p>

(27) (B). Given n = 15, $\Sigma x = 170$, $\Sigma x^2 = 2830$ Since once observation 20 was found be wrong and it replaced by its correct value 30. So, corrected $\Sigma y = \Sigma x - 20 + 30 = 180$ **2** = 2π (3) π (8) π) π (8) π (8) π (2) π (2)

corrected
$$
\Sigma y^2 = \Sigma x^2 - 20^2 + 30^2 = 3330
$$

The correct variance =
$$
\frac{1}{n} \Sigma y^2 - \left(\frac{1}{n} \Sigma y\right)^2
$$

$$
= \frac{1}{15} \times 3330 - \left(\frac{1}{15} \times 180\right)^2 = 78
$$

(28) (A). Number of observations = 2n (even) and observations are a, a,nand -a, -a.......n

$$
SD = \sqrt{\frac{n (a-0)^2 + n (-a-0)^2}{2n}}
$$

$$
280 \sim
$$

TESTICS
\nS.D. =
$$
\sqrt{\frac{\sum (x_i - \overline{x})^2}{n}} = \sqrt{\frac{na^2 + na^2}{2n}} = \sqrt{a^2} = \pm a = |a|
$$

\nGiven S.D. = 2 \Rightarrow |a| = 2
\n(A). Given n = 2, p = 0.6
\n \therefore p + q = 1 \Rightarrow q = 1 – 0.6 = 0.4
\nVariance of the variable x = $\sigma^2(x)$ = npq = 0.48
\nVariance of the random variable
\n(a) 0, (b). It is a fundamental property

Given S.D. = $2 \implies |a| = 2$

ICS (O.B.- SOLUTIONS EXECUTIONS (29) (A). Given $n = 2$, $p = 0.6$ \therefore p + q = 1 \Rightarrow q = 1 – 0.6 = 0.4 Variance of the variable $x = \sigma^2(x) = npq = 0.48$ Variance of the random variable TICS **(D.B.- SOLUTIONS**)
 $D = \sqrt{\frac{\sum (x_i - \overline{x})^2}{n}} = \sqrt{\frac{na^2 + na^2}{2n}} = \sqrt{a^2} = \pm a = |\alpha|$
 \therefore Correct $\alpha = \sqrt{\frac{364100}{200}} - (39.95)^2$
 \therefore Corrected $\sigma = \sqrt{\frac{364100}{200}} - (39.95)^2$
 \therefore Corrected $\sigma = \sqrt{\frac{364100}{200}} - (39.9$ TICS
 $D = \sqrt{\frac{\sum (x_i - \overline{x})^2}{n}} = \sqrt{\frac{na^2 + na^2}{2n}} = \sqrt{a^2} = \pm a = |a|$
 \therefore Correct $\sum x^2 = 365000 - 2500 + ...$
 \therefore Corrected $\sigma = \sqrt{\frac{364100}{200} - (39.600) - (11.600)} = \sqrt{21.600}$
 \therefore Corrected $\sigma = \sqrt{\frac{364100}{200} - (39.600) - (1$ **(0.B.- SOLUTIONS**
 $\frac{1}{2}(\frac{x_1 - \overline{x})^2}{n} = \sqrt{\frac{na^2 + na^2}{2n}} = \sqrt{a^2} = \pm a = |a|$
 \therefore Corrected $\sigma = \sqrt{\frac{364100}{200}}$
 $\ln = 2, p = 0.6$
 $11 = 2, p = 1 - 0.6 = 0.4$
 $\text{if the variable } x = \sigma^2(x) = npq = 0.48$
 $\sigma^2 = \sqrt{(1820.5 - 1596)} = \sqrt{(1820.5 -$ **ICS)**
 O.B. SOLUTIONS
 $=\sqrt{\frac{\sum (x_i - \overline{x})^2}{n}} = \sqrt{\frac{na^2 + na^2}{2n}} = \sqrt{a^2} = \pm a = |\alpha|$
 \therefore Corrected $\sigma = \sqrt{\frac{364100}{200} - (39.95)^2}$
 \therefore Corrected $\sigma = \sqrt{\frac{364100}{200} - (39.95)^2}$
 \therefore Corrected $\sigma = \sqrt{\frac{364100}{200} - (39$

$$
\frac{x}{2} = \sigma^2 \left(\frac{x}{2} \right) = \frac{1}{4} \sigma^2(x) = 0.12
$$

(30) (C). Mean
$$
\bar{x} = \frac{1+2+3+4+5}{5} = 3
$$

ITSTICS
\nS.D. =
$$
\sqrt{\frac{\sum (x_i - \overline{x})^2}{n}} = \sqrt{\frac{na^2 + na^2}{2n}} = \sqrt{a^2} = \pm a = |\mathbf{a}|
$$

\nGiven S.D. = 2 $|\mathbf{a}| = 2$
\n $\therefore \mathbf{b} + \mathbf{q} = 1 \Rightarrow \mathbf{q} = 1 - 0.6 = 0.4$
\n $\therefore \mathbf{c} + \mathbf{r} = 1 \Rightarrow \mathbf{q} = 1 - 0.6 = 0.4$
\n $\therefore \mathbf{c} + \mathbf{r} = 1 \Rightarrow \mathbf{r} = 0.6 = 0.4$
\nVariance of the variable $\mathbf{x} = \sigma^2(\mathbf{x}) = \text{npq} = 0.48$
\n $\frac{\mathbf{x}}{2} = \sigma^2(\frac{\mathbf{x}}{2}) = \frac{1}{4}\sigma^2(\mathbf{x}) = 0.12$
\n**(A)** Variance = $(\mathbf{S}.\mathbf{D})^2 = \frac{1}{n}\sum \mathbf{x}_1^2 - (\overline{\mathbf{x}})^2$
\n**(B)**. It is a fundamental property.
\n**(C)** Mean $\overline{\mathbf{x}} = \frac{1+2+3+4+5}{5} = 3$
\n $\mathbf{S}.\mathbf{D} = \sigma = \sqrt{\frac{1}{n}\sum \mathbf{x}_1^2 - (\overline{\mathbf{x}})^2}$
\n $= \sqrt{\frac{1}{5}(1+4+9+16+25)-9} = \sqrt{11-9} = \sqrt{2}$.
\n**(A)** If each item of a data is increased or decreased by the same constant, the standard deviation of the data remains

- **(31) (A).** If each item of a data is increased or decreased by the same constant, the standard deviation of the data remains unchanged.
- **(32) (D).** When each item of a data is multiplied by λ , variance is multiplied by λ^2 . Hence, new variance = $5^2 \times 9 = 225$

(33) (B). Let *^c ax ^b y* i.e., *cb x ca* i.e., *^y Ax ^B* , where *ca ^A* , *cb ^B y Ax B y y A*(*x x*) ² ² ² (*y y*) *A* (*x x*) x¹ , x² ,xⁿ ² ² ² (*y y*) *A* (*x x*) ² ² ² . . *^y ^x n A n* ² ² ² *^y A ^x ^y ^A ^x* [|] [|] *^y ^x ca*

(34) (B). Let the two unknown items be x and y.

Then, mean = 4.4
$$
\Rightarrow
$$
 $\frac{1+2+6+x+y}{5} = 4.4$
Total mean = $\frac{32n_1 + 27}{n_1 + n_2}$
 $\Rightarrow x + y = 13$ (i)
The 9/*of* stream = $\frac{2}{x}$

and variance $= 8.24$

$$
\Rightarrow \frac{1^2 + 2^2 + 6^2 + x^2 + y^2}{5} - (\text{mean})^2 = 8.24
$$
 (4)

 \Rightarrow 41 + $x^2 + y^2 = 5$ {(4.4)² + 8.24} \Rightarrow $x^2 + y^2 = 97$ (ii) A.M. = $\frac{a + b + c}{a}$. Solving (i) and (ii) for x and y, we get $x = 9$, $y = 4$ or $x = 4$, $y = 9$.

(35) **(B).** Corrected
$$
\Sigma x = 40 \times 200 - 50 + 40 = 7990
$$

\n∴ Corrected $\overline{x} = 7990 / 200 = 39.95$
\nIncorrect $\Sigma x^2 = n[\sigma^2 + \overline{x}^2] = 200[15^2 + 40^2] = 365000$

Correct $\Sigma x^2 = 365000 - 2500 + 1600 = 364100$

Q.B.- SOLUTIONS
\nCorrect
$$
\Sigma x^2 = 365000 - 2500 + 1600 = 364100
$$

\nCorrected $\sigma = \sqrt{\frac{364100}{200} - (39.95)^2}$
\n= $\sqrt{(1820.5 - 1596)} = \sqrt{224.5} = 14.98$
\nno = 0.48 (36) (C). (37) (C). (38) (D).

$$
= \sqrt{(1820.5 - 1596)} = \sqrt{224.5} = 14.98
$$

(36) (C). (37) (C). (38) (D).

$$
(39) \t\t (B).
$$
 It is a fundamental property.

Q.B.- SOLUTIONS
\n
$$
\frac{1-\overline{x})^2}{n} = \sqrt{\frac{na^2 + na^2}{2n}} = \sqrt{a^2} = \pm a = |a|
$$
\n
$$
\frac{2 \Rightarrow |a| = 2}{2n} = 0.6
$$
\n
$$
\Rightarrow q = 1 - 0.6 = 0.4
$$
\n
$$
\Rightarrow \text{arabola} = \frac{364100}{200} - (39.95)^2
$$
\n
$$
\Rightarrow \text{arabola} = \frac{1}{2} = 2, \text{ p = 0.6}
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.6 = 0.4}
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.6 = 0.4}
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.6 = 0.4}
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.7} = \frac{1}{2} = 2, \text{ p = 0.4}
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.7} = \frac{1}{2} = 2, \text{ q = 0.4}
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.7} = \frac{1}{2} = 2, \text{ q = 0.4}
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.6} = 0.4
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.7} = \frac{1}{2} = 2, \text{ q = 0.4}
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.7} = \frac{1}{2} = 2, \text{ q = 0.4}
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.6} = 0.4
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.6} = 0.4
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.6} = 0.4
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.6} = 0.4
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.7} = \frac{1}{2} = 2, \text{ q = 0.4}
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.7} = \frac{1}{2} = 2, \text{ q = 0.4}
$$
\n
$$
\Rightarrow \text{ q = 1 - 0.7} =
$$

$$
= \frac{n(n+1)(2n+1)}{6n} - \left(\frac{n(n+1)}{2n}\right)^2 = \frac{n^2-1}{12}.
$$

(41) (C). Let the two unknown items be x and y, then

Mean =
$$
4 \Rightarrow \frac{1+2+6+x+y}{5} = 4 \Rightarrow x+y=11
$$
(i)
and variance = 5.2

2
$$
(x_1 - \overline{x})^2
$$

\n $\sqrt{\frac{1}{n} - \sqrt{\frac{1}{n^2 + n a^2}} - \sqrt{a^2 - \pm a - |a|}$
\n $\ln 2 - 2 \Rightarrow |a| = 2$
\n $\ln 2 - 2 \Rightarrow |a| = 2$
\n $\ln 2 - 2 \Rightarrow |a| = 2$
\n $\ln 2 - 2 \Rightarrow |a| = 2$
\n $\ln 2 - 2 \Rightarrow |a| = 2$
\n $\ln 2 - 2 \Rightarrow |a| = 2$
\n $\ln 2 - 1 \Rightarrow q = 0.6$
\n $\ln 2 + 2 \Rightarrow q = 0.6$
\n $\ln 3 + 4 \Rightarrow q = 0.6$
\n $\ln 4 + 9 \Rightarrow 16 \Rightarrow 12 \Rightarrow q = 0.4$
\n $\ln 5 - 3 \Rightarrow q = 12$
\n $\ln \frac{1}{2} - \frac{1}{4}a^2(x) = 0.12$
\n<

 $y = \frac{a}{x} + \frac{b}{y}$ (42) (A). Total sales for the first 11 months = 12000 × 11 Rs. Average sales for the whole year = 11375 Rs. Let value of the sale during the last month of year was x

Rs. So,
$$
\frac{12000 \times 11 + x}{12} = 11375 \Rightarrow x = 4500 \text{ Rs.}
$$

(43) (B). Let x_1, x_2, \dots, x_n are n positive numbers such that = 1 (1) \therefore A.M. \geq G.M. x = 4, y = 7 or x = 7, y = 4.

(A). Total sales for the first 11 months = 12000 × 11 Rs.

Average sales for the whole year = 11375 Rs.

Let value of the sale during the last month of year was x

Rs. So, $\frac{12000 \times 11 + x}{1$ r the first 11 months = 12000 × 11 Rs.

the whole year = 11375 Rs.

le during the last month of year was x
 $\frac{1+x}{1-x} = 11375 \Rightarrow x = 4500$ Rs.

.... x_n are n positive numbers such that

...... x_n are n positive numbers s the analytical multiple space of the sp 1 1 1 g the last month of year was x

1375 \Rightarrow x = 4500 Rs.

n positive numbers such that

.........(1)

(x₁, x₂, x_n)^{1/n} = 1

by (1)

and women in the group are

= 30 $\Rightarrow \frac{n_1}{n_2} = \frac{3}{2}$
 $= 40$

e positive

So,
$$
\frac{x_1 + x_2 + \dots + x_n}{n} \ge (x_1, x_2, \dots, x_n)^{1/n} = 1
$$

 $\sigma_y = \left| \frac{a}{c} \right| \sigma_x$. Thus, new S.D. $= \left| \frac{a}{c} \right| \sigma$. (44) $\Rightarrow x_1 + x_2 + \dots + x_n \ge n$ by (1)
(C). Let the number of men and women in the group are \Rightarrow x₁ + x₂ + + x_n ≥ n by (1) n_1 and n_2 respectively.

Total mean =
$$
\frac{32n_1 + 27n_2}{n_1 + n_2} = 30 \implies \frac{n_1}{n_2} = \frac{3}{2}
$$

The % of women =
$$
\frac{2}{5} \times 100 = 40
$$

$$
(45) (B).
$$

 $-$ (mean)² = 8.24 **(46) (C).** A.M. and H.M. of three positive number a, b, c.

(A). Total sales for the first 17 months = 12000 × 11 Ks.
Average sales for the whole year = 11375 Rs.
Let value of the sale during the last month of year was x
Rs. So,
$$
\frac{12000 \times 11 + x}{12} = 11375 \Rightarrow x = 4500 Rs
$$
.
(B). Let x_1, x_2, \dots, x_n are n positive numbers such that
 $x_1, x_2, \dots, x_n = 1$ (1)
 \therefore A.M. \ge G.M.
So, $\frac{x_1 + x_2 + \dots + x_n}{n} \ge (x_1, x_2, \dots + x_n)^{1/n} = 1$
 $\Rightarrow x_1 + x_2 + \dots + x_n \ge n$ by (1)
(C). Let the number of men and women in the group are
n₁ and n₂ respectively.
Total mean = $\frac{32n_1 + 27n_2}{n_1 + n_2} = 30 \Rightarrow \frac{n_1}{n_2} = \frac{3}{2}$
The % of women = $\frac{2}{5} \times 100 = 40$
(B).
(C). A.M. and H.M. of three positive number a, b, c.
A.M. = $\frac{a + b + c}{3}$ $\Rightarrow \frac{3}{\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right)}$ \therefore A.M. \ge H.M.
 $\Rightarrow \frac{a + b + c}{3} \ge \frac{3}{\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right)}$ \therefore A.M. \ge H.M.

$$
\Rightarrow \frac{a+b+c}{3} \ge \frac{3}{\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right)} \quad \therefore \quad A.M. \ge H.M.
$$

$$
\Rightarrow (a+b+c)\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right) \ge
$$

EXAMPLE 2.13
\n**QODX AONXCED HERRARAL : MATHEMATICS**
\n⇒
$$
(a + b + c) \left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c} \right) \ge 9
$$

\n⇒ $(a + b + c) \left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c} \right) \ge 9$
\n**QCDX AONX CED HERIAL : MATHEMATICS**
\n**QCDX AON**
\n**QCDX AON**
\n**QCDX AON**
\n**QCDX AON**
\n**QCDY AON**

(48) (D). Let the number of observations of two sets are n_1 and n_2 whose means \bar{x}_1 and \bar{x}_2 respectively.

EXECUTE:
$$
\frac{1}{2}
$$
 Ω + b + c) $\left(\frac{1}{4} + \frac{1}{b} + \frac{1}{c} \right) ≥ 9$
\n⇒ (a + b + c) $\left(\frac{1}{4} + \frac{1}{b} + \frac{1}{c} \right) ≥ 9$
\n⇒ (a + b + c) $\left(\frac{1}{4} + \frac{1}{b} + \frac{1}{c} \right) ≥ 9$
\n⇒ (a + b + c) $\left(\frac{1}{4} + \frac{1}{b} + \frac{1}{c} \right) ≥ 9$
\n⇒ (a + b + c) $\left(\frac{1}{4} + \frac{1}{b} + \frac{1}{c} \right) ≥ 9$
\n⇒ (a + b + c) $\left(\frac{1}{4} + \frac{1}{b} + \frac{1}{c} \right) ≥ 9$
\n⇒ (a + b + c) $\left(\frac{1}{4} + \frac{1}{b} + \frac{1}{c} \right) ≥ 9$
\n⇒ (b) ∴ 1.12n + 1.22n + 2.2n + 2.2n + 3.31
\n⇒ 4.65
\n⇒ 8465
\n⇒ 845
\n⇒ 845
\n⇒ 845
\

$$
\Rightarrow x < x_2 \qquad \qquad \dots
$$
\n
$$
Bv(i) & (ii), \quad \overline{x}_1 < \overline{x} < \overline{x}_2
$$

(49) **(B).** Mean =
$$
\frac{-1+0+4}{3} = 1
$$
.

Hence M.D. (about mean) $=$ $\frac{|-1-1|+|0-1|+|4-1|}{3} = 2$.

(50) (C). The formula for combined mean is $\bar{x} = \frac{n_1 x_1 + n_2 x_2}{n_1 + n_2}$ 13

Given, $\bar{x} = 500$, $\bar{x}_1 = 510$, $\bar{x}_2 = 460$

Let $n_1 + n_2 = 100$ and n_1 denotes male, n_2 denotes female for this $n_2 = 100 - n_1$

$$
500 = \frac{510 n_1 + (100 - n_1)460}{100}
$$
\n(2) 7. Arrang
\n
$$
36,42
$$
\nHence, n =
\n
$$
50000 = 510 n_1 + 46000 - 460 n_1
$$
\n(3) 36,42
\nHence, n =
\nSo, media
\n
$$
n_1 = \frac{4000}{50} = 80
$$
\n(4) 16,42
\n
$$
36,42
$$
\n(5) 36,42
\n
$$
36,42
$$
\n(6) 16,43
\n
$$
36,42
$$
\n(7) 16,44
\n
$$
36,42
$$
\n(8) 16,44
\n
$$
36,42
$$
\n(9) 17. Arrang
\n
$$
36,42
$$
\n(10)

Hence, the percentage of male employees in the factory is 80.

(51) **(C).**
$$
V_{\text{av}} = \frac{\text{Total distance}}{\text{Total time taken}}
$$

Time taken for first half journey is, $t_1 = (d/v_1)$ and time $\begin{bmatrix} 60 \\ 22 \end{bmatrix}$ taken for rest half journey is, $t_2 = (d/v_2)$

$$
\therefore V_{av} = \frac{2d}{(d/v_1)+(d/v_2)} = \frac{2v_1v_2}{v_1+v_2}.
$$

(Q.B.- SOLUTIONS STUDY MATERIAL:
 $\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$ ≥ 9
 $\qquad (52)$ **(D).** Total number of students = 40 + 35

Total marks obtained
 $= (40 \times 50) + (35 \times 60) + (45 \times 55) + (45 \times 55) + (55 \times 60)$
 $\qquad = 8465$
 $\qquad = \frac{\Sigma$ **(O.B.- SOLUTIONS)** STUDY MATERIAL:
 $\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$ ≥ 9

(52) (D). Total number of students = 40 + 35

Total marks obtained
 $= (40 \times 50) + (35 \times 60) + (45 \times 55) + (45 \times 55) + (45 \times 55) + (55 \times 60) + (35 \times 60) + (45 \times 55) +$ **(0.8. SOLUTIONS** STUDY MATERIAL:N

($\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$) ≥ 9

(52) (D). Total number of students = 40 + 35 +

Total marks obtained

= (40 × 50) + (35 × 60) + (45 × 55) + (4:

= 8465

Overall average of marks per st **O.B.- SOLUTIONS** STUDY MATERIAL: MATHEMATICS
 $\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right) \ge 9$ (52) (D). Total number of students = 40 + 35 + 45 + 42 = 162

Total marks obtained
 $= (40 \times 50) + (35 \times 60) + (45 \times 55) + (42 \times 45)$
 $= 8465$
 $\$ **(Q.B.- SOLUTIONS) STUDY MATERIAL:M.**
 $\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right) \ge 9$ (52) (D). Total number of students = 40 + 35 +

Total marks obtained
 $2n-1)(2n+1)(2n+3)$ = 40 × 50) + (35 × 60) + (45 × 55) + (42

= 4465
 $\frac{5n}{n} =$ **Q.B.- SOLUTIONS** STUDY MATERIAL: MATHEMATICS
 $\left(-\frac{1}{b} + \frac{1}{c}\right) \ge 9$ (52) (D). Total number of students = 40 + 35 + 45 + 42 = 162

Total marks obtained
 $= (40 \times 50) + (35 \times 60) + (45 \times 55) + (42 \times 45)$
 $= \frac{\Sigma T_n}{n} = \frac{1}{n}$ **(52) (D).** Total number of students = $40 + 35 + 45 + 42 = 162$ Total marks obtained $= (40 \times 50) + (35 \times 60) + (45 \times 55) + (42 \times 45)$ $= 8465$

Overall average of marks per students $=$ $\frac{8465}{162}$ = 52.25.

$$
(53) \quad (B).
$$

(54) (B). A.M. =
$$
\frac{3+4+5+6+7}{5} = 5
$$

$$
\therefore \text{ Mean deviation} = \frac{\sum |x_i - \overline{x}|}{n}
$$

$$
= \frac{|3-5| + |4-5| + |5-5| + |6-5| + |7-5|}{5}
$$

$$
\therefore \overline{x}_2 > \overline{x}_1
$$

$$
= \frac{2+1+0+1+2}{5} = \frac{6}{5} = 1.2
$$

EXERCISE-2

$$
\therefore \overline{x}_1 < \overline{x}_2 \qquad \qquad (1) \qquad 3. \text{ Mean of the given data is}
$$

$$
u = 0
$$
\n
$$
u
$$

M.D. about mean = $\frac{1}{n} \sum_{i=1}^{n} |x_i - \overline{x}| = \frac{1}{n} \times 24 = 3$ $1\sum_{i=1}^{n}$ $-1\sum_{i=1}^{n}$ $\frac{1}{n}\sum_{i=1}^{n} |x_i - \overline{x}| = \frac{1}{8} \times 24 = 3$

(2) 7. Arranging the data in ascending order, we have 36, 42, 45, 46, 46, 49, 51, 53, 60, 72 Hence, $n = 10$ (which is even) So, median is average of 5th and 6th observations

$$
\begin{array}{c|c}\n7 & 3 \\
8 & 2 \\
9 & 1 \\
10 & 0 \\
12 & 2 \\
13 & 3 \\
17 & 7\n\end{array}
$$
\nTotal 24\nM.D. about mean = $\frac{1}{n}\sum_{i=1}^{n} |x_i - \overline{x}| = \frac{1}{8} \times 24 = 3$ \n
\n7. Arranging the data in ascending order, we have
\n36, 42, 45, 46, 46, 49, 51, 53, 60, 72\nHence, n = 10 (which is even)\nSo, median is average of 5th and 6th observations\n
\n∴ Median = $\frac{46 + 49}{2} = \frac{95}{2} = 47.5$ \n
\n $\frac{x_i}{45} \quad \frac{|x_i - M|}{55} = \frac{3.5}{46} = \frac{2.5}{2.5}$ \n
\n $\frac{46}{46} \quad \frac{1.5}{1.5} = \frac{46}{46} = \frac{1.5}{1.5}$ \n
\n51 3.5 53 5.5 56 72 24.5\nTotal 70

282

(3) 16.

STATISTICS Q.B.- SOLUTIONS

M.D. about median =
$$
\frac{1}{n}\sum_{i=1}^{n} |x_i - M| = \frac{1}{10} \times 70 = 7
$$

Mean deviation about mean

$$
= \frac{1}{N} \sum_{i=1}^{n} f_i |x_i - \overline{x}| = \frac{1}{80} \times 1280 = 16
$$

1
\n
$$
\frac{x_1}{11} + \frac{x_1}{
$$

Here, N = 40,
$$
\Sigma f_i x_i = 760
$$
 $\therefore \overline{x} = \frac{\Sigma f_i x_i}{N} = \frac{760}{40} = 19$
\nWe have, $\overline{x} = \Sigma f_i (x_1 - \overline{x})^2 = 1736$
\n $\therefore \quad \sigma^2 = \frac{1}{N} {\Sigma f_i (x_1 - \overline{x})^2} = \frac{1736}{40} = 43.4$ $= \begin{bmatrix} 1 \\ 1 \end{bmatrix}$

(6) 11. Let the assumed mean be 98

(0.8.- SOLUTIONS)

(6) 11. Let the assumed mean
 $\sum_{i=1}^{n} |x_i - M| = \frac{1}{10} \times 70 = 7$

(6) 11. Let the assumed mean
 $\frac{x_i}{16} + \frac{f_i}{16} + \frac{d_i}{16} = x_i - \frac{92}{160}$

(160

480

480

93 2 93-98=

98 2 98-98= **(O.B.- SOLUTIONS**

(6) 11. Let the assumed mean be 98
 $|x_i - M| = \frac{1}{10} \times 70 = 7$
 $\frac{x_i}{15} + \frac{1}{15} + \frac{1}{15} = \frac{1}{10} \times 70 = 7$
 $\frac{x_i}{15} + \frac{1}{15} + \frac{1}{15} = \frac{1}{10} \times 70 = 7$
 $\frac{x_i}{15} + \frac{1}{15} + \frac{1}{15} = \frac{1}{10} \times 70 = 7$ **Q.B.- SOLUTIONS**

(6) 11. Let the assumed mean be 98

70 = 7
 $\frac{x_1}{92} + \frac{f_1}{3} + \frac{d_1}{292} = \frac{x_1 - 98}{36} + \frac{d_1^2}{46} + \frac{f_1 d_1}{108}$

92 3 92 - 98 = -6 36 - 18 108

93 2 93 - 98 = -5 25 - 10 50

97 3 97 - 98 = -1 1 **(0) B. SOLUTIONS**

(6) 11. Let the assumed mean be 98
 $\frac{1}{10} \times 70 = 7$
 $\frac{x_i}{10} + \frac{1}{10} + \frac{1}{10} = \frac{x_i - 98}{36} + \frac{1}{10} + \frac{1}{10} + \frac{1}{10}$
 $\frac{1}{92} + \frac{1}{3} + \frac{1}{10} + \frac{1}{10} = \frac{x_i - 98}{36} + \frac{1}{10} + \frac{1}{10} + \frac{1}{10}$ **CS**

about median = $\frac{1}{n} \sum_{i=1}^{n} |x_i - M| = \frac{1}{10} \times 70 = 7$
 $\frac{x_i}{100} + \frac{x_i}{40} + \frac{x_i}{40} + \frac{x_i}{40} + \frac{x_i}{100}$
 $\frac{x_i}{100} + \frac{x_i}{40} + \frac{x_i}{40} + \frac{x_i}{40} + \frac{x_i}{40} + \frac{x_i}{100} + \frac{x_i}{100} + \frac{x_i}{100} + \frac{x_i}{100} + \frac{x_i}{40} + \frac{x_i}{100} +$ **CS**

about median = $\frac{1}{n} \sum_{i=1}^{n} |x_i - M| = \frac{1}{10} \times 70 = 7$

about median = $\frac{1}{n} \sum_{i=1}^{n} |x_i - M| = \frac{1}{10} \times 70 = 7$
 $\frac{x_i}{100} + \frac{f_i}{400} + \frac{x_i}{100} + \frac{f_i}{400} + \frac{f_i}{400} + \frac{f_i}{400} + \frac{f_i}{400} + \frac{f_i}{400} + \frac{f_i}{400}$ **CS**
 30 24 7 28 28 1400
 30 24 120
 30 4 40 20
 30 24 140
 30 24 140
 30 24 120
 30 24 120
 30 24 120
 50 28 1400
 50 28 1400
 50 28 140
 50 28 **CS**
 (3)

about median = $\frac{1}{n} \sum_{i=1}^{n} |x_i - M| = \frac{1}{10} \times 70 = 7$
 $\frac{x_i}{10} + \frac{f_i}{10} \times \frac{x_i}{10} + \frac{f_i}{10} \times \frac{x_i}{10} = \frac{1}{10} \times 70 = 7$
 $\frac{x_i}{10} + \frac{f_i}{10} \times \frac{x_i}{10} + \frac{f_i}{10} \times \frac{x_i}{10} = \frac{1}{100} \times 70 = 7$
 $\frac{x_i}{10} +$ **CS**
 COLUTIONS

about median = $\frac{1}{n} \sum_{i=1}^{n} |x_i - M| = \frac{1}{10} \times 70 = 7$
 $\frac{x_i}{10} + \frac{f_i}{10} = \frac{x_i}{10} \times \frac{1}{10} = \frac{1}{10} \times 70 = 7$
 $\frac{x_i}{10} + \frac{f_i}{10} = \frac{x_i}{10} \times \frac{1}{10} = \frac{1}{10} \times \frac{1}{10} = \frac{1}{10} \times \frac{1}{10} = \frac{1}{10}$ **CS**
 EXECUTIONS

about median = $\frac{1}{n} \sum_{i=1}^{n} |x_i - M| = \frac{1}{10} \times 70 = 7$
 $\frac{x_i}{10} \left(\frac{x_i}{4} + \frac{x_i}{10} + \frac{x_i}{10} \right) = \frac{1}{10} \times 70 = 7$
 $\frac{x_i}{10} \left(\frac{x_i}{4} + \frac{x_i}{10} + \frac{x_i}{10} \right) = \frac{1}{10} \times 70 = 7$
 $\frac{x_i}{10} \left(\frac{x_i}{4} + \frac$ **13**

and $\frac{1}{2}$ and **13**

bout median = $\frac{1}{n} \sum_{i=1}^{n} |x_i - M| = \frac{1}{10} \times 70 = 7$
 $\frac{1}{10} \left[\frac{1}{10} \times \frac{1}{10} \right]$

bout median = $\frac{1}{n} \sum_{i=1}^{n} |x_i - M| = \frac{1}{10} \times 70 = 7$
 $\frac{1}{10} \left[\frac{1}{10} \times \frac{1}{10} \right]$
 $\frac{1}{10} \left[\frac{1}{10} \times \frac{1}{$ = $\frac{1}{n}$ $\left| \frac{x_i - 50}{16} \right|$ $\frac{x_i - 50}{160}$
 $\frac{x_i - 50}{40}$ $\frac{x_i - 50}{160}$
 $\frac{x_i - 50}{40}$ $\frac{x_i - 50}{160}$
 $\frac{x_i - 50}{40}$ $\frac{x_i - 50}{160}$
 $\frac{x_i - 50}{92}$ $\frac{x_i}{3}$ $\frac{92 - 98}{92}$
 $\frac{92 - 3}{3}$ $\frac{92 - 98}{2}$
 \frac **(O.B., SOLUTIONS)**

edian = $\frac{1}{n} \sum_{i=1}^{n} |x_i - M| = \frac{1}{10} \times 70 = 7$

(6) 11. Let the assumed mean be 98
 $\frac{x_i}{40} + \frac{x_{i-1} - 50}{40} + \frac{x_{i-1} - 50}{40}$
 $\frac{92}{40} + \frac{92}{40} - \frac{32}{40} = -6$
 $\frac{93}{40} + \frac{93}{40} - \frac{32}{40}$ **10.8. SOLUTIONS**

(6) 11. Let the assumed mean be 98
 $\frac{1}{10} \times 70 = 7$
 $\frac{x_1}{10} + \frac{1}{10} = \frac{1}{10} \times 70 = 7$
 $\frac{x_2}{10} + \frac{1}{10} = \frac{1}{10} \times 70 = 7$
 $\frac{x_1}{92} + \frac{1}{3} = \frac{1}{92 - 98 = -6}$
 $\frac{1}{92} + \frac{1}{3} = \frac{1}{92 - 98 = -$ **(O.B.- SOLUTIONS**

(6) 11. Let the assumed mean be 98
 $M = \frac{1}{10} \times 70 = 7$

(6) 11. Let the assumed mean be 98
 $\frac{x_1}{92} + \frac{1}{102} + \frac{1}{108}$
 $\frac{93}{93} + \frac{2}{92 - 98} = -6$
 $\frac{50}{95} + \frac{1}{108}$
 $\frac{93}{95} + \frac{2}{95 - 98$ $\frac{30}{2} \frac{1}{2} \frac{1}{3} \frac{92}{2} - 98 = -6 \frac{1}{36} \frac{1}{4} \frac{1}{1} \frac{1}{4} \frac{1}{1} \frac{1}{4} \frac{1}{1} \frac{1}{4} \frac{1}{1} \frac{1}{4} \frac{1}{2} \frac{1}{2} \frac{1}{2} \frac{1}{2} \frac{1}{2} \frac{1}{2} \frac{1}{2}$ N (8) 2(a) $\frac{1}{15}$ (a) $\frac{1}{15}$ (a) $\frac{1}{15}$ (b) $\frac{1}{15}$ (a) $\frac{1}{15}$ (b) $\frac{92}{3}$ 2 93-98=-6 36 -18 108

480 $\frac{97}{32}$ 2 40 160

20 480

0 40 320

10 320

10 320

40 320

40 320

102 6 102-98=4 16 24 96

103 3 98-98-0 0 0 0

103 98 2 98-98-0 0 0 0

103 98 104-98-6 36 161

109-98=11 121 33 363

109-98=11 221

121 33 363

121 33 363

121 33 3 **EXECUTE ARABYTER COMPANYANCED LEARNING**
 2 $\frac{2}{\mathbf{i}}$ **f**_i **d**_i **f**_i **d**_i **f**_i **d**²
 6 -18 **108**
 6 -10 **50**
 1 -3 **3**
 0 0 EDIMADVANGED LEARNING

Let the assumed mean be 98
 $\begin{array}{r}\nx_i \quad f_i \quad d_i = x_i - 98 \quad d_i^2 \quad f_i d_i \quad f_i d_i^2 \\
\hline\n92 \quad 3 \quad 92 - 98 = -6 \quad 36 \quad -18 \quad 108 \\
\hline\n93 \quad 2 \quad 93 - 98 = -5 \quad 25 \quad -10 \quad 50 \\
\hline\n97 \quad 3 \quad 97 - 98 = -1 \quad 1 \quad -3 \quad 3 \\
\hline\n98 \quad 2$ **EXECUTE ARABING**

Let the assumed mean be 98
 $\begin{array}{r} x_i \r_i \r_i \r_{i+1} \r_{i+1} \r_{i+2} \r_{i+3} \r_{i+4} \r_{i+5} \r_{i+6} \r_{i+7} \r_{i+8} \r_{i+9} \r_{i+1} \r_{i$ Let the assumed mean be 98
 $\frac{x_1}{x_2} + \frac{f_1}{x_1} + \frac{d_1}{x_2} = \frac{x_1 - 98}{x_2 - 98} = -\frac{d_1^2}{x_2} + \frac{f_1 d_1}{x_1} + \frac{f_1 d_1^2}{x_2 - 98} = -\frac{d_1^2}{x_2 - 98} = -\frac{d_1^2}{x_2 - 98} = -\frac{d_1^2}{x_2 - 98} = -\frac{d_1^2}{x_2 - 98} = -\frac{d_1^2}{x$ Let the assumed mean be 98
 $\begin{array}{r} x_i \text{ } f_i \text{ } d_i = x_i - 98 \text{ } d_i^2 \text{ } f_i d_i \text{ } f_i d_i^2 \end{array}$
 $\begin{array}{r} x_i \text{ } f_i \text{ } d_i = x_i - 98 \text{ } d_i^2 \text{ } f_i d_i \text{ } f_i d_i^2 \end{array}$
 $\begin{array}{r} 92 \quad 3 \quad 92 - 98 = -6 \quad 36 \quad -18 \quad 108 \end{array}$
 $\begin{array}{r} 93 \quad 2 \$ Let the assumed mean be 98
 $\frac{x_i}{92}$ $\frac{f_i}{3}$ $\frac{d_i}{92-98} = \frac{4i}{6}$ $\frac{f_i d_i}{164}$ $\frac{f_i d_i^2}{168}$

92 3 92-98 = -6 36 -18 108

93 2 93-98 = -5 25 -10 50

97 3 97-98 = -1 1 -3 3

98 2 98-98 = 0 0 0 0

02 6 102-98 = 102 6 102 98 4 16 24 96 105 3 104 98 6 36 18 108 109 3 109 98 11 121 33 363 **11.** Let the assumed mean be 98
 $\frac{x_i}{92}$ $\frac{1}{3}$ $\frac{1}{92 - 98} = -6$ $\frac{1}{36}$ $\frac{1}{16}$ $\frac{1}{16}$ $\frac{1}{16}$ $\frac{1}{16}$ $\frac{1}{16}$
 $\frac{92}{93}$ $\frac{3}{2}$ $\frac{92 - 98 = -6}{97}$ $\frac{36}{97}$ $\frac{1}{16}$ $\frac{1}{108}$
 $\frac{$ **SPERIMAD VANGED LEARNING**

d mean be 98
 $= x_i - 98$ d_i^2 $f_i d_i$ $f_i d_i^2$
 $-98 = -6$ 36 -18 108
 $-98 = -5$ 25 -10 50
 $-98 = -1$ 1 -3 3
 $-98 = 0$ 0 0 0 0 EXECUTE ARNING

EXECUTE ARNING

EXECUTE ARNING
 $\frac{x_i - 98}{-98} = \frac{d_i^2}{36} = \frac{f_i d_i}{-18} = \frac{f_i d_i^2}{108}$
 $\frac{-98}{-98} = -\frac{5}{25} = \frac{25}{-10} = \frac{-10}{50} = \frac{50}{-98}$
 $\frac{-98}{-98} = 0 = 0 = 0 = 0$
 $\frac{0}{2} = -98 = 4 = 16$
 $\frac{24}{96} =$ Example 1 and 1 a CONVENUES LEARNING

d mean be 98

= $x_i - 98$ d² f_id_i f_id²

-98 = -6 36 -18 108

-98 = -5 25 -10 50

-98 = -1 1 -3 3

-98 = 0 0 0 0 0

2-98 = 4 16 24 96

4-98 = 6 36 18 108

-98 = 1 1 33 363 d mean be 98
 $\frac{x_1-98}{98}$ $\frac{d_1^2}{d_1^2}$ $\frac{f_1d_1}{f_1d_1^2}$
 $\frac{-98}{98}$ $\frac{-5}{98}$ $\frac{25}{25}$ $\frac{-10}{108}$
 $\frac{-98}{98}$ $\frac{-5}{98}$ $\frac{25}{108}$
 $\frac{-10}{98}$ $\frac{-3}{108}$
 $\frac{-98}{98}$ $\frac{-98}{108}$
 $\frac{-98}{98}$ $\$ M COMMADVANCED LEARNING

1 mean be 98
 $\frac{x_1 - 98}{98 = -6}$ $\frac{d_1^2}{36}$ $\frac{f_1 d_1}{18}$ $\frac{f_1 d_1^2}{188}$
 $\frac{98 = -5}{98 = -1}$ $\frac{25}{11}$ $\frac{-10}{-3}$ $\frac{3}{3}$
 $\frac{-98}{98 = -1}$ $\frac{1}{11}$ $\frac{-3}{-3}$ $\frac{3}{3}$
 $\frac{-98}{98 =$ COMMOVANCED LEARNING

1 mean be 98
 $\frac{x_1 - 98}{98} = -6$ 36 -18 108

98 = -5 25 -10 50

98 = -1 1 -3 3

-98 = 0 0 0 0 0

-98 = 4 16 24 96

-98 = 4 16 24 96

-98 = 1 1 21 33 363

44 728 d mean be 98
 $\frac{x_1 - 98}{98} = \frac{d_1^2}{6}$ $\frac{f_1 d_1}{f_1 d_1}$ $\frac{f_1 d_1^2}{f_1 d_1^2}$
 $\frac{-98 = -6}{98 = -5}$ $\frac{25}{25}$ $\frac{-10}{-10}$ $\frac{50}{50}$
 $\frac{-98 = -1}{-98 = 0}$ $\frac{1}{-98}$ $\frac{-98}{-98 = 0}$ $\frac{1}{-98}$
 $\frac{-98}{-98 = 0}$ $\$ assumed mean be 98
 $\frac{1}{1}$ i d_i = x_i - 98 d_i f_i d_i f_i d_i fi d_i d_i
 $\frac{1}{3}$ 92 - 98 = -6 36 - 18 108

2 93 - 98 = -5 25 - 10 50

3 97 - 98 = -1 1 -3 3

2 98 - 98 = 0 0 0 0 0

5 102 - 98 = 4 16 24 96
 ssumed mean be 98
 $\frac{d_i}{2} = x_i - 98$ $\frac{d_i^2}{2} = \frac{f_i d_i}{18} = \frac{f_i d_i^2}{108}$
 $\frac{93 - 98 = -5}{97 - 98 = -1}$
 $\frac{93 - 98 = -5}{97 - 98 = -1}$
 $\frac{1}{18} = \frac{1}{18}$
 $\frac{1}{102 - 98 = 4}$
 $\frac{16}{104 - 98 = 6}$
 $\frac{16}{18} = \frac{24}{18}$
 $\frac{$ **11.** Let the assumed mean be 98
 $\frac{x_1}{2} + \frac{f_1}{2} + \frac{d_1}{2} = \frac{x_1 - 98}{4} = \frac{d_1^2}{6} + \frac{f_1 d_1}{6} + \frac{f_1 d_1^2}{108}$
 $\frac{92}{93} + \frac{92 - 98}{93} = -5 \quad 25 \quad -10 \quad 50$
 $\frac{97}{93} + \frac{97 - 98}{3} = -1 \quad 1 \quad -3 \quad 3 \quad 3 \quad 98 \quad 2 \quad 9$ assumed mean be 98
 $\frac{1}{1}$ d_i = x_i - 98 d_i f₁d_i f₁d_i f₁d_i
 $\frac{1}{3}$ 92-98 = -6 36 - 18 108

2 93-98 = -5 25 - 10 50

3 97-98 = -1 1 -3 3

2 98-98 = 0 0 0 0 0

5 102-98 = 4 16 24 96

3 104-98 = 6 36 1 Let the assumed mean be 98
 $\frac{x_i}{1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1}}}} = \frac{98}{4} + \frac{1}{1 + \frac{1}{1$ **EXECUTE:**
 EXECUTE 2 and $\frac{1}{2}$ a **60 MADVANCED LEARNING**

98
 $\frac{d_1^2}{36}$ $\frac{f_1 d_1}{-18}$ $\frac{f_1 d_1^2}{108}$
 $\frac{25}{25}$ $\frac{-10}{10}$ $\frac{50}{50}$
 $\frac{1}{108}$
 $\frac{-3}{16}$ $\frac{3}{18}$
 $\frac{3}{108}$
 $\frac{108}{121}$
 $\frac{33}{36}$
 $\frac{363}{44}$
 $\frac{44}{728}$ **EDENTADYANGEDIEARMING**
 E 98
 a₁² **f**₁**d**₁ **f**₁**d**₁²
 36 -18 108
 25 -10 50
 1 -3 3
 0 0 0 0
 16 24 96
 36 18 108
 121 33 363
 44 728
 =98 + $\frac{44}{22}$ =98 + 2 = 100
 1 93 2 93-98 = -5 25 - 10 50

97 3 97-98 = -1 1 -3 3

98 2 98-98 = 0 0 0 0 0

102 6 102-98 = 4 16 24 96

105 3 104-98 = 6 36 18 108

109 3 109-98 = 11 121 33 363

Total 22

= A + $\frac{\Sigma f_i d_i}{\Sigma f_i}$ = 98 + $\frac{\Sigma f_i d_i}{\Sigma f_i}$ = 9 93-98 = -5 25 -10 50

97-98 = -1 1 -3 3

98-98 = 0 0 0 0 0

102-98 = 4 16 24 96

104-98 = 6 36 18 108

109-98 = 11 121 33 363

2
 $\frac{d_i}{d_i} = 98 + \frac{\Sigma f_i d_i}{\Sigma f_i} = 98 + \frac{44}{22} = 98 + 2 = 100$
 $i d_i^2$ } - $\left{\frac{1}{N} \Sigma f_i d_i\right}^2$ t the assumed mean be 98
 $\frac{1}{3}$ $\frac{1}{92-98} = -6$ $\frac{1}{2}$ $\frac{1}{164}$ $\frac{1}{164}$
 $\frac{1}{3}$ $\frac{92-98 = -6}{2}$ $\frac{36-18}{2108}$
 $\frac{108}{2}$ $\frac{98-98 = -1}{2}$ $\frac{1}{96-98}$
 $\frac{2}{6}$ $\frac{98-98 = 0}{102-98}$ $\frac{1}{6}$ $\$ **EDENTIFYERED FRAMENTALES (DENTIFYERED FRAMENTALES)**

11. Let the assumed mean be 98
 $\frac{x_i}{92} + \frac{f_i}{3} + \frac{d_i}{92 - 98 = -6} + \frac{d_i^2}{36} + \frac{f_i d_i^2}{181 + 3} + \frac{f_i d_i^2}{181 + 3}$

97. 3. 97-98 = -1 1 -3. 3.

98. 2. 98-98 = 0 0 0 $f_1 d_i$ $f_1 d_i^2$
 -18 108
 -10 50
 -3 3

0 0

24 96

18 108

33 363

44 728

44 728
 $+44$
 $+22$ = 98 + 2 = 100
 $\frac{1}{22}$ {728} - $\left\{\frac{1}{22} \times 44\right\}^2$

40 = $\frac{320}{11}$ = 29.09 $\frac{f_1 d_1}{f_2 d_1^2}$
 $\frac{-18}{f_1 d_1^2}$
 $\frac{-10}{f_2 d_1^2}$
 $\frac{-3}{f_1 d_1^2}$
 $\frac{24}{f_2 d_1^2}$
 $\frac{96}{f_1 d_1^2}$
 $\frac{144}{f_2 d_1^2}$
 $\frac{144}{f_2 d_1^2}$
 $\frac{1}{f_2 d_1^2}$
 $\frac{1}{f_2 d_1^2}$
 $\frac{1}{f_1 d_1^2}$
 $\frac{1}{f_1 d$ **EDENTADVANCED LEARNING**

8
 $\frac{d_1^2}{36} + \frac{f_1 d_1}{164} + \frac{f_1 d_1^2}{108}$
 $\frac{25}{1} - \frac{10}{3} - \frac{3}{3}$

0 0 0 0

16 24 96

36 18 108

121 33 363

44 728
 $98 + \frac{44}{22} = 98 + 2 = 100$
 $=\frac{1}{22} \{728\} - \left{\frac{1}{22} \times 44\right}^2$ 1; $a_1 = x_1 - y_0$

1 3 $92-98 = -6$ 36 -18 1 13 1

2 $93-98 = -5$ 25 -10 50

3 $97-98 = -1$ 1 -3 3

2 $98-98 = 0$ 0 0 0 0

6 $102-98 = 4$ 16 24 96

3 $104-98 = 6$ 36 18 108

3 $109-98 = 11$ 121 33 363

22
 22 44 728
 $\frac{\Sigma f_i d_i}{\Sigma f$ 3 92-98 = -6 36 - 18 108

2 93-98 = -5 25 - 10 50

3 97-98 = -1 1 -3 3

2 98-98 = 0 0 0 0

6 102-98 = 4 16 24 96

3 104-98 = 6 36 18 108

3 109-98 = 11 121 33 363

22 44 728
 $\sum f_i d_i = 98 + \frac{\sum f_i d_i}{\sum f_i} = 98 + \frac{44}{22} = 98 +$ i f_i d_i = x_i - 98 d_i f_i f_i f_i d_i f_i d_i

2 3 92-98 = -6 36 - 18 108

7 3 97-98 = -1 1 -3 3

8 2 98-98 = 0 0 0 0

102-98 = 4 16 24 96

103 5 4 104-98 = 6 36 18

109-98 = 11 12 13 3 363

12 2 44 728

12 4

$$
\overline{x} = A + \frac{\Sigma f_i d_i}{\Sigma f_i} = 98 + \frac{\Sigma f_i d_i}{\Sigma f_i} = 98 + \frac{44}{22} = 98 + 2 = 100
$$

Variance,

97 3 97-98 = -1 1 -3 3
\n98 2 98-98 = 0 0 0 0 0
\n102 6 102-98 = 4 16 24 96
\n105 3 104-98 = 6 36 18 108
\n109 3 109-98 = 11 121 33 363
\nTotal 22
\n44 728
\n
$$
\overline{x} = A + \frac{\Sigma f_i d_i}{\Sigma f_i} = 98 + \frac{\Sigma f_i d_i}{\Sigma f_i} = 98 + \frac{44}{22} = 98 + 2 = 100
$$
\nVariance,
\n
$$
\sigma^2 = \frac{1}{N} \{ \Sigma f_i d_i^2 \} - \left\{ \frac{1}{N} \Sigma f_i d_i \right\}^2 = \frac{1}{22} \{ 728 \} - \left\{ \frac{1}{22} \times 44 \right\}^2
$$
\n
$$
= \frac{1}{22} [728 - 22 \times 2^2] = \frac{1}{22} \times 640 = \frac{320}{11} = 29.09
$$
\n17. We have,
\n
$$
\frac{x_i}{60} = \frac{f_i}{10} = \frac{1}{60} = \frac{64}{60} = \frac{36}{60} = \frac{320}{11} = 29.09
$$
\n18. We have,
\n
$$
\frac{x_i}{60} = \frac{f_i}{10} = \frac{1}{60} = \frac{64}{60} = \frac{1}{60} = \frac
$$

(7) 17. We have,

Now,
$$
\overline{x} = A + \frac{\Sigma f_i d_i}{\Sigma f_i} = 64 + \frac{0}{100} = 64
$$

Variance,
$$
\sigma^2 = \frac{1}{N} \{ \Sigma f_i d_i^2 \} - \left\{ \frac{1}{N} \Sigma f_i d_i \right\}^2
$$

= $\left[\frac{1}{100} \times 286 - \left(\frac{1}{100} \times 0 \right)^2 \right] = 2.86$

(8) 132.

Mean
$$
(\overline{x}) = A + \frac{\Sigma fu}{N} \times h = 25 + \frac{10}{50} \times 10 = 25 + 2 = 27
$$
 (5)

Variance (2) = 2 2 h N ⁼ ² 2 2 ⁼ ¹ 6 6 i i i 1 i 1

(9) 12. Let the observations be x_1, x_2, x_3, x_4, x_5 , and x_6 , On multiplying each observation by 3, we get the new (8) observations as $3x_1$, $3x_2$, $3x_3$, $3x_4$, $3x_5$ and $3x_6$.

Variance of new observations

$$
\sum_{i=1}^{6} (3x_i - 24)^2 \qquad 3^2 \sum_{i=1}^{6} (x_i - 8)^2
$$

= $(9/1) \times$ Variance of old observations = $9 \times 4^2 = 144$
Thus, standard deviation of new observations
= $\sqrt{Variance} = \sqrt{144} = 12$

EXERCISE-3

(1) (A). Obviously
$$
G = \frac{G_1}{G_2}
$$
 (9) (D). As no.

- **(2) (A).** Median of new set remain same as that of the original set.
- **(3) (B).** Mean of binomial distribution = $np = 4$ Variance of binomial distribution = $npq = 2$ from above $q = 1/2$

$$
P(X=r) = {}^{n}C_{r} q^{n-r} \cdot p^{r}; \ p+q=1
$$

$$
q = \frac{1}{2} \Rightarrow p = 1/2; \ n \times \frac{1}{2} = 4 \Rightarrow n=8
$$

$$
P(X=1) = {}^{8}C_{1} \cdot \left(\frac{1}{2}\right)^{7} \left(\frac{1}{2}\right)^{1} = 8 \times \frac{1}{2^{8}} = \frac{1}{32}
$$

 $=\frac{x-25}{10}$ fu \int fu² one observation 20 replaced by 30 then **Q.B.- SOLUTIONS** STUDY MATERIAL: MATHEMATICS
 EXECUTIONS STUDY MATERIAL: MATHEMATICS
 EXECUTIONS SUDY MATERIAL: MATHEMATICS
 EXECUTIONS SUDDERING SURVEY ON THE MATHEMATICS
 EXECUTIONS SURVEY ON THE MATHEMATICS
 (Q.B.- SOLUTIONS STUDY MATERIAL: MATHEMATICS
 (A) (B). Given N = 15, $\Sigma x^2 = 2830 \& \Sigma x = 170$

one observation 20 replaced by 30 then
 $\Sigma x^2 = 2830 - 400 + 900 = 3330$
 $\Sigma x = 170 - 20 + 30 = 180$

0

0

16

16

10

12

12
 (4) (B). Given $N = 15$, $\Sigma x^2 = 2830 \& \Sigma x = 170$ $\Sigma x^2 = 2830 - 400 + 900 = 3330$ Σ x = 170 – 20 + 30 = 180 STUDY MATERIAL: MATHEMATICS
 (i). Given N = 15, $\Sigma x^2 = 2830 \& \Sigma x = 170$

ie observation 20 replaced by 30 then
 $x^2 = 2830 - 400 + 900 = 3330$
 $x = 170 - 20 + 30 = 180$

priance,
 $2 = \frac{\Sigma x^2}{N} - (\frac{\Sigma x}{N})^2 = \frac{3330}{15} - (\frac{180}{1$ STUDY MATERIAL: MATHEMATICS

ven N = 15, $\Sigma x^2 = 2830 \& \Sigma x = 170$

servation 20 replaced by 30 then

830–400+900 = 3330

(0-20+30 = 180

e,
 $\frac{x^2}{N} - \left(\frac{\Sigma x}{N}\right)^2 = \frac{3330}{15} - \left(\frac{180}{15}\right)^2 = \frac{1170}{15} = 78$

dy (a) and **STUDY MATERIAL: MATHEMATICS**

iven N= 15, $\Sigma x^2 = 2830 \& \Sigma x = 170$

oservation 20 replaced by 30 then

2830–400+900=3330

70–20+30=180

ce,
 $\frac{\Sigma x^2}{N} - \left(\frac{\Sigma x}{N}\right)^2 = \frac{3330}{15} - \left(\frac{180}{15}\right)^2 = \frac{1170}{15} = 78$

mly (a) **SOMAGERIAL: MATHEMATICS**
 (B). Given N = 15, $\Sigma x^2 = 2830 \& \Sigma x = 170$

one observation 20 replaced by 30 then
 $\Sigma x^2 = 2830 - 400 + 900 = 3330$
 $\Sigma x = 170 - 20 + 30 = 180$

Variance,
 $\sigma^2 = \frac{\Sigma x^2}{N} - \left(\frac{\Sigma x}{N}\right)^2 = \frac{3330}{15$ MATERIAL: MATHEMATICS

= 2830 & Σ x = 170

ced by 30 then

3330
 $\frac{330}{15} - \left(\frac{180}{15}\right)^2 = \frac{1170}{15} = 78$

correct.

servation, a – a = 0
 $\sqrt{\frac{\Sigma x^2}{2}}$ TERIAL: MATHEMATICS

0 & Σ x = 170

by 30 then

0
 $-\left(\frac{180}{15}\right)^2 = \frac{1170}{15} = 78$

ect.

act.

act. STUDY MATERIAL: MATHEMATICS

en N= 15, $\Sigma x^2 = 2830 \& \Sigma x = 170$

ervation 20 replaced by 30 then

330 – 400 + 900 = 3330

9 – 20 + 30 = 180

3

7

($\frac{x^2}{N} - \left(\frac{\Sigma x}{N}\right)^2 = \frac{3330}{15} - \left(\frac{180}{15}\right)^2 = \frac{1170}{15} = 78$

y (a

Variance,

$$
\sigma^2 = \frac{\Sigma x^2}{N} - \left(\frac{\Sigma x}{N}\right)^2 = \frac{3330}{15} - \left(\frac{180}{15}\right)^2 = \frac{1170}{15} = 78
$$

(5) (C). Only (a) and (b) are correct.

(6) (C). Mean of total 2n observation, $a - a = 0$

S
\nS
\nS
\nS
\n(S). Given N= 15,
$$
\Sigma x^2 = 2830 \& \Sigma x = 170
$$

\none observation 20 replaced by 30 then
\n $\Sigma x^2 = 2830 - 400 + 900 = 3330$
\n $\Sigma x = 170 - 20 + 30 = 180$
\nVariance,
\n
$$
\sigma^2 = \frac{\Sigma x^2}{N} - \left(\frac{\Sigma x}{N}\right)^2 = \frac{3330}{15} - \left(\frac{180}{15}\right)^2 = \frac{1170}{15} = 78
$$
\n(C). Only (a) and (b) are correct.
\n(C). Mean of total 2n observation, a – a = 0
\n $SD = \sqrt{\frac{\Sigma (x - \overline{x})^2}{N}}, 2 = \sqrt{\frac{\Sigma x^2}{2n}}$
\n $4 = \sqrt{\frac{\Sigma x^2}{2n}} \Rightarrow \frac{2na^2}{2n} \Rightarrow a^2 = 4$; $|a| = 2$
\n(D). Mode = 3 Median – 2 Mean
\nMode = 3 (22) – 2 (21) = 66 – 42 = 24
\n(B). AM of mth power > mth power of AM (If m > 1)
\n $\frac{x_1^2 + x_2^2 + \dots x_n^2}{n} > \left(\frac{x_1 + x_2 + \dots x_n}{n}\right)^2$

(7) **(D).** Mode =
$$
3 \text{ Median} - 2 \text{ Mean}
$$

Mode = $3(22)-2(21) = 66-42=24$

(8) (B). AM of mth power > mth power of AM (If m > 1)

2 2 2 (3x 24) 3 (x 8) 6 6 ⁼ Variance 144 12 1 2 n 1 2 n x xx x xx n n 2 n n 2 i i i 1 i 1 x x n n ⁼ ² 400 80 n n ² n 6400 n 400 ; ² n 16 n ; n > 16 2 2 2 2 2 (6 a) (6 b) (6 8) (6 5) (6 10) 6.80

- $\overline{G_2}$ (9) (D). As no. of observations same in both cases. Also mean and difference is same hence $V_A/V_B = 1$
	- **(10) (C).** Taking $n_1 + n_2 = 100$. Substituting in the formula of combined mean we get the percentage of boys in the class as 80.
	- **(11) (C).** According to given conditions,

ariance of old observations = 9 × 4² = 144
\ndard deviation of new observations
\n
$$
\frac{1}{\csc} = \sqrt{144} = 12
$$
\n**EXERCISE-3**\n
$$
G = \frac{G_1}{G_2}
$$
\n
$$
G = \frac{G_1}{G_2}
$$
\n
$$
G = \frac{G_2}{G_2}
$$
\n
$$
G = \frac{G_1}{G_2}
$$
\n
$$
G =
$$

(12) Mean of given numbers,

$$
\overline{x} = \frac{1 + (1 + d) + \dots (1 + 100d)}{101} = 1 + 50d
$$

15TICS
\nMean of given numbers,
\n
$$
\overline{x} = \frac{1 + (1 + d) + \dots (1 + 100d)}{101} = 1 + 50d
$$

\nMean deviation = $\sum |x_i - \overline{x}| = \frac{100}{10}$
\nMean deviation = $\sum |x_i - \overline{x}| = \frac{100}{10}$
\nMean deviation = $\sum |x_i - \overline{x}| = \frac{100}{10}$
\n $\frac{100}{101} = \frac{d.50 \times 51}{101} = \frac{d.50 \times 51}{101} = 255 \Rightarrow d = 10.1$
\n**2**
\nGiven that mean deviation is 255
\n**3**
\n**4**
\n**5**
\n**6**
\n**6**
\n**6**
\n**7**
\n**8**
\n**9**
\n**10**
\n**11**
\n**11**
\n**12**
\n**13**
\n**14**
\n**15**
\n**16**
\n**17**
\n**18**
\n**19**
\n**10**
\n**10**
\n**11**
\n**10**
\n**11**
\n**12**
\n**13**
\n**14**
\n**15**
\n**16**
\n**17**
\n**18**
\n**19**
\n**10**
\n**10**
\n**10**
\n**11**
\n**10**
\n**11**
\n**12**
\n**13**
\n**14**
\n**15**
\n**16**
\n**17**
\n**17**
\n**18**
\n**19**
\n**10**
\n**10**
\n**11**
\n**10**
\

$$
\frac{\sum_{r=0}^{100} |(r-50d)|}{101} = \frac{d \ 50 \times 51}{101}
$$
\n
$$
\Rightarrow a + 3a + 5a + \dots +
$$
\n
$$
\Rightarrow a + 3a + 5a + \dots +
$$
\n
$$
\Rightarrow a + 3a + 5a + \dots +
$$
\n
$$
\Rightarrow a + 3a + 5a + \dots +
$$
\n
$$
\Rightarrow a + 3a + 5a + \dots +
$$
\n
$$
\Rightarrow a + 3a + 5a + \dots +
$$

Given that mean deviation is 255

$$
\Rightarrow \frac{\text{d } 50 \times 51}{101} = 255 \Rightarrow \text{d} = 10.1
$$

(13) (D). Variance, $\sigma =$ 2

Let 2, 4, 6, 2n be the numbers.

161 (a) (b) A. M. of 2x₁. 2x₃ = 50
\nMean deviation =
$$
\sum |x_1 - \bar{x}| = \frac{100}{101}
$$

\n $\frac{100}{101} = \frac{100 \times 51}{101}$
\n $\frac{100}{101} = \frac{450 \times 51}{101}$
\n $\frac{450 \times 51}{101} = 255 \Rightarrow d = 10.1$
\nGiven that mean deviation is 255
\n $\Rightarrow \frac{d50 \times 51}{101} = 255 \Rightarrow d = 10.1$
\n(iii) (b) A. M. of 2x₁. 2x₂....2x₃ is
\n $\Rightarrow \frac{d50 \times 51}{101} = 255 \Rightarrow d = 10.1$
\n(ii) (i) (i) A. M. of 2x₁. 2x₂....2x₃ is
\n $\Rightarrow \frac{d50 \times 51}{101} = n + 1$
\n $\Rightarrow \bar{x} = \frac{2(n+1)}{2n} = n + 1$
\n $\Rightarrow \bar{x} = \frac{2(n+1)}{2n} = n + 1$
\n $\Rightarrow \frac{2(n+2)}{2n} = n + 1$
\n $\Rightarrow \frac{2(n+2)(n+1)}{2n} = n + 1$
\n $\Rightarrow \frac{4(n+1)+(2n+1)}{2n} - (n+1)^2$
\n $\Rightarrow \frac{4(n+1)+(2n+1)}{3} - (n+1)^2$
\n $\Rightarrow \frac{4(n+1)+(2n+1)}{3} - (n+1)^2$
\n $\Rightarrow \frac{4n^2 + 6n + 2 - 3n^2 - 6n - 3}{3} = \frac{n^2 - 1}{3}$
\n $\Rightarrow \frac{2 \times 1}{3} = 2 \div x = 10.2x_1 = 20$
\n $\Rightarrow x_1 = 10.2x_1 = 20$
\n $\Rightarrow x_2 = \frac{2(10)^2 + 3n + 1}{3} -$

$$
6x - (2^{2\lambda_1}) (x) - 5^{2\lambda_1}
$$

$$
\Sigma x_i^2 = 40, \Sigma y_i^2 = 105
$$

$$
\sigma_z^2 = \frac{1}{10} (\Sigma x_i^2 + \Sigma y_i^2) - (\frac{\overline{x} + \overline{y}}{2})
$$

$$
= \frac{1}{10}(40+105) - 9 = \frac{145-90}{10} = \frac{55}{10} = \frac{11}{2}
$$

CS

Mean of given numbers,
 $+(1+d)+.....(1+100d)$
 $101 = 1+50d$
 $\frac{100}{10}$
 $\frac{100}{2}$
 $\frac{100}{1}$
 $\frac{100}{2}$
 $\frac{1$ $\frac{145 - 90}{\frac{145 - 90}{10} = \frac{55}{10} = \frac{11}{2}}$
= 25.5 a
ion about median = 50
 $\frac{5.5a}{a}$ = 50 **(15) (C).** Median = 25.5 a Mean deviation about median = 50

1 (Q.B. SOLUTIONS)
\nMean of given numbers,
\n
$$
= \frac{1}{10}(40+105)-9 = \frac{145-90}{10} = \frac{55}{10} = \frac{11}{2}
$$
\n
$$
= \frac{1}{10}(40+105)-9 = \frac{145-90}{10} = \frac{55}{10} = \frac{11}{2}
$$
\n
$$
= \frac{1}{10}(40+105)-9 = \frac{145-90}{10} = \frac{55}{10} = \frac{11}{2}
$$
\n
$$
= \frac{1}{10}(40+105)-9 = \frac{145-90}{10} = \frac{55}{10} = \frac{11}{2}
$$
\n
$$
= \frac{1}{10} = \frac{100}{10} \qquad \qquad \text{Mean deviation about median} = 50
$$
\n
$$
= 2 \times 1.5 \text{ at } -1.5 \times 1.5 \text{ at } -
$$

$$
\Rightarrow \frac{25}{2}(50a) = 2500 \Rightarrow a = 4
$$

(16) (D). A.M. of
$$
2x_1
$$
, $2x_2$ $2x_n$ is

$$
\frac{2x_1 + 2x_2 + \dots + 2x_n}{n} = 2\left(\frac{x_1 + x_2 + \dots + x_n}{n}\right) = 2\overline{x}
$$

So statement-2 is false variance ($2x_i$) = 2^2 variance (x_i) = $4\sigma^2$ so statement-1 is true.

(17) (D). Variance is not changed by the change of origin.

4.3 a + 23.3a + + 0.3a + 0.3a + + 24.3a - 2500
\n+ 3a + 5a + + 49a = 2500
\n
$$
\frac{25}{2}(50a) = 2500 \Rightarrow a = 4
$$
\nA.M. of 2x₁, 2x₂....2x_n is
\n
$$
\frac{1 + 2x_2 + + 2x_n}{n} = 2\left(\frac{x_1 + x_2 + + x_n}{n}\right) = 2\overline{x}
$$
\n
$$
\frac{1 + 2x_2 + + 2x_n}{n} = 2\left(\frac{x_1 + x_2 + + x_n}{n}\right) = 2\overline{x}
$$
\n
$$
\frac{1}{2}\left(\frac{x_1 + 2x_2 + + x_n}{n}\right) = 2\overline{x}
$$
\n
$$
\frac{1}{2}\left(\frac{x_1 + 2x_2 + + x_n}{n}\right) = 2\overline{x}
$$
\n
$$
\frac{1}{2}\left(\frac{x_1 + 2x_2 + + x_n}{n}\right) = \frac{2}{\overline{x}}
$$
\n
$$
\frac{1}{2}\left(\frac{x_1 + 2x_2 + + x_n}{n}\right) = \frac{2}{\overline{x}}
$$
\n
$$
\frac{1}{2}\left(\frac{x_1 + 2x_2 + + x_n}{n}\right) = \frac{2}{\overline{x}}
$$
\n
$$
\frac{1}{2}\left(\frac{x_1 + 2x_2 + + x_n}{n}\right) = \frac{2}{\overline{x}}
$$
\n
$$
\frac{1}{2}\left(\frac{x_1 + 2x_2 + + x_n}{n}\right) = \frac{2}{\overline{x}}
$$
\n
$$
\frac{1}{2}\left(\frac{x_1 + 2x_2 + + 2x_2}{n}\right) = \frac{1}{\overline{x}}
$$
\nSo variance will not change whereas mean, median and mode will increase by 10.\n
$$
\sigma^2 = \left(\frac{\sum x_i^2}{n}\right) - \overline{x}^2
$$
\n
$$
\frac{50}{\overline{x}} = \frac{1}{50} = 51 \text{ s}
$$
\n
$$
\sigma^2 = \frac{50}{50} - 51 = 51 \text{ s}
$$
\

Now each is increased by 10

$$
\sigma_2^2 = \frac{\sum [(x_i + 10) - (\overline{x} + 10)]^2}{N} = \sigma_1^2
$$

So variance will not change whereas mean, median and mode will increase by 10.

(18) **(B).**
$$
\sigma^2 = \left(\frac{\Sigma x_i^2}{n}\right) - \overline{x}^2
$$

\n statement-2 is false
\n once (2x_i) = 2² variance (x_i) = 4σ²
\n attempt-1 is true.
\n Variance is not changed by the change of origin.
\n If initially all marks were x_i then σ₁² =
$$
\frac{\sum (x_i - \overline{x})^2}{N}
$$

\n Now each is increased by 10
\n $\sigma_2^2 = \frac{\sum [(x_i + 10) - (\overline{x} + 10)]^2}{N} = \sigma_1^2$
\n So variance will not change whereas mean, median and mode will increase by 10.
\n $\sigma^2 = \left(\frac{\sum x_i^2}{n}\right) - \overline{x}^2$
\n $\overline{x} = \frac{\sum_{i=1}^{50} 2r}{50} = 51$; $\sigma^2 = \frac{\sum_{i=1}^{50} 4r^2}{50} - (51)^2 = 833$
\n Mean = 16; Sum = 16 × 16 = 256
\n New sum = 256 - 16 + 3 + 4 + 5 = 252
\n Mean = 252/18 = 14
\n Variance
\n $= \frac{\sum x_i^2}{n} - \left(\frac{\sum x_i^2}{n}\right)^2 = \frac{4 + 9 + a^2 + 121}{4} - \left(\frac{16 + a}{4}\right)^2$ \n

(19) (C). Mean = 16 ; Sum =
$$
16 \times 16 = 256
$$

New sum = $256 - 16 + 3 + 4 + 5 = 252$
Mean = $252/18 = 14$

(20) (A). Variance

$$
\sigma_2^2 = \frac{\sum [(x_i + 10) - (\overline{x} + 10)]^2}{N} = \sigma_1^2
$$

So variance will not change whereas mean, median
and mode will increase by 10.

$$
\sigma^2 = \left(\frac{\sum x_i^2}{n}\right) - \overline{x}^2
$$

$$
\frac{\sum_{i=1}^{50} 2r}{50} = 51 \ ; \ \sigma^2 = \frac{\sum_{i=1}^{50} 4r^2}{50} - (51)^2 = 833
$$

Mean = 16; Sum = 16 × 16 = 256
New sum = 256 - 16 + 3 + 4 + 5 = 252
Mean = 252/18 = 14
Variance

$$
= \frac{\sum x_i^2}{n} - \left(\frac{\sum x_i^2}{n}\right)^2 = \frac{4 + 9 + a^2 + 121}{4} - \left(\frac{16 + a}{4}\right)^2
$$

Q.B. SOLUTIONS
\n**EXAMPLERAL: MATHEMATIC
\n
$$
= \frac{4(134+a^2)-256-a^2-32a}{16}
$$
\n**Q.B. SOLUTIONS**
\n
$$
= \frac{4(134+a^2)-256-a^2-32a}{16}
$$
\n**Q.b. Let x be the 6th observation
\n⇒ 45+54+41+57+43+x=48×6=288⇒ x=48
\n $3a^2-32a+84=0$
\n $3a^2-32a+84=0$
\n $3a^2-32a+84=0$
\n**Q.b. Variance**
\n**Q.b. Curiance**
\n**Q.b. Curiance**
\n
$$
= \left(\frac{\sum x_i^2}{6} - (\overline{x})^2\right) = \frac{14024}{6} - (48)^2 = \frac{100}{3}
$$
\n \Rightarrow Standard deviation $= \frac{10}{\sqrt{3}}$
\n**Q5 (B).** SD = $\sqrt{\frac{\sum (x-\overline{x})^2}{n}}$; $\overline{x} = \frac{\sum x}{4} = \frac{-1+0+1+k}{4} = \frac{k}{4}$
\n $\sigma = \sqrt{\text{Variance}} = 2$
\n**Q2 (B).** Given $\overline{x} = \frac{\sum x_i}{5} = 150$; $\sum_{i=1}^{5} x_i = 750$ (i)
\n $\sum x_i^2 = 112590$ (ii)
\n $\sum x_i^2 = 112590$ (iii)
\n $\Rightarrow 5 \times 4 = 2\left(1 + \frac{k}{16}\right)^2 + \frac{6k^2}{8}$
\n $\Rightarrow 18 = \frac{3k^2}{4} \Rightarrow k^2 = 24 \Rightarrow k = 2\sqrt{6}$
\n $\overline{x}_{new} = \frac{\sum_{i=1}^{6} x_i}{6} = \frac{750+156}{6} = 151$
\nAlso, New variance $\frac{\sum_{i=1}^{6} x_i^2}{16} - (\overline{x}_{new})^2$
\n $\Rightarrow 42 = \frac$****

$$
\Sigma x_i^2 = 112590 \qquad \qquad \dots \dots (ii)
$$

Given height of new student, $x_6 = 156$

$$
\vec{x}_{\text{new}} = \frac{\sum_{i=1}^{6} x_i}{6} = \frac{750 + 156}{6} = 151
$$

Also, New variance
$$
=
$$

$$
\frac{\sum_{i=1}^{6} x_i^2}{6} - (\overline{x}_{new})^2
$$

$$
=\frac{112590+(156)^2}{6}-(151)^2=22821-22801=20.
$$

(23) (C). Let 7 observations be $x_1, x_2, x_3, x_4, x_5, x_6, x_7$

$$
\Sigma x_1^2 = 112590
$$
(ii)
\n
$$
\Sigma x_1 = 112590
$$
(iii)
\n
$$
\Sigma x_1 = 112590
$$
(iv)
\n
$$
\Sigma x_1 = \frac{5}{14}x_1^2 - \frac{750 + 156}{6} = 151
$$
 3
\n
$$
\Sigma x_1 = \frac{5}{6}x_1^2
$$
 4
\n
$$
\Sigma x_1 = \frac{5}{6}x_1^2
$$
 5
\nAlso, New variance = $\frac{1}{6}x_1^2 - (\overline{x}_{new})^2$
\n
$$
= \frac{112590 + (156)^2}{6} - (151)^2 = 22821 - 22801 = 20.
$$
 42 = $\frac{10 + 22 + 26 + 29 + 34 + 36 + 42 + 67 + 70 + y}{420 - 336 = y \Rightarrow y = 84}$
\n
$$
\Sigma x_1 = 56
$$
 43 = $\frac{1}{36}x_1^2$
\n
$$
\Sigma x_1 = 56
$$
(1)
\n
$$
\overline{x} = 8 \Rightarrow \sum_{i=1}^{7} x_i = 56
$$
(1)
\n
$$
16 = \frac{1}{7}(\sum_{i=1}^{7} x_i^2) - (\overline{x})^2; 16 = \frac{1}{7}(\sum_{i=1}^{7} x_i^2) - 64
$$
 5
\n
$$
\Sigma x_1 = 56
$$
 6
\n
$$
16 = \frac{1}{7}(\sum_{i=1}^{7} x_i^2) = 560
$$
(2)
\nNow, $x_1 = 2, x_2 = 4, x_3 = 10, x_4 = 12, x_5 = 14$
\n
$$
\Sigma x_1 = 14
$$
 5
\n
$$
\Sigma x_1 = 2x_1 + 14, x_2 = 14, x_3 = 12, x_5 = 14
$$

\n
$$
\Sigma x_1 = 2x_2 - 4, x_3 = 10, x_4 = 12
$$

$$
x_6^2 + x_7^2 = 100 \text{ (from (2))}
$$

∴
$$
x_6^2 + x_7^2 = (x_6 + x_7)^2 - 2x_6x_7 \Rightarrow x_6x_7 = 48
$$

(24) (A). Let x be the 6th observation

$$
\Rightarrow 45 + 54 + 41 + 57 + 43 + x = 48 \times 6 = 288 \Rightarrow x = 48
$$

STUDY MATERIAL: MATHEMATICS
\nLet x be the 6th observation
\n45 + 54 + 41 + 57 + 43 + x = 48 × 6 = 288
$$
\Rightarrow
$$
 x = 48
\nVariance = $\left(\frac{\Sigma x_i^2}{6} - (\overline{x})^2\right) = \frac{14024}{6} - (48)^2 = \frac{100}{3}$
\nStandard deviation = $\frac{10}{\sqrt{3}}$
\nS.D = $\sqrt{\frac{\Sigma (x - \overline{x})^2}{n}}$; $\overline{x} = \frac{\Sigma x}{4} = \frac{-1 + 0 + 1 + k}{4} = \frac{k}{4}$

$$
\Rightarrow
$$
 Standard deviation = $\frac{10}{\sqrt{3}}$

ITIONS STUDY MATERIAL: MATHEMATICS
\n**(24) (A).** Let x be the 6th observation
\n
$$
\Rightarrow 45 + 54 + 41 + 57 + 43 + x = 48 \times 6 = 288 \Rightarrow x = 48
$$

\nVariance $= \left(\frac{\sum x_i^2}{6} - (\overline{x})^2\right) = \frac{14024}{6} - (48)^2 = \frac{100}{3}$
\n \Rightarrow Standard deviation $= \frac{10}{\sqrt{3}}$
\n**(25) (B).** S.D $= \sqrt{\frac{\sum (x - \overline{x})^2}{n}}$; $\overline{x} = \frac{\sum x}{4} = \frac{-1 + 0 + 1 + k}{4} = \frac{k}{4}$
\n $\sqrt{5} = \sqrt{\frac{-1 - \frac{k}{4}}{1}^2 + \left(b - \frac{k}{4}\right)^2 + \left(k - \frac{k}{4}\right)^2}$

Q.B. SOLUTIONS
\n
$$
32\frac{1}{-32a}
$$
\n(24) (A) Let x be the 6th observation
\n⇒ 45 + 54 + 41 + 57 + 43 + x = 48 × 6 = 288 ⇒ x = 48
\n
$$
\frac{7}{2} \Big)^2 = 4 \times 49
$$
\n
$$
49
$$
\n
$$
52 = \sqrt{16} \text{ (B)}.
$$
 SD = $\sqrt{\frac{2(x-3)^2}{n}}; \frac{1}{3} = \frac{2x}{4} = \frac{-1+0+1+k}{4} = \frac{k}{4}$
\n
$$
-1 = 4
$$
\n(25) (B) SD = $\sqrt{\frac{2(x-3)^2}{n}}; \frac{1}{3} = \frac{2x}{4} = \frac{-1+0+1+k}{4} = \frac{k}{4}$
\n
$$
-1(150)^2 = 18
$$
\n(26)
$$
-18 = \frac{3k^2}{4} \text{ (a) } \frac{1}{2} = \frac{3k^2}{4} \text{ (b) } \frac{1}{2} = \frac{3k^2}{4} = k^2 = 24 \Rightarrow k = 2\sqrt{6}
$$
\n
$$
k = 151
$$
\n(27)
$$
k = 15
$$
\n
$$
k =
$$

$$
\Rightarrow 5 \times 4 = 2\left(1 + \frac{k}{16}\right)^2 + \frac{5k^2}{8}
$$

$$
\Rightarrow 18 = \frac{3k^2}{4} \Rightarrow k^2 = 24 \Rightarrow k = 2\sqrt{6}
$$

i 1 ² new (x) ⁶ ² 112590 (156) ² = 22821– 22801 = 20. i 1 x 8 x 56(1) 2 2 ; i 1 16 x 64 ² 3k ² 18 k 24 k 2 6 **(26) (A).** 34 x 35 x 36 2 10 22 26 29 34 36 42 67 70 y ⁴² 10 420 – 336 = y y = 84 y 84 7 x 36 3 **(27) (A).** f i = 20 = 2x² + 2x – 4 x 2 + 2x –24 = 0 x = 3, –4 (rejected) i i x f x 2.8 () 16 ⁵⁰ (256) 2 ⁵⁰ 2 2 i i i (x 4) x 16 50 8 x 50 50

$$
\overline{x} = \frac{\sum x_i f_i}{\sum f_i} = 2.8
$$

(28) **(D).** Mean
$$
(\mu) = \frac{\sum x_i}{50} = 16
$$

Standard deviation (
$$
\sigma
$$
) = $\sqrt{\frac{\sum x_i}{50} - (\mu)^2} = 16$

$$
(256) \times 2 = \frac{\sum x_i^2}{50}
$$

New mean
$$
=
$$
 $\frac{\Sigma (x_i - 4)^2}{50} = \frac{\Sigma x_i^2 + 16 \times 50 - 8 \Sigma x_i}{50}$
 $= (256) \times 2 + 16 - 8 \times 16 = 400$

STATISTICS	Q.B. SOLUTIONS	By	
(29)	(B) x ₁ + ... + x ₄ = 44	$x_5 + ... + x_{10} = 96$	If p = 1/2 then q = 0 (from equation (1))
$\bar{x} = 14, \ \Sigma x_i = 140$	If p = -1/2 then q = 2.0		
$\bar{x} = 14, \ \Sigma x_i = 140$	$\bar{x} = 24$		
$\bar{x} = 14, \ \Sigma x_i = 140$	$\bar{x} = 24$		
$\bar{x} = 24$	$\bar{x} = 24$		
$\bar{x} = 24$	$\bar{x} = 24$		
$\bar{x} = 24$	$\bar{x} = 24$		
$\bar{x} = 24$	$\bar{x} = 24$		
$\bar{x} = 24$	$\bar{x} = 24$		
$\bar{x} = 24$	$\bar{x} = 24$		
$\bar{x} = 24$	$\bar{x} = 24$		
$\bar{x} = 24$	$\bar{x} = 24$		
$\bar{x} = 24$	$\bar{x} = 24$		
$\bar{x} = 24$	$\bar{x} = 24$		
$\bar{x} = 24$	$\bar{x} = 24$		
$\bar{x} = 24$			

(32) (B). If each observation is multiplied with p & then q is

$$
\Rightarrow 10 = p(20) - q \qquad(1)
$$

and new standard deviations

$$
\sigma_2 = |p| \sigma_1 \Rightarrow 1 = |p|(2) \Rightarrow |p| = 1/2
$$

15.5
\n
$$
\frac{1}{x_1 + ... + x_4 = 44}
$$
\n
$$
\frac{1}{x_2 + ... + x_1 = 96}
$$
\n
$$
\frac{x_1 + ... + x_4 = 44}{x_1 + 2x_1 = 140}
$$
\n
$$
\frac{1}{x_2 - 140}
$$
\n
$$
\frac{1}{x_1 - 12 \text{ then } q = -20}
$$
\n
$$
\frac{1}{x_1 - 12 \text{ then } q = -20}
$$
\n
$$
\frac{1}{x_1 - 12 \text{ then } q = -20}
$$
\n
$$
\frac{1}{x_1 - 12 \text{ then } q = -20}
$$
\n
$$
\frac{1}{x_1 - 12 \text{ then } q = -20}
$$
\n
$$
\frac{1}{x_1 - 12 \text{ then } q = -20}
$$
\n
$$
\frac{1}{x_1 - 12 \text{ then } q = -20}
$$
\n
$$
\frac{1}{x_1 - 12 \text{ then } q = -20}
$$
\n
$$
\frac{1}{x_1 - 12 \text{ then } q = -20}
$$
\n
$$
\frac{1}{x_1 - 12 \text{ then } q = -20}
$$
\n
$$
\frac{1}{x_1 - 12 \text{ then } q = -20}
$$
\n
$$
\frac{1}{x_1 - 12 \text{ then } q = 200 - 4
$$
\n
$$
\frac{1}{x_1 - 12 \text{ then } q = 200 - 81 + 121 - \frac{202}{20} = 280
$$
\n
$$
\frac{(n+1)(2n+1)}{6} = \frac{(n+1)^2}{2} = 10
$$
\n
$$
n^2 - 1 = 120 \Rightarrow n = 11
$$
\n
$$
n^2 - 1 = 120 \Rightarrow n = 11
$$
\n
$$
n^2 - 1 = 48 \Rightarrow m = 7 \Rightarrow m + n = 18
$$
\n
$$
\frac{3 \cdot 7}{3 \cdot 7 + 9 + 12 + 13 + 20 + x + y} = 10
$$
\n
$$
\frac{3 \cdot 7 + 2 + 12 + 13 + 20 + x + y
$$

 $\Rightarrow \mu$ = mean of observation (x_i – 3) $=$ (mean of observation $(x_i - 5)$) + 2 = 1 + 2 = 3 Variance of observation

$$
x_i - 5 = {1 \over 10} \sum_{i=1}^{10} (x_i - 5)^2
$$
 - (Mean of $(x_i - 5)$)² = 3

⇒
$$
\lambda
$$
 = variance of observation (x_i - 3)
= variance of observation (x_i - 5) = 3
∴ (µ, λ) = (3, 3)