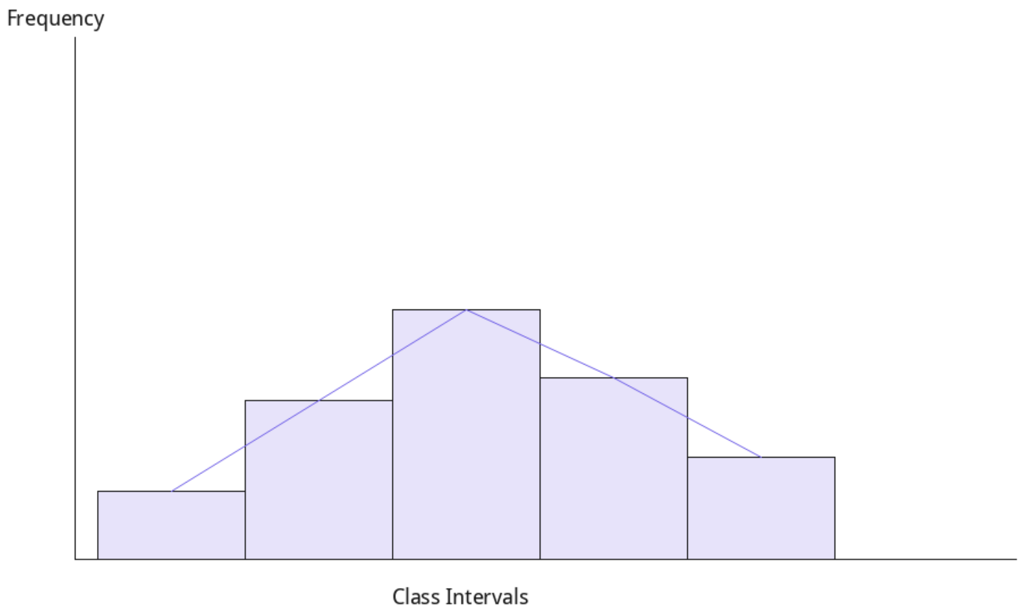
CLASS 11 MATHS NCERT SOLUTIONS

NCERT Solutions for Class 11 Maths Chapter 13: Statistics – Free PDF Download

Statistics is the branch of mathematics that deals with collecting, organising, analysing and interpreting numerical data. In earlier classes we studied measures of central tendency — mean, median and mode — which give a single representative value for a data set. However, two data sets can have the same mean or...

Contents

Statistics is the branch of mathematics that deals with collecting, organising, analysing and interpreting numerical data. In earlier classes we studied measures of central tendency — mean, median and mode — which give a single representative value for a data set. However, two data sets can have the same mean or median and yet be very differently spread out. Class 11 Maths Chapter 13, Statistics, introduces measures of dispersion — range, mean deviation, variance and standard deviation — which tell us how scattered the observations are about a measure of central tendency. This page provides complete, step-by-step NCERT solutions for every exercise in the chapter, solved directly from the current NCERT textbook. These solutions cover mean deviation (about mean and median) for ungrouped and grouped data, and variance and standard deviation (direct and shortcut methods), exactly as per the latest rationalised NCERT syllabus.



A histogram (bars) with its frequency polygon (joining line) -- used to visualise grouped frequency data.

Reference figure — histogram of grouped data

Exercise 13.1

Q1. Find the mean deviation about the mean for the data: 4, 7, 8, 9, 10, 12, 13, 17

Number of observations, $n = 8$.
Mean, $\bar{x} = (4 + 7 + 8 + 9 + 10 + 12 + 13 + 17)/8 = 80/8 = 10$.
Absolute deviations $|x_i - \bar{x}|$: 6, 3, 2, 1, 0, 2, 3, 7.
Sum of absolute deviations = 6 + 3 + 2 + 1 + 0 + 2 + 3 + 7 = 24.
Mean deviation about mean, M.D.($\bar{x}$) = 24/8 = **3**.

Q2. Find the mean deviation about the mean for the data: 38, 70, 48, 40, 42, 55, 63, 46, 54, 44

Number of observations, $n = 10$.
Mean, $\bar{x} = (38+70+48+40+42+55+63+46+54+44)/10 = 500/10 = 50$.
Absolute deviations $|x_i - \bar{x}|$: 12, 20, 2, 10, 8, 5, 13, 4, 4, 6.
Sum of absolute deviations = 12+20+2+10+8+5+13+4+4+6 = 84.

Mean deviation about mean, M.D.($\bar{x}$) = 84/10 = **8.4**.

Q3. Find the mean deviation about the median for the data: 13, 17, 16, 14, 11, 13, 10, 16, 11, 18, 12, 17

Number of observations, n = 12. Arranging in ascending order:
10, 11, 11, 12, 13, 13, 14, 16, 16, 17, 17, 18.
Since n is even, Median = mean of 6th and 7th observations = (13 + 14)/2 = 13.5.
Absolute deviations $|x_i – M|$: 3.5, 2.5, 2.5, 1.5, 0.5, 0.5, 0.5, 2.5, 2.5, 3.5, 3.5, 4.5.
Sum of absolute deviations = 28.
Mean deviation about median, M.D.(M) = 28/12 = **2.33** (approx).

Q4. Find the mean deviation about the median for the data: 36, 72, 46, 42, 60, 45, 53, 46, 51, 49

Number of observations, n = 10. Arranging in ascending order:
36, 42, 45, 46, 46, 49, 51, 53, 60, 72.
Since n is even, Median = mean of 5th and 6th observations = (46 + 49)/2 = 47.5.
Absolute deviations $|x_i – M|$: 11.5, 5.5, 2.5, 1.5, 1.5, 1.5, 3.5, 5.5, 12.5, 24.5.
Sum of absolute deviations = 70.
Mean deviation about median, M.D.(M) = 70/10 = **7**.

Q5. Find the mean deviation about the mean for the data:

x_i	5	10	15	20	25
f_i	7	4	6	3	5

N = Σf_i = 7+4+6+3+5 = 25.
$\Sigma f_i x_i$ = 5(7)+10(4)+15(6)+20(3)+25(5) = 35+40+90+60+125 = 350.
Mean, $\bar{x}$ = 350/25 = 14.
$\Sigma f_i|x_i – \bar{x}|$ = 7(9)+4(4)+6(1)+3(6)+5(11) = 63+16+6+18+55 = 158.
Mean deviation about mean, M.D.($\bar{x}$) = 158/25 = **6.32**.

Q6. Find the mean deviation about the mean for the data:

x_i	10	30	50	70	90
f_i	4	24	28	16	8

N = Σf_i = 4+24+28+16+8 = 80.
$\Sigma f_i x_i$ = 10(4)+30(24)+50(28)+70(16)+90(8) = 40+720+1400+1120+720 = 4000.
Mean, $\bar{x}$ = 4000/80 = 50.
$\Sigma f_i|x_i – \bar{x}|$ = 4(40)+24(20)+28(0)+16(20)+8(40) = 160+480+0+320+320 = 1280.
Mean deviation about mean, M.D.($\bar{x}$) = 1280/80 = **16**.

Q7. Find the mean deviation about the median for the data:

x_i	5	7	9	10	12	15

f_i	8	6	2	2	2	6

$N = \Sigma f_i = 8+6+2+2+2+6 = 26$. Cumulative frequencies: 8, 14, 16, 18, 20, 26.
$N/2 = 13$. The cumulative frequency just greater than 13 is 14, corresponding to $x_i = 7$. So both the 13th and 14th observations equal 7.
Median = 7.
$\Sigma f_i|x_i - M| = 8(2)+6(0)+2(2)+2(3)+2(5)+6(8) = 16+0+4+6+10+48 = 84$.
Mean deviation about median, M.D.(M) = 84/26 = **3.23** (approx).

Q8. Find the mean deviation about the median for the data:

x_i	15	21	27	30	35
f_i	3	5	6	7	8

$N = \Sigma f_i = 3+5+6+7+8 = 29$. Cumulative frequencies: 3, 8, 14, 21, 29.
$(N+1)/2$ = 15th observation. The cumulative frequency just greater than 14 is 21, corresponding to $x_i = 30$.
Median = 30.
$\Sigma f_i|x_i - M| = 3(15)+5(9)+6(3)+7(0)+8(5) = 45+45+18+0+40 = 148$.
Mean deviation about median, M.D.(M) = 148/29 = **5.10** (approx).

Q9. Find the mean deviation about the mean for the data:

Income per day (₹)	0-100	100-200	200-300	300-400	400-500	500-600	600-700	700-800
Number of persons	4	8	9	10	7	5	4	3

$N = \Sigma f_i = 4+8+9+10+7+5+4+3 = 50$. Mid-points x_i: 50, 150, 250, 350, 450, 550, 650, 750.
$\Sigma f_i x_i = 200+1200+2250+3500+3150+2750+2600+2250 = 17900$.
Mean, $\bar{x} = 17900/50 = 358$.
$\Sigma f_i|x_i - \bar{x}| = 4(308)+8(208)+9(108)+10(8)+7(92)+5(192)+4(292)+3(392) =$
$1232+1664+972+80+644+960+1168+1176 = 7896$.
Mean deviation about mean, M.D.($\bar{x}$) = 7896/50 = **157.92**.

Q10. Find the mean deviation about the mean for the data:

Height (cm)	95-105	105-115	115-125	125-135	135-145	145-155
Number of boys	9	13	26	30	12	10

$N = \Sigma f_i = 9+13+26+30+12+10 = 100$. Mid-points x_i: 100, 110, 120, 130, 140, 150.
$\Sigma f_i x_i = 900+1430+3120+3900+1680+1500 = 12530$.
Mean, $\bar{x} = 12530/100 = 125.3$.
$\Sigma f_i|x_i - \bar{x}| = 9(25.3)+13(15.3)+26(5.3)+30(4.7)+12(14.7)+10(24.7) =$

227.7+198.9+137.8+141+176.4+247 = 1128.8.
Mean deviation about mean, M.D.($\bar{x}$) = 1128.8/100 = **11.29** (approx).

Q11. Find the mean deviation about median for the following data:

Marks	0-10	10-20	20-30	30-40	40-50	50-60
Number of girls	6	8	14	16	4	2

N = Σf_i = 6+8+14+16+4+2 = 50. Cumulative frequencies: 6, 14, 28, 44, 48, 50.
N/2 = 25. The class 20-30 has cumulative frequency 28 (just greater than 25), so it is the median class: l = 20, C = 14, f = 14, h = 10.
Median = l + [(N/2 – C)/f] × h = 20 + [(25–14)/14] × 10 = 20 + 7.857 = 27.86 (approx).
Mid-points x_i: 5, 15, 25, 35, 45, 55.
$\Sigma f_i|x_i - M|$ = 6(22.86)+8(12.86)+14(2.86)+16(7.14)+4(17.14)+2(27.14) ≈ 137.14+102.86+40.0+114.29+68.57+54.29 = 517.14.
Mean deviation about median, M.D.(M) = 517.14/50 = **10.34** (approx).

Q12. Calculate the mean deviation about median age for the age distribution of 100 persons given below:

Age (years)	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55
Number	5	6	12	14	26	12	16	9

Hint (as given in the book): Convert the given data into a continuous frequency distribution by subtracting 0.5 from the lower limit and adding 0.5 to the upper limit of each class interval, giving classes 15.5-20.5, 20.5-25.5, 25.5-30.5, 30.5-35.5, 35.5-40.5, 40.5-45.5, 45.5-50.5, 50.5-55.5.
N = Σf_i = 100. Cumulative frequencies: 5, 11, 23, 37, 63, 75, 91, 100.
N/2 = 50. The class 35.5-40.5 has cumulative frequency 63 (just greater than 50), so it is the median class: l = 35.5, C = 37, f = 26, h = 5.
Median = 35.5 + [(50–37)/26] × 5 = 35.5 + 2.5 = 38.
Mid-points x_i: 18, 23, 28, 33, 38, 43, 48, 53.
$\Sigma f_i|x_i - M|$ = 5(20)+6(15)+12(10)+14(5)+26(0)+12(5)+16(10)+9(15) = 100+90+120+70+0+60+160+135 = 735.
Mean deviation about median, M.D.(M) = 735/100 = **7.35**.

Exercise 13.2

Q1. Find the mean and variance for the data: 6, 7, 10, 12, 13, 4, 8, 12

n = 8. Mean, $\bar{x}$ = (6+7+10+12+13+4+8+12)/8 = 72/8 = 9.
Deviations ($x_i - \bar{x}$): –3, –2, 1, 3, 4, –5, –1, 3. Squares: 9, 4, 1, 9, 16, 25, 1, 9.
$\Sigma(x_i - \bar{x})^2$ = 9+4+1+9+16+25+1+9 = 74.
Variance, σ^2 = 74/8 = **9.25**. Mean = **9**.

Q2. Find the mean and variance for the data: First n natural numbers

The first n natural numbers are 1, 2, 3, …, n.
Mean, $\bar{x} = (1+2+\ldots+n)/n = [n(n+1)/2]/n =$ **$(n+1)/2$**.
It is a standard result that $\Sigma x_i^2 = n(n+1)(2n+1)/6$, so
Variance, $\sigma^2 = (1/n)\Sigma x_i^2 - \bar{x}^2 = (n+1)(2n+1)/6 - (n+1)^2/4 = (n+1)[2(2n+1) - 3(n+1)]/12 = (n+1)(n-1)/12$.
Variance = **$(n^2 - 1)/12$**.

Q3. Find the mean and variance for the data: First 10 multiples of 3

The first 10 multiples of 3 are: 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, i.e., 3 times the first 10 natural numbers.
Mean of first 10 natural numbers = (10+1)/2 = 5.5, so Mean, $\bar{x} = 3 \times 5.5 =$ **16.5**.
Variance of first 10 natural numbers = $(10^2 - 1)/12 = 99/12 = 8.25$.
Since each observation is multiplied by 3, variance scales by $3^2 = 9$.
Variance, $\sigma^2 = 9 \times 8.25 =$ **74.25**.

Q4. Find the mean and variance for the data:

x_i	6	10	14	18	24	28	30
f_i	2	4	7	12	8	4	3

$N = \Sigma f_i = 2+4+7+12+8+4+3 = 40$.
$\Sigma f_i x_i = 12+40+98+216+192+112+90 = 760$. Mean, $\bar{x} = 760/40 = 19$.
$\Sigma f_i x_i^2 = 72+400+1372+3888+4608+3136+2700 = 16176$.
Variance, $\sigma^2 = (\Sigma f_i x_i^2)/N - \bar{x}^2 = 16176/40 - 19^2 = 404.4 - 361 =$ **43.4**. Mean = **19**.

Q5. Find the mean and variance for the data:

x_i	92	93	97	98	102	104	109
f_i	3	2	3	2	6	3	3

$N = \Sigma f_i = 3+2+3+2+6+3+3 = 22$.
$\Sigma f_i x_i = 276+186+291+196+612+312+327 = 2200$. Mean, $\bar{x} = 2200/22 = 100$.
$\Sigma f_i x_i^2 = 25392+17298+28227+19208+62424+32448+35643 = 220640$.
Variance, $\sigma^2 = 220640/22 - 100^2 = 10029.09 - 10000 =$ **29.09** (approx). Mean = **100**.

Q6. Find the mean and standard deviation using short-cut method:

x_i	60	61	62	63	64	65	66	67	68
f_i	2	1	12	29	25	12	10	4	5

$N = \Sigma f_i = 100$. Let assumed mean A = 64 and h = 1, so $d_i = x_i - 64$: −4, −3, −2, −1, 0, 1, 2, 3, 4.
$\Sigma f_i d_i = -8-3-24-29+0+12+20+12+20 = 0$. Mean, $\bar{x} = A + (\Sigma f_i d_i)/N = 64 + 0 =$ **64**.
$\Sigma f_i d_i^2 = 32+9+48+29+0+12+40+36+80 = 286$.
Variance, $\sigma^2 = (h^2/N^2)[N\cdot\Sigma f_i d_i^2 - (\Sigma f_i d_i)^2] = (1/10000)[100\times 286 - 0] = 28600/10000 =$ **2.86**.
Standard deviation, $\sigma = \sqrt{2.86} =$ **1.69** (approx).

Q7. Find the mean and variance for the following frequency distribution:

Classes	0-30	30-60	60-90	90-120	120-150	150-180	180-210
Frequencies	2	3	5	10	3	5	2

$N = \Sigma f_i = 30$. Mid-points x_i: 15, 45, 75, 105, 135, 165, 195. Let $A = 105$, $h = 30$, $d_i = (x_i - A)/h$: −3, −2, −1, 0, 1, 2, 3.
$\Sigma f_i d_i = -6-6-5+0+3+10+6 = 2$. Mean, $\bar{x} = A + (\Sigma f_i d_i/N)\times h = 105 + (2/30)\times 30 =$ **107**.
$\Sigma f_i d_i^2 = 18+12+5+0+3+20+18 = 76$.
Variance, $\sigma^2 = (h^2/N^2)[N\cdot\Sigma f_i d_i^2 - (\Sigma f_i d_i)^2] = (900/900)[30\times 76 - 4] = 2280 - 4 =$ **2276**.

Q8. Find the mean and variance for the following frequency distribution:

Classes	0-10	10-20	20-30	30-40	40-50
Frequencies	5	8	15	16	6

$N = \Sigma f_i = 50$. Mid-points x_i: 5, 15, 25, 35, 45. Let $A = 25$, $h = 10$, $d_i = (x_i - A)/h$: −2, −1, 0, 1, 2.
$\Sigma f_i d_i = -10-8+0+16+12 = 10$. Mean, $\bar{x} = 25 + (10/50)\times 10 =$ **27**.
$\Sigma f_i d_i^2 = 20+8+0+16+24 = 68$.
Variance, $\sigma^2 = (h^2/N^2)[N\cdot\Sigma f_i d_i^2 - (\Sigma f_i d_i)^2] = (100/2500)[50\times 68 - 100] = 0.04\times 3300 =$ **132**.

Q9. Find the mean, variance and standard deviation using the short-cut method:

Height (cm)	70-75	75-80	80-85	85-90	90-95	95-100	100-105	105-110	110-115
No. of children	3	4	7	7	15	9	6	6	3

$N = \Sigma f_i = 60$. Mid-points x_i: 72.5, 77.5, 82.5, 87.5, 92.5, 97.5, 102.5, 107.5, 112.5. Let $A = 92.5$, $h = 5$, $d_i = (x_i - A)/h$: −4, −3, −2, −1, 0, 1, 2, 3, 4.
$\Sigma f_i d_i = -12-12-14-7+0+9+12+18+12 = 6$. Mean, $\bar{x} = 92.5 + (6/60)\times 5 = 92.5 + 0.5 =$ **93**.
$\Sigma f_i d_i^2 = 48+36+28+7+0+9+24+54+48 = 254$.
Variance, $\sigma^2 = (h^2/N^2)[N\cdot\Sigma f_i d_i^2 - (\Sigma f_i d_i)^2] = (25/3600)[60\times 254 - 36] = (25/3600)\times 15204 =$ **105.58** (approx).
Standard deviation, $\sigma = \sqrt{105.58} =$ **10.27** (approx).

Q10. The diameters of circles (in mm) drawn in a design are given below. Calculate the standard deviation and mean diameter of the circles.

Diameters	33-36	37-40	41-44	45-48	49-52
No. of circles	15	17	21	22	25

Hint (as given in the book): First make the data continuous by writing the classes as 32.5-36.5, 36.5-40.5, 40.5-44.5, 44.5-48.5, 48.5-52.5, and then proceed.
$N = \Sigma f_i = 100$. Mid-points x_i: 34.5, 38.5, 42.5, 46.5, 50.5. Let $A = 42.5$, $h = 4$, $d_i = (x_i - A)/h$: −2, −1, 0,

1, 2.
$\Sigma f_i d_i = -30-17+0+22+50 = 25$. Mean, $\bar{x} = 42.5 + (25/100)\times 4 = 42.5 + 1 =$ **43.5**.
$\Sigma f_i d_i^2 = 60+17+0+22+100 = 199$.
Variance, $\sigma^2 = (h^2/N^2)[N\cdot\Sigma f_i d_i^2 - (\Sigma f_i d_i)^2] = (16/10000)[100\times 199 - 625] = (16/10000)\times 19275 = 30.84$.
Standard deviation, $\sigma = \sqrt{30.84} =$ **5.55** (approx). Mean diameter = **43.5 mm**.

Miscellaneous Exercise

Q1. The mean and variance of eight observations are 9 and 9.25, respectively. If six of the observations are 6, 7, 10, 12, 12 and 13, find the remaining two observations.

Let the remaining two observations be x and y. Given n = 8, mean = 9, variance = 9.25.
Sum of all 8 observations = 9 × 8 = 72. Sum of known six = 6+7+10+12+12+13 = 60, so x + y = 72 – 60 = **12**.
$\Sigma x_i^2 = n(\text{variance} + \text{mean}^2) = 8(9.25 + 81) = 8 \times 90.25 = 722$.
Sum of squares of known six = 36+49+100+144+144+169 = 642, so $x^2 + y^2 = 722 - 642 = 80$.
Now $(x+y)^2 = x^2+y^2+2xy \Rightarrow 144 = 80 + 2xy \Rightarrow xy = 32$.
So x and y are roots of $t^2 - 12t + 32 = 0 \Rightarrow (t - 8)(t - 4) = 0 \Rightarrow t = 8$ or 4.
The remaining two observations are **4 and 8**.

Q2. 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.

Let the remaining two observations be x and y. Given n = 7, mean = 8, variance = 16.
Sum of all 7 observations = 8 × 7 = 56. Sum of known five = 2+4+10+12+14 = 42, so x + y = 56 – 42 = **14**.
$\Sigma x_i^2 = n(\text{variance} + \text{mean}^2) = 7(16 + 64) = 7 \times 80 = 560$.
Sum of squares of known five = 4+16+100+144+196 = 460, so $x^2 + y^2 = 560 - 460 = 100$.
Now $(x+y)^2 = x^2+y^2+2xy \Rightarrow 196 = 100 + 2xy \Rightarrow xy = 48$.
So x and y are roots of $t^2 - 14t + 48 = 0 \Rightarrow (t - 8)(t - 6) = 0 \Rightarrow t = 8$ or 6.
The remaining two observations are **6 and 8**.

Q3. The mean and standard deviation of six observations are 8 and 4, respectively. If each observation is multiplied by 3, find the new mean and new standard deviation of the resulting observations.

When each observation is multiplied by a constant a, the new mean becomes a times the old mean, and the new standard deviation becomes |a| times the old standard deviation.
New mean = 3 × 8 = **24**.
New standard deviation = 3 × 4 = **12**.

Q4. Given that $\bar{x}$ is the mean and σ^2 is the variance of n observations $x_1, x_2, \ldots, x_n$. Prove that the mean and variance of the observations $ax_1, ax_2, ax_3, \ldots, ax_n$ are a $\bar{x}$ and $a^2\sigma^2$, respectively (a ≠ 0).

Let $y_i = ax_i$ for i = 1, 2, …, n.
Mean of y_i, $\bar{y} = (1/n)\Sigma y_i = (1/n)\Sigma(ax_i) = a \times (1/n)\Sigma x_i =$ **a $\bar{x}$**.
Variance of y_i, $\sigma_y^2 = (1/n)\Sigma(y_i - \bar{y})^2 = (1/n)\Sigma(ax_i - a\,\bar{x})^2 = (1/n)\Sigma a^2(x_i - \bar{x})^2 = a^2 \times (1/n)\Sigma(x_i - \bar{x})^2 =$

$a^2\sigma^2$.
Hence proved that the mean and variance of $ax_1, ax_2, \ldots, ax_{\square}$ are a $\bar{x}$ and $a^2\sigma^2$ respectively.

Q5. 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:

If the wrong item is omitted.

Original sum = 10 × 20 = 200. Original $\Sigma x_{\square}^2$ = n(variance + mean^2) = 20(4 + 100) = 2080.
After omitting 8: new n = 19, new sum = 200 – 8 = 192, so new mean = 192/19 = **10.11** (approx).
New $\Sigma x_{\square}^2$ = 2080 – 64 = 2016.
New variance = 2016/19 – $(192/19)^2$ = 106.11 – 102.12 = 3.99 (approx).
New standard deviation = √3.99 ≈ **2.00**.

If it is replaced by 12.

New sum = 200 – 8 + 12 = 204 (n remains 20), so new mean = 204/20 = **10.2**.
New $\Sigma x_{\square}^2$ = 2080 – 64 + 144 = 2160.
New variance = 2160/20 – $(10.2)^2$ = 108 – 104.04 = 3.96.
New standard deviation = √3.96 ≈ **1.99**.

Q6. The mean and standard deviation of a group of 100 observations were found to be 20 and 3, respectively. Later on it was found that three observations were incorrect, which were recorded as 21, 21 and 18. Find the mean and standard deviation if the incorrect observations are omitted.

Original sum = 20 × 100 = 2000. Original $\Sigma x_{\square}^2$ = n(variance + mean^2) = 100(9 + 400) = 40900.
After omitting the three incorrect observations (21, 21, 18): new n = 97, new sum = 2000 – 21 – 21 – 18 = 1940, so new mean = 1940/97 = **20**.
New $\Sigma x_{\square}^2$ = 40900 – ($21^2 + 21^2 + 18^2$) = 40900 – (441+441+324) = 40900 – 1206 = 39694.
New variance = 39694/97 – 20^2 = 409.22 – 400 = 9.22 (approx).
New standard deviation = √9.22 ≈ **3.04**.

Class 11 Maths Chapter 13 – Notes and Extra Questions

Range = Maximum value – Minimum value; it gives only a rough idea of dispersion since it depends only on the two extreme values.

Mean deviation is the average of the absolute deviations of observations from a central value (mean or median); absolute values are used because the algebraic sum of deviations from the mean is always zero.

For ungrouped data, $M.D.(\bar{x}) = (1/n)\Sigma|x_i - \bar{x}|$; for discrete/continuous grouped data, $M.D.(\bar{x}) = (1/N)\Sigma f_i|x_i - \bar{x}|$, where $N = \Sigma f_i$.

For the median, observations must first be arranged in order; the median class for grouped data is located using cumulative frequency and N/2.

Variance, σ^2, is the mean of the squares of the deviations from the mean: $\sigma^2 = (1/n)\Sigma(x_i - \bar{x})^2$ for ungrouped data, and $\sigma^2 = (1/N)\Sigma f_i(x_i - \bar{x})^2$ for grouped data.

Standard deviation, $\sigma = \sqrt{(\text{variance})}$, is the positive square root of the variance and is expressed in the same units as the data.

Shortcut (step-deviation) method: with assumed mean A and class width h, $d_i = (x_i - A)/h$, and variance $\sigma^2 = (h^2/N^2)[N\cdot\Sigma f_i d_i^2 - (\Sigma f_i d_i)^2]$.

If every observation is multiplied by a constant a, the new mean is a times the old mean and the new variance is a^2 times the old variance (new SD is |a| times the old SD); adding a constant to every observation does not change the variance or SD.

Extra practice: Find the mean deviation about the mean for the data 10, 12, 14, 16, 18, 20 and verify it against the mean deviation about the median.

Extra practice: Calculate the variance and standard deviation of the first 15 natural numbers using the direct formula.

Extra practice: For a grouped frequency distribution with classes of width 10, use the step-deviation method to compute variance and compare the result with the direct method.

Q1. What is the difference between mean deviation and standard deviation?

Mean deviation uses the absolute values of deviations from a measure of central tendency (mean or median), while standard deviation uses the square root of the average of the squared deviations from the mean. Standard deviation is more commonly used because it is amenable to further algebraic treatment, whereas mean deviation, based on absolute values, is not.

Q2. Why do we take the absolute value or square the deviations while calculating mean deviation and variance?

Because the sum of deviations of observations from their mean is always zero (positive and negative deviations cancel out), simply averaging the deviations would always give zero. Taking absolute values (for mean deviation) or squaring the deviations (for variance) prevents this cancellation and gives a meaningful, non-zero measure of dispersion.

Q3. How is the median class located for finding mean deviation about the median in grouped data?

First, find $N = \Sigma f_i$ and compute N/2. Then find the cumulative frequency just greater than or equal to N/2; the class corresponding to this cumulative frequency is the median class. The median is then calculated using Median = $l + [(N/2 - C)/f] \times h$, where l is the lower limit, C is the cumulative frequency before the median class, f is the frequency of the median class, and h is the class width.

Q4. What happens to the mean, variance and standard deviation if every observation is multiplied by a constant or increased by a constant?

If every observation is multiplied by a constant a, the new mean becomes a times the old mean, and the new variance becomes a^2 times the old variance (so the new standard deviation is $|a|$ times the old standard deviation). If a constant is added to every observation, the mean increases by that constant, but the variance and standard deviation remain unchanged, since deviations from the mean are unaffected by a constant shift.