MathCity.org *Merging man and maths*	**Exercise 6.3 (Solutions)** **Mathematics (Science Group): 10th** Written by Amir Shahzad, Version: 1.0

1. **What do you understand by Dispersion?**
   Dispersion means the spread or scatter ness of observations in a data set. By dispersion means the extent to which observations in a sample or n a population are spread out. The main measure of dispersion are range, variance and standard deviation's.
2. **How do you define measure of dispersion?**
   The measure that are used to determine the degree or extent of variation in a data set are called measure of dispersion.
3. **Define Range, Standard deviation and Variance.**

Solution:

i. **Range:**
Range measure the extent of variation between two extreme observations of a data set.
It is given by the formula:

$$X_{max} - X_{min} = X_m - X_o$$

Where $X_{max} = X_m = \boldsymbol{the\ maximum, highest\ or\ largest\ observation}.$

$$X_{min} = X_o = \boldsymbol{the\ minimum\ lowest\ or\ smallest\ observation}.$$

The formula to find range for grouped continuous data us given below.

Range $= (\boldsymbol{Upper\ class\ boundary\ of\ last\ group}) - (\boldsymbol{Lower}$ **class boundary of first group).**

i. **Variance:**
Variance is defined as the mean of the squared deviation of $x_i(i = 1, 2, 3, \ldots, n)$ **observation from their arithmetic mean. In symbols,**

$$Variance\ of\ X = Var(X) = S^2 = \frac{\sum(X - \bar{X})^2}{n}$$

ii. **Standard Deviation**
Standard deviation is defined as the positive square root of mean of the squared deviations of
$X_i(i = 1, 2, 3, \ldots, n)$ **observations from their arithmetic mean. In symbols we write**

$$standard\ Devaition\ of\ X = S.D(X) = S = \sqrt{\frac{\sum(X - \bar{X})^2}{n}}$$

Computations of Variance and Standard Devotions
We uses the following to compute Variance and standard Deviations for Ungrouped and Grouped Data.
Ungrouped Data:
The formula of Variance is given by

$$Var(X) = S^2 = \frac{\sum X^2}{n} - \left(\frac{\sum X}{n}\right)^2$$

And standard Deviation

$$S.D(X) = S = \sqrt{\left[\frac{\sum X^2}{n} - \left(\frac{\sum X}{n}\right)^2\right]}$$

4. The salaries of five teachers in Rupees are as follows.
11500,12400,15000,14500,14800.
find Range and Standard devitions

Solution:

$$X = 11500, 12400, 15000, 14500, 14800.$$

Here $X_{min} = 11500$, $X_{max} = 15000$

$$Range = X_{max} - X_{min}$$
$$= 15000 - 11500$$
$$= 3500$$
$$\bar{X} = \frac{\sum x}{n}$$
$$= \frac{11500 + 12400 + 15000 + 14500 + 14800}{5}$$
$$= \frac{68200}{5} = 13640$$

X	$X - \bar{X}$	$(X - \bar{X})^2$
11500	-2140	4579600
12400	-1240	1537600
15000	1360	1849600
14500	860	739600
14800	1160	1345600

$$\sum (X - \bar{X})^2 = 10052000, \qquad n = 5$$

$$S.D(X) = S = \sqrt{\left[\frac{\sum X^2}{n} - \left(\frac{\sum X}{n}\right)^2\right]}$$
$$= \sqrt{\frac{10052000}{5}}$$
$$= \sqrt{2010400}$$
$$= 1417.88$$

5. (a) Find the standard deviation "S" of each set of numbers:
i. 12,6,7,3,15,10,18,5
ii. 9,3,8,8,9,8,9,18.
(b) Calculate variance for the data 10,8,9,7,5,12,8,6,8,2

Solution:
i.

X	$X - \bar{X}$	$(X - \bar{X})^2$
12	2.5	6.25

6	-3.5	12.25
7	-2.5	6.25
3	-6.5	42.25
15	5.5	30.25
10	0.5	0.25
18	8.5	72.25
5	-4.5	20.25

$$\sum X = 76 \qquad \sum (X-\bar{X})^2 = 190, n = 8$$

$$\bar{X} = \frac{76}{8} = 9.5$$

$$\boldsymbol{S.D(X) = S} = \sqrt{\left[\frac{\sum X^2}{\boldsymbol{n}} - \left(\frac{\sum X}{\boldsymbol{n}}\right)^2\right]}$$

$$= \sqrt{\frac{190}{8}}$$

$$= \sqrt{23.75}$$

$$= 4.87$$

ii.

X	$X-\bar{X}$	$(X-\bar{X})^2$
9	0	0
3	-6	36
8	-1	1
8	-1	1
9	0	0
8	-1	1
9	0	0
18	9	81

$$\sum X = 72 \qquad \sum (X-\bar{X})^2 = 120, n = 8$$

$$\bar{X} = \frac{\sum X}{n} = \frac{7o}{8} = 9$$

$$\boldsymbol{S.D(X) = S} = \sqrt{\left[\frac{\sum X^2}{\boldsymbol{n}} - \left(\frac{\sum X}{\boldsymbol{n}}\right)^2\right]}$$

$$= \sqrt{\frac{120}{8}}$$

$$= \sqrt{15} = 3.87$$

(b) Calculate variance for the data 10,8,9,7,5,12,8,6,8,2

Solution:

X	$X-\bar{X}$	$(X-\bar{X})^2$
10	2.5	6.25
8	0.5	25
9	1.5	2.25
7	-0.5	.25
5	-2.5	6.25
12	4.5	20.25
8	0.5	.25

6	-1.5	2.25
8	0.5	.25
2	-5.5	30.25

$$\sum X = 75 \qquad \sum (X-\bar{X})^2 = 68.5, n = 10$$

$$\bar{X} = \frac{\sum X}{n} = \frac{75}{10} = 7.5$$

$$\boldsymbol{Variance\ of\ X = Var(X) = S^2} = \frac{\sum(X-\bar{X})^2}{\boldsymbol{n}}$$

$$= \frac{68.5}{10} = 6.85$$

6. The length of 32 items are given below. Find the mean length and standard deviation of the distribution.

Length	$20-22$	$23-25$	$26-28$	$29-31$	$32-34$
frequency	3	6	12	9	2

Solution:

$C.I$	f	Mid points(x)	fx	$X-\bar{X}$	$(X-\bar{X})^2$	$f(X-\bar{X})^2$
$20-22$	3	21	63	-6	36	108
$23-25$	6	24	144	-3	9	54
$26-28$	12	27	324	0	0	0
$29-31$	9	30	270	3	9	81
$32-34$	2	33	66	6	36	72
total	32		$\sum fx = 867$		90	315

$$\bar{X} = \frac{\sum fx}{n} = \frac{867}{32} = 27.093 = 27 approx \qquad \bar{X} = \frac{\sum X}{n} = \frac{75}{10} = 7.5$$

$$\boldsymbol{S.D(X) = S} = \sqrt{\left[\frac{\sum X^2}{\boldsymbol{n}} - \left(\frac{\sum X}{\boldsymbol{n}}\right)^2\right]} = \sqrt{\frac{315}{\boldsymbol{32}}} = \sqrt{9.84375} = \boldsymbol{3.3137}$$

7. For the following distribution of marks calculator Range

	Frequency/No.
$33-40$	28
$41-50$	31
$51-60$	12
$61-70$	9
$71-75$	5

Solution:

$C.I$	Class Boundaries	f
$33-40$	$32.5-40.5$	28
$41-50$	$40.5-50.5$	32
$51-60$	$50.5-60.5$	12

$61-70$	$60.5-70.5$	9
$71-75$	$70.5-75.5$	5

Here

$$X_{max} = 75.5$$
$$X_{min} = 32.5$$
$$Range = X_{max} - X_{min}$$
$$= 75.5 - 32.5 = 43$$