# LINEAR TRANSFORMATION OF DATA

| OLD DATA $\boxed{x}$ | $\xrightarrow{+5}$ | NEW DATA $\boxed{x+5}$ |
|---|---|---|
| 3 | | 8 |
| 4 | | 9 |
| 4 | | 9 |
| 8 | | 13 |
| $\Sigma x = 19$ | $\xrightarrow[+4(5)]{+nd}$ | $\Sigma(x+5) = 39$ |

$$\text{Mean}(x) = \frac{\Sigma x}{n} = \frac{19}{4} = 4.75 \qquad \text{Mean}(x+5) = \frac{\Sigma(x+5)}{n} = \frac{39}{4} = 9.75$$

$\boxed{1}$ New Mean = Old mean $\pm$ d

$$\text{Mean}(x \pm d) = \text{Mean}(x) \pm d$$

$\boxed{2}$ New Sum = old Sum $\pm$ nd

$$\Sigma(x \pm d) = \Sigma(x) \pm nd$$

$\boxed{3}$ NEW SD = OLD SD

NEW VARIANCE = OLD VARIANCE

$$SD(x \pm d) = SD(x)$$

$$VAR(x \pm d) = VAR(x)$$

NOTE: WE CANNOT CONVERT $\Sigma x^2$ to $\Sigma(x \pm d)^2$ DIRECTLY. FOR THIS WE USE SD FORMULA TWICE AND EQUATE.

**19** The length of time, $t$ minutes, taken to do the crossword in a certain newspaper was observed on 12 occasions. The results are summarised below.

$$\Sigma(t - 35) = -15 \qquad \Sigma(t - 35)^2 = 82.23$$

Calculate the mean and standard deviation of these times taken to do the crossword $t$ [4]

$\boxed{n = 12}$

OLD NEW

$$\boxed{t} \xrightarrow{-35} \boxed{t - 35}$$

This is not possible directly to predict $\Sigma x^2$ $\longleftarrow$ $\Sigma(t-35)^2 = 82.23$

$$\boxed{\Sigma(t)} \xrightarrow[-12(35)]{-n\ d} \Sigma(t-35) = -15$$

$\Sigma(t) = -15 + 12(35)$

$\Sigma t = 405$

$$\text{Mean}(t) = \frac{405}{12} \xrightarrow{-35} \text{New Mean} : \frac{\Sigma(t-35)}{n}$$

$= 33.75.$

$= \frac{-15}{12}$

$+35$

$= -1.25$

new data = old data − 35

new mean = old mean − 35

$-1.25$ = old mean − 35

old mean = 33.75.

$$SD(t) = SD(t-35)$$

$$= \sqrt{\frac{\Sigma(t-35)^2}{n} - \left(\frac{\Sigma(t-35)}{n}\right)^2}$$

$$= \sqrt{\frac{82.23}{12} - \left(\frac{-15}{12}\right)^2}$$

$$SD(t) = 2.3180$$

**35** Esme noted the test marks, $x$, of 16 people in a class. She found that $\Sigma x = 824$ and that the standard deviation of $x$ was 6.5.

**(i)** Calculate $\Sigma(x - 50)$ and $\Sigma(x - 50)^2$. [3]

$\boxed{n=16}$

OLD NEW

$$\boxed{x} \xrightarrow{-50} \boxed{x-50}$$

OLD DATA $-50$ = NEW DATA

$$\Sigma x = 824 \xrightarrow[-(16)(50)]{-nd} \Sigma(x-50) = ??$$

$$\Sigma(x-50) = 24$$

$$SD(x) = SD(x-50)$$

$$6.5 = \sqrt{\frac{\Sigma(x-50)^2}{n} - \left(\frac{\Sigma(x-50)}{n}\right)^2}$$

$$6.5 = \sqrt{\frac{\Sigma(x-50)^2}{16} - \left(\frac{24}{16}\right)^2}$$

$$6.5 = x^2\sqrt{\phantom{x}}$$

$$6.5^2 = \frac{\Sigma(x-50)^2}{16} - \left(\frac{24}{16}\right)^2$$

$$\Sigma(x-50)^2 = 712$$

**40** A sample of 36 data values, $x$, gave $\Sigma(x - 45) = -148$ and $\Sigma(x - 45)^2 = 3089$.

**(i)** Find the mean and standard deviation of the 36 values. [3]

**(ii)** One extra data value of 29 was added to the sample. Find the standard deviation of all 37 values. [4]

**44** The values, $x$, in a particular set of data are summarised by

$$\Sigma(x - 25) = 133, \qquad \Sigma(x - 25)^2 = 3762.$$

The mean, $\bar{x}$, is 28.325.

**(i)** Find the standard deviation of $x$. [4]

**(ii)** Find $\Sigma x^2$. [2]