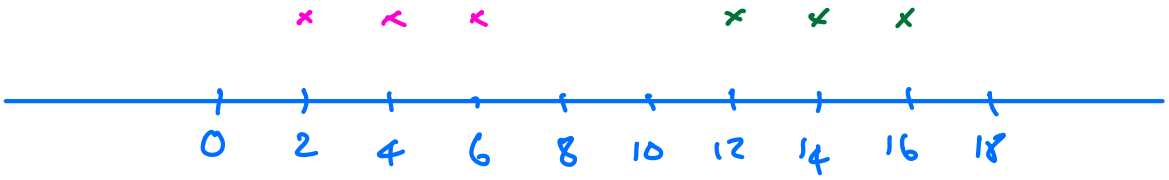
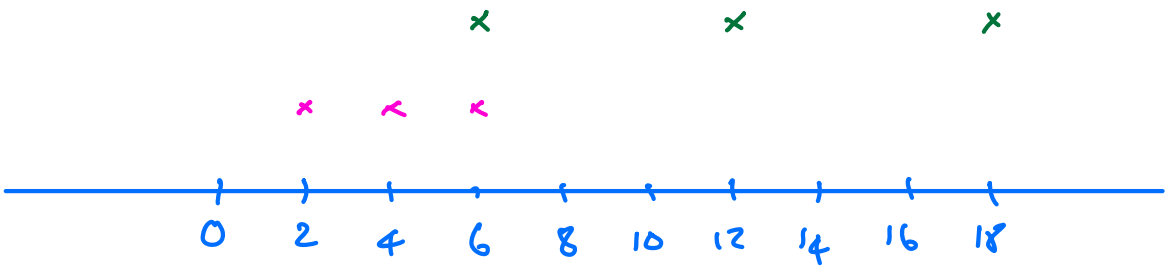
Coding



Data add 10 adds 10 to the mean

Data subtract 10 subtracts 10 from the mean

In both these cases the spread of the data is not affected. ∴ the standard deviation is unaffected



Multiply Data by 3 multiplies the mean by 3

Multiplying the data by 3 multiplies the gaps between the data by 3. This means the standard deviation is multiplied by 3.

Dividing the data by 2 would divide mean by 2

It also halves the gaps between data items which would divide the standard deviation by 2

In general if data is coded using the formula

$$y = \frac{x - a}{b}$$

The new mean $\bar{y} = \frac{\bar{x} - a}{b}$

The new standard deviation $\sigma_y = \frac{\sigma_x}{b}$

Examples

	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Max Temp x	20°C	25°C	21°C	30°C	32°C	14°C	16°C

$\bar{x} = 22.57$

$\sigma_x = 6.276$

Convert temperatures to Farenheit y

$$y = \frac{9x}{5} + 32$$

$$\bar{y} = \frac{9}{5}\bar{x} + 32 = \frac{9 \times 22.57}{5} + 32$$

$$= 72.6\,°F$$

$$\sigma_y = \frac{9}{5}\sigma_x = \frac{9}{5} \times 6.276 = 11.3\,°F$$

In a class of 30 students percentage attendance was as follows

Number of students	6	7	5	4	8
Attendance	84%	90%	92%	96%	100%

Find mean attendance $\bar{x}$ and σ_x

$$\bar{x} = 92.6\ \%$$

$$\sigma_x = 5.71\ \%$$

If y represents absence (%)

Find $\bar{y}$ and σ_y

Coding $\quad y = 100 - x$

$$\Rightarrow \quad \bar{y} = 100 - \bar{x}$$

$$= 100 - 92.6 = 7.4\ \%$$

$$\sigma_y = \sigma_x = 5.71\ \%$$

Ex 3 Find $\bar{x}$, σ_x

50,783, 50,964, 51,011, 50,666, 49820

$$\bar{x} = 50648.8 \qquad \sigma_x = 432.6$$

Alternatively Let $y = x - 50000$

Sample for y 783, 964, 1011, 666, −180

$\bar{y}$ 648.8

σ_y 432.6

$$\bar{y} = \bar{x} - 50000$$

$$\bar{y} + 50000 = \bar{x}$$

$$648.8 + 50000 = \bar{x}$$

$$50648.8 = \bar{x}$$

$$\sigma_y = \sigma_x$$

$$432.6 = \sigma_x$$

Ex 10 from textbook

x	332°C	355°C	306°C	317°C	340°C

Use coding $y = \dfrac{x - 300}{10}$

Without fancy calculator

y	3.2	5.5	0.6	1.7	4.0

$$\bar{y} = \frac{3.2 + 5.5 + 1.7 + 4.0}{5} \quad 2.88$$

$$\Sigma x^2 = 3.2^2 + 5.5^2 + 0.6^2 + 1.7^2 + 4^2 = 59.74$$

$$\sigma_y = \sqrt{\frac{59.74}{5} - 2.88^2} = 1.911$$

$$\bar{y} = \frac{\bar{x} - 300}{10}$$

$$10\bar{y} = \bar{x} - 300$$

$$10\bar{y} + 300 = \bar{x}$$

$$10 \times 2.88 + 300 = \bar{x}$$

$$328.8\,^{\circ}C = \bar{x}$$

$$\sigma_y = \frac{\sigma_x}{10}$$

$$10\sigma_y = \sigma_x$$

$$10 \times 1.911 = \sigma_x$$

$$19.11 = \sigma_x$$

Q6 income i for 100 women recorded

coded $y = \frac{i - 90}{100}$

$\Sigma y = 131$ $\Sigma y^2 = 176.84$

Estimate actual s.d. of income

$$\sigma_y = \sqrt{\frac{\Sigma y^2}{n} - \bar{y}^2}$$

$$\bar{y} = \frac{131}{100} = 1.31$$

$$= \sqrt{\frac{176.84}{100} - 1.31^2} = 0.2287$$

$$\sigma_y = \frac{\sigma_i}{100}$$

$$100\sigma_y = \sigma_i$$

$$\sigma_i = 22.87$$
