Linear Coding

SCAN ME

REVISE THIS TOPIC

1 The race times, x, to the nearest minute, of the first 10 finishers in the London marathon are shown.

124 124 127 127 128 129 130 130 131 131

The data is coded using the formula $y = \dfrac{x - 120}{4}$

(a) Work out the coded value for the runner who finished in 3rd place. **(1)**

One of the coded race times is 2.5 minutes.

(b) Work out the original race time for this coded value. **(1)**

$\bar{x} = 128.1$ $\sigma_x = 2.468$ (to 3 decimal places).

(c) Using these values, or otherwise, work out the mean ($\bar{y}$) and standard deviation (σ_y) of the coded values. **(2)**

(a) $\dfrac{127 - 120}{4} = 1.75$

(b) $\dfrac{x - 120}{4} = 2.5$

$x - 120 = 10$

$x = 130$

(c) $\bar{y} = \dfrac{\bar{x} - 120}{4}$

$= \dfrac{128.1 - 120}{4}$

$= 2.025$

$\sigma_y = \dfrac{\sigma_x}{4}$

$= \dfrac{2.468}{4}$

$= 0.617$

(Total for Question 1 is 4 marks)

2 The heights, h, to the nearest centimetre, of 10 students are summarised below.

$$\sum h = 1776 \qquad S_{hh} = 236.4$$

(a) Work out the mean ($\bar{h}$) and standard deviation (σ_h) **(3)**

The data is coded using the formula $c = h - 165$

(b) Work out the mean ($\bar{c}$) and standard deviation (σ_c) for the coded values. **(2)**

(a) $\bar{h} = \dfrac{1776}{10} = 177.6$ cm

$\sigma_h = \sqrt{\dfrac{236.4}{10}} = 4.862$ cm

(b) $\bar{c} = \bar{h} - 165$

$= 12.6$

$\sigma_c = \sigma_h$

$\sigma_h = 4.862$

(Total for Question 2 is 5 marks)

3 The masses, x, to the nearest kg, of 8 cows are summarised below.

$$\sum x = 4120 \qquad \sum x^2 = 2\,121\,856$$

(a) Work out the mean ($\bar{x}$) and standard deviation (σ_x) **(3)**

The data is coded using the formula $y = \dfrac{x}{5} - 100$

(b) Work out the mean ($\bar{y}$) and standard deviation (σ_y) for the coded values. **(2)**

(a) $\bar{x} = \dfrac{4120}{8} = 515$ kg

$\sigma_x = \sqrt{\dfrac{2\,121\,856}{8} - 515^2}$

$= 2.65$ kg

(b) $\bar{y} = \dfrac{\bar{x}}{5} - 100$

$= \dfrac{515}{5} - 100$

$= 3$

$\sigma_y = \dfrac{\sigma_x}{5}$

$= \dfrac{2.65\ldots}{5}$

$= 0.529$

(Total for Question 2 is 5 marks)

4 The daily temperatures, x, to the nearest °C, are recorded for 30 days in Antarctica

The data is coded using the formula $y = x + 50$

$\sum y = 210 \qquad \sum (y - \bar{y})^2 = 172$

(a) Work out the mean daily temperature for the 30 days. **(2)**

(b) Work out standard deviation of the daily temperatures for the 30 days. **(3)**

(a) $\bar{y} = \frac{210}{30} = 7$

$\bar{y} = \bar{x} + 50$

$7 = \bar{x} + 50$

$\bar{x} = -43$°C

(b) $\sigma_y = \sqrt{\frac{172}{30}} = 2.394$

$\sigma_x = \sigma_y$

$\sigma_x = 2.394$ °C

(Total for Question 4 is 5 marks)

5 Jim cycles at least 100 km each day for 20 consecutive days.
Jim records his daily distance cycled, x, to the nearest km for each of the 20 days.

Jim wants to convert the data from kilometres to miles.

He codes the data using the formula $m = \frac{x}{1.6}$, where the units of m are miles.

$\sum m = 1300 \qquad \sum m^2 = 84\,550$

(a) Work out the mean daily distance cycled, in **km**, for the 20 days. **(2)**

(b) Work out standard deviation of the daily distance cycled, in **km**, for the 20 days. **(3)**

(a) $\bar{m} = \frac{1300}{20} = 65$

$\bar{m} = \frac{\bar{x}}{1.6}$

$65 = \frac{\bar{x}}{1.6}$

$\bar{x} = 104$ km

(b) $\sigma_m = \sqrt{\frac{84\,550}{20} - 65^2}$

$\sigma_m = 1.58\ldots$

$\sigma_m = \frac{\sigma_x}{1.6}$

$1.58\ldots = \frac{\sigma_x}{1.6}$

$\sigma_x = 1.58\ldots \times 1.6$

$\sigma_x = 2.53$ km

(Total for Question 5 is 5 marks)

6 The weekly wages, w, to the nearest pound, are recorded for 6 employees at a company.

The data is coded using the formula $x = \dfrac{w - 800}{5}$

$\sum x = 66$ $\sum x^2 = 4356$

(a) Work out the mean weekly wage, in pounds, of the 6 employees. **(2)**

(b) Work out, to the nearest pound, the standard deviation of the weekly wages of the 6 employees. **(3)**

(a) $\bar{x} = \dfrac{66}{6} = 11$

$\bar{x} = \dfrac{\bar{w} - 800}{5}$

$11 = \dfrac{\bar{w} - 800}{5}$

$55 = \bar{w} - 800$

$\bar{w} = £855$

(b) $\sigma_x = \sqrt{\dfrac{4356}{6} - 11^2}$

$\sigma_x = 24.5967\ldots$

$\sigma_x = \dfrac{\sigma_w}{5}$

$24.5967\ldots = \dfrac{\sigma_w}{5}$

$\sigma_w = 24.5967\ldots \times 5$

$\sigma_w = £123$

(Total for Question 6 is 5 marks)

7 The masses, m, of ten 1p coins are recorded in grams.

The data is coded using the formula $x = 1000m - 3500$

$x = 640$ $S_{xx} = 17\,284$

(a) Work out the mean mass, in grams, of the ten 1p coins. **(2)**

(b) Work out the standard deviation, in grams, of the masses of the ten 1p coins **(3)**

(a) $\bar{x} = \dfrac{640}{10} = 64$

$\bar{x} = 1000\bar{m} - 3500$

$64 = 1000\bar{m} - 3500$

$3564 = 1000\bar{m}$

$\bar{m} = 3.564$ g

(b) $\sigma_x = \sqrt{\dfrac{17284}{10}} = 41.574\ldots$

$\sigma_x = 1000\sigma_m$

$41.574\ldots = 1000\sigma_m$

$\sigma_m = 0.041574$ g

(Total for Question 6 is 5 marks)