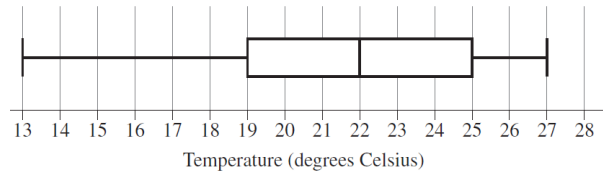




**20 MA** **27** A cricket is an insect. The male cricket produces a chirping sound. **5**

A scientist wants to explore the relationship between the temperature in degrees Celsius and the number of cricket chirps heard in a 15-second time interval. Once a day for 20 days, the scientist collects data. Based on the 20 data points, the scientist provides the information below.

- A box-plot of the temperature data is shown.
- The mean temperature in the dataset is  $0.525^{\circ}\text{C}$  below the median temperature in the dataset.
- A total of 684 chirps was counted when collecting the 20 data points.



The scientist fits a least-squares regression line using the data  $(x, y)$ , where  $x$  is the temperature in degrees Celsius and  $y$  is the number of chirps heard in a 15-second time interval. The equation of this line is  $y = -10.6063 + bx$ , where  $b$  is the slope of the regression line.

The least-squares regression line passes through the point  $(\bar{x}, \bar{y})$  where  $\bar{x}$  is the

sample mean of the temperature data and  $\bar{y}$  is the sample mean of the chirp data.

Calculate the number of chirps expected in a 15-second interval when the temperature is  $19^{\circ}$  Celsius. Give your answer to the nearest whole number.

From the box plot, median = 22. ✓

$$\begin{aligned} \text{Temperature sample mean } (\bar{x}) &= 22 - 0.525 \\ &= 21.475 \end{aligned}$$

$$\begin{aligned} \text{Chirp data sample mean } (\bar{y}) &= \frac{684}{20} \\ &= 34.2 \quad \checkmark \end{aligned}$$

$$\bar{y} = -10.6063 + b\bar{x}$$

$$34.2 = -10.6063 + b(21.475)$$

$$21.475b = 44.8063$$

$$b = 2.086440047\dots$$

$$= 2.0864 \text{ (4 dec pl)} \quad \checkmark$$

$$\therefore y = -10.6063 + 2.0864x \quad \checkmark$$

Substitute  $x = 19$ :

$$y = -10.6063 + 2.0864(19)$$

$$= 29.0353$$

$$= 29 \text{ (nearest whole)} \quad \therefore 29 \text{ chirps. } \checkmark$$

State Mean:  
**2.3/5**

### HSC Marking Feedback

#### Students should:

- read longer questions more than once, highlighting or selecting important information from the question
- not be distracted by words and phrases irrelevant to the solution of the question
- show all working in a clear and organised manner
- break down the key parts to the question.

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**In better responses, students were able to:**

- find the value of  $\bar{x}$  and  $\bar{y}$
- substitute the values of  $\bar{x}$  and  $\bar{y}$  into the formula provided on the exam booklet
- solve the equation after substitution to calculate the value of  $b$
- use  $x = 19$  to calculate the number of chirps and obtain the solution: chirps = 29
- round once only, at the very end of the question
- recognise that this question did not require gradient of rise over run to be calculated, nor did it require any integration.

**Areas for students to improve include:**

- understanding the difference between the median and mean
- practising longer, worded, un-scaffolded problems
- showing their working clearly
- finding parts of solutions to complete if finding a problem difficult
- practising solving equations and substituting correctly
- understanding the need to only round off once only at the end of a question.

\* These solutions have been provided by [projectmaths](http://projectmaths.com.au) and are not supplied or endorsed by NESA.