Statistics and regression - Applications test

Name: _____ Date: _____

10 questions | 58 marks | 75 minutes

Evaluate competing interpretations and models using supplied evidence and transparent calculations.

Use a graphics calculator or appropriate digital tool for labelled tasks.

1. A monitoring study records time since maintenance x and a vibration measure y. [7 marks]

Paired measurements

Days	Vibration units
2	7
4	8
6	12
8	12
10	16

(a) Fit y on x and state the observed predictor range. [4 marks]

(b) Predict at day 7 and interpret the result as an estimate. [3 marks]

2. Use the monitoring data from Question 1. [6 marks]

(a) Calculate r and r^2. [3 marks]

(b) A technician claims time causes exactly $r^2 \times 100$ percent of all vibration. Correct the claim. [3 marks]

3. The monitoring model is used on day 40. [5 marks]

(a) Find the model prediction. [2 marks]

(b) Explain why this value should not be accepted without further evidence. [3 marks]

4. A measurement at day 8 was originally recorded as 120 but the signed instrument log shows 12. [5 marks]

(a) What is the justified treatment? [2 marks]

(b) How would the response differ if 120 were confirmed as genuine? [3 marks]

5. A proposed line has residuals $(2, -1, -2, -1, 2)$, while a curved model has $(0.5, -0.5, 0, 0.5, -0.5)$. [6 marks]

(a) Calculate both sums of squared residuals. [3 marks]

(b) Give a numerical and a graphical reason to investigate the curve. [3 marks]

6. A decaying response is modelled by $y = 240e^{-0.18t}$, $t \geq 0$. [6 marks]

(a) Find its one-unit multiplier and percentage decrease. [3 marks]

(b) Find when the model first reaches 120. [3 marks]

7. An analyst has two fitted equations: y-on-x is $\hat{y} = 4 + 2x$, while x-on-y is $\hat{x} = -1 + 0.4y$. [7 marks]

(a) Use the appropriate model to predict y when $x = 5$. [2 marks]

(b) Use the appropriate model to predict x when $y = 14$. [2 marks]

(c) Explain why the two predictions do not reverse exactly. [3 marks]

8. A normal measurement X has mean 30 and SD 2.5. Accepted measurements must lie between 26 and 34. [6 marks]

(a) Calculate the acceptance probability. [3 marks]

(b) Among 600 measurements, find the expected rejected count. [3 marks]

9. A normal model has mean 120 and SD 10. A threshold is to exceed 97.5% of outcomes. [5 marks]

(a) Find the threshold. [3 marks]

(b) A report instead uses lower-tail area 0.025. Explain the effect. [2 marks]

10. A report presents a regression line and a normal model but omits the sample source, variable units and data range. [5 marks]

(a) Explain two ways this prevents a useful judgement. [3 marks]

(b) State what should be checked before accepting the normal model. [2 marks]