

AP Statistics - Inference for the Slope of a Regression Line - Answer Key

Common Core AP STAT 9.1, AP STAT 9.2, AP STAT 9.3, AP STAT 9.4, AP STAT 9.5, AP STAT 9.6, HSS-ID.B.6 · maths-pdf.fr/en/

Each solution lists the conditions, the degrees of freedom $n - 2$, the interval or t statistic, and a conclusion in context. Values come directly from the computer output printed in the problem.

AP Statistics · Common Core State Standards: **AP STAT 9.1, AP STAT 9.2, AP STAT 9.3, AP STAT 9.4, AP STAT 9.5, AP STAT 9.6, HSS-ID.B.6**

Exercise 1 - Parameters

β is the true slope of the population regression line of free throws made on weekly practice hours: the change in the mean number made per additional hour.

$H_0: \beta = 0$ and $H_a: \beta \neq 0$.

Exercise 2 - LINER conditions

Linear, Independent, Normal, Equal variance, Random.

Equal variance is checked on the residual plot: the vertical spread of residuals should be about the same for all x (no fan shape).

Exercise 3 - Residual plot

The residuals scatter randomly around 0 with no curve and no change in spread.

Yes: no pattern supports Linear, and the roughly constant spread supports Equal variance.

Exercise 4 - Read the output

Constant 1.003, slope 1.133, SE of the slope 0.104.

$\hat{y} = 1.003 + 1.133x$; **SE_b = 0.104.**

Exercise 5 - Interpret the slope

The slope is a predicted change per unit of x .

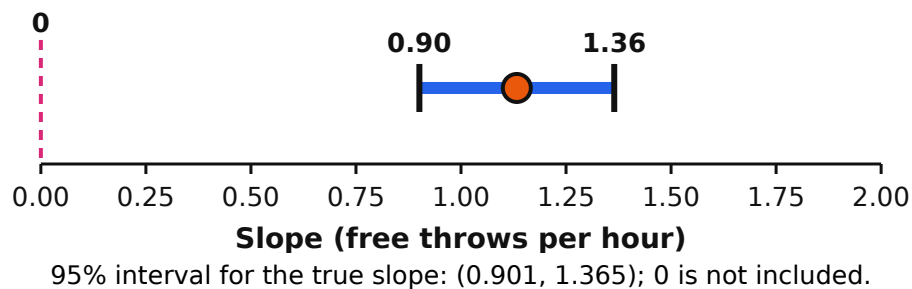
For each additional hour of weekly practice, the predicted number of free throws made increases by about 1.13.

Exercise 6 - Degrees of freedom and t^*

$$df = n - 2 = 10.$$

$$df = 10; t^* = 2.228.$$

Exercise 7 - Confidence interval



$$b \pm t^* SE_b = 1.133 \pm 2.228(0.104).$$

$$(0.901, 1.365).$$

Exercise 8 - Interpret the interval

State the parameter and the units.

We are 95% confident that the true slope is between 0.901 and 1.365: for each additional hour of weekly practice, the mean number of free throws made increases by between 0.90 and 1.36.

Exercise 9 - t statistic

$$t = \frac{1.133}{0.104} = 10.89 \text{ with } df = 10.$$

$$t = 10.89.$$

Exercise 10 - Conclusion

$$0.0000 < 0.05.$$

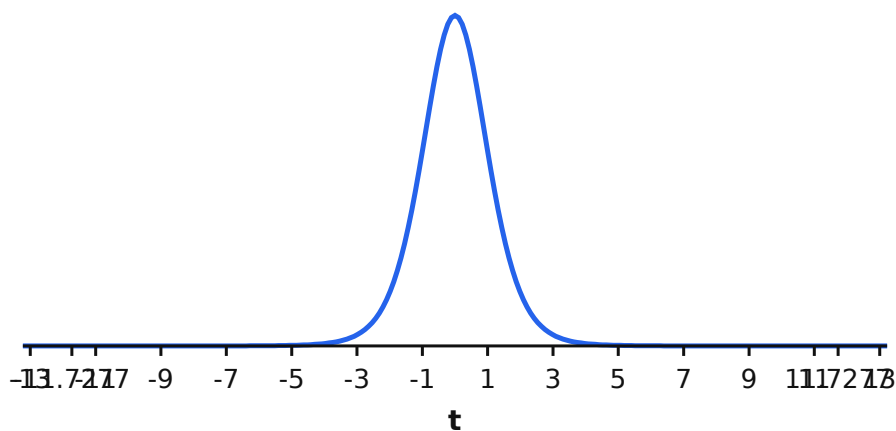
Reject H_0 . There is convincing evidence of a linear relationship between weekly practice hours and free throws made.

Exercise 11 - Interval and test

0 is inside the interval.

Fail to reject H_0 : not convincing evidence of a linear relationship.

Exercise 12 - Temperature and sales

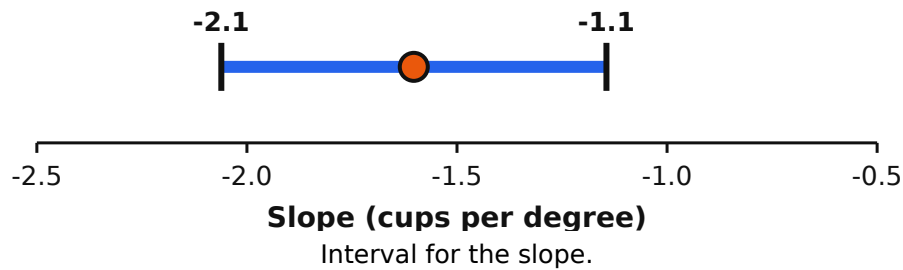


Two-sided p-value for the slope.

$$\hat{y} = 59.45 - 1.60x. \quad t = -11.73, \quad df = 8, \quad \text{p-value} = 0.0000.$$

Reject H_0 : convincing evidence of a negative linear relationship between temperature and hot cocoa sales.

Exercise 13 - Interval from output



$$df = 8, t^* = 3.355, ME = 0.459.$$

(-2.061, -1.144) cups per degree.

Exercise 14 - R squared and r

The slope is negative, so $r = -\sqrt{0.945} = -0.972$.

$r = -0.972$; about 94.5% of the variation in cocoa sales is explained by the linear relationship with temperature.

Exercise 15 - One-sided test

$$t = \frac{0.62}{0.30} = 2.07 \text{ is positive, in the direction of } H_a.$$

$$\text{One-sided p-value} = 0.059/2 = 0.0295.$$

$0.0295 < 0.05$: reject H_0 . There is convincing evidence that the true slope is positive (more rainfall goes with more mud).

Exercise 16 - Residual plot warning

The U shape means the relationship is curved.

No: the Linear condition fails, so the t procedure is not appropriate until the data are transformed.

Exercise 17 - Choose a procedure

(a) t interval for the slope. (b) Two-proportion z test. (c) Chi-square goodness-of-fit.

(a) slope t interval; (b) two-proportion z test; (c) goodness-of-fit.

Exercise 18 - Standard error of the slope

$$SE_b = \frac{s}{s_x \sqrt{n-1}} = \frac{24}{3\sqrt{19}} = 0.1835.$$

0.1835.

Exercise 19 - Multi-step

$$t = \frac{-1.35}{0.21} = -6.43, df = 16, \text{ p-value } p < 0.0001.$$

$$t^* = 2.120, ME = 0.445.$$

Reject H_0 ; 95% interval (-1.795, -0.905): each extra year of age lowers the mean price by between about 0.90 and 1.79 thousand dollars.

Exercise 20 - Predict and caution

$$\hat{y} = 1.00 + 1.133(8) = 10.07.$$

About 10.1 free throws. $x = 40$ is far outside the data (extrapolation), so the line cannot be trusted.