

AP STATISTICS — UNIT 9 QUICK NOTES

Model: $Y = \alpha + \beta x + \varepsilon$, $\varepsilon \sim N(0, \sigma)$

Sample fit: $\hat{y} = a + bx$, $b = r \frac{s_y}{s_x}$, $a = \bar{y} - b\bar{x}$

Residual SD: $s = \sqrt{\frac{\sum (y_i - \hat{y}_i)^2}{n - 2}}$, $SE_b = \frac{s}{\sqrt{\sum (x_i - \bar{x})^2}}$, $df = n - 2$

Conditions (LINER):

1. **L — Linearity:** Scatterplot/residual plot show no curvature.
 2. **I — Independence:** Observations independent; if sampling w/o replacement, $n \leq 0.1N$.
 3. **N — Normality:** Residuals roughly normal (histogram/NPP).
 4. **E — Equal variance:** Residual spread constant across x .
 5. **R — Randomness:** Data from random sample or random assignment.
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SPDC Framework for Regression Inference:

State Identify the population slope β and state hypotheses or confidence level in context. Clearly define variables.

Plan Name the procedure (t -test or t -interval for slope) and check LINER conditions.

Do Perform the calculations — find b , SE_b , test statistic $t = \frac{b - \beta_0}{SE_b}$, and p -value; or compute $b \pm t^* SE_b$ for a CI.

Conclude Interpret the results in context, linking back to the slope and the original research question.

Confidence Interval for β :

$$CI: b \pm t_{n-2}^* \cdot SE_b$$

Interpretation: “We are $C\%$ confident that the slope for the population is between . . .”

Hypothesis Test for β :

$$H_0 : \beta = 0 \quad H_a : \beta > 0, \beta < 0, \text{ or } \beta \neq 0$$

$$t = \frac{b - 0}{SE_b}, \quad p = 2 \cdot P(t_{n-2} > |t|)$$

Interpretation: Probability of getting a slope as extreme as b if H_0 were true.

TI-84 Instructions:

1. Enter x in L1, y in L2.
 2. Turn on diagnostics: `2nd` \rightarrow `0 (CATALOG)` \rightarrow `DiagnosticOn`.
 3. Run `LinRegTTest`: `STAT` \rightarrow `TESTS` \rightarrow `F:LinRegTTest`.
 4. Select L_1 , L_2 , alternative hypothesis ($\neq, >, <$), and `Calculate`.
 5. Output: a (intercept), b (slope), s , SE_b , t , p , r , r^2 .
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Quick Tips:

- Always check LINER before t -procedures.
 - CI excluding 0 \implies reject H_0 at matching α .
 - Include context, variables, & units in interpretations.
 - R^2 : percent of variation in y explained by x .
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Future Topics: Multiple Linear Regression, Logistic Regression, GLMs, Machine Learning.