A series of measurements has been taken in order to determine what, if any, relationship exists between the thickness in  $\mu$ m of a conformal coating applied to the body of a resistor (x) and the measured stray capacitance in pF (y).

Test #	Coating thickness, µm (x)	Stray capacitance, pF (y)
_ 1	100	0.054
2	125	0.068
3	150	0.078
4	175	0.092
5	200	0.110
6	225	0.124
7	250	0.138

Determine least-squares estimates for slope  $(\beta_1)$  and intercept  $(\beta_0)$  of the simple linear regression model for stray capacitance vs. coating thickness.

$$\hat{\beta}_{1} = \frac{\sum y_{i} x_{i} - \frac{(\sum y_{i})(\sum x_{i})}{n}}{\sum x_{i}^{2} - \frac{(\sum x_{i})^{2}}{n}} = \frac{S_{XY}}{S_{XX}}$$

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x}$$

$$S_{XX} = 231875 - \frac{1225^2}{7} = 17500$$

$$\overline{X} = \frac{1225}{7} = 175$$
 $\overline{Y} = \frac{2464}{7} = 0.094857$ 

Write the equation for the estimated regression line  $(\hat{y})$  with your actual numbers for  $\hat{\beta}_0$  and  $\hat{\beta}_1$ .

Write a 95% confidence interval on the mean stray capacitance at  $x = 180 \mu m$ .

$$V = -4.14 \times 10^{-3} + 5.657 \times 10^{-4} - 180$$

$$= 0.097686 (PF)$$

$$= 0.008608 - 7 \cdot 0.094867^{2}$$

$$= 0.005623 (H)$$

$$SSF = 0.005623 - 5.657 \times 10^{-4}.9.9$$

$$SS_{E} = 0.005623 - 5.657 \times 10^{-1}.9.9$$

$$= 2.262 \times 10^{-5} \quad \textcircled{A}$$

$$\theta^{2} = \frac{SSE}{N-2} = 4.523 \times 10^{-6}$$

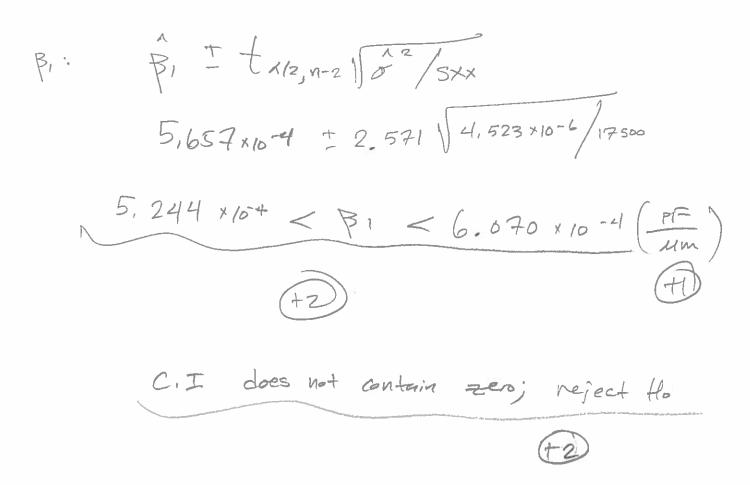
$$M_{1/180}$$
: 0,097686 ± 2,571  $\sqrt{4,523\times10^{-6}\left[\frac{1}{7}+\left(\frac{180-175}{17500}\right)^{2}\right]}$ 

$$0.09561 < UY|_{180} < 0.09976$$
 (AF)

Write a 95% confidence interval on the value of slope and use it to test the following hypotheses that the slope is zero. Include a unit with the C.I.

$$H_0: \hat{\beta}_1 = 0$$

$$H_1: \hat{\beta}_1 \neq 0$$



List two theoretical scenarios that would fail to reject  $H_0$ . What does *your* conclusion, above, imply about the relationship between coating thickness and stray capacitance?

there is a significant linear relationship between coating thickness and stray apacitance

Write a 95% confidence interval on the correlation coefficient  $\rho$ , if y and x may both be considered random variables. (Ignore the fact that n  $\gg$  30.)

$$R^{2} = 1 - \frac{SSE}{SST}$$

$$= 1 - \frac{2.262 \times 60^{-5}}{0.005623}$$





