



RICE  
JONES GRADUATE  
SCHOOL OF BUSINESS

## Linear Regression for Business Statistics



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A small red arrow pointing upwards towards the term  $\beta_2 \text{AdExp}$  in the regression equation.



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$$Sales = \beta_0 + \beta_1 Price + \beta_2 AdExp + \beta_3 PromExp$$
A red arrow pointing upwards towards the coefficient  $\beta_3$  in the regression equation.



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$$\text{Sales} = \beta_0 + \beta_1 \text{Price} + \beta_2 \text{AdExp} + \beta_3 \text{PromExp}$$

$$\text{Sales} = -25096.83 - 5055.27 \text{Price} + 648.61 \text{AdExp} + 1802.61 \text{PromExp}$$



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For every 1000 dollars increase in advertising expenditure, the unit sales increase by 500 units.

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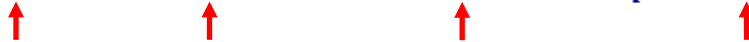
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Estimates based on **Sample data**

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True beta values, *fixed* but *unknown*

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Estimates based on *Sample data*

Hypothesis test needed to test whether  $\beta_2$  is equal to 500



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## Step 1 : Formulate Hypothesis

Null Hypothesis  $H_0: \beta_2 = 500$

Alternate Hypothesis  $H_A: \beta_2 \neq 500$

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Two tailed test

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Two tailed test

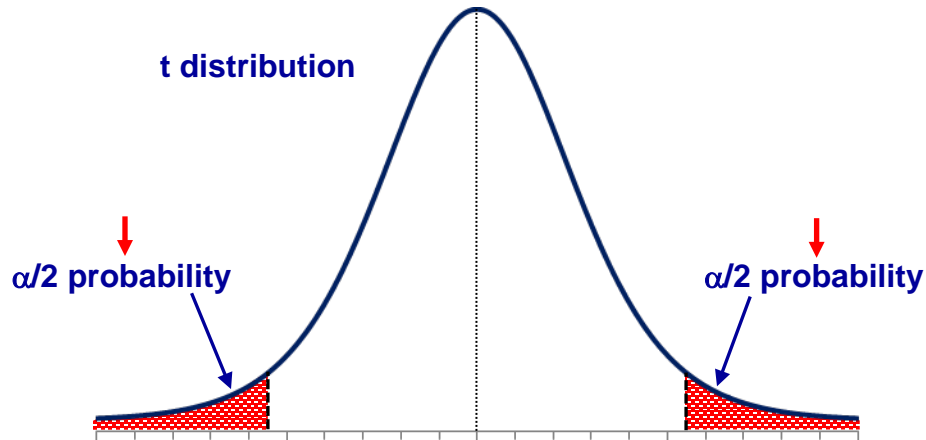
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## Step 2 : Calculate the t-statistic

$$\text{t-statistic} = \frac{b_2 - \beta_2}{s_{b_2}}$$

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$$\text{t-statistic} = \frac{648.61 \rightarrow b_2 - \beta_2}{s_{b_2}}$$



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$$\text{t-statistic} = \frac{b_2 - \beta_2}{s_{b_2}}$$

Diagram illustrating the calculation of the t-statistic:

- The value 648.61 is indicated by a grey arrow pointing to the coefficient  $b_2$  in the numerator.
- The value 500 is indicated by a red arrow pointing to the hypothesized parameter  $\beta_2$  in the numerator.

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$$\text{t-statistic} = \frac{b_2 - \beta_2}{s_{b_2}}$$

Diagram illustrating the calculation of the t-statistic:

- The numerator is  $b_2 - \beta_2$ .
- The value 648.61 is associated with  $b_2$  (indicated by a grey arrow).
- The value 500 is associated with  $\beta_2$  (indicated by a grey arrow).
- The denominator is  $s_{b_2}$ .
- A red arrow points up to  $s_{b_2}$ .

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## Step 2 : Calculate the t-statistic

$$\text{t-statistic} = \frac{b_2 - \beta_2}{s_{b_2}}$$

$\xleftarrow{648.61}$        $\xleftarrow{500}$   
 $b_2 - \beta_2$   
 $\uparrow$   
 $s_{b_2}$

	Coefficients	Standard Error
Intercept	-25096.83	24859.61131
Price (\$)	-5055.27	526.3995537
Adexp ('000\$)	648.61214	209.0048787
Promexp ('000\$)	1802.611	392.8485427

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$$\text{t-statistic} = \frac{b_2 - \beta_2}{s_{b_2}} = 0.711$$

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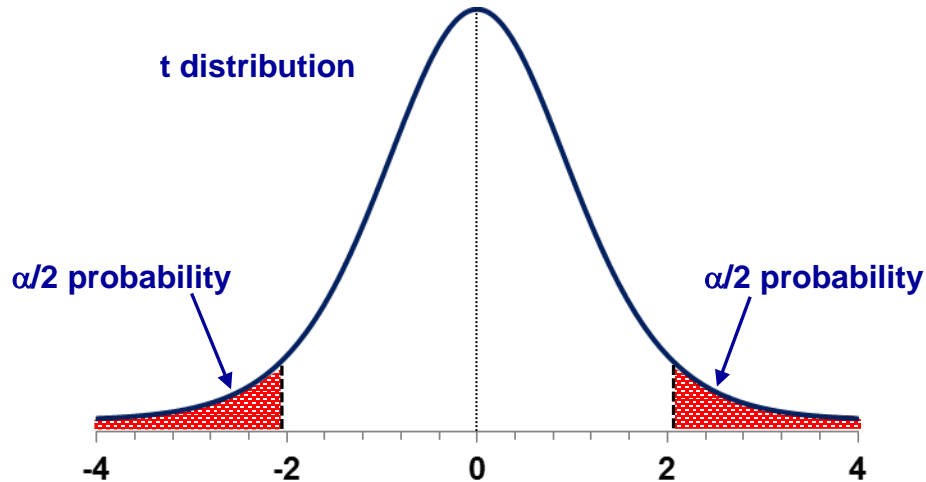
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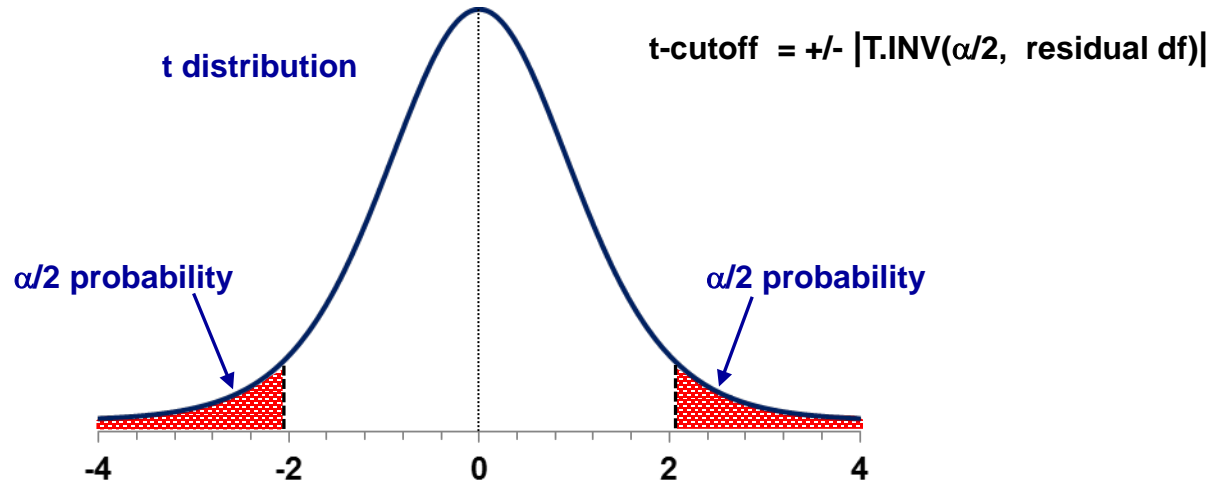


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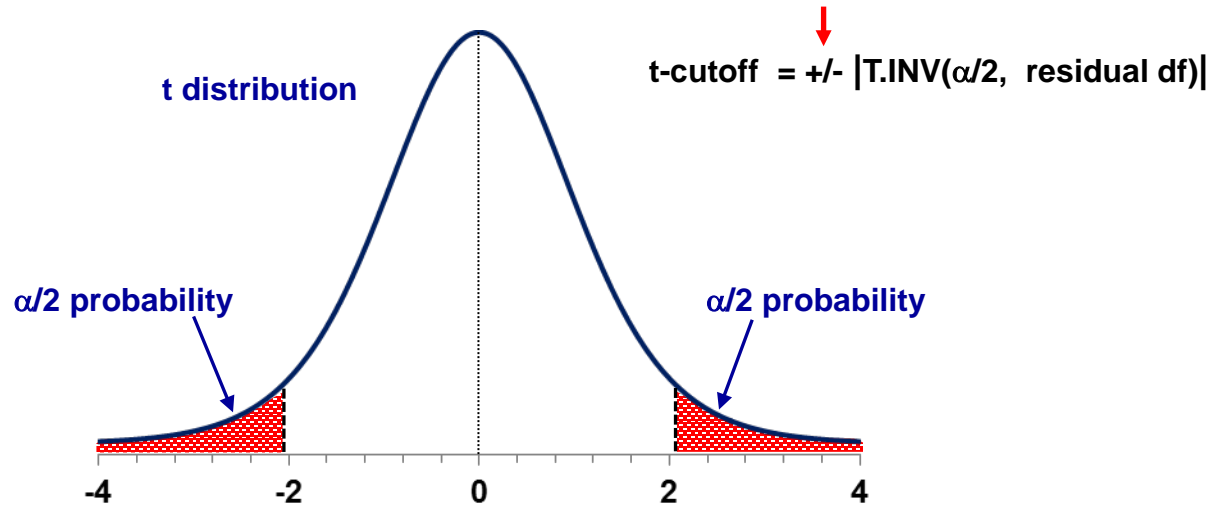


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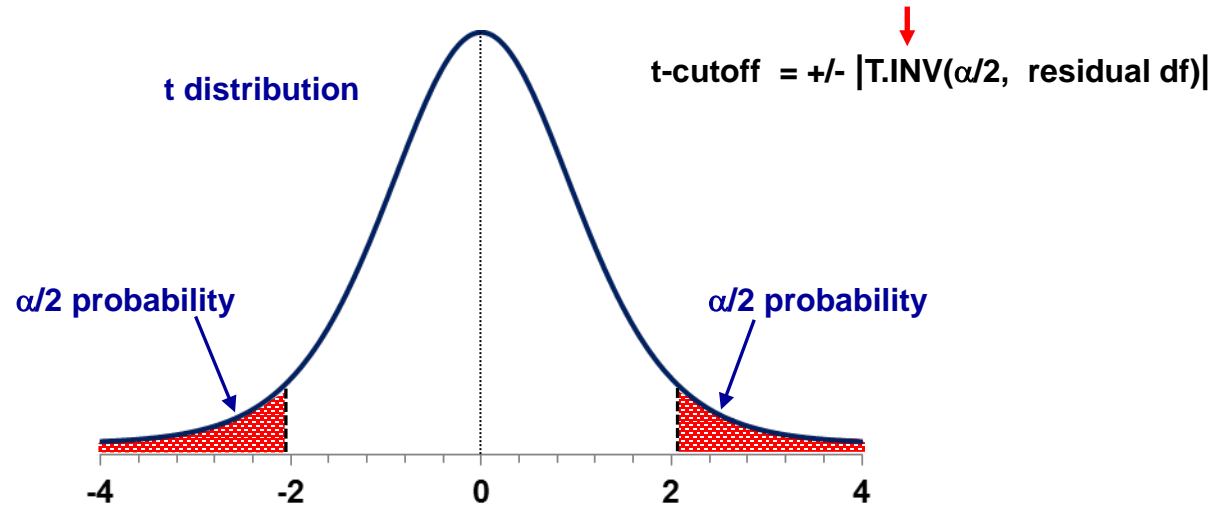


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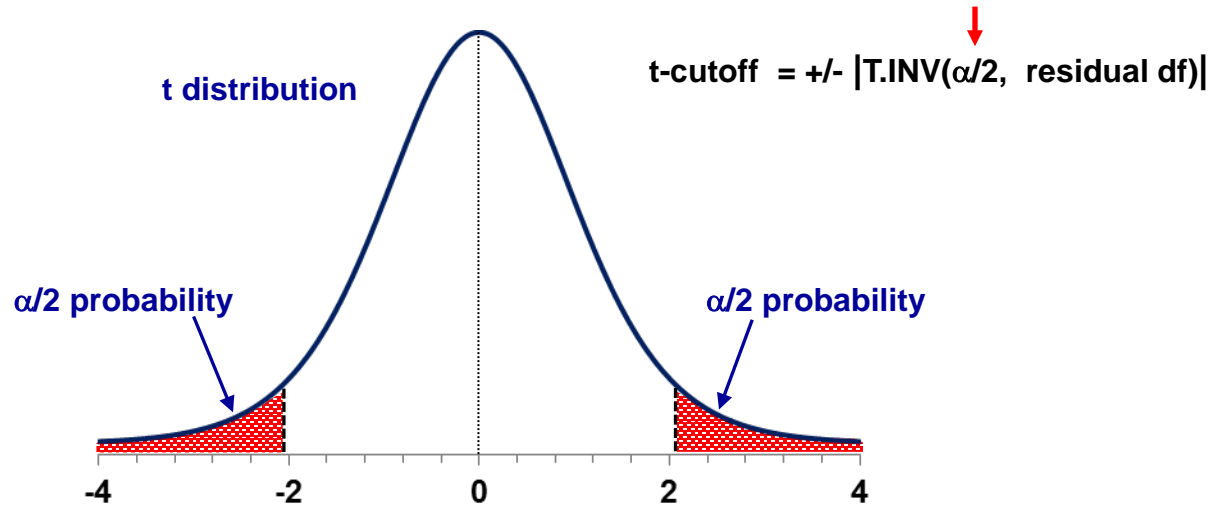


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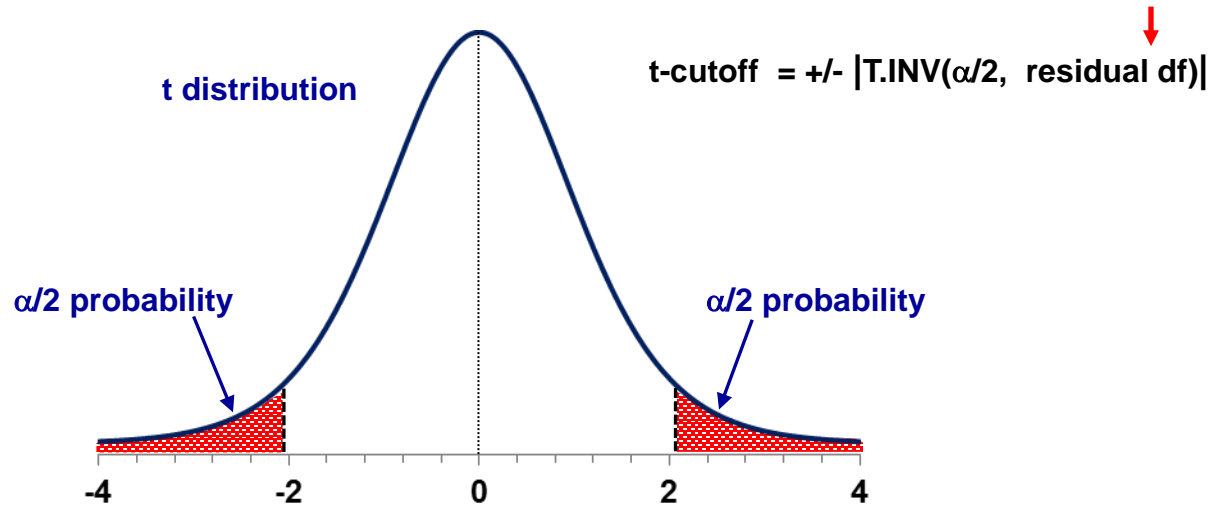


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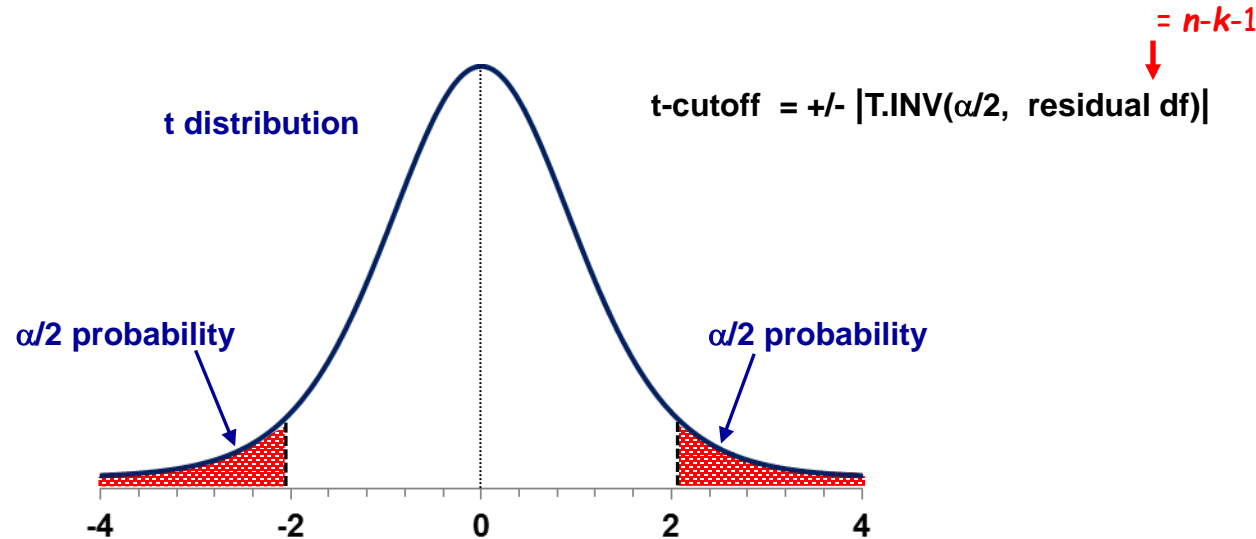


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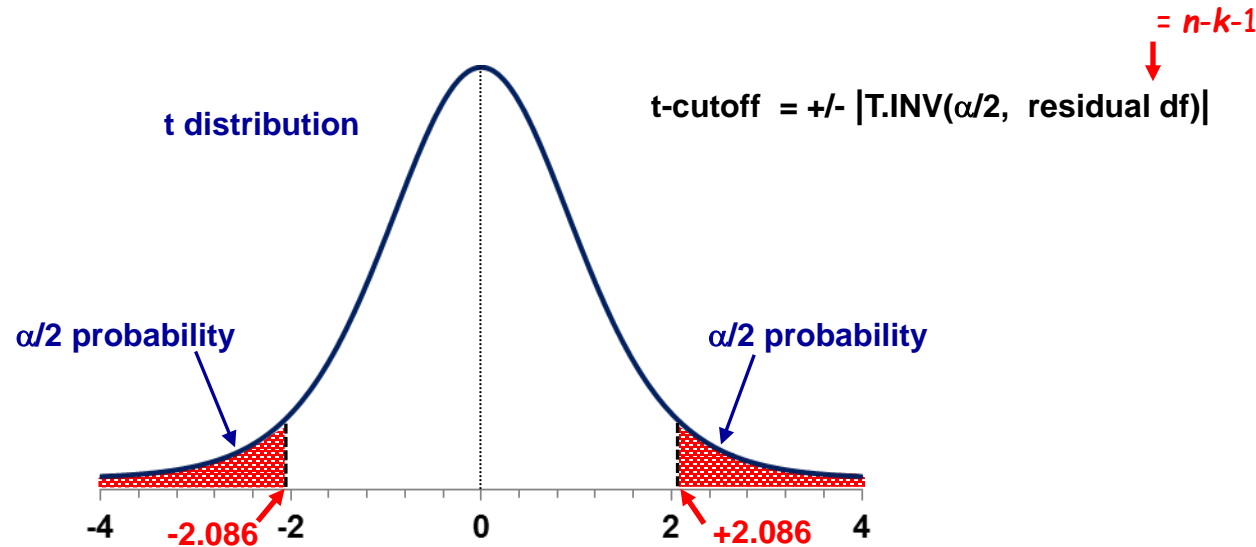


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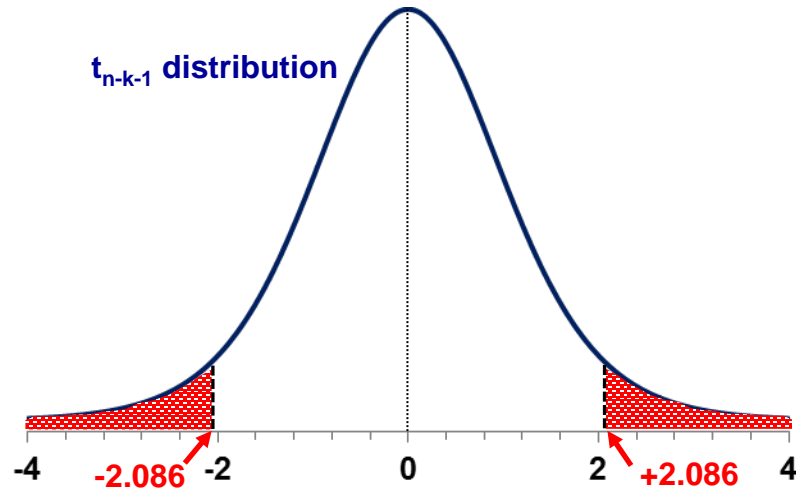
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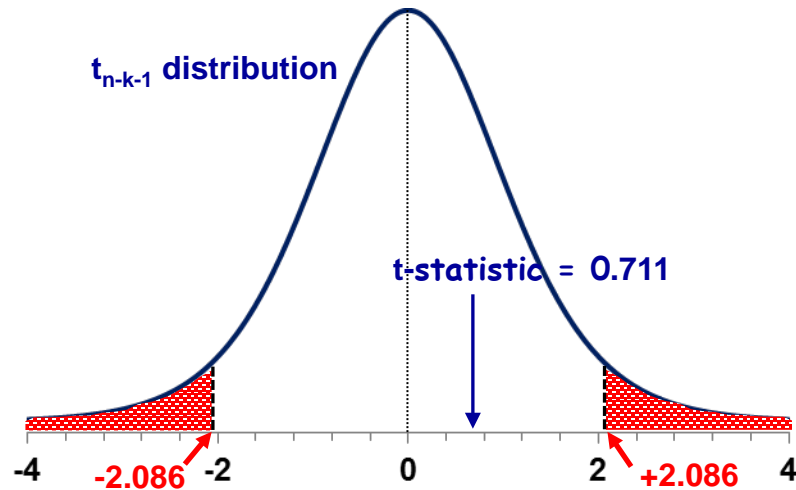
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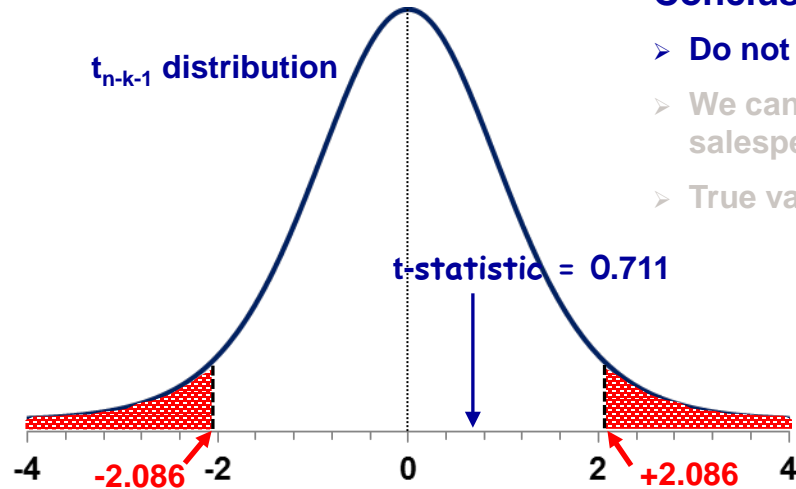
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- Do not reject the Null hypothesis
- We cannot reject the belief held by salespeople
- True value of  $\beta_2$  could be 500



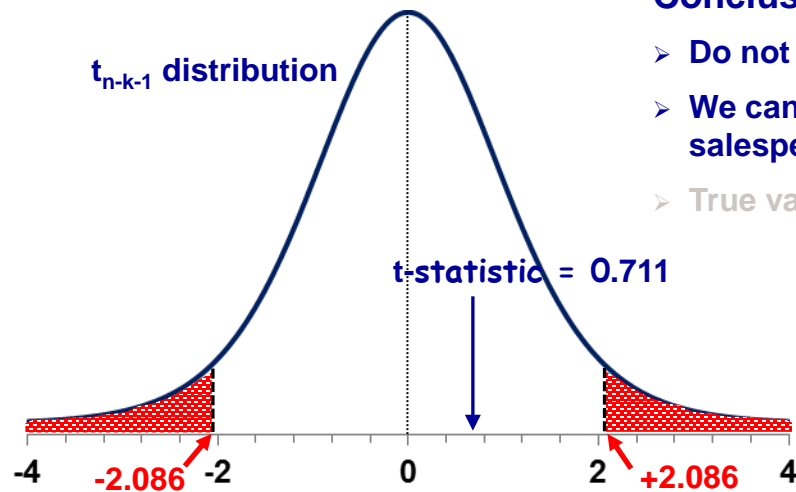
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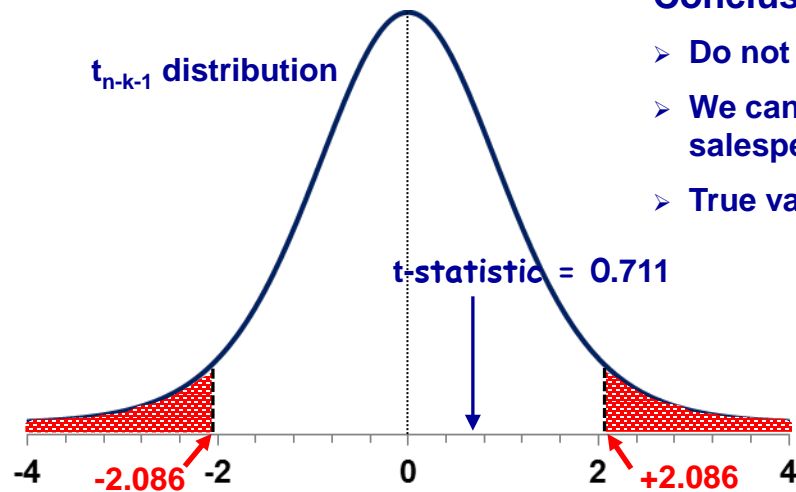
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