

# What is the process for calculating the confidence interval for regression slope?

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## RECOMMENDED CITATION

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The process for calculating the confidence interval for regression slope involves several steps. First, the data must be collected and the regression model must be built. This involves determining the relationship between the dependent and independent variables through the use of statistical methods.

Next, the regression coefficient or slope must be calculated using the least squares method. This coefficient represents the rate at which the dependent variable changes with respect to the independent variable.

Once the slope is calculated, the standard error of the slope is determined. This measures the variability of the slope estimate and takes into account the sample size and the amount of error in the data.

Using the standard error, a t-statistic is calculated. This statistic is used to determine the confidence interval for the slope. The confidence interval represents the range of values in which the true slope of the population is likely to fall with a certain level of confidence.

The final step is to interpret the results and determine the significance of the slope. If the confidence interval includes zero, it indicates that the slope is not significant and there is no relationship between the variables. However, if the confidence interval does not include zero, it can be concluded that there is a significant relationship between the variables.

In summary, the process for calculating the confidence interval for regression slope involves determining the regression model, calculating the slope and its standard error, using a t-statistic to determine the confidence interval, and interpreting the results to determine the significance of the slope.

## Calculate Confidence Interval for Regression Slope

**Simple linear regression is used to quantify the relationship between a predictor variable and a response variable.**

**This method finds a line that best "fits" a dataset and takes on the following form:**

$$\hat{y} = b_0 + b_1x$$

where:

$\hat{y}$ : The estimated response value  
 $b_0$ : The intercept of the regression line  
 $b_1$ : The slope of the regression line  
 $x$ : The value of the predictor variable

Often we're interested in the value for  $b_1$ , which tells us the average change in the associated with a one unit increase in the predictor variable.

We can use the following formula to calculate a confidence interval for the value of  $\beta_1$ , the value of the slope for the overall population:

$$\text{Confidence Interval for } \beta_1: b_1 \pm t_{1-\alpha/2, n-2} * se(b_1)$$

where:

$b_1$  = Slope coefficient shown in the regression table  
 $t_{1-\alpha/2, n-2}$  = The t critical value for confidence level  $1-\alpha$  with  $n-2$  degrees of freedom where  $n$  is the total number of observations in our dataset  
 $se(b_1)$  = The standard error of  $b_1$  shown in the regression table

**The following example shows how to calculate a confidence interval for a regression slope in practice.**

### **Example: Confidence Interval for Regression Slope**

**Suppose we'd like to fit a simple linear regression model using hours studied as a predictor variable and exam score as a response variable for 15 students in a particular class:**

Hours Studied	Exam Score
1	64
2	66
4	76
5	73
5	74
6	81
6	83
7	82
8	80
10	88
11	84
11	82
12	91
12	93
14	89

**We can perform and receive the following output:**

SUMMARY OUTPUT						
<i>Regression Statistics</i>						
Multiple R	0.9115809					
R Square	0.8309798					
Adjusted R Square	0.8179782					
Standard Error	3.6409321					
Observations	15					
<i>ANOVA</i>						
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>	
Regression	1	847.2669759	847.267	63.91387	2.2527E-06	
Residual	13	172.3330241	13.25639			
Total	14	1019.6				
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	65.333952	2.105989497	31.02292	1.41E-13	60.7842381	69.8836655
hours	1.9823748	0.247963753	7.994615	2.25E-06	1.44668165	2.51806789

Using the coefficient estimates in the output, we can write the fitted simple linear regression model as:

The value for the regression slope is 1.982.

This tells us that each additional one hour increase in studying is associated with an average increase of 1.982 in exam score.

We can use the following formula to calculate a 95% confidence interval for the slope:

95% C.I. for  $\beta_1$ :  $b_1 \pm t_{1-\alpha/2, n-2} * se(b_1)$   
 95% C.I. for  $\beta_1$ :  $1.982 \pm t_{.975, 15-2} * .248$   
 95% C.I. for  $\beta_1$ :  $1.982 \pm 2.1604 *$

**.24895% C.I. for  $\beta_1$ :**

**The 95% confidence interval for the regression slope is**

**.**

**Since this confidence interval doesn't contain the value 0, we can conclude that there is a statistically significant association between hours studied and exam score.**

**Note: We used the to find the t critical value that corresponds to a 95% confidence level with 13 degrees of freedom.**

#### **Additional Resources**

**The following tutorials provide additional information about linear regression:**