What is the purpose and significance of the t-test in linear regression analysis?

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The t-test is a statistical tool used in linear regression analysis to determine the significance of the relationship between two variables. It helps to determine whether the observed relationship between the dependent and independent variables is statistically significant or if it occurred by chance. This is important in understanding the strength and direction of the relationship between the variables, and it helps to make informed decisions on the variables to include in the regression model. Additionally, the t-test allows for the identification of any potential errors or flaws in the data, ensuring the accuracy and validity of the regression results. Overall, the t-test is a crucial tool in linear regression analysis as it helps to assess the significance of the relationship between variables and aids in making sound and reliable conclusions.

Understanding the t-Test in Linear Regression

Linear regression is used to quantify the relationship between a predictor variable and a response variable.

Whenever we perform linear regression, we want to know if there is a statistically significant relationship between the predictor variable and the response variable.

We test for significance by performing a t-test for the regression slope. We use the following null and alternative hypothesis for this t-test:

H0: β1 = 0 (the slope is equal to zero)HA: β1 ? 0 (the slope is not equal to zero)

We then calculate the test statistic as follows:

$t = b / SE_b$

where:

b: **coefficient estimate**SE_b**: standard error of the coefficient estimate**

If the p-value that corresponds to *t* is less than some threshold (e.g. α = .05) then we reject the null hypothesis and conclude that there is a statistically significant relationship between the predictor variable and the response variable.

The following example shows how to perform a t-test for a linear regression model in practice.

Example: Performing a t-Test for Linear Regression

Suppose a professor wants to analyze the relationship between hours studied and exam score received for 40 of his students.

He performs simple linear regression using hours studied as the predictor variable and exam score received as the response variable.

The following table shows the results of the regression

model:

	Coefficients	Standard Error	t Stat	p-value
Intercept	66.99	6.211	10.785	<0.000
Hours	1.117	1.025	1.089	0.283

To determine if hours studied has a statistically significant relationship with final exam score, we can perform a t-test.

We use the following null and alternative hypothesis for this t-test:

H0: β1 = 0 (the slope for hours studied is equal to zero)HA: β1 ? 0 (the slope for hours studied is not equal to zero)

We then calculate the test statistic as follows:

***t* = *b* / SE*bt* = 1.117 / 1.025*t* = 1.089**

The p-value that corresponds to *t* = 1.089 with df = n-2 = 40 - 2 = 38 is 0.283.

Note that we can also use the to calculate this p-value:

t score

1.089

Degrees of freedom

38

One-tailed or two-tailed hypothesis?

One-tailed

Two-tailed

Significance level

0.01

0.05

0.10

CALCULATE

P-value: 0.28301

Since this p-value is not less than .05, we fail to reject the null hypothesis.

This means that hours studied *does not* have a statistically significant relationship between final exam score.

The following tutorials offer additional information about linear regression: