**Hypothesis Testing in Simple Linear Regression**

The **Regression Model**, , gives the relationship between and in the population. From the sample, regression calculates the **Estimated Regression Equation**, , which gives the relationship between and in the sample.

**VERY IMPORTANT:**

You must use hypothesis tests to learn about the from the

The following table summarizes the possible relationships between and

|  |  |
| --- | --- |
| **Slope Coefficient** | **Relationship between and** |
|  | Positive linear relationship in the population |
|  | Negative linear relationship in the population |
|  | No relationship in the population |

In order to conclude that there is a relationship between and in the population, we need to confirm that . But we cannot observe the population parameter – we only have the sample statistic How can we draw conclusions about a population parameter from a sample?? We have to use good old hypothesis testing!

If the hypothesis test confirms a relationship between x and y, we typically say that *“the relationship between x and y is statistically significant,”* or, *“there is a statistically significant relationship between x and y.”*

**Hypothesis Test for Significance of the Population Slope**

1. **Formulating the Hypotheses:**

There is only one form of hypotheses, because in regression the question is: is the population slope different from zero? If the slope of a line is zero, there is no relationship between x and y. If the slope is either positive or negative, then there is a relationship between x and y. Therefore, the question calls for a two-tailed test.

|  |
| --- |
| **Hypotheses about the Slope Coefficient in Regression** |
| **Two-Tailed Test** |
|  |
| Answers the question: |
| Whether the population slope is different from zero.  That is to say, whether there is a relationship between |

1. **The Test Statistic:**

The sampling distribution of is the distribution, and so we use a test statistic. The test statistic is:

where

and the degrees of freedom are

1. **Deciding whether or not to Reject :**

|  |  |
| --- | --- |
|  | **For this Two-Tailed Test:** |
| **p-value approach:** | The two-tailed is two times the one-tailed probability of  If the then reject and accept  If the then do not reject . is unsupported.  **NOTE: the two-tailed is reported by Excel in the Regression Output!!** |
| **Critical Value Approach:** | If , then reject and accept .  If , then do not reject . is unsupported. |
| NOTES:   1. is a Test Statistic 2. are Critical Values 3. The degrees of freedom are | |

1. **Interpreting the test:**

In the following interpretations, you should substitute in the actual meaning of .

|  |  |
| --- | --- |
| **When you:** | **The Interpretation is:** |
| **Reject** | At the significance level, we can conclude that the population slope is different from zero. Therefore, the relationship between is statistically significant.  Further:  If there is a positive linear relationship between  If there is a negative linear relationship between |
| **Do not reject** | At the significance level, we cannot conclude that the population slope is different from zero. Therefore, the relationship between is not statistically significant. |