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Department of Statistics

Statistics 100C **Instructor: Nicolas Christou**

Class activity 1 - hypothesis testing

This class activity will demonstrate step-by-step the procedure for finding a test statistic using the t, F, and likelihood ratio test.

Consider the simple regression model $y_i = \beta_0 + \beta_1 x_i + \epsilon_i$. The Gauss-Markov conditions hold and in addition $\epsilon_i \sim N(0, \sigma)$. We wish to test the hypothesis $H_0 : \beta_1 = 1$ against $H_a : \beta_1 \neq 1$. This test can be performed using the following methods:

A. t statistic.

B. F statistic.

C. Likelihood ratio test.

Let's begin...

A. t statistic:

1. What is the distribution of $\hat{\beta}_1$ under H_0.
   $\hat{\beta}_1 \sim N($, $)$.

2. What is the practical difficult in using (1) for inference on β_1?

3. Now obtain a $N(0, 1)$ distribution using (1).

4. Which other distribution do we need to use in order to obtain a t statistic?

5. Construct a t ratio using (3) and (4). What are the degrees of freedom for this t statistic?

B. F statistic:

1. What is the distribution of the square of A-3?

2. Use B-1 and A-4 to construct the F statistic. What are the degrees of freedom?

C. Likelihood ratio test:

1. Estimate the parameters of the model under H_0.

2. Estimate the he parameters of the model under no restrictions.

3. Begin the likelihood ratio test $\lambda = \frac{L(\hat{\omega})}{L(\hat{\Omega})} < k$ and show that it is equivalent to the F statistic (same as in B).