

Tests of General Linear Restrictions

Family of F-tests

Greene's production function data

- Start gretl
- Choose File/open data/sample data; select the Greene tab.
- Choose data set Greene9_1.
- Variables: valadd is output variable; other two are inputs.

Transformations

- Take logs of all variables (except nfirm):
 - Use shift click to select the three variables
 - Choose Add/logs of selected variables.
- Take squares of logs of inputs: select l_labor and l_capital using ctrl-click
 - Then choose Add/squares of selected variables

Transformations

- Compute cross product of `I_capital` and `I_labor`:
 - Choose Add/define new variable and type the formula:
 - `cp_I_capI_lab=I_capital*I_labor`

Models

- In Cobb-Douglas production function
 $l_valadd = f(l_capital, l_labor)$
- Translog model is a more general function that adds the squares and cross product(s) of the logs of all inputs.
- We will first test the validity of the Cobb-Douglas restrictions (the exclusion of all squares and cross products).

Translog Model

- Choose Model/ordinary least squares.
- Double-click on `I_valadd`
- Use shift-click or ctrl-click to highlight the logs of the inputs, the squares and the cross product. Then Ok.
- Note the value of the residual sum of squares, and the degrees of freedom for this model.

Translog Model

- Model 1: OLS estimates using the 25 observations 1-25
- Dependent variable: I_valadd

VARIABLE	COEFFICIENT	STDERROR	T STAT	P-VALUE
const	3.18307	1.04898	3.034	0.00682 ***
$I_capital$	1.82665	1.00574	1.816	0.08515 *
I_labor	-0.975555	1.22580	-0.796	0.43595
$sq_I_capital$	0.206268	0.190113	1.085	0.29151
sq_I_labor	0.441605	0.312857	1.412	0.17426
$cp_I_capl_lab$	-0.654816	0.485215	-1.350	0.19303

- Mean of dependent variable = 5.81209
- Standard deviation of dep. var. = 1.3753
- Sum of squared residuals = 1.05054
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Case I. Testing exclusions

- Test the hypothesis that the coefficients on all squared and cross product terms = 0.
- Go to Tests/omit variables; select squares and cross product to be omitted. Then Ok.
- Resulting model is the Cobb-Douglas model. Note its sum of squared residuals.
- F-test for the exclusions is reported at the bottom of this output. Are Cobb-Douglas restrictions valid?

Cobb-Douglas Function

- Model 2: OLS estimates using the 25 observations 1-25
- Dependent variable: I_valadd

VARIABLE	COEFFICIENT	STDERROR	T STAT	P-VALUE
const	1.84442	0.233593	7.896	<0.00001 ***
$I_capital$	0.245428	0.106857	2.297	0.03152 **
I_labor	0.805183	0.126334	6.373	<0.00001 ***

- Sum of squared residuals = 1.22226
- Comparison of Model 1 and Model 2:
 - Null hypothesis: the regression parameters are zero for the variables
 - $sq_I_capital$
 - sq_I_labor
 - $cp_I_capl_lab$
- Test statistic: $F(3, 19) = 1.03521$, with p-value = 0.399461
- Of the 3 model selection statistics, 3 have improved.

Exercise

- Use the sums of squared residuals that you noted from the two models to compute the F-statistic by hand (homework). You should obtain the same value as gretl's.
- We can conclude that the Cobb-Douglas model is a valid specification, and the following exercises will use this form.

Case II. General linear restrictions

Test of CRTS

- CRTS requires that the coefficients on $I_capital$ and I_labor sum to 1.
- From the Cobb-Douglas output window, choose Tests/linear restrictions, and enter $b2+b3=1$, and Ok. What do you conclude?

Note: gretl numbers the parameters in their order in the equation specification, starting with $b1$ (for the intercept).

Test of CRTS

- Restriction:
- $b[l_capital] + b[l_labor] = 1$
- Test statistic: $F(1, 22) = 1.54069$, with p-value = 0.227587

Case III. Test for structural difference.

- For time series data gretl offers a simple Chow test procedure:

From the equation output window choose Tests/chow test and give the observation number for the first observation in the second period.

For our cross sectional data we will need to construct the test ourselves.

Test for structural break

- Test for structural difference between small vs. large firms; `valadd =500` is dividing value.
- In the main gretl window choose sample/restrict based on criterion and enter `valadd<500`
- Use Model/ordinary least squares to estimate the Cobb-Douglas model over this sample. Note the value of `RSS-1 (.884511)`.

Unrestricted Model

- Return to main window, choose sample/restore full range.
- Then choose sample/restrict based on criterion and enter `valadd>500`.
- Re-estimate the model with this sample, and note the value of RSS-2 (.222267)
- Compute $RSS-U = RSS-1 + RSS-2$

Restricted Model

- Return to main window, choose sample/restore full range.
- Estimate the model over the whole period (the R-model).
- Find the RSS-R (1.22226)

Compute F-statistic

Compute

$$F_{df_u}^r = \frac{(RSS_R - RSS_U) / r}{RSS_U / df_U}$$

$$r = 3$$

$$df_U = 25 - 6 = 19$$

Gretl p-value utility

- To find the p-value associated with the computed F-statistic (1.355), in the main window choose Tools/p-value finder.
- Choose the F tab and enter $dfn=3$; $dfd=19$, and the $F = 1.355$.
- The reported area to the right is the probability associated with F-values > 1.355 . What do you conclude?

Lessons

- Family of F-tests can be used for a variety of hypotheses:
 - Coefficients on group of variables are zero
 - Linear combination of parameters
 - Structural difference