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Exercise E7

Heteroskedasticity and Autocorrelation

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Dpt. Applied Economics III (Econometrics and Statistics)

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E7.1. Beach umbrella rental.

Part I. Simple Linear Regression Model.

Estimate a simple linear regression model to determine the number of rented umbrellas as a function of the temperature:

$$S_t = \alpha + \beta T_t + u_t \quad t = 1, \ldots, 22 \tag{1}$$

a. Estimate the coefficients of the model by OLS.

b. Check whether the variance of the error term is constant using the White test.

c. Is there any evidence in the sample that the error term follow a first order autoregressive process (use the Durbin-Watson test).

d. Given the results of the previous tests, does model (1) satisfy the assumptions of the linear regression model?

e. Test whether the variable temperature is statistically significant.

E7.1. Beach umbrella rental.

Part II. General Linear Regression Model.

Estimate a linear regression model to determine the number of rented umbrellas as a function of temperature, price and whether it is a windy week or not:

$$U_t = \gamma_1 + \gamma_2 T_t + \gamma_3 P_t + \gamma_4 WW_t + w_t \quad t = 1, \ldots, 22 \tag{2}$$

a. Estimate the model by OLS and save the residuals.

b. Plot the OLS residuals against time and comment on the results.

b. Plot the OLS residuals against P and comment on the results.

c. Test the presence of heteroskedasticity in the error term.

d. Test whether the error term is autocorrelated.

e. Comment on the results of the tests.

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E7.2. Holiday cottages.

Model A.

Consider the linear regression model that specifies a linear relationship among room prices and the number of rooms and the price of breakfast:

$$RP_i = \alpha_1 + \alpha_2 NR_i + \alpha_3 BP_i + u_i \tag{3}$$

a. Estimate the model by OLS and save the residuals.

b. Comment on the residuals plots against each of the explanatory variables of the model.

c. Is there any evidence in the sample that the variance of the error term increases with the price of breakfast? Use the Goldfield-Quandt test.

d. Given the results obtained, test the statistical significance of the variable price of breakfast.

E7.2. Holiday cottages.

Model B.

Include two more explanatory variables in model (3): access to WiFi and location.

$$RP_i = \lambda_1 + \lambda_2\, NR_i + \lambda_3\, BP_i + \lambda_4\, WIFIF_i + \lambda_5\, WIFIP_i + \lambda_6\, LOCC_i + u_i \qquad (4)$$

where $WIFIF$ takes the value 1 if the holiday cottage offers free WiFi access and 0 otherwise; $WIFIP$ takes the value 1 if the holiday cottage offers WiFi for an additional fee and 0 otherwise; and, $LOCC$ takes the value 1 if the holiday cottage is in the town center and 0 otherwise.

a. Estimate the coefficients of the model by OLS. Check whether the variance of the error term depends on the explanatory variables of the model using the White test.

b. Given the conclusion of the test, how would you specify and estimate a regression model to determine the price of a room?

c. Test whether the price of a room increase with the number of rooms.

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E7.3. Soy milk.

Part I. General Linear Regression Model.

Consider the general linear regression model where sales depend on prices and advertising expenditures as follows:

$$S_t = \beta_1 + \beta_2 P_t + \beta_3 AE_t + \beta_4 AE_t^2 + u_t \quad t = 1990:1, \ldots, 2012:6. \tag{5}$$

a. Estimate the coefficients by OLS and save the residuals.

b. Comment on the time series residuals plot.

c. Does the error term show first order autocorrelation? Use the Durbin-Watson test.

d. Does the error term show first order autocorrelation? Use the Breusch-Godfrey test.

e. Does the error term show autocorrelation up to order 12? Use the Breusch-Godfrey test.

f. Given the results obtained in the tests, what are your conclusions?

E7.3. Soy milk.

Part II. Trend.

Consider the regression model in Part I and include a time trend as follows:

$$S_t = \beta_1 + \beta_2\, P_t + \beta_3\, AE_t + \beta_4\, AE_t^2 + \beta_5\, time + \beta_6\, time^2 + \beta_7\, time^3 + u_t \qquad (6)$$

a. Estimate the model by OLS.

b. Is there any evidence in the sample of autocorrelation in the error term?

c. Is the trend statistically significant?

d. Which is the most appropriate specification for the trend? Linear? Quadratic? Cubic?