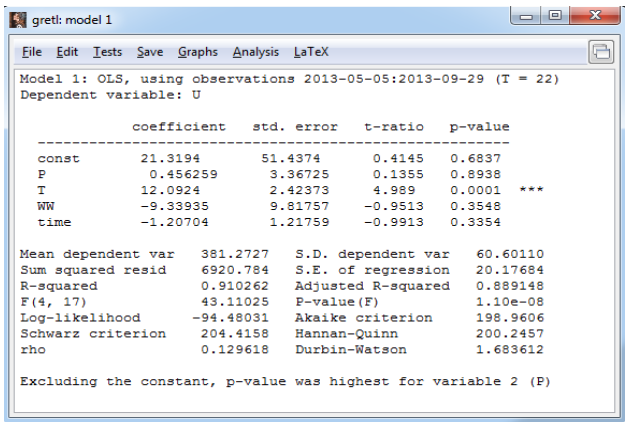
Solution to Task T7.

Residual analysis.

Beach umbrella rental

To estimate model (1), click

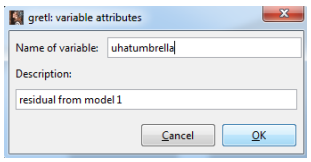
`Model --> Ordinary Least Squares ...`

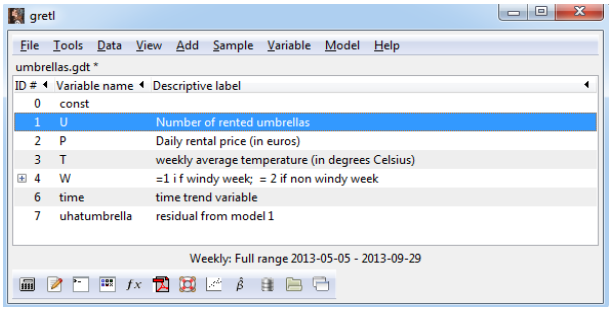


To save the residuals, go up to the menu bar of the estimation results window and click

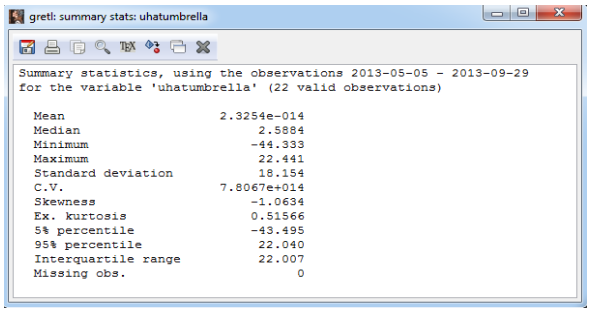
`Save --> Residuals`

The name given to the series of residuals by default is *uhat*1. You may change this name in the dialog box. Let's call them *uhatumbrella*. This new variable is listed in the main window of Gretl.





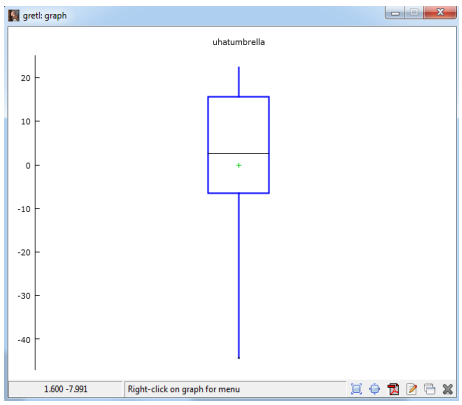
To obtain the descriptive statistics of the residuals, highlight the variable *uhatumbrella*, right-click and select the option *Summary statistics* from the pulldown menu.



To obtain the boxplot of the residuals, highlight the variable *uhatumbrella*, go up to the Menu Bar and click

`Variable --> Boxplot`

Then, mark Simple boxplot.

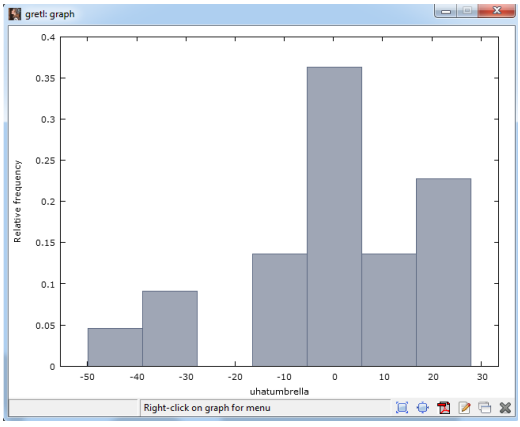


To estimate the density function of the residuals, highlight the variable *uhatumbrella*, go up to the Menu Bar and click

`Variable --> Estimated density plot ...`

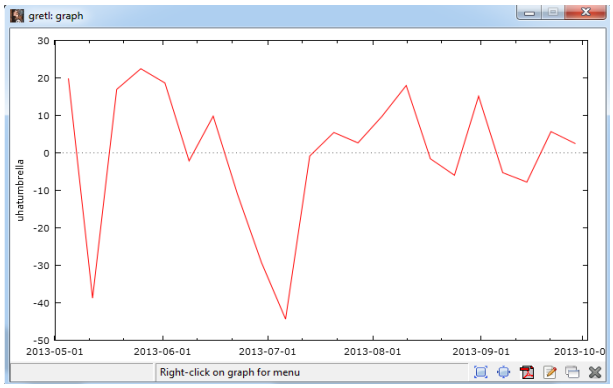
In this example, there are not enough data to estimate the density function. Let's plot the frequency distribution clicking

`Variable --> Frequency distribution ...`



To graph the residuals against time, go up to the menu bar of the estimation results window and click

`Graphs --> Residual plot --> Against time`

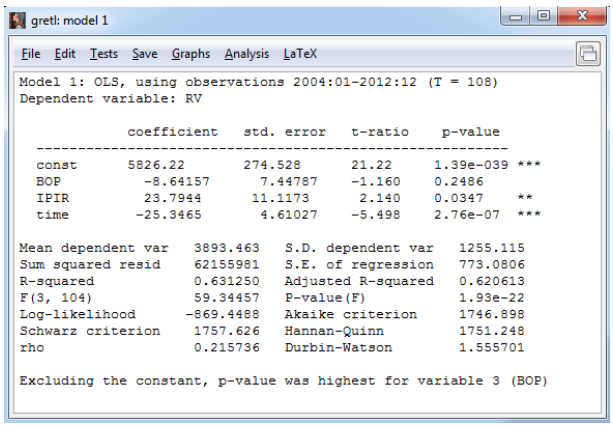


Conclusions:

- The mean of the residuals is almost zero, because it is one of the properties of the Sample Regression Function.
- In general, to reach some conclusion about the distribution of the residuals we should perform some tests, for instance, normality tests.
- The time series plot of the residuals shows clusters of positive residuals followed by clusters of negative residuals. This result suggests that the error term might be autocorrelated. It would be necessary to test this hypothesis using the Durbin-Watson or Breusch-Godfrey tests.

Registered vehicles

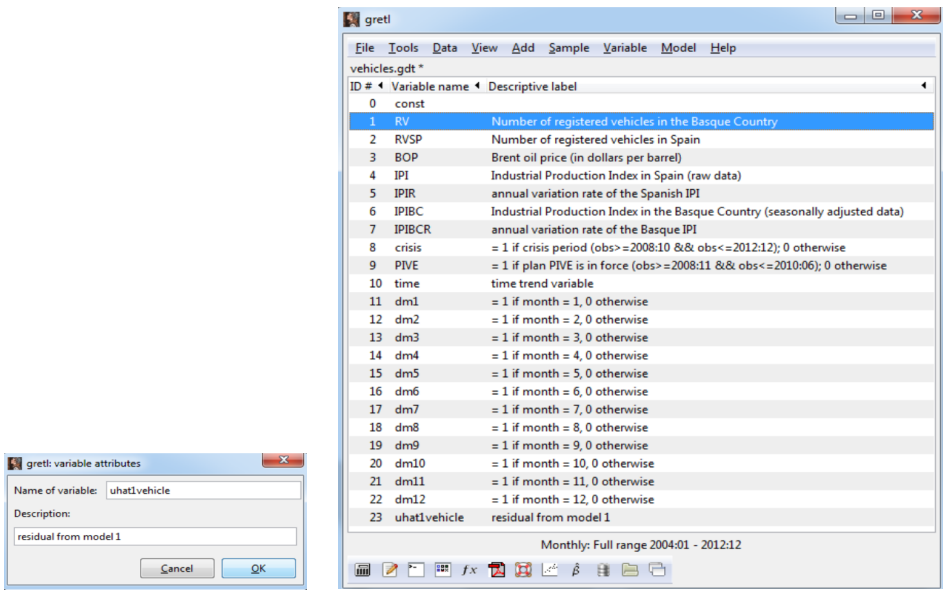
The estimation results of model (2) are shown in the window below.



To save the residuals, go up to the menu bar of the estimation results window and click

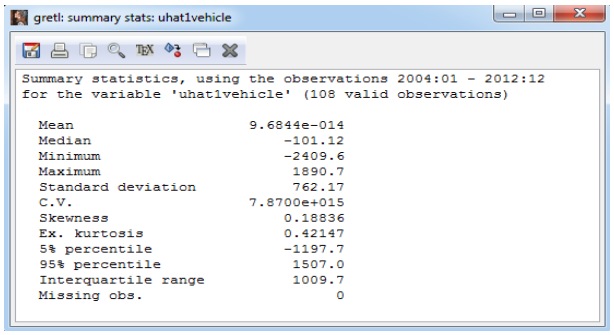
`Save --> Residuals`

Let's call the residuals of this model *uhat1vehicle*.



To obtain the descriptive statistics of the residuals, highlight the variable *uhat1vehicle*, go up to the Menu Bar and click

`Variable --> Summary statistics`

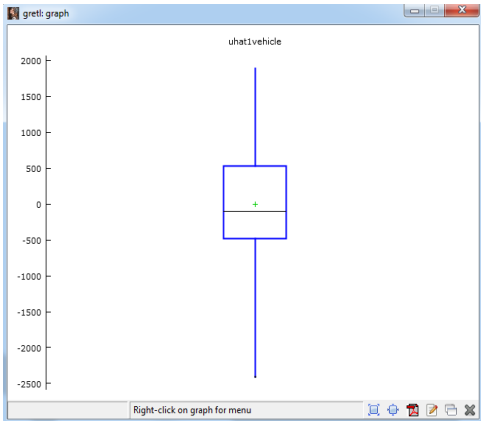


To obtain the boxplot of the residuals, highlight the variable *uhat1vehicle* and click `Variable --> Boxplot` in the Menu Bar. Then mark Simple boxplot.

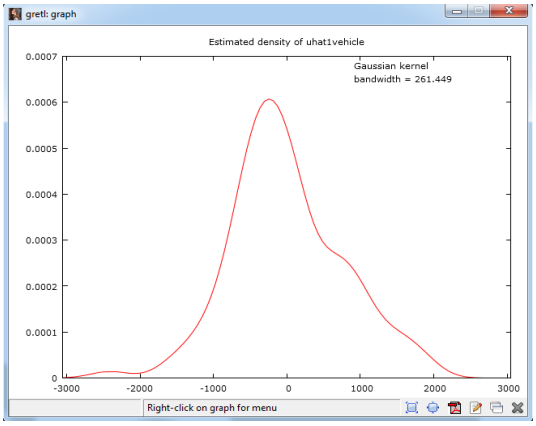
To plot the estimated density function, highlight the variable *uhat1matriculacion*, go up to the Menu Bar and click

`Variable --> Estimated density plot ...`

Boxplot

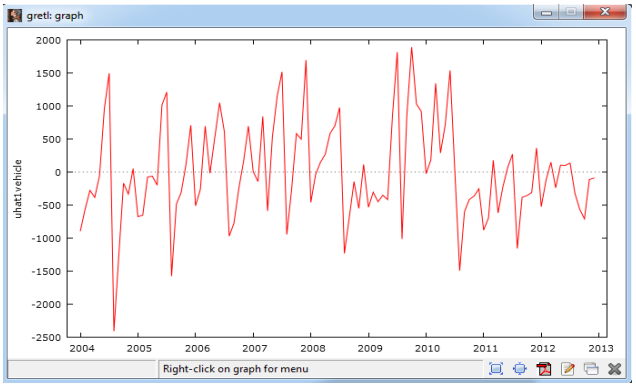


Estimated density plot



To obtain the time series plot of the residuals, go up to the menu bar of the estimation results window and click

```
Graphs --> Residual plot  --> Against time
```



Conclusions:

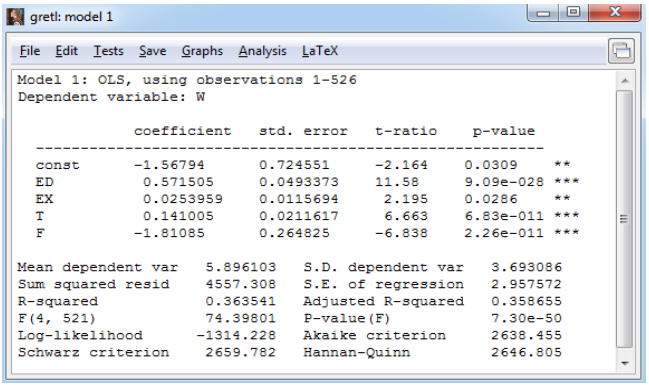
- The mean of the residuals is almost zero, because it is one of the properties of the Sample Regression Function.
- In general, to reach some conclusion about the distribution of the residuals we should perform some tests, for instance, normality tests.
- The time series plot of the residuals shows clusters of positive residuals followed by clusters of negative residuals. This result suggests that the error term might be autocorrelated. It would be necessary to test this hypothesis using the Durbin-Watson or Breusch-Godfrey tests.

  Two characteristics of these residuals should be noted:

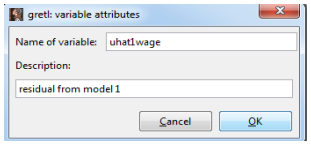
  - A change of level in the residuals is observed from 2010 onwards. This change could be explained by some factors that have not been included in the model. If this were the case, the model (2) would be omitting relevant variables.
  - The residuals show a cyclical behaviour of period one year, which is called seasonality. Since this cyclical pattern has not been included in the specification of the model, it appears in the residuals. Seasonal dummies should be included in the model and their statistical significance tested. If seasonality were a significant factor, the model (2) would be omitting a relevant variable.

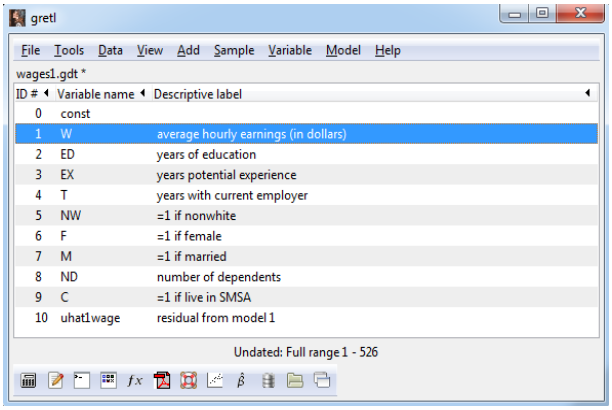
Wages

The results of estimating model (3) are shown in the figure below.



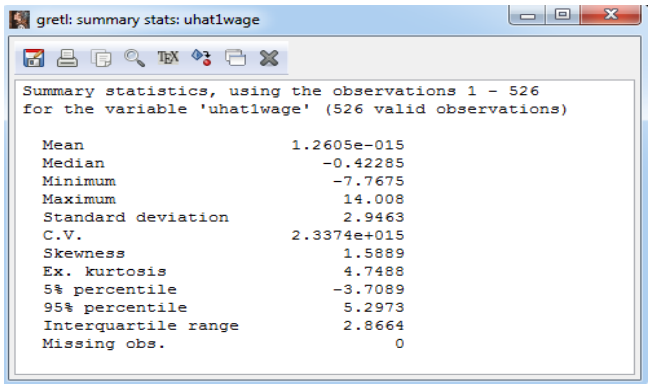
To save the residuals, click `Save --> Residuals` in the estimation results window. Let's call these residuals *uhat1wage*.





To obtain the descriptive statistics, go up to the Menu Bar and click

`Variable --> Summary statistics`

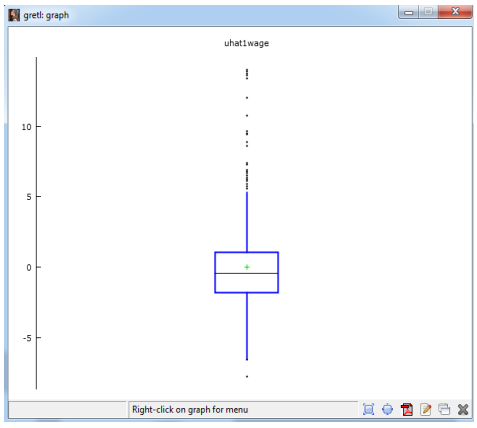


To obtain the boxplot of the residuals, highlight the variable *uhat1wage* and click `Variable --> Boxplot` in the Menu Bar. Then mark Simple boxplot.

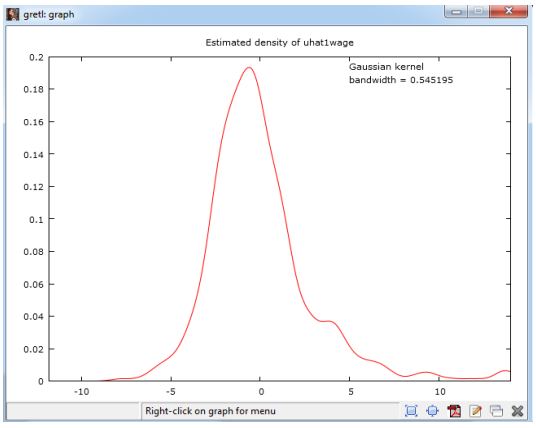
To plot the estimated density function, select the variable *uhat1wate*, go up to the Menu Bar and click

`Variable --> Estimated density plot ...`

Boxplot



Estimated density plot

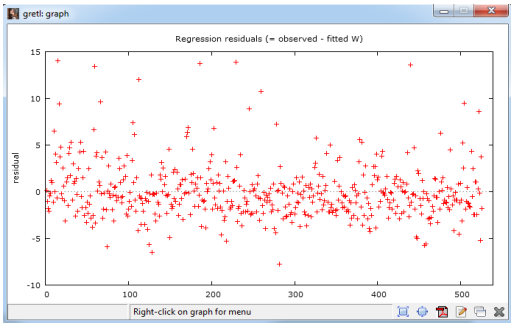


To obtain the plot of the residuals by observation or against a regressor, click in the estimation results window

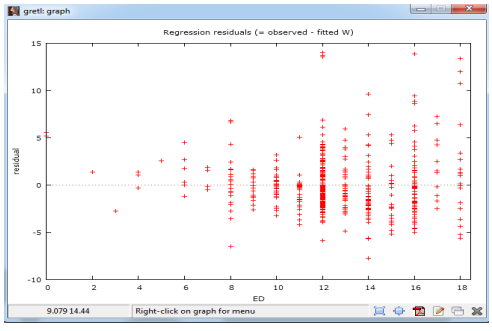
`Graphs --> Residual plot`

and select the option:

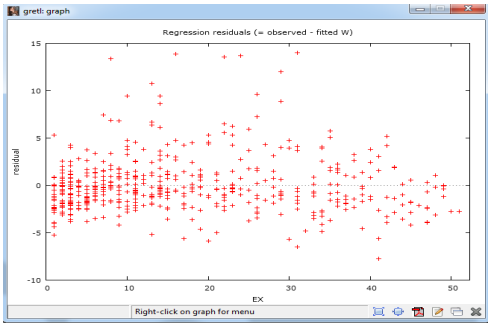
`By observation number`



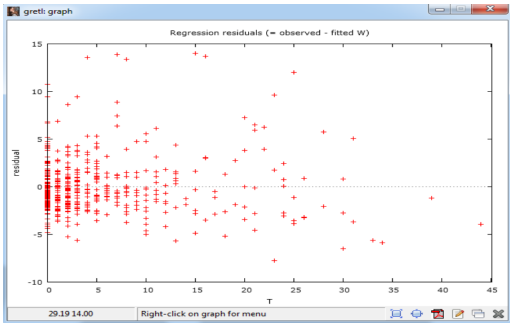
`Against education`



Against experience



Against tenure

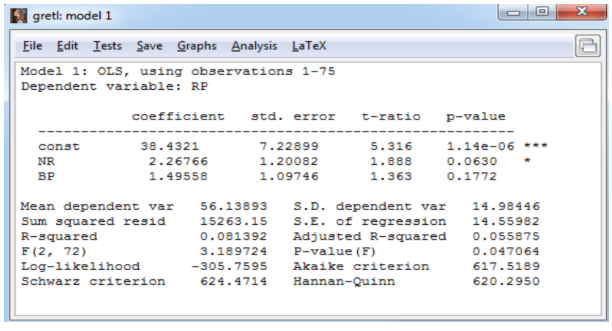


Conclusions:

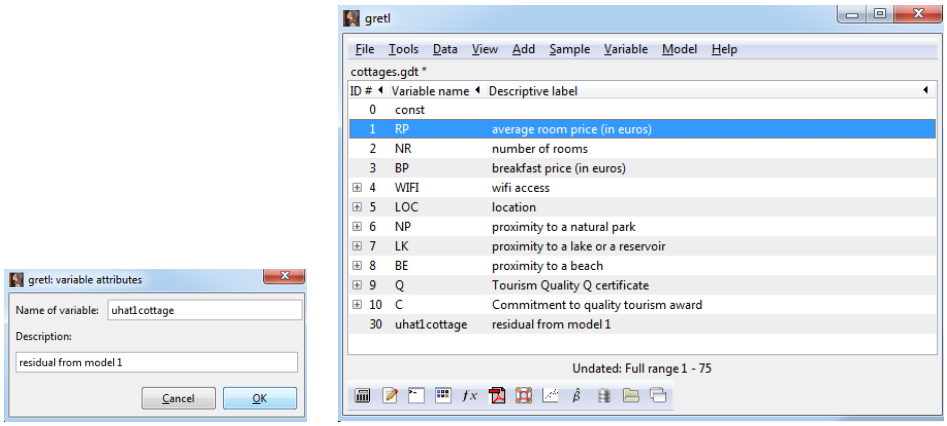
- The mean of the residuals is almost zero, because it is one of the properties of the Sample Regression Function.
- In general, to reach some conclusion about the distribution of the residuals we should perform some tests, for instance, normality tests.
- The plot of the residuals by observation is not of much interest because cross-section data are not ordered.
- The residuals plot against experience and tenure show a quite homogeneous distribution.
- The residuals plots against education suggest that the higher the level of education, the higher the variability in the residuals. This fact suggests that the error term might be heteroskedastic and this heteroskedasticity may be caused by the variable education. The homoskedasticity hypothesis should be tested using the White, Breusch-Pagan or Goldfed-Quandt tests.

Holiday cottages in Bilbao

The results of estimating model (4) appear in the figure below.

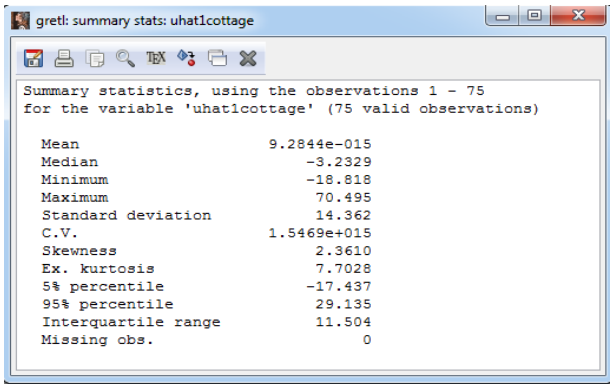


To save the residuals, click `Save --> Residuals` in the estimation results window and then call these residuals *uhat1cottage*.



To obtain the descriptive statistics, go up to the Menu Bar and click

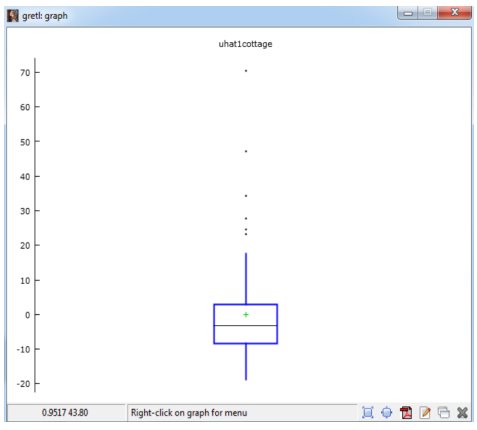
`Variable --> Summary statistics`



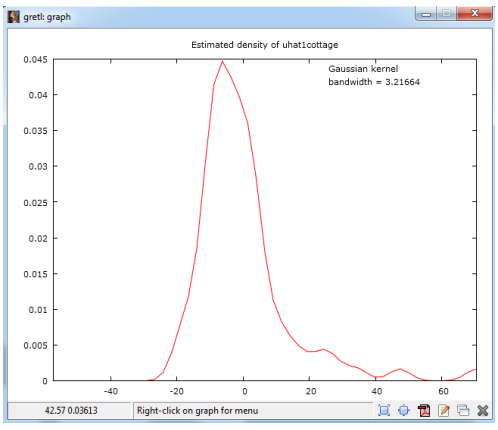
To obtain the boxplot of the residuals, highlight the variable *uhat1cottage* and click `Variable --> Boxplot` in the Menu Bar. Then mark *Simple boxplot*.

To plot the estimated density function, select the variable *uhat1cottage* using the cursor and click `Variable --> Estimated density plot ...` in the Menu Bar.

Boxplot



Estimated density plot

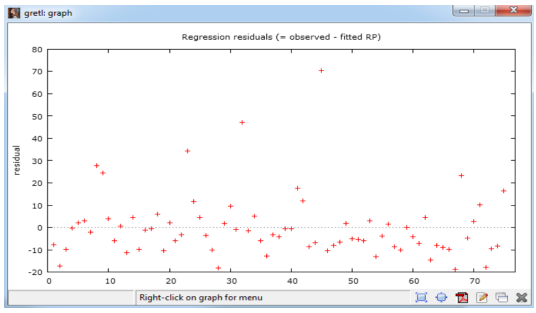


To plot the residuals by observation or against a regressor, click

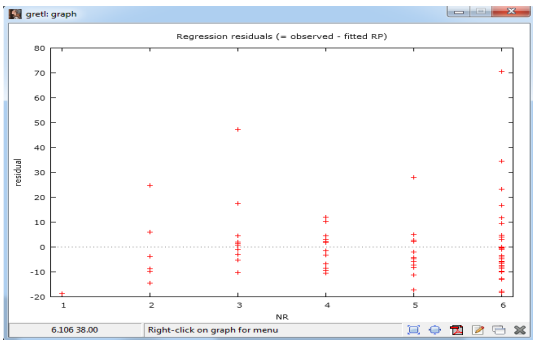
`Graphs --> Residual plot`

in the menu bar of estimation results window and select the option:

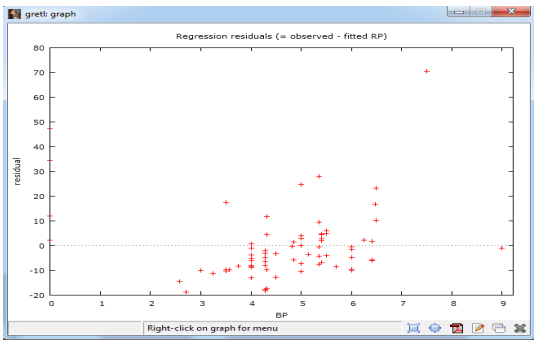
`By observation number`



`Against BP`



`Against NR`



Conclusions:

- The mean of the residuals is almost zero, because it is one of the properties of the Sample Regression Function.
- In general, to reach some conclusion about the distribution of the residuals we should perform some tests, for instance, normality tests.
- The plot of the residuals by observation is not of much interest because cross-section data are not ordered.
- The distribution of the residuals is quite homogeneous in the residuals plot against the regressor number of rooms.
- The residual plot against price of breakfast shows that the higher the price, the higher the variability in the residuals. This fact suggests that the variance of the error term might depend on the price of breakfast. The homoskedasticity hypothesis should be tested using the White, Breusch-Pagan or Goldfed-Quandt tests.