Department of Economics,
Management and Quantitative Methods

B-74-3-B Time Series Econometrics
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Computer Session 1 (version for EViews 9 and 10)

Exercise 1: Import the data from the file armas.txt (downloadable from the website; download the file in the directory you are going to use).
Note: This is a text file: this format is usually used to exchange data with other software. Usually, you should know: (i) how many variables are present, (ii) how are they ordered, (iii) what are the names of the variables and what do they correspond to, (iv) when the starting date of the sample is, and when it is the end.
In order to find out these pieces of information, open the file with a text editor (such as the Notepad) or with Excel. You should be able to easily verify that: (i) there are 6 variables (ii) ordered by columns (first row is the labels; there is no column for the dates) (iii) the names of the variables are u, v, w, x, y, z (but we do not really know what they correspond to, so we will treat them as realisations of stochastic processes of some sort) (iv) there are no dates, but notice that there are 99 observations.

1. Starting up

Activate e-Views.

1.1 Define the workfile

(In this way, we characterise the environment we work in).

From the Menu *File*, select *New* and then *Workfile*. In the window *Workfile Create* you have to indicate if your data have a structure, that is, if they are regularly dated *(Dated-regular frequency)* or if they are undated. If you select the first option, you have to specify the Date: this ranges from *annual* to *daily*, or, if you just know that you have equally spaced observations, you can choose your data to be *integer date*; you can also indicate that the data are *undated*. Your choice will depend on the frequency of the data: from our preliminary inspection of the data, we know they are undated and there are 99 observations (so, set the observations to be between 1 and 99). So you can just select *undated* and then enter in the Range entry that you have 99 observations, or select *integer date* and then entry 1 and 99 as *start* and *end* dates. (When you are done with this window, click *OK*. In general, click *OK* when you are done with any window).

1.2 Import the data

From the Menu *File*, select *Import* and then *Import from file.* Browse until you find the directory where you downloaded the file armas.txt. You are prompted by a ASCII text import mask: *Text read - Step 1 of 4*. You may move to steps 2 to 4 to check that all the information in it is correct (for example, verify that the data are really *order*ed in columns, that no columns are to be *skip*ped, that a space or tab separates the cells); in alternative, you may select *Finish* already at Step 1 and import the data directly (I recommend this, as it is easier to check later). You are prompted by a window *Link imported series and alpha object(s) to external source?* Select *No*.

1.3 Inspect the data

The data have now appeared in the workfile Untitled. Double click on one series, for example u, in order to see it. Compare it with the one in the original text file, to make sure that the two series are really identical.

1.4 Save the data as e-Views file

From the Menu *File*, select *Save as*. In the new window (*Save*), browse to find the location where you want to save the data. Call the new file armas.wf1 (the extension wf1 is the extension of the e-Views workfiles: this is set by default in the Save as window). *Save*.

1.5 Close.

From the Menu *File*, select *Exit.*

Exercise 2: Inspecting and handling data in the file armas.wf1.

(If you did not manage to complete exercise 1, or for comparison, you may find the file armas.wf1 on the web page. Download the file in the directory you are going to use).

2.1 Start

Double click on armas.wf1. (Notice that this activates e-Views and opens the workfile at the same time).

2.2 Inspect the plot of the series u

Double click on u: a spreadsheet with the values of u for each time appears. In order to see the plot of the series, click on the button *View* and *Graph* and choose the *Graph type* options *Basic graph* and *Line & Symbol*. click *OK* to view the plot. In order to return to the spreadsheet, click on *View* and choose *Spreadsheet*.

2.3 Inspect the correlogram of the series u

Click on *View* and choose *Correlogram*; set the number of *lags to include* to 12 (keep the *correlogram of* as *level*, but notice that *1st difference* and *2nd difference* are also available) and click *OK*. You can now see the sample autocorrelation and the sample partial autocorrelation, the Q statistic (which is very similar to the Portmanteau Statistic) and the P-value associated to it. On the plots you can also see the bars indicating the 95% band to test if the data are i.i.d. (On the basis of the sample autocorrelation and partial autocorrelation, we can suspect a cycle, so for example an AR(2) process).

2.4 transform variables

In the Menu *Quick*, select *Generate Series*. You are prompted by a window *Generate series by equation*; in the *Enter equation* cell, you can enter a formula to generate a new variable: for example, q=v^2+abs(w)^0.5-2*x/(1+x^2). You can also transform variables using the lag operator: the series r=y(-1) is obtained by lagging y_t of one period (so, r_t is y_{t-1}). Series may also be generated by using the *genr* button in the *workfile* window.

You may also use this to create variables that may follow different functions depending on the situation. For example, if you want to create q such that q=|w-0.1| if |w|>1, and q=0 otherwise, first we generate (*Generate series by equation*) the series q=0 and click OK; then we generate (*Generate series by equation*) "q=abs(w-0.1)" but writing in the *Sample* cell "if abs(w)>1" (leave the sample too: so, you will write "1 99 if abs(w)>1".

2.5 Close.

Close without saving (if, by mistake, you saved, you may download the correct file armas.wf1 from the web page).

Exercise 3: Estimating and hypotheses testing for arma processes in the file armas.wf1.

3.1 Start

Double click on armas.wf1.

3.2 Estimate an AR(2) model for u.

From the Menu *Quick* select *Estimate equation*. You are prompted by the window *Equation specification*. In the cell, you must specify: the dependent variables (*u*), the explanatory variables (in this case, only *c*, the constant), the ARMA structure (for an AR(2) model, we must specify *AR(1) AR(2)*). In the cell then we must write *u c AR(1) AR(2)* (*c* is the intercept: if we knew c=0 we could omit iit); as for the estimation method, we want to use *LS – Least Squares (NLS and ARMA)* (this is usually set by default, so just make sure not to change it). Click *OK*.

The estimation output include: in the top part of the output panel, the estimated values for the intercept and for the AR(1) and the AR(2) coefficients ($\hat{\phi}_1$ and $\hat{\phi}_2$ respectively), an estimate of the variance of the innovations ($\hat{\sigma}^2$), and the *t* – statistic for the test that the true value of the estimated coefficient is in fact 0, and the Pvalue associated to that test with two-sided alternative (warning: this is actually taken from a *t* distribution: we should use the normal). In the middle part of the estimation output, it is important to look at the log-likelihood and at the information criteria (these are computed with a different scaling, but the same “minimum AIC” or “minimum BIC” is to be applied). In the bottom part of the output panel, there are the inverted AR roots: notice that these are the inverse of the roots of the characteristic equation (so they must be smaller than 1 in absolute value in order to confirm that the process is stationary).

3.3 Estimate an AR(2) model for u via CML.

Note that the default for version 9 and 10 of eviews is Minimum Least Squares (as we studied for Conditional maximum likelihood) but using an algorithm called Kalman filtering: with this algorithm, the residuals that are minimised in the Minimum RSS are computed without treating conditioning observations as fixed (for example, in the MA(1) in CML we set $\varepsilon_0 = 0$ while in Kalman filtering it is treated as a random variable with $E(\varepsilon_0) = 0$ and $Var(\varepsilon_0) = \sigma^2$).

ML may be computationally intensive, especially with complicated ARMA/ARCH models. To use Conditional Maximum Likelihood instead, proceed as before and from Menu *Quick* select *Estimate equation* and, in the window *Equation specification* again enter *u c AR(1) AR(2)*. At this point, before estimating the equation, click on the tap *Options*: in the new window under ARMA select CLS (notice that ML is the default) (note: be careful to select CLS and not GLS).

3.4 Test that model is well specified (no residual autocorrelation)

Estimate the model via ML as in 3.3 (you could do the same using the CLS estimate, the numerical outcome could be very slightly different).

In the estimation output window, from the button *View*, select *residual diagnostics* and then *correlogram Q statistics* (for the modified Portmanteau test). You are prompted by a window asking the number of *lags to include*. This must be bigger than *p+q*, (2 in our case). Select for example 12, click *OK*. At lag 12 the Q statistic takes value *7.08*, with P-value *0.717* (larger than *0.05*, so the hypothesis that there is no residual autocorrelation is not rejected).

3.5 Tests on the coefficients

In the estimation output window, from the button *View*, select *coefficient diagnostics* and then *Wald test-coefficient restrictions*. A Wald test is performed by specifying in the *Wald test* window the coefficient restrictions. For example, if we want to test that the data can be modelled by an AR(2) with $\phi_{0,1} = 1.2$, $\phi_{0,2} = -0.7$, enter *C(2)=1.2, C(3)=-0.7* in the window. Click *OK*.

3.6 Close.

Close without saving.

Exercise 4: Forecasting for arma processes in the file armas.wf1.

4.1 Start

Double click on armas.wf1.

4.2 Change workfile range

In the window *Workfile*, select the button *proc* and then *Structure/Resize current page* and set the *observations* in the *data range* to 120 (in this way, we "make space" for the future observations, that we are forecasting) (if you have an *undated* workfile, set the *data range* to 120 observations).

4.3 Estimate an MA(2) model for z.

From the Menu *Quick* select *Estimate equation*. You are prompted by the window *Equation specification*. In the cell, you must specify: the dependent variables (*z*), the explanatory variables (in this case, only *c*, the constant), the ARMA structure (for an MA(2) model, we must specify *MA(1) MA(2)*). In the cell then we must write *z c MA(1) MA(2)*; estimation method: *LS – Least Squares (NLS and ARMA)*. Click *OK*.

4.4 Forecast.

In the estimation output window, select the button *Forecast*. You are prompted by the Forecast window: keep the *Series name* for the forecast as default (that will be *zf*) and keep the *Method* as default (*dynamic*). Finally, set the *Forecast Sample* to 100-120 (this tells to forecast after the 99th observation, which is our last one). Click *Ok*. You are presented with a plot of forecasts: this is not always easy to read: to know better, go to the *Workfile* window, where the new series *zf* is now present. Double click on it: we are only interested in the forecast of future values, so in the observations from 100 onwards. (Note: this forecast is computed as $\hat{y}_{t|t-1,t-2,...} = \hat{c} + \hat{\theta}_1\hat{\varepsilon}_{t-1} + \hat{\theta}_2\hat{\varepsilon}_{t-2}$, where $\hat{\theta}_1$ and $\hat{\theta}_2$ are the estimates of the MA(2) parameters, and $\hat{\varepsilon}_t$ are the residuals).

4.5 Close. (Close without saving).