44-6873-00L- **Econometrics for Business and Economics**	Dr Amr Algarhi (Miro) Department of Management Sheffield Hallam University
Exercise sheet **9. Autocorrelation** Week 31	

Question 1 (Stata). The finite distributed lag model

Download the data set "***okun.dta***". This data set contains two variables, *g* and *u*, that are quarterly observations on the percentage in *GDP* and the *unemployment rate* for the US from 1985(*Q2*) to 2009(*Q3*), respectively.

Important note

You have to declare the data in the set to be a time-series, in order to use functions for analysing time-series data. If the data do not already have a proper date to identify the time period in which the observation was collected, then adding one is a good idea.

(a) Create a column for the relevant dates in the data set, and then use the dates to identify the observations as time-series and indicate the period of time that separate the individual observations (The data is quarterly in this exercise).
Hint:

```
generate date = q(1985q2) + _n-1

format %tq date

tset date
```

(b) Plot the variables, g and u, against time.
Hint:

```
tsline g
tsline u
tsline g u

label var u "% unemployment"
label var g "% GDP growth"
tsline g u
```

(c) Estimate a model by regressing the *unemployment rate* on the percentage change in *GDP* using least squares and save the residual.
Hint:

```
regress u g
predict uhat, res
```

(d) Detect the autocorrelation by plotting the residuals against time, and by plotting the residuals against its lagged values.
Hint:

```
tsline uhat, yline(0)
scatter uhat L.uhat, yline(0) xline(0)
```

(e) Test for autocorrelation using Durbin-Watson (D-W) d test.
Hint:
```
estat dwatson
```

(f) Now consider an examination of Okun's Law, where the change in the unemployment rate from one period to the next depends on the rate of growth of output in the economy.

$$U_t - U_{t-1} = -\gamma(G_t - G_N)$$

where U_t is the unemployment rate, G_t is GDP growth, G_N is the normal rate of GDP growth. The regression model can be written as,

$$DU_t = \alpha + \beta_0 G_t + u_t \qquad \text{(f-1)}$$

Estimate the model using least squares and save the residual, then test for autocorrelation using Durbin-Watson (D-W) d test.
Hint:
```
reg D.u g
estat dwatson
```

(g) Test for higher order autocorrelation using Breusch-Godfrey (BG) test. Include 4 lagged least square residuals as regressors in the auxiliary regression *AR(4)*.

$$u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \rho_3 u_{t-3} + \rho_4 u_{t-4} + v_t$$

Is there evidence of autocorrelation in the residuals? If Yes, estimate the main regression model (f-1) by least squares with Newey-West standard errors.

Hint:
```
estat bgodfrey, lags(4)

newey D.u g, lag(4)
```

(h) Recognising that changes in output are likely to have a distributed-lag effect on unemployment- not all of the effect will take place instantaneously- lags are added to the model to produce,

$$DU_t = \alpha + \beta_0 G_t + \beta_1 G_{t-1} + \beta_2 G_{t-2} + \cdots + +\beta_q G_{t-q} + u_t \qquad \text{(h-1)}$$

Plot the two time-series *D.u* and *g*. Then estimate the finite distributed lag model in equation (h-1) letting $q = 4$.
Hint:
```
tsline D.u g
regress D.u L(0/4).g
```

(END)