ECON 546: Themes in Econometrics

Lab Exercises #4
(3 February, 2010)

(a) In the last Lab. class we estimated a Box-Cox model to explain expenditure on Research & Development (‘*y*’) in terms of Profit (‘*x*’), and an intercept. We estimated the model by MLE by using the following commands within a **LOGL Object**.

```
@logl ll1
yt = (y^c(1)-1)/c(1)
xt = (x^c(1)-1)/c(1)
res = yt-c(2)-c(3)*xt
ll1 =  -0.5*log(c(4)) + (c(1)-1)*log(y)-(res^2)/(2*c(4))
```

You’ll recall that the starting values that we used for the coefficients were 0.1, 10, 0, and 10.

Now let’s see how we can use MLE to estimate the model when we want to introduce a more general error structure. Specifically, let’s suppose that we want to allow for the possibility that the errors follow a specific form of heteroskedasticity. You won’t find any package that is already set up for this! For example, suppose we want to allow for the following form of heteroskedasticity:

$$\text{var}(\varepsilon_t) = \exp(\delta_0 + \delta_1\sqrt{SALES_t})$$

[Note that if $\delta_1 = 0$ then we have homoskedastic disturbances.]

The EViews workfile from the last lab. is on the server as **S:\Social Sciences\Economics\ECON546\LAB4.WF1** . We can modify our **LOGL Object** to:

```
@logl ll2
yt = (y^c(1)-1)/c(1)
xt = (x^c(1)-1)/c(1)
res = yt-c(2)-c(3)*xt
var=exp(c(4)+c(5)*sales^0.5)
ll2 =  -0.5*log(var) + (c(1)-1)*log(y)-(res^2)/(2*var)
```

(b) Test the null hypothesis of homoskedasticity against the alternative hypothesis of this particular form of heteroskedasticity.

(c) Test to see if a linear model or a log-log model is favoured.

(d) What is the main weakness of the tests that you have just performed? What might we do about this?

Let's now go back to a log-log specification of the model (which is what is favoured if no allowance is made for heteroskedastcity). Keep in mind that the testing we did above relates to a specific form of possible heteroskedasticity – it is quite possible that some other form may be present. So, we might want to use White's test for homoskedasticity.

(e) Conduct White's test with the log-log model.

(f) What is the main weakness of the test that in the present context? What might we do about this?

Now let's use a simple Bootstrap simulation experiment to investigate the finite-sample properties of the t-test on the slope coefficient in the log-log model. It may be the case that there is some other form of heteroskedasticity present, or we may have omitted some regressors from the model. In either case, this t-statistic will *not* be t-distributed under the null hypothesis. The EViews program listed on the next page is available on the server under the name **S:\Social Sciences\Economics\ECON546\LAB4.PRG**.

A comparison between Monte Carlo simulation and Bootstrap simulation is given in the separate handout titled *Monte Carlo and Bootstrap Simulation*. Here, we are going to use the Bootstrap to determine the distribution of the MLE of the slope coefficient in the model, for *our particular sample of data*, without appealing to its asymptotic distribution. (The Bootstrap can also be used to simulate the finite sample bias, MSE, *etc*. of an estimator, but we are not pursuing that here.)

(g) "Re-structure" the EViews workfile so that the sample can be up to 10,000 observations – we will need this for the bootstrap experiment: Select **Proc; Structure/Re-Size Current Page** and set the data-range to 10,000.

(h) Run the program and obtain the sampling distribution for the t-statistic in this particular case. Is this distribution Student-t with (n-k) degrees of freedom? (You may want to note that the *excess* kurtosis for a Student-t distribution with v degrees of freedom is $6 / (v – 4)$, for $v > 4$.)

(i) Are your results sensitive to the number of bootstrap repetitions that you undertake? How many repetitions do you think you need before you get a clear picture of what is going on?

```
' INITIALIZE VARIOUS VALUES
' -------------------------------------------
!nrep=1000
scalar sum=0
rndseed 123456
vector(!nrep) t2
' ESTIMATE THE EQUATION & SAVE THE RESIDUALS & THE COEFFICIENTS
' -------------------------------------------------------------------------------------
smpl 1 27
equation eq1.ls log(y) c log(x)
for !i=1 to 2
scalar b!i=c(!i)
next
series e=resid

'CONVERT SERIES TO MATRIX (VECTOR) FOR RE-SAMPLING
'----------------------------------------
stom(e,ev)
' ===================================
' START THE BOOTSTRAP EXPERIMENT HERE
' ===================================

for !j=1 to !nrep
vector eb=@resample(ev)

' CONVERT RE-SAMPLED VECTOR BACK TO SERIES
'----------------------------------------------------------
mtos(eb,u)
' GENERATE THE DEPENDENT VARIABLE, IMPOSING THE NULL HYPOTHESIS TO
BE TRUE
series depvar=b1+0*log(X) + u
equation eq2.ls depvar  c   log(X)
t2(!j)=@tstats(2)

      next

' ===========================
' END OF THE BOOTSTRAP LOOP
' ===========================
' CONVERT VECTOR TO SERIES SO WE CAN PLOT, ETC.
smpl 1 !nrep
mtos(t2,tee2)
```