Computer Handout 10: Forecasting Cycles Diego Escobari Econ 3342

This Computer Handout 10 will cover an empirical application on how to forecast cycles. We will replicate figures in section 5 of chapter 9.

The variable we want to forecast is the Canadian employment.

Moving Average

Before we estimate the models, let's make sure we all have the same sample:

smpl 1962q1 1993q4

The preferred MA model is an MA(4), so the E-Views command is:

Is caemp c ma(1) ma(2) ma(3) ma(4)

Dependent Variable: CAEMP Method: Least Squares Date: 11/11/10 Time: 16:26 Sample: 1962:1 1993:4 Included observations: 128 Convergence achieved after 18 iterations Backcast: 1961:1 1961:4

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C MA(1) MA(2) MA(3) MA(4)	101.0740 1.633177 1.716449 1.227286 0.515270	1.017602 0.075945 0.121543 0.121236 0.076067	99.32569 21.50477 14.12210 10.12313 6.773914	0.0000 0.0000 0.0000 0.0000 0.0000
R-squared Adjusted R-squared S.E. of regression Sum squared resid Log likelihood	0.938449 0.936448 1.890508 439.6046 -260.5902	Mean depen S.D. depend Akaike info Schwarz crit F-statistic Drob(E statistic	Ident var Ident var criterion terion	101.0176 7.499163 4.149847 4.261255 468.8382
Inverted MA Roots	10+.87i	1087i	7240i	72+.40i

The simplest way to forecast the values between the first quarter of 1994 and the fourth quarter of 1994 is to go to click on the icon "forecast" and then choose the correct forecast sample:

Forecast	— X		
Forecast of CAEMP	Method		
Series names	C Static		
S.E. (optional):	Structural (ignore ABMA)		
GARCH(optional):	- Output		
Forecast sample	Do graph		
1994:1 1994;4	 Forecast evaluation 		
✓ Insert actuals for out-of-sample			
OK Cancel			

This will yield the following forecast:



Notice that this is the shaded area of the Figure 9.1 in your textbook.

A second more interesting way to obtain the same forecast is to follow these steps:

1) Select the sample to estimate the model:

smpl 1962q1 1993q4

2) Estimate the model:

equation ma4.ls caemp c ma(1) ma(2) ma(3) ma(4)

3) Generate a variable with the historical values:

genr history = caemp

4) Modify the your sample to include the period you want to forecast:

smpl 1994:1 1996:4

- Forecast your values (stored in yhat) and the standard errors (stored in se): ma4.forecast yhat se
- 6) Generate the variable that will store the forecasted values:

genr fcst=yhat

7) Generate the 95% confidence intervals:

genr yhatplus=yhat+1.96*se

genr yhatminus=yhat-1.96*se

8) Modify the sample to include what you want to see in the graph:

smpl 1990:1 1994:4

- Open the history, the forecast and the lower and upper limits all in one group: group group01 history fcst yhatplus yhatminus
- 10) Just open the group and graph them all together:



Notice that this is Figure 9.1 in your textbook.

What if we want to forecast all the values until the fourth quarter of 1996?

11) Just select the sample for your graph:

smpl 1990:1 1996:4

12) Open the group you produced in step (9) and graph it.



What if you want to compare the actual values with the forecast? Remember that we do have the data for the following years.

13) Modify the sample again to cover the periods of the forecast and where we have actual data:

smpl 1990:1 1994:4

14) Create another group. This time with the actual data (caemp) intead of the history.

group group02 caemp fcst yhatplus yhatminus

15) Then open the group and graph:



This is Figure 9.4 in your textbook. Notice that the actual values for the 1994 data fall inside the 95% confidence interval forecasted with the MA(4) model with data prior 1994.

Autoregressive

Before we start, let's make sure we have the correct sample we will use to estimate the model:

smpl 1962:1 1993:4

Recall that our preferred AR model was an AR(2) model:

ls caemp c ar(1) ar(2)

Dependent Variable: CAEMP Method: Least Squares Date: 11/11/10 Time: 16:59 Sample: 1990:1 1994:4 Included observations: 20 Convergence achieved after 3 iterations				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C AR(1) AR(2)	89.31536 1.225823 -0.390205	2.226978 0.206639 0.177897	40.10608 5.932207 -2.193431	0.0000 0.0000 0.0425
R-squared Adjusted R-squared S.E. of regression Sum squared resid Log likelihood Durbin-Watson stat	0.925389 0.916611 1.467765 36.62366 -34.42839 2.232747	Mean dependent var S.D. dependent var Akaike info criterion Schwarz criterion F-statistic Prob(F-statistic)		91.01688 5.082799 3.742839 3.892199 105.4244 0.000000
Inverted AR Roots	.6112i	.61+.12i		

The simplest way to forecast the values between the first quarter of 1994 and the fourth quarter of 1994 is to go to click on the icon "forecast" and then choose the correct forecast sample:

Forecast	×		
Forecast of CAEMP	Method Dunamic		
Series names Forecast name: caempf S.E. (optional): GARCH(optional):	C Static Structural (ignore ARMA)		
Forecast sample 1994:1 1994:4	Output ✓ Do graph ✓ Forecast evaluation		
Insert actuals for out-of-sample			

This will yield the following forecast:



Notice that this is the shaded area of the Figure 9.4 in your textbook.

A second more interesting way to obtain the same forecast is to follow these steps:

1) Select the sample you want to use for your model:

smpl 1962:1 1993:4

2) Estimate the AR(2) model and store your estimation under the name ar2

equation ar2.ls caemp c ar(1) ar(2)

- Select the sample you want to include in your forecast: smpl 1994:1 2010:4
- Generate the forecast and the standard error of the forecast: ar2.forecast yhat se
- Generate the variable that will store the forecasted values: genr fcst2=yhat
- 6) Generate the upper and lower levels for your 95% confidence interval:

genr yhatplus2=yhat+1.96*se

genr yhatminus2=yhat-1.96*se

7) Select the sample you want to see in your forecast graph:

smpl 1990:1 1994:4

8) Create a group of all the variables you want to include in your graph:

group group03 history fcst2 yhatplus2 yhatminus2

9) Open the group and graph all variables together:



10) If you want to see the forecast all the way until the end of 1996, just modify the sample size: smpl 1990:1 1996:4



This is figure 9.5 in your tectbook.

11) For the forecast that includes the values until 2010. smpl 1990:1 2010:4



This is figure 9.6 in your textbook.

12) If you want to include the actual values in the forecast, select the sample that contains actual values first:

smpl 1990:1 1994:4

13) Then create a group with the actual values (caempl), the forecast and the 95% upper and lower confidence intervals:

group group04 caemp fcst2 yhatplus2 yhatminus2

14) Finally, open the group and generate the line graph will all the variables:



This is 9.7 in your textbook.

Notice that the forecast lies very close to the actual values. This AR(2) model appears to be a better forecasting model than the MA(4) model discussed earlier.

gretl

Open the data. Select the sample:

📓 gretl: set sam	ple X		
Set sample range			
Start:	End: 1993:4		
Observations: 128			
<u>C</u> ancel	<u>о</u> к		

To estimate the AR(2) model, just go to "Model" then "Time Series" and select "ARIMA":

🕅 gretl: specify model			
	ARIMA		
CAEMP	Dependent variable		
	CAEMP		
	Set as default		
	Independent variables		
	lags		
Non-seasonal			
AR order: 2	specific lags		
Difference: 0			
MA order: D or	specific lags		
Seasonal			
AR order: 0 📮 Differe	nce: 0 MA order: 0		
📝 Include a constant			
Show details of iterations			
Parameter covariance matrix via Hessian			
☑ Difference the independent variables			
Use X-12-ARIMA			
Exact Maximum Likelihood			
<u>H</u> elp <u>C</u> le	ar <u>C</u> ancel <u>O</u> K		

Select the options for an AR(2) model as shown above. You will get the following output:

🙀 gretl: model 2				_ D _ X
<u>F</u> ile <u>E</u> dit <u>T</u> ests	<u>Save G</u> raphs <u>A</u>	nalysis <u>L</u> aTeX		
Function eval	uations: 55			
Evaluations o	f gradient: 2	2		
Model 2: ARMA	, using obser	vations 1962	:1-1993:4 (T	= 128)
Estimated usi	ng Kalman fil	ter (exact MI.	L)	
Dependent var Standard erro	iable: CAEMP	leggian		
	ib basea on i	cooran		
	coefficient	std. error	z p	-value
const	98.0305	4.27360	22.94 1.	91e-116 ***
phi_1	1.44834	0.0771577	18.77 1.	30e-078 ***
phi_2	-0.476697	0.0786910	-6.058 1.	38e-09 ***
Mean dependen	t var 101.0	176 S.D. de	ependent var	7.499163
Mean of innov	ations 0.003	990 S.D. of	f innovations	1.445212
Log-likelihoo	d -230.6	533 Akaike	criterion	469.3067
Schwarz crite	rion 480.7	148 Hannan-	-Quinn	473.9418
	Re	al Imaginar	V Modulus	Frequency
AR	1.00			
Root 1	1.06	74 0.000) 1.0609	0.0000

To obtain the forecast just go to "Analysis" then "Forecast" and select the sample of your choice:

📓 gretl: forecast			×
Forecast range:	Start 1990:1	End 1996:4	
 automatic for 	ecast (dynan	nic out of sample	e)
odynamic forecast			
static forecast	t		
Number of pre-forecast observations to graph 65			
Show fitted values for pre-forecast range			
Plot confidence in	nterval using	error bars	•
1 - α = 0.95	N.		
<u>H</u> elp		<u>C</u> ancel	<u>О</u> К

Gretl will generate the following beautiful graph:



This graph corresponds to a combination of figures 9.5 and 9.7 in your text. This graph shows the actual values, the in-sample forecasted values, the actual values for 1994, the out-of-sample forecast for 1994 through 1996 and the 95% confidence intervals for the out-of-sample forecast.