Chapter 15: Forecasting

In this chapter:

Forecasting chicken consumption using OLS (*UE* 15.1, Equation 6.8, p. 501):

The chicken demand model developed in Chapter 6 was estimated using data from 1951-1994. In order to forecast a variable beyond 1994, the workfile range and sample must be expanded. Follow these steps to forecast chicken consumption for 1995 - 1997 using ordinary least squares:

Step 1. Open the EViews workfile named *Chick6.wf1*.

Step 2. To expand the workfile range, select **Procs/Change Workfile Range** from the workfile menu bar, change the End date from 1994 to 1997, and click **OK**.

Step 3. To expand the sample, select **Sample** on the workfile menu bar, change the second number in the window from 1994 to 1997, and click **OK**. After **Steps 2 & 3** are completed, the top portion of the EViews workfile should look like the graphic on the right (note that the second date for Range: & Sample: have changed from 1994 to 1997).

Step 4. To open *Y, PC, PB, & YD* in a group window, hold down the **Ctrl** button, click on *Y, PC, PB, & YD*, select **Show** from the workfile toolbar, and click **OK**.

Step 5. To enter the data for *Y*, *PC*, *PB*, *& YD* from the text & footnote number 4 in *UE*, p. 502 (see table below), click **edit+/-** on the group menu bar, scroll to the bottom of the spreadsheet and replace the *NA*'s with the appropriate numbers for the period 1995 - 1997. Press **Enter** after each entry and click **edit+/-** on the group menu bar a second time to save your changes. Scroll to the bottom of the group spreadsheet and make sure that it looks like the table below.

	Y	*PC*	*PB*	*YD*
1995	80.30000	6.500000	61.80000	200.6200
1996	81.90000	6.700000	58.70000	208.5000
1997	83.70000	7.700000	63.10000	216.3100

Step 6. Select **Objects/New Object/Equation** on the workfile menu bar, enter *Y C PC PB YD* in the Equation Specification: window, change the Sample: to 1951 - 1994, and click **OK**.[1]

Step 7. Select **Name** on the equation window menu bar, enter *EQ01* in the Name to identify object: window, and click **OK**.

Step 8. Select **Forecast** on the equation menu bar, enter *YFOLS* in the Forecast name: window, set the Sample range to forecast: to 1951 1997, and click **OK**.

Step 9. Open *YFOLS & Y* in a group window by holding down the **Ctrl** button, clicking on *YFOLS & Y*, selecting **Show** from the workfile toolbar, and clicking **OK**. Scroll to the bottom of the group spreadsheet and make sure that it looks like the table below. Note that the predicted values for *YFOLS* in the EViews spreadsheet are a slightly different than those in the *UE*, p. 502 table, because the text uses rounded coefficient values for Equation 6.8 and we used non-rounded EViews estimated coefficients.

	YFOLS	Y
1995	80.71830	80.30000
1996	82.06108	81.90000
1997	83.65985	83.70000

Step 10. Select **Save** on the workfile menu bar to save your changes.

Forecasting chicken consumption using a generalized least squares model estimated with the AR(1) method (*UE*, 15.2.2):

Complete the section entitled Forecasting chicken consumption using OLS before attempting this section. The OLS estimate for chicken consumption should already have been estimated and saved as *EQ01* in the *Chick6.wf1* workfile and the workfile range & sample should have been expanded to 1997 and the data for 1995 - 1997 entered into the workfile spreadsheet.

Step 1. Open the EViews workfile named *Chick6.wf1*.

Step 2. Select **Objects/New Object/Equation** on the workfile menu bar, enter *Y C PC PB YD* AR(1) in the Equation Specification: window, change the Sample: to 1951 - 1994, and click **OK**.

Step 3. Select **Name** on the equation window menu bar, enter *EQ04* in the Name to identify object: window, and click **OK**.

Step 4. Select **Forecast** on the equation menu bar, enter *YFAR1* in the Forecast name: window, set the Sample range to forecast: to 1951 1997, and click **OK**.

Step 5. Open *YFAR1 & Y* in a group window by holding down the **Ctrl** button, clicking on *YFOLS & Y*, selecting **Show** from the workfile toolbar, and clicking **OK**. Scroll to the bottom of the group spreadsheet and make sure that it looks like the table below.

	YFAR1	Y
1995	80.05606	80.30000
1996	81.67044	81.90000
1997	83.85621	83.70000

Step 6. Select **Save** on the workfile menu bar to save your changes.

[1] The reason for changing the workfile sample back to the original setting is to ensure that the equation estimation uses only the data in the original sample (i.e., 1951-1994).

Forecasting chicken consumption using a generalized least squares model estimated with the Cochrane-Orcutt method(*UE*, 15.2.2):

The Cochrane-Orcutt method is a multi-step procedure that requires re-estimation until the value for the estimated first order serial correlation coefficient converges. Follow these steps to use the Cochrane-Orcutt method to estimate a GLS model for chicken consumption. If you have questions concerning the procedure, review the appropriate section of Chapter 9. Complete the section entitled Forecasting chicken consumption using OLS before attempting this section. The OLS estimate for chicken consumption should already have been estimated and saved as *EQ01* in the *Chick6.wf1* workfile and the workfile range & sample should have been expanded to 1997 and the data for 1995 - 1997 entered into the workfile spreadsheet.

Step 1. Open the EViews workfile named *Chick6.wf1*, select **Sample** on the workfile menu bar, change the End date from 1997 to 1994, and click **OK**.

Step 2. Open *EQ01* by double clicking its icon in the workfile window. Create a new series for the residuals (errors) for *EQ01*, by selecting **Procs/Make Residual Series** on the *EQ01* window menu bar, enter the name *E* as the Name for residual series, and click **OK**.

Step 3. Select **Objects/New Object/Equation** on the workfile menu bar. Enter *E C E(-1)* in the Equation Specification: window and click **OK**. The coefficient on the *E(-1)* term (i.e., ρ), is positive and significant at the 1% level (t-statistic = 3.69 and Prob value = 0.0006). This evidence points to positive serial correlation. Select **Name** on the equation menu bar, enter *EQ02* in the Name to identify object: window, and click **OK**.

Step 4. Select **Objects/New Object/Equation** on the workfile menu bar, enter *Y-EQ02.@COEFS(2)*Y(-1) C PC-EQ02.@COEFS(2)*PC(-1) PB-EQ02.@COEFS(2)*PB(-1) YD-EQ02.@COEFS(2)*YD(-1)* in the Equation Specification: window, and click **OK**. Select **Name** on the equation menu bar, enter *EQ03* in the Name to identify object: window, and click **OK**.[2]

Step 5. Calculate the new residual series by typing the following formula in the command window: *series E = Y-(EQ03.@COEFS(1) + EQ03.@COEFS(2)*PC + EQ03.@COEFS(3)*PB + EQ03.@COEFS(4)*YD)* and pressing **Enter** on the keyboard.

Step 6. Re-run *EQ02*, *EQ03* and the *series E* equation[3] in step 5 sequentially until the estimated ρ (i.e., the coefficient on the *E(-1)* term from *EQ02*) does not change by more that a pre-selected value such as 0.001. After 6 iterations, the value for ρ converged (i.e., ρ changed from 0.902484 to 0.902802 between the 5^{th} and 6^{th} iteration).

Step 7. Convert the constant from the final version of *EQ03* by typing the following formula in the command window: *scalar beta0=EQ03.@COEFS(1)/(1-EQ02.@COEFS(2))* and pressing **Enter** on the keyboard.

Step 8. Double click the beta0 icon in the workfile window and read the value, *26.72580*, for the estimated constant in the lower left of the screen. The final GLS equation for chicken consumption is *Y = 26.72580 - 0.109891*PC + 0.090293*PB + 0.242032*YD*, similar to the truncated coefficient model printed in *UE*, Equation 9.22, p. 507.

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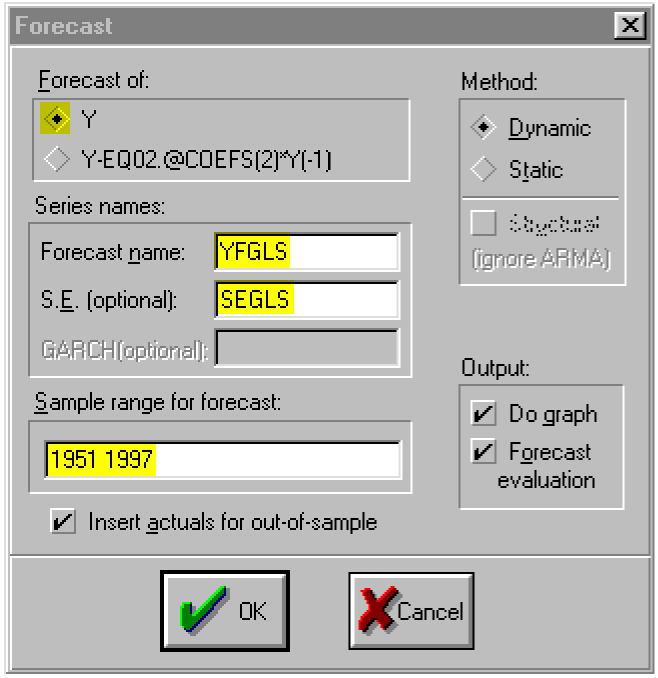
[2] Note that the variable names are truncated in the EViews regression output table because they don't fit in the variable name cell. Nonetheless, the regression is correct. The equation, with the entire variable names printed out, can be viewed by selecting **View/Representations** on the equation menu bar.

[3] You can re-run an equation by opening the equation in a window, selecting **Estimate** on the equation menu bar and clicking **OK**. You can re-run the *series e* equation by clicking the cursor anywhere on the equation in the command window and hitting **Enter** on the keyboard.

Step 9. Select **Sample** on the workfile menu bar and change the End date from 1994 to 1997. Open *EQ03* and select **Forecast** on the equation menu bar. Make sure that *Y* is checked in the Forecast of: window. Change the Forecast name: to *YFGLS*. Check to make sure that the Sample range to forecast: is set to 1951 1997, and click **OK** (see graphic on the right).



Step 10. Open *YFGLS & Y* in a group window by holding down the **Ctrl** button, clicking on *YFGLS & Y*, selecting **Show** from the workfile toolbar, and clicking **OK**. Scroll to the bottom of the group spreadsheet and make sure that it looks like the table below.

	YFGLS	Y
1995	80.05495	80.30000
1996	81.66931	81.90000
1997	83.85514	83.70000

Step 11. Select **Save** on the workfile menu bar to save your changes.

Step 12. Note that the predicted values for ***YFGLS*** in the EViews spreadsheet are slightly different than those in the *UE*, p. 502 table. This is due to the fact that the text uses rounded coefficient values for Equation 9.22 and we used non-rounded EViews estimated values. Delete this group object when finished.

Forecasting confidence intervals (*UE*, 15.2.3):

Follow these steps to make a point prediction of the weight of a male who stands 6'1" tall and calculate the high and low estimated values for a 95% confidence interval.

Step 1. Open the EViews workfile named *Htwt1.wf1*.

Step 2. Follow **Steps 2 & 3** of the section entitled Forecasting chicken consumption using OLS to expand the workfile range and sample range from *20* to *21*. Double click the *X* variable icon in the workfile window, click **edit+/-** on the series menu bar, scroll to the bottom of the spreadsheet, replace the *NA* for the 21^{st} observation with 13 (i.e., height in inches above 5'), and press **Enter**. To save your changes, click **edit+/-** on the series menu bar a second time.

Step 3. Select **Objects/New Object/Equation** on the workfile menu bar, enter *Y C X* in the Equation Specification: window, and click **OK.** Select **Name** on the equation menu bar and enter *EQ01* in the Name to identify object: window.

Step 4. Select **Forecast** on the equation menu bar. Enter *YF* in the Forecast name: window. Check to make sure that the Sample range to forecast: is set to 1 21, and click **OK**. To view the forecast weight of the male student standing 6'1" tall, double click the *YF* series icon in the workfile window and scroll to the bottom. The forecast weight for the 21^{st} observation is 186.2993.

Step 5. Select **Sample** on the workfile menu bar, change the Sample range pairs (or sample object to copy): to 1 20, and click **OK.**

Step 6. Select **Procs/Make Residual Series** on the *EQ01* window menu bar. Enter the name *E* as the Name for residual series, and click **OK**.

Step 7. Generate a new series for the residuals squared (i.e., *E2*) by selecting **Genr** on the workfile menu bar, entering the equation: *E2=E^2* in the Enter equation: window, and clicking **OK.**

Step 8. Generate a new series named *XDEV2* for the residuals squared by selecting **Genr** on the workfile menu bar, entering the equation: *XDEV2=(x-@mean(x))^2* in the Enter equation: window, and clicking **OK**.

Step 9. To calculate the upper confidence interval for the 6'1" student, type the following formula (all one equation) in the command window, and press **Enter** on the keyboard:
scalar YF_HIGH=Yf(21)+((@sum(E2)/@obs(E2)(1+(1/@obs(E))+((X(21)-@mean(X))^2/@sum(XDEV2))))^.5)*@qtdist(.975,(eq01.@regobs-eq01.@ncoef))*

Double click *YF_HIGH* in the workfile window to view the upper confidence interval in the lower left of the screen (i.e., 

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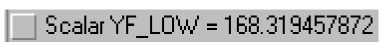
Step 10. To calculate the lower confidence interval for the 6'1"student, type the following formula (all one equation) in the command window and press **Enter** on the keyboard:
scalar YF_LOW=Yf(21)-((@sum(E2)/@obs(E2)(1+(1/@obs(E))+((X(21)-@mean(X))^2/@sum(XDEV2))))^.5)*@qtdist(.975,(eq01.@regobs-eq01.@ncoef))*

Double click *YF_LOW* in the workfile window to view the upper confidence interval in the lower left of the screen (i.e., 

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Forecasting with simultaneous equation systems (*UE* 15.2.4):

EViews has a Type of Object: named **Model** that enables you to solve a system of simultaneous equations and use the model for forecasting and simulation. EViews models do not contain unknown coefficients to be estimated. Instead, the **Model** object allows you to solve for unknown values for the endogenous variables. For a description of various methods of creating model objects in EViews and techniques for using these objects to forecast and perform simulations see **Help/Contents/Hypothesis Testing and Forecasting/Model Solve (Forecast and Simulation)**.

This topic is beyond the scope of this guide but, if you were to do it, you would follow these steps to forecast with a simultaneous equation model:

Step 1. Create a model by selecting **Object/New Object/Model** in the main toolbar, type in a name for your model in the Name for Object: window, click **OK**, and enter the previously estimated equations in the model window.

Step 2. To solve the model, simply select the **Solve** button in the model toolbar. You should see the Model Solution dialog box offering various options for controlling the solution process. EViews solves for the endogenous variables, given data for the exogenous variables.

Forecasting with ARIMA models (*UE* 15.3):

ARIMA (autoregressive, integrated, moving average) models use three tools for modeling the serial correlation in the disturbance:

1. The first tool is the autoregressive or AR term. The AR(1) model introduced above uses only the first-order term but, in general, you may use additional, higher-order AR terms. Each AR term corresponds to the use of a lagged value of the residual in the forecasting equation for the unconditional residual. An autoregressive model of order p is denoted as AR(p).
2. The second tool is the integration order term. Each integration order corresponds to differencing the series being forecast. A first-order integrated component means that the forecasting model is designed for the first difference of the original series. A second-order component corresponds to using second differences, and so on.
3. The third tool is the MA, or moving average term. A moving average forecasting model uses lagged values of the forecast error to improve the current forecast. A first-order moving average term uses the most recent forecast error, a second-order term uses the forecast error from the two most recent periods, and so on.

In ARIMA forecasting, you assemble a complete forecasting model by using combinations of the three building blocks described above. You can use the correlogram view of a series for this purpose (see Testing for nonstationarity by calculating the auto correlation function ACF for a description of this process).

UE did not present an example of ARIMA estimation, but one will be estimated here to demonstrate how to estimate an ARIMA model in EViews. In Chapter 12 we determined that *CO* was integrated order one and probably followed an AR(1) process. For purposes of illustration, follow these steps to estimate an ARIMA(*1*,*1*,*2*)[4] model for *CO*:

Step 1. Open the EViews workfile named *Macro14.wf1*.

Step 2. Select **Objects/New Object/Equation** on the workfile menu bar, enter *D(CO) C AR(1) MA(1) MA(2)* in the Equation Specification: window, and click **OK** to view the EViews Estimation Output printed below.

Dependent Variable: D(CO)				
Method: Least Squares				
Date: 07/15/00 Time: 10:35				
Sample(adjusted): 1965 1994				
Included observations: 30 after adjusting endpoints				
Convergence achieved after 100 iterations				
Backcast: OFF (Roots of MA process too large for backcast)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	67.74008	3.655560	18.53070	0.0000
AR(1)	0.718868	0.251279	2.860836	0.0082
MA(1)	-0.943222	0.362834	-2.599598	0.0152
MA(2)	-0.773132	0.292764	-2.640801	0.0138
R-squared	0.588152	Mean dependent var		72.04333
Adjusted R-squared	0.540631	S.D. dependent var		39.20346
S.E. of regression	26.57083	Akaike info criterion		9.521071
Sum squared resid	18356.23	Schwarz criterion		9.707897
Log likelihood	-138.8161	F-statistic		12.37671
Durbin-Watson stat	2.201209	Prob(F-statistic)		0.000032
Inverted AR Roots	.72			
Inverted MA Roots	1.47	-.53		
	Estimated MA process is noninvertible			

Step 3. Select **Name** on the equation menu bar and enter *EQ01* in the Name to identify object: window.

Step 4. Follow **Steps 2 & 3** of the section entitled Forecasting chicken consumption using OLS to expand the workfile range and sample range from *1994* to *1998*.

Step 5. Select **Forecast** on the *EQ01* menu bar. Enter *COF* in the Forecast name: window. Check to make sure that the Sample range to forecast: is set to 1998, and click **OK**.

Step 6. To view the forecast, double click the *COF* series and scroll to the bottom of the spreadsheet to view the following forecast values for 1995 - 1998:

	COF
1995	3536.473
1996	3604.213
1997	3671.953
1998	3739.694

[4] ARIMA(*1*,*1*,*2*) represents a model that has a first order autoregressive term (i.e., AR(1)), is integrated order one and has two moving average terms (i.e., MA(1) & MA(2)).

Exercises:

2.
   a.
   b. Refer to Running a simple regression for Woody's Restaurants example to estimate Equation 3.7 and Forecasting chicken consumption using OLS to make an unconditional forecast of the gross sales volume at the three proposed restaurant sites.
   c. Open the EViews workfile named *Fish8.wf1*, select **Objects/New Object/Equation** on the workfile menu bar, enter *F C PF/PB log(YD) P* in the Equation Specification: window, and click **OK**. Then follow the steps in Forecasting chicken consumption using OLS to make an unconditional forecast of *F* for 1971-1974, given the numbers printed in the table in *UE*, Exercise 2c, p.517.

3. Open the EViews workfile named *Htwt1.wf1*, select **Objects/New Object/Equation** on the workfile menu bar, enter *Y C X* in the Equation Specification: window, and click **OK**. Ask three students their height (*X=the height in inches exceeding 5'*). Then follow the steps in Forecasting chicken consumption using OLS to make the Unconditional forecast of the weight (*YF*) for each student in your sample. Ask these students their actual weight (*Y*) and compare *Y* with *YF*.

4.
   a. Follow the steps in Forecasting confidence intervals to calculate the 95% confidence interval for the weight for a person standing 5'9" tall (i.e., $X = 9$).
   b.

6. Follow the steps in Chapter 1 for each part of this exercise.