EVIEWS tutorial: time series analysis

Professor Roy Batchelor
City University Business School, London
& ESCP, Paris

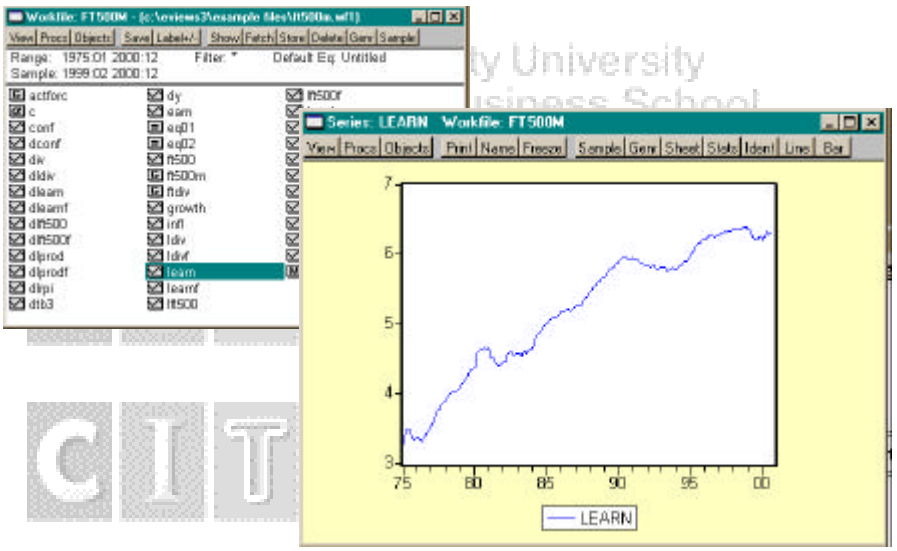
© Roy Batchelor 2000

EVIEWS

- On the City University system, EVIEWS 3.1 is in Start/ Programs/ Departmental Software/CUBS
- Earnings time series in FT500M.wf1
- Box Jenkins analysis
  - ACF, PACF
  - comparing models
- Exponential smoothing models

© Roy Batchelor 2000

Log-Earnings data

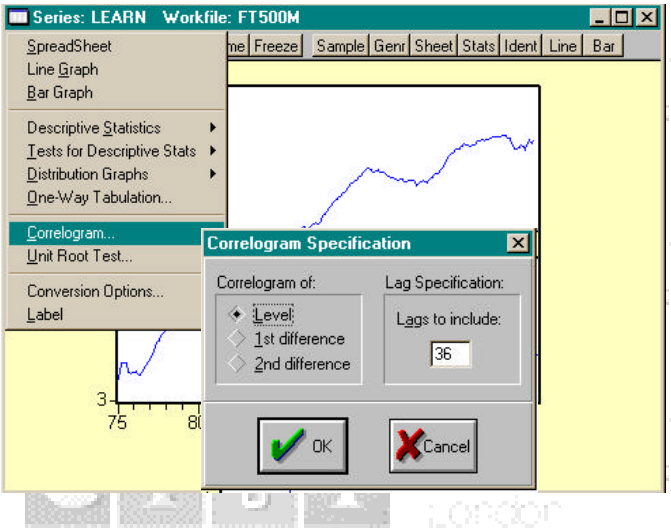


© Roy Batchelor 2000

Box-Jenkins (ARIMA) modeling

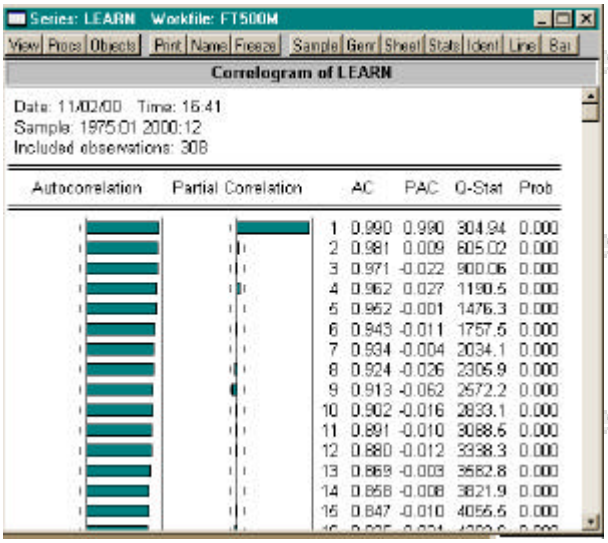
© Roy Batchelor 2000

Correlogram command



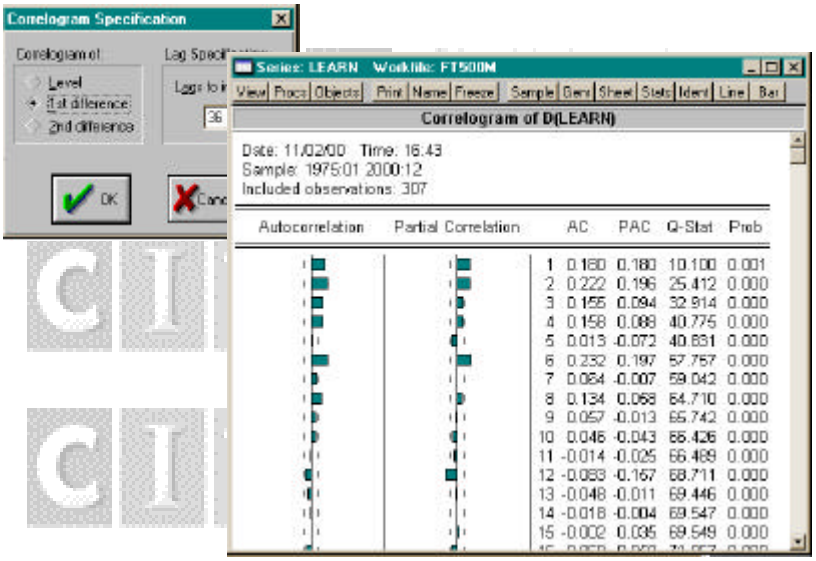
© Roy Batchelor 2000

ACF, PACF for level variable:LEARN



© Roy Batchelor 2000

ACF, PACF for 1st difference: DLEARN



© Roy Batchelor 2000

ARIMA: the Eviews notation

ARIMA Theory

ARIMA (autoregressive integrated moving average) models are generalizations of the simple AR model that use three tools for modeling the serial correlation in the disturbance:

- 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, AR(p) has the form

$$u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \cdots + \rho_p u_{t-p} + \epsilon_t$$

- 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.

- 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. An MA(q) has the form:

$$u_t = \epsilon_t + \theta_1 \epsilon_{t-1} + \theta_2 \epsilon_{t-2} + \cdots + \theta_q \epsilon_{t-q}$$

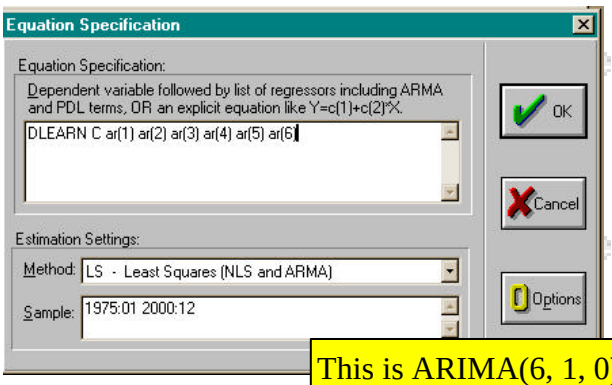
Some authors and software packages use the opposite sign convention for the θ coefficients so that the interpretation of the signs of the MA coefficients may be reversed.

The autoregressive and moving average specifications can be combined to form an ARIMA(p,q) specification

$$u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \cdots + \rho_p u_{t-p} + \epsilon_t + \theta_1 \epsilon_{t-1} + \theta_2 \epsilon_{t-2} + \cdots + \theta_q \epsilon_{t-q}$$

© Roy Batchelor 2000

AR(6) model for DLEARN



This is ARIMA(6, 1, 0) for EARN
or equivalently
ARIMA(6, 0, 0) for DLEARN
or equivalently
AR(6) for DLEARN

© Roy Batchelor 2000

AR(6) model output

Equation: UNTITLED Workfile: FT500M

Dependent Variable: DLEARN
Method: Least Squares
Date: 11/02/00 Time: 16:50
Sample(adjusted): 1975:08 2000:08
Included observations: 301 after adjusting endpoints
Convergence achieved after 3 iterations

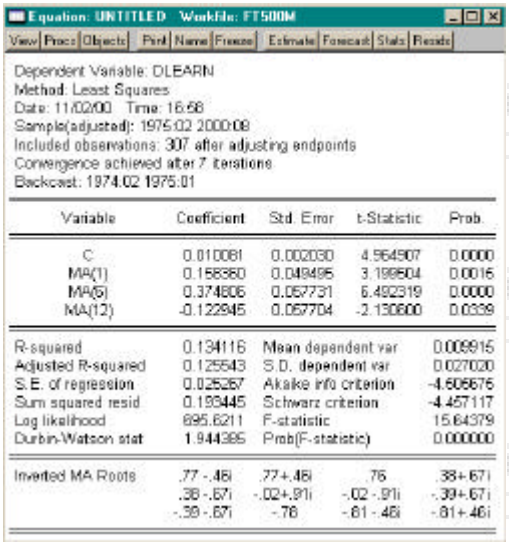
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009416	0.003164	2.976250	0.0032
AR(1)	0.162254	0.057336	2.829895	0.0050
AR(2)	0.143486	0.057773	2.483600	0.0136
AR(3)	0.082823	0.058684	1.411346	0.1592
AR(4)	0.066240	0.056446	1.173503	0.2415
AR(5)	-0.108060	0.055840	-1.935162	0.0539
AR(6)	0.209015	0.055818	3.744591	0.0002

R-squared	0.143314	Mean dependent var	0.009450
Adjusted R-squared	0.125830	S.D. dependent var	0.026075
S.E. of regression	0.024378	Akaike info criterion	-4.567207
Sum squared resid	0.174735	Schwarz criterion	-4.480995
Log likelihood	694.3647	F-statistic	8.197135
Durbin-Watson stat	1.965974	Prob(F-statistic)	0.000000

Inverted AR Roots	.84	.41 - .57i	.41 + .57i	-.34 - .70i
	-.34 + .70i	-.82		

© Roy Batchelor 2000

Seasonal MA model



Equation: UNTITLED Workfile: FT500M

View | Procs | Objects | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: DLEARN
Method: Least Squares
Date: 11/02/00 Time: 16:58
Sample(adjusted): 1975:02 2000:08
Included observations: 307 after adjusting endpoints
Convergence achieved after 7 iterations
Backcast: 1974:02 1975:01

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.010081	0.002030	4.964907	0.0000
MA(1)	0.158360	0.049495	3.199504	0.0016
MA(6)	0.374806	0.057731	6.492319	0.0000
MA(12)	-0.122945	0.057704	-2.130600	0.0339

R-squared	0.134116	Mean dependent var	0.009915
Adjusted R-squared	0.125543	S.D. dependent var	0.027020
S.E. of regression	0.025267	Akaike info criterion	-4.606676
Sum squared resid	0.193445	Schwarz criterion	-4.457117
Log likelihood	895.6211	F-statistic	15.64379
Durbin-Watson stat	1.944385	Prob(F-statistic)	0.000000

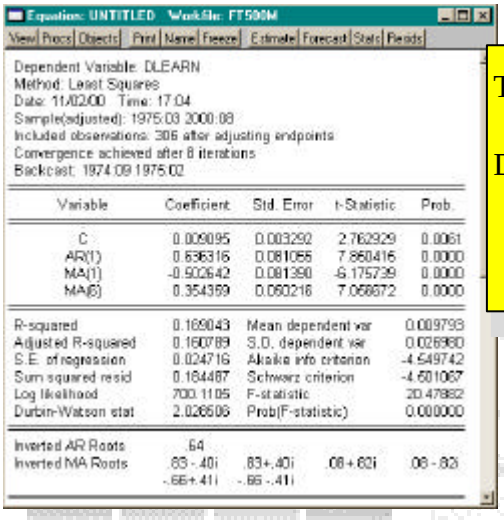
Inverted MA Roots	.77 -.46i	.77+.46i	.76	.38+.67i
	.38 -.67i	-.02+.91i	-.02 -.91i	-.39+.67i
	-.39 -.67i	-.76	-.81 -.46i	-.81+.46i

This model is

$$DLEARN_t = r_0 + u_t + \theta 1 ut_{-1} + \theta_6 u_{t-6} + \theta_{12} u_{t-12}$$

© Roy Batchelor 2000

Mixed AR/MA model



Equation: UNTITLED Workfile: FT500M

View | Procs | Objects | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: DLEARN
Method: Least Squares
Date: 11/02/00 Time: 17:04
Sample(adjusted): 1975:03 2000:08
Included observations: 306 after adjusting endpoints
Convergence achieved after 8 iterations
Backcast: 1974:09 1975:02

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009095	0.003292	2.762929	0.0061
AR(1)	0.636316	0.081055	7.850416	0.0000
MA(1)	-0.902642	0.081398	-6.175739	0.0000
MA(6)	0.354369	0.050216	7.056872	0.0000

R-squared	0.169043	Mean dependent var	0.009793
Adjusted R-squared	0.160789	S.D. dependent var	0.026980
S.E. of regression	0.024716	Akaike info criterion	-4.549742
Sum squared resid	0.184487	Schwarz criterion	-4.501067
Log likelihood	700.1105	F-statistic	20.47882
Durbin-Watson stat	2.026606	Prob(F-statistic)	0.000000

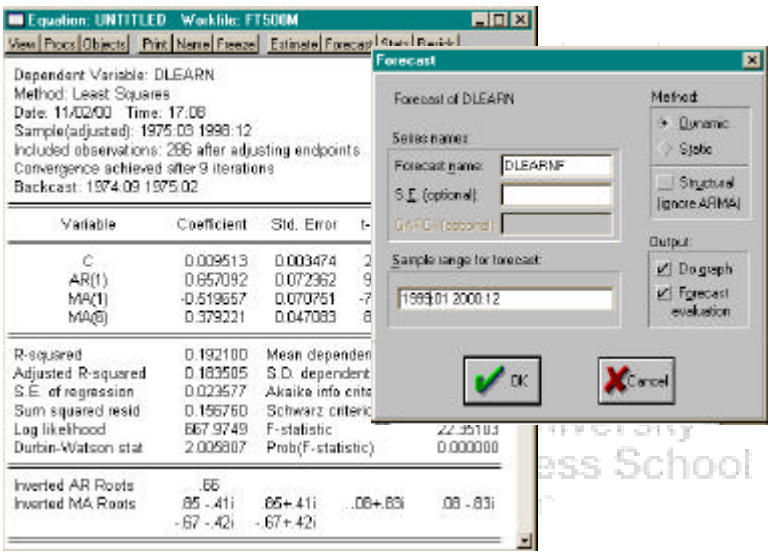
Inverted AR Roots	.64			
Inverted MA Roots	.83 -.40i	.83+.40i	.08+.83i	.08 -.83i
	-.66+.41i	-.66 -.41i		

This model is

$$DLEARN_t = r_0 + \rho_1 DLEARN_{t-1} + u_t + \theta_1 u_{t-1} + \theta_6 u_{t-6}$$

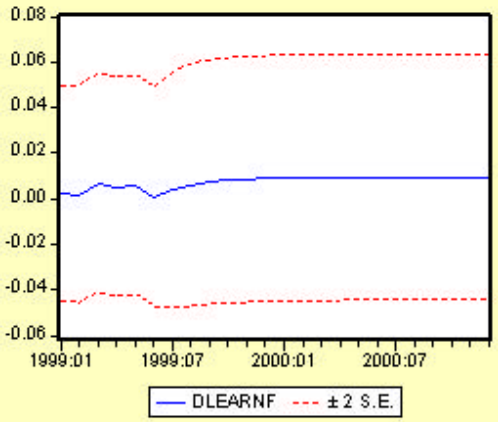
© Roy Batchelor 2000

Forecast evaluation



© Roy Batchelor 2000

Multiperiod out of sample forecasts: 1999-2000

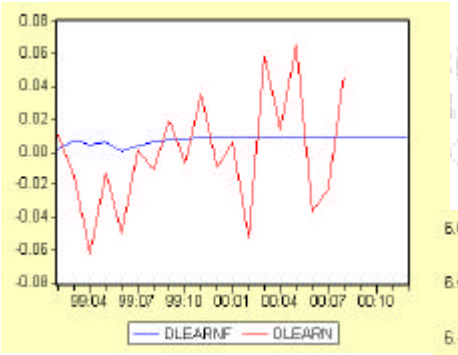


Forecast: DLEARNF
Actual: DLEARN
Sample: 1999:01 2000:12
Include observations: 20

Root Mean Squared Error	0.035365
Mean Absolute Error	0.029234
Mean Abs. Percent Error	114.3886
Theil Inequality Coefficient	0.829923
Bias Proportion	0.075781
Variance Proportion	0.829945
Covariance Proportion	0.094275

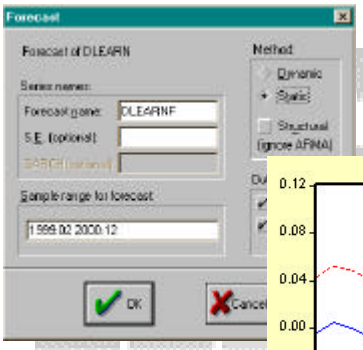
© Roy Batchelor 2000

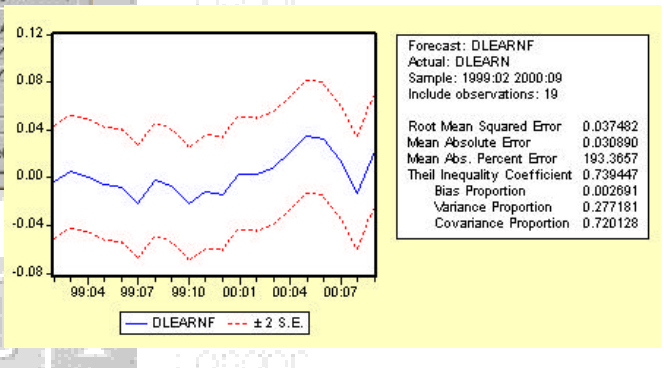
Multiperiod forecasts v. actual



© Roy Batchelor 2000

One-period ahead forecasts



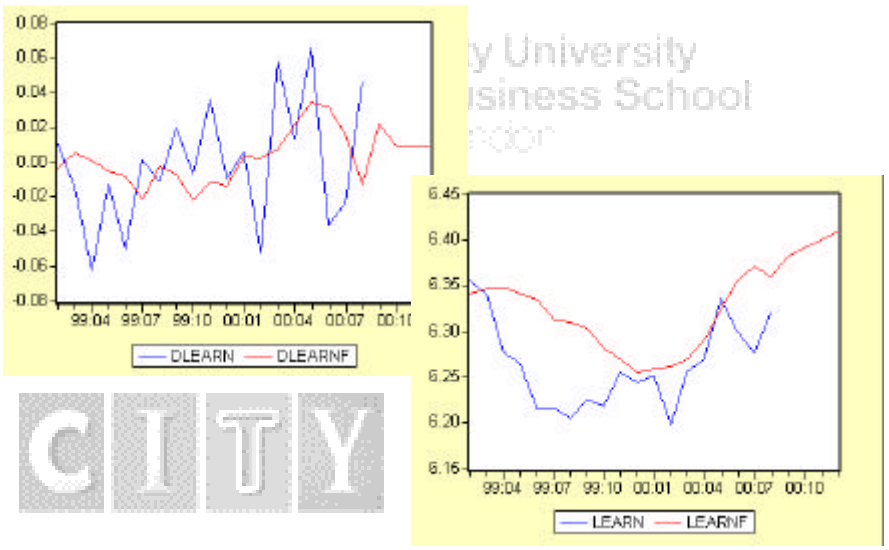


Forecast: DLEARNF
Actual: DLEARN
Sample: 1999:02 2000:09
Include observations: 19

Root Mean Squared Error	0.037482
Mean Absolute Error	0.030890
Mean Abs. Percent Error	193.3657
Theil Inequality Coefficient	0.739447
Bias Proportion	0.002691
Variance Proportion	0.277181
Covariance Proportion	0.720128

© Roy Batchelor 2000

One-period ahead forecasts v. actual



City University Business School London

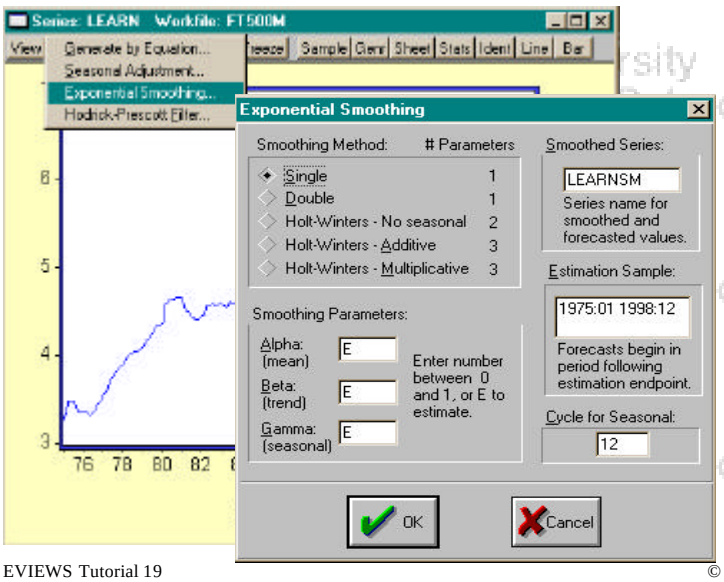
© Roy Batchelor 2000

Exponential smoothing models

City University Business School London
City University Business School London
City University Business School London

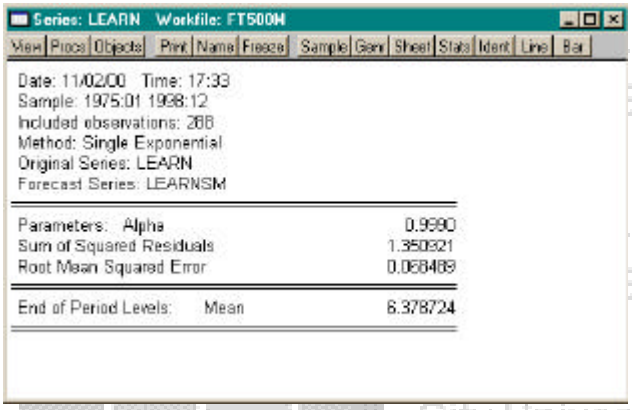
© Roy Batchelor 2000

PROCS/ Exponential smoothing menu



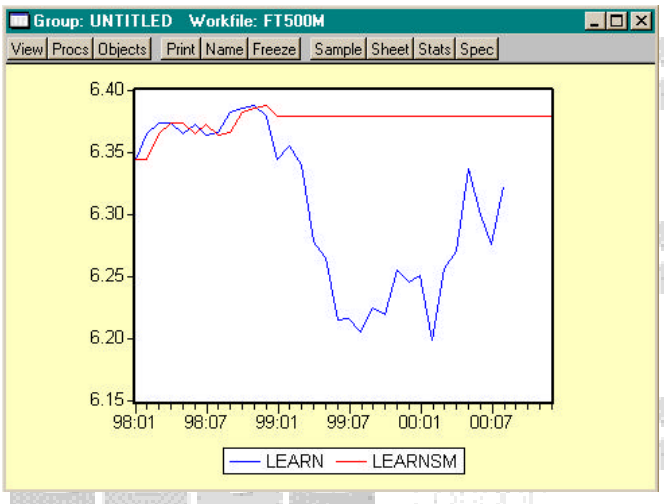
© Roy Batchelor 2000

Single exponential smoothing



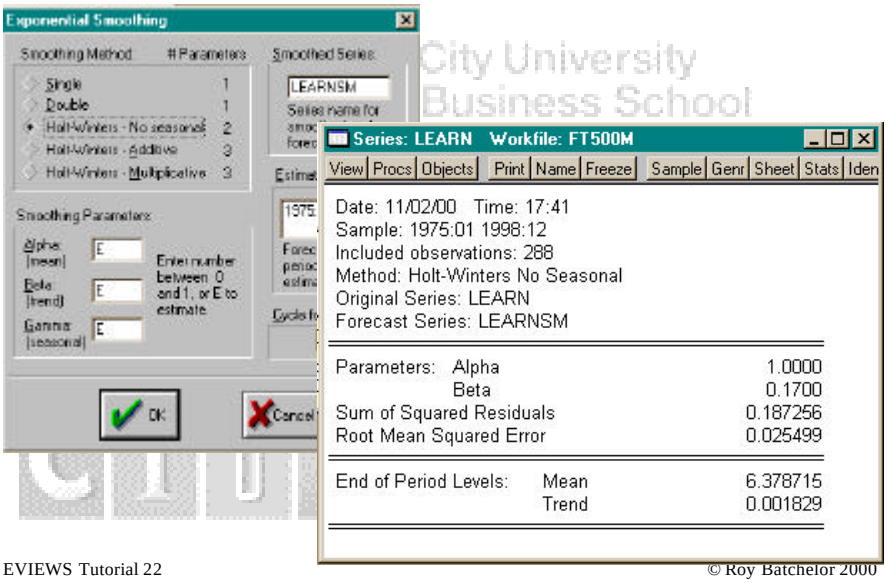
© Roy Batchelor 2000

SES forecast for 1999-2000



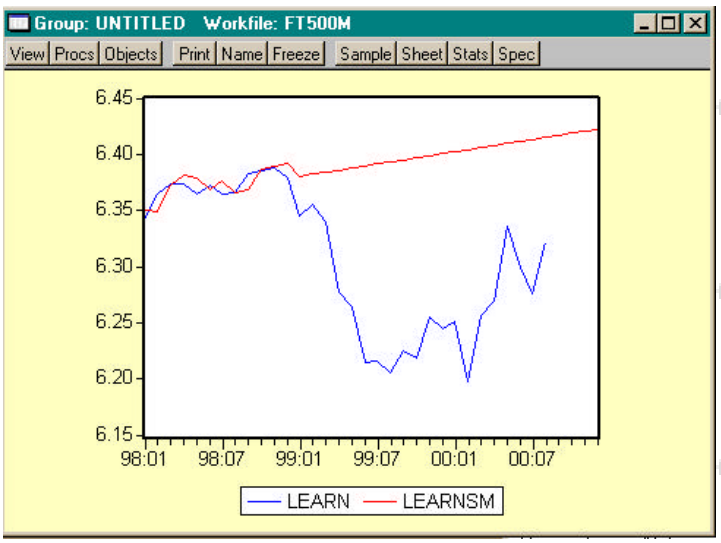
© Roy Batchelor 2000

Holt linear trend model



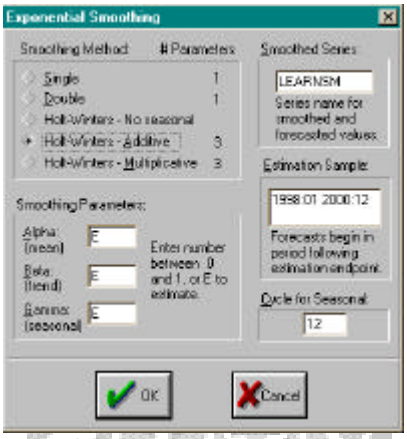
© Roy Batchelor 2000

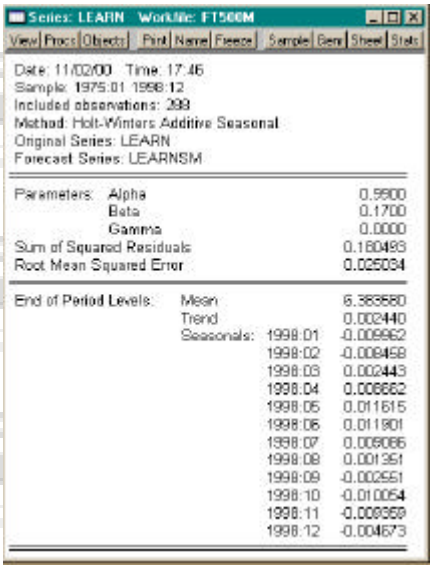
Holt linear trend forecast for 1999-2000



© Roy Batchelor 2000

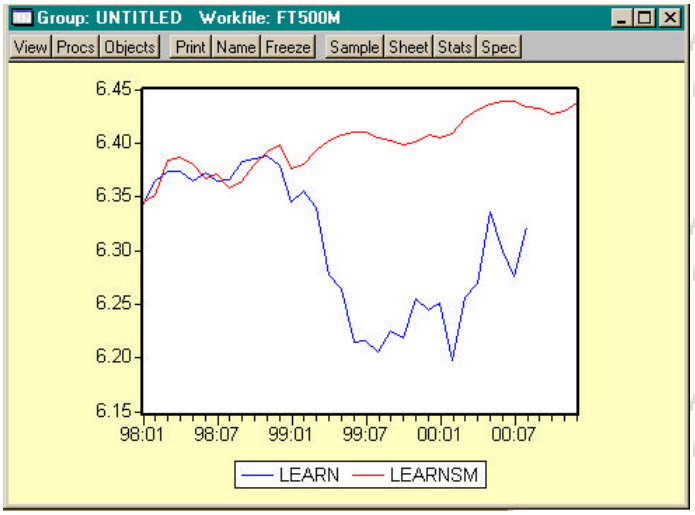
Holt-Winters seasonal model





© Roy Batchelor 2000

Holt-Winters forecast for 1999-2000



© Roy Batchelor 2000