Risk Analysis using OxMetrics ver. 5

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Developers of OxMetrics

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Part I

- The OxMetrics Interface
- Importing Data
- Dates
- Exploratory Graphical Analysis
- PcGive Modeling
 - Dynamic models
 - Model diagnostics
 - Post estimation Graphics
 - Forecasting
 - Forecast Evaluation
- Automatic variable and model selection with Autometrics
 - Theory
 - Settings
 - Intervention modeling
 - Output analysis
 - For univariate and multivariate models

Part II

- Volatility analysis with G@RCH models
 - First generation univariate G@RCH
 - ARCH, GARCH
 - Estimation (QML with bounds and Simulated annealing)
 - Diagnostics
 - Forecasting (simulated confidence intervals)
 - Forecast Evaluation
 - Second generation univariate G@RCH
 - GARCH-in-mean
 - EGARCH
 - GJR GARCH
 - Leverage effects and volatility smiles

G@RCH Advances

- VaR forecasting
- Simulations
- Diffusion models (Ox)
 - Stochastic volatility assessment
 - Realized and Integrated volatility with jumps
 - Microstructure noise with jumps
- Long-Memory Models
 - IGARCH
 - APARCH Dingle, Engle, Granger
 - FIGARCH BBM, Chung
 - FIEGARCH BBM, Chung
 - HYGARCH

Multivariate GARCH

- Multivariate G@RCH
 - BEKK models
 - Factor garch:
 - OGARCH,
 - GOGARCH
- Dynamic correlations:
 - CCC,
 - DCC

The OxMetrics Interface

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Importing Excel data

- We download some data from Yahoo finance and create a cvs file.
- We import this data and sort it into ascending order so the data set appears set as follows.

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Save the csv file

- This file should be saved in the data directory within OxMetrics5.
- OxMetrics is usually stored in the
- C:\program files\OxMetrics5 directory

Click on the open file folder icon

We click on the open file folder icon in the upper left navigation window



Find the excel file you saved in the data directory

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Double click on the file icon to open the loaded file

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Graphical Preview

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This opens a graphics dialog box Select the series and move it into the graph window on the left by clicking on the arrow button

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Click on the actual series button on the lower left

Graphics - sp500.csv	🔀
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Actual series (separately) Scatter plot (YX) All plot	types >

Generating a time series plot



Dates

- The horizontal axis consists of observation numbers.
- To construct dates for those periods, we count the number of observations in the Excel file.
- There are 4342 observations beginning in January 2, 1990.
- We will import the data into a OxMetrics file.

Select the SP500 column in the csv file. Then click on copy

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Construction of a dated Ox file

Click on copy

Click on OK

- Click on file new and a
 - Dialog box opens
- Select OxMetrics (Data: *in7) file

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	OK Cancel	

A Date dialogue box opens

 Change Sample								
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1996 - 2005 Annual								
Frequency and Start Date								
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Days per week 5								
Start Date 1996								
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Sample Size								
Observations 0								
Action Add observations at the end 😪								
OK Cancel								



Paste the SP500 into the new data set

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Now Graph the New Series and save the data set



Dates: frequencies/holidays

Change Sample	
Current Database Sample	
1996 - 2005 Annual	
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Days per week	Annual or undated Quarterly Monthly Weekly (52/year)
Start Date	Other fixed frequency Dated: daily or weekly
year or 1 for undated	
Sample Size	
Observations	0
Action	Add observations at the end 🛛 🔽
OK Cancel	

Other graphics

Paneled time series plots



Overlaid Time Series Plots



Time series Properties

ACF and PACF correlograms



Cross Correlation Function



Distributional Plots



Distributional Kernal Density Plots and Normal Quantile plots



BoxPlots



3-D rotating plots



Rotated 3-D plot


Scatterplots



Scatterplots with spline smoothing



Paneled Scatterplot with smoothers



PcGive 12 Modeling and Forecasting

- Cross-sectional
 - Discrete choice:
 - Count data
 - logit and probit model
 - Multinomial discrete choice
- Univariate dynamic modeling
 - OLS and Autoregressive error models
- ARIFIMA modeling
- Panel data analysis
 - Static
 - Dynamic (GMM)
- Multivariate dynamic modeling
 - Unrestricted VAR
 - Cointegrated VAR
 - Simultaneous equation modeling
 - Constrained sem
- Automatic Modeling
 - Automatic outlier identification and modeling
 - For univariate and multivariaate models

What's new in PcGive 12?

- Autometrics has been included
 - Autometrics can work with univariate or multivariate models, such as VAR.
 - Autometrics can handle more variables than observations, previously thought impossible
 - Can employ dummy saturation
 - Can automatically model univariate and multivariate time series models
- PcNaive has been included in the Monte Carlo methods

Estimation methods

- Estimation (OLS, IV, ALS, recursive estimation)
- Panel-GMM with robust standard errors

Autometrics demonstration

- Function: Automatic variable selection, model building, and model selection for time series or econometric data.
- Value: Crisis analysis
 - when data are available.
 - When time is short
 - When stakes are high
 - When consequences are serious
 - Autometrics may reduce the risk of improper response.
- Value: Econometric Data mining
 - Exploratory data analysis when response time is critical
 - When there are a lot of variables and modeling paths to analyze

Methodology

- Begin with a General Unrestricted Model (GUM).
- The chosen variables should be as congruent as possible.
- The GUM is subjected to a series of misspecification tests. If it passes, the reductions will also pass.
- Reduction of the model by eliminating variables with significance levels of .05 or more.
- Each reduction must pass a series of tests.
- If there are k regressors, there will be 2^k reduction paths.

Methodology II

- There may be several terminal models following reduction. The Schwartz criterion is used to determine the better of these.
- If a reduction causes the previous model to fail a misspecification test, then the variable, though possibly not significant, will be retained in the model.

Example

• We select data.in7 and load the quarterly data into the spreadsheet

🎇 data.in	7 - C:\Program	n Files\OxMe	trics5\data\d	ata.in7
	CONS	INC	INFLAT	OUTPUT
1953(1)	890.45	908.212	3.6595	1203.77
1953(2)	886.543	900.679	2.7649	1200.36
1953(3)	886.329	899.795	2.521	1193.63
1953(4)	884.885	898.482	1.717	1193.04
1954(1)	885.254	895.777	.9729	1194.11
1954(2)	884.528	894.831	.676	1191.03
1954(3)	884.436	892.741	.1739	1191.47
1954(4)	884.311	892.768	3302	1195.34
1955(1)	887.426	896.971	4645	1195.51
1955(2)	889.556	901.406	3819	1198.2
1955(3)	890.659	901.479	2016	1199.24
1955(4)	894.079	905.117	.1956	1203.88
1956(1)	896.831	908.389	. 5363	1211.27
1956(2)	894.984	906.216	1.75	1207.35
1956(3)	893.613	905.942	2.3436	1201.78
1956(4)	891.8	902.649	2.126	1200.69
1957(1)	890.252	901.933	2.0725	1200.2

Select the Module, Category and model class

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Module	PcGive						
Category	Models for time	series data					*
Model class	Single-equation	Dynamic Modelling (using PcGiv	/e			~
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		Options		Close			

Select 2 years of data (8 lags)

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Recall a previous model		data.in7	~				
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Modeling consumption

- Move the variables from the Database window to the Selection window.
- Their lags are automatically constructed and included.
- Also include a Trend variable
- Include Seasonal dummies as well

The Variable Selection



Click OK

In the Model settings dialog box, we set those settings

Mode	l Settings - Single-equati	on Dynamic Modelling	×
C	hoose a model type:		
C	Ordinary least squares	•	
I	nstrumental variables	0	
Æ	Autoregressive least squares	0	
	from lag	1	
	to lag	1	
C	hoose the Autometrics opt	ions:	
Æ	Automatic model selection		Largo Posiduale
	Target size	Default: 0.05	Large Residuals
	Outlier detection	Large residuals	
	Pre-search lag reduction		
Þ	Advanced Autometrics settings		
		OK Cancel	

Model Setting

- Leave model type on OLS
- Click Automatic model selection
- Select outlier detection to large residuals
- Click on Pre-search lag reduction
- Then click on OK

Delimiting for the estimation sample

 For validation, we set aside 3 years for validation (12 forecasts) and click OK

timate - Single-equation Dynamic Modelling			
Choose the estima	tion sample:		
Selection sample	1955(1) - 1992(3)		
Estimation starts at	1955(1)		
Estimation ends at	1992(3)		
Less forecasts	12		
Choose the estima	tion method:		
Estimation method:	Ordinary Least Squares		
Recursive estimation			
Initialization	10		
	OK Cancel		

Autometrics yields an optimal model

 In less than 1 minute, Autometrics generates the model with results of misspecification tests up front

p-values of	diagnostic	checks	for	model va	alidity			
II	nitial GUM	cut-	off	Final	GUM	cut-off	Fina	al model
AR(5)	0.94162	0.01	.000	0.6:	1142	0.01000		0.53842
ARCH(4)	0.43715	0.01	.000	0.25	5648	0.01000		0.51872
Normality	0.53256	0.01	.000	0.79	9925	0.01000		0.93163
Hetero	0.99898	0.01	.000	0.58	3323	0.01000		0.45873
Chow(70%)	0.05426	0.01	.000	0.00	5419	0.01000		0.04416
Summary of <i>i</i>	Autometrics	search						
initial seam	ch space	2^40	fir	hal seard	ch space	≘ 2′	11	
no. estimate	ed models	208	no.	termina	al mode.	ls	4	
test form		LR-F	tar	get size	e 1	Default:0.	.05	
outlier dete	ection	0.025	pre	esearch m	reduction	on la	ags	
backtesting		GUMO	tie	e-breaker	5		sc	
diagnostics	p-value	0.01	sea	arch effo	ort	standa	ard	
time		0.85	Aut	cometrics	s versi	on 1	ι.5	

Weta = 80 + 81 * Lrate- 	File Edit Search View Model Run Window Help					
Instability tests: Image: Constant of the consta	🖺 🗳 🖏 🛄 🕯	📕 😂 🍇 👆 🖆 🛍 🕼 🔗 🖎 🔤 🖬 📝 🤁 🔁				
Documents Picesults Data wixesp00b.in7 Graphics The detaset is: C:\Program Files\OXMetrics\data\data.in7 The detaset is: C:\Program Files\OXMetrics\data\data.in7 The estimation sample is: 1955(1) - 1989(3) Code Model Coefficient Std.Error t-value t-prob Part.R^2 Code Data Model Coefficient Std.Error t-value t-prob Part.R^2 Code Data/Mejdet.ox Coefficient Std.Error t-value t-prob Part.R^2 Dota Data/Mejdet.ox NC 0.482387 NC 0.482387 0.022687 Data/Mejdet.ox NC 0.482387 Tot 0.03744 0.0000 0.6673 Tot 0.0482387 0.02943 1.6.4 0.0000 0.6673 GRIIskdist.out INC_1 -0.314234 0.03374 -9.31 0.0000 0.4448 GRIIskdist.out sigma 1.07068 RSS 155.164728 GRIIskdist.out sigma 1.07068 SS 155.164728 GRIIskdist.out Ingeliktiets Yariance 0.53710* 2.04 Model Yariance 0.53710* 2.04 Yariance 0.53710* <th>xbeta = &0 + &1 * Lrate -</th> <th>🗨 😪 🏕 🔄 🔚 🏝 🥙 🍫 🌠 🗮 🤷 🌮 🚱 // 🗶</th>	xbeta = &0 + &1 * Lrate -	🗨 😪 🏕 🔄 🔚 🏝 🥙 🍫 🌠 🗮 🤷 🌮 🚱 // 🗶				
Deta Figs0b.in7 Wixsp500b.in7 EQ(2) Modelling CONS by OLS Graphics The dataset is: C:\Program Files\0xMetrics5\data\data.in7 Graphics The dataset is: Sisteror t-value t-prob Part.R^2 Code Cons_1 0.874432 0.02687 32.5 0.0000 0.8877 paphics.ox CONS_1 0.874432 0.02687 32.5 0.0000 0.6673 Ioad, Nic_data.ox INC 0.482387 0.02243 16.4 0.0000 0.6673 Ioad, Nic_data.ox INC 0.482387 0.02374 -9.31 0.0000 0.6473 Ioad, Nic_data.ox INC 1 -0.314234 0.03374 -9.31 0.0000 0.6473 Instability casts: ingma 1.07608 SS 155.164728 10g-11kelihod -204.878 DW 2.04 GRIIskKids2.out ing=likelihood -204.878 DW 2.04 no. of observations 139 no. of parameters 5 GRIIskKids2.out Instability tests: Variance 0.53710* Variance	Documents 🛛 🔻	🖹 Results				
Bit Wisspiele Bit C(2) Modelling CONS by OLS Graphics The dataset is: C:\Program Files\OxMetricsS\data\data.in7 Graphics The estimation sample is: 1955(1) - 1989(3) Code Coefficient Std.Error t-value t-prob Part.R^2 backmarkers.ox CONS_1 0.874432 0.02687 32.5 0.0000 0.8877 graphics CONS_5 -0.0438114 0.01760 -2.49 0.0140 0.0442 graphics INC 0.482387 0.02943 16.4 0.0000 0.6877 graphics INC_1 -0.314234 0.03374 -9.31 0.0000 0.3929 Faxt INFLAT -0.911402 0.0877 -10.4 0.0000 0.4488 GRN1isktdst2.out sigma 1.07608 RSS 155.164728 -0.911400 GChung_FIGARCH.out Instability tests: Model 2.04 -0.91400 -0.91400 GChung_FIGARCH.out Instability tests: 0.061948 -0.91400 -0.9142 -0.91400 GChung_FIGARCH.out Instability tests: -0.91942 </td <td>🕽 Data</td> <td></td>	🕽 Data					
Image: State Stat	vixsp500b.in7	EO(2) Modelling CONS by OLS				
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GR11sktdist2.out sigma 1.07608 RSS 155.164728 GR11skt.out log-likelihood -204.878 DW 2.04 Chung_FIGARCH.out no. of observations 139 no. of parameters 5 GR11sktdist3.out mean(CONS) 876.668 var(CONS) 181.815 Modules variance 0.53710* Watiance 0.53710* variance 0.53710* % G@RCH joint 0.91942 1000000000000000000000000000000000000	- 🖹 Results					
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<pre>Chung_FIGARCH.out no. of observations 139 no. of parameters 5 Chung_FIGARCH2.ou GUR11sktdist3.out GUR11sktdist3.out Modules Modules Modules Modules Modules Module Instability tests: Modul GUR1 GUR2 GUR2 CONS_1 0.082496 CONS_1 0.082496 CONS_5 0.08334 CONS_5 0.08334 CONS_5 0.082523 CONS_5 0.082523 CONS_5 0.082720 CONS_6 NC_1 0.082720 CONS_6 NC_1 0.082720 CONS_6 CONS_6</pre>	GJR11skt.out	log-likelihood -204.878 DW 2.04				
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<pre>Basic_matrices.out Modules Module</pre>	<u>∃</u> GJR11sktdist3.out					
Modules variance 0.53710* → ※ Model joint 0.91942 → ※ G@RCH Individual instability tests: → ※ PrGive Individual instability tests: → ※ STAMP CONS_1 0.082496 → ※ Ox CONS_5 0.083334 → ◎ Ox INC 0.082523 → ◎ OxGauss INC_1 0.082720 → ◎ OxPack INFLAT 0.073546 → ◎ OxRun	Ei basic_matrices.out	Instability tests:				
>** Model joint 0.91942 -** G@RCH Individual instability tests: -** ProGive Individual instability tests: -** STAMP CONS_1 0.082496 -** Ox CONS_5 0.083334 -** Ox INC 0.082523 -** OxGauss INC_1 0.082720 -** OxPack INFLAT 0.073546 -** OxAun		variance 0.53710*				
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* Forwer CONS_1 0.082496 ** Ox CONS_5 0.083334 ** OxDebug INC 0.082523 ** OxGauss INC_1 0.082720 ** OxPack INFLAT 0.073546 ** Ox-interactive 1-step (ex post) forecast analysis 1989(4) - 1992(3) ** X12arima Parameter constancy forecast tests: ** Forecast Chi^2(12) = 14.506 [0.2696]		Individual instability tests:				
* Ox CONS_5 0.083334 ** OxDebug INC 0.082523 ** OxGauss INC_1 0.082720 ** OxPack INFLAT 0.073546 ** OxRun	STAMP	CONS 1 0.082496				
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** OxPack INFLAT 0.073546 *** OxRun *** 1-step (ex post) forecast analysis 1989(4) - 1992(3) *** X12arima Parameter constancy forecast tests: *** Forecast Chi^2(12) = 14.506 [0.2696]	🏶 OxGauss	INC_1 0.082720				
<pre></pre>	🏶 OxPack	INFLAT 0.073546				
<pre># Ox-interactive 1-step (ex post) forecast analysis 1989(4) - 1992(3) # X12arima # X12arima Forecast Chi^2(12) = 14.506 [0.2696] # The parameter constance is the parameter consta</pre>	🏶 OxRun					
** X12arima Parameter constancy forecast tests: Forecast Chi ² (12) = 14.506 [0.2696]	🏶 Ox - interactive	1-step (ex post) forecast analysis 1989(4) - 1992(3)				
Forecast $Chi^2(12) = 14.506 [0.2696]$	🏶 X12arima	Parameter constancy forecast tests:				
		Forecast Chi [^] 2(12) = 14.506 [0.2696]				
Chow $F(12, 134) = 1.1773 [0.3055]$		Chow $F(12, 134) = 1.1773 [0.3055]$				

Collinearity diagnostics, parameter constancy tests, and a summary of misspecification tests are generated

1-step (ex post) forecast analysis 1989(4) - 1992(3) Parameter constancy forecast tests: Forecast Chi²(12) = 14.506 [0.2696] Chow F(12, 134) = 1.1773 [0.3055]Descriptive statistics of variables used in the model: Means CONS CONS 1 CONS 5 INC INC 1 INFLAT 876.67 876.83 877.48 892.40 892.53 1.7908 Standard deviations (using T-1) CONS CONS 1 CONS 5 INC INC 1 INFLAT 13.488 13.313 10.670 10.555 13.533 1.3219 Correlation matrix: CONS 5 INC 1 CONS CONS 1 INC CONS 1.0000 0.98675 0.87823 0.94106 0.91444 CONS 1 0.98675 1.0000 0.91055 0.93138 0.94063 CONS 5 0.87823 0.91055 0.86143 0.88359 1.0000 INC 0.94106 0.93138 0.86143 1.0000 0.95412 INC 1 0.91444 0.94063 0.88359 0.95412 1.0000 INFLAT -0.35465-0.27388 -0.11480-0.13230-0.074755INFLAT CONS -0.35465CONS 1 -0.27388CONS 5 -0.11480INC -0.13230-0.074755 INC 1 INFLAT 1.0000 AR 1-5 test: F(5, 129) = 0.81877 [0.5384]ARCH 1-4 test: F(4, 126) = 0.81365 [0.5187] $Chi^{2}(2) = 0.14163 [0.9316]$ Normality test: F(10, 123) = 0.98657 [0.4587]Hetero test: Hetero-X test: F(20, 113) = 0.88671 [0.6039]RESET test: F(1, 133) = 2.0920 [0.1504]

Dynamic Analysis is available

Dynamic Analysis - Single-equation Dynamic Modelling				
	Dynamic Analysis			
	Static long-run solution			
	Lag structure analysis			
	Roots of lag polynomials			
	Test for common factors			
Ξ	Lag weights			
	Graph normalized lag weights			
	Graph cumulative normalized lag weights			
	Write lag weights			
		OK Cancel		

Output of dynamic analysis

Solved static long-run equation for CONS Coefficient Std.Error t-value t-prob INC 0.992759 0.001339 741. 0.0000 INFLAT -5.380820.6321 -8.51 0.0000 Long-run sigma = 6.35306 ECM = CONS - 0.992759*INC + 5.38082*INFLAT; WALD test: Chi²(2) = 2.60735e+006 [0.0000] ** Analysis of lag structure, coefficients: SE (Sum) Lag 0 Lag 1 Lag 2 Lag 3 Lag 4 Lag 5 Sum CONS -1 0.874 -0 -0.0438-0.1690.0223 -0 -0 INC 0.482 -0.3140 0.168 0.022 Ο. 0 Ο. INFLAT -0.9110 0 0 0 0 -0.9110.088 Tests on the significance of each variable Variable F-test Value [Prob] Unit-root t-test CONS F(2, 134) =717.54 [0.0000] ** -7.6108** INC F(2, 134) =147.19 [0.0000] ** 7.6586 INFLAT F(1, 134) =107.34 [0.0000] ** -10.361Tests on the significance of each lag Lag 5 F(1, 134) =6.1943 [0.0140]* Lag 1 F(2, 134) =533.55 [0.0000] ** Tests on the significance of all lags up to 5 F(1, 134) =Lag 5 - 5 6.1943 [0.0140]* Lag 4 - 5 F(1, 134) =6.1943 [0.0140]* Lag 3 - 5 F(1,134) = 6.1943 [0.0140]* Lag 2 - 5 F(1, 134) =6.1943 [0.0140]* Lag 1 - 5 F(3, 134) =518.77 [0.0000] **

More dynamic analysis output

Variable	F-test	Value	[Prob]	Unit-root t-test
CONS	F(2,134) =	717.54	[0.0000]**	-7.6108**
INC	F(2,134) =	147.19	[0.0000]**	7.6586
INFLAT	F(1,134) =	107.34	[0.0000]**	-10.361
Tests on the	significance	of each	lag	
Lag 5	F(1,134) =	6.1943	[0.0140]*	
Lag 1	F(2,134) =	533.55	[0.0000]**	
Tests on the	significance	of all .	lags up to 5	
Lag 5 - 5	F(1,134) =	6.1943	[0.0140]*	
Lag 4 - 5	F(1,134) =	6.1943	[0.0140]*	
Lag 3 - 5	F(1,134) =	6.1943	[0.0140]*	
Lag 2 - 5	F(1,134) =	6.1943	[0.0140]*	
Lag 1 - 5	F(3,134) =	518.77	[0.0000]**	
Tests on the	significance	of all .	lags up to 4	
Lag 1 - 4	F(2, 134) =	533.55	[0.0000]**	
Tests on the	significance	of all .	lags up to 3	
Lag 1 - 3	F(2,134) =	533.55	[0.0000]**	
Tests on the	significance	of all .	lags up to 2	
Lag 1 - 2	F(2, 134) =	533.55	[0.0000]**	
D	~			
ROOTS OF CON:	5 lag polynomi	.al:		
rea.	1 1mag	f m	Daulus	
0.7027	2 0.047116	, U	.70429	
0.7027		, U	.70429	
-0.05138	0 0.45123	; U	.45415	
-0.05138	0 -0.45123	, 0	.45415	
-0.42824	4 U.UUUUU	, U	.42824	
ROOTS OF INC	lag polynomia	a1:]]	
rea.	1 1mag	y mo	oaulus	
0.6514	1 0.00000	, ,	.03141	

You can request information criteria and output in equation format

Fur	Further Output - Single-equation Dynamic Modelling				
	Further results and reports				
	Information criteria				
	Heteroscedasticity consistent standard errors				
	R^2 relative to difference and seasonals				
	Correlation matrix of regressors				
	Covariance matrix of estimated parameters				
	Reduced form estimates				
	Static (1-step) forecasts				
	Print large residuals				
	Exceeding standard error by factor	3.5			
Ξ	Write model results				
	Equation format				
	LaTeX format				
	Non-linear model format				
	Significant digits for parameters:	4			
	Significant digits for std.errors:	3			
		OK Cancel			

Information criteria and equation format

When	the	log-likelihood co:	nsta	nt is	NOT	included:	
AIC		0.181	956	sc			0.287512
HQ		0.224	351	FPE			1.19960
When	the	log-likelihood co:	nsta	nt is	inc.	luded:	
AIC		3.01	983	sc			3.12539
HQ		3.06	273	FPE			20.4885
No re CONS (SE)	No residuals exceed 3.5 standard errors CONS = + 0.8744*CONS_1 - 0.04381*CONS_5 + 0.4824*INC - 0.3142*INC_1 (SE) (0.0269) (0.0176) (0.0294) (0.0337)						
	-	- 0.9114*INFLAT (0.088)					

A Vast variety of tests may be requested

Test - Single-equation Dynamic Modelling	N 2010
Test	
Residual autocorrelations and Portmanteau statistic	
with length	12
Error autocorrelation test	
from lag	1
to lag	5
Normality test	
Heteroscedasticity test (using squares)	
Heteroscedasticity test (using squares and cross products)	
ARCH test	
with order	4
RESET test (using squares)	
Instability tests	
Encompassing tests	
ОК	Cancel

Heteroskedasticity tests for individual variables

*OxMetrics - Results - [Results]						
🖹 File Edit Search View Model Run Window Help						
🞦 ぢ 🕼 🛄 🎒 🌭 🍇 🍁 🕋 💼 💼 🕼 🔗 🖓 🔤 data.in7 🛛 💌 🌌 📓 🖧 🦉						
xbeta = 8.0 + 8.1 * Lrate · 🖌 🕵 🍂 👔 📳 📰 🔛 🦓 🍫 🧔 💷 📽 🐙 🙌 // 挨						
Documents v Heteroscedasticity coefficients:						
🕽 Data		Coefficient	Std.Error	t-value		
- 199 vixsp500b.in7	CONS_1	1.0095	3.3437	0.30190		
- 1997 data.in7	CONS_5	-1.8339	2.3927	-0.76644		
Graphics	INC	3.8138	3.9656	0.96171		
🚾 Model	INC_1	-0.92414	4.5435	-0.20340		
📈 Forecasts	INFLAT	0.36530	0.27526	1.3271		
Code	CONS 1^2	-0.00055919	0.0019149	-0.29203		
	CONS 5^2	0.0010317	0.0013676	0.75443		
	INC ²	-0.0021432	0.0022196	-0.96556		
graphics3.ox	INC 1^2	0.00050604	0.0025454	0.19881		
	INFLAT ²	-0.066640	0.049688	-1.3412		
Text Results	RSS = 315.274 Regression in	sigma = 1.601 deviation from	effective no. mean	of paramete	rs = 11	
GJR11sktdist2.out						

White's test with Squares and Cross-products

Unterrogendenti	aita acefficien	+-·			
neteroscedasticity coefficients:					
20112 4		Stu.Effor	C-Value		
	-5.5165	0.0225	-0.80888		
CONS_5	0.35170	3.4720	0.10130		
INC	8.8870	4.8902	1.8173		
INC_1	0.18354	7.0257	0.026125		
INFLAT	-1.6414	18.487	-0.088782		
CONS_1^2	-0.014014	0.011420	-1.2271		
CONS_5^2	0.0037279	0.0052004	0.71685		
INC ²	-0.022690	0.013895	-1.6329		
INC_1 [^] 2	-0.020476	0.015845	-1.2923		
INFLAT ²	-0.043740	0.091384	-0.47864		
CONS_1*CONS_5	0.0011317	0.010481	0.10798		
CONS_5*INC	-0.014104	0.0096119	-1.4673		
INC*INC_1	0.026377	0.027445	0.96109		
INC_1*INFLAT	-0.044168	0.060444	-0.73073		
CONS_1*INC	0.023204	0.016234	1.4293		
CONS_5*INC_1	0.0052349	0.010645	0.49177		
INC * INFLAT	0.048572	0.045915	1.0579		
CONS_1*INC_1	0.0094504	0.023285	0.40585		
CONS_5*INFLAT	0.0075926	0.036289	0.20923		
CONS_1*INFLAT	-0.0099337	0.054494	-0.18229		
DGG = 204.265	aicome = 1.614	offortive n	o of noremete		

```
RSS = 294.365 sigma = 1.614 effective no. of parameters = 21
Regression in deviation from mean
```

Testing for heteroscedasticity using squares and cross products Chi²(20) = 18.855 [0.5312] and F-form F(20,113) = 0.88671 [0.6039]

Robust Standard errors: White's, Newey-West, and Jacknifed

Heteroscedasticity consistent standard errors

	Coefficients	SE	HACSE	HCSE	JHCSE
CONS_1	0.87443	0.026869	0.020131	0.024021	0.024825
CONS_5	-0.043811	0.017603	0.015224	0.017811	0.018201
INC	0.48239	0.029428	0.025429	0.026583	0.027186
INC_1	-0.31423	0.033742	0.026054	0.030809	0.031688
INFLAT	-0.91140	0.087969	0.071854	0.080678	0.084607
	Coefficients	t-SE	t-HACSE	t-HCSE	t-JHCSE
CONS_1	0.87443	32.544	43.437	36.403	35.224
CONS_5	-0.043811	-2.4888	-2.8779	-2.4597	-2.4071
INC	0.48239	16.392	18.970	18.147	17.744
INC_1	-0.31423	-9.3128	-12.061	-10.199	-9.9166
INFLAT	-0.91140	-10.361	-12.684	-11.297	-10.772

Graphical Residual Analysis



Model Graphics can be paneled



Out-of-Sample Forecasting (Or Generated Individually)



Or Customized to your needs



Residuals, Fitted values, and forecasts may be stored for future analysis.

Stor	e in Database - Single-e	quation Dynamic Modelling	×
	Store in database		
	Residuals		
	Fitted values		
	Structural residuals		
	Forecasts		
	Dynamic simulations		
+	Recursive results		
+	Non-linear estimation		
		OK Cancel	

Dummy Saturation is another outlier detection option

Model Settings - Single-equati	on Dynamic Modelling		
Choose a model type:			
Ordinary least squares	۲		
Instrumental variables	0		
Autoregressive least squares	0		
from lag	1		
to lag	1		
		Outlier dete	ction with
Choose the Autometrics op	tions:	dummy satu	ration
Automatic model selection			
Target size	Default: 0.05		
Outlier detection	Dummy saturation		
Pre-search lag reduction			
Advanced Autometrics settings			
	OK Cancel		

The Dummy Saturation Option

 Opting for dummy saturation will automatically reveal additive outliers in the data.

The dataset is: C:\Program Files\OxMetrics5\data\data.in7						
The estimation sample is: 1955(1) - 1992(3)						
	Coefficient	Std.Error	t-value	t-prob	Part.R [^] 2	
CONS_1	0.835649	0.02154	38.8	0.0000	0.9127	
INC	0.497909	0.02722	18.3	0.0000	0.6992	
INC_1	-0.297895	0.03336	-8.93	0.0000	0.3564	
INFLAT	-0.947522	0.08393	-11.3	0.0000	0.4695	
OUTPUT_3	-0.0275453	0.01317	-2.09	0.0383	0.0295	
I:1976(2)	-2.84717	1.070	-2.66	0.0087	0.0469	
I:1987(3)	3.30161	1.057	3.12	0.0022	0.0634	
sigma	1.04351	RSS		156.8049	968	
log-likelihood	-217.108	DW		1	.97	
no. of observation	s 151	no. of par	ameters		7	
mean(CONS)	875.415	var(CONS)		186.3	147	
Comparative Model Analysis (progress)

rogress - Single-equation Dynamic Modelling 🛛 🛛
✓ BQ(3) 5 x 154 -227.140 OLS
EQ(2) 5 x 139 -204.878 OLS GUM(1) not estimated
< Del > Mark Specific to General Mark General to Specific
OK Cancel

Autometrics can also model multivariate models

- Unrestricted Vector Autoregression
- Automatic outlier identification and modeling
- Blockwise modeling allows models with observations < # variables
 - For omitted regressors
 - For lag reduction
 - For specification criteria
 - For outlier detection and modeling

An Unrestricted Vector Autoregression

Formulate - Multiple-equation Dynamic Mo	delling - MulTut1.i	in7	
Selection	Lags	Database	
Y Ya U Constant Ya_1 Ya_2 Ya_3	Lag 0 to 💌 4	Ya Yb Yc Yd	
Ya_4 Y Yb Yb_1 Yb_2 Yb_3 Yb_4	<<		
Yc Yc_1 Yc_2 Yc_3 Yc_4			
Yd_1 Yd_2 Yd_3 Yd_4	Clear>>	Constant CSeasonal Trend	
Z: regressor Set		Seasonal MulTut1.in7	
	к Са	ncel	

Check the Autometrics selection

Mod	lel Settings - Multiple-equation Dyn	amic Modelling	×
	Choose a model type:		
	Unrestricted system	•	
	Cointegrated VAR	0	
	Simultaneous equations model	0	
	Constrained simultaneous equations model	0	
	Choose the Autometrics options:		
	Automatic model selection		
	Target size	Default: 0.05	
	Outlier detection	None	
	Pre-search lag reduction		
	Advanced Autometrics settings		

Define the estimation sample

Estimate - Multiple-eq	juation Dynamic Modelling 🛛 🛛 🔀
Choose the estima	tion sample:
Selection sample	1951(1) - 2004(4)
Estimation starts at	1951(1)
Estimation ends at	2004(4)
Less forecasts	8
Choose the estima	tion method:
Estimation method:	Ordinary Least Squares
Recursive estimation	
Initialization	10
	OK Cancel

Vector Autoregression output

0.168830 -0.369900 0.379201 0.102550 -0.255820 0.0791111 12 RSS = 0.02 1279.03305 .56288247e-008 0.999999 ions 208	0.1089 0.1175 0.05911 0.06987 0.05576 107593279 -T/2log Ome log Y'Y/T R^2(LM) no. of para	0.1033 0.1189 0.07263 0.07986 0.05069 ga 18 -3. meters	-3.58 3.19 1.41 -3.20 1.56 669.31148 66896302 0.999002 18	0.0004 0.0017 0.1595 0.0016 0.1202		
0.168830 -0.369900 0.379201 0.102550 -0.255820 0.0791111 12 RSS = 0.02 1279.03305 .56288247e-008 0.999999 ions 208	0.1089 0.1175 0.05911 0.06987 0.05576 107593279 -T/2log Ome log Y'Y/T R^2(LM) no. of para	0.1033 0.1189 0.07263 0.07986 0.05069 ga 18 -3. meters	-3.58 3.19 1.41 -3.20 1.56 669.31148 66896302 0.999002 18	0.0004 0.0017 0.1595 0.0016 0.1202		
0.168830 -0.369900 0.379201 0.102550 -0.255820 0.0791111 12 RSS = 0.02 1279.03305 .56288247e-008 0.999999	0.1089 0.1175 0.05911 0.06987 0.05576 107593279 -T/2log Ome log Y'Y/T R^2(LM)	0.1033 0.1189 0.07263 0.07986 0.05069 ga 18 -3.	-3.58 3.19 1.41 -3.20 1.56 669.31148 66896302 0.999002	0.0004 0.0017 0.1595 0.0016 0.1202		
0.168830 -0.369900 0.379201 0.102550 -0.255820 0.0791111 12 RSS = 0.02 1279.03305 .56288247e-008	0.1089 0.1175 0.05911 0.06987 0.05576 107593279 -T/210g Ome log Y'Y/T	0.1033 0.1189 0.07263 0.07986 0.05069 ga 18 -3.	-3.58 3.19 1.41 -3.20 1.56 669.31148 66896302	0.0004 0.0017 0.1595 0.0016 0.1202		
0.168830 -0.369900 0.379201 0.102550 -0.255820 0.0791111 12 RSS = 0.02 1279.03305	0.1089 0.1175 0.05911 0.06987 0.05576 107593279 -T/2log Ome	0.1033 0.1189 0.07263 0.07986 0.05069 ga 18	-3.58 3.19 1.41 -3.20 1.56	0.0004 0.0017 0.1595 0.0016 0.1202		
0.168830 -0.369900 0.379201 0.102550 -0.255820 0.0791111 12 RSS = 0.02	0.1089 0.1175 0.05911 0.06987 0.05576	0.1033 0.1189 0.07263 0.07986 0.05069	-3.58 3.19 1.41 -3.20 1.56	0.0004 0.0017 0.1595 0.0016 0.1202		
0.168830 -0.369900 0.379201 0.102550 -0.255820 0.0791111	0.1089 0.1175 0.05911 0.06987 0.05576	0.1033 0.1189 0.07263 0.07986 0.05069	-3.58 3.19 1.41 -3.20 1.56	0.0004 0.0017 0.1595 0.0016 0.1202		
0.168830 -0.369900 0.379201 0.102550 -0.255820	0.1089 0.1175 0.05911 0.06987	0.1033 0.1189 0.07263 0.07986	-3.58 3.19 1.41 -3.20	0.0004 0.0017 0.1595 0.0016		
0.168830 -0.369900 0.379201 0.102550	0.1089 0.1175 0.05911	0.1033 0.1189 0.07263	-3.58 3.19 1.41	0.0004 0.0017 0.1595		
0.168830 -0.369900 0.379201	0.1089 0.1175	0.1033 0.1189	-3.58 3.19	0.0004 0.0017		
0.168830 -0.369900	0.1089	0.1033	-3.58	0.0004		
0.168830						
	0.06740	0.06426	2.63	0.0093		
0.843141	0.06635	0.06285	13.4	0.0000		
-0.00553180	0.04860	0.04348	-0.127	0.8989		
-0.0122296	0.05299	0.04804	-0.255	0.7993		
Coefficient	Std.Error	HACSE	t-HACSE	t-prob		
c: Yb						
38 RSS = 0.03	211594175					
0.06/130/	0.06883	0.05665	1.18	0.2375		
-0.232570	0.08625	0.08749	-2.66	0.0085		
-0.523929	0.07297	0.07766	-6.75	0.0000		
0.176671	0.1450	0.1478	1.20	0.2332		
-0.905628	0.1345	0.1279	-7.08	0.0000		
-0.191287	0.08320	0.07687	-2.49	0.0137		
0.295147	0.08190	0.07584	3.89	0.0001		
0.286423	0.05999	0.05640	5.08	0.0000		
0.606263	0.06542	0.06185	9.80	0.0000		
Coefficient	Std.Error	HACSE	t-HACSE	t-prob		
c: Ya						
Indefon Sample	15. 1551(1)	2002(1)				
metion comple	/gram files(∪ ia• 1051/1)	_ 2002(4)	uacayMull	uc1.117		
anat in. C.\Dwa	man Files		detel No.17			
:: i	<pre>xset is: C:\Pro imation sample Coefficient</pre>	<pre>iset is: C:\Program Files\0 imation sample is: 1951(1) :: Ya Coefficient Std.Error 0.606263 0.06542 0.286423 0.05999 0.295147 0.08190 -0.191287 0.08320 -0.905628 0.1345 0.176671 0.1450 -0.523929 0.07297 -0.232570 0.08625 0.0671307 0.06883</pre>	<pre>set is: C:\Program Files\OxMetrics5\ imation sample is: 1951(1) - 2002(4) :: Ya Coefficient Std.Error HACSE 0.606263 0.06542 0.06185 0.286423 0.05999 0.05640 0.295147 0.08190 0.07584 -0.191287 0.08320 0.07687 -0.905628 0.1345 0.1279 0.176671 0.1450 0.1478 -0.523929 0.07297 0.07766 -0.232570 0.08625 0.08749 0.0671307 0.06883 0.05665 </pre>	<pre>iset is: C:\Program Files\OxMetricsS\data\MulT imation sample is: 1951(1) - 2002(4) :: Ya Coefficient Std.Error HACSE t-HACSE 0.606263 0.06542 0.06185 9.80 0.286423 0.05999 0.05640 5.08 0.295147 0.08190 0.07584 3.89 -0.191287 0.08320 0.07687 -2.49 -0.905628 0.1345 0.1279 -7.08 0.176671 0.1450 0.1478 1.20 -0.523929 0.07297 0.07766 -6.75 -0.232570 0.08625 0.08749 -2.66 0.0671307 0.06883 0.05665 1.18</pre>	<pre>aset is: C:\Program Files\OxMetrics5\data\MulTut1.in7 imation sample is: 1951(1) - 2002(4) :: Ya Coefficient Std.Error HACSE t-HACSE t-prob 0.606263 0.06542 0.06185 9.80 0.0000 0.286423 0.05999 0.05640 5.08 0.0000 0.295147 0.08190 0.07584 3.89 0.0011 -0.191287 0.08320 0.07687 -2.49 0.0137 -0.905628 0.1345 0.1279 -7.08 0.0000 0.176671 0.1450 0.1478 1.20 0.2332 -0.523929 0.07297 0.07766 -6.75 0.0000 -0.232570 0.08625 0.08749 -2.66 0.0085 0.0671307 0.06883 0.05665 1.18 0.2375 </pre>	<pre>iset 1s: C:\Program Files()XMetricsS(data(Mullut1.1h7) imation sample is: 1951(1) - 2002(4) :: Ya Coefficient Std.Error HACSE t-HACSE t-prob</pre>

Misspecification test output

F-test on regressors except unrestricted: F(16,396) = 31591.2 [0.0000] ** F-tests on retained regressors, F(2,198) = Ya 1 42.7338 [0.000] ** Ya 2 11.3421 [0.000]** 88.3598 [0.000] ** Yb 2 5.57155 [0.004] ** Yb 1 6.05194 [0.003]** Yc 29.0741 [0.000] ** Yc 1 Yd 26.7710 [0.000] ** Yd 1 10.6148 [0.000]** Constant U 1.52068 [0.221] correlation of URF residuals (standard deviations on diagonal) Ya Yb 0.012704 -0.032341Ya. Vh. -0.032341 0.010291 correlation between actual and fitted Ya Yh 0.99977 0.99954 1-step (ex post) forecast analysis 2003(1) - 2004(4) Parameter constancy forecast tests: using Omega $Chi^{2}(16) = 13.829 [0.6115] F(16,199) = 0.86430 [0.6111]$ using V[e] Chi²(16) = 12.877 [0.6817] F(16,199) = 0.80482 [0.6792] using V[E] Chi²(16) = 13.567 [0.6310] F(16,199) = 0.84791 [0.6300] Ya : Portmanteau(12): 5.98075 : Portmanteau(12): 5.69824 Yb. : AR 1-5 test: Ya. F(5, 194) = 0.94690 [0.4518]Yb. : AR 1-5 test: F(5, 194) = 0.43524 [0.8236]: Normality test: Chi²(2) = 0.16233 [0.9220] Ya : Normality test: Chi^2(2) = 0.11950 [0.9420] Yb. Ya : ARCH 1-4 test: F(4, 191) = 0.27419 [0.8944]: ARCH 1-4 test: F(4,191) = 1.8443 [0.1220] Yb. Ya : Hetero test: F(16, 182) = 1.4975 [0.1045]: Hetero test: F(16, 182) = 0.67227 [0.8188]Yb. Ya. : Hetero-X test: F(44,154) = 1.4901 [0.0402]* ٧h : Hetero-X test: F(44,154) = 1.1106 [0.3150]

Multivariate and cointegration tests

Vector Portmanteau(12): 30.8591 Vector AR 1-5 test: F(20, 376) =1.0451 [0.4076] Vector Normality test: Chi^2(4) = 0.30101 [0.9897] Vector Hetero test: F(48,536) = 1.1607 [0.2199]Vector Hetero-X test: F(132,456)= 1.2253 [0.0662] I(1) cointegration analysis, 1951(1) - 2002(4) eigenvalue loglik for rank 1141.543 0 1269.711 0.70840 1 0.085735 1279.033 2 rank Trace test [Prob] Max test [Prob] Trace test (T-nm) Max test (T-nm) 274.98 [0.000] ** 256.34 [0.000] ** 0 269.69 [0.000] ** 251.41 [0.000] ** 18.64 [0.000]** 18.64 [0.000]** 18.29 [0.000] ** 18.29 [0.000] ** 1

Graphical forecasts from VAR

