% Examples Chapter 2

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% Example 1 %

% Box-Jenkins Analysis %

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% File upload

macv=xlsread('Chap2UKmacvar.xlsx');

infl=macv(2:end,14);

% Stationarity ADF test

[h,pvalue]=adftest(infl);

% 1. Specification

Mdl = arima(1,0,0);

% 2. Selection

% 2.1 Estimation

[inflEstMdl inflEstMdlParamCov infllogL]=estimate(Mdl,infl);

% 2.2 Information criteria

[aic,bic] = aicbic(infllogL,2,size(infl,1));

% 3. Model checkDiagnostics

% Residuals

[resinflFit] = infer(inflEstMdl,infl);

% 3.1 Normality

[hNorm0,pNorm0] = lillietest(resinflFit, 'Alpha',0.01);

% 3.2 Ljung-Box Q-test

[hLBQ0,pValueLBQ0] = lbqtest(resinflFit,'Lags',[5,10],'Alpha',0.01);

% Graph residuals

stdr = resinflFit/sqrt(inflEstMdl.Variance);

figure; hold('on');

subplot(2,2,1); plot(stdr);

title('a. Time Series of Residuals')

subplot(2,2,2); hist(stdr);

title('b. Histogram Standardized Residuals')

subplot(2,2,3); autocorr(stdr);

title('c. Sample Autocorrelation Function')

subplot(2,2,4); parcorr(stdr);

title('d. Sample Partial Autocorrelation Function')

set(gcf, 'PaperPositionMode', 'manual');

set(gcf, 'PaperUnits', 'centimeters');

set(gcf, 'PaperPosition', [0.5 0.5 28 20]); %left bottom width heigh

set(gcf, 'PaperOrientation', 'landscape');

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% Example 2 %

% Simulation and Estimation VAR(1) %

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% 1. Simulation

Spec = vgxset(...

'a', [0.2; 0.2], ...

'AR', {[0.3, 0.2; 0.2, 0.3]}, ...

'Q', [1, 0.8; 0.8, 1]);

numObs=50;

seed=12;rng(seed); % set seed

VAR1model = vgxsim(Spec,numObs);

% 2. Stationarity check

% Eigenvalues

eigenv=eig([0.3, 0.2; 0.2, 0.3]);

% Output

% 0.1000 0.5000

% ADF test

[hV1,pvalueV1]=adftest(VAR1model(:,1));

[hV2,pvalueV2]=adftest(VAR1model(:,2));

% Output

% hV1 = 1 pvalueV1 = 1.0000e-03

% hV2 = 1 pvalueV2 = 1.0000e-03

% 3. Estimation of the VAR(1) process

SpecVAR=vgxset('n',2,'nAR',1, 'Constant',true);

[EstSpec,EstStdErrors,LLF,W]= vgxvarx(SpecVAR,VAR1model);

vgxdisp(EstSpec, EstStdErrors);

% Output

% Model : 2-D VAR(1) with Additive Constant

% Conditional mean is AR-stable and is MA-invertible

% Standard errors without DoF adjustment (maximum likelihood)

% Parameter Value Std. Error t-Statistic

% -------------- -------------- -------------- --------------

% a(1) 0.25496 0.157005 1.6239

% a(2) 0.29826 0.160368 1.85985

% AR(1)(1,1) 0.224719 0.246773 0.910628

% (1,2) 0.252047 0.240863 1.04643

% (2,1) 0.294353 0.252059 1.16779

% (2,2) 0.180505 0.246023 0.733691

% Q(1,1) 0.959693

% Q(2,1) 0.805833

% Q(2,2) 1.00125

% 4. Diagnostic

% Ljung-Box Q-test

res=VAR1model-W;

[hV1,pV1] = lbqtest(res(:,1),'Lags',[5,10], 'Alpha', 0.01);

[hV2,pV2] = lbqtest(res(:,2),'Lags',[5,10], 'Alpha', 0.01);

% hV1 = 0 0; pV1 = 0.0106 0.0112;

% hV2 = 0 0; pV2 = 0.0109 0.0142;

% Normality

[hnV1,pnV1] = lillietest(res(:,1), 'Alpha', 0.01);

[hnV2,pnV2] = lillietest(res(:,2), 'Alpha', 0.01);

% hnV1 = 0; pnV1 = 0.3826;

% hnV2 = 0; pnV2 = 0.1480;

% Graph simulated vs. fitted

tt=1:1:size(VAR1model,1);

figure

subplot(2,1,1);

plot(tt,VAR1model(:,1)', tt, W(:,1)', 'k--+', 'LineWidth', 2.5);

title('x\_1','Fontsize',15);

legend('Simulated', 'Fitted', 'Location', 'NW');

subplot(2,1,2);

plot(tt,VAR1model(:,2)', tt, W(:,2)','k--+', 'LineWidth', 2.5);

title('x\_2', 'Fontsize',15);

legend('Simulated', 'Fitted','Location', 'NW');

set(gcf, 'PaperUnits', 'centimeters');

set(gcf, 'PaperPosition', [0.5 0.5 28 20]); %left bottom width heigh

set(gcf, 'PaperOrientation', 'landscape');

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% Example 3 %

% VEC Analysis %

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% File upload

mac=xlsread('Chap2UKmacvar.xlsx');

macv=mac(2:end,7:12);

% 1. Check for stationarity (ADF test) original time series

[hGDP,pvalueGDP]=adftest(macv(:,1));

[hDP,pvalueCPI]=adftest(macv(:,2));

[hEQ,pvalueEQ]=adftest(macv(:,3));

[hER,pvalueER]=adftest(macv(:,4));

[hRS,pvalueRS]=adftest(macv(:,5));

[hRL,pvalueRL]=adftest(macv(:,6));

% 1.1 ADF test on first difference transformation

GDPd1= diff(macv(1:end,1)); [hGDPd1,pvalueGDPd1]=adftest(GDPd1);

CPId1= diff(macv(1:end,2)); [hCPId1,pvalueCPId1]=adftest(CPId1);

EQd1= diff(macv(1:end,3)); [hEQd1,pvalueEQd1]=adftest(EQd1);

ERd1= diff(macv(1:end,4)); [hERd1,pvalueERd1]=adftest(ERd1);

RSd1= diff(macv(1:end,5)); [hRSd1,pvalueRSd1]=adftest(RSd1);

RLd1= diff(macv(1:end,6)); [hRLd1,pvalueRLd1]=adftest(RLd1);

% 2. Specification

mod='H1\*';

lagCVAR=1;

% 3. Estimation-selection

[h,pValue,stat,cValue,mles] = ...

jcitest(macv,'model',mod,'lags',lagCVAR, 'test', 'trace');

% Output

% Data: macv

% Effective sample size: 51

% Model: H1\*

% Lags: 1

% Statistic: trace

% Significance level: 0.05

%

%

% r h stat cValue pValue eigVal

% ----------------------------------------

% 0 1 125.7773 103.8476 0.0010 0.5950

% 1 1 79.6779 76.9721 0.0307 0.3981

% 2 0 53.7836 54.0779 0.0532 0.3744

% 3 0 29.8613 35.1929 0.1681 0.2852

% 4 0 12.7375 20.2619 0.4290 0.1491

% 5 0 4.5017 9.1644 0.4073 0.0845

% 3. Misspecification Analysis

% Residuals

res=mles.r2.res;

resmean=mean(res);

resstdev=std(res);

resst=zeros(size(res,1),size(res,2));

for j=1:size(macv,2)

resst(:,j)=(res(:,j)-resmean(1,j))/resstdev(1,j);

end

eU=resst';

alpha=0.05; %significance for the tests

p=2; % model order

h=1; %number of lags

% WHITENESS: portmanteau Ljung-Box test

[pval,Qh,critlo,crithi,crit1tail,C0,stringWhite,...

flagWhite]=test\_whiteness(eU,p,h,alpha);

% Output

% non-rejection: signals are WHITE

% NONGAUSSIANITY of W residuals

[pGauss,ps,pk,lambdas,lambdak,crittresh,stringGauss,...

flagGauss]=test\_gaussianity(resst',alpha);

%Output

% non-rejection: signals are GAUSSIAN

% Graph time series

GDP= macv(:,1); CPI= macv(:,2);

EQ= macv(:,3); ER= macv(:,4);

RS= macv(:,5); RL= macv(:,6);

FDates=datenum({ '31?Mar?2000' '30?Jun?2000' '30?Sep?2000' '31?Dec?2000' '31?Mar?2001' '30?Jun?2001' '30?Sep?2001' '31?Dec?2001' '31?Mar?2002' '30?Jun?2002' '30?Sep?2002' '31?Dec?2002' '31?Mar?2003' '30?Jun?2003' '30?Sep?2003' '31?Dec?2003' '31?Mar?2004' '30?Jun?2004' '30?Sep?2004' '31?Dec?2004' '31?Mar?2005' '30?Jun?2005' '30?Sep?2005' '31?Dec?2005' '31?Mar?2006' '30?Jun?2006' '30?Sep?2006' '31?Dec?2006' '31?Mar?2007' '30?Jun?2007' '30?Sep?2007' '31?Dec?2007' '31?Mar?2008' '30?Jun?2008' '30?Sep?2008' '31?Dec?2008' '31?Mar?2009' '30?Jun?2009' '30?Sep?2009' '31?Dec?2009' '31?Mar?2010' '30?Jun?2010' '30?Sep?2010' '31?Dec?2010' '31?Mar?2011' '30?Jun?2011' '30?Sep?2011' '31?Dec?2011' '31?Mar?2012' '30?Jun?2012' '30?Sep?2012' '31?Dec?2012' '31?Mar?2013'});

FT=numel(FDates);

figure;

hold('on');

subplot(3,2,1);

plot(FDates,GDP, 'k-','LineWidth', 2.5);

title('y ','Fontsize',15);

datetick('x');

subplot(3,2,2);

plot(FDates,CPI, 'k-','LineWidth', 2.5);

title('\pi','Fontsize',15);

datetick('x');

subplot(3,2,3);

plot(FDates,EQ, 'k-','LineWidth', 2.5);

title('eq','Fontsize',15);

datetick('x');

subplot(3,2,4);

plot(FDates,ER, 'k-','LineWidth', 2.5);

title('er','Fontsize',15);

datetick('x');

subplot(3,2,5);

plot(FDates,RS,'k-','LineWidth', 2.5);

title('r^{ST}','Fontsize',15);

datetick('x');

subplot(3,2,6);

plot(FDates,RL, 'k-', 'LineWidth', 2.5);

title('r^{LT}','Fontsize',15);

datetick('x');

set(gcf, 'PaperPositionMode', 'manual');

set(gcf, 'PaperUnits', 'centimeters');

set(gcf, 'PaperPosition', [0.5 0.5 28 20]);

set(gcf, 'PaperOrientation', 'landscape');

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% Example 4 %

% Simulation and Forecast Analysis %

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% Matrices of estimated parameters Example 3

A=mles.r2.paramVals.A;

B=mles.r2.paramVals.B;

B1=mles.r2.paramVals.B1;

c0=mles.r2.paramVals.c0;

SIGMA=mles.r2.EstCov;

LLrest=mles.r2.rLL;

LLUnrest=mles.r2.uLL;

% Simulation

nSim=1000; % Number of simulations

ini=2; % Initial step

len=24; % Number of simulation steps

nrow=ini-1+len; % Number of rows of sim. vector

ncol=size(macv,2); % Number of variables to simulate

yt2=macv(end-1,:); % Initializing values time: t-1

yt1=macv(end,:); % Initializing values time: t

% CVARsim function creates a matrix "nrow x ncol x nSim"

% Each simulation block is added on the right hand side

[ySimt]=CVARsim1(nSim,nrow,ncol,lagCVAR,yt2,yt1,...

SIGMA,A,B,B1,c0);

% Graph simulation

GDPsim=zeros(len,nSim); CPIsim=zeros(len,nSim);

EQsim=zeros(len,nSim); ERsim=zeros(len,nSim);

RSsim=zeros(len,nSim); RLsim=zeros(len,nSim);

for j=1:nSim

GDPsim(:,j) =ySimt(ini:end,ncol\*(j-1)+1);

CPIsim(:,j) =ySimt(ini:end,ncol\*(j-1)+2);

EQsim(:,j) =ySimt(ini:end,ncol\*(j-1)+3);

ERsim(:,j) =ySimt(ini:end,ncol\*(j-1)+4);

RSsim(:,j) =ySimt(ini:end,ncol\*(j-1)+5);

RLsim(:,j) =ySimt(ini:end,ncol\*(j-1)+6);

end

figure;

hold('on');

tt=1:1:len;

subplot(3,2,1)

plot(tt,GDPsim);

title('y','Fontsize',15);

subplot(3,2,2)

plot(tt,CPIsim);

title('\pi','Fontsize',15);

subplot(3,2,3)

plot(tt,EQsim);

title('eq','Fontsize',15);

subplot(3,2,4)

plot(tt,ERsim);

title('er','Fontsize',15);

subplot(3,2,5)

plot(tt,RSsim);

title('r^{ST}','Fontsize',15);

xlabel('Time','Fontsize',15)

subplot(3,2,6)

plot(tt,RLsim);

title('r^{LT}','Fontsize',15);

xlabel('Time','Fontsize',15)

set(gcf, 'PaperPositionMode', 'manual');

set(gcf, 'PaperUnits', 'centimeters');

set(gcf, 'PaperPosition', [0.5 0.5 28 20]);

set(gcf, 'PaperOrientation', 'landscape');