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% Example 2.2 %

% 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');