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% Test 2 Answer
clc;clear;

% DGP for Q1. For Q2, chage rho = 0.9

for iq = 1:2;
 if iq == 1; rho = 0;   phi = 0.9; end;
 if iq == 2; rho = 0.9; phi = 0.9; end;

n = 100; % can be any number

e = randn(n+100,1);
v = randn(n+100,1);

u=e;  x= v;
for i = 2:n+100; % should start from 2.
   u(i) = u(i-1)*rho + e(i);
   x(i) = x(i-1)*phi + v(i);
end;

u = u(101:n+100,:); % discard the first 100 obs
x = x(101:n+100,:);

y = u;    % set a=b=0 where yt = a + b*xt + ut

% OLSE

z = [ones(n,1) x];
b = inv(z'*z)*z'*y;
u = y - z*b;     % keep u for GLS
vu = var(u)*inv(z'*z);
vu = sqrt(diag(vu));
ordt = b./vu;   % ordinary t-value

%================== GLS ============================
% estimation of AR(1) coefficient
uy = u(2:n); ux = u(1:n-1);
rho = inv(ux'*ux)*ux'*uy; % or equivalently rho = sum(ux.*uy)/sum(ux.*ux)
e = uy-ux*rho;
ve = var(e);
% constructing co-variance and variance matrix
omega = eye(n).*ve./(1-rho^2);
for i = 1:n;
for j = i+1:n;
omega(i,j) = rho^(j-i);
omega(j,i) = omega(i,j);
end;
end;

% Cholesky Decomposition

omega = inv(omega);
P = chol(omega);

% Pre-multiplying P matrix
ys = P*y;
zs = P*z;
c = inv(zs'*zs)*zs'*ys;

% variance matrix for c
vc = inv(zs'*zs);

% GLS t-values
tra = c./sqrt(diag(vc));

[ordt tra]
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end;
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