```
clear
%generate data for a state space model
%Y=Beta[t]*X+e1
%Beta[t]=mu+F*Beta[t-1]+e2
%var(e1)=R
%var(e2)=Q
```

$$Y_t = X_t\beta_t + v_t$$

$$\beta_t = \mu + F\beta_{t-1} + e_t$$

$$VAR(v_t) = R$$

$$VAR(e_t) = Q$$

```
t=500;
Q=0.001;
R=0.01;
F=1;  %these are fixed
mu=0;  %these are fixed
e1=randn(t,1)*sqrt(R);
e2=randn(t,1)*sqrt(Q);
Beta=zeros(t,1);
Y=zeros(t,1);
X=randn(t,1);
for j=2:t
    Beta(j,:)=Beta(j-1,:)+e2(j,:);
    Y(j)=X(j,:)*Beta(j,:)'+e1(j);
end
Start of the Kalman filter
%%Step 1 Set up matrices for the Kalman Filter
beta0=zeros(1,1);   %state variable  b[0/0]   β_{0\0}
p00=1;          %variance of state variable p[0/0]   p_{0\0}
beta_tt=[];          %will hold the filtered state variable
ptt=zeros(t,1,1);    % will hold its variance
%initialise the state variable
beta11=beta0;   β_{t-1|t-1}
p11=p00;   p_{t-1\t-1}
for i=1:t Loop from period 1 to end of sample
    x=X(i);
    %Prediction
beta10=mu+beta11*F';   β_{t|t-1} = μ + Fβ_{t-1|t-1}
p10=F*p11*F'+Q;        p_{t\t-1} = Fp_{t-1\t-1}F' + Q
yhat=(x*(beta10)')';   X_tβ_{t|t-1}
eta=Y(i,:)-yhat;       η_{t\t-1} = Y_t − X_tβ_{t|t-1}
feta=(x*p10*x')+R;     f_{t\t-1} = X_tp_{t\t-1}X_t' + R
%updating
K=(p10*x')*inv(feta);  K_t = p_{t\t-1}X_t'f_{t\t-1}^{-1}   Kalman gain
beta11=(beta10'+K*eta')';   β_{t\t} = β_{t|t-1} + K_tη_{t\t-1}
```

$$p_{t\backslash t} = p_{t\backslash t-1} - K_t X_t p_{t\backslash t-1}$$

```
40 p11=p10-K*(x*p10);
41 ptt(i,:,:)=p11;
42 beta_tt=[beta_tt;beta11];
43 end
44 %%%%%%%%%%end of Kalman
Filter%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
45 plot([beta_tt Beta])
46 axis tight
47 legend('estimated \beta_{t}','true \beta_{t}');
```

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