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%%Written by James Davis March 2011 for UFL Numerical Methods 1
Spring 2011
%%Calculate and plot basic linear state space model with none,
Gaussian random, and
%%Cauchy random noises
%%requires mtit for proper title display in figures 2 and 3
%%mtit can be found on the matlab file exchange
clear all
close all
clc

%Part 1 calculate and Plot
% $x_{k+1} = F x_k + G W_{k+1}$ ,
% $F = I + \Delta A$ ,  $I = n \times n$  Identity Matrix

A = [-.2, 1; -1, -.2];
Delta = 0.02;
F = eye(2) + Delta * A;
j = 2000;
x = zeros(j, 2);
x(1, 1) = 3;
x(1, 2) = -2;

for i = 1:j
    x(i+1, :) = F * x(i, :)' ;
end
plot(x(:, 1), x(:, 2), '.k', 'MarkerSize', 5)
title('Plot of Linear state space model of x')
hold
%Part 2 find and plot final x by taking,
% $\lim_{k \rightarrow \infty} x = \lim_{k \rightarrow \infty} (F^{k+1})$  as  $k \rightarrow \infty$ 
Finf = [0, 0; 0, 0];
plot(0, 0, '.r', 'MarkerSize', 20)
plot(x(1, 1), x(1, 2), '.b', 'MarkerSize', 20)
hold off

% Part 3 input gaussian random noise using randn function,
% input via additions to F
figure
x = zeros(j, 2);
x(1, 1) = 3;
x(1, 2) = -2;

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G=[1;1];
dat=[.5,1,2];
for k=1:3
alpha=dat(k);
for i=1:j
wi=randn(1);
x(i+1,:)=F*x(i,:)+G*alpha*wi;
end
subplot(2,2,k)
plot(x(:,1),x(:,2),'.k', 'MarkerSize',5)
name=['\alpha = ',num2str(alpha)];
title(name)
hold
%Limit of F^n as n->Infinity
Finf=[0,0;0,0];
plot(0,0, '.r', 'MarkerSize',20)
plot(x(1,1),x(1,2), '.b', 'MarkerSize',20)
axis tight
hold off
end
p=mtit('Plot of LSSMRN of x with Gaussian random
noise', 'fontsize',12, 'color', [0 0 0], 'xoff',0, 'yoff',.025);

% Part 4 input Cauchy random noise using rand as a seed
funciton,
% input via additions to F
figure
x=zeros(j,2);
x(1,1)=3;
x(1,2)=-2;
G=[1;1];
dat=[.5,1,2];
m=0;
b=1;
for k=1:3
alpha=dat(k);
for i=1:j
wi=b*tan(pi*(rand(1) - 1/2))+m;
x(i+1,:)=F*x(i,:)+G*alpha*wi;
end
subplot(2,2,k)
plot(x(:,1),x(:,2),'.k', 'MarkerSize',5)

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name=['\alpha = ',num2str(alpa)];
title(name)
hold
%Limit of F^n as n->Infinity
Finf=[0,0;0,0];
plot(0,0, '.r', 'MarkerSize',20)
plot(x(1,1),x(1,2), '.b', 'MarkerSize',20)
axis tight
hold off
end
p=mtit('Plot of LSSMRN of x with Cauchy random
noise', 'fontsize',12, 'color', [0 0 0], 'xoff',0, 'yoff',.025);
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