Group 17: Assignment 3(Weiner Process)

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Question:

1. Simulate a sample path {W(t)} $t \in$ [0,1], for a standard Wiener process, by sampling the process 1000 times per unit of time, so that increments are N(0, 0.001) distributed and show the result with a plot.
2. Consider the stationary Gaussian process

X(t) = W(t)+t , t>0

for where {W(s)}s $\in$ Ris a Wiener process so that increments are N(0, 1)   distributed. Simulate a sample path of {X(t)}$t \in$ [0,10]and show the result with a   plot. Also find the first passage time for a= 2.

Simulating a Weiner Process

```
T = 1; N = 1000; dt = T/N;

dW = normrnd(0,0.001,[1,1000]);    % increments
W = cumsum(dW);                    % cumulative sum

plot([0:dt:T],[0,W],'b-')          % plot W against t
xlabel('t','FontSize',16)
ylabel('W(t)','FontSize',16,'Rotation',0)
grid on
title('Weiner Simulation')
```

Weiner Simulation
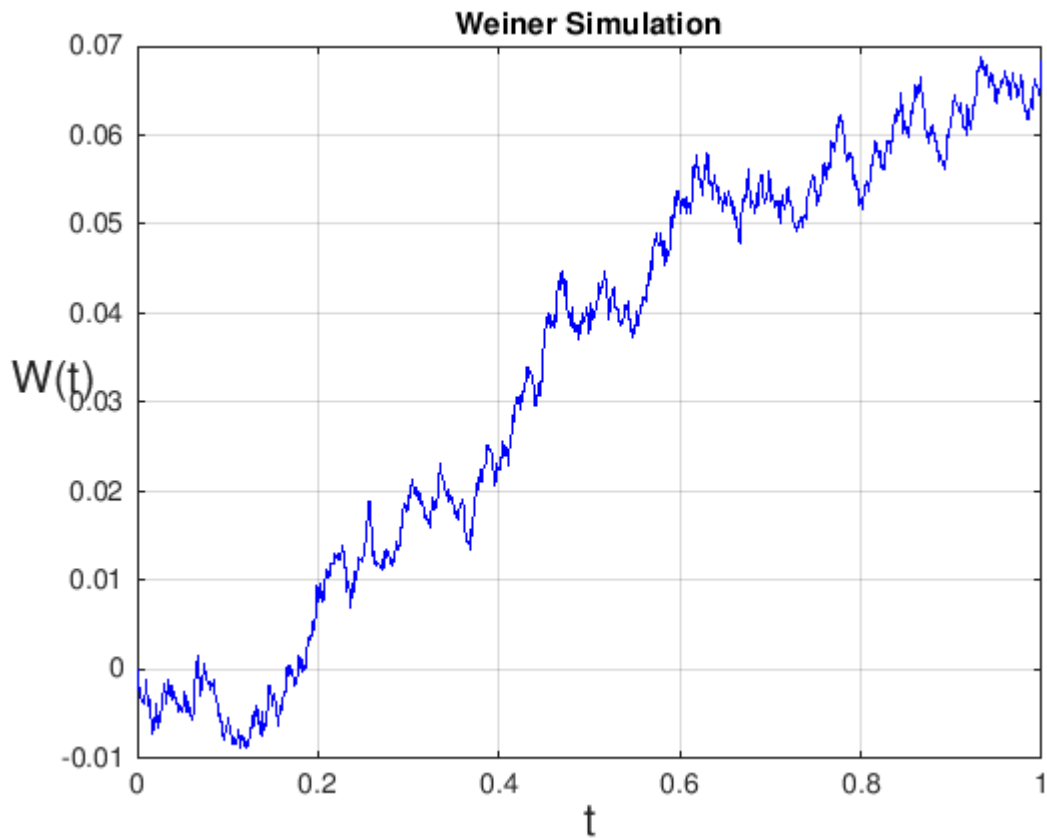
Part 2:

```
mu=0;          %mu=mean of normal distribution
sig=sqrt(1);   %sig=variance of normal distribution
n=1000;T=10;     %T=total time length, N=number of iterations
alpha=2;         %alpha = given fixed point
DT=T/n;          %DT=small time interval
DX=SIGMA*sqrt(DT);     %DX=small displacement
p=.5*(1+(MU*sqrt(DT)/sig));q=1-p;
for i=1:1000
    A(i)=i*(T/n);   %A(i)=time
    if rand(1,1)<p
        Z(i)=DX;    %Z(i)=length of ith step
    else
        Z(i)=-DX;
    end
    if i==1
        W(i)=Z(i);   %W(i)=displacement of Wiener process
    else
        W(i)=W(i-1)+Z(i);
    end
    X(i)=W(i)+A(i);   %X(i)=displacement of process acc. to given
end
i=1;
while(X(i)<=alpha)
        FPT=A(i);    %FPT=first passage time
```

```
        i=i+1;
    end
disp("first passage time for alpha=2")
```

first passage time for alpha=2

FPT

FPT = 0.5800

```
figure
plot(A,X,'r-')
grid minor
axis([0 10 -1 15])
xlabel('Time')
ylabel('Displacement')
title('Stationary Gaussian Process')
```