```
clear
clc
close all

% initialize
m = 10;
b = 1;
k = 5;
x0 = 1;
v0 = 0;
h = .5;
b_eq = b/m;
omega_n = sqrt(k/m);
zeta = b/(2*sqrt(m*k));
omega_d = omega_n*sqrt(1-zeta^2);
t = 0:.5:50;
x = zeros(1,101);
x(1) = 1;

% analytical
xdouble = (1/m)*(-k*1);
x(2) = 1 +xdouble*((h^2)/2);
x_analytical =
(((v0+zeta*omega_n*x0)/omega_d)*sin(omega_d.*t)+x0*
cos(omega_d.*t)).*exp(- zeta*omega_n.*t);


for i = 2:length(t)-1
 x(i+1) = (1/((m/(h^2))+(b/(2*h))))*(-k*x(i)+b*x(i-
1)/(2*h)-(m/h^2)*(x(i-1)-2*x(i)));

end

for i = 1:length(t)
xa(i) = (exp(-
zeta*omega_n*t(i)))*((zeta*omega_n/omega_d)*sin(ome
ga_d*t(i))+cos(omega_d*t(i)));
end
```

```
% plot
plot(t,x)
hold on
plot(t,xa)
xlabel('time')
ylabel('x')
title('analytical v. numerical')
legend('numerical''analytical')
```