
Table of Contents

MAE 150 HW 3 Problem 1	1
Parameters	1
(i) Uniformly Distributed Random Numbers	1
(ii) Normally Distributed Random Numbers $N = 1000000$;	2
(b) Figure 3	3

MAE 150 HW 3 Problem 1

```
clear
clc
close all
fontsize = 14;
```

Parameters

```
k_n = 40;
dk = 0.8;
m_n = 2;
dm = 0.2;
m_s_n = 0.4;
dm_s = 0.05;

f_n = 1/(2*pi)*sqrt(k_n./(m_n+m_s_n/3));

N = 100000;
nbins = 50;

fprintf('Part (a)\n')
```

(i) Uniformly Distributed Random Numbers

```
k = 2*dk*rand(N,1) + k_n - dk;
m = 2*dm*rand(N,1) + m_n - dm;
m_s = 2*dm_s*rand(N,1) + m_s_n - dm_s;

f_n_i = 1/(2*pi)*sqrt(k./(m+m_s/3));

% Figure for (i)
figure

ax(1) = subplot(2,2,1);
histogram(k,nbins)
title('Distribution of Spring Stiffness k')
xlabel('k (N/m)')
ylabel('count')
set(gca,'fontsize',fontsize)
```

```

ax(2) = subplot(2,2,2);
histogram(m,nbins)
title('Distribution of Block Mass m')
xlabel('m (kg)')
ylabel('count')
set(gca,'fontsize',fontsize)

ax(3) = subplot(2,2,3);
histogram(m_s,nbins)
title('Distribution of Spring Mass m_s')
xlabel('m_s (kg)')
ylabel('count')
set(gca,'fontsize',fontsize)

ax(4) = subplot(2,2,4);
histogram(f_n_i,nbins)
title('Distribution of Natural Frequency f_n')
xlabel('f_n (Hz)')
ylabel('count')
set(gca,'fontsize',fontsize)

linkaxes(ax,'y')
sgtitle(sprintf('(i) Monte Carlo Analysis of Mass-Spring System, N = %d',N),'fontsize',1.25*fontsize,'fontweight','bold')

```

(ii) Normally Distributed Random Numbers $N = 1000000$;

```

k = k_n + dk/3*randn(N,1);
m = m_n + dm/3*randn(N,1);
m_s = m_s_n + dm_s/3*randn(N,1);

f_n_ii = 1/(2*pi)*sqrt(k./(m+m_s/3));

% Figure for (ii)
figure

ax(1) = subplot(2,2,1);
histogram(k,nbins)
title('Distribution of Spring Stiffness k')
xlabel('k (N/m)')
ylabel('count')
set(gca,'fontsize',fontsize)

ax(2) = subplot(2,2,2);
histogram(m,nbins)
title('Distribution of Block Mass m')
xlabel('m (kg)')
ylabel('count')
set(gca,'fontsize',fontsize)

ax(3) = subplot(2,2,3);

```

```

histogram(m_s,nbins)
title('Distribution of Spring Mass m_s')
xlabel('m_s (kg)')
ylabel('count')
set(gca,'fontsize',fontsize)

ax(4) = subplot(2,2,4);
histogram(f_n_ii,nbins)
title('Distribution of Natural Frequency f_n')
xlabel('f_n (Hz)')
ylabel('count')
set(gca,'fontsize',fontsize)

linkaxes(ax,'y')
sgtitle(sprintf('(ii) Monte Carlo Analysis of Mass-Spring System, N = %d',N),'fontsize',1.25*fontsize,'fontweight','bold')

```

(b) Figure 3

```

fprintf('Part (b)\n')
markersize = 10;
linewidth = 2;

f_n_i_mean = mean(f_n_i);

figure
histogram(f_n_i,nbins)
hold on
xline(f_n,'b','LineWidth',linewidth)
xline(f_n_i_mean,'r','LineWidth',linewidth)
plot(f_n,0,'bo','MarkerSize',markersize,'LineWidth',linewidth)
plot(f_n_i_mean,0,'rx','MarkerSize',markersize,'LineWidth',linewidth)
hold off
title('(i) Distribution of Natural Frequency f_n')
xlabel('f_n (Hz)')
ylabel('count')
legend('Bin counts','Nominal value','Mean value','Location','northeast')
set(gca,'fontsize',fontsize)

f_n_ii_mean = mean(f_n_ii);

figure
histogram(f_n_ii,nbins)
hold on
xline(f_n,'b','LineWidth',linewidth)
xline(f_n_ii_mean,'r','LineWidth',linewidth)
plot(f_n,0,'bo','MarkerSize',markersize,'LineWidth',linewidth)
plot(f_n_ii_mean,0,'rx','MarkerSize',markersize,'LineWidth',linewidth)
hold off
title('(ii) Distribution of Natural Frequency f_n')
xlabel('f_n (Hz)')
ylabel('count')
legend('Bin counts','Nominal value','Mean value','Location','northeast')

```

```
set(gca,'fontsize',fontsize)
```

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