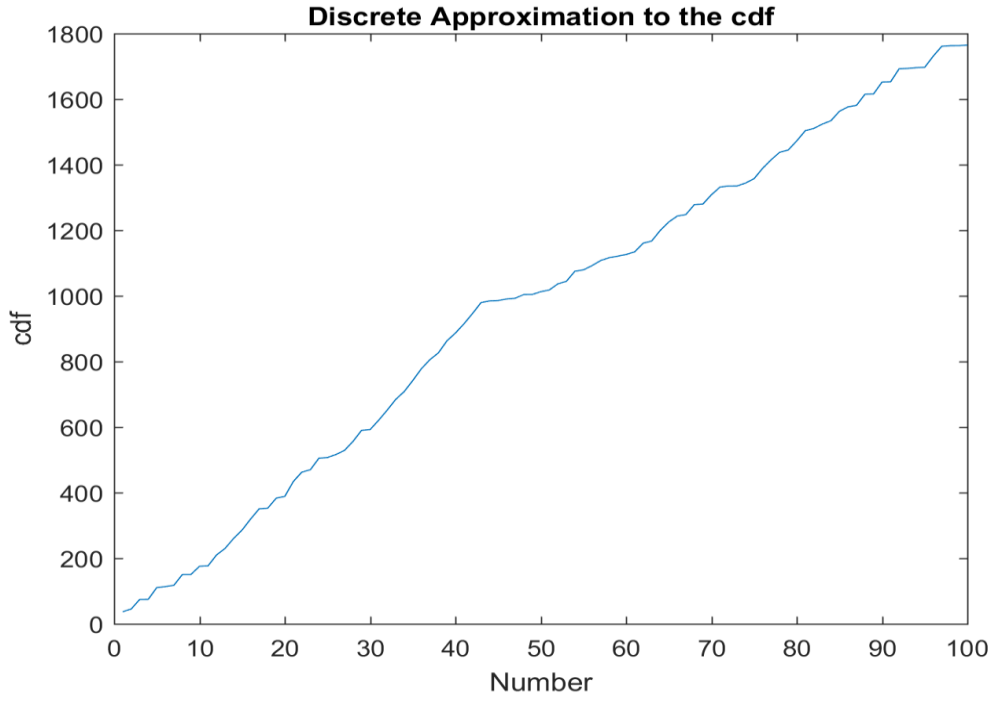
4. Results and Observations

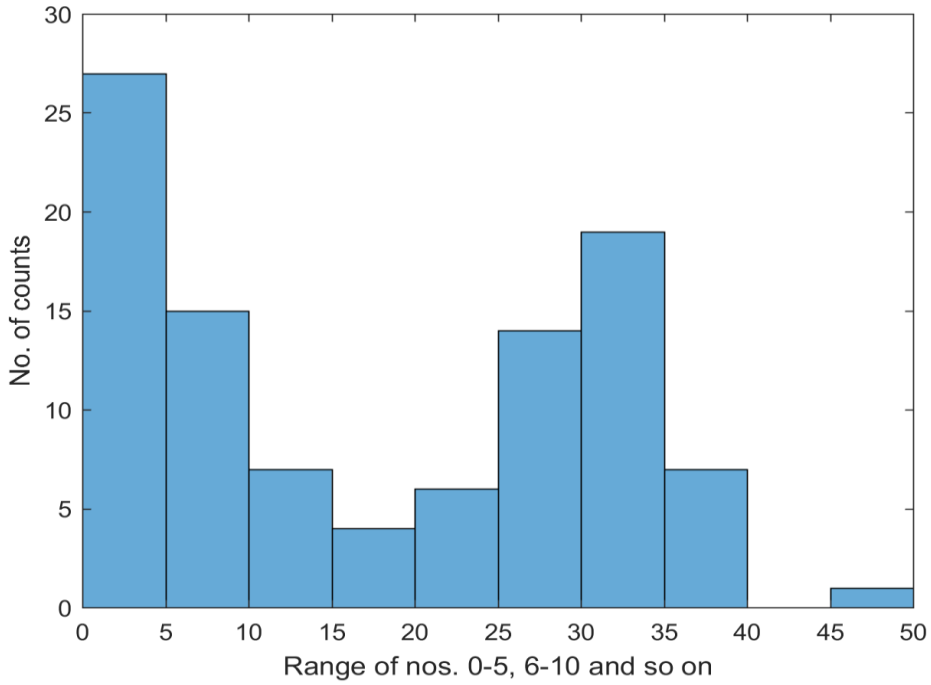
For part (a), Sample Mean = 17.6471

Sample Variance = 177.2323

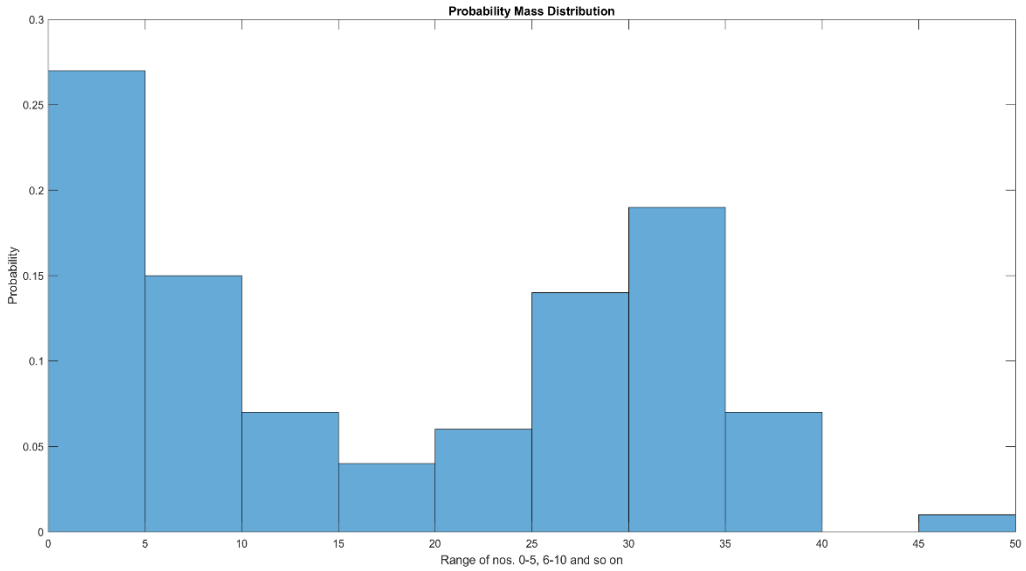
For part (b),



For part (c),



The histogram looks like above of the dataset provided. It shows how much of the data falls in every range of equal size. The PMF, normalized between 0 and 1, looks like below:



For part (d),
I got 100 values of sample means and sample variances for M = 100 and similarly, 50 values of sample means and sample variances for M = 50.

For part (e),
For sample mean,
MSE for M = 50, MSE = 1.4587
MSE for M = 100, MSE = 2.2385

For part (f),
For sample variance,
MSE for M = 50, MSE = 102.4106
MSE for M = 100, MSE = 118.7877

For my experiment, as value of M increases, i.e., as the number of bootstrap samples increase, there is an increase in MSE for both the mean and variance.

For every bootstrapping sample of 100 values, the mean and variance of that sample is very close to the original mean and variance.

5. Code

```
clc;
clear all;
```

```
% Part a
Nos = [37.12 8.45 28.96 0.27 36.22 2.78 3.98 32.79 0.14 24.87 1.33 33.25
19.91 30.43 25.84 33.55 31.10 1.86 30.57 5.34 45.39 28.67 7.12 35.38 1.92
9.25 12.55 27.49 33.72 2.30 28.32 30.92 32.62 24.10 33.56 35.62 27.88 20.71
36.62 24.03 28.00 31.44 33.32 5.01 1.30 4.56 2.28 11.33 0.24 8.53 5.27 18.52
7.63 31.03 4.06 12.83 15.43 8.75 4.65 5.21 7.90 26.48 6.81 32.20 25.69 18.18
4.48 30.33 1.68 28.44 23.26 3.35 0.17 8.90 13.29 31.54 26.16 22.79 6.89 27.92
30.99 6.93 13.27 10.08 28.95 13.40 4.57 34.10 0.76 36.40 0.60 39.74 1.11 2.40
1.05 34.10 29.95 1.94 0.16 1.43];
Exp_val = mean(Nos);
Variance = var(Nos);

% Part b
E = zeros(1,100);
E(1) = Nos(1);
for i = 2:100
    E(i) = E(i-1) + Nos(i);
end

figure
plot(E);
xlabel('Number');
ylabel('cdf');
title('Discrete Approximation to the cdf');

% Part c
figure
edges = [0:5:50];
h = histogram(Nos, edges);
Val = h.Values;
xlabel('Range of nos. 0-5, 6-10 and so on');
ylabel('No. of counts');


Val = Val/100;
figure
h = histogram(Nos, 'Normalization', 'probability');
h.BinEdges = [0:5:50];
xlabel('Range of nos. 0-5, 6-10 and so on');
ylabel('Probability');
title('Probability Mass Distribution');

% Part d
M = 50;
sample1 = zeros(M,100);

for i = 1:M
    for j = 1:100

        pos = randi(length(Nos));
        sample1(i,j) = Nos(pos);

    end
end

sample_mean1 = mean(sample1,2);
```

```
sample_var1 = var(sample1.').';

% Part e
sm1 = (sample_mean1 - Exp_val).^2;
S1 = sum(sm1);
MSE1 = S1/M;

% Part f
sv1 = (sample_var1 - Variance).^2;
S2 = sum(sv1);
MSE2 = S2/M;
```

% For M = 50, just change the value of M in the code.