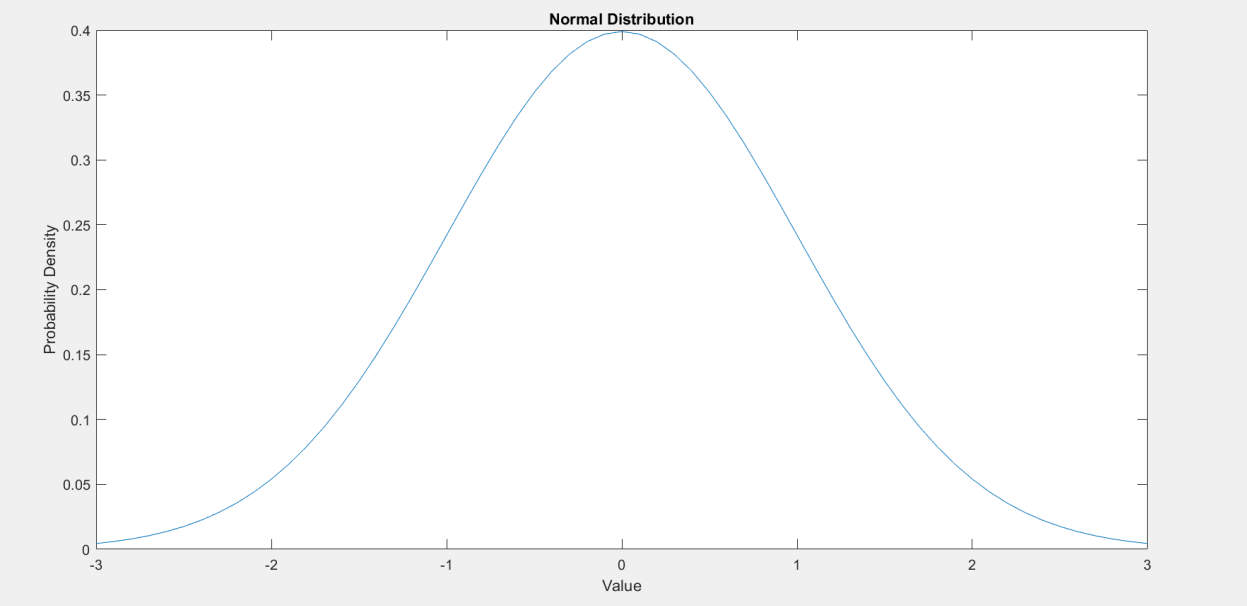
Probability Distribution Problems

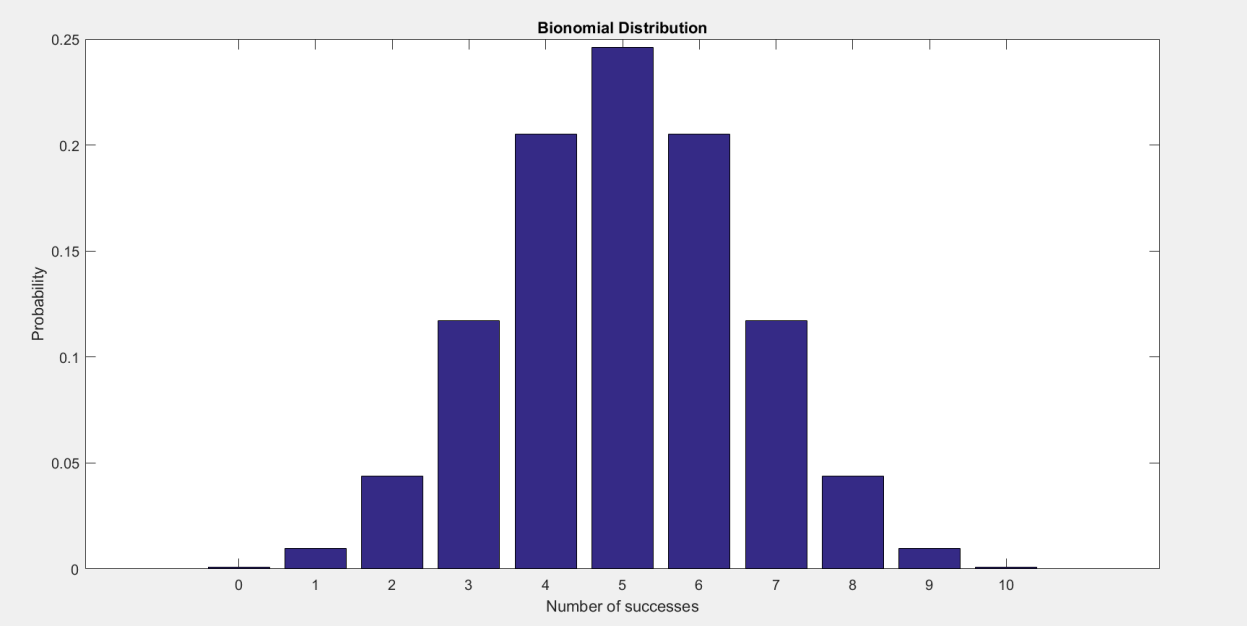
Problem 1: Simulating a Normal Distribution

```
%Simulating a Normal Distribution.....

clc;

clear all;

close all;

 %Parameters

mu=0;    %mean

sigma=1;     %Standard Deviation

 %Generate a normal distribution

x= -3*sigma:0.1:3*sigma;

y= normpdf(x,mu,sigma);

 %Plot figure

plot(x,y);

title('Normal Distribution');

xlabel('Value');

ylabel('Probability Density');
```



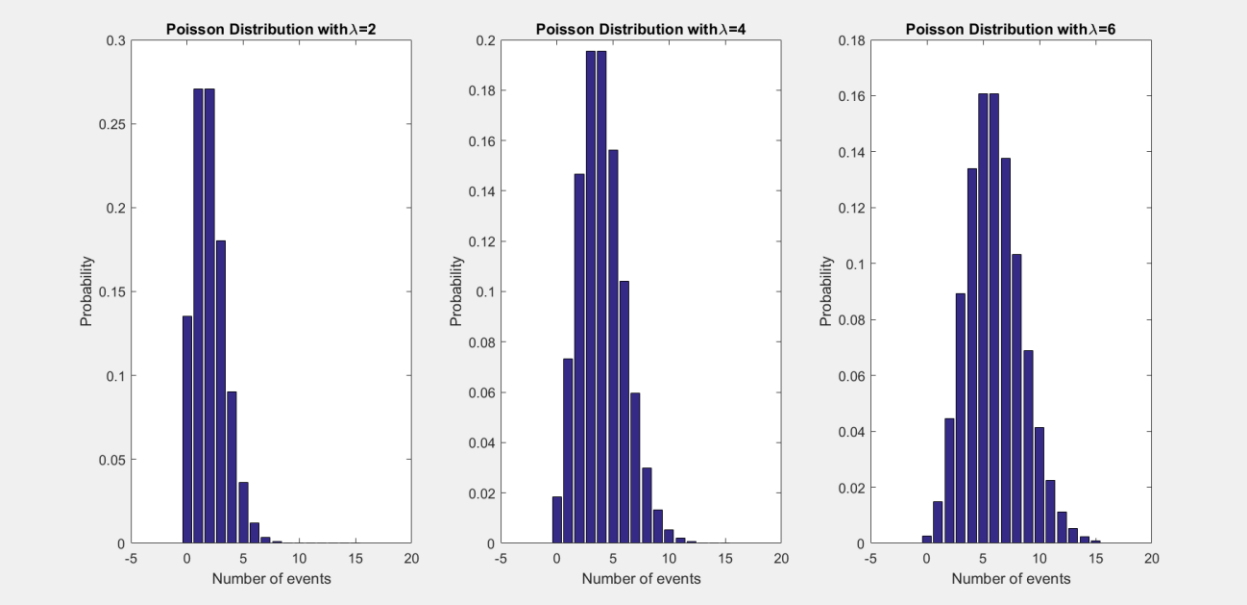
Problem 2: Calculating Binomial Probabilities

```
%Calculating Binomial Probabilities.....

clc;

clear all;

close all;

 %Parameters

n=10;  %Number of trials

p=0.5; %Probability of success

 %Calculate binomial probabilities

x= 0:n;

y= binopdf(x,n,p);

 %Plot figure

bar(x,y);

title('Binomial Distribution');

xlabel('Number of successes');

ylabel('Probability');
```



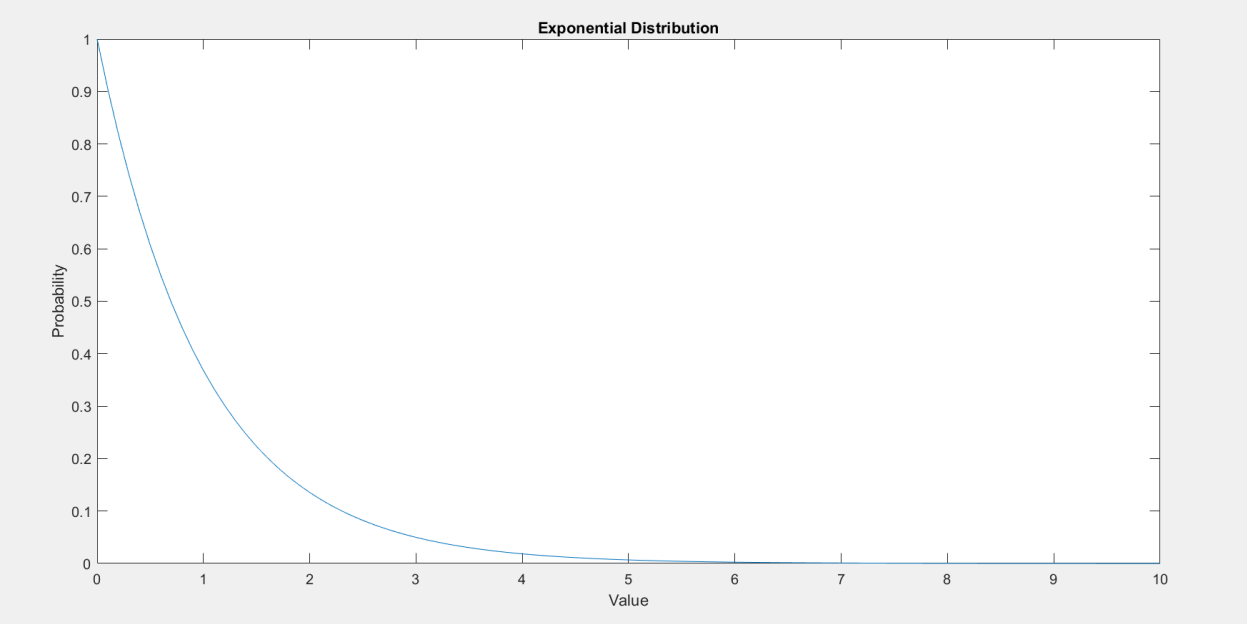
Problem 3: Poisson Distribution

```
%Poisson Distribution.....

clc;

clear all;

close all;

 %Parameters

lambda=[2,4,6];   %Different mean value

 %Generate and plot poisson distributions

for i=1:length(lambda)

   x=0:15;

   y=poisspdf(x,lambda(i));

   subplot(1,length(lambda),i);

   bar(x,y);

   title(['Poisson Distribution with\lambda=',num2str(lambda(i))]);

   xlabel('Number of events');

   ylabel('Probability');

end
```



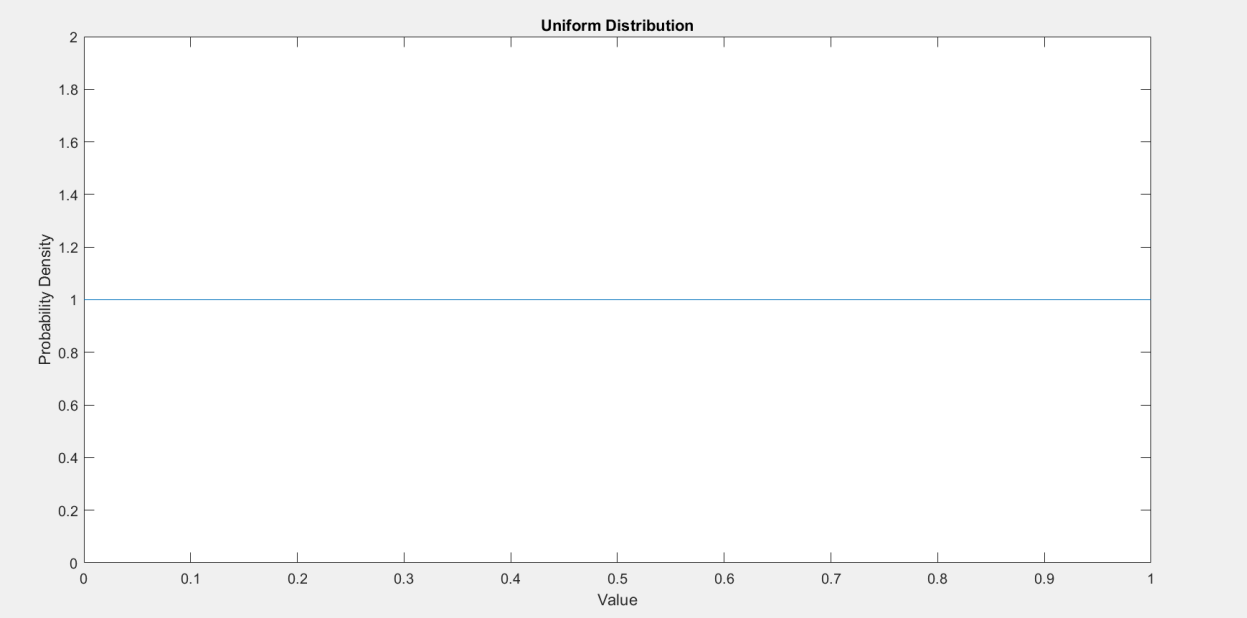
Problem 4: Exponential Distribution

```
%Exponential Distribution.....

clc;

clear all;

close all;

 %Parameters

lambda=1; %Rate parameter

 %Generate exponential distribution

x=0:0.1:10;

y=exppdf(x,1/lambda);

 %Plot figure

plot(x,y);

title('Exponential Distribution');

xlabel('Value');

ylabel('Probability');
```



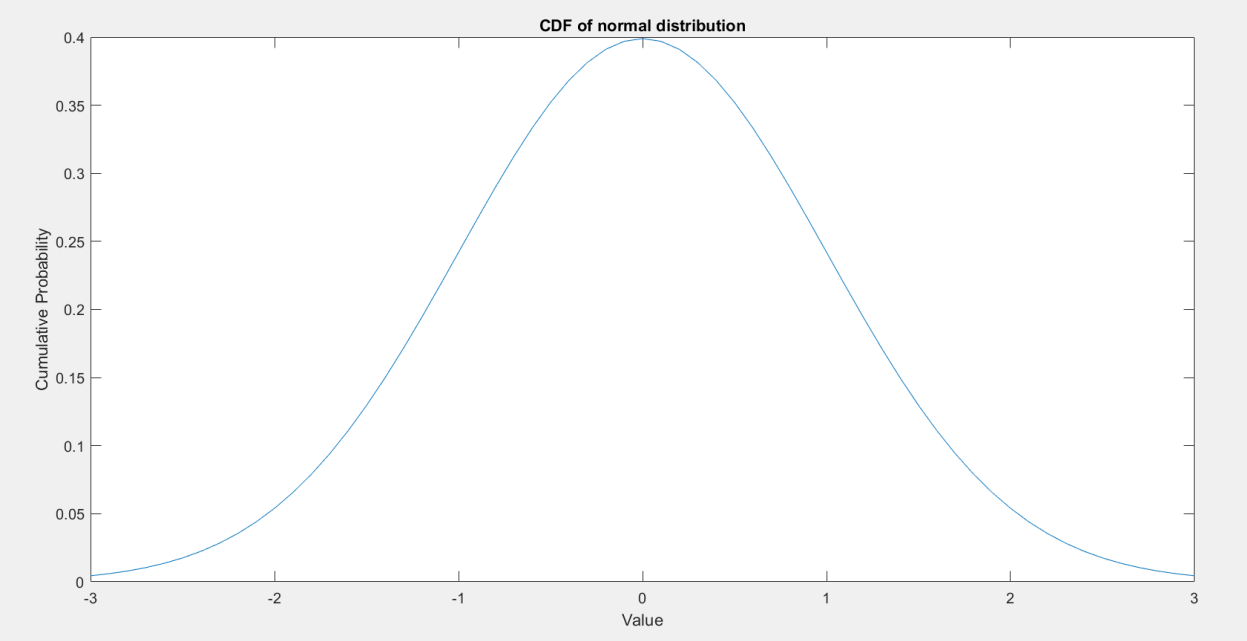
Problem 5: Uniform Distribution

```
%Uniform Distribution.....

clc;

clear all;

close all;

 %Parameters

a=0;  %Lower bound

b=1;  %Upper bound

 %Generate uniform distribution

x=0:0.01:b;

y=unifpdf(x,a,b);

 %Plot figure

plot(x,y);

title('Uniform Distribution');

xlabel('Value');

ylabel('Probability Density');
```



Problem 6: Cumulative Distribution

```
%Cumulative Distribution Function(CDF).....

clc;

clear all;

close all;

 %Parameters

mu=0;  %Mean

sigma=1;  %Strandard deviation

 %Generate CDF

x= -3*sigma:0.1:3*sigma;

y= normpdf(x,mu,sigma);

 %Plot figure

plot(x,y);

title('CDF of normal distribution');

xlabel('Value');

ylabel('Cumulative Probability');
```



Problem 7: Working with Random Variables

```
%Working with Random Variables.....
clc;
clear all;
close all;
 %Parameters
num_samples= 1000;
samples=normrnd(0,1,[num_samples,1]);
 %Calculate statistics
mean_val= mean(samples);
std_dev= std(samples);
 %Display results
fprintf('Mean:%2f\n',mean_val);
fprintf('Standard Deviation:%2f\n',std_dev);
```

OUTPUT:

```
Mean:0.038275
Standard Deviation:1.005476
```

Basic Statistics with MATLAB

1. Calculating Mean, Median, and Mode

```
%Calculating Mean, Median, and Mode.....
clc;
clear all;
close all;
 %Data
data=[15,9,26,13,14,12,22, 19];
```

```
%Mean
mean_val= mean(data);
%median
median_val= median(data);
%mode
mode_val= mode(data);
%Display results
fprintf('Mean:%.2f\n',mean_val);
fprintf('Median:%.2f\n',median_val);
fprintf('Mode:%.2f\n',mode_val);
```

OUTPUT:

```
Mean:16.25
Median:14.50
Mode:9.00
```

2.Standard Deviation and Variance

```
%Standard Deviation and Variance.....
clc;
clear all;
close all;
 %Data
data=[15,9,26,13,14,12,22,19];
 %Standard deviation
std_dev=std(data);
 %Variance
variance=var(data);
 %Display results
```

```
fprintf('Standard Deviation:%.2f\n',std_dev);

fprintf('Variance:%.2f\n',variance);
```

OUTPUT:

Standard Deviation:5.65

Variance:31.93

3.Linear Correlation Coefficient

```
%Linear Correlation Coefficient.....

clc;

clear all;

close all;

 %Data

data_x= [1,2,3,4,5];

data_y= [2,4,5,4,5];

 %Correlation Coefficient

corr_coeff= corrcoef(data_x,data_y);

 5%Display results

fprintf('Correlation Coefficient:%.2f\n',corr_coeff(1,2));
```

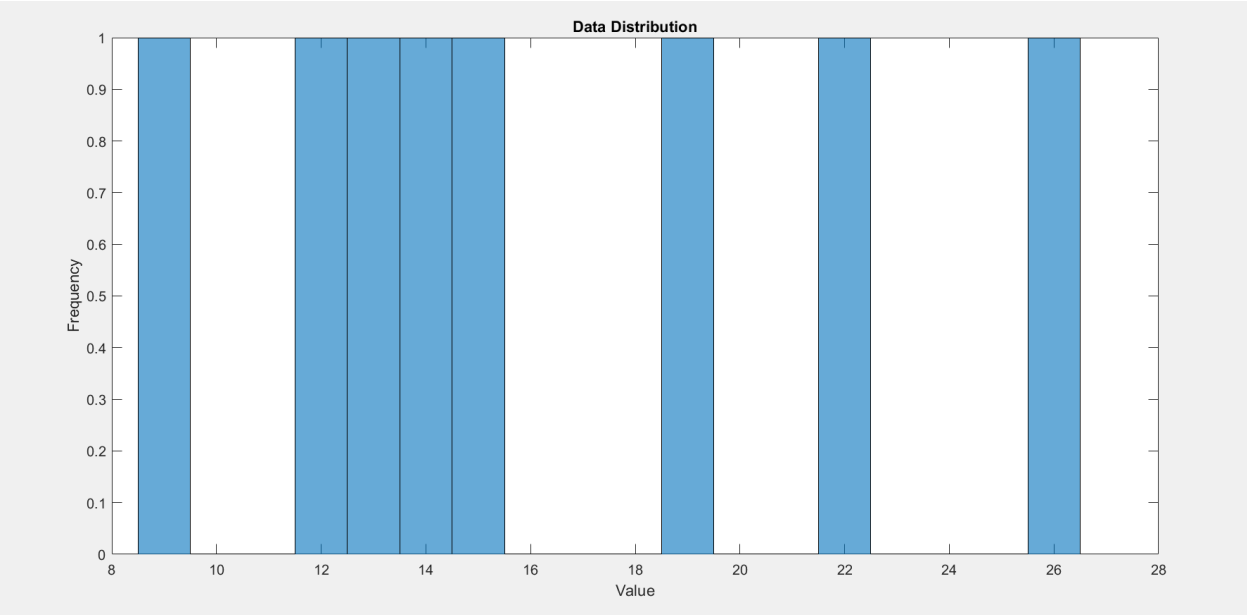
OUTPUT:

Correlation Coefficient:0.77

4.Histogram Plotting

```
%Histogram Plotting.....

clc;

clear all;

close all;
```

```
 %Data
data= [15,9,26,13,14,12,22,19];
 %Plot Histogram figure
histogram(data);
title('Data Distribution');
xlabel('Value');
ylabel('Frequency');
```



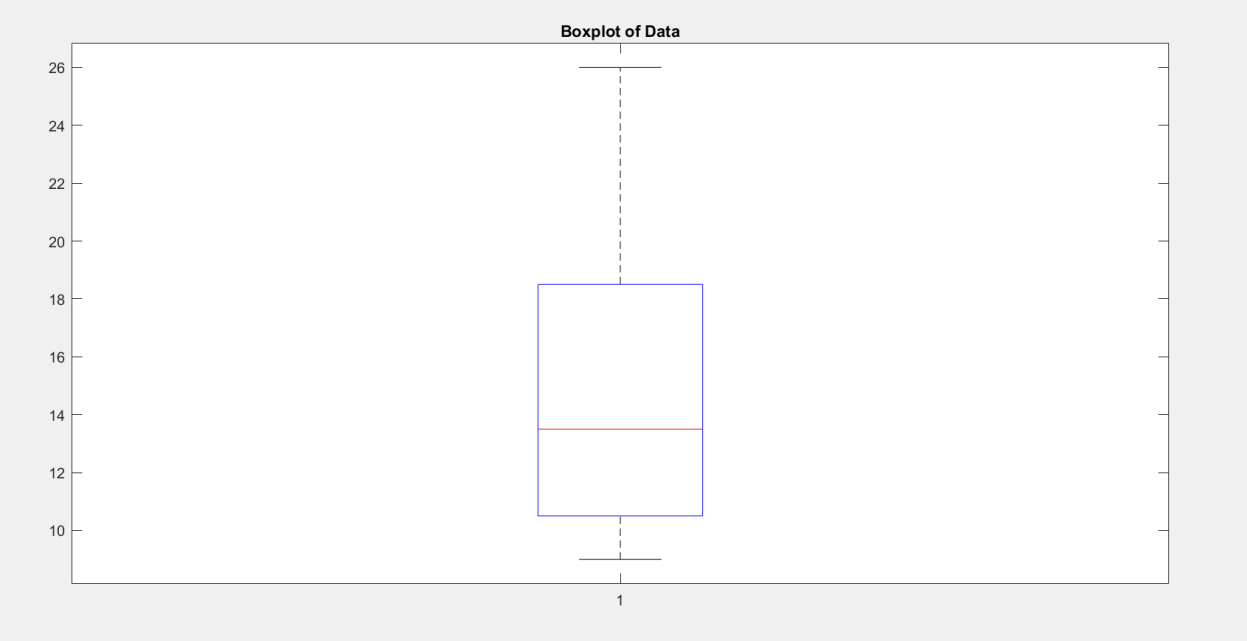
5. Boxplot of Data Distribution

```
%Boxplot for Data Distribution.....
clc;
clear all;
close all;
 %Data
data=[15,9,26,13,14,12,22,9];
```

%Boxplot figure

boxplot(data);

title('Boxplot of Data');



6.Scatter Plot for Two Variables

%Scatter Plot for Two Variables.....

clc;

clear all;

close all;

%Data

data_x= [1,2,3,4,5];

data_y= [2,4,5,4,5];

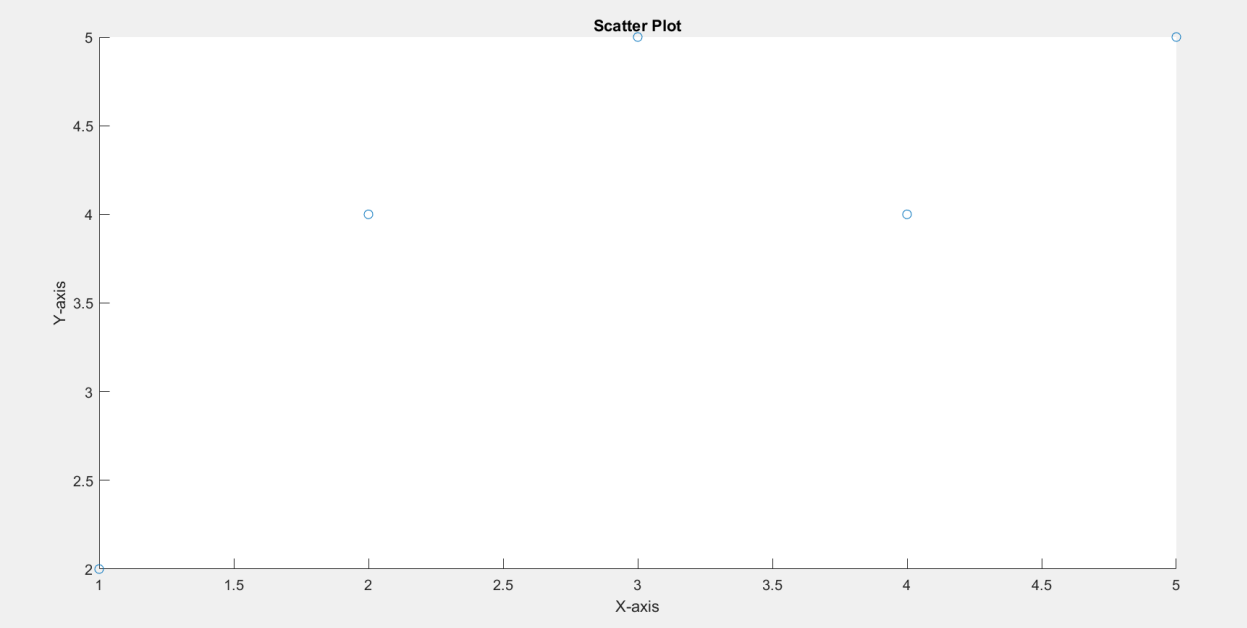
%Scatter Plot figure

scatter(data_x,data_y);

title('Scatter Plot');

xlabel('X-axis');

ylabel('Y-axis');



7.Generating Random Data and Analyzing

%Generating Random Data and Analyzing.....

clc;

clear all;

close all;

% Generate random data

data = normrnd (0, 1, [100, 1]); % 100 random numbers from N(0,1)

% Mean and Standard Deviation

mean_val = mean(data);

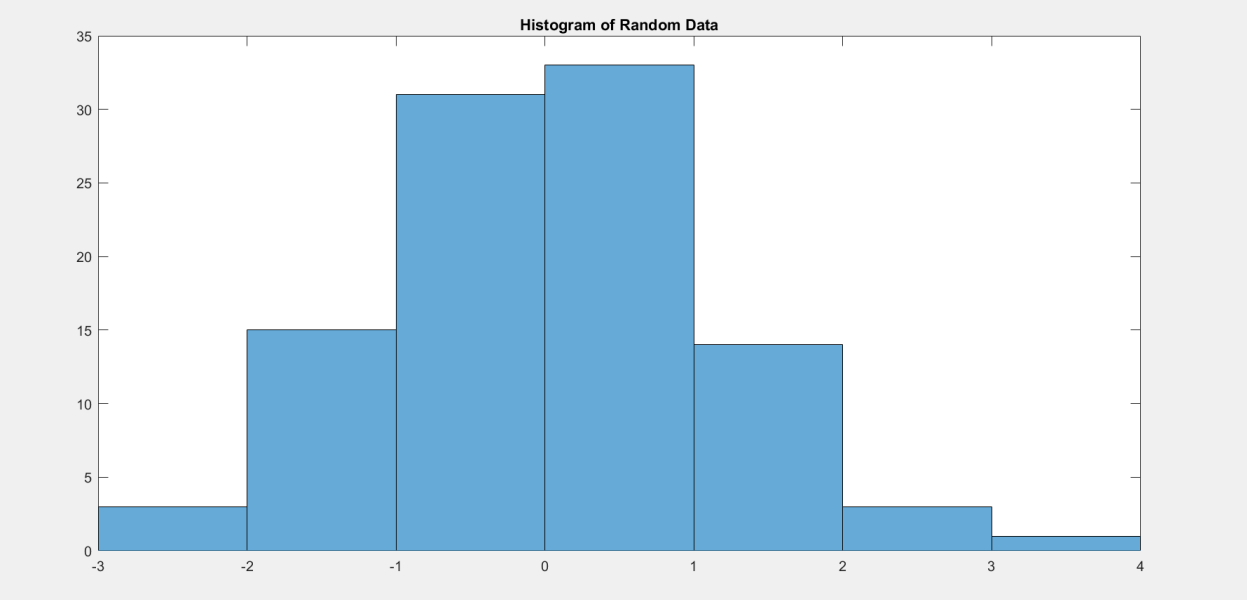
std_dev = std(data);

% Display results

fprintf('Mean of Random Data: %.2f\n', mean_val);

fprintf('Standard Deviation of Random Data: %.2f\n', std_dev);

```
% Plot Histogram
figure;
histogram(data);
title('Histogram of Random Data');
```

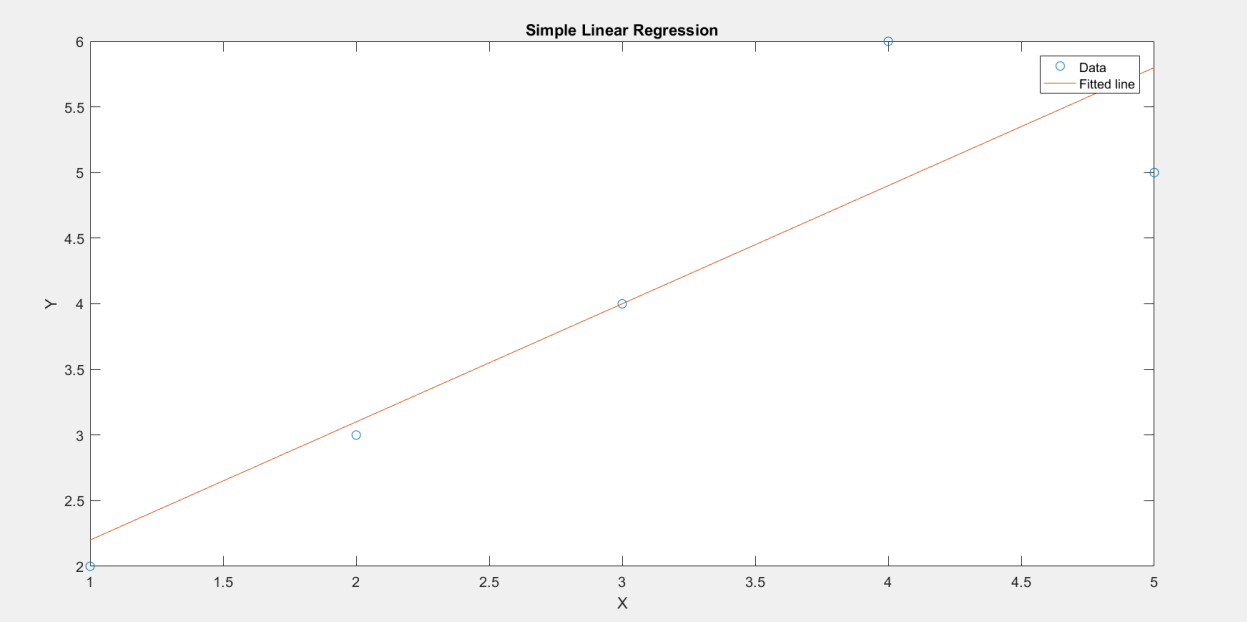


Regression Analysis

Simple Linear Regression

```
%Simple Linear Regression.....
clc;
clear all;
close all;
 %Sample Data
x=[1,2,3,4,5];
y=[2,3,4,6,5];
```

```
%Perform linear regression
p=polyfit(x,y,1);   %p(1) is slope, p(2) is intercept
%Create a linear model
y_fit= polyval(p,x);
 %Plot figure
plot(x,y,'o');   %original data
hold on;
plot(x,y_fit,'-');   %fitted line
title('Simple Linear Regression');
xlabel('X');
ylabel('Y');
legend('Data','Fitted line');
```



Multiple Linear Regression

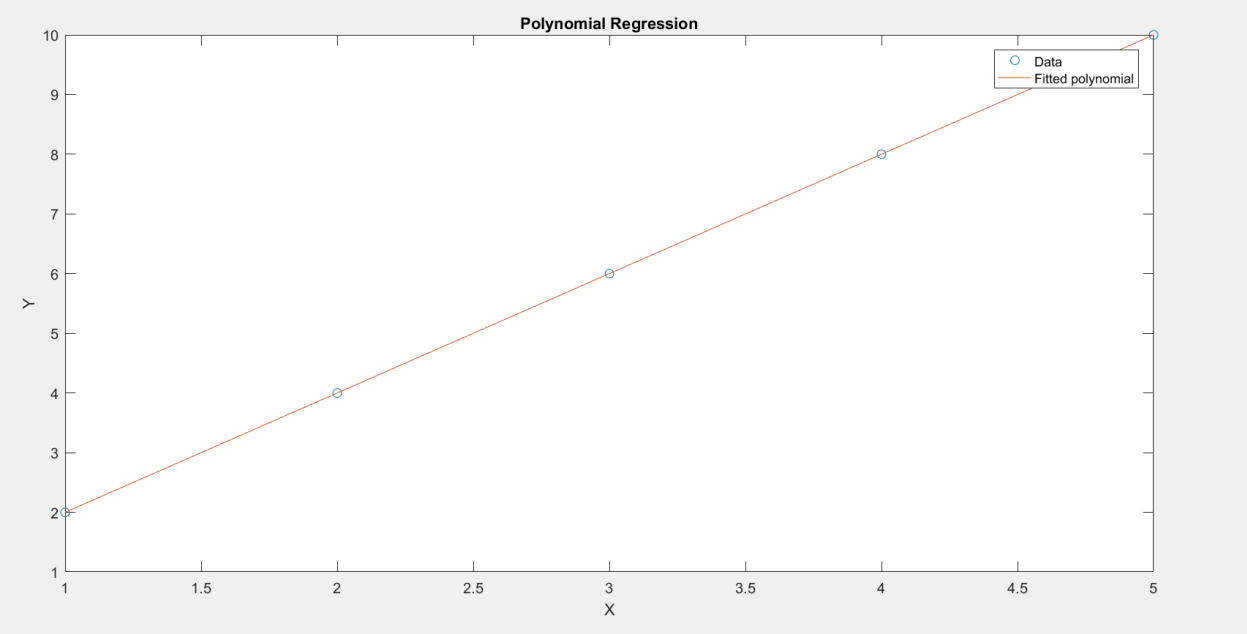
```
%Multiple Linear Regression.....................

clc;

clear all;

close all;


%Sample data

X=[1,2,3; 2,3,4; 3,4,5; 4,5,6; 5,6,7];  %Each row is an observation

Y=[2;3;4;6;5];    %Dependent variable

 %Add a column of ones to X for the intercept

X=[ones(size(X,1),1)];

 %Perform regression

b=regress(Y,X);   %Returns the regression coefficients

 %Predicted values

Y_pred=X*b;

%Display the coefficients

disp('Coefficients(including intercept):');

disp(b);

%Plot-only practical if you have 1 or 2 independent variables

%For more variables, consider 3D plots or partial regression plots
```

OUTPUT:

```
Coefficients(including intercept):

   4.0000
```

Polynomial Regression

```
%Polynomial Regression.....

clc;

clear all;

close all;

%Sample Data

x=[1,2,3,4,5];

y=[2,4,6,8,10];

 %Polynomial degree

degree = 2;

 %Perform polynomial regression

p= polyfit(x,y,degree);

%Create a polynomial model

x_fit= linspace(min(x),max(x),100);  %100 points for a smoother plot

y_fit= polyval(p,x_fit);

%Plot figure

plot(x,y,'o');   %original polynomial

hold on;

plot(x_fit,y_fit,'-');   %fitted polynomial

title('Polynomial Regression');

xlabel('X');

ylabel('Y');

legend('Data','Fitted polynomial');
```


Polynomial Regression
Data
Fitted polynomial
Y
X
10
9
8
7
6
5
4
3
2
1
1
1.5
2
2.5
3
3.5
4
4.5
5