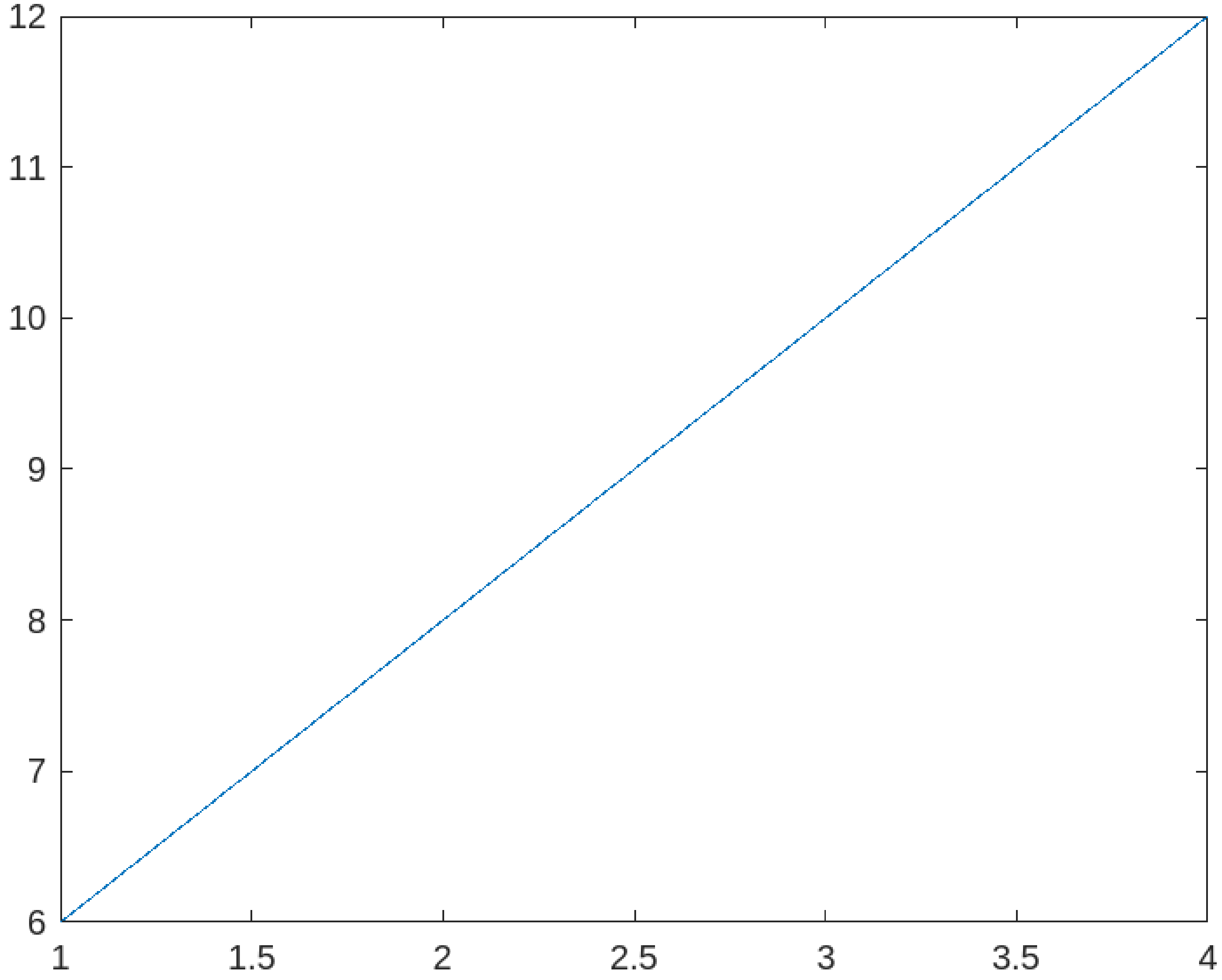
Table of Contents

Experiment 1 : Creating Arrays

```
% Array Addition
a = [1 2 3 4];
b = [5 6 7 8];

c = a + b;
d = a - b;

% Matrix Addition and Multiplication

A = [1 2 3; 4 5 6; 7 8 9; ];
B = [ 10 11 12; 13 14 15; 16 17 19 ];

C = A + B;
D = A * B;

% Transpose a Matrix

E = A';

% Rank of a Matrix

F = rank(A);

plot(c)

plot(d)

plot(C)

plot(D)

plot(E)
```

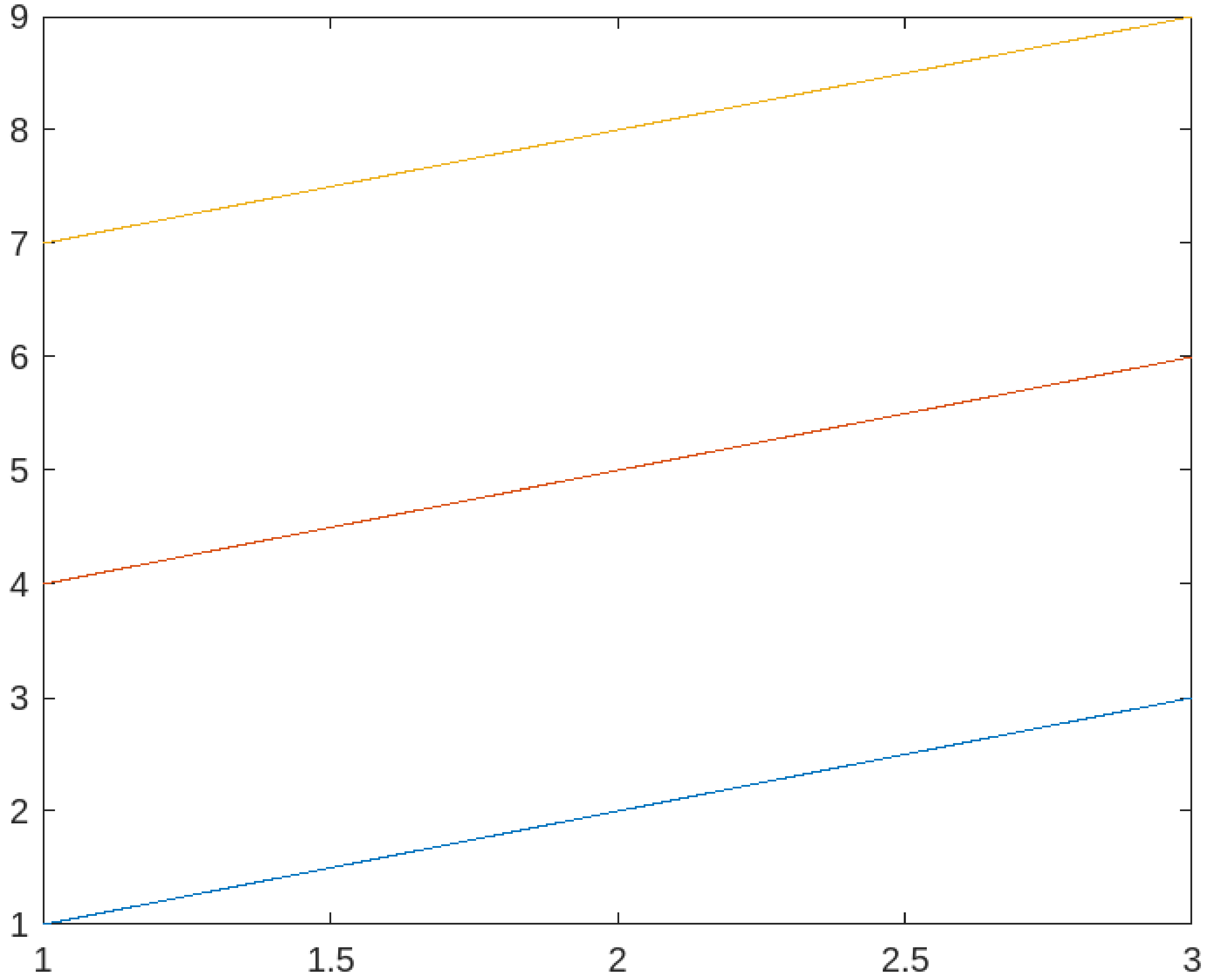
Output

Array Addition

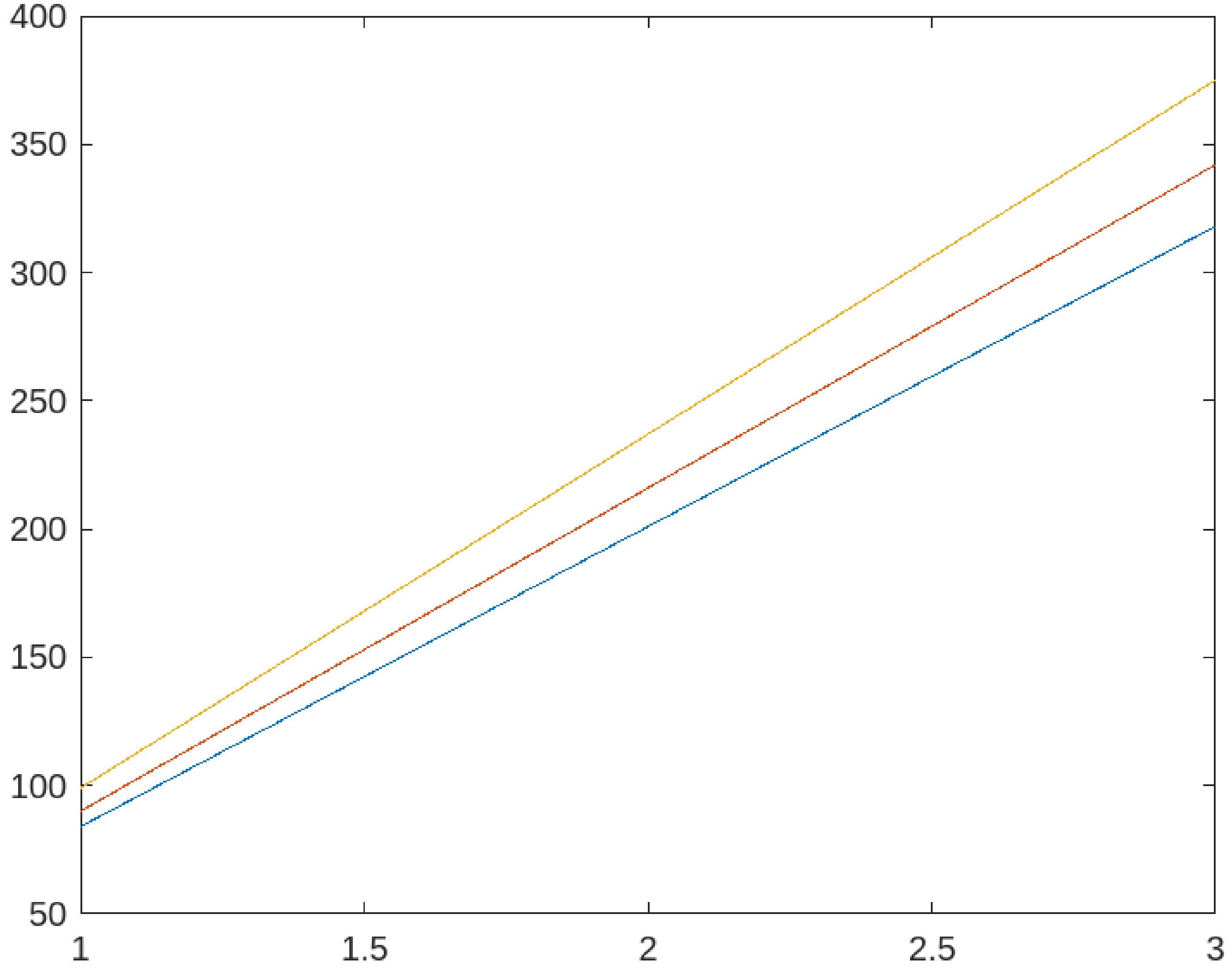


Matrix Addition and Multiplication

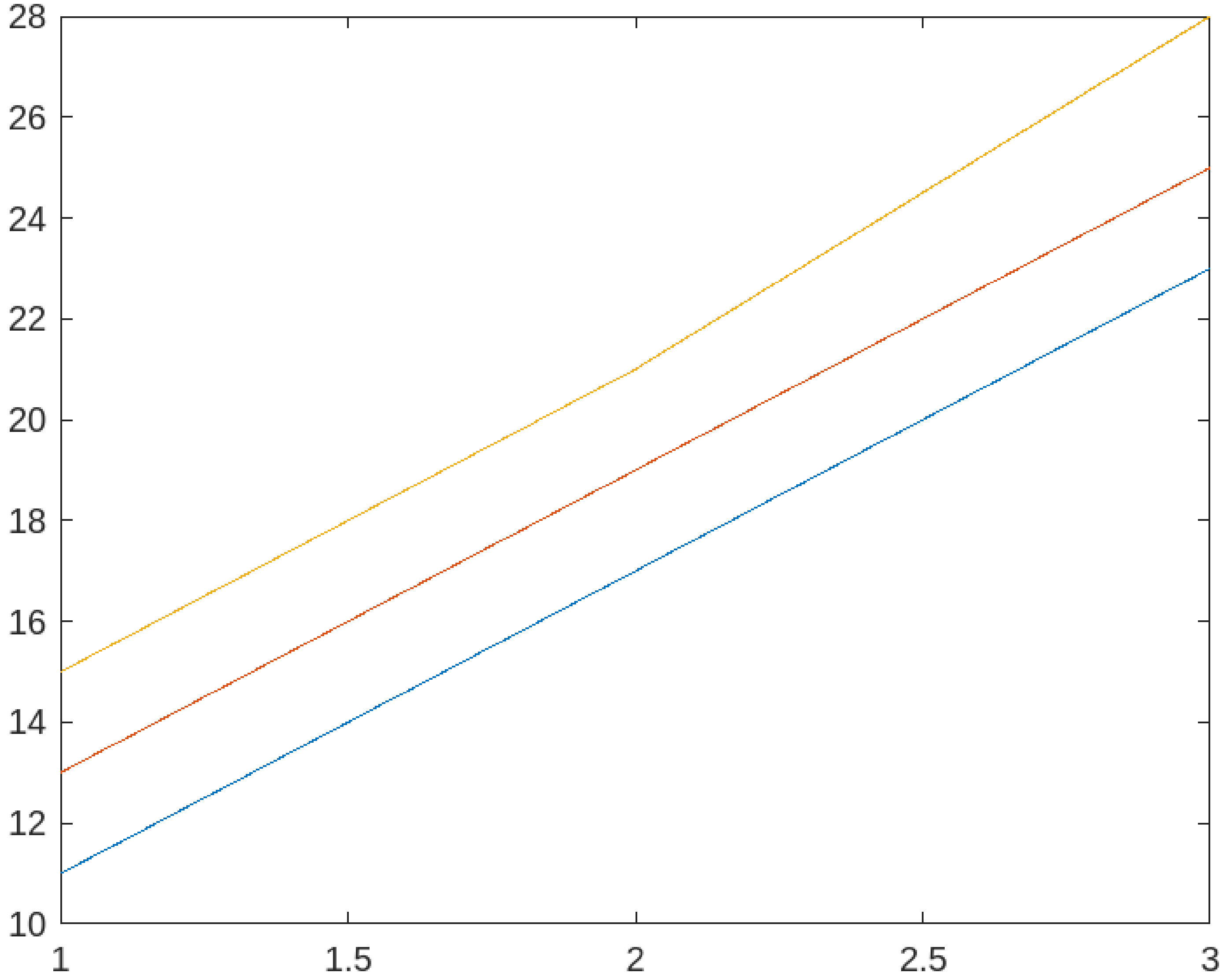
Matrix Addition



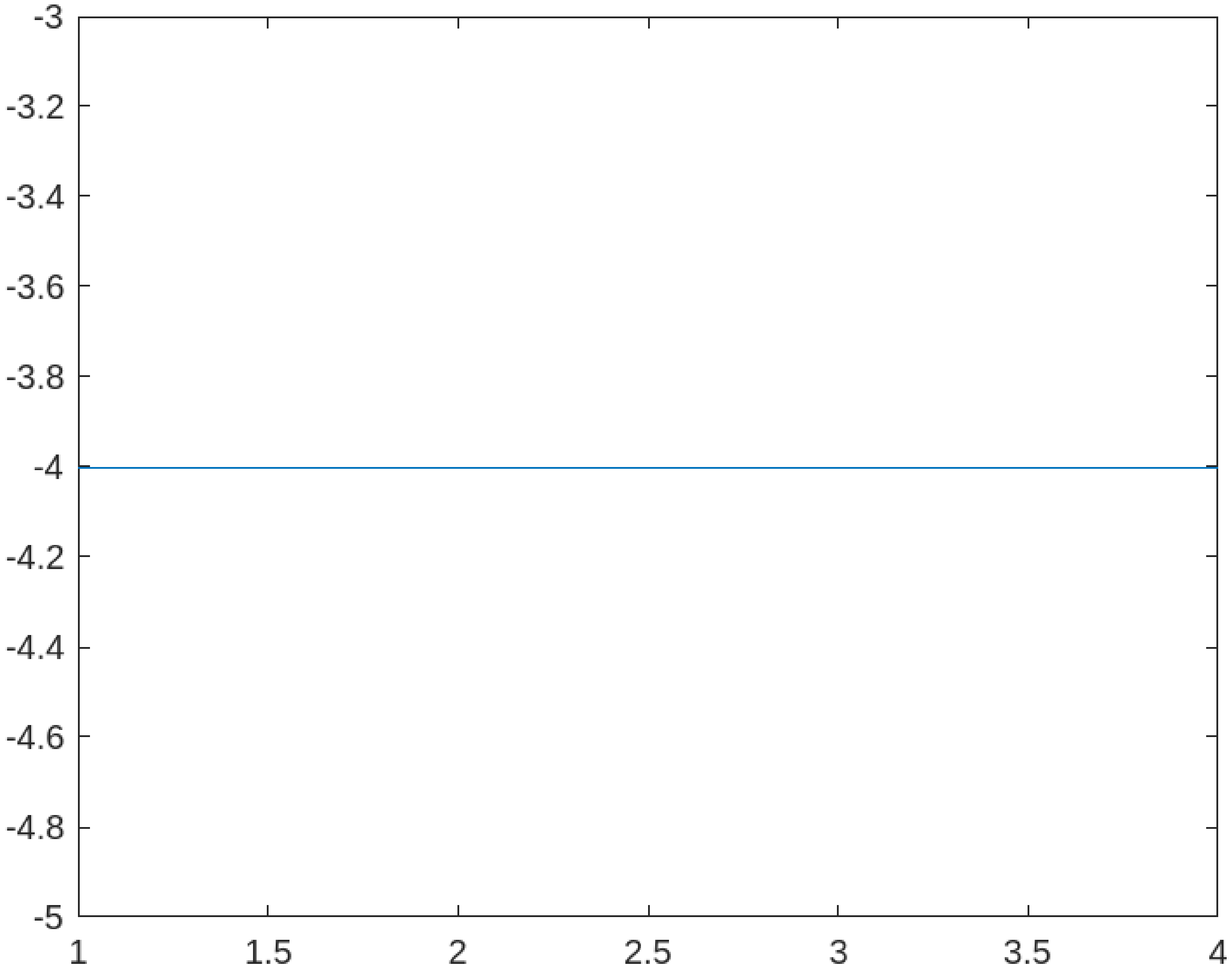
Matrix Multiplication



Transpose a Matrix



Rank of a Matrix


-3
-3.2
-3.4
-3.6
-3.8
-4
-4.2
-4.4
-4.6
-4.8
-5
1
1.5
2
2.5
3
3.5
4

Experiment 2 : Matrix Manipulations

```
% Concatenating two matrices horizontally
A = [1 2; 3 4];
B = [5 6; 7 8];
C = [A B];

% Concatenating two matrices vertically
A = [1 2; 3 4];
B = [5 6; 7 8];
C = [A; B];

% Indexing an element in a matrix
A = [1 2; 3 4];
A(2,1) % returns 3

% Indexing a range of elements in a matrix
A = [1 2 3; 4 5 6; 7 8 9];
B = A(1:2,2:3); % returns [2 3; 5 6]

% Sorting the rows of a matrix in ascending order
A = [4 3 1; 2 5 6; 7 8 9];
B = sort(A);

% Sorting the columns of a matrix in descending order
A = [4 3 1; 2 5 6; 7 8 9];
B = sort(A,'descend');

% Shifting elements of a matrix by a given amount
A = [1 2 3; 4 5 6; 7 8 9];
B = circshift(A,1); % shifts all elements down by 1

% Reshaping a matrix to a different size
A = [1 2 3; 4 5 6; 7 8 9];
B = reshape(A,9,1); % reshapes to a column vector

% Reshaping a matrix to a different size while preserving the number of elements
A = [1 2 3; 4 5 6; 7 8 9];
B = reshape(A,3,3); % reshapes to the original size
```

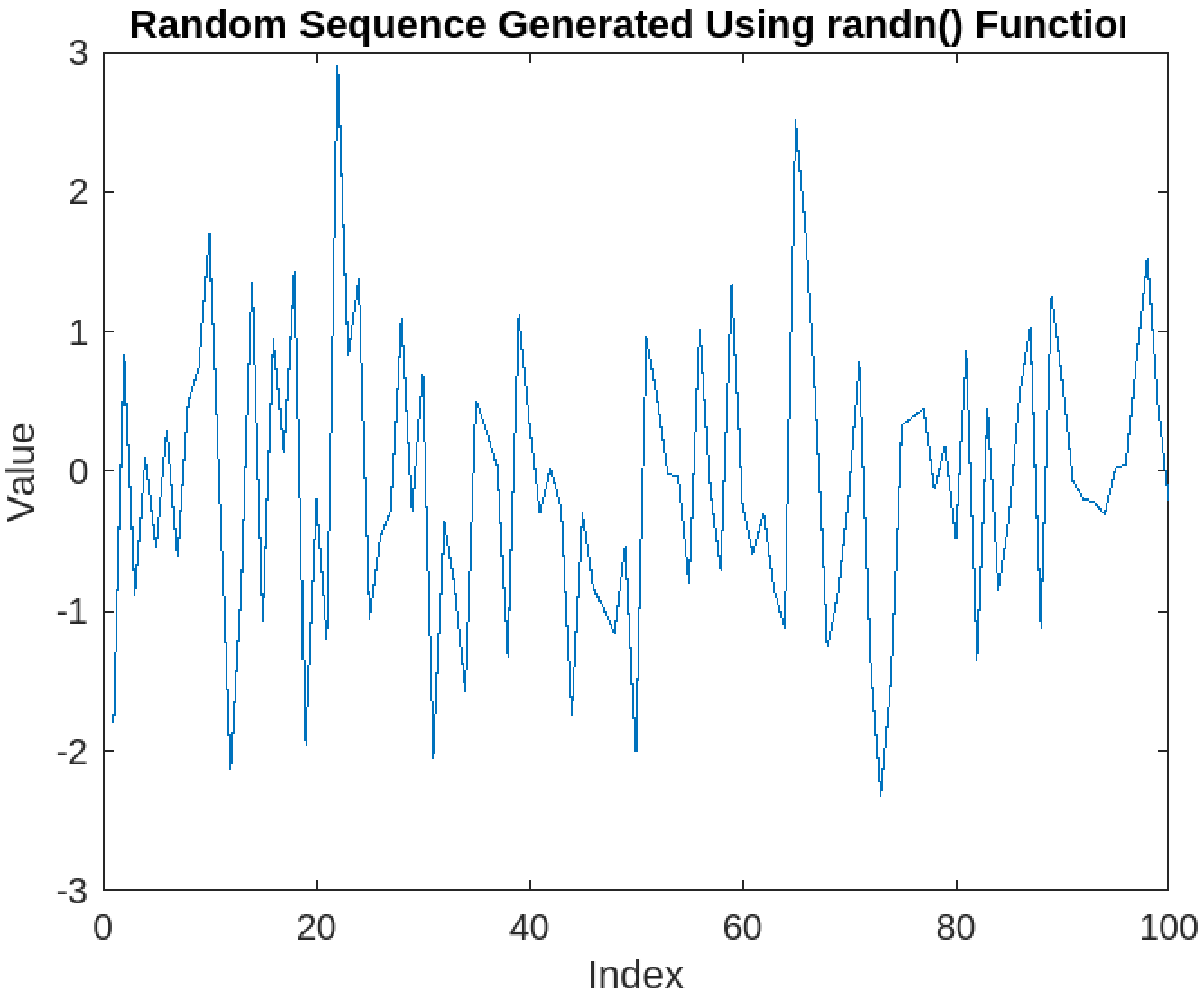
```
% Resizing a matrix to a different size
A = [1 2 3; 4 5 6; 7 8 9];
B = imresize(A,2); % increases the size of A by a factor of 2

% Resizing a matrix to a different size using interpolation
A = [1 2 3; 4 5 6; 7 8 9];
B = imresize(A,2,'bicubic'); % increases the size of A by a factor of 2 using bicubic interpolation

% Flipping a matrix about a vertical axis
A = [1 2 3; 4 5 6; 7 8 9];
B = fliplr(A);

% Flipping a matrix about a horizontal axis
A = [1 2 3; 4 5 6; 7 8 9];
B = flipud(A);
```

Experiment 3 : Relational and Logical Operations

Input

```
% Add up the values of the elements (Check with sum)
X = [1, 2, 3, 4, 5];
total_sum = sum(X);

% Compute the Running Sum (Check with sum), where Running Sum for element j = the sum of the elements from 1 to j, inclusive.

running_sum = cumsum(X);

% Generate a random sequence using rand() function
seq = rand(1, 100); % generates 1x100 array of random values between 0 and 1

% Plot the sequence
plot(seq)
title('Random Sequence Generated Using rand() Function')
xlabel('Index')
ylabel('Value')

% Generate a random sequence using randn() function
seq = randn(1, 100); % generates 1x100 array of random values from a normal distribution with mean 0 and standard deviation 1

% Plot the sequence
plot(seq)
title('Random Sequence Generated Using randn() Function')
xlabel('Index')
ylabel('Value')
```

Output


Random Sequence Generated Using randn() Functio
Value
Index
3
2
1
0
-1
-2
-3
0
20
40
60
80
100

Experiment 4 : Random Sequences and Plots

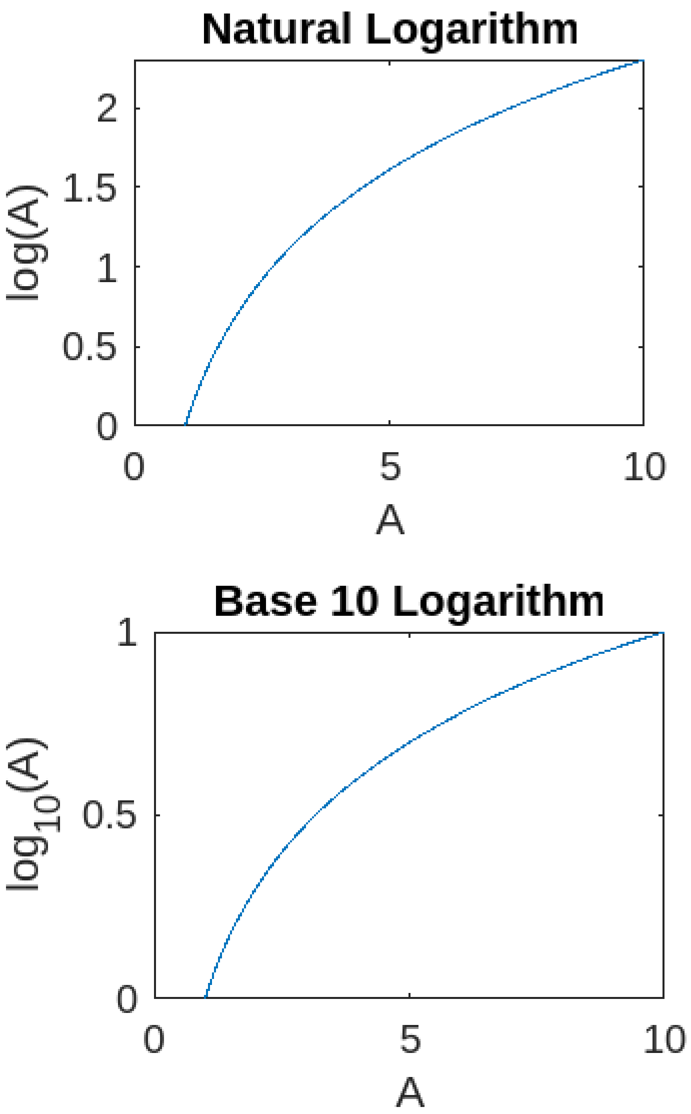
Input

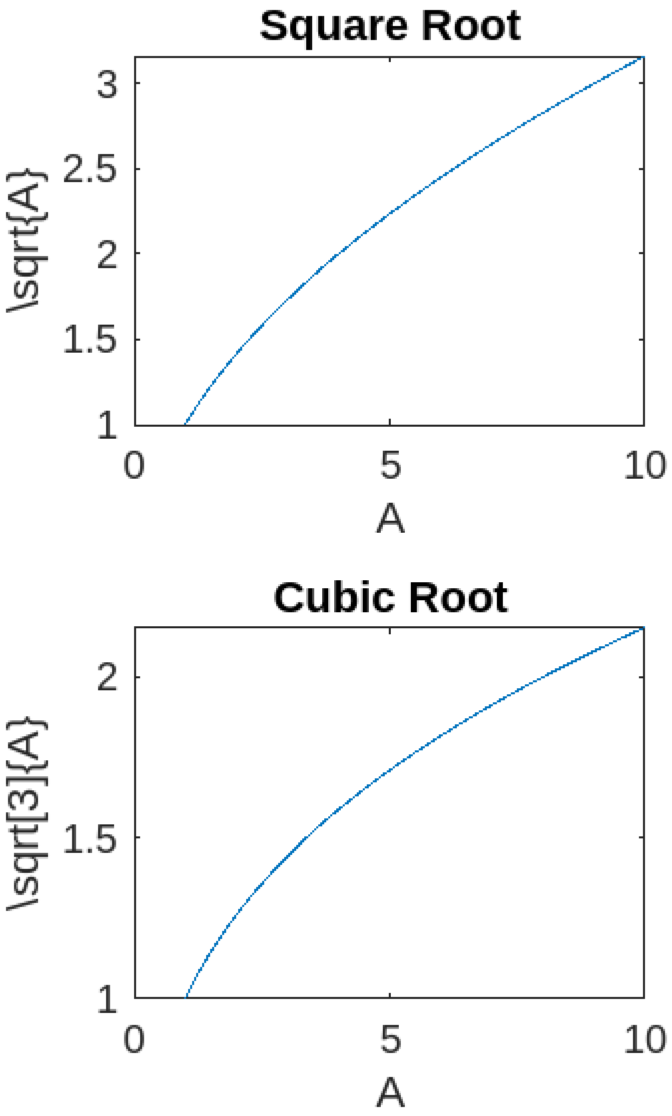
```
% Trigonometric Functions – sin(t),cos(t), tan(t), sec(t), cosec(t) and cot(t) for a given duration, ‘t’.

x = 5.7;
rounded1 = round(x);
rounded2 = floor(x);
rounded3 = ceil(x);
rounded4 = fix(x);

t = 0:0.01:2*pi;
y1 = sin(t);
y2 = cos(t);
y3 = tan(t);
y4 = sec(t);
y5 = csc(t);
y6 = cot(t);

subplot(2,3,1);
plot(t, y1);
title('Sine Function');
xlabel('t');
ylabel('sin(t)');

subplot(2,3,2);
plot(t, y2);
title('Cosine Function');
xlabel('t');
ylabel('cos(t)');

subplot(2,3,3);
plot(t, y3);
title('Tangent Function');
xlabel('t');
ylabel('tan(t)');

subplot(2,3,4);
```

```
plot(t, y4);
title('Secant Function');
xlabel('t');
ylabel('sec(t)');

subplot(2,3,5);
plot(t, y5);
title('Cosecant Function');
xlabel('t');
ylabel('csc(t)');

subplot(2,3,6);
plot(t, y6);
title('Cotangent Function');
xlabel('t');
ylabel('cot(t)');


% Logarithmic and other Functions – log(A), log10(A), Square root of A, Real nth root of A.

A = 1:0.1:10; % sample points from 1 to 10 with 0.1 interval
y1 = log(A);
y2 = log10(A);
y3 = sqrt(A);
y4 = nthroot(A, 3); % 3rd root of A

subplot(2,2,1);
plot(A, y1);
title('Natural Logarithm');
xlabel('A');
ylabel('log(A)');

subplot(2,2,2);
plot(A, y2);
title('Base 10 Logarithm');
xlabel('A');
ylabel('log_{10}(A)');

subplot(2,2,3);
plot(A, y3);
title('Square Root');
xlabel('A');
```

```
ylabel('\sqrt{A}');

subplot(2,2,4);
plot(A, y4);
title('Cubic Root');
xlabel('A');
ylabel('\sqrt[3]{A}');
```

Output




Square Root
\sqrt{A}
3
2.5
2
1.5
1
0
5
10
A
Cubic Root
\sqrt[3]{A}
2
1.5
1
0
5
10
A

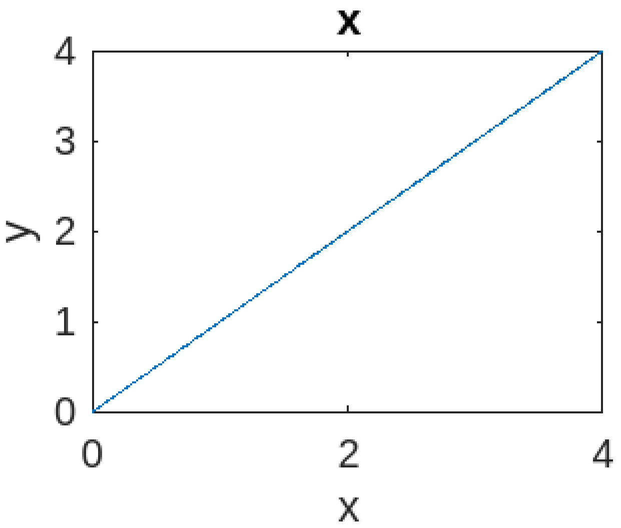
Experiment 5 : Evaluating Expressions and Plots

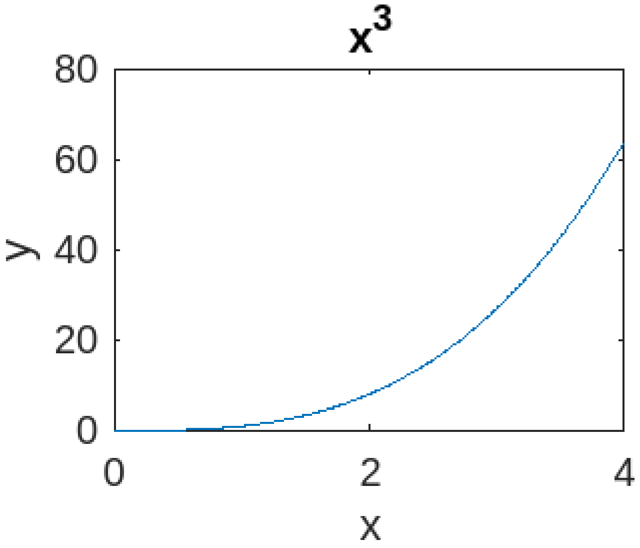
Input

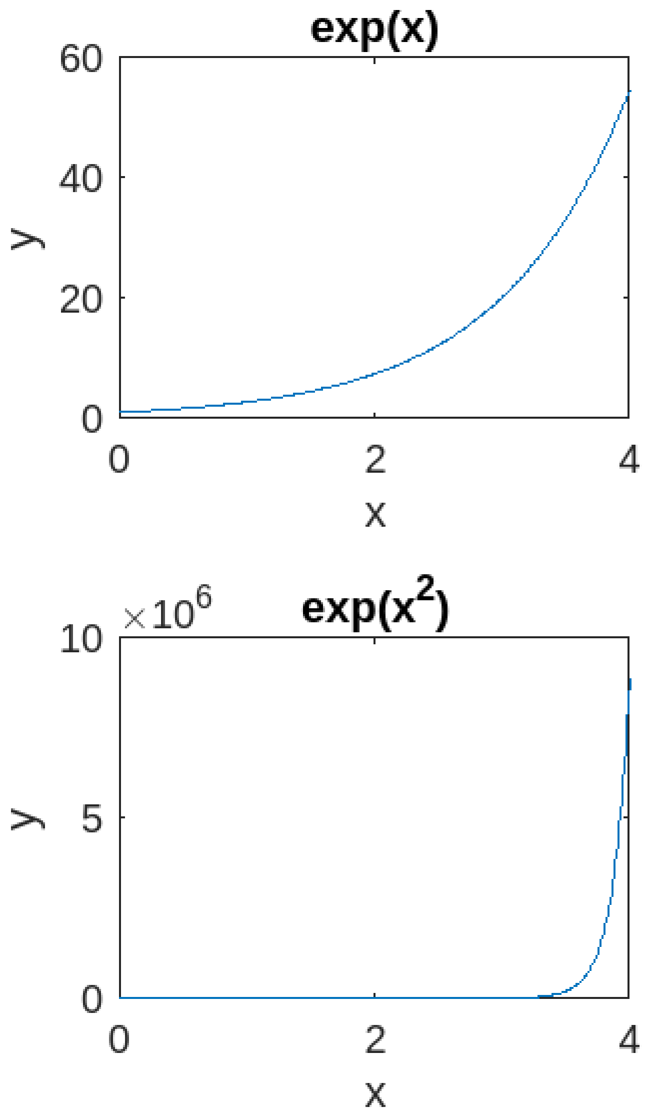
```
% Creating a vector X with elements Xn = (-1)^(n+1)/(2n-1) and adding up 100
elements of the vector X

N = 100;
X = zeros(1, N);

for n = 1:N
    X(n) = (-1)^(n+1)/(2*n-1);
end

sum_X = sum(X(1:N));

% Plotting the functions x, x^3, exp(x), and exp(x^2) over the interval 0 <
x < 4

x = 0:0.01:4;
y1 = x;
y2 = x.^3;
y3 = exp(x);
y4 = exp(x.^2);

subplot(2,2,1);
plot(x, y1);
title('x');
xlabel('x');
ylabel('y');

subplot(2,2,2);
plot(x, y2);
title('x^3');
xlabel('x');
ylabel('y');

subplot(2,2,3);
plot(x, y3);
title('exp(x)');
```

```
xlabel('x');
ylabel('y');

subplot(2,2,4);
plot(x, y4);
title('exp(x^2)');
xlabel('x');
ylabel('y');
```

Output







exp(x)
60
40
20
0
y
0
2
4
x
exp(x^2)
×10^6
10
5
0
y
0
2
4
x

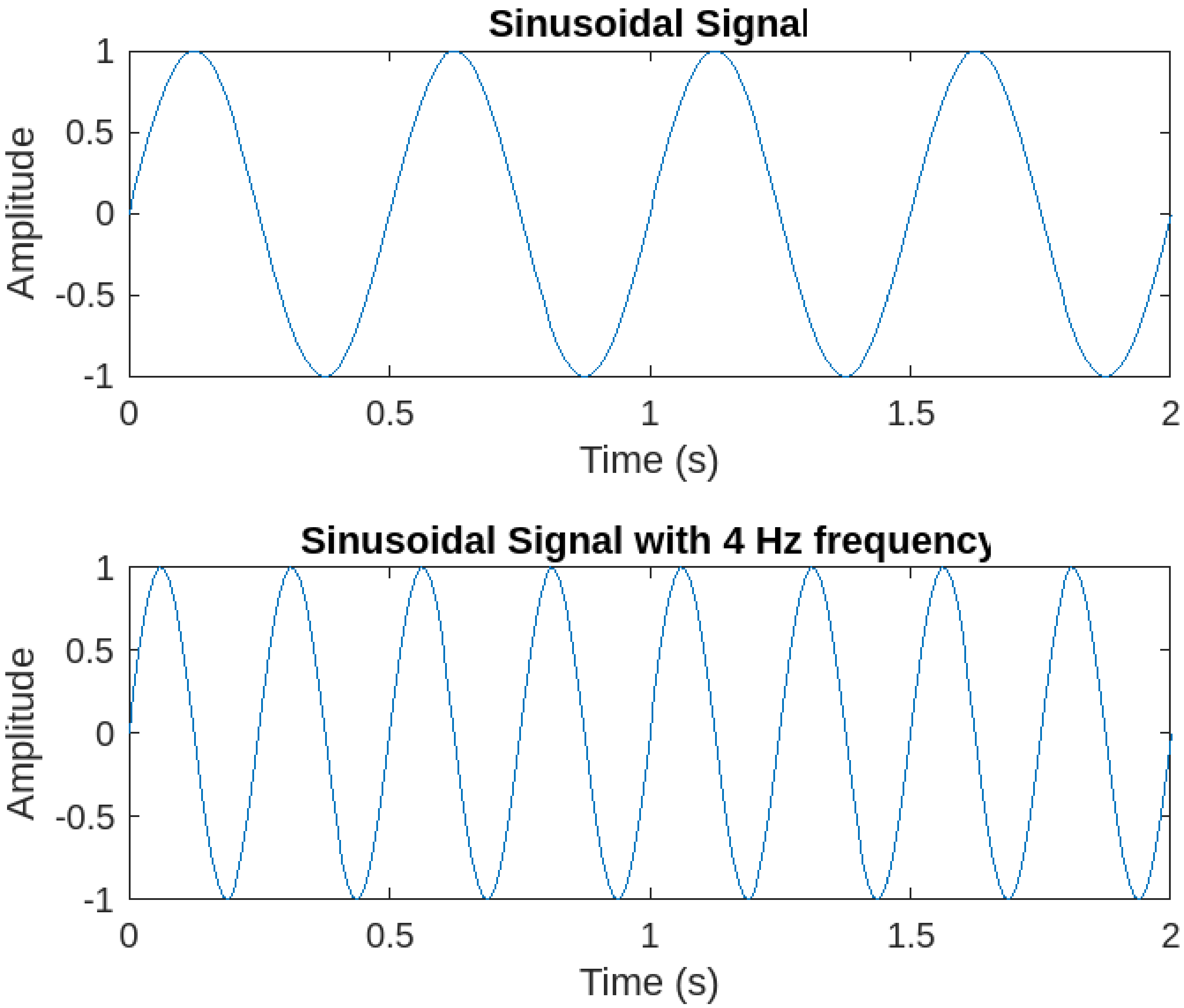
Experiment 6 : Generating Sinusoidal Signals

Input

```
% Define the frequency of the signal
freq = 2;

% Define the time duration of the signal
t = 0:0.01:2;

% Generate the sinusoidal signal
x = sin(2*pi*freq*t);

% Plot the signal
plot(t,x);

% Add labels and title
xlabel('Time (s)');
ylabel('Amplitude');
title('Sinusoidal Signal');

% Add legends
legend('Signal');

% Add text
text(1.5,0.5,'Signal Frequency = 2 Hz');

% Print Greek letters
text(1.5,-0.5,'\omega = 2\pi f');

% Generate multiple plots
figure;
subplot(2,1,1);
plot(t,x);
xlabel('Time (s)');
ylabel('Amplitude');
title('Sinusoidal Signal');

subplot(2,1,2);
plot(t,sin(2*pi*4*t));
xlabel('Time (s)');
```

```
ylabel('Amplitude');
title('Sinusoidal Signal with 4 Hz frequency');
```

Output



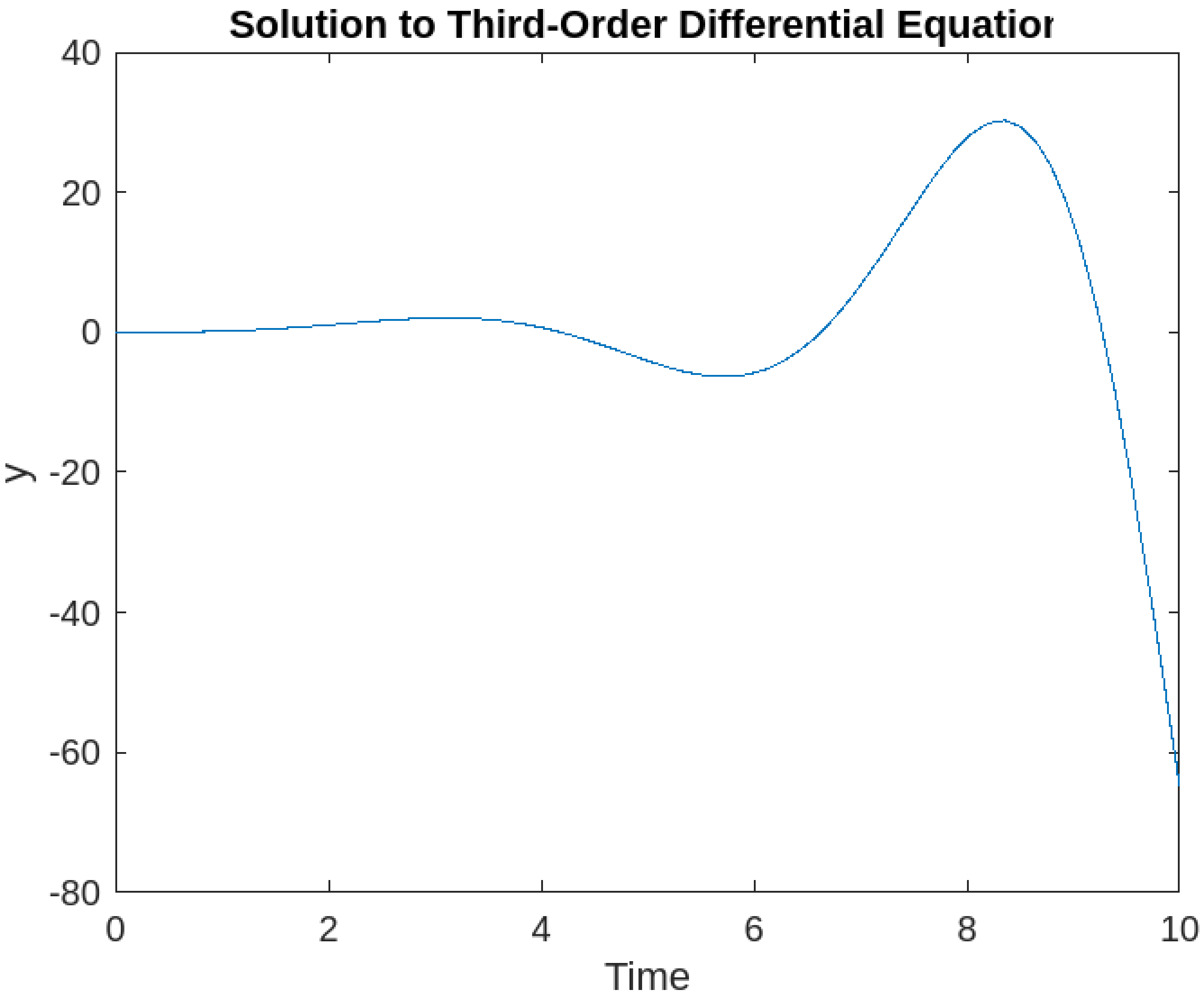
Experiment 7 : Solving Differential Equations

Input

```
% First Order

% Define the differential equation
dydt = @(t,y) -2*y + 1;

% Define the time duration and initial condition
tspan = [0 10];
y0 = 0;

% Solve the differential equation
[t,y] = ode45(dydt,tspan,y0);

% Plot the solution
plot(t,y);
xlabel('Time');
ylabel('y');
title('Solution to First-Order Differential Equation');

% % % % % % % % % % % % % % %

% Second Order

% Define the differential equation
dy2dt2 = @(t,y) -2*y(1) - 0.5*y(2) + 1;
dy1dt = @(t,y) y(2);
dydt = @(t,y) [dy1dt(t,y); dy2dt2(t,y)];

% Define the time duration and initial condition
tspan = [0 10];
y0 = [0; 0];

% Solve the differential equation
[t,y] = ode45(dydt,tspan,y0);

% Plot the solution
plot(t,y(:,1));
xlabel('Time');
```

```
ylabel('y');
title('Solution to Second-Order Differential Equation');

% % % % % % % % % % % % % % %



% Third Order

% Define the differential equation
dy3dt3 = @(t,y) -2*y(1) - 0.5*y(2) + 1;
dy2dt = @(t,y) y(3);
dy1dt = @(t,y) y(2);
dydt = @(t,y) [dy1dt(t,y); dy2dt(t,y); dy3dt3(t,y)];

% Define the time duration and initial condition
tspan = [0 10];
y0 = [0; 0; 0];

% Solve the differential equation
[t,y] = ode45(dydt,tspan,y0);

% Plot the solution
plot(t,y(:,1));
xlabel('Time');
ylabel('y');
title('Solution to Third-Order Differential Equation');
```

Output


Solution to Third-Order Differential Equatior
40
20
0
-20
-40
-60
-80
y
0
2
4
6
8
10
Time

Experiment 8 : Input Scripts

Input

```
% Request user input for T value
T = input("Enter a value for T between 0 and 100: ");

% Check if T is within the valid range
if T < 0 || T > 100
    disp("Invalid input. T must be between 0 and 100.")
else
    % Evaluate the function h(T)
    h = T - 10;
    disp("h(T) = " + h);
end


% Request user input for T value
T = input("Enter a value for T: ");

% Check if T is greater than 100
if T > 100
    % Evaluate the function h(T)
    h = 0.45*T + 900;
    disp("h(T) = " + h);
else
    disp("Invalid input. T must be greater than 100.")
end
```

Output

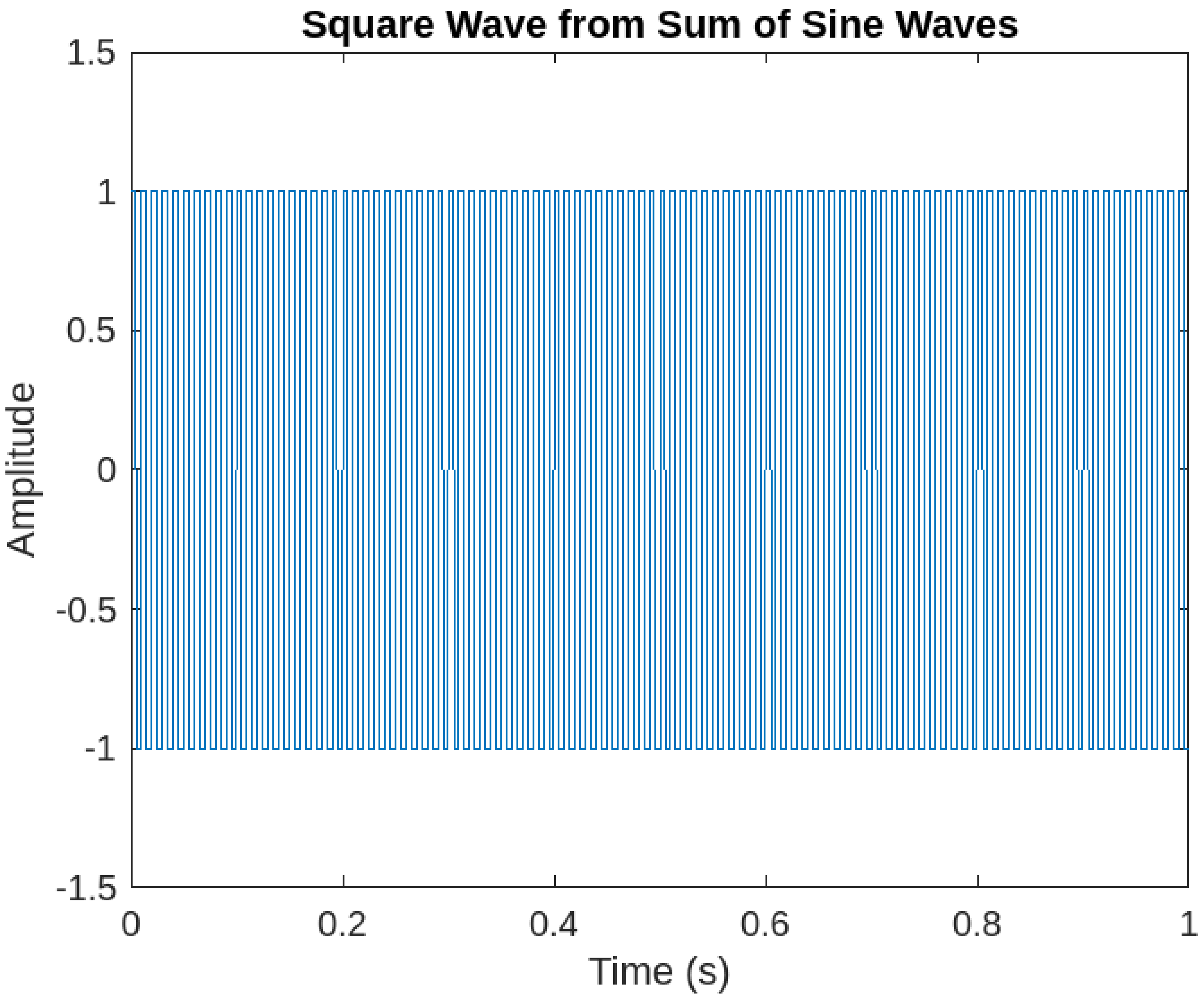
```
>> Enter a value for T between 0 and 100:
67
>> h(T) = 57
>> Enter a value for T:
167
>> h(T) = 975.15
```

Experiment 9 : Generating Square Waves

Input

```
% Define the frequency and amplitude of the sine waves
f1 = 100; % frequency of first sine wave
A1 = 1; % amplitude of first sine wave
f2 = 300; % frequency of second sine wave
A2 = 0.5; % amplitude of second sine wave

% Define the time axis and sampling rate
Fs = 10000; % sampling rate
t = 0:1/Fs:1; % time axis

% Generate the sine waves
s1 = A1*sin(2*pi*f1*t);
s2 = A2*sin(2*pi*f2*t);

% Add the sine waves together to create a square wave
square_wave = s1 + s2;
square_wave(square_wave >= 0) = 1;
square_wave(square_wave < 0) = -1;

% Plot the square wave
plot(t, square_wave);
ylim([-1.5 1.5]);
xlabel('Time (s)');
ylabel('Amplitude');
title('Square Wave from Sum of Sine Waves');
```

Output


Square Wave from Sum of Sine Waves
1.5
1
0.5
0
-0.5
-1
-1.5
Amplitude
0
0.2
0.4
0.6
0.8
1
Time (s)

Experiment 10 : Basic 2D and 3D Plots

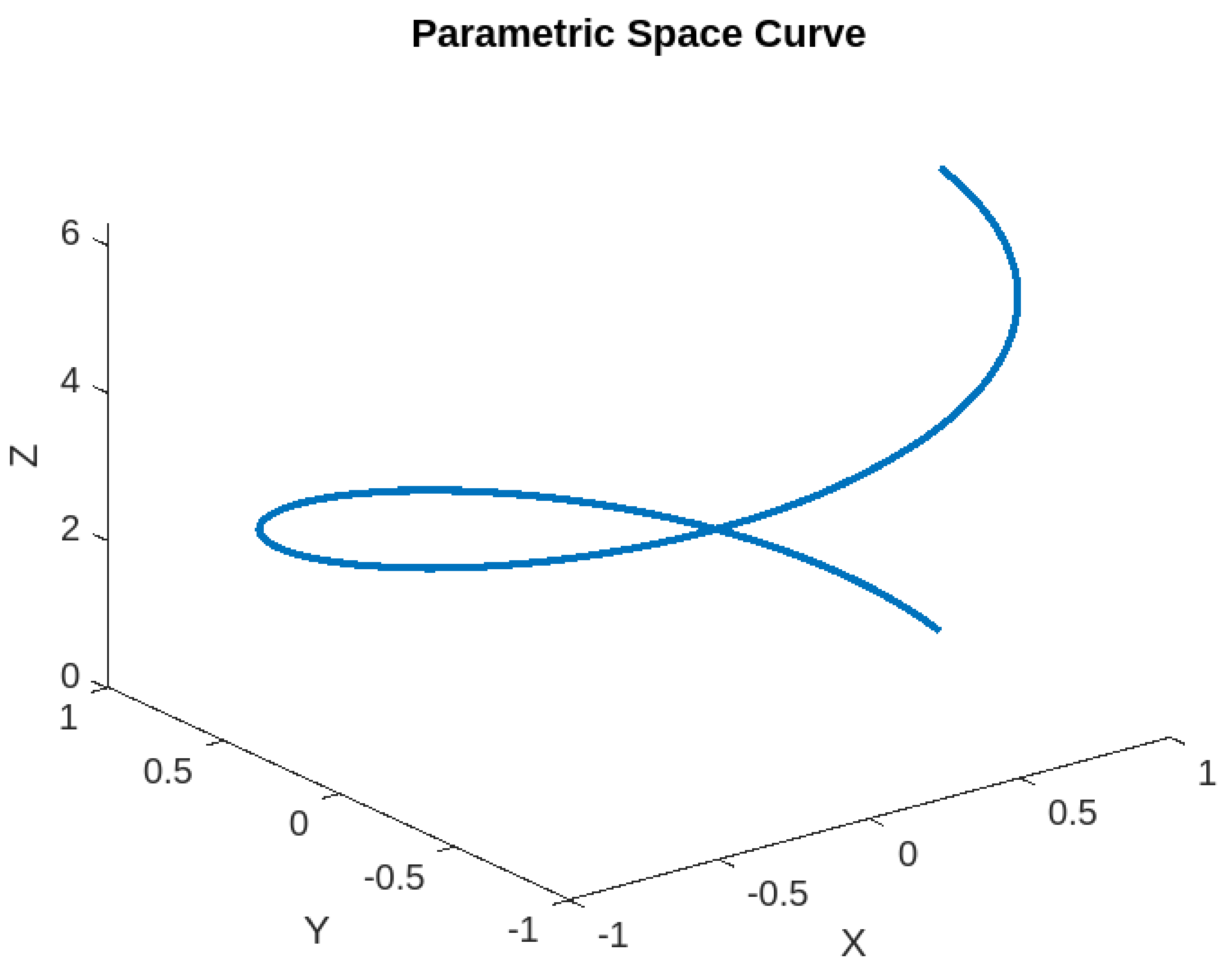
Input

```
% Parametric Space Curve

% Define the parameter t
t = linspace(0, 2*pi, 1000);

% Define the x, y, and z coordinates as functions of t
x = cos(t);
y = sin(t);
z = t;

% Plot the curve in 3D
plot3(x, y, z, 'LineWidth', 2);
xlabel('X');
ylabel('Y');
zlabel('Z');
title('Parametric Space Curve');


% Polygon with Vertices

% Define the vertices of the polygon
x = [0 1 1 0];
y = [0 0 1 1];

% Plot the polygon
patch(x, y, 'r');
axis equal;
xlabel('X');
ylabel('Y');
title('Polygon with Vertices');


% 3D Contour Lines

% Define the function to plot
[X,Y,Z] = peaks(25);
```

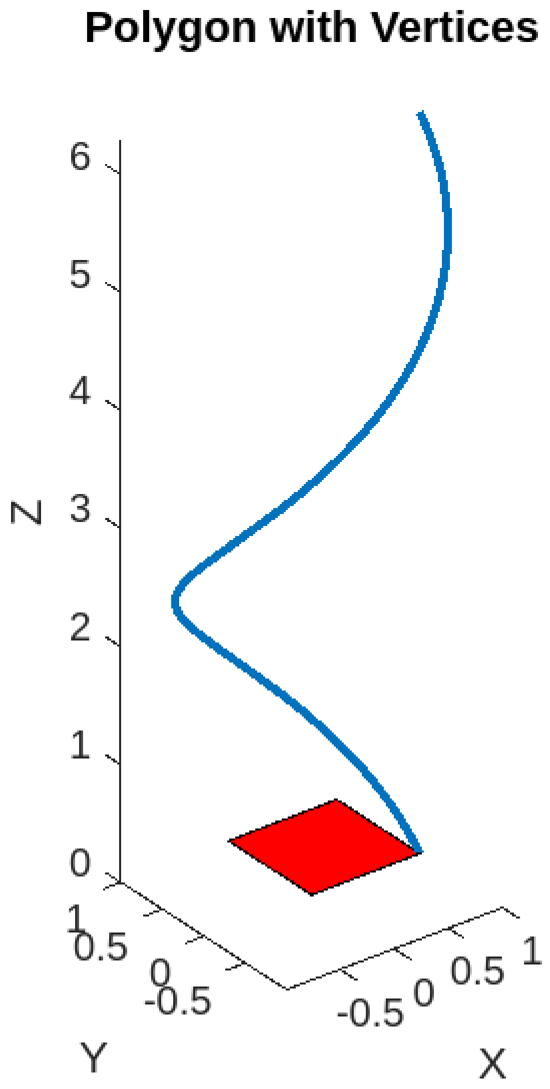
```
% Plot the contour lines
contour3(X,Y,Z,20);
xlabel('X');
ylabel('Y');
zlabel('Z');
title('3D Contour Lines');


% Pie Chart

% Define the data to plot
data = [20 30 50];

% Plot the pie chart
pie(data);
legend({'Slice 1', 'Slice 2', 'Slice 3'});
title('Pie Chart');


% Bar Chart

% Define the data to plot
data = [10 20 30 40 50];

% Plot the bar chart
bar(data);
xlabel('X');
ylabel('Y');
title('Bar Chart');
```

Output

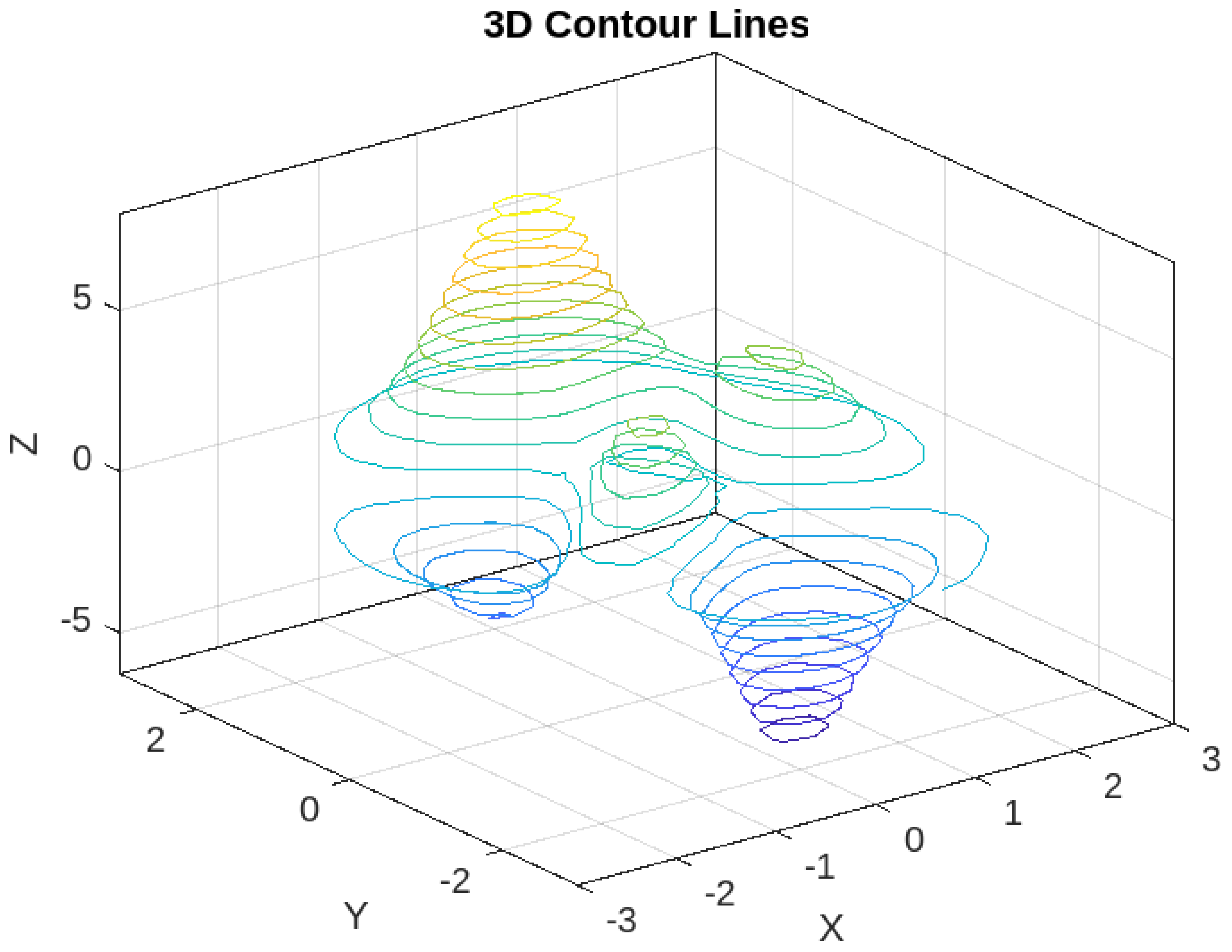
Polygon with Vertices



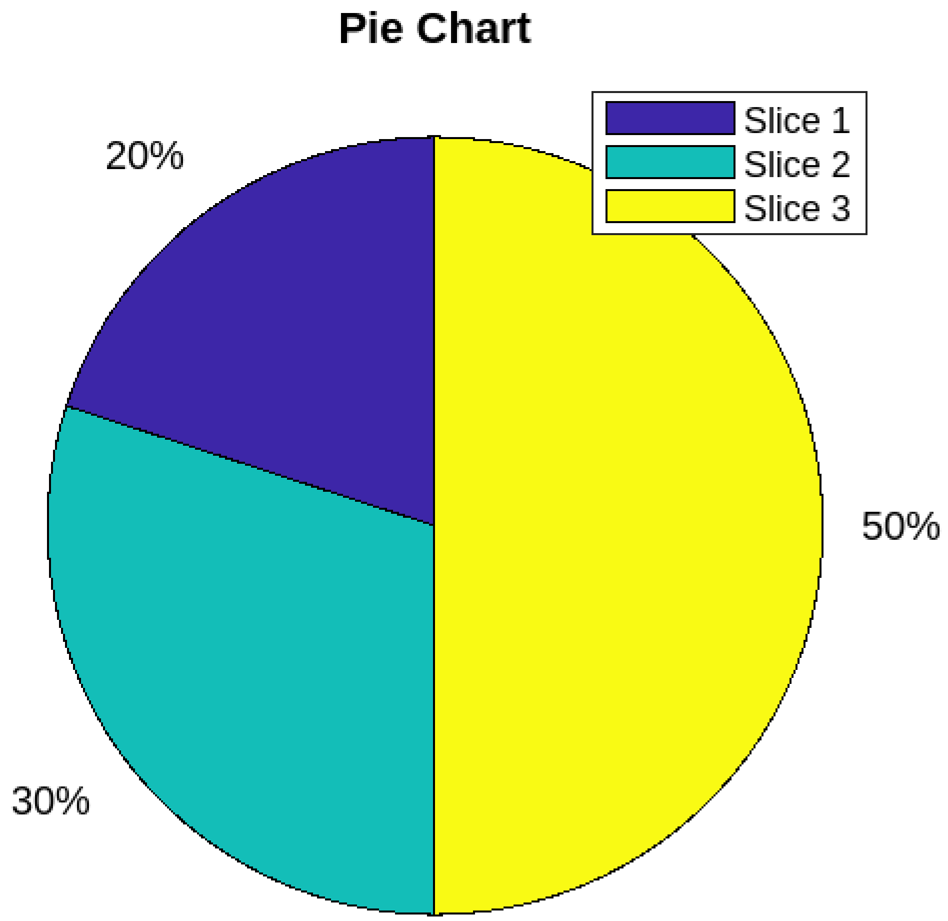
Parametric Space Curve



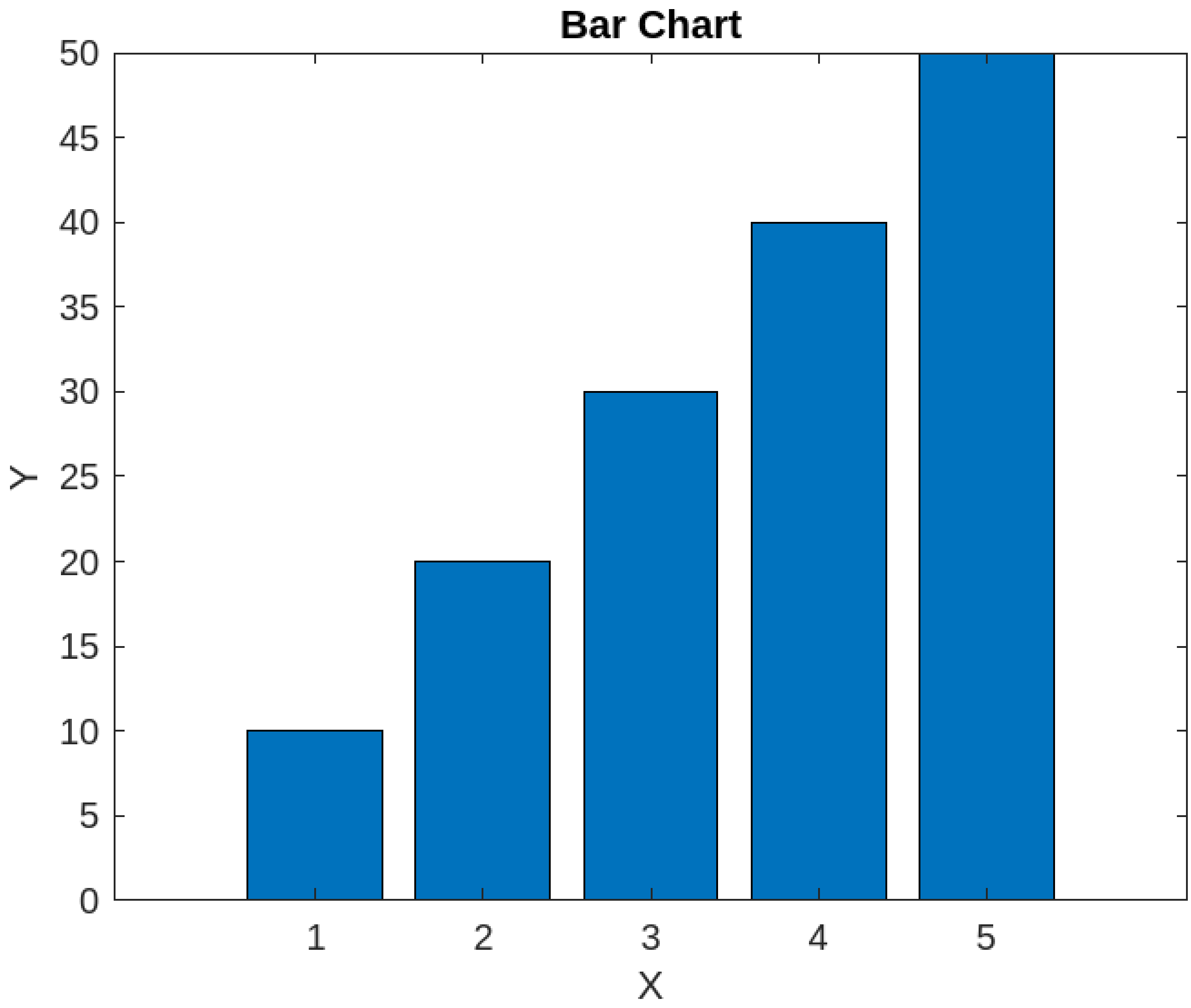
3D Contour Lines


3D Contour Lines
Z
5
0
-5
Y
2
0
-2
X
-3
-2
-1
0
1
2
3

Pie Chart


Pie Chart
Slice 1
Slice 2
Slice 3
20%
30%
50%

Bar Chart


Bar Chart
Y
X