**BS-3304L Numerical Analysis Lab**

**Trapezoidal Rule for Integration**

The Trapezoidal Rule is a technique for approximating definite integrals of a function. The method works by approximating the region under the graph of the function as a trapezoid and calculating its area.

For the function, , shown in Figure 1, the definite integral within the limits and is,

The trapezoidal rule approximation of the integral is,



Figure 1

**Trapezoidal Rule Algorithm**

Here is the pseudo code for the trapezoidal rule algorithm.

1. Define the function to be integrated, the limits of integration and , and the number of intervals .
2. Set the interval width to be , where is the number of intervals.
3. Initialize a variable sum to 0. This will be used to store the sum of the areas of the intervals.
4. For each interval from to , do the following:
5. Calculate the values at the start and end of the interval: and .
6. Calculate the values at the start and end of the interval: and .
7. Calculate the area of the trapezoid formed by the interval: .
8. Add the area of the interval to the sum: .
9. Return the sum as the approximate value of the integral.

This algorithm calculates the integral by summing the areas of the trapezoids formed by the function at the endpoints of each interval and the interval width.

The number of intervals and the interval width determine the accuracy of the integration.

You can increase the number of intervals to improve the accuracy, at the cost of increased computational time.

**Task 1**

Develop a MATLAB function for the Trapezoidal Rule.

The function should accept the following inputs:

1. Function handle
2. Function Limits
3. Number of divisions

The function should return the function integral as the output

Write a script that uses the function to calculate the integral of between the limits and .

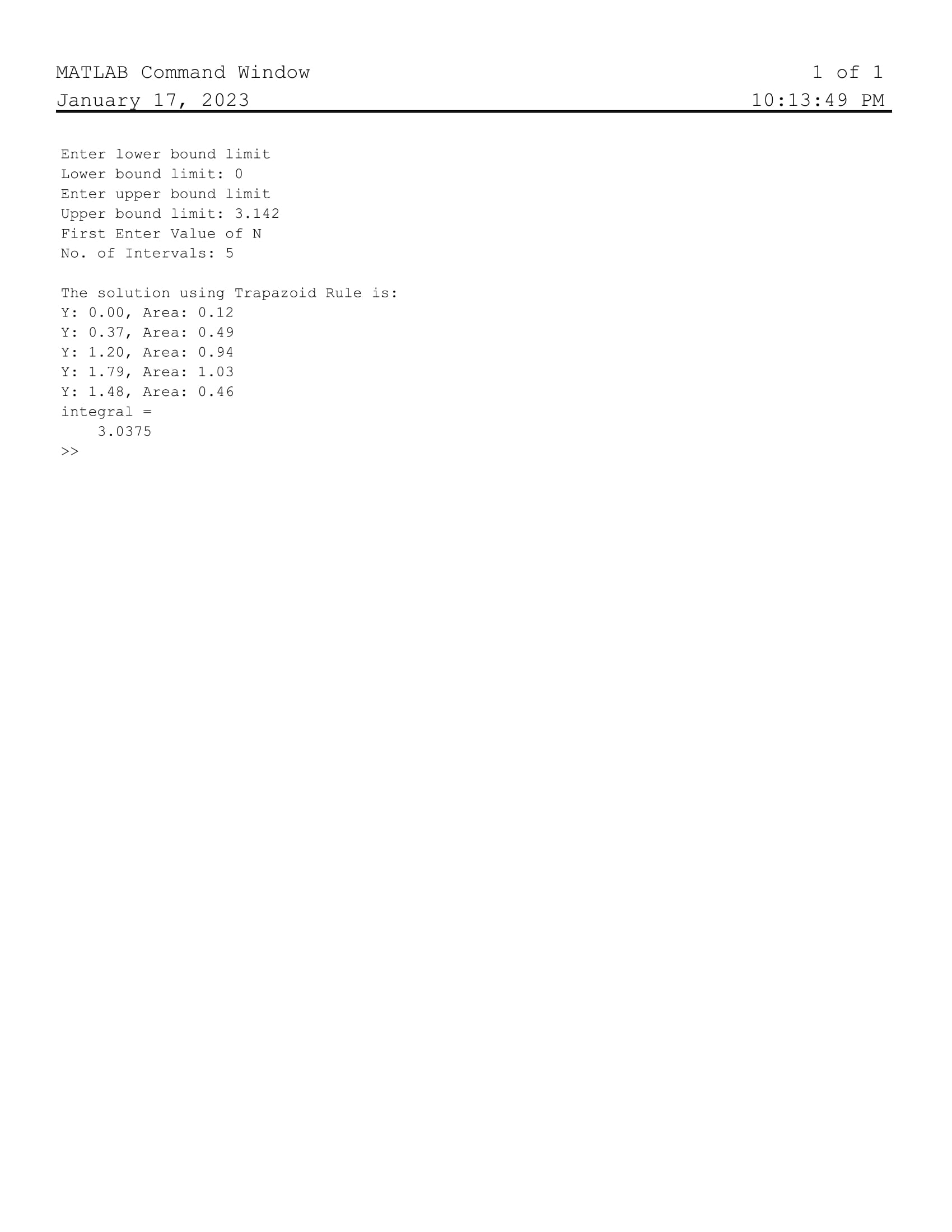
**Task 2**

Modify the function you wrote so that if accepts vectors of values of and points and calculates the integral.

**Code:**

|  |
| --- |
| clc, clear all    f = @ (x) x\*sin(x);    %a = 0;  disp('Enter lower bound limit')  a = input("Lower bound limit: ");    %b = pi;  disp('Enter upper bound limit')  b = input("Upper bound limit: ");    %N = 20;  disp('First Enter Value of N')  N = input('No. of Intervals: ');    fprintf('\nThe solution using Trapazoid Rule is: \n')  integral = trapozide\_rule (f,a,b,N)    function sum = trapozide\_rule (f,a,b,N)    h = (b - a) / N;  sum = 0;    for i = 1:N  x1 = a + ((i - 1) \* h);  x2 = a + (i \* h);  y1 = f(x1);  y2 = f(x2);  area = (y1 + y2) \* (h / 2);  sum = sum + area;    fprintf('Y: %.2f, Area: %.2f\n', y1, area)    end  end |

**Command Window Output:**

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