Machine Problem 3
Due: Friday, March 8, 2024, 11:59 PM

Write a program to evaluate the following integral between a and b. Use the trapezoidal approximation to evaluate the integral. The program should prompt the user to enter the parameter m, the lower limit a, upper limit b, and the number of trapezoids n. The range of the parameter must be $0 < m$. The program should continue to prompt the user and calculate integrals until the number of trapezoids entered is zero. The program should take into account the possibility of incorrect input from the user. Note that $\lim\limits_{x \to 0} \frac{\sin(mx)}{mx} = 1$ using L'Hopital's rule.

$$\int_a^b \frac{\sin(mx)}{mx} dx$$

The integral can be approximated using the trapezoidal rule:

$$Area \cong \frac{b-a}{2n}[g(x_0) + 2g(x_1) + \cdots + 2g(x_{n-1}) + g(x_n)]$$
$$x_k = a + k\frac{b-a}{n}, \quad k = 0,1,\ldots,n$$
$$g(x) = \frac{\sin(mx)}{mx}$$

Some example runs are given below.

Enter the desired number of trapezoids (zero to exit): 1000

Enter the parameter m (0 < m) : 0.5

Enter the lower limit: 0

Enter the upper limit: 3

The integral is equal to: 2.6494

Enter the desired number of trapezoids (zero to exit): 1000

Enter the parameter m (0 < m): 1

Enter the lower limit: 0

Enter the upper limit: 3

The integral is equal to: 1.8487

Enter the desired number of trapezoids (zero to exit): 1000

Enter the parameter m (0 < m): -1

Enter the lower limit: 0

Enter the upper limit: 3

Incorrect parameter value, m < 0

Enter the desired number of trapezoids (zero to exit): eadf

Enter the parameter m (0 < m): isisi

Enter the lower limit: sdf

Enter the upper limit: sfgg

Incorrect entries

Enter the desired number of trapezoids (zero to exit): −1000

Enter the parameter m (0 < m): -1

Enter the lower limit: 0

Enter the upper limit: 3

Incorrect number of trapezoids, n ≥ 0

Enter the desired number of trapezoids (zero to exit): 0

Program terminated