Lab Session 5

MA581: Numerical Computations Lab S. Bora August 31, 2022

---

1. Write MATLAB function program `y = trapezoid(f,a,b,n)` to evaluate $\int_a^b f(x)dx$ via composite trapezoid rule with n panels on $[a, b]$.

2. Write MATLAB function program $\texttt{y} = \texttt{simpsononethird}(\texttt{f}, \texttt{a}, \texttt{b}, \texttt{n})$ to evaluate $\int_a^b f(x)dx$ via composite Simpson one-third rule with n panels on $[a, b]$.

3. Since $\displaystyle\int_0^1 \frac{4}{1+x^2}dx = \pi$ one can compute an approximate value for π using numerical integration of the given function.

   Use the midpoint, trapezoid, and Simpson composite quadrature rules to compute the approximate value for π for various stepsizes h. Display the accuracy of the rules with each other (based on the known value of π) by plotting the errors for each formula for $n = 1, 2, \ldots, 200$ in semilogy scale. Show all plots in a single figure using `hold on`. Is there any point beyond which decreasing h yields no further improvement?

4. Use composite midpoint, trapezoid, and Simpson composite quadrature rules to verify or refute the following conjectures.

   (a) $\displaystyle\int_0^1 \frac{e^{-9x^2} + e^{-1024(x-1/4)^2}}{\sqrt{\pi}}dx = 0.2$

   (b) $\displaystyle\int_0^1 \sqrt{x}\log(x)dx = -\frac{4}{9}.$

   Note that as $\log x$ is not defined at $x = 0$, you will need to replace the interval $[0, 1]$ by $[\texttt{realmin}, 1]$ when approximating the integral in (b) by any quadrature rule.

Submit a folder containing all figures and a livescript program that contains all comments, answers and codes necessary to produce the required output. Ensure that the answers are correctly numbered. The filename of the livescript program should be Your-rollnumber-MA581-Lab4.mlx and the folder should be named as Your-rollnumber-MA581-Lab4

*** End ***