Math 252 **Maple Approximating Integrals Lab**

F1: Quick Help List **Ctrl F1: Help** **F5: Toggle between Math and Text**

Open and save a new Maple document
Use the basic “Starting with Maple” directions on the Directions and Reference Page

Maple Commands (reference only, the lab starts on the next page)

1. Starting in Maple (do this at the top of every Maple worksheet)

>with(student):	(Loads needed Maple commands
>with(plots):	: suppresses a display of what loads)

2. Defining functions and finding K for error bounds

   1) Define a function (x^2 as an example)
      $f := x -> x^2$
   2) Plot the absolute value of the appropriate derivative (x^2, $0 \le x \le 4$ as an example)
      $plot(abs(f'''(x)), x = 0..4)$
   3) Max y value on displayed graph will be K.

3. Maple code for defining and evaluating Left, Right, Midpoint, Trapezoid and Simpson’s Rule functions. Note, you must have already defined the function *f*.

   For specific values of a and b, using n as an independent variable:

   $L := n -> \text{evalf}\left(\text{leftsum}\left(f\left(x\right),\ x = a..b,\ n\right)\right)$ $L(10)$, for example, to evaluate

   $R := n -> \text{evalf}\left(\text{rightsum}\left(f\left(x\right),\ x = a..b,\ n\right)\right)$ $R(10)$, for example, to evaluate

   $M := n -> \text{evalf}\left(\text{middlesum}\left(f\left(x\right),\ x = a..b,\ n\right)\right)$ $M(10)$, for example, to evaluate

   $T := n -> \frac{1}{2}\cdot\left(L(n) + R(n)\right)$ $T(10)$, for example, to evaluate

   $S := n -> \frac{1}{3}\cdot T(\frac{n}{2}) + \frac{2}{3}\cdot M(\frac{n}{2})$ $S(10)$, for example, to evaluate

4. Maple code for defining and evaluating Midpoint, Trapezoid and Simpson's Rule Error functions

   For the specific numerical value of the integral in question--A, for actual

   $EM := n -> M(n) - A$ $\quad$ $EM(10)$, for example, to evaluate

   $ET := n -> T(n) - A$ $\quad$ $ET(10)$, for example, to evaluate

   $ES := n -> S(n) - A$ $\quad$ $ES(10)$, for example, to evaluate

5. Maple code for defining and evaluating Error Bound Midpoint, Trapezoid and Simpson's Rule functions

   For specific values of a and b, using n as an independent variable:

   $EMB := n -> \dfrac{K \cdot (b-a)^3}{24 \cdot n^2}$ $\quad$ $EMB(10)$, for example, to evaluate

   $ETB := n -> \dfrac{K \cdot (b-a)^3}{12 \cdot n^2}$ $\quad$ $ETB(10)$, for example, to evaluate

   $ESB := n -> \dfrac{K \cdot (b-a)^5}{180 \cdot n^4}$ $\quad$ $ESB(10)$, for example, to evaluate

6. Maple code for integrating; example $\int_0^1 x^3 \ dx$

   integrate($x^3, x = 0..1$)

Maple Approximating Integrals Lab Activities
Do all work in a Maple worksheet and, as directed, have Maple carry out all computations.
This lab is a modification of question #19; Section 5.9

1. Define $f(x) = \sin x$

2. Use Maple to determine $\int_0^{\pi} \sin x \, dx$ (use the π symbol for numerical results)

3. Define the Trapezoid, Midpoint and Simpson's Rule functions for $\int_0^{\pi} \sin x \, dx$ (you will also need to define the *L* and *R* functions as part of this process).

4. Define the Midpoint, Trapezoid and Simpson's Rule Error functions for $\int_0^{\pi} \sin x \, dx$.
   Note, you will need to determine your specific *A* value first.

5. Define the Error Bound Midpoint, Trapezoid and Simpson's Rule functions for $\int_0^{\pi} \sin x \, dx$.
   Note, you will need to determine your specific *K* values first.

6. Use Maple, and the functions you have defined, to find the approximate sum areas:
   $M(10), T(10)$ and $S(10)$ for $\int_0^{\pi} \sin x \, dx$

7. Use Maple, and the functions you have defined, to find the corresponding errors:
   $EM(10), ET(10)$ and $ES(10)$ for $\int_0^{\pi} \sin x \, dx$

8. Use Maple, and the functions you have defined, to find the corresponding maximum error bounds: $EMB(10), ETB(10)$ and $ESB(10)$ for $\int_0^{\pi} \sin x \, dx$.
   How much better is the error you determined than the predicted error bound?

9. How large do you have to choose *n* so that the approximations $M(n), T(n)$ and $S(n)_n$ to $\int_0^{\pi} \sin x \, dx$ are accurate to within 0.00001? Answer as follows:

   a. Determine each *n* algebraically. Using a specific value of *K*, you can have Maple do this for you as shown by the example code for $EM(n)$.

   $$solve\left(\frac{K \cdot (\pi - 0)^3}{24 \cdot n^2} = .00001, n\right)$$

   b. Use Maple to compute $EM(n), ET(n)$ and $ES(n)$ for the *ns* that you determined. Compare to the predicted error bounds.

One copy/partner pair: Email your correctly named Maple worksheet to fleschb@wou.edu
Email subject line: Maple Approximate