

# Lab 6: Student Assignment

Week 6, February 15

MAT 229, Spring 2021

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## Exercises to submit

**Submit a Mathematica notebook with your results. For the hand calculations, report the results in the notebook as outlined in the questions.**

### Exercise 1

Consider the definite integral  $\int_1^e x (\ln(x))^2 dx$ .

- a. Compute this integral by hand. What technique(s) of integration did you use?
  - a.a. For any substitutions, say what your substitutions were.
  - a.b. For any integration by parts, say what your choices for  $u$  and  $dv$  are.
- b. What is the result of your hand calculation?
- c. Set up the summation to numerically integrate this using the midpoint rule with  $n = 20$ , and have Mathematica evaluate the sum.
- d. What is the maximum error in this estimation from the midpoint rule error estimate?
- e. What is the actual error?

### Exercise 2

Consider the definite integral  $\int_0^2 x^3 \sqrt{4 - x^2} dx$ .

- a. Compute this integral by hand. What technique(s) of integration did you use?
  - a.a. For any substitutions, say what your substitutions were.
  - a.b. For any integration by parts, say what your choices for  $u$  and  $dv$  are.
- b. What is the result of your hand calculation?
- c. Estimate this integral using the left endpoint rule with  $n = 50$ .
- d. Estimate this integral using the right endpoint rule with  $n = 50$ .
- e. Estimate this integral using the trapezoid rule with  $n = 50$ .

### Exercise 3

Consider the definite integral  $\int_0^{10} (3 \sin(\sqrt{1+x^2}) + x) dx$ .

- a. Estimate this integral using the trapezoid rule with  $n = 100$ .
- b. What is the maximum error in your estimate as given by the trapezoid rule error estimate?
- c. Estimate this integral using the midpoint rule with  $n = 100$ .
- d. What is the maximum error in this estimate as given by the midpoint rule error estimate?
- e. Estimate this integral using Simpson's rule with  $n = 100$ .
- f. What is the maximum error in this estimate as given by the Simpson rule error estimate?