Homework 9

Math 171H (section 201), Fall 2023

This homework is due on **Tuesday, October 17** at the start of class. (Turn in answers to questions 1–7.)

0. Read Sections 3.9–3.10

1. The length of a rectangle is increasing at a rate of 4 cm/s and the width is increasing at a rate of 2 cm/s. When the length is 5 cm and the width is 3 cm, how fast is the area of the rectangle increasing?

2. When the diameter of a spherical tumor is 10 mm, the diameter is increasing at a rate of 4 mm per week. How fast is the volume of the tumor changing at that time?

3. A light is at the top of a 10-ft pole, and a 5-ft person is walking away from the pole at a rate of 2 ft/s.

   (a) Compute the rate at which the tip of the person's shadow moving is away from the pole, when the person is 25 ft from the pole.

   (b) Compute the rate at which the tip of the person's shadow moving is away from the person, when the person is 25 ft from the pole.

4. Determine the value(s) of m and b that make the following function differentiable:

$$f(x) = \begin{cases} \arctan x & \text{if } x < 1 \\ mx + b & \text{if } x \geq 1 \end{cases}$$

5. Compute the linear approximation of $f(x) = \log_5(-x)$ at $x = -5$.

6. (a) Determine the linear approximation of $f(x) = e^{2x}$ at $x = 0$.

   (b) Use the linear approximation you found to estimate $e^{-0.4}$.

7. Explain why $\sin x \approx x$ for $x \approx 0$. Compare $\sin(0.1)$ to this approximation (using a calculator).

8. The edge of a cube was measured to be 10 inches with a possible measurement error of 0.1 inches. Estimate the maximum **error** and **relative error** that arises when using the edge-measurement to compute the cube's surface area.