

# Homework 9

Math 147, Fall 2023

This homework is due on Friday, October 20 (at the start of recitation). *Turn in (via Gradescope) your answers to questions 1–7.*

0. Read Section 4.11.
1. Compute the derivative of  $f(x) = x^2 + x^{\cos x} - (\ln x)^x$ .
2. (a) Determine  $\sin(\arccos \frac{3}{5})$ . *Hint:* Let  $\theta = \arccos \frac{3}{5}$  be one angle of a right triangle.  
(b) Determine  $\cos(\arcsin \frac{3}{5})$ .
3. Determine the value(s) of  $m$  and  $b$  that make the following function differentiable:

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

4. Compute the linear approximation of  $f(x) = \log_5(-x)$  at  $x = -5$ .
5. (a) Determine the linear approximation of  $f(x) = e^{2x}$  at  $x = 0$ .  
(b) Use the linear approximation you found to estimate  $e^{-0.4}$ .
6. Let  $N(t)$  denote the size of a population for which the per-capita growth rate is 3%. Find a differential equation that  $N(t)$  satisfies.
7. Section 4.11. # 10, 18, 38, 42
8. (These problems are *not* to be turned in!) Section 4.11 # 1, 7, 11, 15, 17, 25, 33, 37

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*Reminder:* The second exam is on Monday and Tuesday, October 23 and 24. Please bring pencils. The topics for the exam are from Sections 4.2–4.11. The following questions may guide your studying for the exam:

- When should I use the product rule? chain rule? implicit differentiation? logarithmic differentiation? the formula for the derivative of an inverse function?
- What steps do I take when doing a related rates problem? doing implicit differentiation? logarithmic differentiation?
- Can I use the power rule for computing the derivative of  $x^x$ ? What about  $5^x$  or  $x^5$ ?
- How can I determine whether a piecewise function is continuous and/or differentiable?
- How can I find the differential equation for a radioactive decay function or an exponential growth function?
- How do I compute acceleration? velocity? the instantaneous per-capita growth rate?