

Week 7 Classwork/Homework Assignment

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For the assignment, you only need to turn in a completed pdf. You may need to attach a hand written document showing your work for these problems. Make sure that the compiled documents will display all the required code to get your results.

The assignment is due Tuesday October 3 at 3:30 PM.

1. Experimental evidence suggests that the response y of the body to the concentration x of injected adrenalin is given by

$$y = \frac{x}{a + bx} \quad (1)$$

where a and b are constants determined from experimental data.

- Is the function continuous $\forall x \in \mathbb{R}$?
 - Biologically, what can we constrain x and y to be?
 - Assuming this, must a and b both be positive, negative, or have opposite signs?
2. The highest recorded temperature in the state of Alaska was $100^\circ F$ and occurred in June 27, 1915, at Fort Yukon. The heat index is the apparent temperature of the air at a given temperature and humidity level. If x denotes the relative humidity (in percent), then the heat index (in $^\circ F$) for the air temperature of $100^\circ F$ can be approximated using the function

$$f(x) = 0.009x^2 + 0.139x + 91.875 \quad (2)$$

- At what rate is the heat index changing when the humidity is 50%?
 - Interpret this biologically.
3. For fiddler crabs, data gathered by Thompson show that the relationship between the weight C of the claw and the weight of the body W is given by

$$C = 0.11W^{1.54} \quad (3)$$

where W and C are in grams.

- Find the function that gives the rate of change of claw weight with respect to body weight.
 - Plot the relationship for crabs with a body weight from $[0, 100]$.
4. It is determined that a wildlife refuge can support a group of up to 120 of a certain endangered species. If 75 are introduced onto the refuge and their population after t years is given by

$$p(t) = 75\left(1 + \frac{4t}{t^2 + 16}\right) \quad (4)$$

find the rate of population growth after t years. Find the rate after each of the first 7 years.

5. We can describe a population of microorganism at time t (in minutes) as

$$P = 1000 - 1000(t + 10)^{-1} \quad (5)$$

Find the rate of change of the population.

6. The amount of photosynthesis that takes place in a plant depends on the intensity of light x according to the equation

$$P(x) = 154x^2 - 30x^3 \quad (6)$$

- Find the rate of change of photosynthesis with respect to intensity.
- What is the rate of change $x=1$? when $x=3$?
- How fast is the rate found above changing when $x=1$? when $x=3$?
- Interpret $P'(1)$ and $P''(1)$.