# Week 7 Classwork/Homework Assignment-Answers

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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 that the response y of the body to the concentration x of injected adrenalin is given by

$$y = \frac{x}{a + bx} \tag{1}$$

where a and b are constants determined from experimental data.

- Is the function continuous $\forall x \in IR$?

The function is continuous where $a + bx \neq 0$. This occurs when $x = \frac{-a}{b}$.

- Biologically, what can we constrain x and y to be?

Since x is a concentration and y is a body response we can constrain x and y to be positive. However, if we are saying the body response was relative to a mean then it is possible that y could be negative.

- Assuming this, must a and b both be positive, negative, or have opposite signs?

a and b can be positive will result in all positive values for y. a can be negative and b can be positive or a can be negative and b can be positive as long as $a + bx > 0$.

2. The higest recorded temperature in the state of Alaska was $100°F$ and occured 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 $°F$) for the air temperature of $100°F$ can be approximated using the function

$$f(x) = 0.009x^2 + 0.139x + 91.875 \tag{2}$$

- At what rate is the heat index changing when the humidity is 50%?

$$f^{'}(x) = 0.018x + 0.139 \tag{3}$$

$$\begin{aligned} f^{'}(50) &= 0.018(50) + 0.139 && (4)\\ &= 1.039 && (5) \end{aligned}$$

- Interpret this biologically.

At 50% humidity the heat index is changing by 1.039 $\circ F$.

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

$$C = 0.11W^{1.54} \tag{6}$$

where W and C are in grams.

- Find the function that gives the rate of change of claw weight with respect to body weight.

$$C^{'} = 0.1694W^{0.54} \tag{7}$$

- Plot the relationship for crabs with a body weight from $[0, 100]$.

```
dC.fun = function(W){return(0.1694*W^0.54)}

W.vec = seq(0, 100, 0.1)

plot(W.vec, dC.fun(W.vec), type="l", xlab="W", ylab="C")
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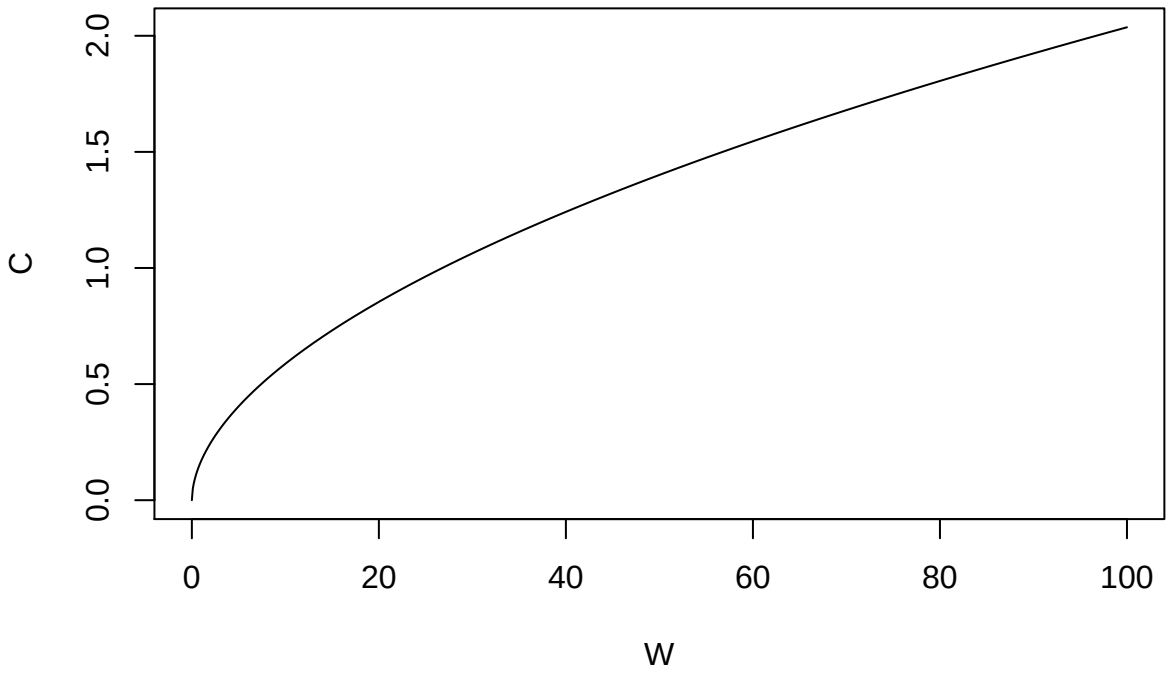


4. It is determined that a wildlife refuge can support a group of up to 120 of a certain endangered species. If 75 are introduced onto the refuge and their population after t years is given by

$$p(t) = 75(1 + \frac{4t}{t^2 + 16}) \tag{8}$$

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

$$p^{'}(t) = \frac{4800 - 300t^2}{(t^2 + 16)^2} \tag{9}$$

$$p^{'}(7) = \frac{4800 - 300(7)^2}{(7^2 + 16)^2} \approx 2.343 \tag{10}$$

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

$$P = 1000 - 1000(t + 10)^{-1} \tag{11}$$

Find the rate of change of the population.

$$P^{'} = 1000(t + 10)^{-2} \tag{12}$$

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

$$P(x) = 154x^2 - 30x^3 \tag{13}$$

- 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 is changing when x=1? when x=3?
- Interpret $P^{'}(1)$ and $P^{''}(1)$.