Written Assignment 4

MAT 229, Spring 2021

Logs -n- frogs

Biological phenomenon

(c) Females discriminate most strongly against short calls

Phonotaxis score

$f(x) = 0.48*ln(x) - 0.40$

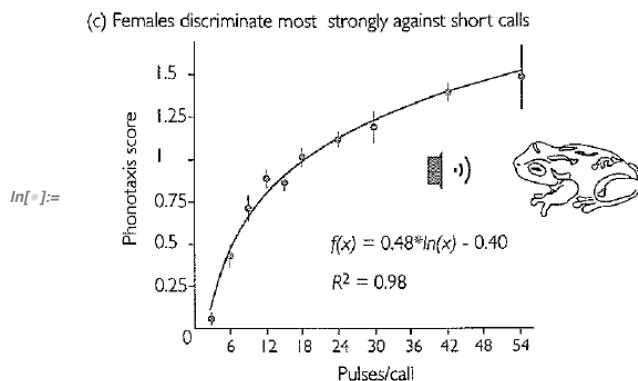$R^2 = 0.98$

Pulses/call

In[●]:=

Figure 11.21 Gerhardt et al.'s data on the preferences of female gray tree frogs (a) Most females prefer long calls to short calls, even when the short calls are initially louder ($P < 0.001$). After Gerhardt el al. (1996). (b) Most females will pass a loudspeaker playing short calls to approach a loudspeaker playing long calls ($P < 0.001$). After Gerhardt el al. (1996). (c) Females discriminate most strongly against short calls. A female's "phonotaxis score" for a particular test call is the time it took her to approach a control call with 18 pulses per second divided by the time it took her to approach the test call. Higher scores indicate a stronger preference for the test call relative to the control. Each data point is the average score of 10 females; the whiskers show ±1 standard error. From Bush et al. (2002).

The full article with this data is available here.

When the collected data, the points in the above plot, are fit with a curve, the resulting curve looks like a logarithmic function $p(x) = a + b \ln(x)$. This function represents the *Phonotaxis score*, that gives the relative rate at which a female frog will approach a male that gives x pulses per call. Professor Long used Mathematica to determine values of a and b to get the function

$$p(x) = -0.40 + 0.48 \ln(x)$$

The approach time for a female is inversely proportional to the relative rate (i.e. faster speed, shorter time). A function for the approach time is

$$a(x) = \frac{p(18)}{p(x)} = \frac{0.987378}{-0.40 + 0.48 \ln(x)}$$

This function has been scaled to represent the time it takes a female to approach a male producing x pulses per second, compared with the "average frog" that produces 18 pulses per second. So $a(18) = 1$.

Your work

1. How much more time does it take the female to approach if the male is producing only 10 pulses per second as one that produces the standard 18 pulses per second? Express your answer as a percentage.

2. How much less time does it take the female to approach if the male is producing 30 pulses per second as one that produces the standard 18 pulses per second? Express your answer as a percentage.

3. At what number of pulses does the approach time double from the standard at 18 pulses?

4. From the last homework assignment you computed the average value of continuous functions on some interval using an integral. Compute the average approach time for the interval of pulses from 18 to 30. Use Simpson's method. Choose *n* so that you are assured your value is less than 0.0001 from Simpson's error estimate.