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Eco 634 – Lab 5

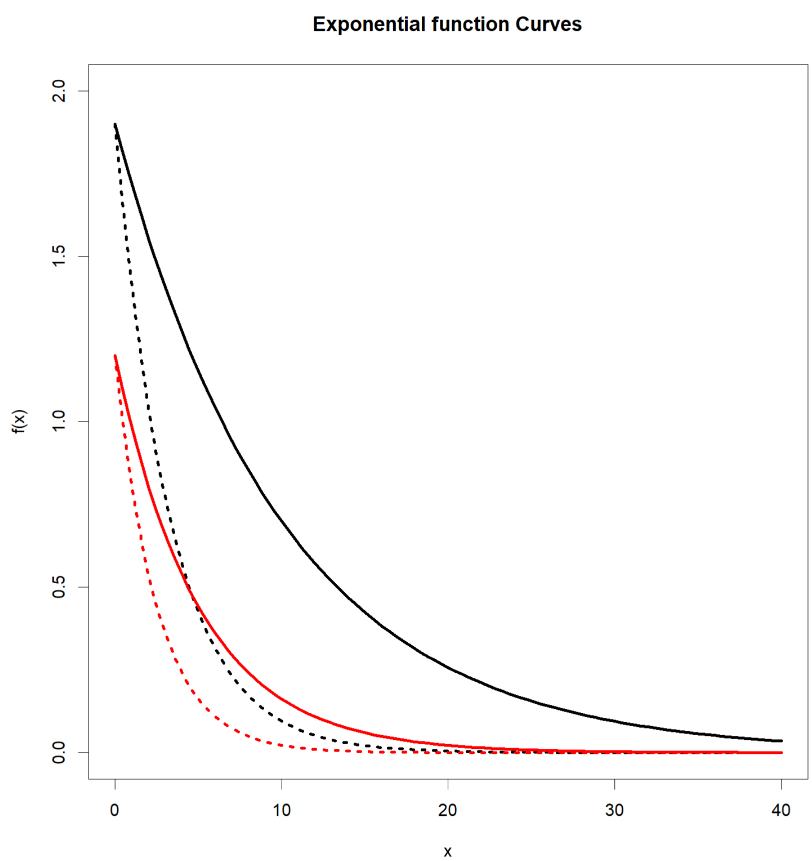
10/6/21

Q1. R code you used to create exp_fun()

```
exp_fun = function(x, a, b)
{
  return(a * exp(-b * x))
}
```

Q2. In your lab report, include a single figure containing **four** negative exponential curves with these parameter values:

- curve 1: a = 1.9, b = 0.1, line color = black, line texture = solid
- curve 2: a = 1.9, b = 0.3, line color = black, line texture = dotted
- curve 3: a = 1.2, b = 0.2, line color = red, line texture = solid
- curve 4: a = 1.2, b = 0.4, line color = red, line texture = dotted



Q3. Qualitatively describe what happens to the Exponential curve as you vary parameter a:

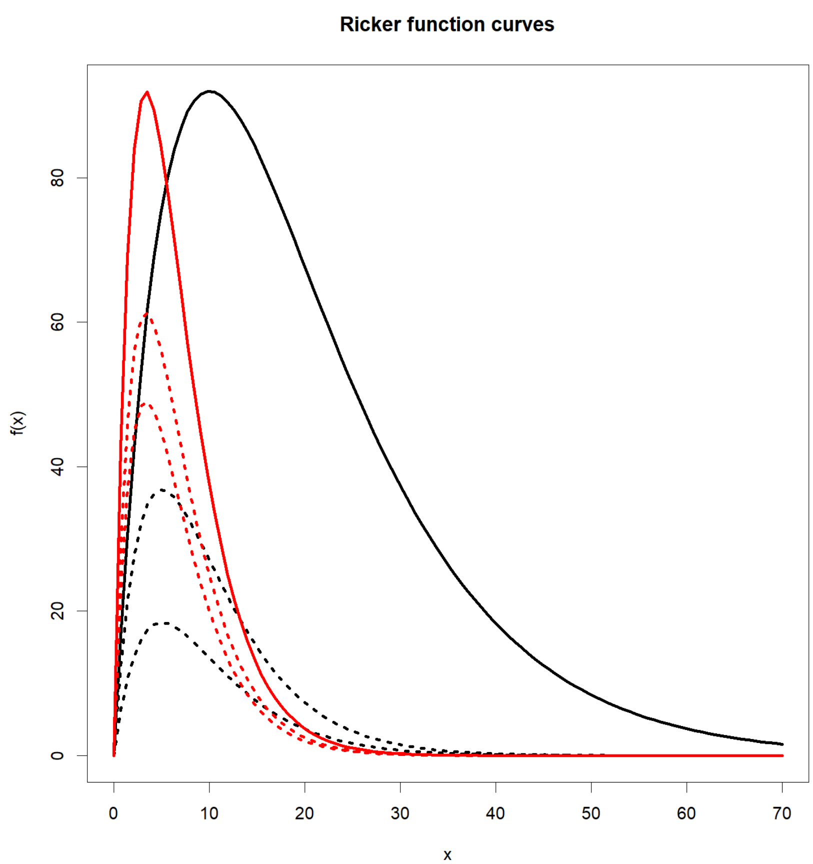
When the value of a decreases, the exponential curve appears to shift downwards. Changing a does not appear to affect the slope or rate of change of the exponential curve. Perhaps changing a affects the y-intercept of the curve. We can appear the shift down form the black solid to the red solid line.

Q4. Qualitatively describe what happens to the Exponential curve as you vary parameter b:

When you increase the value of b, this increases the steepness of the curve and the rate of the exponential. Increasing b, you see a curve with a more drastic and faster rate of exponential change and see a steeper slope. We can observe this by looking at the black solid line compared to the black dotted line. The dotted curve, which has a higher b value, it's initial slope decreases exponentially much faster than the black solid line, which has a lower b value. We observe the same trend when comparing the red solid line to the red dotted line.

Q5. Single plot containing 6 Ricker curves with these parameter values:

- curve 1: a = 25, b = 0.1, line color = black, line texture = solid
- curve 2: a = 20, b = 0.2, line color = black, line texture = dotted
- curve 3: a = 10, b = 0.2, line color = black, line texture = dotted
- curve 4: a = 75, b = 0.3, line color = red, line texture = solid
- curve 5: a = 50, b = 0.3, line color = red, line texture = dotted
- curve 6: a = 40, b = 0.3, line color = red, line texture = dotted



Q6. Qualitatively describe what happens to the Ricker curve as you vary parameter a:

Increasing the value of a in the Ricker function increases the initial slope of the curves. You can see this in the three red curves, as a is increased from 40 to 50 in the two dotted line red curves, the slope of the curve increases and gets steeper. It also appears that increasing a also increases the height of the curves, however according to the lab documentation we know the maximum height of the curve depends on both a and b.

Q7. Qualitatively describe what happens to the Ricker curve as you vary parameter b:

The x-coordinate of the Ricker curve peak depends on the parameter b. We see that increasing the b value (from 0.1 to 0.2) shifts the Ricker curve to the left on the x-axis. When we observe the same b value of 0.2 for both black dotted curves, the peak is over the same value on the x-axis. We also know the variable b contributes to the height of the Ricker curves as well. The combination of the initial slope (controlled by a), as well as the shifting of where the maximum peak will be along the x-axis (due to the b value) dictates the maximum height the curve reaches.

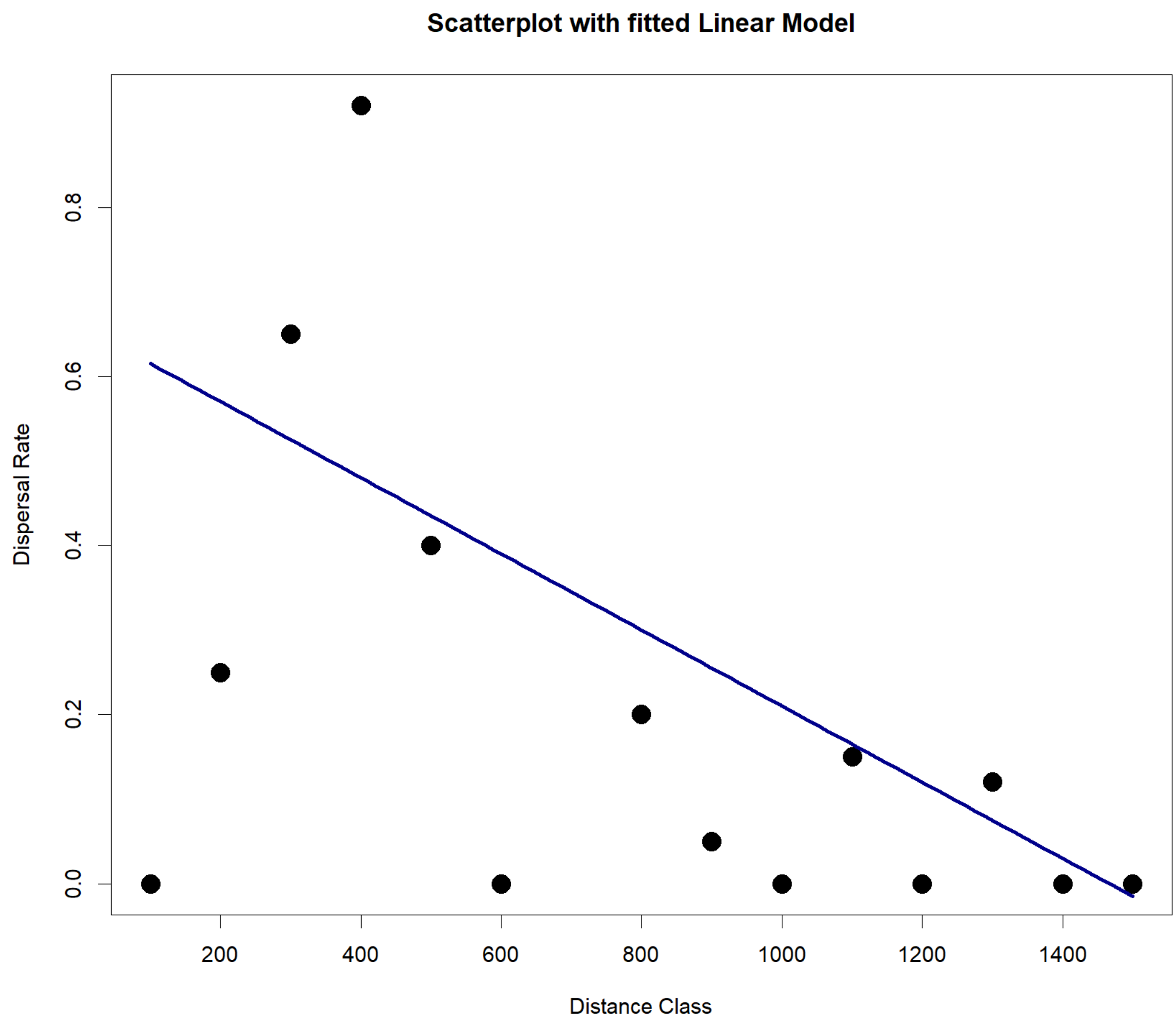
SALAMANDER MODELS

Q8. Linear Model. Provide the values of the slope and intercept parameters you chose. Briefly describe how you chose the values.

The x intercept value I chose was 800 as I visually interpreted the scatterplot to see the middle of the x values was about 800. The y intercept value I chose was 0.3 as this also appeared to be about the middle of the y values on the plot. This took a few tries in shifting the linear model up and down to fit the data best and find a good midpoint from which to approximate the linear model.

The slope I chose was -0.00045. Immediately, I knew we needed a negative slope based on the scatterplot and how dispersal rate generally seems to decrease with increasing distance class. However, when first plotting the linear model, I used -0.2 which was far too steep given the x and y values of our data. I quickly realized we would need a much flatter slope, so I fiddled with the slope value and got it down to be much lower of a number. The slope -0.00045 seemed to fit all of the data points best, given the limited capabilities of a linear model in this scenario.

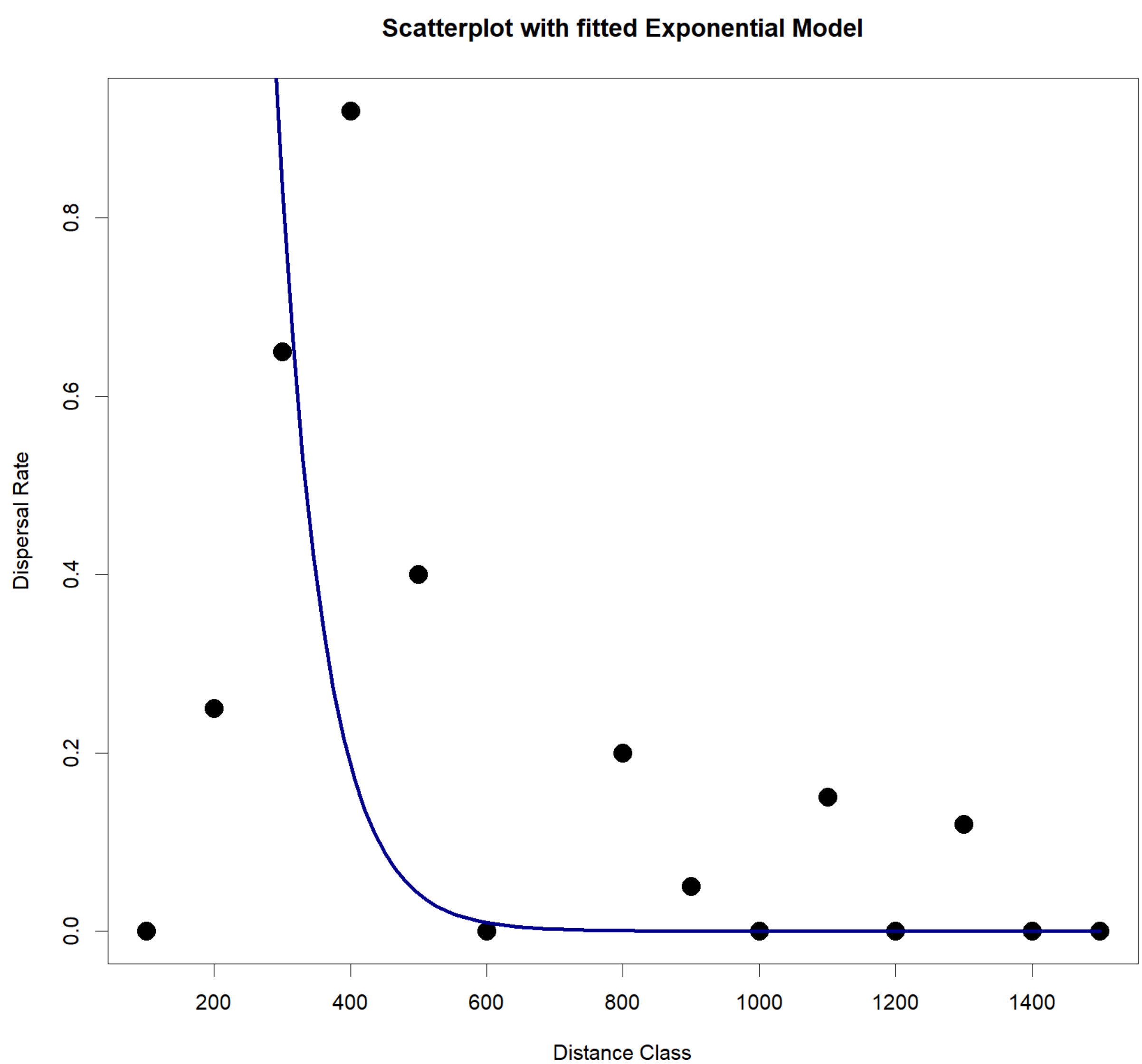
Q9. Scatterplot of the salamander data with your fitted linear model.



Q10. Exponential Model. Provide the values of the a and b. Briefly describe how you chose the values.

The a value was selected by testing random values. The final a value we chose was 75. We know that a affects the placement of the curve along the x-axis. The b value for the exponential model was selected also using random numbers. We know that the b value affects the exponential rate of change or the steepness of the curve and placement along the x-axis so we changed this value until it was appropriately lined up with most of the scatterplot data. Overall, this process was largely trial and error with some understanding of what a and b do to the curve. In general, I tried to fit the exponential curve to the most amount of the data points as possible. There seems to be a tradeoff in whether to fit the curve best to the highest dispersal rate points versus fit the curve best to the higher distance class values with lower dispersal rates. This fit was purely visual.

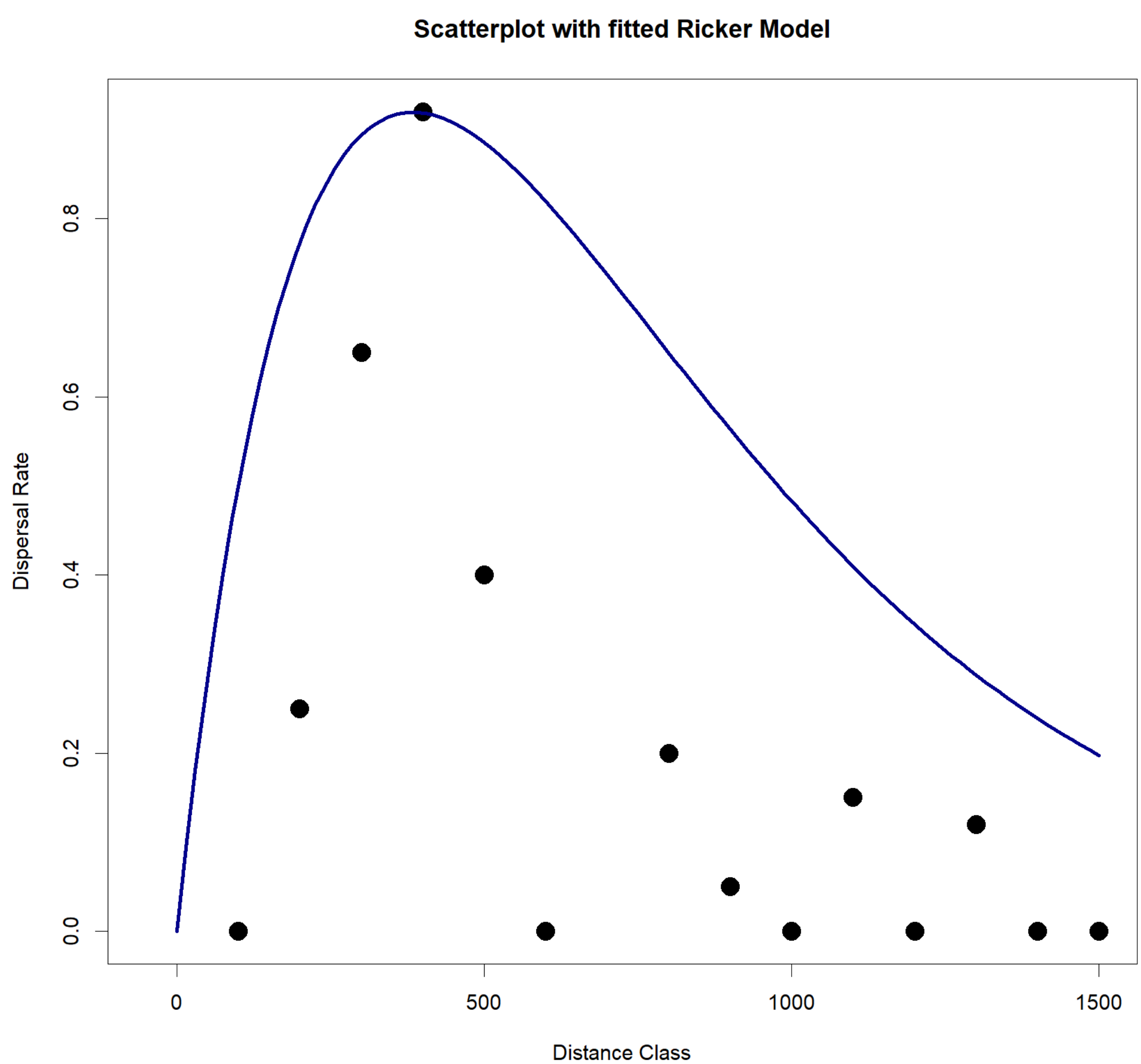
Q11. In your lab report, include a scatterplot of the salamander data with your fitted exponential model.



Q12. Ricker Model Provide the values of the a and b. Briefly describe how you chose the values.

I used a = 0.0065 and b = 0.0026. We worked with another student to get these values and tweaked them a little bit. Since we know that with Ricker functions, the a value controls initial slope of the curve and b controls the spot on the x-axis where the curve reaches its peak, we could tweak these values to best fit the dispersal and distance class data. It is definitely a trade off for fitting the Ricker curve – you can either make sure the curve goes right through the maximum value data point in its peak or you could focus on fitting the right-side tail of the Ricker curve to more of the data points with low dispersal rates. Here, I chose to tweak a and b values so that the curve runs right through the maximum data value for dispersal rate. This is where you see the curve peak. We see that initially as distance class increases, dispersal rate increases, then we see the opposite trend once the dispersal rate reaches its maximum at 0.85.

Q13. In your lab report, include a scatterplot of the salamander data with your fitted ricker model.

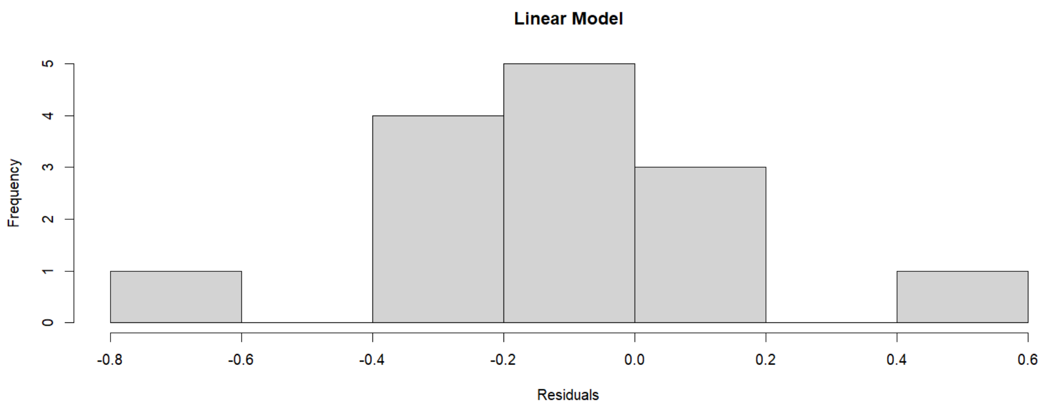


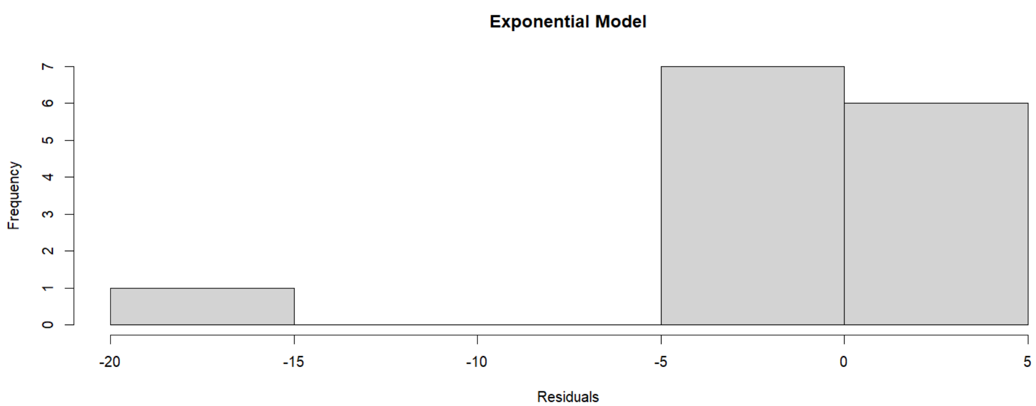
Q14. R code you used to create your data frame of model residuals.

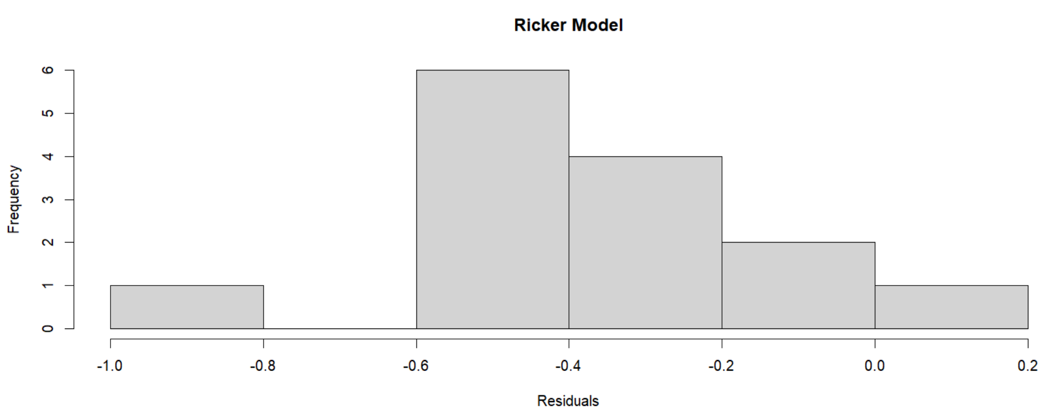
***I added the residuals to my original dat.dispersal data frame in which I read in the provided CSV file.**

```
#Q14 Code for Residuals

image_file = "lab_05_Q15.png"

png(here("images", image_file), width = 1500, height = 1800, res = 180)

par(mfrow = c(3,1))

dat_disp$lin_ypred = line_point_slope(dat_disp$dist.class, guess_x, guess_y, guess_slope)

dat_disp$resids_linear = dat_disp$disp.rate.ftb - dat_disp$lin_ypred

hist(dat_disp$resids_linear, main = "Linear Model", xlab = "Residuals")

dat_disp$exp_ypred = exp_fun(dat_disp$dist.class, 75, 0.015)

dat_disp$resids_exp = dat_disp$disp.rate.ftb - dat_disp$exp_ypred

hist(dat_disp$resids_exp, main = "Exponential Model", xlab = "Residuals")

dat_disp$rick_ypred = ricker_fun(dat_disp$dist.class, 0.0065, 0.0026)

dat_disp$resids_ricker = dat_disp$disp.rate.ftb - dat_disp$rick_ypred

hist(dat_disp$resids_ricker, main = "Ricker Model", xlab = "Residuals")

dev.off()
```

Q15. In your lab report, include histograms of the residuals for each of your three models.







Here, we observe the residual values in the histogram for the linear function are pretty good, as they are relatively centered around 0. For the exponential model, the majority of the residual values are between -5 and 5, with one outlier value (the first observation) being much lower at -20 since my exponential curve plots dispersal rate much higher than the observed dispersal rate point. This is a tradeoff between fitting the exponential curve to most of the points which are on the right side of the plot (higher distance classes) versus the fewer lower distance class values. If we wanted to improve these models based on looking at those residuals, we could adjust the a and b values.