Lab 10 – self assessment # 2, on logistic regression

Earlier in the semester, we looked at Hermon Bumpus’s sparrow data. These were data on physical measurements of sparrows along with whether or not they survived a severe winter storm in 1898. Earlier, we compared humerus lengths in two groups of sparrows: those that survived the storm and those that didn’t. This week we turn that around and predict the probability of survival and ask how strongly that depends on the humerus length. Humerus length is measured in inches (this was a late 19’th century study).

The data in sparrow2.csv are the same data as sparrow.csv used earlier with the additional of an alive variable that has a 1 if the sparrow survived and a 0 if it died.

1) Plot the data with humerus length on the X axis and alive on the Y axis. Your answer is the plot.

2) Visually, are birds with longer humerus bones more likely to survive? Briefly explain what in the plot suggests they do or not.

3) Fit a logistic regression to these data. What are the estimated intercept and slope?

4) Write an interpretation of the slope. Include units where possible. A causal-like interpretation is fine.

5) What is the change in the log odds of survival if you compare two birds with humerus lengths that differ by 0.05 inch?

6) Based on the logistic regression, is there an association between humerus length and the probability of surviving? Briefly explain your answer.

7) Predict the log odds of survival for two birds, one with a humerus length of 0.70, the other with a humerus length of 0.76. Report the two log odds and their standard errors.

8) Predict the survival probabilities for two birds, one with a humerus length of 0.70, the other with a humerus length of 0.76.

9) Calculate the Z statistic that tests whether the survival probability for a bird with a humerus length of 0.76 differs from 50% (i.e., 0.5). Report the Z statistic.

Note: Remember that computations like this should be done on log odds, not probabilities.

Answers are on the next page.

My answers:

1) 

2) Yes, birds with humerus lengths above 0.75 are more likely to be 1’s (alive); birds with humerus lengths below 0.72 are more likely to be 0’s (dead).

3) Intercept: -16.25, Slope: 22.68

4) Increasing the humerus length by 1 inch increases the log odds of survival by 22.7.

Note: A better, non-causal, interpretation would be If you compare two birds with humerus lengths that differ by 1 inch, the log odds of survival for the larger bird are estimated to be 22.7 higher than that for the smaller bird.

5) 1.13

Note: Computed as change in X (0.05 inch) times the slope (22.7 log odds / inch) = 2.27

6) Weak evidence of an association between humerus length and survival. p = 0.090

7) Humerus = 0.70, estimated log odds = -0.38, se = 0.52; Humerus = 0.76, log odds = 0.98, se = 0.45

8) Humerus = 0.70, estimated survival probability = 0.41; Humerus = 0.76, survival probability = 0.73

9) Z = 2.167.

Computations: survival probability of 0.5 is a log odds of 0. From 7), log odds = 0.985 with se = 0.455.

So: Z = (0.985 – 0 ) / 0.455 = 2.17

The computation in 9) needs to be done on the log odds scale because log odds are normally distributed; probabilities are not.