Methods in Experimental Ecology - PCB 6466
Exam # 1 – October 8, 2013 (Take Home)

Instructions: Along with this file, you should download the files called `Saxifraga.txt` and `Birds.txt` from the class website. Since all files were made available at 3 PM on Tuesday, you have until 3 PM on Wednesday to return a single word document containing all your answers to both instructors (Mac users make sure your document shows up well on a PC). Each answer should be labeled properly and you should include all relevant R scripts and output in an annex. Make sure you get confirmation from Lina that we received your file and could open it properly, as we will not grade any files received after 3 PM. Please work on these questions individually. For full credit, all analytical work needs to be done in R.

Saxifraga spp. plants

1. Using the data from the `Birds.txt` file, calculate the mean, variance and 95% confidence intervals of the means of wing length for a flycatcher and a tanager. Identify any clear outlier(s) in the dataset, remove it/them, and redo the necessary analyses to discuss how the mean, variance and CI were affected by its/their removal (**1 point**).

2. For each of the following answer: TRUE, FALSE or NOT ENOUGH INFORMATION (**1 point**).

   a. If $X \sim N(\mu, \sigma > 0)$ then $\sigma > \sigma^2$
   b. If $X \sim N(\mu, \sigma > 0)$ in a small sample ($n<30$) then $s = \sigma$
   c. For the Poisson distribution: $\mu = \sigma^2$
   d. For the Binomial distribution: $P(x) = \frac{\lambda^2}{x!} e^{-\lambda}$
   e. If $X \sim N(\mu, \sigma > 0)$ then $\mu > \sigma^2$

NOTE: $X \sim N(\mu, \sigma > 0)$ means that X is a variable with a normal distribution with mean μ and a standard deviation σ larger than 0.

3. A friend of ours collected demographic data of *Saxifraga* species in northern Spain. Using the sample of their data on *S. trifurcata* provided in the file `Saxifraga.txt` estimate the parameters of a regression model of plant area with number of fruits. For this model use **only** those plants that have fruits. Transform the data if necessary. Present plots of the residuals and inspect these plots as evidence to decide what model best follows the assumptions of regression (**2 points**).

4. Calculate the confidence intervals of the slope, the intercept and the fitted values of your best model in question 3 (**2 points**).

   BONUS: *Estimate the parameters of this model with a Bayesian approach (**2 points**). If you get more than 10 total points for this exam, all the extra points will be transferred to your lowest future exam grade.*

5. For cases A and B, state your research question, briefly describe your sampling design, justify your selected model for data analysis, mention how you are going to make sure to meet the relevant assumptions of your statistical design, and describe the steps necessary to obtain informative interpretations from your expected test results (**1 point each, 2 points total**).

   A - You are asked to design an experiment to compare green turtle carapace length in three different foraging sites.

   B - You are asked to design an experiment to relate the number of fledglings (young birds that have recently left their nests) produced per nest to the number of fruiting trees within the parents' home range.

6. In one paragraph and in your own words, summarize the main messages of two of the readings assigned in class (you can choose from the six papers and the Ghost Map book). In another paragraph explain how these messages are going to influence the way you approach information gathering and analysis in your future research (**2 points**).


FLYCATCHER


TANAGER