Tutorial 9

1. An operations manager in a company that manufactures electronic audio equipment is in-specting a new type of battery. A batch of 20 batteries is randomly assigned to four groups (so that there are 5 batteries per group). Each group of batteries is then subjected to a particular pressure level (low, normal high, or very high). The batteries are simultaneously tested under these levels and the times to failure (in hours) are recorded in the data file `batfail.txt`. The operations manager, by experience, knows that such data come from populations that are not normally distributed. He wants to use a non parametric procedure for purposes of data analysis.

   (a) At the 5% level of significance, analyze the data to determine whether there is evidence of a significant difference in the four pressure levels with respect to median batteries life. Use SAS. (Computation of exact p-value is not required.)

   (b) Repeat (a) using R.

   (c) Repeat (a) using Python.

2. Consider the horseshoe female crab data given in the csv file `crab.csv`. We would want to form a model for the weight of the female crabs (kg), which depends on its width (cm) and its spine condition (1 = both good, 2 = one worn or broken, 3 = both worn or broken).

   Use R, Python and SAS to solve questions below.

   (a) Set up a scatter plot of variable width and weight for different condition of spine.

   (b) Fit a linear regression model for weight which has two regressors width and spine. In this model, variable spine should be represented by two indicator variables, where spine = 3 is chosen to be the reference category.

   (c) At the 0.05 level of significance, test if variable width is significant in the fitted model.

   (d) Find a 95% confidence interval for β_1 of variable width.

   (e) Determine the coefficient of determination R^2.

   (f) Find an estimate of the variance σ^2 of the error term.

   (g) Derive the residual plots (qq plot of standardized residuals (SR) and the plot of SR vs fitted values).

   (h) What assumptions did you make? Check these assumptions.

   (i) Predict the weight of a female crab that has width of 27 cm and both spine are in good condition. Provide a 95% CI for the mean weight of this crab.