**R Lesson 11 - Analysis of Variance**

**References:**   
Black Chapter 11 Analysis of Variance and Design of Experiments (pp. 415-437)   
Verzani Chapter 12 Analysis of Variance (pp. 404-424)  
Stowell Chapter 6 Tabular Data (pp. 73-86) and Chapter 10 Hypothesis Testing (pp. 144-146, 158)   
Lander Chapter 15 Basic Statistics (pp.207-210)

**Exercises:**

**Data set:** [tableware.cvsView in a new window](https://canvas.northwestern.edu/courses/38799/files/2178909/download?wrap=1)

**Variable Names:**

1. TYPE: bowl, cass, dish, tray, plate
2. BOWL: Bowl (1) or not (0)
3. CASS: Casserole (1) or not (0)
4. DISH: Dish (1) or not (0)
5. TRAY: Tray (1) or not (0)
6. DIAM: Diameter of item, or equivalent (inches)
7. TIME: Grinding and polishing time (minutes)
8. PRICE: Retail price ($)
9. RATE: Retail price divided by Time ($ per minute)

**Exercises:**

1. Use the [tableware.cvsView in a new window](https://canvas.northwestern.edu/courses/38799/files/2178909/download?wrap=1) data to test the hypothesis that the mean RATE for the five levels of TYPE are equal. Test the hypothesis using a 0.05 significance level. Produce and plot means and confidence intervals for each level of TYPE. (Use the example given in Section 16.1.1 of Lander as a reference and guide. Try the analysis two different ways.  Use -1 in the model to suppress the intercept, and alternatively without using -1.  Compare results.  Load both ggplot2 and plyr.)
2. Use the [tableware.cvsView in a new window](https://canvas.northwestern.edu/courses/38799/files/2178909/download?wrap=1) data to test the hypothesis that the mean PRICE for the five levels of TYPE are equal. Test the hypothesis using a 0.05 significance level. Print out 95% confidence intervals for each level of TYPE.

**Data Set:** [hot\_dogs.csvView in a new window](https://canvas.northwestern.edu/courses/38799/files/2178785/download?wrap=1) (Original source: Consumer Reports, June 1986, pp. 366-367.)

**Variable Names:**

1. Type = Type of hotdog (beef, meat, or poultry)
2. Calories = Calories per hot dog
3. Sodium = Milligrams of sodium per hot dog
4. Use the hot\_dogs.csv data. Perform a one-way AOV by Type on Calories and also Sodium. Use Tukey’s Honest Significant Difference Test if the F-test is significant. Generate boxplots.

**Running into Trouble?** Check out these solutions to help guide you along.

* [Lesson\_11\_Solutions-1.pdfPreview the documentView in a new window](https://canvas.northwestern.edu/courses/38799/files/2178771/download?wrap=1)
* [Lesson\_11\_Code\_Solution-1.rView in a new window](https://canvas.northwestern.edu/courses/38799/files/2178749/download?wrap=1)