

## Stat 205 Homework 8

Write up your solution on one page.

**Radish growth** (pp. 55–56): Does light exposure alter initial radish shoot growth?  $n = 42$  radish seeds were randomly assigned to one of three growing conditions:  $n_1 = 14$  were germinated in complete darkness,  $n_2 = 14$  were grown in diurnal light (12 hours of light followed by 12 hours of dark), and  $n_3 = 14$  were grown in complete light. At the end of three days, each shoot length was measured in millimeters (mm). The data are available under the Chapter 11 data link from the course web page.

1. Prepare side-by-side boxplots. Which growing condition produces the longest shoots, which produces the shortest?
2. Define three population means  $\mu_1$ ,  $\mu_2$ , and  $\mu_3$  for the three growing conditions.
3. Carry out the analysis of variance for these data in R, show your R code and output including the ANOVA table.
4. What is the P-value for testing  $H_0 : \mu_1 = \mu_2 = \mu_3$ ? Do you accept  $H_0$  or reject  $H_0$  at the 5% level?
5. **Extra credit:** compare the three means using Tukey's procedure as in the notes. Draw a "lines" plot showing which means are significantly different.
6. **Extra credit:** report normal probability plots for each growing condition. Is normality reasonable here? Note `qqnorm(radish[light==1])` gives the normal probability plot for group 1, etc.
7. **Extra credit:** Use Bartlett's test to test  $H_0 : \sigma_1 = \sigma_2 = \sigma_3$  across groups. The function is `bartlett.test` in R and the syntax is the same as `aov`. What is the p-value for testing  $H_0$ ? Do you reject or accept that the variances are the same?