Chapter 1 - Linear Model Foundation

- 1.1 – **[10 pts]**
  1. Results from `anova()` , `summary()` , and `confint()` are shown in the tables below.

Table B.1: Analysis of variance table for the diastolic blood pressure by diet type.

```
          Df Sum Sq Mean Sq F value   Pr(>F)
diet       1 208.29  208.29  9.3762 0.009861
Residuals 12 266.57   22.21
Total     13 474.86
```

Table B.2: Coefficient results from the one-way ANOVA fit of diastolic blood pressure by diet type.

```
             Estimate Std. Error t value Pr(>|t|)
(Intercept)     6.571      1.781   3.689  0.00310
dietStandard   -7.714      2.519  -3.062  0.00986
---
Residual standard error: 4.713 on 12 degrees of freedom
Multiple R-squared: 0.4386,       Adjusted R-squared: 0.3918
F-statistic: 9.376 on 1 and 12 DF,  p-value: 0.009861
```

Table B.3: Coefficient confidence interval results from the one-way ANOVA fit of diastolic blood pressure by diet type.

```
                  2.5 %    97.5 %
(Intercept)    2.690040 10.452817
dietStandard -13.203398 -2.225174
```

  2. Results from the `t.test()` are shown in the table below.

Table B.4: Resutls from two-sample t-test of diastolic blood pressure by diet type.

```
        Two Sample t-test

data:  DBP by diet
t = 3.0621, df = 12, p-value = 0.009861
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
  2.225174 13.203398
sample estimates:
    mean in group Fish mean in group Standard
              6.571429              -1.142857
```

  3. Both methods provide a very strong rejection of the null hypothesis (p=0.0099). The group means appear to be different.
  4. The difference in the means (i.e., -1.14-6.57 = -7.71) is the same as the slope coefficient in the one-way ANOVA model (i.e., -7.714). This is because the slope coefficient shows the change in DBP for a one "unit" change in "diet group" or a change from the "Fish" group to the "Standard" group.

5. The confidence interval for the difference in means and the slope coefficient in the one-way ANOVA are identical, except for the sign which is due to the difference in order of subtraction of the two groups.
6. The intercept coefficient in the one-way ANOVA is the same as the mean of the first (Fish) group in the two-sample t-test. This is because the fish group is the "reference" group.
7. The df from the two-sample t-test and the within (denominator) df from the one-way ANOVA are identical. The within df are equal to the total number of individuals (n=$n_1 + n_2$) minus the number of groups (I=2).
8. The F test statistic is the square of the t test statistic. This is a fact when the numerator df is equal to one.
9. All of these p-values are exactly the same because they all test the exact same hypothesis (no difference between groups).
10. The SE for the difference in means is equal to $\frac{\bar{x}_1 - \bar{x}_2}{t} = \frac{6.571429+1.142857}{3.0621} = 2.519280$. The pooled variance is then equal to this value divided by the sum of the reciprocals of the sample sizes – i.e., $\frac{SE^2_{\bar{x}_1 - \bar{x}_2}}{\frac{1}{n_1}+\frac{1}{n_2}} = \frac{2.519280^2}{\frac{1}{7}+\frac{1}{7}} = 22.2137$. This is the same as MS_{within}.

R commands

```
> DBP <- c(8, 12, 10, 14, 2, 0, 0, -6, 0, 1, 2, -3, -4, 2)
> diet <- rep(c("Fish", "Standard"), each = 7)
> diet <- factor(diet)
> d <- data.frame(DBP, diet)
> view(d)
> attach(d)
> lm1 <- lm(DBP ~ diet)
> anova(lm1)
> summary(lm1)
> confint(lm1)
> t.test(DBP ~ diet, var.equal = TRUE)
```