

Question 1.2 (15 pts)

- a. Results from the `t.test()` are shown in the Table 1.

Table 1. Results from two-sample t-test of diastolic blood pressure by diet type.

```
Two Sample t-test with 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
```

- b. Results from `anova()` and `summary()` are shown in Table 2 and Table 3, respectively.

Table 2. 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	208.286	9.3762	0.009861
Residuals	12	266.57	22.214		
Total	13	474.86			

Table 3. 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

- c. The overall p-value from the ANOVA table ($p = 0.0099$), for the slope coefficient ($p = 0.0099$), and for the two-sample t-test ($p = 0.0099$) are equal. With these p-values, very strong evidence to reject the null hypothesis exists. Thus, the group means appear to be different.
- d. The intercept coefficient in the one-way ANOVA (6.57) is the same as the mean of the first (Fish) group in the two-sample t-test (6.57). This occurs because an intercept is defined as the “value of Y when $X=0$, on average” and the fish group is coded with a zero in `lm()`.
- e. 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., -7.71). This is because the slope coefficient shows the change in Y (DBP) for a one “unit” change in X (“diet group”), which is a change from the “Fish” group (coded with a zero) to the “Standard” group (code with a one) because of the coding in `lm()`.
- f. The df from the two-sample t-test (12) and the within df from the one-way ANOVA (12) are identical. The within df are equal to the total number of individuals ($n = n_1 + n_2$) minus the number of groups ($I = 2$), which is the same as for the two-sample t-test.
- g. The F test statistic (9.38) is equal to the square of the t test statistic ($3.06^2 = 9.38$). This relationship occurs when the numerator df for the ANOVA is equal to one (i.e., there are only two groups).
- h. 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., $\frac{SE_{\bar{x}_1 - \bar{x}_2}^2}{\frac{1}{n_1} + \frac{1}{n_2}} = \frac{2.519280^2}{\frac{1}{7} + \frac{1}{7}} = 22.214$. This is the same as MS_{within} (Table 2).

R commands

```
> ## The three lines below are an alternative way to enter the data
> ##   using read.table() is likely easier
> DBP <- c(8,12,10,14,2,0,0,-6,0,1,2,-3,-4,2)
> diet <- factor(rep(c("Fish","Standard"),each=7))
> d <- data.frame(DBP,diet)
> t.test(DBP~diet,data=d,var.equal=TRUE)
> lm1 <- lm(DBP~diet,data=d)
> anova(lm1)
> summary(lm1)
> confint(lm1)
```