

Homework 5 Solution
 BIOS 600

1. Fill in the ANOVA table.

Source	DF	Sum of Squares	Mean Square	F -Value	$\text{Pr} > F$
Model (Between)	2	35.4	17.7	2.7623	0.1001
Error (Within)	13	83.3	6.4077		
Corrected Total	15	118.7			

2. Fill in the ANOVA table.

Source	DF	Sum of Squares	Mean Square	F -Value	$\text{Pr} > F$
Model (Between)	5	6.1	1.22	3.21	0.0099
Error (Within)	100	38	0.38		
Corrected Total	105	44.1			

3. Fill in the ANOVA table.

Source	DF	Sum of Squares	Mean Square	F -Value	$\text{Pr} > F$
Model (Between)	3	2850.52	950.1734	6.38	0.000291
Error (Within)	622	92634.46	148.93		
Corrected Total	625	95484.98			

4. There are four groups, so $df_{\text{Model}} = 4 - 1 = 3$. There are $4(10) = 40$ total observations in the study, so $df_{\text{Total}} = 40 - 1 = 39$. Finally, $df_{\text{Error}} = df_{\text{Total}} - df_{\text{Model}} = 39 - 3 = 36$.

Therefore, the answer is C: 3 and 36.

5. First we calculate $SS_{\text{Model}} = SS_{\text{Total}} - SS_{\text{Error}} = 1300 - 897 = 403$. Now we obtain the F -statistic.

$$F = \frac{MS_{\text{Model}}}{MS_{\text{Error}}} = \frac{SS_{\text{Model}}/df_{\text{Model}}}{SS_{\text{Error}}/df_{\text{Error}}} = \frac{403/3}{897/36} = \frac{134.33}{24.917} = 5.39 \approx 5.4$$

Therefore, the answer is D: 6.17

It is easiest to just write out the ANOVA table for this problem:

Source	DF	Sum of Squares	Mean Square	F -Value	$\text{Pr} > F$
Model	4	403	100.75	6.17	
Error	55	897	16.3091		
Corrected Total	59	1300			

6. (a) Descriptive Statistics on `pets_HW5.xls`.

Group	Mean (\bar{x}_i)	Standard Deviation (s_i)	Sample Size (n_i)
Group 1 (Dog)	75.2295	9.5362	27
Group 2 (Friend)	90.0096	8.6024	25
Group 3 (Neither)	82.4137	9.4350	26

- (b)
- We will test $H_0 : \mu_1 = \mu_2 = \mu_3$ against the alternative $H_A : \text{at least 1 } \mu_i \text{ differs}$.
 - We set our significance level at $\alpha = 0.05$ and generate our ANOVA table.
 - From the ANOVA table, we get a test statistic of $F = 16.71$ with $p < 0.001$.

Source	DF	Sum of Squares	Mean Square	F -Value	$\text{Pr} > F$
Model (Between)	2	2835.77	1417.89	16.705	0.000000999
Error (Within)	75	6365.92	84.88		
Corrected Total	77	9201.69			

- Our p -value is less than α , therefore we reject the null hypothesis that mean heart rate is the same between all three groups.
 - We have strong evidence to conclude that the mean heart rate differs depending on one's company during exposure to a psychological stressor.
- (c) After a significant F -test result, we would like to identify which groups differ from each other using the LSD method. We test the $c = 3$ pairwise comparisons using the following modified 2-sample t -tests. To compare Group i versus Group j , we conduct the following test:

$$\begin{aligned}
 H_0 : \mu_i &= \mu_j \\
 H_A : \mu_i &\neq \mu_j \\
 t &= \frac{\bar{x}_i - \bar{x}_j}{\text{adjusted } SE_{\bar{x}_i - \bar{x}_j}} = \frac{\bar{x}_i - \bar{x}_j}{\sqrt{MS_W \left(\frac{1}{n_i} + \frac{1}{n_j} \right)}}
 \end{aligned}$$

with $df = N - k = 78 - 3 = 75$.

	Variance	Std Dev	t_{stat}	p -value
Group 1 vs 2	6.5388	2.5571	-5.78	$1.609 \times (10^{-7})$
Group 1 vs 3	6.4082	2.5315	-2.84	0.0058
Group 2 vs 3	6.6597	2.5806	2.94	0.0043