

Homework 5 Solution
BIOS 600

1. Fill in the ANOVA table.

| Source | DF | Sum of Squares | Mean Square | <i>F</i> -Value | Pr > <i>F</i> |
|-----------------|----|----------------|-------------|-----------------|---------------|
| 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 | <i>F</i> -Value | Pr > <i>F</i> |
|-----------------|-----|----------------|-------------|-----------------|---------------|
| 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 | <i>F</i> -Value | Pr > <i>F</i> |
|-----------------|-----|----------------|-------------|-----------------|---------------|
| 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: 5.4

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 |