Solutions for Odd number Questions from 10.1-10.3

10.1 Since only one factor is utilized, the treatments are the four levels (A, B, C, D) of the qualitative factor.

10.3 One has no control over the levels of the factors in an observational experiment. One does have control of the levels of the factors in a designed experiment.

10.13

a. \( F_{.05}(4, 4) = 6.39 \)
b. \( F_{.01}(4, 4) = 15.98 \)
c. \( F_{10}(30, 40) = 1.54 \)
d. \( F_{.025}(15, 12) = 3.18 \)

10.15 In the second dot diagram b, the difference between the sample means is small relative to the variability within the sample observations. In the first dot diagram a, the values in each of the samples are grouped together with a range of 4, while in the second diagram b, the range of values is 8.

10.21 a. Some preliminary calculations are:

\[
CM = \frac{(\sum_{all} y_{ij})^2}{n} = \frac{3712}{12} = 114.701
\]

\[
SSTO = \sum_{all} y_{ij}^2 - CM = 145.89 - 114.701 = 31.189
\]

\[
SST = \sum_{i=1}^{3} \frac{T_i^2}{n_i} - CM = \frac{16.6^2}{3} + \frac{16.0^2}{4} + \frac{4.2^2}{3} - 114.701 = 12.301
\]

\[
SSE = SSTO - SST = 31.189 - 12.301 = 18.888
\]

\[
MST = \frac{SST}{k-1} = \frac{12.301}{2} = 6.1505, \quad MSE = \frac{SSE}{n-k} = \frac{18.888}{12-3} = 2.0987
\]

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
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<tr>
<td>Treatments</td>
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<td>12.301</td>
<td>6.1505</td>
<td>2.931</td>
</tr>
<tr>
<td>Error</td>
<td>9</td>
<td>18.888</td>
<td>2.0987</td>
<td></td>
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<tr>
<td>Total</td>
<td>11</td>
<td>31.189</td>
<td></td>
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</tr>
</tbody>
</table>

b. \( H_0 : \mu_1 = \mu_2 = \mu_3 \)

\( H_a \): At least two treatment means differ
The test statistic is \( F = \frac{MST}{MSE} = \frac{6.1505}{2.0987} = 2.931 \)

The rejection region is \( F > F_{.01}(2, 9) = 8.02 \). Since \( F = 2.931 < 8.02 \), it’s not in the RR. we fail to reject \( H_0 \). There is insufficient evidence to indicate a difference in the treatment means at \( \alpha = .01 \).

10.25 a. To determine if the mean ages of all powerful American women differ among three groups based on position within the firm, we test

\[ H_0 : \mu_1 = \mu_2 = \mu_3 \]
\[ H_a : \text{At least two treatment means differ} \]

b. The means at the bottom of the output are sample means. These sample means are actually observed values of random variables. Even if we took a second sample from within each treatment, the new sample means will probably differ from the first sample means. Thus, simply comparing the sample means is not valid. In order to determine if the three population means differ, we must compare the variation within the treatments(sampling variability) to the variation between the treatments. That is to do F-test.

c. For the printout, the test statistic is \( F = 1.78 \) and the p-value is \( p = .179 \). Since the p-value(.179) is greater than \( \alpha = .10 \), \( H_0 \) is not rejected. There is insufficient evidence to indicate the mean ages of all powerful American women differ among three groups based on position within the firm at \( \alpha = .10 \).

d. We will talk about checking assumptions later.

10.31 a. To determine if the mean level of trust differs among the six treatments, we test:

\[ H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6 \]
\[ H_a : \text{At least two of the } \mu_i \text{'s differ} \]

b. The test statistic is \( F = 2.21 \). The RR is \{ \( F > F_{.05}(5, 231) \approx 2.21 \) \}. So the calculated \( F = 2.21 \) does not fall in the RR. There is insufficient evidence to indicate that at least two mean trust differ at \( \alpha = .05 \).

c. We must assume that all six samples are drawn from normal populations, the six population variances are the same, and that the samples are independent.
d. I would classify this experiments as designed. Each subject was randomly assigned to receive one of the six scenarios.

10.33 The total number of pairwise comparisons is equal to $k(k - 1)/2$.

a. $k = 3$, then the number of comparisons is $3(3 - 1)/2 = 3$.

b. $k = 5$, then the number of comparisons is $5(5 - 1)/2 = 10$.

c. $k = 4$, then the number of comparisons is $4(4 - 1)/2 = 6$.

d. $k = 10$, then the number of comparisons is $10(10 - 1)/2 = 45$.

10.39 a. Tukey’s multiple comparison method is preferred over other methods, because here we compare all of the pairs of means, and when the design is balanced, that is all treatment sample sizes are equal, Tukey method controls experimental error, which is 1 minus simultaneous confidence level, at the choose $\alpha$ level. It is more powerful than the other methods.

b. From the confidence interval comparing large-cap and medium cap mutual funds, we find that 0 is in the interval. Thus, 0 is not an unusual value for the difference in the mean rates of return between large-cap and medium-cap mutual funds. This means we would not reject $H_0$. There is insufficient evidence of a difference in mean rates of return between large-cap and medium-cap mutual funds at $\alpha = .05$.

c. From the confidence interval comparing large-cap and small-cap mutual funds, we find that 0 is not in the interval. Thus, 0 is an unusual value for the difference in the mean rates of return between large-cap and small-cap mutual funds. This means we would reject $H_0$. There is sufficient evidence of a difference in mean rates of return between large-cap and small-cap mutual funds at $\alpha = .05$. Also, since lower bound and upper bound of the confidence interval are greater than 0, we think $\mu_{large}$ is significantly greater than $\mu_{small}$.

d. The interpretation is similar as question b.

e. From the above, the mean rate of return for large-cap mutual funds is the largest, followed by medium-cap, followed by small-cap mutual funds. The mean rate of return for large-cap funds is significantly larger than that for small-cap funds. No other differences exist.

f. We are 95% confidence of this decision.