Multiple Choice (1 mark)

Identify the letter of the choice that best completes the statement or answers the question.

Note. What will NOT be on the exam? (1) calculating SS from raw data (with the exception of correlations), (2) stating Hypotheses (despite answers below which include these), (3) you will be told which of the nonparametric tests to use (e.g., Wilcoxon), and (4) all post-hoc followups will use Tukey (vs. Scheffe). Formula sheets and Tables will be copied from the textbook (e.g., F, t, q for Tukey).

1. A two-factor research study has 2 levels of factor A and 3 levels of factor B with a separate sample of n = 5 subjects in each treatment condition. Based on this information, what are the df values for the F-ratio evaluating the main effect of factor B?
   a. df = 1, 24
   b. df = 1, 29
   c. df = 2, 24
   d. df = 2, 29

2. A two factor analysis of variance produces SS_A = 20, SS_B = 40 and SS_AxB = 10. If SS_within treatments = 120, then what is the value of η^2 for factor A?
   a. 20/120
   b. 20/140
   c. 20/90
   d. 20/190

3. An analysis of variance produces SS_within treatments = 40 and MS_within treatments = 10. In this analysis, how many treatment conditions are being compared?
   a. 4
   b. 5
   c. 30
   d. 50

4. For an independent-measures experiment comparing two treatment conditions with a sample of n = 10 in each treatment, the F-ratio would have df equal to _________.
   a. 18
   b. 19
   c. 1, 18
   d. 1, 19

5. One sample has n = 6 and SS = 20 and a second sample has n = 6 and SS = 30. What is the pooled variance for the two samples?
   a. 25
   b. 50
   c. 50/10
   d. 50/12
6. What is the pooled variance for the following two samples?

   Sample 1: n = 6 and SS = 56  
   Sample 2: n = 4 and SS = 40  

   a. 5  
   b. $\sqrt{5}$  
   c. 12  
   d. 9.6

7. A set of n = 5 pairs of X and Y values has $\Sigma X = 10$, $\Sigma Y = 20$, and $\Sigma XY = 60$. For this set of scores, the value of SP is __________.

   a. -20  
   b. -28  
   c. 20  
   d. 60

8. For the following data, SP equals __________.

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

   a. 6  
   b. -5  
   c. 43  
   d. None of the other 3 choices is correct.

9. Which of the following accurately describes the observed and expected frequencies in a chi-square test?

   a. Both the observed and expected frequencies will always be whole numbers.  
   b. The observed frequencies are always whole numbers but the expected frequencies may be decimals or fractions.  
   c. The expected frequencies are always whole numbers but the observed frequencies may be decimals or fractions.  
   d. Both the observed and expected frequencies may be decimals or fractions.

10. Three months ago a nationwide survey indicated that 60% of the population approved of the president's foreign policy, 30% disapproved, and 10% had no opinion. A researcher plans to use a sample of n = 300 people to determine whether opinions have changed during the past three months. If a chi-square test is used to evaluate the data, what is the expected frequency for the no opinion category?

   a. 10  
   b. 30  
   c. 90  
   d. 150
11. To compute the value for the Mann-Whitney U
   a. each of the samples is ranked separately
   b. the two samples are combined and the individuals in the total group are ranked
   c. the difference between treatment 1 and treatment 2 is computed for each individual, then
      the positive differences and the negative differences are ranked separately
   d. the difference between treatment 1 and treatment 2 is computed for each individual, then
      the total set of difference scores is ranked without regard to signs

12. What kind of research study produces data appropriate for the Wilcoxon test?
   a. an independent-measures study comparing two treatments
   b. an independent-measures study comparing more than two treatments
   c. a repeated-measures study comparing two treatments
   d. a repeated-measures study comparing more than two treatments

Short Answer (10 or 15 points depending on length)

13. The following data were obtained from a two-factor independent-measures experiment.

<table>
<thead>
<tr>
<th></th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>B4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T = 5</td>
<td>T = 0</td>
<td>T = 15</td>
<td>T = 20</td>
</tr>
<tr>
<td>A1</td>
<td>SS = 40</td>
<td>SS = 30</td>
<td>SS = 50</td>
<td>SS = 40</td>
</tr>
<tr>
<td></td>
<td>T = 5</td>
<td>T = 10</td>
<td>T = 5</td>
<td>T = 40</td>
</tr>
<tr>
<td>A2</td>
<td>SS = 30</td>
<td>SS = 20</td>
<td>SS = 40</td>
<td>SS = 70</td>
</tr>
</tbody>
</table>

EX^2 = 800

a. State the hypotheses for each of the three separate tests included in the two-factor ANOVA.
b. Calculate degrees of freedom and locate the critical region for each of the three tests.
c. Calculate the three F-ratios.
d. State a conclusion for each test.

14. The data below are from an independent-measures experiment comparing three different treatment conditions.

<table>
<thead>
<tr>
<th>Treatment 1</th>
<th>Treatment 2</th>
<th>Treatment 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>0</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

G = 24
EX^2 = 92

<table>
<thead>
<tr>
<th></th>
<th>T = 2</th>
<th>T = 6</th>
<th>T = 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS = 3</td>
<td>SS = 9</td>
<td>SS = 6</td>
<td></td>
</tr>
</tbody>
</table>

a. Use an analysis of variance with α = .05 to determine whether these data indicate any
   significant differences among the treatments.
b. Use the Scheffe test to determine which of the treatments are significantly different from each
   other. Use the .05 level of significance for all tests.
15. A biopsychologist studies the role of the brain chemical serotonin in aggression. One sample of rats serves as a control group and receives a placebo. A second sample of rats receive a drug that lowers brain levels of serotonin. Then the researcher tests the animals by recording the number of aggressive responses each of the rats display. The data are presented below.

a. Does the drug have a significant effect on aggression? Use an alpha level of .05, two tails.

b. Use Cohen's $d$ to measure the effect size.

<table>
<thead>
<tr>
<th></th>
<th>Low Serotonin</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>M</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>SS</td>
<td>108</td>
<td>180</td>
</tr>
</tbody>
</table>

16. Find the regression equation for predicting $Y$ from $X$ for the following set of scores.

<table>
<thead>
<tr>
<th>$X$</th>
<th>$Y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
</tr>
</tbody>
</table>

17. A statistics instructor would like to know whether it is worthwhile to require students to do weekly homework assignments. For one section of the statistics course, homework is assigned, collected, and graded each week. For another section, the same problems are suggested each week, but the students are not required to turn in their homework. At the end of the semester, all students take the same final exam. The grade distributions for the two sections are as follows:

<table>
<thead>
<tr>
<th>FINAL EXAM GRADE</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>12</td>
<td>15</td>
<td>17</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>No Homework</td>
<td>12</td>
<td>21</td>
<td>28</td>
<td>25</td>
<td>14</td>
</tr>
</tbody>
</table>

Do these data indicate a significant difference between the grade distributions for students with homework versus students with no homework? Test with $\forall = .05$.

18. The following data are ranks for a sample of 18 students from three different schools. The students participated in a music competition and were ranked by a committee of professional musicians. Do the data indicate any significant differences between the three schools. Use a Kruskal-Wallis test at the .05 level of significance.

School A: 1, 2, 4, 7, 8, 10
School B: 3, 6, 9, 11, 12, 15
School C: 5, 13, 14, 16, 17, 18
332_fnl_prac
Answer Section

MULTIPLE CHOICE

1. ANS: C  REF:  p. 493
2. ANS: B  REF:  p. 499
3. ANS: B  REF:  p. 411
4. ANS: C  REF:  p. 414  OBJ:  TYPE: WWW
5. ANS: C  REF:  p. 313  OBJ:  TYPE: WWW
6. ANS: C  REF:  p. 313
7. ANS: C  REF:  p. 528  OBJ:  TYPE: WWW
8. ANS: B  REF:  p. 528
9. ANS: B  REF:  p. 583
10. ANS: B  REF:  p. 582
12. ANS: C  REF:  p. 645
13. ANS:

a. The hypotheses are:

For factor A:  
\( H_0: \mu_{A1} = \mu_{A2} \) (no A-effect)  
\( H_1: \mu_{A1} \neq \mu_{A2} \)

For factor B:  
\( H_0: \mu_{B1} = \mu_{B2} = \mu_{B3} = \mu_{B4} \) (no B-effect)  
\( H_1: \) at least one of the B-means is different from another

For A x B:  
\( H_0: \) there is no interaction  
\( H_1: \) there is an interaction

b. For factor A, the F-ratio has df = 1, 32 and the critical value is \( F = 4.15 \). For factor B and the A x B interaction, the F-ratios have df = 3, 32 and the critical value is \( F = 2.90 \).

c.  

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Treatments</td>
<td>7</td>
<td>230</td>
<td></td>
</tr>
<tr>
<td>Factor A</td>
<td>1</td>
<td>10</td>
<td>10.00</td>
</tr>
<tr>
<td>Factor B</td>
<td>3</td>
<td>170</td>
<td>56.67</td>
</tr>
<tr>
<td>A x B</td>
<td>3</td>
<td>50</td>
<td>16.67</td>
</tr>
<tr>
<td>Within Treatments</td>
<td>32</td>
<td>320</td>
<td>10.00</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>550</td>
<td></td>
</tr>
</tbody>
</table>

d. The results indicate that there are significant differences among the levels of factor B, but the overall A-effect is not significant and the interaction is not significant.

14. ANS:

a.  

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>26</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Within</td>
<td>18</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>44</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

With df = 2, 9 the critical value is 4.26. Reject \( H_0 \) and conclude that there are significant differences among the treatments.

b.  

Start with the largest mean difference, Treatment 1 versus 3: \( SS_{between} = 24.5 \),  
\( MS_{between} = 12.25, F(2,9) = 6.125 \) (significant). Treatment 2 versus 3: \( SS_{between} = 12.5 \),  
\( MS_{between} = 6.25, F(2,9) = 3.125 \) (not significant). No other treatment differences are significant.
15. ANS:
   a. $H_0: \mu_1 - \mu_2 = 0$. For these data the pooled variance is 24, the standard error is 2.65, and the $t$ statistic is $t(12) = 3.02$. Reject $H_0$. Lower serotonin levels cause an increase in aggression.
   b. Cohen's $d = \frac{8}{\sqrt{24}} = 1.63$.

16. ANS:
   $SS_X = 2$, $SP = 2$, $M_X = 1$, and $M_Y = 9$. $\bar{Y} = (1)X + 8$.

17. ANS:
   The null hypothesis states that there is no difference between the grade distributions for the two sections. With $\alpha = .05$ and $df = 4$, the critical value is 9.49. The expected frequencies are as follows:

<table>
<thead>
<tr>
<th>FINAL EXAM GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Homework</td>
</tr>
<tr>
<td>No Homework</td>
</tr>
</tbody>
</table>

   For these data, chi-squared = 13.08. Reject $H_0$ and conclude that there is a significant difference between the two sections.

18. ANS:
   The three treatment totals are 32, 56, and 83. For these data, chi-square = 7.618. With $df = 2$, the critical value is 5.99. Reject the null hypothesis and conclude that there are significant differences among the three schools.