1. Questions

(1) A researcher wants to find out if gender has any effect on the annual income of the lawyers when they get hired right after finishing law school. What is the best method for testing the relevant null?
   (a) Two sample test of percentage
   (b) One sample test of percentage
   (c) Paired sample test of the mean
   (d) Two sample test of the mean
   (e) One sample test of the mean

(2) We showed that for the two sample test of the mean, you calculate $t$ by dividing the difference in the sample means by $S_{(\bar{X}_1 - \bar{X}_2)}$. What does $S_{(\bar{X}_1 - \bar{X}_2)}$ show?
   (a) Standard deviation of the difference between two population means
   (b) Standard error of $(\bar{X}_1 - \bar{X}_2)$ distribution
   (c) Variance of sample one minus sample two
   (d) Standard deviation of the difference between $X_1$ and $X_2$ distribution

(3) Jay is testing a hypothesis regarding the effect of marital status (married and single) on GPA of graduate students who major in social science. For a random sample of 100 married and 100 single students he finds the following 95% CI for the difference in the GPA of married and single students.

   $[-0.40, +0.30]$

   What is the best answer?
   (a) He should fail to reject the null and conclude that marital status has no effect on GPA.
   (b) He should reject the null and conclude that GPA and marital status are related to each other.
   (c) He should reject the null and conclude that GPA is higher for married students.
   (d) He should reject the null and conclude that the GPA for single students is +0.30 higher than married ones.

(4) A professor wants to examine the effect of using plots in teaching descriptive statistics. He randomly divides his class of 30 students into two groups and he teaches the concepts of percentile and scatter with and without plots. Given that $N_1 = N_2 = 15$, What distribution should he use to find the P value?
(a) The t distribution with $\text{df} = \infty$
(b) The t distribution with $\text{df} = 28$
(c) The Z distribution
(d) The t distribution with $\text{df} = 14$

(5) One of the objectives of a study on law related education was to find out if the students who were exposed to case studies on law as well as the social studies book showed a similar gain with respect to "attitude toward law and authority" as those who were only exposed to the social studies book (the control group). Given the following data:
- Average gain for experimental = 2.25%
- Average gain for control = 0.75%
- $t = 2.24$, $P = 0.025$ (two tailed $P$)
- $N_{\text{control}} = 447$
- $N_{\text{experimental}} = 907$

What is the best answer?
(a) We should not reject the null, the data has neither practical and nor statistical significance
(b) We should reject the null, the data has both statistical and practical significance.
(c) We should reject the null, the data has statistical but not practical significance
(d) We should not reject the null, the data has practical but not statistical significance

(6) A researcher wants to examine the effectiveness of a weight loss program. 100 people volunteer to participate in the study and he randomly assigns 50 of them to the new program which consists of yoga and weight training and 50 to weight training only. He collects data on weight prior to program, weight after program, calories consumed per day and gender. What is the best analysis to run?
(a) Paired sample test of the mean comparing the before and after weight for the control and experimental group.
(b) Two sample test of the mean on the amount of weight loss for the control and experimental group.
(c) Two sample test of the mean on weight loss as a function of the number of calories consumed per day.
(d) One sample test of the mean on weight loss for the control and for the experimental group.

(7) At a university hospital they believe that a new drug is more effective than the one they have been using for a long time for lowering HDL (high density cholesterol). 100 people volunteer to participate in the study and they are randomly assigned to the experimental (new drug) and the control group (old drug). The following data show the mean and the standard deviation of drop in the cholesterol level of the patients in the experimental and the control groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Sample Size</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Group</td>
<td>50</td>
<td>14</td>
<td>3.0</td>
</tr>
<tr>
<td>Control Group</td>
<td>50</td>
<td>13</td>
<td>3.0</td>
</tr>
</tbody>
</table>

What is the best answer?
(a) The P value is approximately 0.0475, we reject the null, and conclude that the new drug is more effective than the old one.
(b) The P value is approximately 0.095, we fail to reject the null, and conclude that the new and the old drug are equally effective.
(c) The confidence interval for the difference between the sample means is going to include zero and we conclude that the two drugs are equally effective.
(d) Given the small sample size and the fact that the subjects were volunteers, statistical inferential techniques cannot be used to test the null hypothesis.

(8) Given that data on gender of lawyers (male vs. female), annual income (in 2007 and 2008) and type of practice (family vs. criminal law) was collected on a random sample of 400 lawyers, what statistical method will you use to answer the following questions?
   • Are males more likely to become lawyers?
   • Does the type of law practiced have any effect on salary increase of from 2007 to 2008?

   (a) I will use two sample test of the mean for both cases.
   (b) I will use two sample test of percentage for case one and two sample test of the mean for case two.
   (c) I will use two sample test of percentage for case one and paired sample test of the mean for case twice.
   (d) I would use one sample test of percentage (once for males and once for females) and one sample test of the mean (repeated twice by the type of law practice) for case two.

(9) 138 students were taught mathematics through cooperative learning. They were pre-tested and post-tested on their knowledge of fractions and the following data was reported:
   • $\bar{x}_{pre} = 39.6$
   • $\bar{x}_{post} = 59.41$
   • $r$ (correlation between pre and post data) = 0.46
   • 95% CI = 15.8, 23.72

   What is the best answer?

   (a) The one sample test of the mean was used to test the null that gain on fraction is zero and we are 95% confident that the students gained between 16% to 24% on their knowledge of fractions.
   (b) The statistical method used was the paired sample test of the mean. We need the p value to decide if the null was rejected.
   (c) The statistical method used was the paired sample test of the mean and the null was rejected.
   (d) The statistical method used to analyze the data was the two sample test of the mean and the null was not rejected.

(10) Why is it important to distinguish independent from dependent data?
   (a) Dependent data are correlated and this impacts the calculation of standard error as well as how the experiment is designed.
(b) With independent data we need to meet certain assumptions and with dependent data we do not.
(c) Mathematically speaking the paired sample test of the mean is similar to the one-sample test of the mean and the two-sample test is not.
(d) In the case of independent data the correlation is equal to zero and thus we can be sure that the standard error will be lower than it is for the dependent data.

(11) One of the objective a study that I evaluated was to find out whether there was any relationship between level of education (high school, four year college, and graduate work) and attitude toward pre-screening for breast cancer (i.e., going for mammograms).

<table>
<thead>
<tr>
<th>Sum of squares</th>
<th>df</th>
<th>Mean square</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between group</td>
<td>1815.068</td>
<td>2</td>
<td>907.534</td>
<td>?</td>
</tr>
<tr>
<td>Within group</td>
<td>51912.079</td>
<td>509</td>
<td>101.988</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>53727.147</td>
<td>511</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(a) Reject the null and conclude there is a relationship between level of education and seeking prescreening for breast cancer.
(b) Fail to reject the null and conclude that there is no relationship between level of education and attitude toward prescreening for breast cancer.
(c) Reject the null hypothesis and conclude that the higher the level of education the more positive the attitude toward seeking prescreening for breast cancer.
(d) Fail to reject the null and conclude that high school, four year college, and graduates have a similar attitude toward prescreening for breast cancer.

(12) Given the following information on attitude toward doing mammograms:

<table>
<thead>
<tr>
<th>Level of education</th>
<th>Sample size</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>High School</td>
<td>100</td>
<td>70</td>
</tr>
<tr>
<td>Four Year College</td>
<td>200</td>
<td>75</td>
</tr>
<tr>
<td>Graduate</td>
<td>200</td>
<td>80</td>
</tr>
</tbody>
</table>

Calculate mean square between

(a) $MS_{between} = 6900$
(b) $MS_{between} = 2300$
(c) $MS_{between} = 3500$
(d) $MS_{between} = 5750$

(13) The following data has been collected by a researcher on a random sample of 500 middle school students:

- Parental socio-economic status (upper middle class, middle class, lower middle class)
- Standardized scores on reading in 2009
- Standardized scores on reading in 2008
- Student gender

What statistical method would you recommend to answer the following questions:
• Question one: Is there any relationship between socio-economic status and gain in standardized reading scores from 2009 to 2010?
• Question two: For the upper middle class, was there a gain in reading scores from 2009 to 2010?
• Question three: Did girls show more gain in reading scores than boys?

(a) One-way anova for A, one-sample test of the mean for B, and one-way anova for C.
(b) Two sample test of the mean repeated three times for all three.
(c) One-way anova for A, paired sample test for B, and two-sample test for C.
(d) Independent sample test for A, dependent sample test for B, and one-sample test of the mean for C.

(14) Dr. Sullivan has a grant from the National Science Foundation to examine the effect of three methods for lowering the symptoms of schizophrenia among subjects in the 30-40 year age range. He randomly assigns 90 subjects who have volunteered to participate in the study to one of the three programs (medication only, medication plus living in a group home, medication, plus living in a group home, plus group counseling). What is the best way to state the null hypothesis for this study? Symptoms of schizophrenia are measured at baseline and after six months in the program. Both scores are in terms of percentages.

(a) $\bar{x}_1 = \bar{x}_2 = \bar{x}_3 = \bar{x}_{\text{grand}}$
(b) $\mu_1 = \mu_2 = \mu_3 = \mu_{\text{grand}}$
(c) $\alpha_1 = \alpha_2 = \alpha_3 = 0$
(d) $\alpha_1 = \alpha_2 = \alpha_3 = 0$

(15) The following output was generated as part of a statistical analysis for examining the relationship between level of education (high school, college, and graduate) and the knowledge of breast cancer (range 0-100).

Leven's test results:

<table>
<thead>
<tr>
<th>F value</th>
<th>df 1</th>
<th>df 2</th>
<th>Sig. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.866</td>
<td>2</td>
<td>432</td>
<td>0.421</td>
</tr>
</tbody>
</table>

What is the best way to interpret the table?

(a) We fail to reject the null that $\mu_1 = \mu_2 = \mu_3$ and there is no need to carry post-hoc methods like Tukey.
(b) Fail to reject the null hypothesis and conclude that there is no relationship between level of education and knowledge of breast cancer.
(c) We conclude that the assumption of equality of variance is tenable and $S_1^2 = S_2^2 = S_3^2$.
(d) We can conclude that the variance for the knowledge of breast cancer is not significantly different in the three populations from which the samples were drawn.

(16) In an analysis conducted on the relationship between the number of years lived in the US (1-5, 5-10, 10-25, and > 25 years) and knowledge of breast cancer the following data was reported:
\[ F = \frac{MSB}{MSW} = 5.453, \ P = 0.001 \]

Results obtained from Tukey post-hocs:

<table>
<thead>
<tr>
<th>Ethnic background compared</th>
<th>P value from Tukey test</th>
</tr>
</thead>
<tbody>
<tr>
<td>African American v. Arab</td>
<td>0.448</td>
</tr>
<tr>
<td>African American v. Persian</td>
<td>0.626</td>
</tr>
<tr>
<td>African American v. Southeast Asian</td>
<td>0.973</td>
</tr>
<tr>
<td>Arab v. Persian</td>
<td>0.001</td>
</tr>
<tr>
<td>Arab v. Southeast Asian</td>
<td>0.448</td>
</tr>
<tr>
<td>Persian v. Southeast Asian</td>
<td>0.535</td>
</tr>
</tbody>
</table>

What is the best way to interpret the above results?

(a) We fail to reject the null hypothesis and conclude that there is no statistically significant difference between the mean of the four ethnic backgrounds on the extent to which religious attitude prohibits prevention practices for breast cancer.
(b) Since five out of six post-hocs are insignificant, we fail to reject the null that there is no relationship between ethnic background and the extent to which religious practices effect prevention practices for breast cancer.
(c) The null hypothesis is rejected. The only groups that are different are Persians and Arabs. But, we do not know which group is more prohibited by religion because we do not have the means.
(d) We reject the null and conclude that there is a relationship between ethnic background and the extent to which religious attitude prohibits practice preventions for breast cancer.

(17) A researcher who has conducted one-way ANOVA, reports the following results. Calculate mean square within. What does it show?

<table>
<thead>
<tr>
<th>Group 1</th>
<th>( n_1 = 101 )</th>
<th>SD = 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 2</td>
<td>( n_1 = 201 )</td>
<td>SD = 11</td>
</tr>
<tr>
<td>Group 3</td>
<td>( n_1 = 101 )</td>
<td>SD = 12</td>
</tr>
</tbody>
</table>

(a) MSW = 11. It shows the standard deviation of variation within the three groups.
(b) MSW = 121.5. It shows the average deviation within the three groups.
(c) MSW = 1466.67. It shows the variation of the scores in the three groups around the grand mean
(d) MSW = 16200. It shows the sum of the square of deviations from the mean of each group.

(18) A researcher has collected on type of law practice (criminal, family, labor), gender, and annual income in dollars on a random sample of 500 lawyers. He wants to answer the following questions:
A. Is there any relationship between gender and type of law practice?
B. Is there a relationship between the type of law practice and annual income?

What statistical method should he use to answer questions A and B?
(a) Two separate one-way ANOVAs for case A (one for male and one for female) and multiple t-tests for case B.
(b) Contingency table for case A and plot of the means for case B.
(c) One-way ANOVA for case A and chi square for case B.
(d) Chi Square for case A and one-way ANOVA for case B.

(19) A researcher conducts one-way ANOVA to find out whether there is any relationship between major (engineering, mathematics, statistics, and computer science) and annual income upon graduation from college. He collects this data on a random sample of 400, (100 from each discipline). What does SS total show?
(a) Average annual income of each group minus the mean annual income for all subjects squared, added, and multiplied by 100.
(b) The variance for all the annual income of all the 400 subjects multiplied by 399
(c) Annual income of each subject minus the mean of income for his group squared and added.
(d) Annual income for each subject minus the average income for all 400 subjects squared and added.