### Quiz 12

**Question 1**

In a hypothesis test, if the computed P-value is greater than a specified level of significance, then we

- **a)** reject the null hypothesis.  
  \[ \text{If } P\text{-value } \leq a \Rightarrow \text{ } H_0 \text{ is rejected.} \]
- **b)** fail to reject the null hypothesis.  
  \[ \text{If } P\text{-value } > a \Rightarrow \text{ } F \text{ reject } H_0. \]
- **c)** retest with a different sample.

**Question 2**

A one-sided significance test gives a P-value of .05. From this we can

- **a)** Reject the null hypothesis with 94% confidence.  
  \[ C = 1 - a = 0.94 \Rightarrow a = 0.06 \Rightarrow P\text{-value} \leq a \]
- **b)** Say that the probability that the null hypothesis is true is .05.  
  \[ \text{Wrong} \]
- **c)** Reject the null hypothesis with 95% confidence.  
  \[ C = 0.95 \Rightarrow a = 0.05 = P\text{-value} \]
- **d)** Say that the probability that the null hypothesis is false is .05.  
  \[ \text{Wrong} \]

**Question 3**

It is believed that the average amount of money spent per U.S. household per week on food is about $98, with standard deviation $10. A random sample of 100 households in a certain affluent community yields a mean weekly food budget of $100. We want to test the hypothesis that the mean weekly food budget for all households in this community is higher than the national average. State the null and alternative hypotheses for this test.

- **a)** \( H_0: \mu = 98, \ H_a: \mu > 98 \)
- **b)** \( H_0: \mu = 98, \ H_a: \mu < 98 \)
- **c)** \( H_0: \mu = 100, \ H_a: \mu < 100 \)
- **d)** \( H_0: \mu = 100, \ H_a: \mu > 100 \)
- **e)** \( H_0: \mu = 98, \ H_a: \mu \neq 98 \)

**Question 4**

It is believed that the average amount of money spent per U.S. household per week on food is about $98, with standard deviation $10. A random sample of 100 households in a certain affluent community yields a
mean weekly food budget of $100. We want to test the hypothesis that the mean weekly food budget for all households in this community is higher than the national average. Are the results significant at the 5% level?

a) ○ No, we should fail to reject $H_0$.

b) ○ Yes, we should reject $H_0$.

**Question 5**

Based on information from a large insurance company, 66% of all damage liability claims are made by single people under the age of 25. A random sample of 52 claims showed that 42 were made by single people under the age of 25. Does this indicate that the insurance claims of single people under the age of 25 is higher than the national percent reported by the large insurance company? State the null and alternate hypothesis.

a) ○ $H_0: p = .81, H_a: p > .81$

b) ○ $H_0: p = .66, H_a: p < .66$

c) ○ $H_0: p = .66, H_a: p > .66$

b) ○ $H_0: p = .66, H_a: p < .81$

e) ○ $H_0: p = .66, H_a: p ≠ .66$

**Question 6**

Based on information from a large insurance company, 67% of all damage liability claims are made by single people under the age of 25. A random sample of 51 claims showed that 43 were made by single people under the age of 25. Does this indicate that the insurance claims of single people under the age of 25 is higher than the national percent reported by the large insurance company? Give the test statistic and your conclusion.

a) ○ $z = 2.130; reject H_0$ at the 5% significance level

b) ○ $z = -2.130; fail to reject $H_0$ at the 5% significance level

c) ○ $z = 2.630; fail to reject $H_0$ at the 5% significance level

d) ○ $z = 2.630; reject $H_0$ at the 5% significance level

**Question 7**

Let $x$ represent the hemoglobin count (HC) in grams per 100 milliliters of whole blood. The distribution for HC is approximately normal with $\mu = 14$ for healthy adult women. Suppose that a female patient has taken 12 laboratory blood samples in the last year. The HC data sent to her doctor is listed below. We would like to know if the data indicates this patient has significantly high HC compared to the population.

\[(19, 14, 23, 20, 15, 19, 21, 16, 18, 18, 16, 21)\]

State the null and alternate hypothesis.

\[H_0: \mu = 14 \quad H_a: \mu > 14\]
a) $H_0: \mu = 14, H_a: \mu > 14$

b) $H_0: \mu = 14, H_a: \mu < 14$

c) $H_0: \mu = 18.3, H_a: \mu < 18.3$

d) $H_0: \mu = 18.3, H_a: \mu > 18.3$

e) $H_0: \mu = 14, H_a: \mu \neq 14$

Question 8

Let $x$ represent the hemoglobin count (HC) in grams per 100 milliliters of whole blood. The distribution for HC is approximately normal with $\mu = 14$ for healthy adult women. Suppose that a female patient has taken 12 laboratory blood samples in the last year. The HC data sent to her doctor is listed below. We would like to know if the data indicates this patient has significantly high HC compared to the population.

(19, 14, 23, 20, 15, 19, 21, 16, 18, 18, 16, 21)

Give the p-value and interpret the results.

a) $p = .0762$; Based on 5% significance level, I will fail to reject the null hypothesis and conclude this patient does not have a high HC level.

b) $p = .1053$; Based on 5% significance level, I will fail to reject the null hypothesis and conclude this patient does not have a high HC level.

c) $p = .0001$; Based on 5% significance level, I will reject the null hypothesis and conclude this patient has a high HC level.

d) $p = .001$; Based on 5% significance level, I will reject the null hypothesis and conclude this patient has a high HC level.

e) $p = .0562$; Based on 5% significance level, I will fail to reject the null hypothesis and conclude this patient does not have a high HC level.

Question 9

An experimenter flips a coin 100 times and gets 44 heads. Test the claim that the coin is fair against the two-sided claim that it is not fair at the level $\alpha=.01$.

a) $H_0: p = .5, H_a: p \neq .5; z = -1.20$; Reject $H_0$ at the 1% significance level.

b) $H_0: p = .5, H_a: p \neq .5; z = -1.21$; Fail to reject $H_0$ at the 1% significance level.

c) $H_0: p = .5, H_a: p \neq .5; z = -1.20$; Fail to reject $H_0$ at the 1% significance level.

d) $H_0: p = .5, H_a: p < .5; z = -1.20$; Reject $H_0$ at the 1% significance level.

e) $H_0: p = .5, H_a: p < .5; z = -1.21$; Fail to reject $H_0$ at the 1% significance level.
> before=c(31,37,66,52,28)
> after=c(26,34,58,51,26)
> t.test(before,after,alternative = "greater",paired = T)

Paired t-test

data:  before and after

t = 3.0621, df = 4, p-value = 0.01879
alternative hypothesis: true difference in means is greater than 0

95 percent confidence interval:
  1.154448    Inf

sample estimates:
mean of the differences
  3.8
**Question 10**

In an experiment on relaxation techniques, subject's brain signals were measured before and after the relaxation exercises with the following results:

<table>
<thead>
<tr>
<th>Person</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before</strong></td>
<td>31</td>
<td>37</td>
<td>66</td>
<td>52</td>
<td>28</td>
</tr>
<tr>
<td><strong>After</strong></td>
<td>26</td>
<td>34</td>
<td>58</td>
<td>51</td>
<td>26</td>
</tr>
</tbody>
</table>

Assuming the population is normally distributed, is there sufficient evidence to suggest that the relaxation exercise slowed the brain waves? (Use α=0.05)

- a) Fail to reject the null hypothesis which states there is no change in brain waves.
- b) Reject the null hypothesis which states there is no change in brain waves in favor of the alternate which states the brain waves slowed after relaxation.
- c) There is not enough information to make a conclusion.

**Question 11**

An auditor for a hardware store chain wished to compare the efficiency of two different auditing techniques. To do this he selected a sample of nine store accounts and applied auditing techniques A and B to each of the nine accounts selected. The number of errors found in each of techniques A and B is listed in the table below:

<table>
<thead>
<tr>
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<th>Errors in B</th>
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<tbody>
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<td>25</td>
<td>11</td>
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<tr>
<td>28</td>
<td>17</td>
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<tr>
<td>26</td>
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<tr>
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</table>

Does the data provide sufficient evidence to conclude that the number of errors in auditing technique A is greater than the number of errors in auditing technique B at the 0.1 level of significance? Select the [Alternative Hypothesis, Value of the Test Statistic]. (Hint: the samples are dependent)

- a) [A > B, 1.976]
- b) [μ_D > 0, 1.976]
- c) [μ_D = 0, 1.976]
- d) [μ_D ≥ 0, 1.976]
e) $\mu_D > \mu_1, 1.976$

f) None of the above

**Question 12**

An auditor for a hardware store chain wished to compare the efficiency of two different auditing techniques. To do this he selected a sample of nine store accounts and applied auditing techniques A and B to each of the nine accounts selected. The number of errors found in each of techniques A and B is listed in the table below:

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<td>21</td>
</tr>
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</table>

Does the data provide sufficient evidence to conclude that the number of errors in auditing technique A is greater than the number of errors in auditing technique B at the 0.1 level of significance? Select the [Rejection Region, Decision of Reject (RH$_{0}$) or Failure to Reject (FRH$_{0}$)]. (Hint: the samples are dependent)

a) $[t < -1.4 \text{ or } -t < -1.4, \text{RH}_0]$  

b) $[t > 1.4, \text{RH}_0]$  

c) $[-t < 1.4 \text{ and } t < 1.4, \text{RH}_0]$  

d) $[z < -1.4 \text{ and } -z < -1.4, \text{FRH}_0]$  

e) $[t < -1.4, \text{FRH}_0]$  

f) None of the above

**Question 13**

Failing to reject a false null hypothesis is classified as a

a) Type II error

b) Power

c) Type I error
Question 1

In a hypothesis test, if the computed P-value is greater than a specified level of significance, then we

a) ☐ fail to reject the null hypothesis.  \( P\text{-value} > \alpha \)  FR \( H_0 \)

b) ☐ retest with a different sample.

c) ☐ reject the null hypothesis.

Question 2

In an experiment on relaxation techniques, subject's brain signals were measured before and after the relaxation exercises with the following results:

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<tr>
<td>2</td>
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<td>36</td>
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<tr>
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Assuming the population is normally distributed, is there sufficient evidence to suggest that the relaxation exercise slowed the brain waves? (Use \( \alpha = 0.05 \))

a) ☐ Reject the null hypothesis which states there is no change in brain waves in favor of the alternate which states the brain waves slowed after relaxation.

b) ☐ There is not enough information to make a conclusion.

c) ☐ Fail to reject the null hypothesis which states there is no change in brain waves.

Question 3

An experimenter flips a coin 100 times and gets 44 heads. Test the claim that the coin is fair against the two-sided claim that it is not fair at the level \( \alpha = .01 \).

a) ☐ \( H_0: p = .5, H_a: p < .5; z = -1.20 \); Reject \( H_0 \) at the 1% significance level.

b) ☐ \( H_0: p = .5, H_a: p \neq .5; z = -1.20 \); Fail to reject \( H_0 \) at the 1% significance level.

c) ☐ \( H_0: p = .5, H_a: p < .5; z = -1.21 \); Fail to reject \( H_0 \) at the 1% significance level.

d) ☐ \( H_0: p = .5, H_a: p \neq .5; z = -1.21 \); Fail to reject \( H_0 \) at the 1% significance level.

e) ☐ \( H_0: p = .5, H_a: p \neq .5; z = -1.20 \); Reject \( H_0 \) at the 1% significance level.

Question 4
Identify the most appropriate test to use for the following situation:
Quart cartons of milk should contain at least 32 ounces. A sample of 22 cartons was taken and amount of milk in ounces was recorded. We would like to determine if there is sufficient evidence exist to conclude the mean amount of milk in cartons is less than 32 ounces?

\[ H_0: \mu = 32 \quad H_A: \mu < 32 \]

1-sample \( n = 22 \) \( \sigma = \text{popSD} \) does not give use + test

- a) Two sample \( t \) test
- b) \( \square \) One sample \( t \) test
- c) \( \square \) Matched pairs
- d) \( \square \) Two sample \( z \) test

**Question 5**

To use the two sample \( t \) procedure to perform a significance test on the difference of two means, we assume:

- a) \( \square \) The populations' standard deviation are known.
- b) \( \square \) The samples from each population are independent.
- c) \( \square \) The distributions are exactly normal in each population.
- d) \( \square \) The sample sizes are large.

**Question 6**

Solid fats are more likely to raise blood cholesterol levels than liquid fats. Suppose a nutritionist analyzed the percentage of saturated fat for a sample of 6 brands of stick margarine (solid fat) and for a sample of 6 brands of liquid margarine and obtained the following results:

- **Stick** = [25.8, 25.5, 26.7, 25.6, 26.3, 26.7]
- **Liquid** = [17.1, 16.6, 17.3, 16.9, 16.9, 17.2]

We want to determine if there a significant difference in the average amount of saturated fat in solid and liquid fats. What is the test statistic? (assume the population data is normally distributed)

- a) \( z = 37.359 \)
- b) \( z = 36.859 \)
- c) \( t = 36.859 \)
- d) \( t = 37.359 \)
- e) \( t = 25.026 \)

**Question 7**

It has been observed that some persons who suffer renal failure, again suffer renal failure within one year of the first episode. This is due, in part, to damage from the first episode. The performance of a new drug designed to prevent a second episode is to be tested for its effectiveness in preventing a second episode. In order to do this two groups of people suffering a first episode are selected. There are 45 people in the first
group and this group will be administered the new drug. There are 75 people in the second group and this group will be administered a placebo. After one year, 12% of the first group has a second episode and 14% of the second group has a second episode. Conduct a hypothesis test to determine, at the significance level 0.1, whether there is reason to believe that the true percentage of those in the first group who suffer a second episode is less than the true percentage of those in the second group who suffer a second episode? Select the [Alternative Hypothesis, Value of the Test Statistic].

a) \[ p_1 < p_2 , -0.3129 \]

b) \[ p_1 > p_2 , -0.3129 \]

c) \[ p_1 \neq p_2 , -0.2129 \]

d) \[ p_1 \neq p_2 , -0.3129 \]

e) \[ p_1 = p_2 , -0.3129 \]

f) None of the above

**Question 8**

It has been observed that some persons who suffer acute heartburn, again suffer acute heartburn within one year of the first episode. This is due, in part, to damage from the first episode. The performance of a new drug designed to prevent a second episode is to be tested for its effectiveness in preventing a second episode. In order to do this two groups of people suffering a first episode are selected. There are 75 people in the first group and this group will be administered the new drug. There are 75 people in the second group and this group will be administered a placebo. After one year, 10% of the first group has a second episode and 9% of the second group has a second episode. Conduct a hypothesis test to determine, at the significance level 0.1, whether there is reason to believe that the true percentage of those in the first group who suffer a second episode is different from the true percentage of those in the second group who suffer a second episode? Select the [Rejection Region, Decision to Reject (RH\( _0 \)) or Failure to Reject (FRH\( _0 \))].

<table>
<thead>
<tr>
<th></th>
<th>[z &lt; -1.65 and z &gt; 1.65, FRH( _0 )]</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>[z &lt; -1.65 or z &gt; 1.65, FRH( _0 )]</td>
</tr>
<tr>
<td>c</td>
<td>[z &gt; 1.65, FRH( _0 )]</td>
</tr>
<tr>
<td>d</td>
<td>[z &lt; -1.65, RH( _0 )]</td>
</tr>
<tr>
<td>e</td>
<td>[z &gt; -1.65 and z &lt; 1.65, RH( _0 )]</td>
</tr>
<tr>
<td>f</td>
<td>None of the above</td>
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**Question 9**

A private and a public university are located in the same city. For the private university, 1047 alumni were surveyed and 651 said that they attended at least one class reunion. For the public university, 793 out of 1317 sampled alumni claimed they have attended at least one class reunion. Is the difference in the sample proportions statistically significant? (Use \( \alpha=0.05 \))
Private: \( n_1 = 1047 \quad x_1 = 651 \quad \hat{p}_1 = \frac{651}{1047} = 0.6218 \)

Public: \( n_2 = 1317 \quad x_2 = 793 \quad \hat{p}_2 = 0.6021 \)

Two-Sample Z-test for proportions

\( H_0: p_1 = p_2 \quad H_A: p_1 \neq p_2 \)

\[
Z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}_1(1-\hat{p}_1) + \hat{p}_2(1-\hat{p}_2)}} = \frac{(0.6218 - 0.6021)}{\sqrt{\frac{0.6218(1-0.6218)}{1047} + \frac{0.6021(1-0.6021)}{1317}}} = 0.9757
\]

\( P-value = P( Z < -0.9757 \text{ or } Z > 0.9757 ) = 2 \times \text{pnorm}(-0.9757) = 0.369 > 0.05 \quad \text{F reject } H_0
\]

\[
> \text{prop.test(x=c(651,793), n=c(1047,1317))}
\]

2-sample test for equality of proportions with continuity correction

data: c(651, 793) out of c(1047, 1317)
X-squared = 0.86662, df = 1, p-value = 0.3519
alternative hypothesis: two.sided
95 percent confidence interval:
-0.02072419 0.06002511
sample estimates:
prop 1  prop 2
0.6217765 0.6021260
a) Reject the null hypothesis which states there is no difference in the proportion of alumni that attended at least one class reunion in favor of the alternate which states there is a difference in the proportions.

b) Fail to reject the null hypothesis. There is not enough evidence to conclude that there is a difference in the proportions.

c) There is not enough information to make a conclusion.

Question 10

Mars Inc. claims that they produce M&Ms with the following distributions:

<table>
<thead>
<tr>
<th></th>
<th>Brown</th>
<th>Red</th>
<th>Yellow</th>
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<tbody>
<tr>
<td>Brown</td>
<td>30%</td>
<td>20%</td>
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</tr>
<tr>
<td>Orange</td>
<td>10%</td>
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A bag of M&Ms was randomly selected from the grocery store shelf, and the color counts were:

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<tr>
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<td>22</td>
<td>24</td>
<td>19</td>
<td>14</td>
</tr>
<tr>
<td>Orange</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>15</td>
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</tbody>
</table>

Using the $\chi^2$ goodness of fit test to determine if the proportion of M&Ms is what is claimed, what is the test statistic?

a) $\chi^2 = 8.049$

b) $\chi^2 = 16.098$

c) $\chi^2 = 1.960$

d) $\chi^2 = 7.249$

e) $\chi^2 = 11.749$

f) None of the above

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<td>16</td>
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</table>
Using the $\chi^2$ goodness of fit test ($\alpha = 0.10$) to determine if the proportion of M&Ms is what is claimed. Select the [p-value, Decision to Reject (RH$_0$) or Failure to Reject (FRH$_0$)].

<table>
<thead>
<tr>
<th></th>
<th>p-value</th>
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<tbody>
<tr>
<td>a)</td>
<td>0.133</td>
<td>FRH$_0$</td>
</tr>
<tr>
<td>b)</td>
<td>0.867</td>
<td>FRH$_0$</td>
</tr>
<tr>
<td>c)</td>
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<td>RH$_0$</td>
</tr>
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<td>0.867</td>
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</tr>
<tr>
<td>e)</td>
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