Please circle your instructor’s name:

Nasir Abbas               Mohammad Saleh

Name:_____________________________ ID#:________________

Section#:____ Class Time: __________ Serial#:________________

Instructions:

1. Formula sheet will be provided to you in exam. You are not allowed to bring with you, any formula sheet or other printed/written paper.

2. Mobiles are not allowed in exam. If you have your mobile with you, turn it off and keep it under your seat so that it is visible to proctor.

3. Show all your work. **No points for answer without justification.**

4. Round up to 4 decimal points if needed.

5. Make sure you have 8 unique pages of exam paper (including this title page).

<table>
<thead>
<tr>
<th>Question No</th>
<th>Full Marks</th>
<th>Marks Obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>06</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>57</strong></td>
<td></td>
</tr>
</tbody>
</table>
Q.No.1: (10 points) A sample of 314 KFUPM students was asked if they have ever taken an online course. Their majors were also recorded as if they were business or non-business students. Out of 106 business students in the sample, 63 students never took any online course. Moreover, there were 113 non-business students who never took any online course. Determine if there is a relationship between major and whether or not someone has taken an online course.

H₀: ________________________________________________________________________

H₁: ________________________________________________________________________

Test Statistic:

Decision Rule and Critical Value:

Decision:

Conclusion:
Q.No.2: - (8+7 = 15 points) A manufacturer launches a new car to achieve better highway fuel efficiency. A sample of 28 cars of this brand resulted in the following mileage per gallon (MPG):

<table>
<thead>
<tr>
<th>30.6</th>
<th>29.5</th>
<th>31.7</th>
<th>26.1</th>
<th>31.6</th>
<th>29.1</th>
<th>29.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.9</td>
<td>29.1</td>
<td>29.4</td>
<td>28.8</td>
<td>30.2</td>
<td>29.7</td>
<td>30.1</td>
</tr>
<tr>
<td>27.4</td>
<td>30.2</td>
<td>29.8</td>
<td>28.7</td>
<td>29.2</td>
<td>28.5</td>
<td>29.1</td>
</tr>
<tr>
<td>32.4</td>
<td>29.9</td>
<td>28.9</td>
<td>28.9</td>
<td>26.3</td>
<td>28.5</td>
<td>29.6</td>
</tr>
</tbody>
</table>

\[ \sum X = 821.7, \quad \sum X^2 = 24164.81 \]

Use the above information to solve (a) and (b).

(a) A consumer interest group would like to test whether there is any statistical evidence of MPG being less than 30. What conclusions can be drawn from the sample results? Test at 0.01 level of significance and use \( p \)-value approach.

\[ H_0: \quad \text{ } \quad H_1: \quad \text{ } \]

Assumptions:

Test Statistic:

\[ p\text{-value}: \]

Decision Rule & Decision:

Conclusion:
(b) The consumer interest group also claims that the percentage of cars having mileage more than 30 MPG is less than 42%. What conclusions can be drawn from the sample results? Test at 0.05 level of significance and use critical value approach.

H<sub>0</sub>: ___________________________  \hspace{1cm} H<sub>1</sub>: ___________________________

Test Statistic:

Decision Rule & Critical Value:

Decision & Conclusion:

Q.No.3: - (6 points) A cigarette manufacturer wishes to test the claim that the variance of nicotine content of its cigarettes is less than 0.0644. Nicotine content is measured in milligrams and is assumed normally distributed. A sample of 20 cigarettes has a mean of 1.00 milligram with a standard deviation 0.17. At 0.05 level of significance, is there enough evidence to reject the manufacturer’s claim?

H<sub>0</sub>: ___________________________  \hspace{1cm} H<sub>1</sub>: ___________________________

Test Statistic:

Decision Rule and Critical value:

Decision and Conclusion:
Q. No. 4: - (10 points) A manufacturer of stereo amplifiers has three assembly lines. We want to test that the three lines do not differ with respect to the number of defectives produced. Independent samples of size 30 amplifiers each are selected from the output of the lines and number of defectives is 6, 5 and 9 respectively. Do you think that the defective proportions are significantly different?

**H₀:** ___________________________________________________________

**H₁:** __________________________________________________________

Test Statistic:

Decision Rule and Critical value:

Decision and Conclusion:
Q.No.5: A transport company wants to compare the fuel efficiencies of the two types of lorry it operates. It obtains data from samples of the two types of lorry, with the following results:

<table>
<thead>
<tr>
<th>Type</th>
<th>Average mpg</th>
<th>Stddev</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>30.1</td>
<td>9.2</td>
<td>13</td>
</tr>
<tr>
<td>B</td>
<td>33.2</td>
<td>5.8</td>
<td>17</td>
</tr>
</tbody>
</table>

Use the above information to solve (a) and (b).

(a) Do you think that the variation in mpg of two types are equal? Test at 0.05 level of significance.

\[ H_0: \text{______________________________} \quad H_1: \text{______________________________} \]

Test Statistic:

Decision Rule:

Critical Value:

Decision:

Conclusion:
(b) Test the hypothesis that lorries of type B are more efficient than type A. Use critical value approach and assume equal variation in mpg of two types.

\[ H_0: \quad \text{____________________________} \quad \quad \quad H_1: \quad \text{____________________________} \]

Test Statistic:

Decision Rule:

Critical Value:

Decision:

Conclusion: