King Fahd University of Petroleum & Minerals
Mathematics & Statistics Department

STAT 319: Probability & Statistics for Engineers & Scientists

Term 152
Third Major Exam
Wednesday 27/04/2016
6:45 – 8:00 PM

Please circle your instructor name:

Al-Momani   Al-Sawi   Riaz   Saleh   Samuh

Std. Name:   Std. ID:   Serial No.:   

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Full Mark</th>
<th>Marks Obtained</th>
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<tr>
<td>1.</td>
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Q1]...[13 points] A researcher engineer for a tire manufacturer is investigating tire life for a new rubber compound and has built 16 tires and tested them to the end-of-life in a road test. The sample mean and standard deviation are 57389.6 and 3645.94 km.

1. (6 points) Find and interpret a 95% confidence interval on the mean tire life.

2. (2 points) Someone says that the mean life tire is 60000 km, depend on your answer in part (1) above, do these data contradict this claim? Explain.

3. (5 points) How large must $n$ be if the length of the 99% confidence interval of the mean tire life is to be 2000 km?
The proportion of households in the KSA who prefer shopping in HyperPanda is being studied. From a sample of 100 households, 70 prefer to shop from HyperPanda store.

1. (6 points) Using the critical value approach, can you conclude that at least 75% of the households prefer shopping form HyperPanda? Use $\alpha = 0.05$.

2. (4 points) Construct a 97% two-sided confidence interval on the proportion of households in the KSA who prefer shopping in HyperPanda.

3. (5 points) How large must $n$ be if you want to be 98% confident that the error in estimating the population proportion is at most 0.01, assuming no prior information is available?
Q3]...[14 points] An experiment was performed to compare the abrasive wear of two different laminated materials. Twelve pieces of material 1 were tested by exposing each piece to a machine measuring wear. Ten pieces of material 2 were similarly tested. In each case, the depth of wear was observed. The samples of material 1 gave an average wear of 85 units with a standard deviation of 4, while the samples of material 2 gave an average of 81 and a standard deviation of 5. Assume the populations to be approximately normal with equal variances.

1. (8 points) Can you conclude at the 0.10 level of significance that the abrasive wear of material 1 exceeds that of material 2 by more than 2 units? Use the $p-$value approach.

2. (4 points) Construct a 95% confidence interval on the difference in mean of abrasive wear for the two laminated materials.

3. (2 points) Does your findings in part (2) agree with your findings in part (1)? Why? Why not?
Q4]...[8 points] A computer scientist is investigating the usefulness of two different design languages in improving programming tasks. Twelve expert programmers familiar with both languages are asked to code a standard function in both languages and the time in minutes is recorded. The data follow.

<table>
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<tr>
<th>Programmer</th>
<th>Design Language 1</th>
<th>Design Language 2</th>
<th>Difference</th>
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<td>1</td>
<td>17</td>
<td>18</td>
<td>-1</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
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1. (6 points) Perform an appropriate test of hypothesis to determine whether the average time for coding is greater for Design Language 1 than for Design Language 2. Use $\alpha = 0.05$.

2. (2 points) In part (1) above, do you need any assumptions? If yes, what? If no, why?
Q5]...[10 points] The heat evolved in calories per gram of a cement mixture is approximately normally distributed. The mean is thought to be 100, and the standard deviation is 3. You wish to test $H_0 : \mu = 100$ versus $H_1 : \mu \neq 100$ with a sample of 9 specimens. Suppose the acceptance region is $98.5 \leq X \leq 101.5$.

1. (4 points) Find the type I error probability $\alpha$.

2. (4 points) Find the type II error probability $\beta$ for the case in which the true mean heat evolved is specified to be 103.

3. (2 points) Suppose you wanted to find $\beta$ for the case in which the true mean heat evolved is specified to be 105. Without calculating, would this value of $\beta$ be larger or smaller than the one found in part (2)? Why?