[*Show your work!*]

1. [**Use R**] The cost of auto insurance varies by coverage, location, and the driving record of the driver. The goal of the experiment described here is to compare the average annual insurance cost for five insurance companies (*A*, *B*, *C*, *D*, *E*). Four cities of different sizes were selected. The following are estimates of the annual cost for standard coverage for five young male drivers residing in each of the four cities (20 males in total), with no accidents or violations, driving new 2021 Toyota Highlanders:

 **Insurance company**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **City** | *A* | *B* | *C* | *D* | *E* |
| *Pella* | 1572 | 1108 | 1507 | 767 | 1460 |
| *Waterloo* | 1492 | 1300 | 1646 | 931 | 1568 |
| *Des Moines* | 1447 | 1156 | 1844 | 1063 | 1914 |
| *Sheldon* | 1393 | 1110 | 1449 | 727 | 1686 |

1. What design was used in this experiment? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Construct the ANOVA table for this experiment. Copy/paste (or write) it here:
3. At a 5% significance level, do we have enough evidence to conclude that there is a difference in mean annual cost between the different insurance companies? YES NO Write down the *p*-value used to answer this question \_\_\_\_\_\_\_
4. Use Tukey’s method to conduct pairwise comparisons of mean costs for these insurance companies. Copy/paste the output below. Which companies have the same mean annual cost of insurance? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. An experiment was conducted to determine if there is a difference in mean rating between four smartphone suppliers (labeled 1-4). Four smartphones were ordered from each supplier and each smartphone was rated on the scale 0-100. The following ANOVA table was obtained:

 Df Sum Sq Mean Sq F value

supplier 3 246.1 82.05 5.831

Residuals 12 168.8 14.07

1. What are the treatments in this experiment? \_\_\_\_\_\_\_\_\_\_
2. At a significance level of 0.05, write down the rejection region of the test that compares the treatment means \_\_\_\_\_\_\_\_\_\_\_\_. Is there enough evidence to conclude that there is a difference in mean rating between these suppliers? YES NO
3. The (sample) mean rating of each supplier is listed below:

Supplier 1 2 3 4

67.850 67.525 62.650 58.300

Use Fisher’s LSD method to perform pairwise comparisons of mean ratings between suppliers. The LSD value is \_\_\_\_\_\_\_\_\_

1. The following ANOVA table was obtained for an RCBD, where the treatments are several bonding agents:

 Df Sum Sq Mean Sq F value Pr(>F)

agent 3 24.52 8.17 0.510 0.6855

batch 3 246.14 82.05 5.116 0.0245 \*

Residuals 9 144.33 16.04

1. How many bonding agents were used in this experiment? \_\_\_\_\_\_\_
2. If the batches have random effects and the treatments have fixed effects, what percent of the total variability of the response variable is due to the different batches? \_\_\_\_\_\_\_