**Business Applications Problem Set Three**

This is the third of three business applications problem sets that you will complete for Math 222. To complete the assignment, first save this Word document on your computer. Then complete each of the problems or questions by answering the problem or question in the Word document you saved. Where appropriate, you must show your work to get credit for the problem and you must clearly indicate your answer. In some cases, showing your work can be done by pasting appropriate Excel or PHStat output into the Word file. Don’t just paste the Excel or PHStat output into the document—also clearly indicate your answer. When you complete the assignment, save it, and then turn it in using the Blackboard Assignment Tool. If you have questions, please ask your instructor.

Excel files needed for these problems can be found on the CD that came with your text.

1. Data File **ERWAITING** contains the waiting times in minutes for 15 randomly selected patients at a hospital main emergency room facility and at three satellite facilities.
2. At the .05 level of significance, is there evidence that the mean waiting time at the main facility is more than one hour?

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| Complete the following: |
| 1. State H0.  |  |
| 2. State H1.  |  |
| 3. State the value of α.  |  |
| 4. State the value of the test statistic.  |  |
| 5. State the p-value.  |  |
| 6. State the decision in terms of H0 and why. |  |
| 7. State the decision in terms of the problem. |  |

1. Suppose you use a .01 level of significance instead of a .05 level. Without doing the problem again, would the result be different from that in part (a)? Explain your answer.
2. A *Wall Street Journal* article suggests that age bias is becoming an even bigger problem in the corporate world. In 2001, an estimated 78% of executives believed that age bias was a serious problem. In a 2004 study by ExecuNet, 82% of the executives surveyed considered age bias a serious problem. The sample size for the 2004 study was not disclosed. Suppose 50 executives were surveyed.

 Hypothesis Test Output for n = 50:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Observed* | *Hypothesized* |  |  |  |
| 0.82 | 0.78 |  p (as decimal) |  |
|  41/50 |  39/50 |  p (as fraction) |  |
| 41. | 39. |  X |  |  |
| 50 | 50 |  n |  |  |
|  |  |  |  |  |
|  | 0.0586 |  std. error |  |  |
|  | 0.68 |  z |  |  |
|  | .2474 |  p-value (one-tailed, upper) |

Hypothesis Test Output for n = 1000:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Observed* | *Hypothesized* |  |  |  |
| 0.82 | 0.78 |  p (as decimal) |  |
|  820/1000 |  780/1000 |  p (as fraction) |  |
| 820. | 780. |  X |  |  |
| 1000 | 1000 |  n |  |  |
|  |  |  |  |  |
|  | 0.0131 |  std. error |  |  |
|  | 3.05 |  z |  |  |
|  | .0011 |  p-value (one-tailed, upper) |

1. At the .05 level of significance, is there evidence that the proportion of executives who believed age bias was a serious problem increased between 2001 and 2004, that is, is there evidence that the proportion of executives who believed age bias to be a serious problem in 2004 is greater than 78%?

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| Complete the following: |
| 1. State H0.  | p≤0.78 |
| 2. State H1.  | p>0.78 |
| 3. State the value of α.  | 0.05 |
| 4. State the value of the test statistic.  | 0.6828 |
| 5. State the p-value.  | 0.2474 |
| 6. State the decision in terms of H0 and why. | Fail to reject H0 since 0.2474>0.05 |
| 7. State the decision in terms of the problem. | There is no sufficient evidence that the problem is now greater than 78% |

1. Explain the meaning of the p-value in this problem. It is the probability of concluding that the proportion is now greater than 78%, while in fact it is not
2. Suppose the sample size used was 1000. Does that change the conclusion you reached in part (a)? How? Yes, in this case, we get the p-value as 0.0011 (<0.05). So we reject H0 and accept H1 and conclude that the proportion is greater than 78%.
3. Discuss the effect that sample size had on the outcome of this analysis and, in general, on the effect sample size plays in hypothesis-testing. As the sample size increased, the probability of rejecting the true null hypothesis decreased. In general, increasing the sample size makes the findings more reliable.
4. The data file **RESTAURANTS** contains the ratings for food, décor, service, and price per person for a sample of 50 restaurants located in an urban area and 50 restaurants located in a suburban area. At the .05 level of significance, is there evidence of a difference in the mean food rating between urban and suburban restaurants?

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| Complete the following: |
| 1. State H0.  |  |
| 2. State H1.  |  |
| 3. State the value of α.  |  |
| 4. State the value of the test statistic.  |  |
| 5. State the p-value.  |  |
| 6. State the decision in terms of H0 and why. |  |
| 7. State the decision in terms of the problem. |  |

1. A newspaper article discussed the opening of a Whole Foods Market in the Time-Warner building in New York City. The data in file **WHOLEFOODS1** compares the prices of some kitchen staples at the Whole Foods Market and at the Fairway Market located about 15 blocks from the Time-Warner building.
2. At the .01 level of significance, is there evidence that the mean price is higher at Whole Foods Market than at the Fairway supermarket?

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| Complete the following: |
| 1. State H0.  |  |
| 2. State H1.  |  |
| 3. State the value of α.  |  |
| 4. State the value of the test statistic.  |  |
| 5. State the p-value.  |  |
| 6. State the decision in terms of H0 and why. |  |
| 7. State the decision in terms of the problem. |  |

1. What assumption is necessary about the population distribution in order to perform the test in (a)?
2. Construct a 99% confidence interval estimate of the difference in price between Whole Foods and Fairway. Do the results of the confidence interval and the hypothesis test agree? Explain.
3. As more Americans use cell phones, they question where it is okay to talk on cell phones. The following is a table of results, in percentages, for 2000 and 2006. Suppose the survey was based on 100 respondents in 2000 and 100 respondents in 2006.

|  |  |
| --- | --- |
|  | Year |
| OKAY TO TALK ON A CELL PHONE IN A | 2000 | 2006 |
| Bathroom | 39 | 38 |
| Movie/theater | 11 | 2 |
| Car | 76 | 63 |
| Supermarket | 60 | 66 |
| Public transit | 52 | 45 |
| Restaurant | 31 | 21 |

1. At the .05 level of significance, if there evidence that the proportion of Americans who thought it was okay to use a cell phone in a car in 2000 is significantly greater than the proportion of Americans who thought it was okay to use a cell phone in a car in 2006?

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| Complete the following: |
| 1. State H0.  |  |
| 2. State H1.  |  |
| 3. State the value of α.  |  |
| 4. State the value of the test statistic.  |  |
| 5. State the p-value.  |  |
| 6. State the decision in terms of H0 and why. |  |
| 7. State the decision in terms of the problem. |  |

1. Construct a 95% confidence interval estimate of the difference between the proportion of Americans who thought it was okay to use a cell phone in a car in 2000 and the proportion of Americans who thought it was okay to use a cell phone in a car in 2006. Do the results of the hypothesis test and confidence interval agree? Explain.
2. Nine experts rated four brands of Colombian coffee in a taste-testing experiment. A rating on a 7-point scale (1 = extremely unpleasing, 7 = extremely pleasing) is given for each of the four characteristics: taste, aroma, richness, and acidity. The data in file **COFFEE** give the ratings for four brands of coffee.
3. At the .05 level of significance, is there evidence of a difference in the mean ratings for the four brands of coffee?

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| Complete the following: |
| 1. State H0.  |  |
| 2. State H1.  |  |
| 3. State the value of α.  |  |
| 4. State the value of the test statistic.  |  |
| 5. State the p-value.  |  |
| 6. State the decision in terms of H0 and why. |  |
| 7. State the decision in terms of the problem. |  |

1. If appropriate, determine which brands differ.
2. One assumption of ANOVA is that the variances of the populations are equal. At the .05 level of significance, is there evidence of a difference in the variation in the ratings of the four brands of coffee?

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| Complete the following: |
| 1. State H0.  |  |
| 2. State H1.  |  |
| 3. State the value of α.  |  |
| 4. State the value of the test statistic.  |  |
| 5. State the p-value.  |  |
| 6. State the decision in terms of H0 and why. |  |
| 7. State the decision in terms of the problem. |  |

1. The health-care industry and consumer advocates are at odds over the sharing of a patient’s medical records without the patient’s consent. The health-care industry believes that no consent should be necessary to openly share data among doctors, hospitals, pharmacies, and insurance companies. Suppose a study is conducted in which 600 patients are randomly assigned, 200 each, to three “organizational groupings”—insurance companies, pharmacies, and medical researchers. Each patient is given material to read about the advantages and disadvantages concerning the sharing of medical records within the assigned “organizational grouping.” Each patient is then asked, “would you object to the sharing of your medical records with…” and the results are recorded in the cross-classification table below.

|  |  |
| --- | --- |
|  | Organizational Grouping |
| OBJECT TO SHARING INFORMATION | Insurance | Pharmacy | Research |
| Yes | 40 | 80 | 90 |
| No | 160 | 120 | 110 |

* 1. Is there evidence of a difference in the proportions who object to sharing information among the organizational groupings? (Use α = .05.)

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| Complete the following: |
| 1. State H0.  |  |
| 2. State H1.  |  |
| 3. State the value of α.  |  |
| 4. State the value of the test statistic.  |  |
| 5. State the p-value.  |  |
| 6. State the decision in terms of H0 and why. |  |
| 7. State the decision in terms of the problem. |  |

* 1. If appropriate, us the Marascuilo procedure and α = .05 to determine which groups are different.
1. *USA Today* reported on preferred types of office communication by different age groups. Suppose the results were based on a survey of 500 respondents in each age group. The results are cross-classified in the following table:

|  |  |  |
| --- | --- | --- |
|  | Type of Communication Preferred |  |
| AGE GROUP | GroupMeetings | Face-to-FaceMeetings withIndividuals | E-mails | Other | Total |
| Generation X | 180 | 260 | 50 | 10 | 500 |
| Generation Y | 210 | 190 | 65 | 35 | 500 |
| Boomer | 205 | 195 | 65 | 35 | 500 |
| Mature | 200 | 195 | 50 | 55 | 500 |
| Total | 795 | 840 | 230 | 135 | 2000 |

At the .05 level of significance, is there evidence of a relationship between age group and type of communication preferred?

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| Complete the following: |
| 1. State H0.  | Type of communication is independent of the age group |
| 2. State H1.  | Type of communication is dependent on the age group |
| 3. State the value of α.  | 0.05 |
| 4. State the value of the test statistic.  | 52.66 |
| 5. State the p-value.  | 0 |
| 6. State the decision in terms of H0 and why. | Reject H0 since the p- value < α  |
| 7. State the decision in terms of the problem. | Type of communication is dependent on the age group |