**Quantitative Methods**

**List of Exercises N. 6**

**Selected Exercises from McClave (2014) – Chapters 8**

**8.2 Comparing Two Population Means: Independent Sampling**

1. (22, SMILE). ***Service without a Smile***. “Service with a smile” is a slogan that many businesses adhere to. However, there are some jobs (e.g., those of judges, law enforcement officers, pollsters) that require neutrality when dealing with the public. An organization will typically provide “display rules” to guide employees on what emotions they should use when interacting with the public. A *Journal of Applied Psychology* (Vol. 96, 2011) study compared the results of surveys conducted using two different types of display rules: positive (requiring a strong display of positive emotions) and neutral (maintaining neutral emotions at all times). In this designed experiment, 145 undergraduate students were randomly assigned to either a positive display rule condition (n1 = 78) or a neutral display rule condition (n2 = 67). Each participant was trained on how to conduct the survey using the display rules. As a manipulation check, the researchers asked each participant to rate, on a scale of 1 = “strongly agree” to 5 “strongly disagree” the statement: “This task requires me to be neutral in my expressions.”
2. If the manipulation of the participants was successful, which group should have the larger mean response? Explain.
3. The data for the study (simulated based on information provided in the journal article) are listed in the table below. Access the data and run an analysis to determine if the manipulation was successful. Conduct a test of hypothesis using α = 0.05.
4. What assumptions, if any, are required for the inference from the test to be valid?

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Positive Display Rule | | | | | | | | | | | | | | | | | | | |
| 2 | 4 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 |
| 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 |
| 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |  |  |
| Neutral Display Rule | | | | | | | | | | | | | | | | | | | |
| 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 |  |
| 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |  |
| 3 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |  |
| 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  |  |  |  |

1. (24, GASTRB). ***Cooling method for gas turbines***. The *Journal of Engineering for Gas Turbines and Power* (Jan. 2005) dis a study of gas turbines augmented with high-pressure inlet fogging. The researchers cklassified gas turbines into 3 categories: traditional, advanced, and aeroderivative. Summary statistics on heat rate (kilojoules per kilowatt per hour) for each of the 3 types of gas turbines are shown in the table below.
2. Is there sufficient evidence of a difference between the mean heat rates of traditional augmented gas for turbines and aeroderivative augmented gas turbines? Test using an α = 0.05.
3. Is there sufficient evidence of a difference between the mean heat rates of advanced augmented gas turbines and aeroderivative augmented gas turbines? Test using an α = 0.05.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable | Engine | N | Mean | St Dev | Minimum | Maximum |
| Heatrate | Advanced | 21 | 9764 | 639 | 9105 | 11588 |
|  | Aeroderiv | 7 | 12312 | 2652 | 8714 | 16243 |
|  | Traditional | 39 | 11544 | 1279 | 10086 | 14796 |

**8.3 Comparing Two Population means: Paired Difference sampling**

3. (37, NAPS). ***Taking ”power naps” during work breaks***. Lack of sleep costs companies about 18 billion dollars a year in lost productivity according to the National Sleep Foundation. Companies are waking up to the problem, however. Some even have quiet rooms available for study or sleep. “Power naps” are in vogue (*Athens Daily News*, Jan. 9, 2000). A major airline recently began encouraging reservation agents to nap during their breaks. The accompanying table lists the number of complaints received about each of a sample of 10 reservation agents during the 6 months before naps were encouraged and during the 6 months after the policy change.

1. Do the data present sufficient evidence to conclude that the new napping policy reduced the mean number of customers complaints about reservations agents? Test using α = 0.05.
2. What assumptions must hold to ensure the validity of the test?
3. What variables, not controlled in the study, could lead to an invalid conclusion?

|  |  |  |
| --- | --- | --- |
| Operator | Before Policy | After Policy |
| 1 | 10 | 5 |
| 2 | 3 | 0 |
| 3 | 16 | 7 |
| 4 | 11 | 4 |
| 5 | 8 | 6 |
| 6 | 2 | 4 |
| 7 | 1 | 2 |
| 8 | 14 | 3 |
| 9 | 5 | 5 |
| 10 | 6 | 1 |

4. (39, CIRCUT). ***Testing electronic circuits***. Japanese researchers have developed a compression/ depression method of testing electronic circuits based on Huffman coding (*IEICE Transactions of Information & System*, Jan. 2005). The new method is designed to reduce the time required for input decompression and output compression – called the *compression ratio*. Experimental results were obtained by testing a sample of 11 benchmark circuits (all of different sizes) from a SUN Blade 1000 workstation. Each circuit was tested using the standard compression/ depression method and the new Huffman-based coding method, and the compression ratio was recorded. The data are given in the table below. Compare the two methods with a 95% confidence interval. Which method has the smaller mean compression rate?

|  |  |  |
| --- | --- | --- |
| Circuit | Standard Method | Huffman-coding Method |
| 1 | .80 | .78 |
| 2 | .80 | .80 |
| 3 | .83 | .86 |
| 4 | .53 | .53 |
| 5 | .50 | .51 |
| 6 | .96 | .68 |
| 7 | .99 | .82 |
| 8 | .98 | .72 |
| 9 | .81 | .45 |
| 10 | .95 | .79 |
| 11 | .99 | .77 |

**8.4 Comparing two population proportions: Independent sampling**

5. (58. SWDEF). Refer to the PROMISE Software Engeneering Repository data on 498 modules of software code written in “C” language for a NASA spacecraft instrument, saved in the file. The software code in each module was evaluated for defects; 49 were classified as “true2 (i.e. module has defective code), and 449 were classified as “false” (i.e. module has correct code). Consider these to be independent random samples of software code modules. Researchers predict the defecte status of each module using the simple algorithm, “If number of lines of code in the module exceeds 50, predict the module to have a defect”. The accompanying SPSS print out shows the number of modules in each of the two samples that were predicted to have defects (PED\_LOC = ”yes”) and predicted to have no defects (PRED\_LOC = “no”). Now, define the *accuracy rate* of the algorithm as the proportion of modules that were correctly predicted. Compare the accuracy rate of the algorithm when applied to modules with defective code to the accuracy rate of the algorithm when applied to modules with correct code. Use 99% confidence interval.

DEFECT \* PRED\_LOC Crosstabulation

Count

|  |  |  |  |
| --- | --- | --- | --- |
|  | PRED\_LOC | | Total |
| no | yes |
| DEFECT false  true  Total | 400  29  429 | 49  20  69 | 449  49  498 |

**8.5 Determining the required sample size**

6. ***Users of home shopping services***. All cable companies carry at least one home shopping channel. Who uses these home shopping services? Are the shoppers primarily men or women? Suppose you want to estimate the difference in the proportions of men and women the difference in the proportions of men and women who say they have used or expect to use televised home shopping using an 80% confidence interval of width .06 or less.

a) Approcimatelly how many people should be included in your samples?

b) Suppose you want to obtain individual estimates for the two proportions of interest. Will the sample size found in part **a** be large enough to provide estimates of each proportion correct to within .02 with probability equal to .90? Justify your response.

**8.6 Comparing two population variances: Independent sampling**

7. (88, HCOUGH). ***Is honey a cough remedy?*** Refer to the Archives of pediatrics and adolescent medicine (Dec. 2007) study of honey as a children cough remedy. Exercise 23. The data (cough improvement scores) for the 33 children in the DM dosage group and the 35 children in the honey dosage group are reproduced in the table below. In exercise 23, you used a comparison of two means to determine whether “honey may be a preferable treatment for the cough and sleep difficulty associated with childhood upper respiratory tract infection”. The researchers also want to know if the variability in coughing improvement scores differ for the two groups. Conduct the appropriate analysis, using α = .10.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Honey dosage: | 12 | 11 | 15 | 11 | 10 | 13 | 10 | 4 | 15 | 16 | 9 | 14 | 10 | 6 | 10 | 8 | 11 | 12 | 12 | 8 |
| 9 | 11 | 15 | 10 | 15 | 9 | 13 | 8 | 12 | 10 | 8 | 9 | 5 | 12 | 12 |  |  |  |  |  |
| DM dosage: | 4 | 6 | 9 | 4 | 7 | 7 | 7 | 9 | 12 | 10 | 11 | 6 | 3 | 4 | 9 | 12 | 7 | 6 | 8 | 12 |
| 12 | 4 | 12 | 13 | 7 | 10 | 13 | 9 | 4 | 4 | 10 | 15 | 9 |  |  |  |  |  |  |  |