PBAF 527: Quantitative Methods **Assignment 5**

Hypothesis Testing

The first part of this assignment gives you some practice at hypothesis testing. The second part applies hypothesis testing to the work you are doing for your policy memo.

Part I

1. In dealing with impacts of the various funding reductions in recent years, Metro is trying to decide how to change its services. To this end, Metro is examining bus service in different areas of the city. If the average number of miles traveled by bus over the routes in question by all residents of an area is about 5 miles per day, then no change will be necessary. If the average number of miles traveled per person per day is below 5, then changes in service may be appropriate—that might be a good place to reduce service. The required level of significance for this test is α=0.05. A random sample of 120 residents of the area is taken, and it is found that the sample mean is 2.3 miles per resident per day and the sample standard deviation is 1.5 miles. Is a change in service necessary? Advise Metro on what should be done. Explain your recommendation. Could you state the same result at different levels of significance? Explain. Compute the observed significance level and interpret it.
2. An article about women in business claims that 30% of all small businesses in the US are owned by women. An analyst wants to test this claim. The analyst looks at a random sample of 2000 small businesses and found that 852 of them were owned by women. Conduct the test and state your conclusion.
3. The computer systems department at a large university needs to choose a new mainframe computer. Of the two models the department is considering, one is made by IBM and the other is made by DEC. The department contracts with a research agency to determine if one of the models gets a higher average performance rating by professional systems operators or whether the average performance ratings are not statistically different. The agency asks 30 systems operators to rate each model, i.e., 30 operators rate the IBM and 30 rate the DEC. The ratings are on a scale of 1 to 10, with 10 being the best score. The average sample rating for the IBM is 8.5 and the sample standard deviation is 2.1. For the DEC sample, the mean is 7.8 and the standard deviation is 1.8. Is there a significant difference between the average ratings of the two mainframes? If so which one is rated higher?

Part II

In this assignment, we'll use hypothesis tests, p-values, and graphs to explore the relationship between 2-4 variables. To answer the questions below, use variables from your policy report.

For Q1-Q3 you'll need 2 variables. One should be continuous and the other categorical.

1. Test the null hypothesis that there is no difference between the population mean value of the outcome (continuous) variable for 2 categories of the explanatory (categorical) variable. [See the last page of this assignment for SPSS directions.] What is your alternative hypothesis? Did you reject the null hypothesis? Was the difference in your means statistically significant? Is the difference important? [Note that if your categorical variable has more than 2 categories you probably want to compare each category to all the others, or if it is ordinal, to those adjacent to it.]
2. Using the same results as above, calculate the probability that you would get the sample difference in means as large or larger than you did, if the null hypothesis had been true (p-value). What does it mean? How does this relate to part 1?

3. Graph the mean outcome for each of your categories. To do this:

   In SPSS, click on GRAPHS, BAR, DEFINE then fill in your categorical variable as the CATEGORY AXIS. Click on OTHER SUMMARY FUNCTION and move your outcome variable from the list to the BARS variable. Now click OK. This will give you a bar chart with the bar height as the mean of the outcome for each category.

4. Now test the null hypothesis that there is no difference in the population proportion for two categories. Pick a dummy variable for your outcome (one with only 2 possible values of 0 and 1 from the survey or that you have created) and a categorical variable for your explanatory variable. The mean of a dummy variable is a proportion, so use the same procedure as above to test whether your sample information is strong enough to conclude that the proportion in the population differs for two categories of your explanatory variable. [An example hypothesis is that the proportion of families in poverty is different for families in King county and those in one of the other regions.]
5. Write a short paragraph for your client, describing the relationships between each pair of variables for the non-technical reader.

T-tests and Confidence Intervals in SPSS

ONE MEAN

To get a confidence interval around one mean or proportion or to test a hypothesis about it, you can click on:

ANALYZE, COMPARE MEANS, ONE SAMPLE T TEST

Put your outcome variable into the TEST VARIABLE list by selecting the variable then clicking the arrow to move it over. Then put your null hypothesis into the TEST VALUE. Click Ok.

INDEPENDENT SAMPLES

Usually you will want to compare the mean of one outcome variable for 2 separate groups of observations. For example, I want to compare the mean household income for householders who use ecological transportation and those who do not. To do this I click on:

ANALYZE, COMPARE MEANS, INDEPENDENT SAMPLES T TEST

Select the outcome variable from the variable list and click on arrow to move it to the TEST VARIABLE list on right.

Select the variable that you've used to define your comparison groups and click on arrow to move it to GROUPING VARIABLE list. Click on DEFINE GROUPS to tell SPSS how to divide up your sample into the groups. You can either give a cut-off value (e.g., divide households by whether or not they have 4 or more members) or put in specific values (e.g., group 1 has a value of 3 and group 2 has a value of 4). Click on CONTINUE when you're done.

If you want something other than a 95% confidence level then click on OPTIONS and set a different level. Click on CONTINUE when finished.

Now click on OK to get results. Your output will include the outcome means, N, and S, and confidence interval for each of your categories. It will also include the t values and p values ("sig. Two-tailed.") for the test of whether the means for the 2 categories are significantly different. It provides information on the test under 2 different assumptions: equal variances (the variance of the outcome for the 2 groups is the same) or unequal variances. It also gives the results of a test of whether or not the variances are equal ("**Levine's test for equality of variances**"). If your outcome variable is continuous then use the line that corresponds to assuming equal variances if $p>.05$ ("sig." is the p value) and use the line for not assuming equal variances if $p<.05$ (you reject the null hypothesis of equal variances). If your outcome variable is binary, then always use the line for "equal variances assumed" because if the proportions are the same, then the variances are as well.

PAIRED

Sometimes you'll want to compare the means of 2 different outcome variables for the same group of cases. A classic example is before and after measures of the same outcome after some kind of "treatment". For example, you could use this to compare earnings for householders and their partners.

To do this choose:

ANALYZE, COMPARE MEANS, PAIRED SAMPLES T TEST

Select the 2 outcome variables and click on arrow to move them to the PAIRED VARIABLES list. Again you can use OPTIONS to change confidence level. Click on RUN to get results.

Here, SPSS will give you means for both variables and confidence intervals for the difference between the outcomes.