Psychology 202a

Advanced Psychological Statistics

Seventh homework assignment, 12/3/2020 (due 12/10/2020).

Part One

In Chapter 8, Howell lists the following exercise:

```
We have just conducted a study comparing cognitive development of low- and
normal-birthweight babies who have reached 1 year of age.  Using a scale we
devised, we found that the sample means of the two groups were 25 and 30,
respectively, with a pooled standard deviation of 8. Assume that we wish to
replicate this experiment with 20 subjects in each group.  If we assume that
the true means and standard deviations have been estimated exactly, what is
the a priori probability that we will find a significant difference in our
replication?
```

Here is a little more information necessary to specify the problem fully: assume that the test will be two-tailed and that the alpha level will be .05. Answer the following questions by using G*power:

- Answer the question that Howell poses: What is the a priori probability that we will find a significant difference in our replication?
- Suppose you are worried that the previous study may have underestimated the standard deviation. Assume, instead, that the standard deviation is 10. How does this affect power? (Be specific; that is, repeat the power analysis with the change in your assumed standard deviation.)
- Now suppose that you are going to gear up for a larger scale, definitive study. You want to be really convincing, so you decide that you will work with an alpha level of .01, and you will continue to assume that the standard deviation is 10, rather than 8. How large a sample size will you need in order to achieve power of .90?

Part Two

Consider the Eysenck one-way ANOVA example that has been discussed in class.

Here are your tasks for Part Two:

- Use R to conduct the ANOVA with the lm() function; the data are available at the data link from the class web page.
- Use R to manually conduct the same ANOVA without the lm() function and match the results to the first one (see the second half of the R transcript from November 5th for example code for the between-groups sum of squares; calculate the within-groups sum of squares by averaging the variances of the five groups). Include your code for calculating the sums of squares, mean squares, *F*-statistic, and *p*-value.
- Recall that Eysenck expected memory to improve as level of processing increased from counting to rhyming to adjective to imagery, and that he had no strong expectation for the intentional learning group. R code already posted on the web site (see the November 17 link) showed two ways to specify orthogonal contrasts that reflect Eysenck's interests. Identify another set of orthogonal contrasts that you believe also reflects Eysenck's interests. List the coefficients, and demonstrate that they are orthogonal.
- Attach an appropriate contrast matrix to the factor in *R* and run the contrasts. Remember that *R* thinks about the factor levels in alphabetical order.
- Interpret the results: what do the tests of the contrasts say about Eysenck's assertion?
- Use R to evaluate the assumptions of normality and homoscedasticity. Remember that this is *not* a regression, so the assumptions are not about errors and are not assessed by looking at residuals; rather, they are about the distribution of values in each of the five populations. Does each group look like a sample from a normal population? Does variability in the five groups appear consistent with the idea that all five populations have equal variance? Support your answer with descriptive statistics and graphs.

Part Three (Extra Credit)

Implement a dummy coding system for the Eysenck ANOVA problem, and run the ANOVA without using the given “Group” variable in your code. Show that your overall *F* statistic matches the value you obtained in Part Two.

If you want supremely high exalted special outrageously impressive extra credit, implement a coding system that duplicates the contrasts you performed in Part Two. Show that the results match your results from Part Two.

Note: success on extra credit questions can potentially elevate your score above 10. In such a case, the excess credit can offset a lower score on a previous assignment.