STA441s18 Assignment Seven

Quiz on Tuesday March 6th in Tutorial.

If an overall (initial) F-test has s numerator degrees of freedom and critical value c, the critical value of a Scheffé follow-up test with r degrees of freedom is $c \times s/r$.

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1. Choosing the appropriate statistical method is an important part of this course, and now we have seen a fair range of methods. For each of the brief passages below, state whether it is an experimental study or an observational study. Suggest a test or method you would recommend, and name SAS procedure that would do the job. You don't have to write any code. Assume you are talking to another student in the class, so you are communicating with someone who is supposed to know as much as you do. Many elementary methods are special cases of more advanced methods. *Name the most basic, elementary method you can*.
    a. You have marks in first, second, third and fourth year for a sample of University of Toronto students. You want to know whether average marks in first year are different from average marks in fourth year.
    b. Employees at a large corporation filled out a set of questionnaires that asked about Relations with colleagues at work, Relations with magnagement, Job satisfaction, and Commitment to the organization. To find out whether these questionnaire responses predict what people actually do, the data file also includes whether they were still working for the company one year later.
    c. The Titanic was a passenger ship that hit an iceberg and sank on its very first voyage in 1912. It was the largest passenger ship in the world at the time, and supposedly unsinkable. More than 1,500 of the roughly 2,200 passengers and crew died. Passengers were either in 1st class (where there were some lifeboats), 2nd class or 3d class, and they either lived or died. Was class actually related to survival on the Titanic, or is the supposed relationship a myth?
    d. Volunteer cancer patients are randomly assigned to receive either radiation treatment, chemotherapy or both. Tumor size at the end of 4 weeks is recorded.
    e. Volunteer cancer patients are randomly assigned to receive either radiation treatment, chemotherapy or both. Status one year later is recorded: (1) Alive, cancer in remission (2) Alive, cancer not in remission, or (3) Dead.
    f. Volunteer cancer patients are randomly assigned to receive either radiation treatment, chemotherapy or both. Status one year later is recorded: (1) Alive, cancer in remission (2) Alive, cancer not in remission, or (3) Dead. Severity of disease at the start of the trial is a covariate.
    g. In a study of success in university, the subjects are first-year university students. We seek to predict number of credits completed in first year from Sex, Immigration Status (Citizen, Permanent Resident or Visa), and family income.

2. It has been reported that drivers who talk more on their cell phones while behind the wheel are more likely to get into an accident. What is a possible confounding variable here? Briefly explain.
3. I copied the following from a news report. "*While it has been known for many years that people with acne might have a lower mood resulting from their skin, this is the first study to show conclusively that acne can be more than just a skin blemish, and can have a substantial impact on mental health in the form of clinical depression,*" *Vallerand said*. Comment in terms of correlation-causation.

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4. In a study of remedies for lower back pain, volunteer patients at a back clinic were randomly assigned to one of seven treatment conditions:
    1. OxyContin: A pain pill in the opiate family.

2. Ibuprofin: A non-steroidal anti-inflammatory drug (Advil, Motrin)
3. Acupuncture: The insertion and manipulation of thin needles into specific points on the body to relieve pain or for therapeutic purposes.
4. Chiropractic: A form of therapy that includes manipulation of the spine, other joints and soft tissue.
5. Stress management training based on thinking positive thoughts, a treatment that theoretically should not be effective. This is the non-drug control condition.
6. Placebo: A sugar pill; patients were told that it was a pain killer with few side effects. This is the drug control condition.
7. Waiting list control group: Patients were told that the clinic was overcrowded (true), and that they would be placed on a waiting list. This group received no treatment at all, not even a pretend treatment --- until the study was over, at which point they received the most effective treatment based on the results of the study. We'll call this the "No treatment" group.

The idea is that the effectiveness of the drug treatments could be measured relative to the drug control (placebo), while the effectiveness of the non-drug treatments could be measured relative to the non-drug control (stress reduction training). Placebo effects from both control condition can be can be assessed relative to no treatment at all (wait list control).

Degree of reported pain was measured by a questionnaire before treatment began, and again after six weeks. The response variable was Before-minus-After difference in reported pain, which will be called "improvement," or "effectiveness." Expected improvement refers to the true or "population" treatment means μ_1 through μ_7.

The following questions can be answered by testing whether one or more contrasts of treatment means are different from zero. For each question below, first state the null hypothesis in terms of μ_1 through μ_7, and then give the weights of the contrast or contrasts. For null hypotheses involving more than one contrast, make a table. There is one column in your table for each treatment mean, and one row for each contrast. See the lecture slides and Chapter 3 of the text for examples of this format.

Note that some of these questions ask whether certain treatments are better than others, while other questions just ask about a difference in effectiveness. In some courses, this would be a signal to choose between a one-tailed and a two-tailed test. But here, we will *always* use non-directional tests.

a. Does OxyContin work better than the placebo?
b. Does Ibuprofin work better than the placebo?
c. Do Chiropractic treatment and Stress reduction training differ in their effectiveness?
d. Which results in more mean improvement, Acupuncture or Stress reduction training?
e. Is the average expected improvement from the two drug therapies different from the expected improvement from the placebo?
f. Does either drug therapy differ from the placebo in its effectiveness? (This involves 2 contrasts.)
g. Does either non-drug therapy differ in effectiveness from Stress reduction training?
h. Is the Placebo better than no treatment at all?
i. Is Stress reduction training better than no treatment at all?
j. Is the average expected effectiveness of the drug therapies different from the average expected effectiveness of the non-drug therapies?
k. Do Stress reduction training and the Placebo differ in their effectiveness?
l. Does either control condition (Drug or Non-Drug) differ from no treatment at all? This is a single test.
m. Is treatment condition (the full explanatory variable) related to improvement?

5. In the Chick Weights data, newly hatched chickens were randomly allocated to six groups, and each group was given a different feed supplement. Their weights in grams after six weeks were recorded.
    a. Is this an experimental study, an observational study, both, or neither?
    b. Produce a table of means, standard deviations and sample sizes for the 6 feed types.
    c. Test whether the six mean weights are different. Get the F statistic, degrees of freedom, p-value and proportion of explained variation. These are all numbers on your printout. What do you conclude?
    d. Carry out Scheffé tests for all pairwise differences between means. Let's assign numbers to the feed types, so that 1 is the type with the highest sample mean, 2 is the next higherst, and so on. Based on the Scheffé tests,
        i. Is mean weight for feed type 1 different from mean weight for feed type 2?
        ii. Is mean weight for feed type 2 different from mean weight for feed type 3?
        iii. Is mean weight for feed type 3 different from mean weight for feed type 4?
        iv. Is mean weight for feed type 4 different from mean weight for feed type 5?
        v. Is mean weight for feed type 5 different from mean weight for feed type 6?
        vi. Is mean weight for feed type 1 different from mean weight for feed type 6?
    e. The top three feed types appear to be sunflower, casin and meatmeal. Conduct a single test for differences among these three types. Please do this with `contrast`, and not by subsetting the data. Get the F statistic, degrees of freedom, p-value. Sticking strictly to the 0.05 significance level, do you find evidence of any differences among means?
    f. The worst three feed types appear to be horsebean, linseed and soybean. Conduct a single test for differences among these three types. Please do this with `contrast`, and not by subsetting the data. Get the F statistic, degrees of freedom, p-value. Based on the ordinary 0.05 significance level (not adjusted for multiple comparisons), do you find evidence of any differences among means?
    g. Now convert that last test to a Scheffé follow-up to the overall test of differences among the six means. The best way is to steal my code from lecture, and use `proc iml` to create a table of Scheffé critical values for collections of contrasts. You don't have to fully understand the code; just hack it.
        i. What is the Scheffé critical value for the test comparing the bottom three feed types? The answer is a number from your printout.
        ii. Does your F statistic exceed the critical value? Is the result significant by a Scheffé test?
        iii. Based on the Scheffé pairwise comparisons, where does this difference among the three means come from?
        iv. Draw a directional conclusion for the significant difference betweeen means. Use plain, non-statistical language.
    h. Estimate the difference in expected chick weight between Sunflower and Horsebean. Accompany your estimate with a 95% confidence interval.

Please bring your log file and your results file to the quiz. Make sure your name and student number are on both printouts.

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