**Exam #2, Spring 1994**

## Question 1

Within educational circles, there has been a recent debate over the relative efficacy of several alternative teaching strategies.

First, debate has centered around the relative merits of skill-based versus standards-based education. Skill-based theories emphasize the teaching of basic skills such as reading, writing, and arithmetic. Standards-based theories emphasize the teaching of ethics, logic skills, and reasoning skills in addition to the basics.

Second, debate has centered around the relative merits of the whole language approach to education versus the standardized text book approach. The standardized text book approach emphasizes the use of standardized text books to teach reading, math, writing, science, health, etc. Those who use the whole language approach do not use textbooks but instead integrate the teaching of all subjects around a unifying theme. For example, a teacher might plan a unit about space exploration; he would use this topic to teach all subjects such that his students would <u>read</u> about space exploration, <u>write</u> stories about space exploration, study <u>arithmetic</u> operations that might be useful in space exploration, etc.

A small school district has decided to test the relative efficacy of these methods. By chance, the school district has a total of 16 second-grade classrooms: four of which are taught using a skill-based, whole language approach; four are taught using a skill-based, standardized text approach; four are taught using a standards-based, whole language approach; and four are taught using a standards-based, standardized text approach.

The school district is also enrolling 32 new second-grade students (students who moved into the school district during the summer break). Sixteen of these students are boys and sixteen are girls. The school district randomly assigns one boy and one girl to
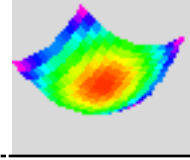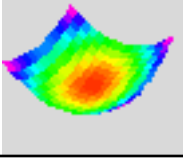
each of the sixteen classrooms. Thus, there are four classrooms in each of the four teaching method conditions and two subjects (one boy and one girl) in each classroom.

At the end of the academic year, the standardized test scores of these sixteen children are used to examine the relative efficacy of these teaching methods as well as any sex differences.

A. Give the source and df columns of the full source table for the full analysis of variance of these data, <u>defining variables in ways that we can understand</u>. Read question B before designing your source table to make sure that it includes the hypotheses the school district wants to test.

B. The school district is especially interested in testing the following hypotheses. Circle and number (with the number corresponding to the hypothesis tested) the row in your source table that tests each of these hypotheses.

1. Test scores will be better for those assigned to the skills-based condition than for those assigned to the standards-based condition.

2. Standardized test scores will be better for boys than for girls.

3. The difference between scores for children assigned to skills-based classrooms and scores for children assigned to standards-based classrooms will be greater for boys than for girls.

C. Specify Models C and A for tests of the following questions. Be sure to fully define all x variables and any transformed dependent variables that you would need to create for each test. Note, the tests and variables (or transformations) for this question are not necessarily the same as those you used to generate the full source table for questions A and B.
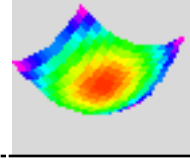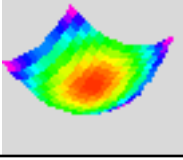
1.  Improvement is only realized for those children who are exposed to both a whole language approach and to a standards-based approach.

2.  The improvement realized for children exposed to both the whole language and standard-based approaches is greater for boys than for girls.

**Question 2:**

A second school district is only interested in the relative efficacy of the standards-based versus skills-based approaches that were defined in the previous question. By chance, this second school district has 3 second grade classrooms that are taught using the standards-based approach and three second-grade classrooms that are taught using the skills-based approach. This school district collects the following data from one boy and one girl in each of these six classrooms.  Data represent scores on a standardized achievement test and range from 20 to 80 with higher scores indicating greater achievement.

| Classroom | Method | Boy | Girl |
|-----------|-----------|-----|------|
| 1 | standards | 62 | 68 |
| 2 | standards | 59 | 65 |
| 3 | standards | 64 | 67 |
| 4 | skills | 55 | 55 |
| 5 | skills | 60 | 57 |
| 6 | skills | 58 | 56 |

Based on these data, what is the SSR associated with the test to determine whether boys have higher achievement scores  than girls on average.
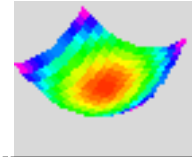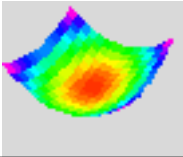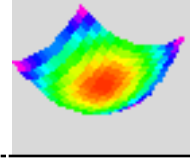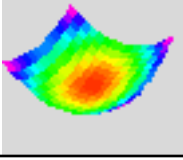
## Question 3

A cognitive psychologist conducts a memory study in which she is interested in memory for incongruent information. She gives subjects a list of 50 behavioral acts to read. In one condition, all 50 of these behavioral acts are congruent with an overall theme (e.g., they are all intelligent behaviors). In a second condition, 90% of the behavioral acts are congruent and 10% are incongruent. In a third condition, 80% are congruent and 20% incongruent. Following a filler task, she asks subjects to recall as many of the presented behaviors as they can. She records both the number of behavioral acts recalled (MEMORY) and the time spent studying the list (TIME). She believes that memory for the behavioral acts should increase as the proportion of incongruent acts increases. Additionally, she believes that this difference ought to be due to differences in study time: incongruent behaviors in a list result in longer study times and this in turn is responsible for better memory.

To analyze the resulting data (24 subjects, 8 assigned to each condition of incongruency level - 0% versus 10% versus 20% incongruency), she constructs two contrast codes to compare congruency conditions. X1 codes the linear trend in congruency, with a value of -1 if 0% incongruent behavioral acts, 0 if 10% incongruent behavioral acts, and +1 if 20% incongruent behavioral acts. X2 codes the quadratic trend, with values of -1 if 0% or 20% incongruent behavioral acts and a value of +2 if 10% incongruent behavioral acts.

On the attached pages are the results of her analyses. First, means are given for both the number of behavioral acts recalled (MEMORY) and the time spent studying the list (TIME) for each congruency (PERCENT) condition. Next, the following four regressions models are estimated:

|  |  |  |
|---|---|---|
| MODEL 1: | MEMORY | = X1 X2; |
| MODEL 2: | TIME | = X1 X2 |
| MODEL 3: | MEMORY | = X1 X2 TIME |
| MODEL 4: | MEMORY | = X1 X2 TIME INT1 INT2 |

In this last model INT1 is the product of TIME with X1 and INT2 is the product of TIME with X2.

In light of these analyses, answer the following questions:

A.     As the proportion of incongruent behavioral acts increases, is there a reliable increase in memory? (Please provide values of PRE, F*, and interpret the crucial parameter estimate.)

B.     When TIME is controlled, is there still a reliable increase in memory with increasing proportions of incongruent behavioral acts? (Please provide values of PRE, F*, and interpret the crucial parameter estimate.)

C.     What are the values of the adjusted MEMORY means for the two conditions where subjects were given 0% and 20% incongruent behavioral acts when controlling for TIME?

D. What are the values of PRE and F* for the omnibus test of the homogeneity of regression assumption for the analysis of covariance that this researcher conducted?

E. Interpret the following two parameter estimates from the final model estimated (don't worry about whether they are reliable):

     1.    -16.62     (the slope estimate for X1)
     2:    1.05     (the slope estimate for INT1)

F. Write a <u>short</u> paragraph that summarizes the results of this study.

[OUTPUT for this problem are not currently available.  We are still looking.]