Homework 3: Repeated Measures Plus

For each problem, estimate all the values that you would ordinarily think important (e.g., effect size, homogeneity of variance of between factors). Be sure to focus your attention on providing a clear interpretation of the outcome of the study.

1. [Howell] It is at least part of the folklore that repeated experience with the Graduate Record Examination (GRE) leads to better scores, even without any intervening study. We obtain eight participants and give them the GRE verbal exam every Saturday morning for three weeks. The data are as follows:

Participant	1^{st}	2^{nd}	3^{rd}
1	550	575	580
2	440	440	470
3	610	630	610
4	650	670	670
5	400	460	450
6	700	680	710
7	490	510	515
8	580	550	590

Analyze these data and report what you would conclude about practice effects on GRE performance. You should probably comment on the counterbalancing issue that this study raises (i.e., what would you counterbalance?, what can't you counterbalance?) and its impact on the number of participants that you should run.

2. An experiment is conducted in which four different drugs (a_2, a_3, a_4, and a_5) and a placebo (a_1) are administered to each of *n* = 5 different animals. The order in which the conditions are presented is counterbalanced using a Latin square approach. (This is not as effective as a balanced incomplete counterbalancing scheme, but it suffices for allowing us to remove order effects.) The response measure consists of the number of discrimination problems solved within a given time limit. The data appear first in condition order and then in position order. (Problem is directly from K&W, p. 399, #1)

	a_1	a_2	a_3	a_4	a_5
Animal 1	11	11	9	6	7
Animal 2	8	13	2	10	5
Animal 3	13	9	3	4	6
Animal 4	12	3	6	13	6
Animal 5	7	8	8	9	13

	p_1	p_2	p_3	p_4	p_5
Animal 1	9	11	11	6	7
Animal 2	13	10	5	8	2
Animal 3	13	6	9	3	4
Animal 4	13	12	6	6	3
Animal 5	13	8	9	8	7

Conduct a standard repeated measures ANOVA on these data.
Is there a significant practice effect? Remove the order effects from the error term and re-compute your ANOVA with the residual error term. Modify your data removing the practice effects and compute post hoc analyses.

3. [Howell] In an attempt to demonstrate the practical uses of basic learning principles, a psychologist with an interest in behavior modification has collected data in a study designed to teach self-care skills to severely retarded children. One group was an experimental group and received reinforcement for activities related to self care. A second group received an equivalent amount of attention, but no reinforcement. A rater (blind to conditions) rated the children on a 10-point scale of self-sufficiency. The ratings were done in a baseline session and at the end of training. The data are given below.

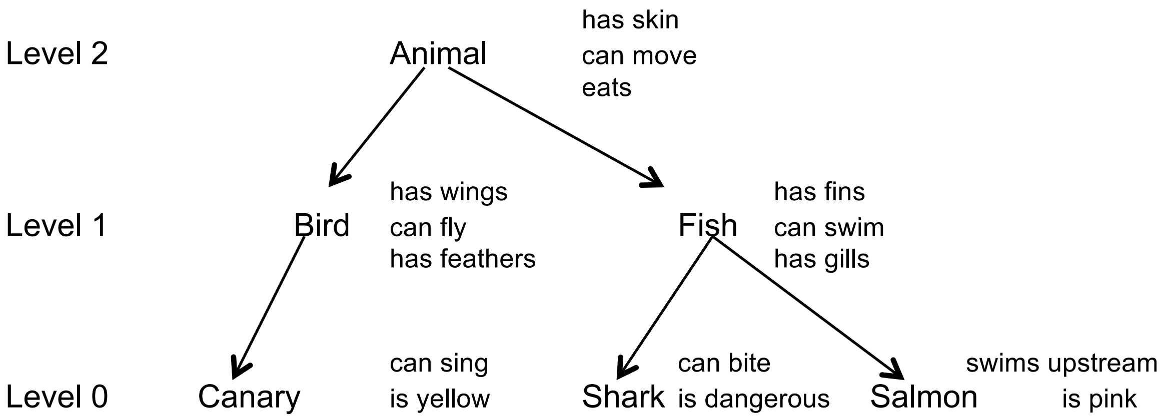
Experimental Group		Control Group	
Baseline	Post-Training	Baseline	Post-Training
8	9	3	5
5	7	5	5
3	2	8	10
5	7	2	5
2	9	5	3
6	7	6	10
5	8	6	9
6	5	4	5
4	7	3	7
4	9	5	5

Run the appropriate analyses and state your conclusions. You could also run an independent groups ANOVA on the change scores (Post-Training minus Baseline). You should have the computer calculate those change scores for you! What would happen were you to do so, and what would that tell you about the efficacy of using change scores in analyses? (Look *carefully* at the source tables of the original analysis and the change scores analysis!)

In an effort to understand just what happened in the above experiment, our experimenter took a third group who were evaluated at the same times as the first two groups, but were otherwise treated just like all the other residents of the training school. In other words, they did not receive reinforcement or even the extra attention that the control group did. Add these data to those you already have and re-compute your basic analyses (now as a 2x3 mixed design). What would you conclude from the results of all three groups?

Baseline	Post-Training
3	4
5	5
8	6
5	6
5	4
6	7
6	7
6	3
3	2
4	2

4. Thinking of memory in spatial terms has been quite popular over the years. Collins and Quillian (1969) proposed one hypothetical memory structure for information that can be hierarchically arranged. Below is an example:



Statements such as "A canary is a canary" (LEVEL 0), "A canary is a bird" (LEVEL 1), and "A canary is an animal" (LEVEL 2) are called Category statements. Statements such as "A canary can sing" (LEVEL 0), "A canary can fly" (LEVEL 1) and "A canary has skin" (LEVEL 2) are called Property statements.

If memory is organized spatially, with links like those depicted above, it should take longer to say "true" to statements from higher levels in the hierarchy (e.g., A canary has skin) than to statements from lower levels in the hierarchy (e.g., A canary can sing). Also, in general, statements about properties (or characteristics) should take longer to verify than statements about category membership ("is a" statements).

Ten participants were tested in a completely repeated measures design. Sentences were displayed on a CRT one at a time, and for each sentence the participant pressed one of two buttons signifying true or false, as quickly as possible. The investigators were primarily interested in the reaction times for correct responses to true statements (and that is what you are given below, with higher numbers indicating longer reaction times). Analyze these data as fully as you possibly can.

	CATEGORY			PROPERTY		
	Level 0	Level 1	Level 2	Level 0	Level 1	Level 2
S1	2	4	5	5	6	7
S2	1	4	5	4	5	6
S3	1	2	3	3	3	4
S4	1	4	5	4	5	6
S5	1	4	5	4	6	7
S6	1	3	4	4	5	6
S7	2	4	6	3	5	6
S8	1	4	5	4	6	8
S9	1	3	6	5	5	7
S10	1	3	5	4	6	7

5. [Howell] For two years Howell carried on a running argument with his daughter concerning hand calculators. His daughter wanted one. Howell maintained that children who use calculators never learn to do arithmetic correctly, whereas his daughter maintained that they do. To settle the argument, they selected five of the daughter's classmates who had calculators and five who did not, and made the totally unwarranted assumption that the presence or absence of calculators was all that distinguished these children. They then gave each child three 10-point tests (addition, subtraction, and multiplication), which they were required to complete in a very short time in their heads. The number correct for each test is shown below. Analyze the data completely. (Howell ended up buying his daughter a calculator anyway.)

	Addition	Subtraction	Multiplication
Calculator owners	8	5	3
	7	5	2
	9	7	3
	6	3	1
	8	5	1
Non-calculator owners	10	7	6
	7	6	5
	6	5	5
	9	7	8
	9	6	9

6. [M&D] A cognitive psychologist was interested in the effects of different difficulty manipulations on subject's recall of brief text passages. Each of three different difficulty manipulations was believed to induce a different type of processing of the written material. The three difficulty manipulations of interest here were letter deletion (LD), sentence scrambling (SS), and a control condition (C) of normal text. [Similar to a study by McDaniel, et al., 1986.] Twelve participants each read three different passages, one with LD, one with SS, and one C. The recall scores are seen below. Think about the design and the primary interest (difficulty manipulations) before conducting analyses that make sense to you. (In other words, the current ordering of the data is by position: first, second, third. That may be one useful ordering of the data, but it's not the primary one.)

Subject	Passage 1	Passage 2	Passage 3
1	55 (LD)	38 (SS)	54 (C)
2	43 (SS)	36 (C)	39 (LD)
3	49 (C)	42 (LD)	39 (SS)
4	40 (SS)	38 (C)	42 (LD)
5	61 (C)	46 (LD)	45 (SS)
6	41 (LD)	26 (SS)	40 (C)
7	53 (C)	39 (LD)	43 (SS)
8	47 (SS)	39 (C)	41 (LD)
9	33 (LD)	36 (SS)	36 (C)
10	52 (LD)	36 (SS)	51 (C)
11	53 (C)	45 (LD)	42 (SS)
12	51 (SS)	43 (C)	47 (LD)