

Question 1

A cognitive researcher is interested in the effects of categorization on judgment. He hypothesizes that objects that are categorized together will be seen as more similar than objects that are in different categories. He gives subjects pairs of dates from the calendar and asks them to judge how similar the mean high temperature in Boulder is likely to be on the two days in each pair.

In total, each subject estimates the similarity of mean high temperatures for three pairs of dates, with one pair consisting of days that are 3 days apart, one pair of days 9 days apart, and the final pair consisting of days that are 15 days apart. For one third of the subjects the days in each pair span the two months of March and April. One third of the subjects are given pairs of days that are all in the earlier month (March). The final third of the subjects are given pairs of days that are all in the later month (April). The primary categorization hypothesis is that pairs of days that are in the same month (whether the earlier one or the later one) will be judged to be more similar than pairs that are between months, even though all pairs consist of days that are objectively equally far apart. Additionally, the researcher expected that differences due to the two days being further apart ought to be smaller if they come from the same months (within category differences) than if they come from different ones.

The specific pairs of days that are given to subjects are presented in the table below:

	Span 2 Months	Within Earlier Month	Within Later Month
3 days apart	March 30, April 2	March 16, March 19	April 13, April 16
9 days apart	March 27, April 5	March 13, March 22	April 10, April 19
15 days apart	March 24, April 8	March 10, March 25	April 7, April 22

Similarity ratings are given on a 9 point scale, with higher numbers indicating that the subject believes the mean high temperatures for the two days in a pair are more similar.

Four subjects are run in each of the three conditions (defined by whether the two dates span the two months or are in one of the two months - either the earlier one or the later one). The cell means are given below:

	Span 2 Months	Within Earlier Month	Within Later Month
3 days apart	8.00	8.75	8.75
9 days apart	6.50	8.00	7.75
15 days apart	5.00	7.50	7.00

The researcher has access to an analysis of variance program that reports only the omnibus main effect and interaction tests. The following source table results:

Source	SS	df	MS	F*	p
Between subjects					
Type of Pair	17.39	2	8.69	11.31	.0035
Error	6.92	9	0.77		
Within subjects					
Days Apart	24.06	2	12.03	29.52	.0001
Days Apart X Type of Pair	3.28	4	0.82	2.01	.1359
Error Within	7.33	18	0.41		

“Type of Pair” refers to whether the pairs that were judged spanned the 2 months, were all within the earlier month (March), or were all within the later month (April). “Days Apart” refers to whether the judged pair of days were 3, 9, or 15 days apart.

Based on this research and reported results, answer the following questions:

- A. Assuming that you have learned not to be content with omnibus, multiple-df tests, in light of the researcher’s hypotheses, what between subject contrast codes would you construct and test? (Give exact contrast weights.)
- B. In light of the researcher’s hypotheses, what within subject contrast codes would you construct and test? (Give exact contrast weights.)
- C. Given the codes that you have defined in A and B, what model A’s would you estimate from your data? (Give them in terms of b’s – you don’t need to provide values of parameter estimates.) In each of these models, indicate which coefficients you would expect to be significant and which ones you would not expect to be significant, given the researcher’s hypotheses and the cell means (which are consistent with those hypotheses).
- D. What is the sum of squares due to the between-subject contrast that tests whether similarity ratings are higher on average for judgments when the pairs span 2 months than when they do not? What is the F* statistic that would test the null hypothesis that this contrast is not significant?
- E. The omnibus source table above reports an SSR due to the Days Apart X Type of Pair interaction of 3.28 with 4 degrees of freedom. Give the models C and A (in b terms, not in terms of the estimated parameters) whose comparison(s) result in this SSR. (Hint: Answer in light of the contrasts you have constructed in A and B.)

G. Assuming that you are correct about which contrasts are significant and which are not in question C (in light of the cell means – you might draw a rough graph of them), write a short paragraph that reports the results from this study.

Question 2

A researcher is interested in factors that affect stated levels of marital satisfaction. Fifty couples are randomly selected and in each, both spouses rate their satisfaction with marriage. Couples vary in how long they have been married, from just a few weeks to nearly 50 years. Each spouse also indicates how much time he or she thinks that they spend together in a typical week.

A. The researcher believes that marital satisfaction may be influenced by length of marriage, gender of spouse, and the amount of time couples spend together, as reported by the two spouses. For each of these independent variables, indicate whether it varies within or between couples.

B. The research computes the husband – wife difference in marital satisfaction and regresses it on a predictor that is computed as the husband – wife difference in the judged amount of time the couple spends together in a week. Both the intercept and the slope in this model have associated t statistics. For each, state in words the null hypothesis that is being tested (state these in substantive terms, referring to the variables as they are defined).

Question 3

Physiological measures are increasingly used as an index of emotional reactions to emotion-evoking stimuli. One such measure is involuntary facial movements that are often too small to be seen. For example, cheek muscle movements are associated with positive emotions like happiness while movement in the eyebrow area are associated with negative emotional reactions such as anger or disgust.

Recently, prejudice researchers have explored the use of physiological indicators because it is believed that participants cannot control such reactions. This is important because in this age of political correctness many researchers believe that people will not report their true attitudes on self-report surveys. Thus, a measure of facial movements is thought to capture the “true” reactions people have to members of different social groups.

Based on these ideas, a researcher is interested in how the affective reactions to African-Americans versus Caucasian-Americans differ for people of different prejudice levels (to make things simpler, we’ll include only Caucasian participants). She predicts that there will be less positive emotional reactions to African-American than to Caucasian-American faces. In addition, she believes this difference will be more pronounced with increasing levels of prejudice.

The researcher recruits 20 participants who pretested as low in prejudice, 20 participants who were moderate in prejudice and 20 participants who were high in prejudice (note this is equivalent to chunking a continuous variable into 3 categories, a strategy we would definitely not encourage!). Within each prejudice level, one-half of the participants were randomly assigned to see an African-American photo and one-half were assigned to see a Caucasian-American photo. The facial movements of each participant were recorded in response to viewing the photo. The means for each condition are given in the table below. Note that the dependent variable was an index of positive to negative facial activity where higher values indicate more positive affective reactions.

		Prejudice Level		
		<u>Low</u>	<u>Moderate</u>	<u>High</u>
Race of Photo	<u>Caucasian-American</u>	1.40	0.65	2.30
	<u>African-American</u>	-0.80	-1.10	-2.70

The results of the omnibus test follow, analyzing these data as a one way analysis of variance and asking whether there are any differences among the six cell means.

Source	SS	df	MS	F*	PRE	p
Model	168.01	5	33.60	21.82	.70	< .05
Error	72.85	54	1.54			
Total	240.86	59				

- Was the researcher correct in her assumption that people react less positively on average to African-Americans than Caucasian-Americans? In your answer be sure to define the contrast coded variable that would test this prediction, the PRE and F* associated with this test, and a substantive conclusion.
- Test the prediction that the difference in emotional reactions to Caucasian-versus African-American faces increases with prejudice level. Again, specify the contrast coded predictor weights, calculate PRE and F*, and provide a substantive conclusion.
- Suppose you wanted to examine whether negative reactions to only African-American photos increase with higher prejudice levels. Test this prediction, including the contrast-coded predictor you would use, the resulting PRE and F*, and a substantive conclusion.

- d. It turns out that large muscle movements in these facial muscles are relatively rare, that most of the movements are relatively small with only a few large responses. In light of this, what sort of recommendation would you make to the researcher about steps she should take prior to reanalyzing her data.

Question 4

A botanist (with apologies to the real botanists in the class if I'm really off base on this question!) randomly samples plant leaves from a particular genus on Niwot Ridge. The following variables are measured for each plant collected:

ELEVATION (altitude in meters where the plant was collected)

GROUND Nitrogen (amount of nitrogen in the ground near the plant)

DIRECTION: North, East, South (the direction the slope from which the plant was collected faced; note: with the Continental Divide to the west, there are no west-facing slopes)

SPECIES: A and B (the genus in this area has two species)

BASAL (amount of nitrogen in a basal leaf; this is the dependent variable for most of the questions below)

For each question, specify the model A and model C you would use to answer each question. Define any variables you create. You may use the first letter of the above variable names as abbreviations in your models.

1. Is the amount of nitrogen in the ground related to the amount of nitrogen in basal leaves?
2. Does species A tend to have more nitrogen in basal leaves than does species B?
3. As a group are elevation and nitrogen in the ground useful predictors of the amount of nitrogen in basal leaves?
4. There may be a relationship between elevation and the amount of nitrogen in the ground. When controlling for elevation, is nitrogen in the ground still a useful predictor of the amount of nitrogen in basal leaves?
5. Does the effect of nitrogen in the ground on the amount of nitrogen in basal leaves depend on the elevation?

6. For the model A of question 3, do we need to have separate models, one for each species?
7. Ignoring elevation, does the magnitude of the relationship between nitrogen in the ground and the amount of nitrogen in basal leaves change as there are higher levels of nitrogen in the ground?
8. Controlling for species, is it the case that the amount of nitrogen in basal leaves is highest in plants on east-facing slopes? (Use a complete set of codes.)
9. In the previous question, is the superiority of east-facing slopes equally true for both species?
10. In the harsh environment of Niwot Ridge (which ranges from subalpine forest to tundra), only about 60% of the plants successfully produce seeds during the season. For each plant, the researcher records a binomial or categorical dependent variable FLOWER which indicates whether the plant produced seeds during the season (the event) or not. The results from a logistic regression are $\text{FLOWER} = .4 + .3 \text{ SPECIES} - .005 \text{ ELEVATION_DEV}$ where species is contrast coded (+1 for A, -1 for B) and ELEVATION_DEV is the mean-deviated form of elevation (in meters).
 - a. On average, what are the predicted odds of flowering? (If you prefer, you can instead give the probability of flowering.)
 - b. How much more likely (again in either odds or probability) is Species A to flower than Species B?
 - c. Ignoring species, for each 100 meters (remember that elevation is measured in meters in the above equation) change in elevation, how much do the odds (or probability) of flowering change? (If you prefer, you may consider the effect of a 100 meter decrease in altitude.)