Exam 1, Spring 1996

Question 1.

A study currently being conducted in the department examines whether the type of instructions a juror receives affects their decision as to the defendant's guilt or innocence. In the legal system today, there is usually no official mention of such factors as one's race, gender, age, or SES. However, the stereotyping literature suggests that just seeing a defendant with a certain set of characteristics will invoke stereotypes based on these factors, even without the juror's conscious intention or awareness. A possible remedy or preventative measure is to change the judge's instructions to the jurors so that they are aware of their natural tendencies and so that they can overcome any prejudice based on stereotypes, either positive or negative. In particular, the researcher is interested in stereotypes based on race.

To test her hypotheses, the researcher has designed a 3 x 2 x 2 factorial design, with the independent variables type of instruction, time when instruction is presented, and the race of the defendant, and the dependent variable, a verdict decision of guilt or innocence measured on an 8-point scale. Subjects are either presented with a court case with an African American or a White American defendant. Within the case information, the subjects were presented either an instruction like the one currently used in the court system with no mention of race, an instruction that the individual should be race blind, or an instruction to overcome any prejudices or natural tendencies based on the defendant's race. In addition, the point at which subjects were presented these instructions was varied such that some received the instructions before they read the case material and others received the instructions after they had finished reading the case material. The experimenter plans on using 180 subjects in her study. She collects data on the following variables:

Verdict: Guilty or Not Guilty Verdict Decision (1-8 with higher numbers representing more guilt)
Instruction: The type of instruction received (coded: Control, Blind, Overcome)
Order: When the instruction was presented (coded: Before, After)
Race: Defendant's race (coded: Black, White)

A. The experimenter has the following hypotheses:

1) African American defendants will be more likely to be convicted.

2) The new instructions (race blind and overcome) will result in significantly different verdicts than the control instructions.

3) Subjects given the "overcome your prejudices" instruction will be less likely to convict the defendant than if one is given the "be race blind" instructions.

4) The new instructions will only lead to significantly different verdicts when the instructions are presented after the case material has been reviewed.

Please provide a complete set of contrast codes which would allow the researcher to test her hypotheses.

B. Corresponding to the above codes, please provide a layout for the source table, with the source of the sum of squares and degrees of freedom filled in.

C. Even small prejudicial effects are important in the judicial system. What is the approximate power of detecting an omnibus effect (i.e., any difference among means) if the effect is "small" in Cohen's terms? (You won't be able to provide a precise answer given the graininess of our power table.)

D. What is the approximate power of detecting a small effect for any of the one-df contrast questions? Compare the power here to that obtained in C above. What do you think of the old-folks' strategy of doing the omnibus test first and then only bothering with the one-df contrasts if the omnibus test is significant?

Question 2.
[This problem is a modified version of a problem from Glenberg (1988, p. 424).]

A clinical psychologist studied the effectiveness of various therapies for reducing cigarette smoking. He randomly assigned four smokers to each of the 12 groups formed by the factorial combination of three types of therapy (control, verbal, and drug) and four durations of therapy (1, 2, 3, and 4 weeks). He measured the number of cigarettes smoked in the week immediately following therapy. SAS code for generating the contrast codes and conducting the analysis as well as the output generated by SAS follow the questions.

A. Write out the complete source table for a two-way analysis-of-variance of these data, including the omnibus tests for the main effects and the interactions. Be sure to include PRE values for each F* statistic.

B. Draw a rough graph of the cell means and write a short paragraph giving a summary of the experimental results. In this paragraph you need only discuss the reliable differences that the analysis reveals.

C. It appears from the graph that the linear decrease in number of cigarettes smoked as a function of therapy duration is steeper for the verbal group than the drug group. In particular, it appears that after four weeks of therapy, the mean number of cigarettes smoked by the verbal group is dramatically lower than the mean for the drug group. Test to see if the simple difference between these two cells is statistically significant.

D. The linear decrease in number of cigarettes smoked as a function of therapy duration appears to be steeper for the verbal group than the drug group, but the interaction was not significant. If a new experiment were conducted just using verbal and drug groups and if the effect were essentially the same as in this experiment, how many subjects would be needed to have about an 80% of detecting the interaction?

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* problem from Glenberg (1988);
data g.cig;
input therapy $ duration  smokes;
label therapy= 'Type of Therapy'
      duration='Duration (Weeks) of Therapy'
      smokes = 'Cigs Smoked in Week after Therapy';
lindur = (-3/2)*(duration=1)+(-1/2)*(duration=2)+
           (1/2)*(duration=3)+(3/2)*(duration=4);
quaddur =(-1/2)*(duration=1)+(1/2)*(duration=2)+
            (1/2)*(duration=3)+(-1/2)*(duration=4);
cubdur = (-1)*(duration=1)+3*(duration=2)-
            3*(duration=3)+(1)*(duration=4);
label lindur = 'Linear Trend for Duration'
      quaddur ='Quadratic Trend for Duration'
      cubdur = 'Cubic Trend for Duration';
contreat = (-2/3)*(therapy='control')+(1/3)*(therapy='verbal')+
                (1/3)*(therapy='drug');
verbdrug = 0*(therapy='control')+(-1/2)*(therapy='verbal')+
                (1/2)*(therapy='drug');
label contreat='Control vs. Treatments'
      verbdrug='Verbal vs Drug Treatment';
linct = lindur*contreat;
quadct = quaddur*contreat;
cubct = cubdur*contreat;
linvd = lindur*verbdrug;
quadvd = quaddur*verbdrug;
cubvd = cubdur*verbdrug;
label linct ='Linear x Control vs Treatments'
      quadct='Quadratic x Control vs Treatments'
      cubct ='Cubic x Control vs Treatments'
      linvd ='Linear x Verbal vs Drug'
      quadvd='Quadratic x Verbal vs Drug'
      cubvd ='Cubic x Verbal vs Drug';
cards;
control 1 140
control 1  98
.... other data lines omitted ...
drug    4  50
drug    4  56
;;
proc summary data=g.cig;
   class therapy duration;
    var smokes;
    output out=temp mean=mean std=std;
proc print data=temp;
proc reg data=g.cig;
   model smokes = contreat verbdrug lindur quaddur cubdur
                  linct quadct cubct linvd quadvd cubvd/ss2 pcorr2;
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The SAS System

OBS	THERAPY	DURATION	_TYPE_	_FREQ_	MEAN	STD
1		.	0	48	89.729	38.6004
2		1	1	12	110.667	20.8167
3		2	1	12	97.500	32.5031
4		3	1	12	76.083	37.7467
5		4	1	12	74.667	49.5678
6	control	.	2	16	123.188	21.2860
7	drug	.	2	16	85.000	27.5754
8	verbal	.	2	16	61.000	36.8348
9	control	1	3	4	122.000	17.9629
10	control	2	3	4	122.500	30.2710
11	control	3	3	4	117.250	21.6237
12	control	4	3	4	131.000	20.6882
13	drug	1	3	4	110.000	26.7706
14	drug	2	3	4	90.000	29.4392
15	drug	3	3	4	70.000	18.7083
16	drug	4	3	4	70.000	20.0499
17	verbal	1	3	4	100.000	15.0333
18	verbal	2	3	4	80.000	27.8209
19	verbal	3	3	4	41.000	21.3698
20	verbal	4	3	4	23.000	18.9561

Model: MODEL1
Dependent Variable: SMOKES Cigs Smoked in Week after Therapy

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	11	51171.72917	4651.97538	8.881	0.0001
Error	36	18857.75000	523.82639		
C Total	47	70029.47917			

Root MSE	22.88725	R-square	0.7307
Dep Mean	89.72917	Adj R-sq	0.6484
C.V.	25.50704		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	89.729167	3.30349054	27.162	0.0001
CONTREAT	1	-50.187500	7.00776169	-7.162	0.0001
VERBDRUG	1	24.000000	8.09186620	2.966	0.0053
LINDUR	1	-12.941667	2.95473177	-4.380	0.0001
QUADDUR	1	-5.875000	6.60698109	-0.889	0.3798
CUBDUR	1	1.412500	1.47736588	0.956	0.3454
LINCT	1	-22.675000	6.26793261	-3.618	0.0009
QUADCT	1	1.125000	14.01552339	0.080	0.9365
CUBCT	1	0.262500	3.13396630	0.084	0.9337
LINVD	1	13.000000	7.23758516	1.796	0.0809
QUADVD	1	-9.000000	16.18373240	-0.556	0.5816
CUBVD	1	-1.000000	3.61879258	-0.276	0.7839

Variable	DF	Type II SS	Squared Partial Corr Type II	Variable Label
INTERCEP	1	386464	.	Intercept
CONTREAT	1	26867	0.58758150	Control vs. Treatments
VERBDRUG	1	4608.000000	0.19637131	Verbal vs Drug Treatment
LINDUR	1	10049	0.34763968	Linear Trend for Duration
QUADDUR	1	414.187500	0.02149174	Quadratic Trend for Duration
CUBDUR	1	478.837500	0.02476329	Cubic Trend for Duration
LINCT	1	6855.408333	0.26661090	Linear x Control vs Treatments
QUADCT	1	3.375000	0.00017894	Quadratic x Control vs Treat
CUBCT	1	3.675000	0.00019484	Cubic x Control vs Treatments
LINVD	1	1690.000000	0.08224745	Linear x Verbal vs Drug
QUADVD	1	162.000000	0.00851746	Quadratic x Verbal vs Drug
CUBVD	1	40.000000	0.00211665	Cubic x Verbal vs Drug