Psychology 202b

Advanced Psychological Statistics

Makeup Midterm Examination

April 12 - April 19, 2011

Name:_____

As agreed in class, you are on your honor to work alone on this take-home make-up exam. You may visit office hours or email Jack for assistance.

1. Consider the following matrix:

$$\begin{pmatrix} 2 & 1 & 8 & 9 & 2 \\ 4 & 3 & 3 & 8 & 4 \\ 5 & 2 & 4 & 7 & 2 \\ 6 & 5 & 7 & 6 & 4 \\ 7 & 5 & 7 & 5 & 2 \end{pmatrix}$$

   Calculate the inverse of the matrix, and demonstrate, using matrix multiplication, that the inverse actually *is* an inverse. You should use *R* to do this, and present an annotated transcript of your work.

2. Consider the following matrix:

$$\begin{pmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 1 & 0 & 1 \end{pmatrix}$$

Without actually calculating anything, state the value of the determinant of the matrix. Explain why you know this is the value, and describe what this tells you about the invertability of the matrix.

The next several questions refer to a regression problem using the Statlab data we are familiar with from class. The first regression used mean-centered Mothers' Body Mass Index (mbmi) to predict Child's Body Mass Index at age 10 (cbmi). The gender of the children was dummy coded: male=0 implies that the child was female, and male=1 indicates a boy. In addition, a variable called interact was calculated from the product of the male dummy and mbmi. Here is some relevant SAS output:

X'X Inverse Matrix

	Intercept	male	mbmi
Intercept	0.0074922114	-0.007492211	-0.000401648
male	-0.007492211	0.0159739967	0.0004016477
mbmi	-0.000401648	0.0004016477	0.0002193485
interact	0.0004016477	-0.00034267	-0.000219348
cbmi	17.887734522	-0.273360159	0.1852559049

X'X Inverse Matrix

	interact	cbmi
Intercept	0.0004016477	17.887734522
male	-0.00034267	-0.273360159
mbmi	-0.000219348	0.1852559049
interact	0.0007018582	-0.053153395
cbmi	-0.053153395	2151.9769586

Dependent Variable: cbmi

Source	DF	Sum of Squares	Mean Square	F Value
Model	3	218.582552	72.860851	8.87
Error	262	2151.976959	8.213653	
Corrected Total	265	2370.559511		

Source	Pr > F
Model	<.0001
Error	
Corrected Total	

R-Square	Coeff Var	Root MSE	cbmi Mean
0.092207	15.96802	2.865947	17.94805

Source	DF	Type I SS	Mean Square	F Value
male	1	25.9530304	25.9530304	3.16
mbmi	1	188.6040886	188.6040886	22.96
interact	1	4.0254331	4.0254331	0.49

Source	Pr > F
male	0.0766
mbmi	<.0001
interact	0.4845

Source	DF	Type III SS	Mean Square	F Value
male	1	4.6779637	4.6779637	0.57
mbmi	1	156.4622260	156.4622260	19.05
interact	1	4.0254331	4.0254331	0.49

Source	Pr > F
male	0.4511
mbmi	<.0001
interact	0.4845

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	17.88773452	0.24806939	72.11	<.0001
male	-0.27336016	0.36222211	-0.75	0.4511
mbmi	0.18525590	0.04244587	4.36	<.0001
interact	-0.05315339	0.07592641	-0.70	0.4845

3. What is the standard error of the conditional mean BMI for a child who is female and who has a mother whose BMI is 7 points below the mean?

4. Calculate an 80% confidence interval for the conditional mean BMI for that population. (You may use *R* or an introductory statistics text to obtain the relevant critical value needed to calculate the interval.)

5. In your own words, explain what the confidence interval means.

6. Consider a hypothetical data set that includes the following variables: a measure of mathematics achievement (*MATH*), an indicator of family income (*INCOME*), how many years of education the mother has had (*MOMED*), child's year in school (*GRADE*), child's score on Raven's Progressive Matrices test (*RAVEN*), years of experience the child's teacher has (*TCHEXP*), size of the child's school (*SIZE*), and child's score on a reading achievement test (*READING*). Assume that the interest is in explaining variations in children's math achievement. Present a diagram of a plausible path model, and briefly explain the decisions you made in creating the diagram.