Sociology 593
Exam 3 Answer Key
May 5, 1995

I. True-False. (30 points) Indicate whether the following statements are true or false. If false, briefly explain why.

1. A researcher has a sample of men and a sample of women. For both samples separately, she regresses income on education. The R^2 value is larger for men than it is for women. This means that the structural effect of education is larger for men than it is for women (i.e. $\beta^{Men} > \beta^{Women}$).

False. It could just be that there is more variability in men's education than there is in women's. Or, the random influences that affect women's income could be greater than the random influences that affect men.

2. When using OLS, the "best" model is the model with the largest R^2.

False. Your goal is to get a correctly specified model. It would be foolish to increase R^2 by, say, regressing Y on a variable that was one of its consequences rather than one of its causes.

3. One of the advantages of 2 stage least squares is that multicollinearity is not a problem.

False. Multicollinearity can be a major problem if the instruments are poor. Choosing poor instruments can simply shift you from perfect multicollinearity to extreme multicollinearity.

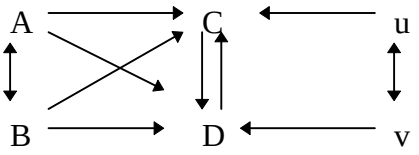
4. A physician has developed a new exercise program. She believes that those who participate in the program will be happier, more physically fit, and will work better on the job than those who do not participate. Happiness, physical fitness, and job productivity are all measured on interval-level scales. Participation in the program is coded 0 or 1. Her best strategy is to simply run three different OLS regressions.

False. Since there are multiple dependent variables, something like MANOVA or LISREL is preferable.

5. Ols provides unbiased estimates of recursive models.

True (assuming the model is correctly specified and no other OLS assumptions are violated).

6. A researcher wants to estimate the following model. Variables A, B, C, D have interval-level measurement. u and v are disturbance terms. She should use 2 stage least squares.



False. She should get a new model. This one is underidentified.

II. *Short answer*. (15 pts each; 45 pts total; up to 10 points extra credit). Answer *three* of the following (up to 5 pts. extra credit for each additional question you answer).

1. A researcher has collected data on the following variables: BLACK (1 = black, 0 = not black), FEMALE (1 = female, 0 = male) and INCOME (measured in thousands of dollars). Her dependent variable is DEMOCRAT (1 = Democrat, 0 = Republican). When she runs her logistic regression, she gets

$b_{Black} = 4.0$
$b_{Female} = 3.2$
$b_{Income} = -0.01$
$a = -3.0$

Complete the following table:

Race	Gender	Income in $1000s	Log odds	Odds	P(Democrat)
Black	Female	20	4.0		
White	Female	20			
White	Male	100			
Black	Male	100	0.0		

Solution.

Race	Gender	Income in $1000s	Log odds	Odds	P(Democrat)
Black	Female	20	4.0	54.60	98.2%
White	Female	20	0.0	1.0	50.0%
White	Male	100	-4.0	.018	1.8%
Black	Male	100	0.0	1	50.0%%

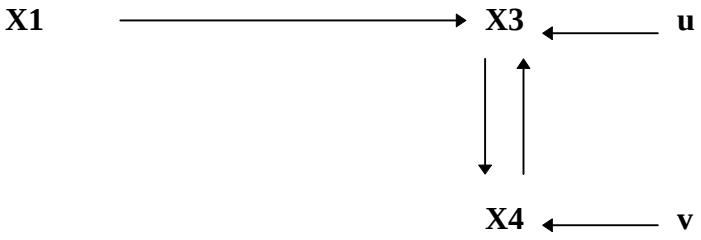
2. A researcher obtains the following printout from a logistic regression. Test the hypothesis that X1 and X2 have equal effects.

```
-> Compute SumX1X2 = X1 + X2.
->
-> LOGISTIC REGRESSION y
->   /METHOD=ENTER sumx1x2 x1.

Dependent Variable..   Y

Beginning Block Number  0.  Initial Log Likelihood Function
```

```
-2 Log Likelihood   301.41613

* Constant is included in the model.

Beginning Block Number  1.  Method: Enter

Variable(s) Entered on Step Number
1..       SUMX1X2
          X1

-2 Log Likelihood      272.741

                     Chi-Square    df Significance

 Model Chi-Square        28.675     2        .0000
 Improvement             28.675     2        .0000

---------------------- Variables in the Equation -----------------------

Variable            B      S.E.     Wald    df      Sig       R   Exp(B)

SUMX1X2        1.0062     .3339   9.0816     1    .0026   .1533   2.7352
X1              .4523     .4786    .8931     1    .3446   .0000   1.5719
Constant        .9917     .2157  21.1378     1    .0000
```

Solution. The Wald value for X1 is not significant. Ergo, we do not reject the hypothesis that the effects are equal.

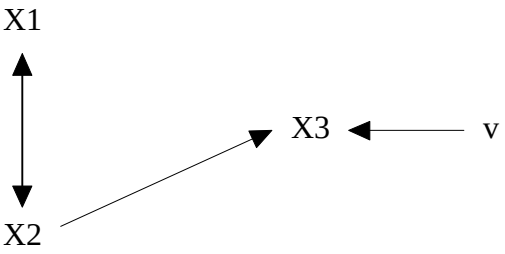
3. Consider the following model:



Explain why you agree or disagree with the following statement: In order to make this model identified, the researcher should try to find an X2 which has a strong effect on X4 but which has zero correlation with X3.

Disagree. X2 would be correlated with X3 (barring suppressor effects). X2 would indirectly affect X3 through X4. Further, X2 would likely be correlated with a cause of X3, X1. What we want is an X2 that is correlated with X3 for these two reasons, but at the same time does NOT have a direct effect on X3.

4. A researcher believes in the following model:



A sample of 100 cases is collected. It is found that $r_{12} = .50$, $r_{13} = .40$, $r_{23} = .50$. Test whether the overidentifying restriction imposed by this model appears to be valid.

This is equivalent to testing whether $\beta_{31} = 0$. In the constrained model (above), $b_{32} = r_{32} = .50$, so $R^2_c = .25$. In the unconstrained model,

$$b_{31} = \frac{r_{13} - r_{12}r_{23}}{1 - r_{12}^2} = \frac{.40 - .50*.50}{1 - .50^2} = .20$$

$$b_{32} = \frac{r_{23} - r_{12}r_{13}}{1 - r_{12}^2} = \frac{.50 - .50*.40}{1 - .50^2} = .40$$

and

$$R_u^2 = b_1'^2 + b_2'^2 + 2b_1'b_2'r_{12} = .20^2 + .40^2 + 2*.20*.40*.50 = .28$$

Doing an incremental F test, we get

$$F_{J,N-K-1} = \frac{(R_u^2 - R_c^2) * (N - K - 1)}{(1 - R_u^2) * J} = \frac{(.28 - .25) * (97)}{(1 - .28) * 1} = \frac{2.91}{.72} = 4.04$$

This F value is significant at the .05 level, so we conclude that the overidentifying restriction is not valid.

5. A researcher has collected data on home mortgage loan applications in St. Joseph County, Indiana. Examine the following printout. Based on this printout, are there racial differences in the determinants of having a loan application denied? If yes, do these racial differences occur in the slopes (i.e. the effects of IVs), the intercepts, or both?

```
-> * Extract from the 1990-1992 HMDA data for St. Joseph County.
-> * Applinc = Applicant Income, $1000s of dollars
-> * Localbnk = Is bank locally owned?
-> * Black = Is applicant black?
-> * Denial = Was loan application denied by bank?
->
-> get file='D:\SOC593\EXAM3.SAV'.

-> compute blkinc = black * applinc.
```

```
-> compute blklocal = black * localbnk.

-> LOGISTIC REGRESSION denial
->   /METHOD=ENTER applinc localbnk
->   /METHOD=ENTER black
->   /METHOD=ENTER blkinc blklocal
->   /CRITERIA PIN(.05) POUT(.10) ITERATE(20) .


      Total number of cases:      10980 (Unweighted)
      Number of selected cases:   10980
      Number of unselected cases: 0

      Number of selected cases:                 10980
      Number rejected because of missing data:  576
      Number of cases included in the analysis: 10404

Dependent Variable..   DENIAL

Beginning Block Number  0.  Initial Log Likelihood Function

-2 Log Likelihood   6766.9628

* Constant is included in the model.


Beginning Block Number  1.  Method: Enter

Variable(s) Entered on Step Number
1..       APPLINC   Applicant income
          LOCALBNK

-2 Log Likelihood     6474.333

---------------------- Variables in the Equation -----------------------

Variable           B      S.E.     Wald    df      Sig       R   Exp(B)

APPLINC       -.0242     .0019 162.7114     1    .0000  -.1541    .9761
LOCALBNK      -.4293     .0710  36.5904     1    .0000  -.0715    .6510
Constant     -1.1270     .0727 239.9658     1    .0000


Beginning Block Number  2.  Method: Enter

Variable(s) Entered on Step Number
1..       BLACK

-2 Log Likelihood     6445.640


---------------------- Variables in the Equation -----------------------

Variable           B      S.E.     Wald    df      Sig       R   Exp(B)

APPLINC       -.0235     .0019 154.3192     1    .0000  -.1534    .9768
LOCALBNK      -.4282     .0711  36.2831     1    .0000  -.0728    .6516
BLACK          .7867     .1377  32.6491     1    .0000   .0688   2.1961
Constant     -1.1903     .0738 260.1834     1    .0000
```

```
Beginning Block Number  3.  Method: Enter

Variable(s) Entered on Step Number
1..       BLKINC
          BLKLOCAL

-2 Log Likelihood     6443.380

---------------------- Variables in the Equation ----------------------

Variable            B      S.E.     Wald    df      Sig       R   Exp(B)

APPLINC        -.0237     .0020 146.9443     1    .0000  -.1500    .9766
LOCALBNK       -.4537     .0737  37.8755     1    .0000  -.0746    .6353
BLACK           .5296     .2878   3.3871     1    .0657   .0147   1.6983
BLKINC          .0042     .0079    .2759     1    .5994   .0000   1.0042
BLKLOCAL        .4112     .2849   2.0834     1    .1489   .0036   1.5087
Constant      -1.1770     .0753 244.1027     1    .0000
```

When BLACK is added (2nd model), the Wald value is highly significant, and the difference in -2LL is also highly significant ($L^2 = 28.69$ with 1 d.f.). However, when the 2 interaction terms are added, neither Wald value is significant, nor is the change in -2LL ($L^2 = 2.26$ with 2 d.f.) Ergo, we conclude that the intercepts are different for blacks and whites, but the effects of income and type of bank are the same.

III. *Essay*. (25 points) Answer *one* of the following questions.

1. Your psychology professor has told you that you should almost always focus on standardized, rather than unstandardized (metric) coefficients. Explain to your professor (as politely as possible) why he is wrong. Among other things, you may want to discuss the relative strengths and weaknesses of standardized vs. unstandardized coefficients with regard to:

a. Variables with arbitrary metrics (e.g. attitudinal scales)
b. Structural equation models
c. Multiple-group comparisons
d. Interpretability of coefficients
e. Effect of random measurement error on coefficients

2. Several assumptions are made when using OLS regression. Discuss TWO of the following. What does the assumption mean? When might the assumption be violated? What effects do violation of the assumption have on OLS estimates? How can violations of the assumption be avoided or dealt with? Be sure to talk about techniques such as 2SLS and logistic regression where appropriate. [NOTE: While the material from the last third of the course is especially relevant here, you should try to tie in earlier material as much as possible too.]

a. The effects of the independent variables are linear
b. Errors are homoskedastic
c. Variables are measured without error
d. The X's (independent variables) are uncorrelated with the residuals

See lecture notes for detailed discussions of each of these topics. Remember that, with question #2, these topics were discussed at multiple points during the semester.