Sociology 63993
Exam 2
March 26, 2010

I. True-False. (20 points) Indicate whether the following statements are true or false. If false, briefly explain why.

1. A researcher has included extraneous variables in her model. Increasing her sample size will help with the problems that are created by doing this.

2. A researcher obtains the following:

```
. estat ovtest

Ramsey RESET test using powers of the fitted values of warm
       Ho:  model has no omitted variables
                 F(3, 2288) =      3.81
                   Prob > F =      0.0098
```

This suggests that she should add interaction terms to her model.

3. A researcher regresses income on the respondent's race, years of education, IQ, and father's education (i.e. the number of years of education the respondent's father had). The estimated effect of father's education is 0 and is statistically insignificant. This means that, in terms of their own income, respondents gain no benefit from having a better educated father.

4. In order to make interaction effects more interpretable, the dependent variable should be centered about its mean.

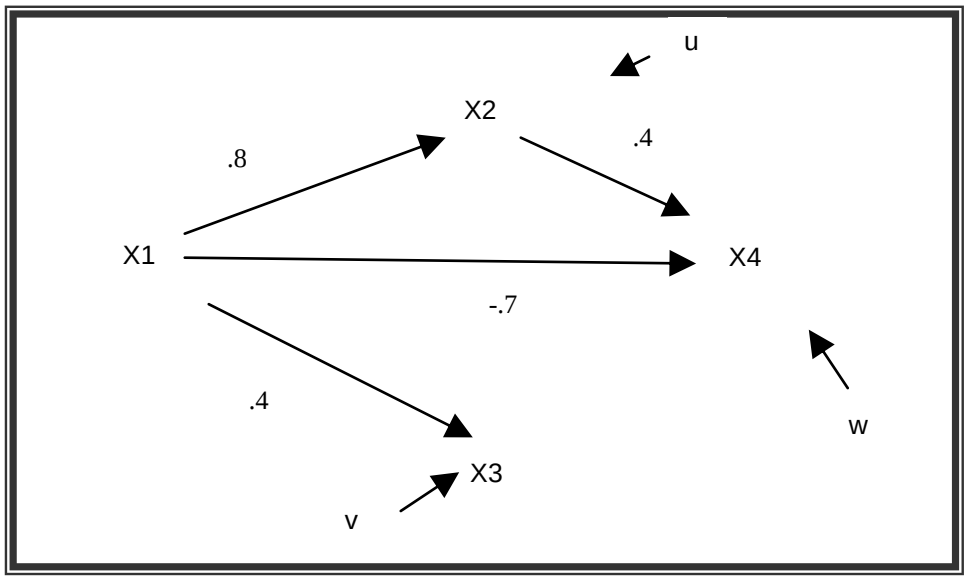
5. A researcher hypothesizes that informedness (measured on a 100 point scale) positively affects feelings of political efficacy for whites but has a negative effect for blacks. She obtains the following:

   $\beta_{White} = 0$
   $\beta_{Inf} = 7$
   $\beta_{Inf*White} = -5$

   β_{Inf} and $\beta_{Inf*White}$ are both highly significant. The results support the researcher's hypothesis.

II. Path Analysis/Model specification (25 pts).

A sociologist believes that the following model describes the relationship between X1, X2, X3, and X4. All her variables are in standardized form. The estimated value of each path in her model is included in the diagram.



a. (5 pts) Write out the structural equation for each endogenous variable, using both the names for the paths (e.g. β_{42}) and the estimated value of the path coefficient.

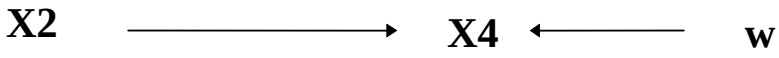
b. (10 pts) Part of the correlation matrix is shown below. Determine the complete correlation matrix. (Remember, variables are standardized. You can use either normal equations or Sewell Wright, but you might want to use both as a double-check.)

	x1	x2	x3	x4
x1	1.0000			
x2	0.8000	1.0000		
x3	?	?	1.0000	
x4	?	?	?	1.0000

c. (5 pts) Decompose the correlation between X1 and X4 into

- Correlation due to direct effects
- Correlation due to indirect effects
- Correlation due to common causes

d. (5 pts) Suppose the above model is correct, but instead the researcher believed in and estimated the following model:



What conclusions would the researcher likely draw? In particular, what would the researcher conclude about the effect of changes in X2 on X4? Discuss the consequences of this mis-specification, and in what ways, if any, the results would be misleading. Why would she make these mistakes?

III. Group comparisons (25 points). The Republican Party is uncertain about its prospects in the November Congressional elections. On the one hand, it is very excited by polls that show that, in a race between a Republican and a Democrat, 44 percent favor the Republican compared to only 39 percent for the Democrat. On the other hand, those same polls show that, if there is a third party candidate on the ballot (specifically, a Tea Party candidate), 36 percent favor the Democrat, 25 percent prefer the Republican and 15 percent say they would vote for the third party candidate. It therefore feels it needs to get a better understanding of support for third party candidacies. It has collected data from 5000 people on the following:

Variable	Description
thirdparty	Support for third party candidates, measured on a scale that ranges from -1500 to 1500. (Higher values indicate more support for a third party candidate.)
socialconservative	Scale that measures conservativism on various social issues, e.g. abortion, gay marriage. Ranges from -100 (very liberal) to 100 (very conservative). The variable has been centered to have a mean of zero.
teaparty	Coded 1 if the respondent says s/he is a supporter of the Tea Party, 0 otherwise
teasocial	teaparty * socialconservative

The results of the analysis are as follows:

```
. * Descriptive statistics
. sum thirdparty socialconservative teaparty teasocial

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
  thirdparty |      5000   -3.07e-06    69.06038   -319.041   1152.123
socialcons~e |      5000   -2.08e-07      13.826  -33.08312   93.46588
    teaparty |      5000       .1056    .3073557          0          1
   teasocial |      5000    .3378557    5.075021  -28.39412   93.46588

. * See if there are differences in 3rd party support by tea party affiliation
. ttest thirdparty, by(teaparty)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |    4472   -7.555341    .4181107    27.96032   -8.375045   -6.735638
       1 |     528    63.99142    8.027088    184.4484     48.2224    79.76044
---------+--------------------------------------------------------------------
combined |    5000   -3.07e-06    .9766612    69.06038   -1.914687    1.914681
---------+--------------------------------------------------------------------
    diff |           -71.54676     3.01283               -77.45323    -65.6403
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t = -23.7474
Ho: diff = 0                                     degrees of freedom =     4998

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

```
. * Estimate Models
. nestreg:  reg thirdparty socialconservative teaparty teasocial

Block  1: socialconservative

      Source |       SS       df       MS              Number of obs =    5000
-------------+------------------------------           F(  1,  4998) = 4421.11
       Model |  11190838.7     1  11190838.7           Prob > F      =  0.0000
    Residual |  12651070.1  4998  2531.22651           R-squared     =  0.4694
-------------+------------------------------           Adj R-squared =  0.4693
       Total |  23841908.8  4999  4769.33562           Root MSE      =  50.311

------------------------------------------------------------------------------
  thirdparty |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
socialcons~e |    3.422105   .0514668    66.49   0.000     3.321207    3.523003
       _cons |   -2.35e-06   .7115092    -0.00   1.000    -1.394872    1.394868
------------------------------------------------------------------------------

Block  2: teaparty

      Source |       SS       df       MS              Number of obs =    5000
-------------+------------------------------           F(  2,  4997) = 2926.95
       Model |  12862350.9     2  6431175.47           Prob > F      =  0.0000
    Residual |  10979557.8  4997   2197.2299           R-squared     =  0.5395
-------------+------------------------------           Adj R-squared =  0.5393
       Total |  23841908.8  4999  4769.33562           Root MSE      =  46.875

------------------------------------------------------------------------------
  thirdparty |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
socialcons~e |     3.3166   .0481036    68.95   0.000     3.222296    3.410904
    teaparty |   59.68283   2.163876    27.58   0.000     55.44069    63.92498
       _cons |   -6.30251   .7011852    -8.99   0.000     -7.67714   -4.927879
------------------------------------------------------------------------------

Block  3: teasocial

      Source |       SS       df       MS              Number of obs =    5000
-------------+------------------------------           F(  3,  4996) =       .
       Model |  23663705.5     3  7887901.82           Prob > F      =  0.0000
    Residual |  178203.299  4996  35.6691952           R-squared     =  0.9925
-------------+------------------------------           Adj R-squared =  0.9925
       Total |  23841908.8  4999  4769.33562           Root MSE      =  5.9724

------------------------------------------------------------------------------
  thirdparty |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
socialcons~e |   2.009966   .0065728   305.80   0.000      1.99708    2.022852
    teaparty |   32.32348   .2801499   115.38   0.000     31.77427     32.8727
   teasocial |   10.01233   .0181946   550.29   0.000     9.976659     10.048
       _cons |  -6.796085   .0893436   -76.07   0.000    -6.971238   -6.620932
------------------------------------------------------------------------------


  +-------------------------------------------------------------+
  |       |          Block  Residual                            Change |
  | Block |       F     df        df   Pr > F       R2    in R2 |
  |-------+-----------------------------------------------------|
  |     1 | 4421.11      1      4998   0.0000   0.4694          |
  |     2 |  760.74      1      4997   0.0000   0.5395   0.0701 |
  |     3 |  3.0e+05     1      4996   0.0000   0.9925   0.4530 |
  +-------------------------------------------------------------+
```

```
. * See if there are differences in social conservatism by tea party affiliation
. ttest socialconservative, by(teaparty)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |    4472   -.3777459    .2032083    13.58915   -.7761347    .0206429
       1 |     528    3.199391    .6673407    15.33432    1.888417    4.510366
---------+--------------------------------------------------------------------
combined |    5000   -2.08e-07    .1955291      13.826    -.383323    .3833226
---------+--------------------------------------------------------------------
    diff |           -3.577137    .6342778                -4.8206   -2.333675
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =  -5.6397
Ho: diff = 0                                     degrees of freedom =     4998

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

The initial t-test shows that Tea Party members have much higher levels of support for third party candidates. Based on the remaining results, explain to the Republican party why that is the case. When thinking about your answers, keep in mind the various reasons that two groups can differ on some outcome measure. Specifically, answer the following:

a) (15 pts) The researchers estimate a series of models. Which of the models do you think is best, and why? What do these models tell us about how social conservatism and tea party membership affect the amount of support for third parties? What ways (if any) do the determinants of third party support differ by tea party membership? According to your preferred model, how does the thirdparty score of the "average" (on social conservatism) tea party member compare to the "average" non-member?

b) (10 pts) The researchers then do one last t-test. What does this test tell us about how social conservatism differs by tea party membership? What additional insights, if any, does this test give us as to why Tea party members are more supportive of third parties?

IV. Short answer. Answer *both* of the following questions. (15 points each, 30 points total.) Each of the following describes a nonlinear or nonadditive relationship between variables. Draw a scatterplot that illustrates the relationship. Describe the harms that might result if you simply regressed Y on X, e.g. would values be over-estimated, under-estimated, or what? Indicate the model you think should be estimated, e.g. $E(Y) = \alpha + \beta_1 X + \beta_2 X^2$. Explain what variables you would need to compute in order to actually estimate the model, e.g. logs of variables, interaction terms. Finally, indicate how you would actually test whether or not nonlinearity or nonadditivity actually was a problem. If you find it helpful, you are welcome to present the Stata commands you would use, but the statistical rationale behind the command still needs to be clear.

a. Our Lady of the Angels Catholic Grade School has many Hispanic immigrant students, most of whom enter first grade speaking little or no English. The Principal suspects that students learn English slowly the first few years, and then start to pick up the language much more quickly. A standardized test is used to measure the English proficiency of all students. The

school finds that, for grades 1-3, each additional year of schooling leads to an average gain of 5 points on the test. For grades 4-8, each additional year of schooling leads to an average gain of 20 points on the test.

b. Notre Dame academic advisors have observed that student satisfaction seems to go up and down throughout the course of a student's four years here. They suspect that students are at first happy to be in college, then start to get tired of it, and then regain their enthusiasm once graduation is in sight. To examine this further, Notre Dame is conducting monthly studies of student satisfaction. It finds that, throughout the first three semesters of school, student satisfaction gradually rises. However, starting around second semester sophomore year, satisfaction steadily declines. However, in the last few months of Senior year, satisfaction once again starts to go up, and at a rapid pace.