Sociology 63993
Exam 2
March 27, 2009

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

1. A researcher regresses Political Liberalism (a scale that ranges between 0 and 100) on X. She does not include dummy variables or interaction terms for race. If the model is correct, it means that, on average, blacks and whites are equally liberal.

2. A researcher has inadvertently omitted an important variable from her model, resulting in omitted variable bias. Unfortunately, increasing the sample size will not help to reduce this bias.

3. A researcher runs the following regressions:

```
. reg health weight if white

      Source |       SS       df       MS              Number of obs =   10335
-------------+------------------------------           F(  1, 10333) =   18.08
       Model |  26.2659433     1  26.2659433           Prob > F      =  0.0000
    Residual |  15008.7554 10333  1.45250706           R-squared     =  0.0017
-------------+------------------------------           Adj R-squared =  0.0017
       Total |  15035.0214 10334   1.4549082           Root MSE      =  1.2052

------------------------------------------------------------------------------
      health |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      weight |  -.0032831   .0007721    -4.25   0.000    -.0047965   -.0017698
       _cons |   3.649905   .0567655    64.30   0.000     3.538634    3.761176
------------------------------------------------------------------------------

. reg health weight if !white

      Source |       SS       df       MS              Number of obs =     516
-------------+------------------------------           F(  1,   514) =    2.05
       Model |  2.96522291     1  2.96522291           Prob > F      =  0.1523
    Residual |  741.707258   514  1.44301023           R-squared     =  0.0040
-------------+------------------------------           Adj R-squared =  0.0020
       Total |  744.672481   515  1.44596598           Root MSE      =  1.2013

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      health |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      weight |  -.0049025     .00342    -1.43   0.152    -.0116213    .0018164
       _cons |   3.707847   .2493572    14.87   0.000     3.217962    4.197731
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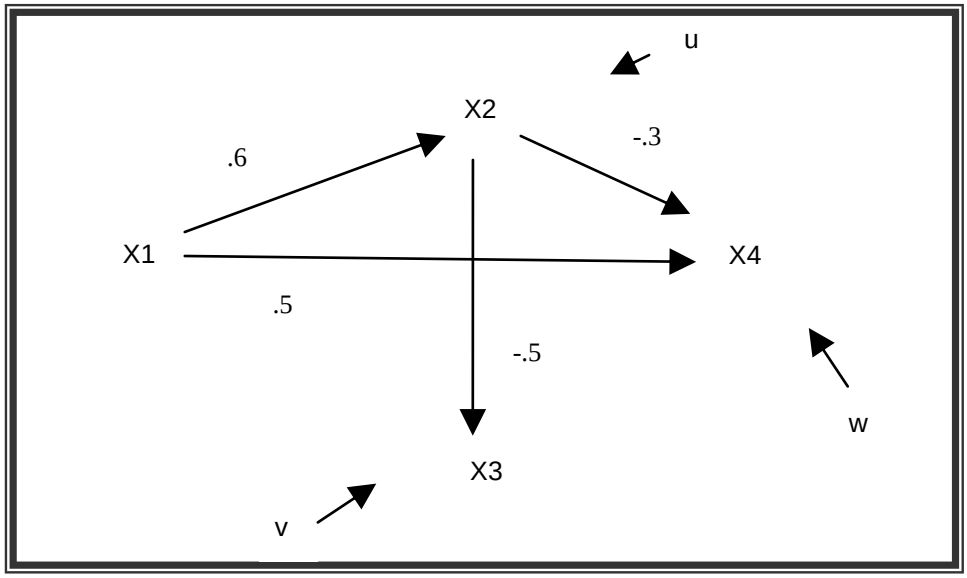
As the results show, weight has a statistically significant effect on the health of whites, but the effect is not significant for nonwhites. The researcher should therefore conclude that the effect of weight on health is significantly greater for whites.

4. Life satisfaction (measured on a 50 point scale) is regressed on Income, Female, and Female*Income. The coefficient for Female is +5. This means that, whenever a man and a woman have equal incomes, the woman is expected to score 5 points higher than the man on life satisfaction.

5. Exponential models are appropriate when we believe that the relationship between two variables is curvilinear.

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.

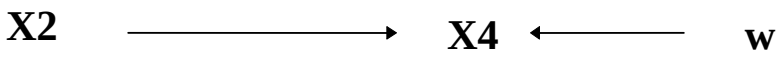
b. (10 pts) Part of the correlation matrix is shown below. Determine the complete correlation matrix. (Remember, variables are standardized. You can use either normal equations or Sewell Wright, but you might want to use both as a double-check.)

	x1	x2	x3	x4
x1	1.0000			
x2	.6000	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). It is mid-April 2009. To the dismay of Notre Dame officials, the controversy over having Barack Obama as commencement speaker continues to rage. More than 500,000 people have signed an online petition protesting the invitation. Hundreds of alumnae have withdrawn their pledges to the University, while dozens of parents are threatening to boycott their own child's graduation ceremony. At the same time, thousands of alumnae and students have expressed strong support for the decision. With the University's finances already suffering, administrators desperately feel that they need to better understand who is supporting the University, and why. An outside polling firm has therefore collected information from more than 10,000 ND alumnae on the following variables:

Variable	Description
nd	Likelihood of donating to Notre Dame, measured on a scale that runs from -100 to +100
prolife	Importance of prolife issues to the respondent. The original item was measured on a scale that ranges from 0 to 200, but the measure used in the analysis has been centered to have a mean of zero.
dem	Coded 1 if the respondent is a Democrat, 0 if Republican
demlife	dem * prolife

The results of the analysis are as follows:

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. * See if there are differences in support by party affiliation
. ttest nd, by(dem)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |    4909    13.47488    .3632543    25.45114    12.76274    14.18702
       1 |    5426    49.66043    .3191398    23.50828    49.03479    50.28607
---------+--------------------------------------------------------------------
combined |   10335    32.47273    .2990589    30.40269    31.88652    33.05895
---------+--------------------------------------------------------------------
    diff |           -36.18555    .4816196               -37.12961   -35.24148
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t = -75.1330
Ho: diff = 0                                     degrees of freedom =    10333

    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 nd prolife dem demlife

Block  1: prolife

      Source |       SS       df       MS              Number of obs =   10335
-------------+------------------------------           F(  1, 10333) = 1486.87
       Model |  1201578.31     1  1201578.31           Prob > F      =  0.0000
    Residual |  8350378.41 10333  808.127205           R-squared     =  0.1258
-------------+------------------------------           Adj R-squared =  0.1257
       Total |  9551956.71 10334  924.323274           Root MSE      =  28.428

------------------------------------------------------------------------------
          nd |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     prolife |  -.7022148    .018211   -38.56   0.000    -.7379119   -.6665177
       _cons |   32.47431   .2796306   116.13   0.000     31.92618    33.02244
------------------------------------------------------------------------------

Block  2: dem

      Source |       SS       df       MS              Number of obs =   10335
-------------+------------------------------           F(  2, 10332) = 3075.43
       Model |  3564476.12     2  1782238.06           Prob > F      =  0.0000
    Residual |  5987480.59 10332  579.508381           R-squared     =  0.3732
-------------+------------------------------           Adj R-squared =  0.3730
       Total |  9551956.71 10334  924.323274           Root MSE      =  24.073

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          nd |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     prolife |  -.3013264   .0166504   -18.10   0.000    -.3339643   -.2686885
         dem |   32.69198   .5119748    63.85   0.000     31.68841    33.69555
       _cons |   15.30973   .3582313    42.74   0.000     14.60752    16.01193
------------------------------------------------------------------------------
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Block 3: demlife

```
      Source |       SS       df       MS              Number of obs =   10335
-------------+------------------------------           F(  3, 10331) = 2092.17
       Model |  3609987.84     3  1203329.28           Prob > F      =  0.0000
    Residual |  5941968.87 10331   575.15912           R-squared     =  0.3779
-------------+------------------------------           Adj R-squared =  0.3778
       Total |  9551956.71 10334  924.323274           Root MSE      =  23.982

------------------------------------------------------------------------------
          nd |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     prolife |  -.4689101   .0251012   -18.68   0.000    -.5181134   -.4197068
         dem |   32.38671   .5112032    63.35   0.000     31.38465    33.38876
     demlife |   .2975046   .0334446     8.90   0.000     .2319467    .3630626
       _cons |   16.33018   .3748686    43.56   0.000     15.59537      17.065
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  +-------------------------------------------------------------+
  |       |          Block  Residual                    Change |
  | Block |       F     df        df   Pr > F       R2  in R2 |
  |-------+-----------------------------------------------------|
  |     1 | 1486.87      1     10333   0.0000   0.1258         |
  |     2 | 4077.42      1     10332   0.0000   0.3732   0.2474 |
  |     3 |   79.13      1     10331   0.0000   0.3779   0.0048 |
  +-------------------------------------------------------------+
```

```
. * Finally, test for differences in prolife attitudes by party affiliation
. ttest prolife, by(dem)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |    4909    6.089225     .194648    13.63787    5.707628    6.470822
       1 |    5428   -5.506997    .1999352    14.73022    -5.89895   -5.115044
---------+--------------------------------------------------------------------
combined |   10337    2.37e-06    .1510277    15.35515   -.2960412    .2960459
---------+--------------------------------------------------------------------
    diff |            11.59622    .2801171                11.04714    12.14531
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =  41.3978
Ho: diff = 0                                     degrees of freedom =    10335

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

The initial t-test shows that Democrats are significantly more likely to donate to Notre Dame. Based on the remaining results, explain to the Notre Dame administration 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 concern about prolife issues affects the likelihood of donating to the University? What ways (if any) do the determinants of support for Notre Dame differ by party affiliation? What insights, if any, does this give us as to why Democrats tend to be more supportive of Notre Dame?

b) (10 pts) The researchers then do one last t-test. What does this test tell us about how the pro-life attitudes of alumnae differ by party affiliation? What additional insights, if any, does this test give us as to why Democrats are more supportive of Notre Dame?

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. The Director of Graduate Studies is concerned about advanced students dropping out of the program; and if they are going to drop out, he wonders why they do not do so sooner. He theorizes that student satisfaction steadily increases during the first four years of study, as students take classes and prepare for area exams. However, after that, as students work on their dissertation, their level of satisfaction steadily decreases across time.

b. Conservative faculty at Georgetown feel that the Obama controversy at Notre Dame gives Georgetown a golden opportunity to finally stake its rightful claim to being the premier Catholic University in America. To add to Notre Dame's woes, it is sending its own pro-life literature to ND alumnae. Because of imperfect distribution methods, some ND alumnae will no doubt receive and read more of this literature than will others. The Georgetown professors feel that exposure to their literature will make alumnae more critical of Notre Dame, but they also think the effect will be greater for men than it is for women.