Sociology 63993, Exam1 Answer Key [Draft]
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I. *True-False.* (20 points) Indicate whether the following statements are true or false. If false, briefly explain why.

1. When working with complex survey data (and using the svy: prefix in Stata) nested models should be tested via the use of incremental F tests (i.e. you should estimate the constrained and unconstrained models separately and then use an incremental F test to contrast them).

False. Incremental tests where you estimate multiple models will not work. Instead you need to estimate the unconstrained model and use Wald tests to see if the constraints are justified.

2. The closer the tolerance of a variable is to 1, the more likely it is that you will have problems with multicollinearity.

False. Tolerance is good. The closer the tolerance is to 1, the better. A high tolerance means that the explanatory variables are not highly correlated with each other and hence multicollinearity will be less of a problem.

3. The most extreme outliers on Y (i.e. the cases where Y is furthest from the mean) will always have the most influence on the regression line.

False. First off, a discrepant value on Y would be a value of Y that was far from the predicted Y, not the mean of Y. Even a highly discrepant value of Y would have little or no effect on the regression line if the X value for the case was close to the mean value for X, because the case would have little or no leverage then.

4. Cohen and Cohen's Dummy Variable Adjustment technique has been discredited and should not be used under any circumstances.

False. The Cohen and Cohen method can still be useful when the X value is missing because it is non-existent, rather than unknown. For example, there might be no value for Father's Education because there was no father in the family. In this case the Cohen and Cohen method could be useful. If, on the other hand, there was a father in the family, but the value of his education is unknown for some reason, using the Cohen and Cohen method could produce biased parameter estimates.

5. A researcher runs the following analysis:

```
. alpha v1 v2 v3, i

Test scale = mean(unstandardized items)

                                                      average
                          item-test     item-rest       interitem
Item          |  Obs  Sign   correlation   correlation     covariance      alpha
--------------+-----------------------------------------------------------------
v1            | 3975    +       0.4842        0.1522        .2360952      0.7907
v2            | 3975    +       0.8448        0.6473        .0374987      0.1997
v3            | 3975    +       0.8836        0.5602        .0342703      0.2815
--------------+-----------------------------------------------------------------
Test scale    |                                             .1026214      0.6060
-------------------------------------------------------------------------------
```

Based on these results, she should drop v2 from her scale.

False. Dropping v2 (or v3) would make the scale less reliable. If anything, you should drop v1.

II. *Short answer.* Discuss all <u>three</u> of the following problems. (15 points each, 45 points total.) In each case, the researcher has used Stata to test for a possible problem, concluded that there is a problem, and then adopted a strategy to address that problem. Explain (a) what problem the researcher was testing for, and why she concluded that there was a problem, (b) the rationale behind the solution she chose, i.e. how does it try to address the problem, and (c) one alternative solution she could have tried, and why. (NOTE: a few sentences on each point will probably suffice – you don't have to repeat everything that was in the lecture notes.)

II-1.

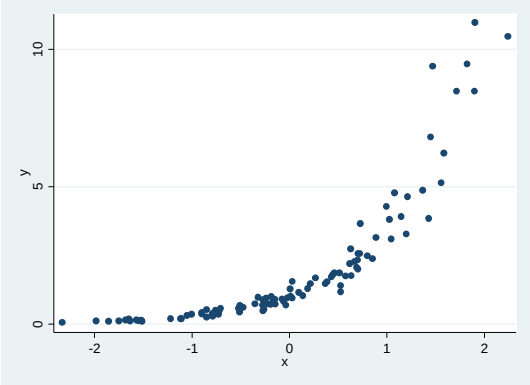
```
. reg health age weight height i.female i.race

      Source |       SS       df       MS              Number of obs =     800
-------------+------------------------------           F(  6,   793) =   28.89
       Model |  193.406808     6   32.234468           Prob > F      =  0.0000
    Residual |  884.811942   793  1.11577798           R-squared     =  0.1794
-------------+------------------------------           Adj R-squared =  0.1732
       Total |  1078.21875   799  1.34946026           Root MSE      =  1.0563

------------------------------------------------------------------------------
      health |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -.0211716   .0022829    -9.27   0.000    -.0256528   -.0166904
      weight |  -.0039733   .0028427    -1.40   0.163    -.0095535    .0016068
      height |   .0127136   .0058336     2.18   0.030     .0012625    .0241647
    1.female |   .1804978   .1031217     1.75   0.080    -.0219259    .3829216
             |
        race |
       Black |  -.7038075   .0977277    -7.20   0.000     -.895643   -.5119719
       Other |  -.0574042   .1235336    -0.46   0.642    -.2998958    .1850873
             |
       _cons |   2.645635   1.012356     2.61   0.009     .6584201    4.632851
------------------------------------------------------------------------------

. sum, sep(6)

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
        race |       800       1.445    .7071776          1          3
         age |      1100    48.88364    17.46024         20         74
      height |      1100    167.2078    10.19798      138.5        200
      weight |      1100     71.0562    15.31384      30.84     149.69
      health |      1100    3.401818    1.172321          1          5
      female |      1100    .5218182     .499751          0          1
```

```
. tab1 race

-> tabulation of race

   1=white, |
   2=black, |
    3=other |      Freq.     Percent        Cum.
------------+-----------------------------------
      White |        545       68.13       68.13
      Black |        154       19.25       87.38
      Other |        101       12.63      100.00
------------+-----------------------------------
      Total |        800      100.00

. mi set mlong

. mi register imputed race
(300 m=0 obs. now marked as incomplete)

. mi impute mlogit race health age height weight female, add(50) rseed(2232)

Univariate imputation                       Imputations =       50
Multinomial logistic regression                   added =       50
Imputed: m=1 through m=50                       updated =        0

------------------------------------------------------------------
                  |               Observations per m
                  |-----------------------------------------------
         Variable |   Complete   Incomplete   Imputed |     Total
------------------+-----------------------------------+----------
             race |        800          300       300 |      1100
------------------------------------------------------------------
(complete + incomplete = total; imputed is the minimum across m
 of the number of filled-in observations.)

. mi estimate: reg health age weight height i.female i.race

Multiple-imputation estimates                     Imputations     =         50
Linear regression                                 Number of obs   =       1100
                                                  Average RVI     =     0.1216
                                                  Largest FMI     =     0.2769
                                                  Complete DF     =       1093
DF adjustment:   Small sample                     DF:     min     =     357.50
                                                          avg     =     823.32
                                                          max     =    1052.35
Model F test:       Equal FMI                     F(   6, 1032.2) =      33.72
Within VCE type:          OLS                     Prob > F        =     0.0000

------------------------------------------------------------------------------
      health |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -.0200064   .0019955   -10.03   0.000    -.0239221   -.0160908
      weight |  -.0051971   .0024855    -2.09   0.037    -.0100745   -.0003198
      height |    .015661   .0050562     3.10   0.002     .0057391    .0255829
    1.female |   .2240806   .0902576     2.48   0.013     .0469683    .4011929
             |
        race |
          2  |  -.7150266     .09896    -7.23   0.000    -.9096434   -.5204098
          3  |  -.0666072   .1224521    -0.54   0.587    -.3074037    .1741892
             |
       _cons |   2.161208   .8808568     2.45   0.014     .4326168    3.889799
------------------------------------------------------------------------------
```

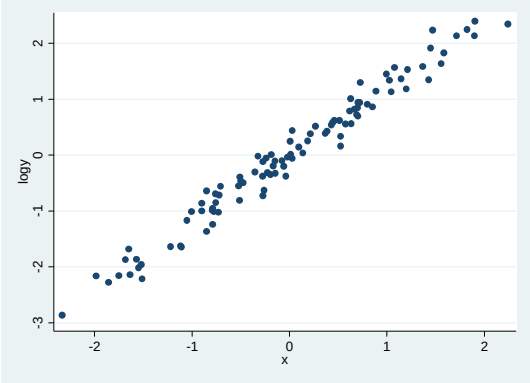
The researcher may have immediately gotten worried because she only had 800 cases when she knew there were 1100 cases in the data. The summarize command showed her that 300 cases had missing data on race. Further the tab1 command showed her that there were three possible values for race. She therefore decided to use multiple imputation to impute values for race. For the imputation method she used mlogit because race was categorical and had three different possible values. (If it only had two values she probably would have used logit.) Note that, once she was able to retrieve data from those 300 cases, the effects of weight and gender became statistically significant. She could have just stuck with using listwise deletion, but then she would have lost more than a fourth of her sample and fewer variables would have had statistically significant effects. The class notes explain why various other methods (e.g. pairwise deletion) could have done more harm than good.

II-2.

```
. reg y x

      Source |       SS       df       MS              Number of obs =     100
-------------+------------------------------           F(  1,    98) =  204.90
       Model |   387.15257     1   387.15257           Prob > F      =  0.0000
    Residual |   185.17243    98  1.88951459           R-squared     =  0.6765
-------------+------------------------------           Adj R-squared =  0.6732
       Total |     572.325    99  5.78106061           Root MSE      =  1.3746

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   1.977532   .1381521    14.31   0.000     1.703373     2.25169
       _cons |    1.94407   .1374596    14.14   0.000     1.671286    2.216854
------------------------------------------------------------------------------

. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of y

         chi2(1)      =    32.27
         Prob > chi2  =   0.0000

. twoway scatter y x, name(g1)
```



```
. gen logy = log(y)

. twoway scatter logy x, name(g2)
```




```
. reg logy x

      Source |       SS       df       MS              Number of obs =     100
-------------+------------------------------           F(  1,    98) = 3528.00
       Model |      142.56     1      142.56           Prob > F      =  0.0000
    Residual |  3.96000021    98  .040408165           R-squared     =  0.9730
-------------+------------------------------           Adj R-squared =  0.9727
       Total |  146.520001    99  1.48000001           Root MSE      =  .20102

------------------------------------------------------------------------------
        logy |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |         1.2   .0202031    59.40   0.000     1.159908    1.240092
       _cons |   2.14e-09   .0201018     0.00   1.000    -.0398913    .0398913
------------------------------------------------------------------------------

. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logy

         chi2(1)      =     0.02
         Prob > chi2  =   0.8781
```

The hettest command suggested her data suffered from heteroskedasticity, which could bias her standard errors. When she did a scatterplot of the data, however, she realized that the relationship between x and y did not appear to be linear, and if so that was a violation of the assumptions of the model. When she computed the log of y and plotted it against x, she saw that the relationship was much more linear. When she regressed logy on x, the relationship was far stronger than in the original model and the subsequent hettest was totally insignificant. She could, of course, have used something like robust standard errors or weighted least squares, but that would have almost certainly been a mistake. The problem was not heteroskedasticity but a mis-specified model that created the appearance of heteroskedasticity.

II-3.

```
. reg y x

      Source |       SS       df       MS              Number of obs =    3975
-------------+------------------------------           F(  1,  3973) =    0.04
       Model |  559.504598     1  559.504598           Prob > F      =  0.8437
    Residual |  57188892.5  3973  14394.3852           R-squared     =  0.0000
-------------+------------------------------           Adj R-squared = -0.0002
       Total |  57189452.1  3974  14390.9039           Root MSE      =  119.98

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   .3505943   1.778278     0.20   0.844    -3.135828    3.837017
       _cons |    3.50558   2.474016     1.42   0.157    -1.344881    8.356041
------------------------------------------------------------------------------

. dfbeta
                      _dfbeta_1: dfbeta(x)

. extremes _df* y x

  +-----------------------------------------+
  |  obs:   _dfbeta_1           y          x |
  |-----------------------------------------|
  | 2846.   -20.48698    7560.241   .1534038 |
  | 2100.   -.0031762   -6.815401   3.137415 |
  | 3828.   -.0019974   -2.850775   3.062574 |
  |   70.   -.0019538    -3.89073   2.776838 |
  | 3739.   -.0019023   -5.510675   2.447441 |
  +-----------------------------------------+

  +-----------------------------------------+
  | 2439.   .0025574   -8.791584   -.8340001 |
  | 2444.    .002686    -7.56208   -1.147358 |
  |  171.   .0027336   -11.03818   -.6557877 |
  | 1442.   .0027977   -7.366304   -1.281223 |
  | 2546.   .0028055   -12.22433   -.5724241 |
  +-----------------------------------------+

. drop  _df*

. replace y = y/1000 in 2846
(1 real change made)
```

```
. reg y x

      Source |       SS       df       MS              Number of obs =    3975
-------------+------------------------------           F(  1,  3973) =  693.88
       Model |  11237.3545     1  11237.3545           Prob > F      =  0.0000
    Residual |  64343.0002  3973  16.1950668           R-squared     =  0.1487
-------------+------------------------------           Adj R-squared =  0.1485
       Total |  75580.3548  3974  19.0187103           Root MSE      =  4.0243

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   1.571213   .0596478    26.34   0.000      1.45427    1.688156
       _cons |   .5203355   .0829846     6.27   0.000     .3576392    .6830318
------------------------------------------------------------------------------

. dfbeta
                      _dfbeta_1: dfbeta(x)

. extremes _df* y x

  +-----------------------------------------+
  |  obs:   _dfbeta_1           y          x |
  |-----------------------------------------|
  | 2100.   -.1018125   -6.815401   3.137415 |
  |  619.   -.0739862    12.73301  -.6295367 |
  | 2606.   -.0678742     12.7148  -.5239393 |
  | 3828.    -.065618   -2.850775   3.062574 |
  | 2574.   -.0643436    10.71742  -.6628681 |
  +-----------------------------------------+

  +-----------------------------------------+
  | 1111.   .0597705    13.48404   2.771187 |
  |  171.   .0599936   -11.03818  -.6557877 |
  | 2724.   .0613352    13.84974   2.727732 |
  |  665.   .0637711    13.70689   2.887728 |
  | 2546.   .0638679   -12.22433  -.5724241 |
  +-----------------------------------------+
```

If the researcher was expecting a strong effect (or any effect) of x on y, she was probably dismayed when this was not the case. Perhaps suspecting that outliers may be a problem, she computed the dfbeta value for each case. The dfbetas indicate how much influence each case is having on the slope coefficient. The subsequent listing of extreme values showed that case 2846 had an enormous value for dfbeta, and also that the Y value for the case seemed to be off by about a factor of a 1000 compared to other cases. She therefore divided the y value for that case by a 1000, and after that everything worked much better. Hopefully she first confirmed that the Y value for case 2846 had indeed been entered incorrectly and if so she chose the best strategy. If, on the other hand, the value was actually correct, she might have considered adding other variables to the model that could explain the extreme value, redefined the population of interest so that the case should no longer be included, or used robust regression techniques that are less sensitive to outliers. If she was sure the value was wrong but could not determine what the correct value was, she might want to just drop the case from the analysis.

III. Computation and interpretation. (35 points total) The Center for Disease Control is very concerned about the anti-vaccination movement in the United States. According to the World Health Organization (http://www.who.int/mediacentre/factsheets/fs286/en/), measles is one of the leading causes of death among young children worldwide even though a safe and cost-effective vaccine is available. In the United States, the number of measles cases has skyrocketed in recent years, largely because growing numbers of parents are choosing not to vaccinate their children. Various explanations have been offered.

- Due to a now discredited study (http://www.newsweek.com/autism-how-childhood-vaccines-became-villains-82273) , some parents fear that the measles vaccine can cause autism.
- Another recent article claimed that vaccination refusal was a "white privilege" problem: it takes money and time to refuse vaccinations, and whites are more likely to have that money and time than are minorities (http://www.xojane.com/issues/vaccination-refusal-white-privilege).
- Finally, another study, recently reported on NPR (http://www.npr.org/blogs/health/2015/02/06/384322665/to-get-parents-to-vaccinate-their-kids-dont-ask-just-tell), claims that a doctor's approach has a major impact on whether or not parents vaccinate their children. When doctors just simply presumed that the parent was going to be fine with the vaccines that the doctor was going to recommend (e.g. "Johnny is due for his DTaP shot today"), parents were much more likely to get their child vaccinated than they were when the doctor asked them how they felt about vaccination.

To assess the validity and importance of these different claims, the CDC has collected complete data from 2000 parents of young children. The items included in the survey are:

Variable	Description
vaccination	Scale that measures feelings about vaccination. Ranges from 0 = extremely negative about vaccinations to 100 = extremely positive. This is the dependent variable.
white	Coded 1 if white, 0 if non-white
autism	Scale that measures beliefs about whether vaccines can lead to autism. 0 = no chance that vaccinations can cause autism to 100 = extremely likely that vaccinations can cause autism.
approach	Scale that measures how forceful the children's doctor is in pushing vaccinations. 0 = not forceful at all, 100 = just assumes the parent will want their child vaccinated.

An analysis of the data yields the following results. [NOTE: You'll need some parts of the following to answer the questions, but other parts are extraneous. You'll have to figure out which is which.]

```
. sum vaccinate white autism approach

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
   vaccinate |      2000     47.3155     26.8503          1        100
       white |      2000        .885    .3191017          0          1
      autism |      2000     27.4605    17.03163          0         71
    approach |      2000      60.605    15.83222          0        100
```

```
. reg vaccinate i.white autism approach, vce(robust)

Linear regression                                       Number of obs =    2000
                                                        F(  3,  1996) =   47.22
                                                        Prob > F      =  0.0000
                                                        R-squared     =  0.0648
                                                        Root MSE      =  25.985

------------------------------------------------------------------------------
             |               Robust
   vaccinate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       white |
      White  |  -4.363207   1.798159    -2.43   0.015    -7.889673   -.8367423
      autism |  -.2537355   .0352135    -7.21   0.000    -.3227946   -.1846764
    approach |   .2573966   .0386828     6.65   0.000     .1815336    .3332596
       _cons |   42.54512   3.013613    14.12   0.000     36.63497    48.45528
------------------------------------------------------------------------------

. reg vaccinate i.white autism approach

      Source |       SS       df       MS              Number of obs =    2000
-------------+------------------------------           F(  3,  1996) =    [2]
       Model |  93383.6877   [1]  31127.8959           Prob > F      =  0.0000
    Residual |  1347772.23  1996  675.236589           R-squared     =    [3]
-------------+------------------------------           Adj R-squared =  0.0634
       Total |  1441155.92  1999      [4]              Root MSE      =  25.985

------------------------------------------------------------------------------
   vaccinate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       white |
      White  |  -4.363207   1.838179     [5]    0.018    -7.968157   -.7582576
      autism |  -.2537355   .0357901    -7.09   0.000    -.3239253   -.1835457
    approach |   .2573966   .0387209     6.65   0.000     .1814591    .3333342
       _cons |   42.54512   3.099787    13.73   0.000     36.46596    48.62428
------------------------------------------------------------------------------


. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of vaccinate

         chi2(1)      =     2.40
         Prob > chi2  =   0.1212

. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      14.88      8    0.0614
            Skewness |      44.28      3    0.0000
            Kurtosis |      56.84      1    0.0000
---------------------+-----------------------------
               Total |     116.00     12    0.0000
---------------------------------------------------
```

```
. testparm i.white autism approach

 ( 1)  1.white = 0
 ( 2)  autism = 0
 ( 3)  approach = 0

       F(  3,  1996) =   46.10
            Prob > F =    0.0000

. test approach = -autism

 ( 1)  autism + approach = 0

       F(  1,  1996) =    0.00
            Prob > F =    0.9514

. pcorr vaccinate white autism approach
(obs=2000)

Partial and semipartial correlations of vaccinate with

               Partial   Semipartial      Partial   Semipartial   Significance
   Variable |    Corr.         Corr.      Corr.^2       Corr.^2          Value
------------+------------------------------------------------------------------
      white |  -0.0531       -0.0514       0.0028        0.0026         0.0177
     autism |  -0.1567       -0.1535       0.0246        0.0235         0.0000
   approach |   0.1472        0.1439       0.0217        0.0207         0.0000

. reg vaccinate i.white autism approach i.white#i.white

      Source |       SS       df       MS              Number of obs =    2000
-------------+------------------------------           F(  3,  1996) =   46.10
       Model |  93383.6877     3  31127.8959           Prob > F      =  0.0000
    Residual |  1347772.23  1996  675.236589           R-squared     =  0.0648
-------------+------------------------------           Adj R-squared =  0.0634
       Total |  1441155.92  1999  720.938429           Root MSE      =  25.985

------------------------------------------------------------------------------
   vaccinate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      white |
      White  |  -4.363207   1.838179    -2.37   0.018    -7.968157   -.7582576
      autism |  -.2537355   .0357901    -7.09   0.000    -.3239253   -.1835457
    approach |   .2573966   .0387209     6.65   0.000     .1814591    .3333342
       _cons |   42.54512   3.099787    13.73   0.000     36.46596    48.62428
------------------------------------------------------------------------------
```

a) (10 pts) Fill in the missing quantities [1] – [5]. (A few other values may have also been blanked out, but you don't need to fill them in.)

Here is the uncensored printout:

```
. reg vaccinate i.white autism approach

      Source |       SS       df       MS              Number of obs =    2000
-------------+------------------------------           F(  3,  1996) =   46.10
       Model |  93383.6877     3  31127.8959           Prob > F      =  0.0000
    Residual |  1347772.23  1996  675.236589           R-squared     =  0.0648
-------------+------------------------------           Adj R-squared =  0.0634
       Total |  1441155.92  1999  720.938429           Root MSE      =  25.985

------------------------------------------------------------------------------
   vaccinate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       white |
      White  |  -4.363207   1.838179    -2.37   0.018    -7.968157   -.7582576
      autism |  -.2537355   .0357901    -7.09   0.000    -.3239253   -.1835457
    approach |   .2573966   .0387209     6.65   0.000     .1814591    .3333342
       _cons |   42.54512   3.099787    13.73   0.000     36.46596    48.62428
------------------------------------------------------------------------------
```

To confirm that Stata got it right:

[1] = model sums of squares = k = 3 (there are 3 explanatory variables). Masochists could also do some algebra with SSmodel and MSmodel and get the same result.

[2] = Global F = 46.10 (because the `testparm` command told you that). Those who prefer more of a challenge can compute F = MSmodel/MSresidual = 31127.8959/675/236589 = 46.10.

[3] = R-squared = SSmodel/SStotal = 93383.6877/1441155.92 = .0648

[4] = MStotal = SStotal/DFtotal = 1441155.92/1999 = 720.94. Or, if you prefer, remember that MStotal = Variance Y = $(SD\ Y)^2 = 26.8503^2 = 720.94$ (the standard deviation is given in the `summarize` output)

[5] = $T_{white} = b_{white}/se_{white} = -4.363207/1.838179 = -2.37$

b) (25 points) Answer the following questions about the analysis and the results, explaining how the printout supports your conclusions.

1. Summarize the key findings. In your discussion, indicate whether or not the beliefs that caused the CDC to examine the variables in the first place were borne out by the results.

Whites have less positive feelings about vaccinations, as do those who believe that vaccinations can cause autism. Parents with doctors who take a more forceful approach about vaccinations have more positive feelings about them. All three effects are highly significant. These findings are all consistent with the claims made in the articles that were cited.

2. An additional 227 cases were dropped from the analysis because they were missing data on race and/or approach. If you wanted to keep those cases in the analysis, what multiple imputation method or methods would you recommend using (e.g. logit, mlogit, regress, ologit, pmm, poisson, or something else)? Briefly explain why.

Since multiple variables have missing data, and some cases have missing data on two variables, I would probably use `mi impute chained`, which supports multivariate

Imputation using Chained Equations (ICE). ICE uses iterative procedures to impute missing values when more than one variable is missing. These variables can be of different types, e.g. they might be binary, ordinal or continuous. I would use logit for white (since it is a dichotomy) and either regress or pmm (predictive mean matching) for approach since it is a continuous variable. The command would look something like

```
mi impute chained (logit) white (regress) approach = vaccinate autism, add(20) rseed(2232)
```

3. The researchers ran the regression with vce(robust) and then again without vce(robust). They noticed that the coefficients did not change, so they decided to not use vce(robust). Do you think this was sound reasoning on their part? Whether it was or was not sound reasoning is there other evidence from the printout that supports or challenges their decision to not use robust standard errors?

It sounds like they made the right decision for the wrong reason. Coefficients are not supposed to change when using robust standard errors; the standard errors do. But, the hettest and imtest commands indicate that heteroskedasticity is not a problem. Further the changes in the standard errors between when vce(robust) is used and not used are trivial.

4. Some of the researchers believe that beliefs about autism have the greatest impact on support for vaccinations. Others say that it is the doctor's approach that matters the most. Still others contend that both variables are about equally important and that the differences in their effects are either trivial or non-existent. What is your own position on this, and why? Be sure to cite multiple pieces of information from the printout to support your position.

It is hard to make a case for one variable over the other. The estimated coefficients are almost identical in magnitude (albeit opposite in sign, as you would expect them to be) and the test command further confirms that (other than sign) there is no significant difference between them. The t values and the semi-partial correlations give a very slight edge to autism but it is a pretty trivial difference. The results seem to indicate that both variables have about equal impact.

5. An undergraduate intern has been told that it is often important to include squared terms in models, so he added white^2 to the final regression. To his surprise, none of the results changed. Indeed the squared term didn't even show up in the output. Explain to him why this was the case. [Note: You can draw on your vast sociological expertise in offering a theoretical explanation for this. Or, if that student happens to be visiting us this weekend, you can explain why Notre Dame Sociology may want to think twice before admitting him.]

If you have a variable that is coded 0/1, the squared values are also 0/1, which means that white and white^2 are perfectly correlated. So, squaring a dichotomy makes no sense; you should only square things like continuous variables. If this person is visiting us this weekend, try to talk about how incredibly cold and snowy it gets here and how you are sure he would be much much happier somewhere else.

Appendix: Stata Code for Exam 1

```
Version 13.1

* Problem I-5.
use http://www3.nd.edu/~rwilliam/statafiles/anomia.dta, clear
clonevar v1 = anomia3
clonevar v2 = anomia7
corr2data e3
gen v3 = v2 + .5*e3
alpha v1 v2 v3, i

* Problem II-1
* Set up data
webuse nhanes2f, clear
keep in 1/1100
keep health age weight height female race
replace race = . in 1/300
* Present output
reg health age weight height i.female i.race
sum, sep(6)
tab1 race
mi set mlong
mi register imputed race
mi impute mlogit race health age height weight female, add(50) rseed(2232)
mi estimate: reg health age weight height i.female i.race

* Problem II-2
* Prepare data
clear all
set obs 100
corr2data x e
gen y = exp(1.2*x + .2*e)
* Present results
reg y x
estat hettest
twoway scatter y x, name(g1)
gen logy = log(y)
twoway scatter logy x, name(g2)
reg logy x
estat hettest

* Problem II-3
* Create/ manipulate data
use http://www3.nd.edu/~rwilliam/statafiles/anomia.dta, clear
corr2data e1 e2
gen x = anomia4 + anomia4 + e1*.40
gen y = anomia4 + anomia5 + x + 4*e2
replace y = y*1000 in 2846
* Now do the analysis
reg y x
dfbeta
extremes _df* y x
drop  _df*
replace y = y/1000 in 2846
reg y x
dfbeta
extremes _df* y x
```

```
* Problem III
* Prepare data
use http://www3.nd.edu/~rwilliam/statafiles/ordwarm2, clear
gen vaccinate = (warm - 1) * 33 + 1
gen autism = age - 18
gen approach = ed * 5
keep vaccinate white autism approach
keep in 1/2000
* Present results
sum vaccinate white autism approach
reg vaccinate i.white autism approach, vce(robust)
reg vaccinate i.white autism approach
estat hettest
estat imtest
testparm i.white autism approach
test approach = -autism
pcorr vaccinate white autism approach
reg vaccinate i.white autism approach i.white#i.white
```