Sociology 593
Exam 1
February 13, 2004

I. True-False. (20 points) These questions all pertain to the following analysis: A researcher is interested in the relationship between race (white, black, and other; dummy variables have been computed for race) and an attitudinal scale she has constructed (psyscale). Her results are as follows:

```
. reg  psyscale white black

      Source |       SS       df       MS              Number of obs =     438
-------------+------------------------------           F(  2,   435) =  155.90
       Model |  334.812471     2  167.406236           Prob > F      =  0.0000
    Residual |  467.105132   435   1.0738049           R-squared     =  0.4175
-------------+------------------------------           Adj R-squared =  0.4148
       Total |  801.917603   437  1.83505172           Root MSE      =  1.0362

------------------------------------------------------------------------------
    psyscale |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       white |   1.897789   .1212834    15.65   0.000     1.659415    2.136163
       black |   1.808343   .1212834    14.91   0.000     1.569969    2.046718
       _cons |   7.081524   .0857603    82.57   0.000     6.912968     7.25008
------------------------------------------------------------------------------

. test white = black

 ( 1)  white - black = 0

       F(  1,   435) =    0.54
            Prob > F =    0.4612
```

Indicate whether the following statements are true or false. If false, briefly explain why.

1. Based on these results, she should conclude that race does not significantly affect attitudes.

2. The researcher is confident that race is well measured, but she also believes that psyscale suffers from random measurement error. Increasing the sample size would help to make this less problematic.

3. The researcher has conducted a GQ test and the test statistic is not significant. This shows that heteroscedasticity is not a problem in her data.

4. The researcher has decided to re-estimate her regression model, this time using robust standard errors. This will probably cause her coefficient estimates, standard errors, and t values to change.

5. The researcher has again decided to re-estimate her regression model, this time using backwards stepwise selection. Hence, in the next step, black will be dropped from her model.

II. Short answer. Discuss <u>three</u> of the following five problems. (15 points each, 45 points total, up to 5 points extra credit for each additional problem.) In each case, the researcher has used SPSS or 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, why the test or tests used were appropriate, 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) at least one or two alternative solutions she could have tried, and why.

II-1.

```
. reg  y x1 x2 x3

      Source |       SS       df       MS              Number of obs =     400
-------------+------------------------------           F(  3,   396) =   70.33
       Model |  126.086202     3  42.0287339           Prob > F      =  0.0000
    Residual |  236.656252   396  .597616798           R-squared     =  0.3476
-------------+------------------------------           Adj R-squared =  0.3426
       Total |  362.742454   399  .909128957           Root MSE      =  .77306

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.0749123   .7937044    -0.09   0.925    -1.635313    1.485489
          x2 |  -.0834071   .7894182    -0.11   0.916    -1.635382    1.468567
          x3 |    .390442    .790224     0.49   0.622    -1.163117    1.944001
       _cons |  -.0138723   .0387045    -0.36   0.720    -.0899643    .0622196
------------------------------------------------------------------------------

. vif

    Variable |       VIF       1/VIF
-------------+----------------------
          x3 |   1358.71    0.000736
          x1 |    454.95    0.002198
          x2 |    445.10    0.002247
-------------+----------------------
    Mean VIF |    752.92


. reg y x1 x2

      Source |       SS       df       MS              Number of obs =     400
-------------+------------------------------           F(  2,   397) =  105.57
       Model |  125.940308     2  62.9701542           Prob > F      =  0.0000
    Residual |  236.802145   397  .596478956           R-squared     =  0.3472
-------------+------------------------------           Adj R-squared =  0.3439
       Total |  362.742454   399  .909128957           Root MSE      =  .77232

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .3166639   .0433117     7.31   0.000     .2315151    .4018128
          x2 |   .3060416   .0435516     7.03   0.000     .2204209    .3916622
       _cons |  -.0130207   .0386293    -0.34   0.736    -.0889642    .0629228
------------------------------------------------------------------------------
```

II-2.

```
. reg inc  educ jobexp

      Source |       SS       df       MS              Number of obs =     500
-------------+------------------------------           F(  2,   497) =   77.17
       Model |  32482.8173     2  16241.4087           Prob > F      =  0.0000
    Residual |  104599.191   497  210.461149           R-squared     =  0.2370
-------------+------------------------------           Adj R-squared =  0.2339
       Total |  137082.008   499  274.713444           Root MSE      =  14.507

------------------------------------------------------------------------------
         inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |    1.99003    .164487    12.10   0.000     1.666854    2.313206
      jobexp |   .5617026   .1293588     4.34   0.000      .307545    .8158602
       _cons |  -5.911479   3.021675    -1.96   0.051    -11.84831    .0253521
------------------------------------------------------------------------------


. hettest educ

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: educ

         chi2(1)      =    78.73
         Prob > chi2  =   0.0000


. reg inc  educ jobexp [aw = 1/educ^2]
(sum of wgt is   6.3404e+00)

      Source |       SS       df       MS              Number of obs =     500
-------------+------------------------------           F(  2,   497) =  338.25
       Model |  59996.7523     2  29998.3762           Prob > F      =  0.0000
    Residual |  44077.9356   497  88.6879992           R-squared     =  0.5765
-------------+------------------------------           Adj R-squared =  0.5748
       Total |  104074.688   499  208.566509           Root MSE      =  9.4174

------------------------------------------------------------------------------
         inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   1.884388   .0830109    22.70   0.000     1.721293    2.047484
      jobexp |   .5667619   .0905118     6.26   0.000      .388929    .7445948
       _cons |  -4.628755   1.219253    -3.80   0.000     -7.02428   -2.233229
------------------------------------------------------------------------------
```

II-3.

```
. reg y x

      Source |       SS       df       MS              Number of obs =     300
-------------+------------------------------           F(  1,   298) =    7.34
       Model |  12944.8562     1  12944.8562           Prob > F      =  0.0071
    Residual |  525247.207   298  1762.57452           R-squared     =  0.0241
-------------+------------------------------           Adj R-squared =  0.0208
       Total |  538192.063   299  1799.97345           Root MSE      =  41.983

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |    2.04354    .754064     2.71   0.007     .5595746    3.527505
       _cons |   -4.00445   3.877035    -1.03   0.303    -11.63429    3.625385
------------------------------------------------------------------------------

. predict rstandard, rstandard

. dfbeta
                            DFx:  DFbeta(x)

. extremes  rstandard DFx  y x

  +-----------------------------------------------------+
  | obs:   rstandard         DFx           y          x |
  |-----------------------------------------------------|
  | 131.   -.4009594   -.0302183   -4.013718   8.195821 |
  | 204.   -.3840846   -.0318037   -2.460587   8.606113 |
  |  42.   -.3784217    -.032272   -1.941961    8.74255 |
  | 134.   -.3583736   -.0484251    4.542933   11.46649 |
  | 151.   -.3270369   -.0070271   -7.064314   5.208639 |
  +-----------------------------------------------------+

  +-----------------------------------------------------+
  |  96.   .2108727   -.0019709    11.97055    3.492507 |
  | 285.   .2430508   -.0384514   -3.518938   -4.685962 |
  | 276.   .2586429   -.0271533    3.099044   -1.799608 |
  | 286.   .3552958   -.0373423     7.11564     -1.8055 |
  |   3.   17.18468    14.61801    731.2714    8.495018 |
  +-----------------------------------------------------+


. rreg y x, nolog

Robust regression estimates                           Number of obs =     299
                                                      F(  1,   297) =  194.24
                                                      Prob > F      =  0.0000

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   1.021697   .0733091    13.94   0.000     .8774255    1.165968
       _cons |  -2.244073   .3758284    -5.97   0.000    -2.983697   -1.504449
------------------------------------------------------------------------------
```

II-4.

```
SUMMARIZE
  /TABLES=y x1 x2
  /FORMAT=VALIDLIST NOCASENUM TOTAL LIMIT=100
  /TITLE='Case Summaries'
  /MISSING=VARIABLE
  /CELLS=COUNT .
```

Summarize

Case Processing Summary[a]

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Y	40	100.0%	0	.0%	40	100.0%
X1	28	70.0%	12	30.0%	40	100.0%
X2	28	70.0%	12	30.0%	40	100.0%

a. Limited to first 100 cases.

Case Summaries[a]

		Y	X1	X2
1		3.02	.57	.
2		3.28	.	1.71
3		3.34	.	1.07
4		3.38	3.05	2.32
5		3.54	.	.
6		3.67	3.24	1.93
7		4.02	1.89	2.90
8		4.23	3.70	.
9		4.29	.	1.94
10		4.31	3.06	.41
11		4.43	3.26	.51
12		4.53	3.07	1.31
13		4.53	.	1.54
14		4.55	2.93	.
15		4.57	.	1.83
16		4.60	3.12	2.49
17		4.65	4.44	3.08
18		4.73	2.83	1.05
19		4.74	4.78	1.95
20		4.80	2.35	.44
21		5.06	3.65	.
22		5.19	.	.70
23		5.28	4.09	3.17
24		5.32	.	2.30
25		5.36	.	2.31
26		5.37	2.99	2.18
27		5.52	3.96	.
28		5.66	3.90	.
29		5.71	3.83	.
30		5.74	1.40	.72
31		5.91	.	1.81
32		5.93	3.32	2.91
33		6.15	4.41	.
34		6.17	3.33	.
35		6.19	3.73	1.54
36		6.22	2.10	.
37		6.28	3.53	3.50
38		6.36	.	.
39		6.57	3.75	2.83
40		6.80	.	2.45
Total	N	40	28	28

a. Limited to first 100 cases.

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING PAIRWISE
  /STATISTICS COEFF OUTS R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT y
  /METHOD=ENTER x1 x2  .
```

Regression

Descriptive Statistics

	Mean	Std. Deviation	N
Y	5.0000	1.00000	40
X1	3.2237	.92467	28
X2	1.8892	.87957	28

Correlations

		Y	X1	X2
Pearson Correlation	Y	1.000	.356	.294
	X1	.356	1.000	.421
	X2	.294	.421	1.000
Sig. (1-tailed)	Y	.	.031	.065
	X1	.031	.	.041
	X2	.065	.041	.
N	Y	40	28	28
	X1	28	28	18
	X2	28	18	28

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.390[a]	.152	.039	.98034

a. Predictors: (Constant), X2, X1

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.584	2	1.292	1.344	.290[a]
	Residual	14.416	15	.961		
	Total	17.000	17			

a. Predictors: (Constant), X2, X1

b. Dependent Variable: Y

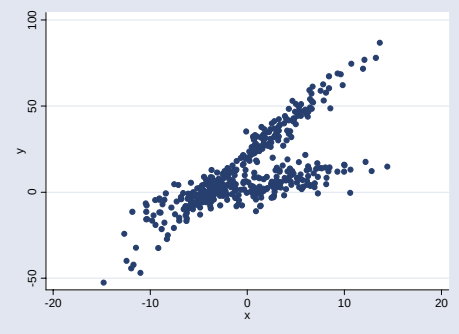
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.639	.879		4.141	.001
	X1	.306	.283	.283	1.079	.298
	X2	.198	.298	.175	.666	.516

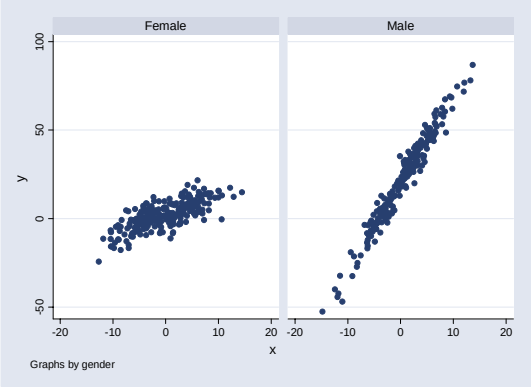
a. Dependent Variable: Y

II-5.

```
. reg y x

      Source |       SS       df       MS              Number of obs =     460
-------------+------------------------------           F(  1,   458) =  487.50
       Model |  99566.5528     1  99566.5528           Prob > F      =  0.0000
    Residual |  93541.5301   458  204.239149           R-squared     =  0.5156
-------------+------------------------------           Adj R-squared =  0.5145
       Total |  193108.083   459  420.714778           Root MSE      =  14.291

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   2.847209   .1289532    22.08   0.000     2.593796    3.100622
       _cons |    10.9082   .6663333    16.37   0.000     9.598751    12.21765
------------------------------------------------------------------------------

. hettest

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

         chi2(1)      =   166.77
         Prob > chi2  =   0.0000

. twoway (scatter y x)
```




```
. twoway (scatter y x), by(gender )
```



```
. reg y x if gender == 1

      Source |       SS       df       MS              Number of obs =     253
-------------+------------------------------           F(  1,   251) =  292.60
       Model |  7547.24475     1  7547.24475           Prob > F      =  0.0000
    Residual |  6474.24443   251  25.7938025           R-squared     =  0.5383
-------------+------------------------------           Adj R-squared =  0.5364
       Total |  14021.4892   252  55.6408301           Root MSE      =  5.0788

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   1.047045   .0612109    17.11   0.000     .9264922    1.167597
       _cons |   2.252601   .3198793     7.04   0.000     1.622611     2.88259
------------------------------------------------------------------------------

. hettest

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

         chi2(1)      =     0.58
         Prob > chi2  =   0.4480



. reg y x if gender == 2

      Source |       SS       df       MS              Number of obs =     207
-------------+------------------------------           F(  1,   205) = 4983.35
       Model |  128707.047     1  128707.047           Prob > F      =  0.0000
    Residual |     5294.62   205  25.8274147           R-squared     =  0.9605
-------------+------------------------------           Adj R-squared =  0.9603
       Total |  134001.667   206  650.493528           Root MSE      =  5.0821

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   4.906713   .0695072    70.59   0.000     4.769672    5.043754
       _cons |   20.05133   .3541185    56.62   0.000     19.35314    20.74951
------------------------------------------------------------------------------

. hettest

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

         chi2(1)      =     0.07
         Prob > chi2  =   0.7977
```

III. Computation and interpretation. (35 points total)

A research is interested in the relationship between health, socio-economic status, race and gender. She has collected data from 600 individuals on the following variables:

Variable	Description
health	Physical health, measured on a scale ranging from 0 to 1500. Higher scores indicate better health.
black	Coded 1 if the respondent is black, 0 otherwise
male	Coded 1 if the respondent is male, 0 otherwise
ses	Socio-economic status, measured on a scale that ranges from a low of 0 to a high of 200.

She obtains the following results.

```
. corr  health ses male black, means
(obs=600)

    Variable |         Mean    Std. Dev.          Min          Max
-------------+--------------------------------------------------------
      health |     763.4698     166.7891     197.6368     1243.452
         ses |     107.6862     18.52201     53.78384     151.8031
        male |           .5     .5004172            0            1
       black |          .15     .3573694            0            1


             |   health      ses     male    black
-------------+------------------------------------
      health |   1.0000
         ses |   0.2901   1.0000
        male |  -0.0772   0.5102   1.0000
       black |  -0.3280  -0.2542   0.0093   1.0000


. * Model 1:

. reg  health black

      Source |       SS       df       MS              Number of obs =     600
-------------+------------------------------           F(  1,   598) =   [ 1 ]
       Model |   1792453.8     1   1792453.8           Prob > F      =  0.0000
    Residual |  14870886.7   598  24867.7035           R-squared     =  0.1076
-------------+------------------------------           Adj R-squared =  0.1061
       Total |  16663340.5   599  27818.5985           Root MSE      =  157.69

------------------------------------------------------------------------------
      health |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       black |  -153.0711   18.02964    -8.49   0.000    -188.4802    -117.662
       _cons |   786.4305   6.982851   112.62   0.000     772.7166    800.1444
------------------------------------------------------------------------------
```

```
. * Model 2:

. reg  health ses male black, beta

      Source |       SS       df       MS              Number of obs =     600
-------------+------------------------------           F(  3,   596) =   50.32
       Model |  3367869.52     3  1122623.17           Prob > F      =  0.0000
    Residual |    13295471   596  22307.8372           R-squared     =  [  2 ]
-------------+------------------------------           Adj R-squared =  0.1981
       Total |  16663340.5   599  27818.5985           Root MSE      =  149.36

------------------------------------------------------------------------------
      health |      Coef.   Std. Err.      t    P>|t|                     Beta
-------------+----------------------------------------------------------------
         ses |   3.276419    .401744     8.16   0.000                  [  3  ]
        male |  -86.89344   14.38207    [ 4 ]   0.000                -.2607064
       black |  -108.7724   17.90827    -6.07   0.000                -.2330604
       _cons |   470.4073    41.2488    11.40   0.000                        .
------------------------------------------------------------------------------

. test ses male

 ( 1)  ses = 0
 ( 2)  male = 0

       F(  2,   596) =   35.31
            Prob > F =    0.0000

. collin  ses male black

  Collinearity Diagnostics

                    SQRT                                    Cond     Cond         R-
  Variable      VIF   VIF    Tolerance       Eigenval      Index1   Index2     Squared
-----------------------------------------------------------------------------------
       ses     1.49   1.22   [  5  ]    1.5664     1     1.0000     1.0000     0.3274
      male     1.39   1.18    0.7190     1.0075     2     1.2469     1.8602     0.2810
     black     1.10   1.05    0.9093     0.4262     3     1.9171     2.8634     0.0907
                                                    4               16.5776
-----------------------------------------------------------------------------------
  Mean VIF     1.33                    Condition Number    1.9171    16.5776
                      Determinant of correlation matrix    0.6725
                      Cond Index1 from deviation SSCP (no intercept)
                      Cond Index2 from scaled raw SSCP (w/ intercept)

. pcorr2  health ses male black
(obs=600)

Partial and Semipartial correlations of health with

    Variable |  Partial    SemiP     Sig.
-------------+----------------------------
         ses |   0.3168   0.2984    0.000
        male |  -0.2402  -0.2211    0.000
       black |  -0.2414  -0.2222    0.000
```

a) (15 pts) Fill in the missing quantities [1] – [5].

b) (15 points) Interpret the results. Be sure to answer the following questions, explaining how the printout supports your conclusions.

1. What percentage of the sample is black? What percentage is male?

2. Who has higher socio-economic status – men or women?

3. Which variable has the strongest impact on health? Cite at least two or three pieces of evidence from the printout to support your conclusion on this point.

4. The effect of black declines once ses and male are added to the model (compare Model 1 with Model 2). Why? Offer a substantive explanation that is supported by the printout.

5. According to the model, which types of individuals will tend to have the worst health?

c) (5 points) In the first regression, health is regressed on black only. In the second regression, health is regressed on black, ses, and male. Test whether the joint effects of male and ses significantly differ from zero, i.e. test

H_0: $\beta_{ses} = \beta_{male} = 0$
H_A: β_{ses} and/or $\beta_{male} \neq 0$