Sociology 63993
Exam 2
April 1, 2011

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

1. A researcher computes a variable $X_4 = X_2 + X_3$. She then estimates the following two models using OLS regression:

   $Y = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$

   $Y = \beta_1 X_1 + \beta_4 X_4 + \varepsilon$

   She can use an incremental F test to determine which of these two models is better.

2. A researcher runs the following:

```
. webuse nhanes2f, clear
. gen femage = female * age
. reg health female age femage

      Source |       SS       df       MS              Number of obs =   10335
-------------+------------------------------           F(  3, 10331) =  549.60
       Model |  2069.28161     3  689.760537           Prob > F      =  0.0000
    Residual |  12965.7398 10331   1.2550324           R-squared     =  0.1376
-------------+------------------------------           Adj R-squared =  0.1374
       Total |  15035.0214 10334   1.4549082           Root MSE      =  1.1203

------------------------------------------------------------------------------
      health |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      female |  -.2752255   .0648373    -4.24   0.000    -.4023191   -.1481319
         age |  -.0280887   .0009315   -30.15   0.000    -.0299146   -.0262627
      femage |   .0043295   .0012822     3.38   0.001     .0018162    .0068428
       _cons |    4.78594   .0469616   101.91   0.000     4.693886    4.877994
------------------------------------------------------------------------------
```

   These results show that age has a negative effect on the health of males and a positive effect on the health of females.

3. A researcher has included several extraneous variables in her model. The larger her sample, the more serious this problem will be.

4. A researcher regresses income on education. She does not include any dummy variables or interaction terms involving gender. One implication of this model is that, if it is true, the mean income for men will be the same as the mean income for women.

5. A researcher is interested in the relationship between bmi (Body Mass Index) and health. She does the following:

```
. webuse nhanes2f, clear
. gen bmi = weight/ (height/100)^2
. gen bmi2 = bmi * bmi
. reg health bmi bmi2
```

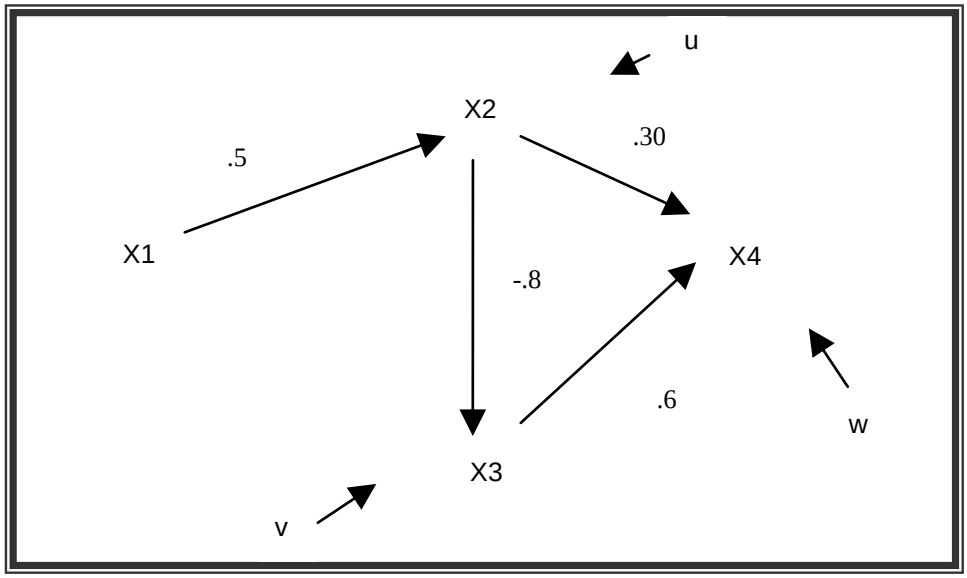
```
      Source |       SS       df       MS              Number of obs =   10335
-------------+------------------------------           F(  2, 10332) =  111.24
       Model |  316.928298     2  158.464149           Prob > F      =  0.0000
    Residual |  14718.0931 10332   1.4245154           R-squared     =  0.0211
-------------+------------------------------           Adj R-squared =  0.0209
       Total |  15035.0214 10334   1.4549082           Root MSE      =  1.1935

------------------------------------------------------------------------------
      health |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         bmi |   .0072049   .0152456     0.47   0.637    -.0226794    .0370892
        bmi2 |  -.0007416   .0002646    -2.80   0.005    -.0012601    -.000223
       _cons |   3.731409   .2147848    17.37   0.000      3.31039    4.152429
------------------------------------------------------------------------------
```

Based on these results, she should conclude that bmi is not related to health.

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.

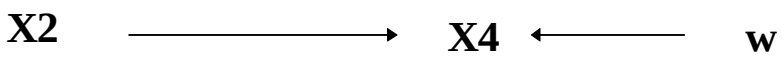
b. (10 pts) Part of the correlation matrix is shown below. Determine the complete correlation matrix. (Remember, variables are standardized. You can use either normal equations or Sewell Wright, but you might want to use both as a double-check.)

	x1	x2	x3	x4
x1	1.0000			
x2	0.5000	1.0000		
x3	?	?	1.0000	
x4	?	?	?	1.0000

c. (5 pts) Decompose the correlation between X3 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). This week, the Supreme Court heard a landmark gender discrimination case against retail giant Wal-Mart. The plaintiffs based their case, in part, on work done by Sociologist William Bielby. Bielby's devastating arguments have put the fear of God into another company making it wonder if it, too, might face such a lawsuit. It has therefore conducted its own study of gender equity within its work force, collecting data from a random sample of 7500 of its employees on the following variables:

Variable	Description
pay	Annual Salary (in thousands of dollars)
qual	A qualifications scale that the company has constructed and believes to be very valid. It takes into account such things as past performance, aptitude test scores, education, and years of experience. The scale ranges from -40 to 40 and has been centered to have a mean of 0 (i.e. 0 means average qualifications; and the higher the score, the more qualified the person is)
female	Coded 1 if female, 0 if male
femqual	female * qual

The results of the analysis are as follows:

```
. ttest pay, by(female)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |    3572     78.1415    .2298254    13.73579     77.6909     78.5921
       1 |    3928    47.23287    .2309217    14.47273    46.78013    47.68561
---------+--------------------------------------------------------------------
combined |    7500    61.95362     .241623    20.92516    61.47997    62.42727
---------+--------------------------------------------------------------------
    diff |            30.90863    .3266069                30.26839    31.54887
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =  94.6356
Ho: diff = 0                                     degrees of freedom =     7498

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

. nestreg: reg pay qual female femqual

Block  1: qual

      Source |       SS       df       MS              Number of obs =    7500
-------------+------------------------------           F(  1,  7498) = 5952.86
       Model |  1453171.17     1  1453171.17           Prob > F      =  0.0000
    Residual |   1830359.2  7498  244.112991           R-squared     =  0.4426
-------------+------------------------------           Adj R-squared =  0.4425
       Total |  3283530.37  7499  437.862431           Root MSE      =  15.624

------------------------------------------------------------------------------
         pay |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        qual |   1.438618   .0186459    77.15   0.000     1.402067    1.475169
       _cons |   61.95362   .1804117   343.40   0.000     61.59996    62.30728
------------------------------------------------------------------------------

Block  2: female

      Source |       SS       df       MS              Number of obs =    7500
-------------+------------------------------           F(  2,  7497) = 5296.84
       Model |  1922795.12     2  961397.559           Prob > F      =  0.0000
    Residual |  1360735.25  7497  181.503969           R-squared     =  0.5856
-------------+------------------------------           Adj R-squared =  0.5855
       Total |  3283530.37  7499  437.862431           Root MSE      =  13.472

------------------------------------------------------------------------------
         pay |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        qual |   .6212315   .0227315    27.33   0.000     .5766715    .6657916
      female |  -22.40072   .4403823   -50.87   0.000    -23.26399   -21.53744
       _cons |   73.68562   .2782026   264.86   0.000     73.14027    74.23098
------------------------------------------------------------------------------
```

Block 3: femqual

```
      Source |       SS       df       MS              Number of obs =    7500
-------------+------------------------------           F(  3,  7496) = 3605.84
       Model |  1939531.43     3  646510.478           Prob > F      =  0.0000
    Residual |  1343998.94  7496  179.295483           R-squared     =  0.5907
-------------+------------------------------           Adj R-squared =  0.5905
       Total |  3283530.37  7499  437.862431           Root MSE      =   13.39

------------------------------------------------------------------------------
         pay |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        qual |   .8329084   .0314714    26.47   0.000     .7712156    .8946012
      female |   -22.3506   .4377256   -51.06   0.000    -23.20866   -21.49253
     femqual |  -.4367667   .0452069    -9.66   0.000    -.5253848   -.3481486
       _cons |   72.16734   .3180414   226.91   0.000     71.54389    72.79079
------------------------------------------------------------------------------
```

Block	F	Block df	Residual df	Pr > F	R2	Change in R2
1	5952.86	1	7498	0.0000	0.4426	
2	2587.40	1	7497	0.0000	0.5856	0.1430
3	93.34	1	7496	0.0000	0.5907	0.0051

. ttest qual, by(female)

```
Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |    3572    7.172654    .1191291    7.119893    6.939086    7.406222
       1 |    3928   -6.522586    .1050536    6.584106   -6.728551   -6.316621
---------+--------------------------------------------------------------------
combined |    7500    3.32e-08    .1117328    9.676342   -.2190275    .2190276
---------+--------------------------------------------------------------------
    diff |            13.69524    .1582456                13.38503    14.00545
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =  86.5442
Ho: diff = 0                     degrees of freedom =     7498

    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 men make substantially more than women. The company then does additional analyses to find out why. It wants your help in answering 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 qualifications and gender affect pay?

b) (10 pts) Suppose the company was sued on the basis that it discriminated against women. What evidence, if any, do you think the company would cite in its defense? What evidence, if any, would its critics cite? Consider both the t-tests and the regression analyses in your answer. If you were the president of the company, would these results make you be worried about a lawsuit?

IV. Short answer. Answer *both* of the following questions. (15 points each, 30 points total.) In each of the following problems, a researcher runs through a sequence of commands. Explain why she didn't stop after the first command, i.e. explain what the purpose of each subsequent command was, what it told her, and why she did not run additional commands after the last one. If she had stopped after the first command, what would the consequences have been, i.e. in what ways would her conclusions have been incorrect or misleading?

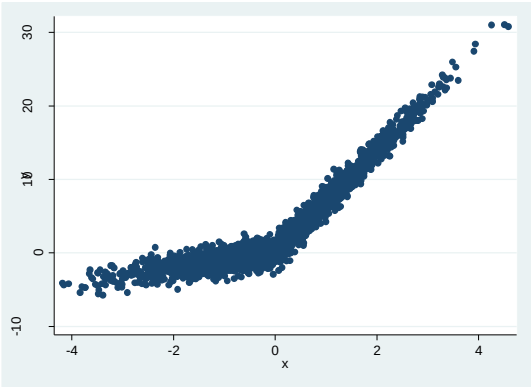
1.

```
. reg y x
```

```
      Source |       SS       df       MS              Number of obs =    2293
-------------+------------------------------           F(  1,  2291) = 9754.77
       Model |  68744.4388     1  68744.4388           Prob > F      =  0.0000
    Residual |  16145.2885  2291  7.04726691           R-squared     =  0.8098
-------------+------------------------------           Adj R-squared =  0.8097
       Total |  84889.7273  2292  37.0374028           Root MSE      =  2.6547

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |    3.94874   .0399807    98.77   0.000     3.870337    4.027142
       _cons |   3.328859   .0554381    60.05   0.000     3.220145    3.437573
------------------------------------------------------------------------------
```

```
. scatter y x
```




```
. mkspline xlow 0 xhigh = x
```

```
. reg y xlow xhigh
```

```
      Source |       SS       df       MS              Number of obs =    2293
-------------+------------------------------           F(  2,  2290) =41359.81
       Model |  82602.9569     2  41301.4785           Prob > F      =  0.0000
    Residual |  2286.77032  2290  .998589661           R-squared     =  0.9731
-------------+------------------------------           Adj R-squared =  0.9730
       Total |  84889.7273  2292  37.0374028           Root MSE      =  .99929

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        xlow |    1.02005    .029061    35.10   0.000     .9630619    1.077039
       xhigh |   6.933698   .0294706   235.28   0.000     6.875907     6.99149
       _cons |   .0479089   .0348016     1.38   0.169     -.020337    .1161549
------------------------------------------------------------------------------
```

2.

```
. reg y x
```

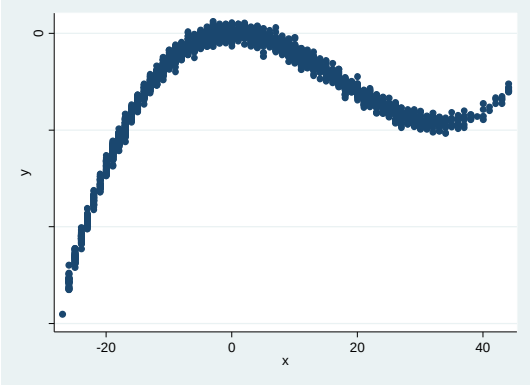
```
      Source |       SS       df       MS              Number of obs =    2293
-------------+------------------------------           F(  1,  2291) =  385.60
       Model |  4.7856e+10     1  4.7856e+10           Prob > F      =  0.0000
    Residual |  2.8433e+11  2291   124108295           R-squared     =  0.1441
-------------+------------------------------           Adj R-squared =  0.1437
       Total |  3.3219e+11  2292   144933916           Root MSE      =   11140

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   272.3303   13.86839    19.64   0.000     245.1343    299.5262
       _cons |  -12109.01   232.6475   -52.05   0.000    -12565.23   -11652.79
------------------------------------------------------------------------------
```

```
. ovtest

Ramsey RESET test using powers of the fitted values of y
       Ho:  model has no omitted variables
                 F(3, 2288) =  94189.71
                   Prob > F =      0.0000
```

```
. scatter y x
```




```
. gen x2 = x^2
. gen x3 = x^3
. reg y x x2 x3
```

```
      Source |       SS       df       MS              Number of obs =    2293
-------------+------------------------------           F(  3,  2289) =       .
       Model |  3.2990e+11     3  1.0997e+11           Prob > F      =  0.0000
    Residual |  2.2843e+09  2289  997934.435           R-squared     =  0.9931
-------------+------------------------------           Adj R-squared =  0.9931
       Total |  3.3219e+11  2292   144933916           Root MSE      =  998.97

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   .3380926   2.407808     0.14   0.888    -4.383621    5.059806
          x2 |  -50.07069    .096471  -519.02   0.000    -50.25987   -49.88151
          x3 |   .9974231   .0039199   254.45   0.000     .9897362     1.00511
       _cons |   24.94746   30.93394     0.81   0.420    -35.71402    85.60894
------------------------------------------------------------------------------
```

```
. ovtest

Ramsey RESET test using powers of the fitted values of y
       Ho:  model has no omitted variables
                 F(3, 2286) =      0.87
                   Prob > F =      0.4561
```