Economics 113 Professor Spearot
Introduction to Econometrics
Spring 2008 – Midterm 2
Name ________________________

Midterm 2 – 120 Points

You must answer all the questions. Please write your name on every page. The exam is closed book and closed notes. You may use calculators, but they must not be graphing calculators. Do not use your own scratch paper.

<u>You must show your work to receive full credit</u>

1. (60 Points) You wish to predict wage outcomes. Specifically, you estimate the following specification:

$$\log(wage) = \beta_0 + \beta_1 educ + \beta_2 tenure + \beta_3 \text{exper} + \beta_4 iq + \beta_5 \text{age} + u$$

The results from running this regression are below:

```
. regress lwage  educ exper tenure iq age

      Source |       SS       df       MS              Number of obs =     935
-------------+------------------------------           F(  5,   929) =   42.80
       Model |  31.0173305     5  6.2034661           Prob > F      =  0.0000
    Residual |  134.638964   929  .144928917           R-squared     =  0.1872
-------------+------------------------------           Adj R-squared =  0.1829
       Total |  165.656294   934  .177362199           Root MSE      =   .3807

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .0510835   .0075279  xxxxxxx   xxxxx     xxxxxxxx    xxxxxxxx
       exper |   .0109616    .003867  xxxxxxx   xxxxx     xxxxxxxx    xxxxxxxx
      tenure |   .0114158   .0025823  xxxxxxx   xxxxx     xxxxxxxx    xxxxxxxx
          iq |   .0056152    .000971  xxxxxxx   xxxxx     xxxxxxxx    xxxxxxxx
         age |   .0108734   .0048769  xxxxxxx   xxxxx     xxxxxxxx    xxxxxxxx
       _cons |   4.953231    .166183  xxxxxxx   xxxxx     xxxxxxxx    xxxxxxxx
------------------------------------------------------------------------------
```

a. Do a one-sided t-test at the 1% level to determine if experience **(exper)** is a statistically significant determinant of the log wage. Please state the null hypotheses, and provide an alternative, briefly justifying your choice. Interpret the result. **(10 points)**

b. What is the two-sided p-value for the coefficient on *age*? Please draw the distribution under the null and compute the two-sided p-value. **(10 points)**

c. The sample average of *iq* is 101. The maximum IQ is 145. Solve for and interpret the change in wages between these two values of *iq*, holding everything else equal. **(10 Points)**

d. Please derive a 90% confidence interval for the coefficient on *educ*. **(10 Points)**

Suppose that instead of the specification in (a), I estimate

$$\log(wage) = \beta_0 + \beta_1 educ + \beta_2 tenure + \beta_3 \text{exper} + \beta_4 married + u$$

Where married is a dummy variable taking the value of 1 if the respondent is married, and zero otherwise.

```
      Source |       SS       df       MS              Number of obs =     935
-------------+------------------------------           F(  4,   930) =   49.73
       Model |  29.1888274     4  7.29720684           Prob > F      =  0.0000
    Residual |  136.467467   930  .146739212           R-squared     =  0.1762
-------------+------------------------------           Adj R-squared =  0.1727
       Total |  165.656294   934  .177362199           Root MSE      =  .38307
------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .0753568   .0064349    11.71   0.000     .0627282    .0879854
       exper |   .0141191   .0033383     4.23   0.000     .0075677    .0206705
      tenure |   .0127554   .0025592     4.98   0.000     .0077329     .017778
     married |    .199171   .0408196     4.88   0.000     .1190618    .2792802
       _cons |   5.330651   .1143785    46.61   0.000     5.106181    5.555121
```

e.)Is this model preferred to the previous model (in a)? Why? **(5 points)**

f.) Using the new model, please interpret the estimate of the constant term, β_0 **(5 points)**

g.) Using the new model, please interpret the estimate of coefficient on married, β_4 **(10 points)**

2. (40 points) Suppose that I run the following regression predicting local housing prices:

$$\log(price) = \beta_0 + \beta_1 \log(assess) + \beta_2 bdrms + \beta_3 sqrft + u$$

In the regression equation, *price* is the sale price, *assess* is the assessed value of the home by an objective observer, *bdrms* is the number of bedrooms, and *sqrft* is the square footage of the household. The results from running this regression are below:

```
      Source |       SS       df       MS              Number of obs =      88
-------------+------------------------------           F(  3,    84) =   94.06
       Model |  6.17840941     3  2.0594698            Prob > F      =  0.0000
    Residual |  1.83921254    84  .021895387           R-squared     =  0.7706
-------------+------------------------------           Adj R-squared =  0.7624
       Total |  8.01762195    87  .092156574           Root MSE      =  .14797
------------------------------------------------------------------------------
      lprice |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lassess |    .989676   .1211277  xxxxxxx   xxxxx     xxxxxxxx    xxxxxxxx
       bdrms |   .0295836   .0222587  xxxxxxx   xxxxx     xxxxxxxx    xxxxxxxx
       sqrft |  -.0000104   .0000577  xxxxxxx   xxxxx     xxxxxxxx    xxxxxxxx
       _cons |  -.0390865   1.435404  xxxxxxx   xxxxx     xxxxxxxx    xxxxxxxx
```

a. Briefly interpret the coefficient on log(assess), β_1. **(5 Points)**

b. Suppose I say that the selling price and the assessed value rise proportionally with one another. That is, the elasticity of price with respect to the assessed value is equal to 1. Please test this hypothesis at the 99% level (the critical t-value for this test is 2.632). Clearly state your null, your alternative, and briefly summarize your result. **(10 Points)**

c. Is *bdrms* a significant determinant of housing prices? Test this hypothesis at the 95% level. Using a two-sided test, please provide your null hypothesis, the alternative, and briefly interpret the result (the critical t-value for this test is 1.98) **(10 Points)**

d. The assessed value is an estimate of the value of the house and its characteristics (size, number of bedrooms, condition, etc..). Given this fact, is it smart to include *lassess* with *sqrft* and *bdrms*? What kind of problem is this? What are the possible consequences? **(5 Points)**

e. I want to test the point in 'd' rigorously. Suppose that I drop *sqrft* and *bdrms* and estimate:

$$\log(price) = \beta_0 + \beta_1 \log(assess) + u$$

Doing so gives us:

```
      Source |       SS       df       MS              Number of obs =      88
-------------+------------------------------           F(  1,    86) =  280.95
       Model |  6.13855286     1  6.13855286           Prob > F      =  0.0000
    Residual |   1.8790691    86  .021849641           R-squared     =  0.7656
-------------+------------------------------           Adj R-squared =  0.7629
       Total |  8.01762195    87  .092156574           Root MSE      =  .14782

------------------------------------------------------------------------------
      lprice |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lassess |   1.013407   .0604607  xxxxxxx   xxxxx     xxxxxxxx    xxxxxxxx
       _cons |  -.2540893   .7635242  xxxxxxx   xxxxx     xxxxxxxx    xxxxxxxx
------------------------------------------------------------------------------
```

Please determine whether or not the new specification is better than the old specification. If a hypothesis test is warranted, please state the null and alternative hypotheses, and test at the 95% level. If not, explain why you used a different approach. **(10 points)**

3. (20 points) Suppose that I wish to run the following regression predicting housing prices:

$$\log(price) = \beta_0 + \beta_1 bdrms + \beta_2 sqrft + \beta_3 sqrft^2 + u$$

a. Please **derive** the estimating equation required to generate a prediction and standard error for a home with 2 bedrooms and 1000 square feet. Please also write the precise STATA commands required to run this regression. **(10 points)**.

b. Suppose that I instead estimate:

$$price = \beta_0 + \beta_1 bdrms + \beta_2 sqrft + \beta_3 lotsize + u$$

My hypothesis is that the effect of *sqrft* is three times bigger than *lotsize*. The interpretation is that increasing the size of the house, holding lot size equal, is three times more valuable than increasing the size of the lot, holding house size equal. Please write this hypothesis in terms of model parameters. Derive a new regression equation that enables me to test this hypothesis. **(10 points)**

Extra Credit:

Please prove the following (**10 points**):

$$\frac{\frac{\mathrm{SSR}_{\mathrm{R}} - SSR_{UR}}{q}}{\frac{SSR_{UR}}{n-k-1}} = \frac{\frac{R^2{}_{UR} - R^2{}_{R}}{q}}{\frac{\left(1 - R^2{}_{UR}\right)}{n-k-1}}$$

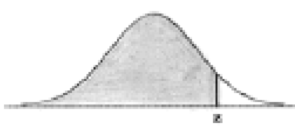
Helpful Formulas

$$\hat{\sigma}_x^2 = \frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \hat{\mu}_x\right)^2 \qquad \hat{\sigma}_{xy} = \frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \hat{\mu}_x\right)\left(y_i - \hat{\mu}_y\right) \qquad \hat{\rho}_{xy} = \frac{\hat{\sigma}_{xy}}{\hat{\sigma}_x \hat{\sigma}_y}$$

$$\hat{\beta}_0 = \hat{\mu}_y - \hat{\beta}_1 \hat{\mu}_x \qquad \hat{\beta}_1 = \frac{\sum_{i=1}^{n}\left(x_i - \hat{\mu}_x\right)\left(y_i - \hat{\mu}_y\right)}{\sum_{i=1}^{n}\left(x_i - \hat{\mu}_x\right)^2}$$

$$R^2 = 1 - \frac{SSR}{SST} \qquad SSR = \sum_{i=1}^{n}\left(\hat{u}_i\right)^2 \qquad SST = \sum_{i=1}^{n}\left(y_i - \hat{\mu}_y\right)^2$$

$$\text{Adj } R^2 = 1 - \frac{\frac{SSR}{n-k-1}}{\frac{SST}{n-1}} \qquad F_{stat} = \frac{\frac{\text{SSR}_{\text{R}} - SSR_{UR}}{q}}{\frac{SSR_{UR}}{n-k-1}}$$



Normal Distribution from -oo to Z

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990