Economics 113 Professor Spearot
Introduction to Econometrics
Fall 2008 – Final
Name ________________________

Final – 115 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. And, have a nice holiday!!!!!!

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

1a.) Congress is considering a "bailout" of the Big 3 Automakers. The worry is that if GM or Chrysler fail, then there would be severe consequences to the real economy. Although these numbers are fictitious, consider the following scenario. Suppose that the probability of a GM bankruptcy is 0.6 and the probability of a Chrysler bankruptcy 0.4. If these two events are independent of one another, what is the probability of GM OR Chrysler going bankrupt? **(10 Points)** b.) Now consider the effect of a bailout on the probability of economic collapse (again, these numbers are made up). Suppose that the probability of a congressional bailout is 0.6. If congress approves a bailout, the probability of an economic collapse is 0.2. In contrast, if the congress does not approve a bailout, the probability of an economic collapse is 0.8. Given that a collapse occurred, what is probability that congress approved a bailout? **(10 Points)**

2. For this question, we will examine the determinants of fuel efficiency. To do so, we have downloaded the Fuel Efficiency Database from the EPA (excluding niche performance brands, such as Ferrari) for the year 2008. Included in this database is every vehicle available for purchase in the United States, the measured fuel efficiency, and other characteristics.

To start the analysis, we run the following regression

$$MPG = \beta_0 + \beta_{displ} displ + \beta_{cyl} cyl + \beta_{auto} \mathrm{auto} + u$$

Here, *MPG* is represents average miles per gallon travelled. Higher values imply greater efficiency. Further, *cyl* represents the number of cylinders in the engine, and *displ* represents the displacement of the engine in liters. Finally, *auto* is a dummy variable taking on the value of 1 if the vehicle has an automatic transmission, and 0 if it is a standard transmission (stick shift).

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      Source |       SS       df       MS              Number of obs =    1200
-------------+------------------------------           F(  3,  1196) =  811.09
       Model |  15366.7919     3  5122.26398           Prob > F      =  0.0000
    Residual |  7553.12472  1196  6.31532167           R-squared     =  0.6705
-------------+------------------------------           Adj R-squared =  0.6696
       Total |  22919.9167  1199  19.1158604           Root MSE      =   2.513

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         cmb |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       displ |   -2.09063   .1343116   -15.57   0.000    -2.354143   -1.827117
         cyl |  -.6174908   .0990547    -6.23   0.000     -.811831   -.4231506
        auto |  -.0072103   .1794679    -0.04   0.968    -.3593172    .3448967
       _cons |   30.44108   .2883117   105.58   0.000     29.87543    31.00673
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a.) Using the 95% confidence level, test whether the coefficient on automatic, β_{auto}, is significantly different from zero. Please state your null and alternative hypotheses, and briefly interpret the result. **(10 Points)** b.) Professor Spearot just purchased a car with 6 cylinders rather than 4. Holding all other attributes equal, what is the effect of purchasing a car with two extra cylinders on fuel efficiency? **(5 Points)**

c.) Also with 6 cylinders, Professor Spearot's car has an automatic transmission and an engine with 3.4 liters of displacement. Please **DERIVE** an estimating equation that will enable you to predict fuel efficiency for this car, and the standard error of the prediction. Please also write the commands required to generate any new variables in STATA. **(10 Points)**

The model in part (a) is much too basic. To remedy this, I add in *truck* and *domestic*, where the former is a dummy variable equal to 1 if the vehicle is a truck (0 otherwise), and the latter is a dummy variable equal to 1 if the vehicle is domestic (0 otherwise).

$$MPG = \beta_0 + \beta_{displ} displ + \beta_{cyl} cyl + \beta_{auto} \text{auto} + \beta_{truck} truck + \beta_{dom} domestic + u$$

Note that the classification "truck" includes SUVs and vans. The results from estimating this equation are below:

```
      Source |       SS       df       MS              Number of obs =    1200
-------------+------------------------------           F(  5,  1194) =  612.55
       Model |  16490.9879     5  3298.19758           Prob > F      =  0.0000
    Residual |  6428.92875  1194  5.38436243           R-squared     =  0.7195
-------------+------------------------------           Adj R-squared =  0.7183
       Total |  22919.9167  1199  19.1158604           Root MSE      =  2.3204

------------------------------------------------------------------------------
         cmb |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       displ |  -1.379712   .1386449    -9.95   0.000    -1.651726   -1.107697
         cyl |  -.9957897   .0974275   -10.22   0.000    -1.186938   -.8046416
        auto |   .3522417   .1682961     2.09   0.037     .0220527    .6824307
       truck |  -2.230827   .1563322   -14.27   0.000    -2.537544   -1.924111
    domestic |   .1960408   .1522806     1.29   0.198    -.1027266    .4948081
       _cons |    30.8768   .2699396   114.38   0.000     30.34719    31.40641
------------------------------------------------------------------------------
```

d.) Is this model preferred to the model in (a)? If a hypothesis test is warranted, test this hypothesis at the 95% level, stating your null and alternative hypotheses. If not, provide other evidence for your conclusion. **(10 Points)** e.) Using a 90% confidence level, produce a confidence interval for the coefficient on *truck*, β_{truck}. Briefly interpret this interval. **(10 Points)**

f.) Trucks tend to be very heavy, and heavy vehicles tend to be less fuel-efficient. Since the EPA database does not include vehicle weight as a variable, weight is an omitted variable. In what direction is the bias? Can I be confident that the coefficient on *truck*, β_{truck}, will still be negative after accounting for this bias? **(10 Points)** g.) Domestic vehicles are often claimed to be less fuel-efficient than their equivalent foreign counterparts. Interpret the coefficient on *domestic*, β_{dom}, and test whether it is significantly less than zero (you do not need a confidence level for this question). Is there evidence for such a claim? **(5 Points)**

h.) Using the regression from (d), Professor Spearot claims that the fuel efficiency for cars with automatic transmissions is different from those without. What is the probability that he is wrong? **(10 Points)**

Engines are an important determinant of fuel-efficiency, and thus, there may be an important interaction between engine displacement *(displ)* and the number of cylinders *(cyl)* contained within the engine. To examine this possibility, we estimate the following equation:

$$MPG = \beta_0 + \beta_{displ} displ + \beta_{cyl} cyl + \beta_{dc} displ * cyl + \beta_{auto} \text{auto} + \beta_{truck} truck + \beta_{dom} domestic + u$$

The results from estimating the specification in (h) equation are below:

Source	SS	df	MS
Model	17081.4864	6	2846.9144
Residual	5838.43025	1193	4.89390633
Total	22919.9167	1199	19.1158604

Number of obs	1200
F(6, 1193)	581.73
Prob > F	0.0000
R-squared	0.7453
Adj R-squared	0.7440
Root MSE	2.2122

cmb	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
displ	-3.665261	.2465046	-14.87	0.000	-4.148892	-3.181631
cyl	-2.243822	.1467528	-15.29	0.000	-2.531745	-1.9559
displ*cyl	.341223	.031064	10.98	0.000	.280277	.4021691
auto	.4683869	.1607962	2.91	0.004	.1529122	.7838617
truck	-1.963128	.1510215	-13.00	0.000	-2.259426	-1.666831
domestic	.187432	.1451816	1.29	0.197	-.0974077	.4722717
_cons	38.37429	.729455	52.61	0.000	36.94314	39.80545

i.) **Derive** the effect of engine displacement (*displ*) on fuel efficiency (*MPG*). Is the interaction between engine displacement and cylinders significant? Test this hypothesis at the 99% level. **(10 Points)** j.) Professor Spearot's car is black, but color does not affect fuel efficiency. Suppose that he includes *Color* in any of the above regressions.   What (if any) are the effects of adding *color*? **(5 Points)**

k.) Suppose that the variance of unobservable factors affecting fuel efficiency increases with engine displacement. What problem is this and how do we correct for it? **(5 Points)**

l.) Suppose I run the following regression predicting the probability that a specific vehicle is domestic:

$$Domestic = \beta_0 + \beta_{displ} displ + \beta_{auto} \text{auto} + \beta_{truck} truck + u$$

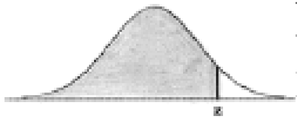
I notice in the results that some predictions are negative. What should be done to correct for this problem? **(5 Points)**

Extra Credit (5 points)

Suppose that instead of the regression in (i, I ran the following:

$$MPG = \beta_0 + \beta_{displ} displ + \beta_{dc} displ * cyl + \beta_{auto} \text{auto} + \beta_{truck} truck + \beta_{dom} domestic + u$$

What problem am I introducing and why?



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