Economics 113 Professor Spearot
Introduction to Econometrics
Fall 2012 / Midterm 3
Name Answer Key ID

Midterm 3 –60 Points

You must answer all 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. No cell phones. Do not use your own scratch paper.

You must show your work to receive full credit

I have neither given nor received unauthorized aid on this examination, nor have I concealed any similar misconduct by others.

Signature

Suppose that you wish to predict light truck prices as a function of a few basic characteristics:

$$\log(price) = \beta_0 + \beta_1 \log(weight) + \beta_2 log(length) + \beta_3 log(width) + \beta_4 log(cyl) + u$$

Here, *price* is measured in dollars, *weight* is measured in pounds, length and width are measured in inches, and *cyl* is the number of cylinders in the engine. The results from estimating this equation are below:

```
      Source |       SS       df       MS              Number of obs =    3297
-------------+------------------------------           F(  4,  3292) =  499.65
       Model |  90.4147706     4  22.6036926            Prob > F      =  0.0000
    Residual |  148.927025  3292  .045239072           R-squared     =  0.3778
-------------+------------------------------           Adj R-squared =  0.3770
       Total |  239.341795  3296  .072615836           Root MSE      =  .21269
------------------------------------------------------------------------------
    logprice |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   logweight |    1.091928   .0322143    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   loglength |    -.173286   .0357808    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    logwidth |   -1.001126   .0807677    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      logcyl |    .0428736    .025818    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
       _cons |    5.942897   .2774355    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
------------------------------------------------------------------------------
```

a.) Using the 95% confidence level, test whether the coefficient on *log(cyl)* is significantly different from zero. Please state your null and alternative hypotheses, and briefly interpret the result. **(10 Points)**

$H_0: \beta_4 = 0$ +1
$H_A: \beta_4 \neq 0$ +1

$t_{stat} = \frac{0.429 - 0}{0.258} = 1.66$ +2

$t_{crit} = 1.96$ +1

$|t_{stat}| < t_{crit}$ +1 => Fail to reject the null. +1

At 95% confidence, there is no significant relationship between the # cylinders and price.

b.) Suppose I claim that the elasticity of *price* within respect to *width* is not equal to -1. What is the probability that I'm wrong? **(10 Points)**

$$t_{stat} = \frac{-1.0011 - (-1)}{0.0808} = -0.0136$$ +1

$$P_{value} = 2(1 - Pr(T < |t_{stat}|)) = [redacted] = [redacted]$$

+6 $= 2 \cdot (1 - 0.504) = \boxed{0.992}$

c.) Suppose I claim that $\beta_1 + \beta_3 = 0$. Please state a null and alternative hypotheses that can test this claim, and derive an equation that allows me to test the null against the alternative. Show your work!! **(10 Points)**

$H_0 : \theta = \beta_1 + \beta_3 = 0$ $\quad (\theta - \beta_1) = \beta_3$

+2 $H_1 : \theta \neq 0$ $\quad \Rightarrow$ sub for β_3 +2

$$\log(price) = \beta_0 + \beta_1 \log(weight) + \beta_2 \log(length) + \beta_3 \log(width) + \beta_4 \log(cyl) + u$$

$$= \beta_0 + \beta_1 \log(weight) + \beta_2 \log\left(\frac{length}{cyl}\right) + (\theta - \beta_1) \log(width) + \beta_4 \log(cyl) + u$$

$$\log(price) = \beta_0 + \beta_1(\log(weight) - \log(width)) + \beta_2 \log(length) + \theta \log(width) + \beta_4 \log(cyl) + u$$

+6

d.) I decide that I'm adding too many variables in predicting the vehicle price. Instead I estimate

$$\log(price) = \beta_0 + \beta_2 log(length) + \beta_4 log(cyl) + u$$

The results from estimating this equation are below:

```
      Source |       SS       df       MS              Number of obs =    3297
-------------+------------------------------           F(  2,  3294) =  309.32
       Model |  37.8161576     2  18.9080788           Prob > F      =  0.0000
    Residual |   201.66028  3294  .061127699           R-squared     =  0.1579
-------------+------------------------------           Adj R-squared =  0.1574
       Total |  239.476438  3297  .072546634           Root MSE      =  .24724
------------------------------------------------------------------------------
    logprice |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   loglength |   .3153531   .0362388    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      logcyl |   .4304159   .0246745    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
       _cons |    7.38903   .1782998    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
------------------------------------------------------------------------------
```

Is this model preferred to the model in 'a'? Please test this at the 95% level, stating your null and alternative hypotheses. Show your work!!! **(10 Points)**

$H_0: B_1 = B_3 = 0$ +1

H_1: H_0 not true +1

$$F_{stat} = \frac{\frac{SSR_R - SSR_{ur}}{q}}{\frac{SSR_{ur}}{df_{ur}}}$$ +6

$$= \frac{\frac{201.66 - 148.9}{2}}{\frac{148.9}{3292}} = 583.23$$

$F_{crit} = 3$ +1

$F_{stat} > F_{crit} \Rightarrow$ Reject the null +1

e.) I'm having second thoughts about using logs, and instead estimate the following:

$$price = \beta_0 + \beta_1 weight + \beta_2 cyl + \beta_3 ltr + u$$

Where the additional variable *ltr* is the liters displacement by the engine. The results are below:

Source	SS	df	MS		
Model	3.2852e+10	3	1.0951e+10	Number of obs	= 3298
Residual	7.4300e+10	3294	22556107.4	F(3, 3294)	= 485.49
				Prob > F	= 0.0000
				R-squared	= 0.3066
				Adj R-squared	= 0.3060
Total	1.0715e+11	3297	32499913.2	Root MSE	= 4749.3

price	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]
weight	4.012499	.134814	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
cyl	447.3331	117.2983	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
ltr	-635.1207	114.4063	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
cons	3137.16	573.5268	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		

Please construct a 90% confidence interval for the coefficient on *weight*. Please interpret this confidence interval. **(10 Points)**

$$\hat{\beta}_1 - se(\hat{\beta}_1) \cdot t_{crit} < \beta_1 < \hat{\beta}_1 + se(\hat{\beta}_1) \cdot t_{crit}$$

$$4.012 - 0.1348 \cdot 1.645 < \beta_1 < 4.012 + 0.1348 \cdot 1.645$$

$$3.79 < \beta_1 < 4.234$$

+6

(1) with 90% confidence a 1 lbs increase in weight has between a $3.79 and $4.23 increase in the price.

or

(2) Weight has a positive and statistically significant effect on the wage.

+4

f.) Finally, after generating the new variables, I run the following regression:

$$price = \beta_0 + \beta_1(weight - 5000) + \beta_2(cyl - 8) + \beta_3(ltr - 5.4) + u$$

The results are below:

Source	SS	df	MS		
Model	3.2852e+10	3	1.0951e+10	Number of obs	3298
Residual	7.4300e+10	3294	22556107.4	F(3, 3294)	485.49
				Prob > F	0.0000
				R-squared	0.3066
				Adj R-squared	0.3060
Total	1.0715e+11	3297	32499913.2	Root MSE	4749.3

price	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]
weight - 5000	4.012499	.134814			XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
cyl - 8	447.3331	117.2983			XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
ltr - 5.4	-635.1207	114.4063			XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
_cons	23348.67	124.8494			XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Please construct a 95% confidence interval for the constant. Please interpret this confidence interval. **(10 Points)**

$23{,}348.67 - 1.96(124.841) < \beta_0 < 23{,}348.67 + 1.96 \cdot 124.841$)

$\downarrow$

$23103.39 < \beta_0 < 23592.61$ +2

With 95% confidence, a vehicle with 8 cyl, 5.4 ltr, and weight = 5000 will cost between $\$23{,}103.39$ and $\$23592.61$. +6

+0 if they say "an increase in the constant"