Economics 113 Professor Spearot
Introduction to Econometrics
Fall 2011 – Midterm 3
Name KEY

ID KEY

Midterm 3 –90 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 KEY

Suppose that you wish to predict housing prices as a function of lot size and floor space via the following specification:

$$\log(price) = \beta_0 + \beta_1 \log(lotsize) + \beta_2 log(sqrft) + u$$

Here, *price* is measured in dollars, *lotsize* is measured in square feet, and sqrft (floorspace) is also measured in square feet. The results from estimating this equation are below:

```
Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)     5.26768    0.60188 XXXXXXXXXXXXXXXXXXXX
log(lotsize)    0.16846    0.03846 XXXXXXXXXXXXXXXXXXXX
log(sqrft)      0.76237    0.08089 XXXXXXXXXXXXXXXXXXXX
---
Multiple R-squared: 0.6353, Adjusted R-squared: 0.6267
F-statistic: 74.04 on 2 and 185 DF,  SSR: 2.924
```

a.) Using the 96% confidence level, test whether the coefficient on *log(lotsize)* is significantly different from zero. Please state your null and alternative hypotheses, and briefly interpret the result. **(10 Points)**

$\left.\begin{array}{l} H_0: \beta_1 = 0 \\ H_A: \beta_1 \neq 0 \end{array}\right\} +2$ $\quad t_{stat} = \frac{0.168 - 0}{0.0384} = 4.380$

$t_{crit} = 2.055 \quad \left.|t_{stat}| > t_{crit.}\right\} +4$

Reject the null!

log(lotsize) has a positive and statistically significant effect on the log wage. +4 b.) Please construct and interpret a 98% confidence interval for the coefficient on *log(sqrft)*. Show your work! **(10 Points)**

$t_{crit} = 2.32$ $\quad 0.762 - 0.081 \cdot 2.32 < B_2 < 0.762 + 0.081 \cdot 2.32$

$+2$ $\quad 0.574 < B_2 < 0.950$

$+4$

With 98% confidence, a 1% increase in sqrft ~~has~~ yields between a 0.574% and 095% increase in the price of the home

$+9$

c.) Suppose I claim that the effects of *log(lotsize)* and *log(sqrft)* are identical. Please state a null and alternative hypothesis, and derive an equation that allows me to test the null against the alternative. Show your work!! **(10 Points)**

$\theta = B_1 - B_2 \Rightarrow \left.\begin{array}{l} H_0 : \theta = 0 \\ H_A : \theta \neq 0 \end{array}\right\} + 3$

$\Downarrow$

$B_1 = \theta + B_2$

$\left.\begin{aligned} \log(price) &= B_0 + B_1 \log(lotsize) + B_2 \log(sqrft) \\ &= B_0 + (\theta + B_2)\log(lotsize) + B_2 \log(sqrft) \end{aligned}\right\} +6$

$\Rightarrow \boxed{\log(price) = B_0 + \theta \log(lotsize) + B_2(\log(lotsize) + \log(sqrft)) + u}$

d.) Suppose that we add the number of bedrooms, *bdrms*, and a variable, *colonial,* that takes on a value of 1 when the house is a colonial and 0 otherwise.

$$\log(price) = \beta_0 + \beta_1 \log(lotsize) + \beta_2 log(sqrft) + \beta_3 bdrms + \beta_4 colonial + u$$

The results are below:

```
Coefficients:
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)       5.55817    0.65104 XXXXXXXXXXXXXXXXXXXX
log(lotsize)      0.16782    0.03818 XXXXXXXXXXXXXXXXXXXX
log(sqrft)        0.70719    0.09280 XXXXXXXXXXXXXXXXXXXX
bdrms             0.02683    0.02872 XXXXXXXXXXXXXXXXXXXX
colonial          0.05380    0.04477 XXXXXXXXXXXXXXXXXXXX
---
Multiple R-squared: 0.6491, Adjusted R-squared: 0.6322
F-statistic: 38.38 on 4 and 183 DF, SSR=2.814
```

Suppose I claim that *bdrms* has a significant effect on *log(price)*. What is the probability that I'm wrong? Please state the null and alternative hypotheses, and show your work! **(10 Points)**

$H_0: B_3 = 0$
$H_A: B_3 \neq 0$ +2

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

$t_{stat} = \frac{0.0268 - 0}{0.0287} = 0.934$

$= 2(1 - 0.824)$

$= \boxed{0.352}$ +6

e.) Is the model in 'd' 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 answer. **(10 Points)**

Nested Model, $q = 2$, $F_{crit} = 3$

$H_0: B_3 = 0 ; B_4 = 0$
H_A H_0 not true +2

$$F_{stat} = \frac{\frac{SSR_R - SSR_{UR}}{q}}{\frac{SSR_{ur}}{df_{ur}}} = \frac{\frac{2.924 - 2.814}{2}}{\frac{2.814}{183}} = \boxed{3.577}$$

+6

$F_{stat} > F_{crit} \Rightarrow$ Reject H_0!
+2

f.) Dr. Spearot is in the market for a house, and would like one that is 1000 square feet in floorspace, 5000 square feet in lot size, 3 bedrooms, and a colonial (*colonial=1*). Please derive an equation that would allow me to estimate a predicted value for such a house with a standard error. Show your work!! **(10 Points).**

$$\theta = \beta_0 + \beta_1 \log(5000) + \beta_2 \log(1000) + \beta_3 \cdot 3 + \beta_4 \, 1$$

+4

$$\Rightarrow \beta_0 = \theta - \beta_1 \log(5000) - \beta_2 \log(1000) - \beta_3 \cdot 3 - \beta_4$$

$$\log(\text{price}) = \beta_0 + \beta_1 \log(\text{lotsize}) + \beta_2 \log(\text{sqrft}) + \beta_3 \text{bdrms} + \beta_4 \text{colonial} + u$$

$$\log(\text{price}) = \theta - \beta_1 \log(5000) - \beta_2 \log(1000) - \beta_3 3 - \beta_4 1$$
$$+ \beta_1 \log(\text{lotsize}) + \beta_2 \log(\text{sqrft}) + \beta_3 \text{bdrms} + \beta_4 \text{colonial} + u$$

$$\log(\text{price}) = \theta + \beta_1 (\log(\text{lotsize}) - \log 5000) + \beta_2 (\log(\text{sqrft}) - \log(1000))$$
$$+ \beta_3 (\text{bdrms} - 3) + \beta_4 (\text{colonial} - 1) + u$$

+6

g.) Do the variables in 'd' tell use anything about the log price? 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 answer. **(10 Points)**

$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ (+3)

H_A: H_0 not true

(+3) (+2)

$F_{stat} = 38.38$ $F_{crit} = 2.37$

$F_{stat} > F_{crit} \Rightarrow$ Reject the null. (+2)

h.) Suppose that we use a different specification, regressing the log housing price on the log of the assessed housing value, *assess*.

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

The results are below:

```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  -0.25409    0.76353 XXXXXXXXXXXXXXXXXXXX
log(assess)   1.01341    0.06046 XXXXXXXXXXXXXXXXXXXX
---
Multiple R-squared: 0.7656, Adjusted R-squared: 0.7629
F-statistic: 280.9 on 1 and 186 DF, SSR:  1.88
```

Is the model in 'h' preferred to the model in 'd'? 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 answer. **(10 Points)**

Nonnested $\Rightarrow$ Adj R^2

Model h: 0.7629 +1

Model d 0.6322 +4

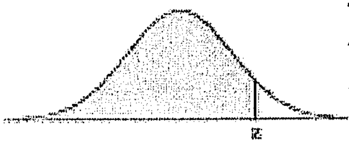
$\Rightarrow$ Model h is preferred +2

+3 if correct F-test applied incorrectly i.) Occupy Santa Cruz is angry about many things, but they are especially angry about the housing market. Whether they know it or not, they claim that housing assessments are unfair, in that the ratio $\frac{price}{assess}$ depends on the value of *assess*. Using the results from 'g', please test this hypothesis as the 95% level, stating your null and alternative hypotheses, and briefly interpret the result. **(10 Points)**

$$\left.\begin{aligned} H_0 &: B_1 = 1 \\ H_A &: B_1 \neq 1 \end{aligned}\right\} +6$$

$$t_{stat} = \frac{1.0134 - 1}{0.06046} = 0.2216 \qquad +2$$

$$\left.\begin{aligned} t_{crit} &= 1.96 \\ |t_{stat}| &< t_{crit} \\ &\text{Fail to reject the Null} \end{aligned}\right\} +2$$



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

TABLE G.3b

5% Critical Values of the F Distribution

Denominator Degrees of Freedom	Numerator Degrees of Freedom: 1	2	3	4	5	6	7	8	9	10
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99
90	3.95	3.10	2.71	2.47	2.32	2.20	2.11	2.04	1.99	1.94
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96	1.91
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83

Example: The 5% critical value for numerator $df = 4$ and large denominator df (∞) is 2.37.
Source: This table was generated using the Stata® function invFtail.