Economics 113 Professor Spearot
Introduction to Econometrics
Fall 2010 – Midterm 3
Name ANSWER KEY ID _____

Midterm 3 – 65 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 _____

Problem 1 (50 Points)

Suppose that you wish to predict wage outcomes via the following specification:

$$\log(wage) = \beta_0 + \beta_1 educ + \beta_2 exper + \beta_3 tenure + \beta_4 Sibs + \beta_5 Brthord + \beta_6 feduc + \beta_7 (meduc + feduc) + u$$

wage is measured in dollars per month, *educ*, *exper*, *tenure*, *meduc* (mother's education) and *feduc* (father's education) are measured in years. *Sibs* measures number of siblings, and *Brthord* measures the order in which the respondent was born (1=first, 2=second, etc). The results from estimating this equation are below:

```
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)     5.4707580  0.1413698  xxxxxxxxxxxxxxxxxx
educ            0.0620606  0.0080466  xxxxxxxxxxxxxxxxxx
exper           0.0185869  0.0040521  xxxxxxxxxxxxxxxxxx
tenure          0.0096864  0.0030322  xxxxxxxxxxxxxxxxxx
sibs            0.0017676  0.0080854  xxxxxxxxxxxxxxxxxx
brthord        -0.0168955  0.0121860  xxxxxxxxxxxxxxxxxx
feduc          -0.0006832  0.0105281  xxxxxxxxxxxxxxxxxx
I(meduc + feduc)  0.0119228  0.0065391  xxxxxxxxxxxxxxxxxx
---
Residual standard error: 0.3745 on 655 degrees of freedom
Multiple R-squared: 0.1835,   Adjusted R-squared: 0.1748
F-statistic: 21.03 on 7 and 655 DF, SSR = 91.84
```

a.) Please construct and interpret a 95% confidence interval for the coefficient on *educ*. **(10 Points)**

$$\hat{\beta}_{Educ} - se(\hat{\beta}_{educ}) \cdot t_{crit} < \beta_{Educ} < \hat{\beta}_{Educ} + se(\hat{\beta}_{educ}) \cdot t_{crit} \quad +2$$

$$0.0621 - 0.00804 \cdot 1.96 < \beta_{Educ} < 0.0621 + 0.00804 \cdot 1.96 \quad +2$$

$$0.0463 < \beta_{Educ} < 0.0779 \quad +4$$

With 95% confidence, a 1 year increase in education has between a 4.6% and 7.8% effect on wages. +2

b.) Using the 93% confidence level, test whether the coefficient on *tenure* is significantly different from zero. Please state your null and alternative hypotheses, and briefly interpret the result. **(10 Points)**

+1 $H_0: \beta_3 = 0$ $t_{crit} = 1.81$ +2

+1 $H_A: \beta_3 \neq 0$ $t_{stat} = \frac{0.00969}{0.00303} = 3.198$ +2

$|t_{stat}| > t_{crit}$ Reject H_0 in favor of H_A +2

+2 Tenure has a positive and statistically significant effect on the wage.

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

+2 $t_{stat} = \frac{0.0119 - 0}{0.0065} = 1.831$

$H_0: \beta_7 = 0$ +2

$H_A: \beta_7 \neq 0$ +2

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

$= 2(1 - 0.9664) = 2 \cdot 0.0336$

$= 0.0672$ +4

d.) Using the 99% confidence level, please test the hypothesis that the effect of *feduc* is significantly different than the effect of *meduc*. Please state your null and alternative hypotheses, and show your work! **(10 Points)**

+2 $H_0: \beta_6 = 0$ $t_{stat} = \frac{-0.000683 - 0}{0.01053} = -0.0649$ +2

+2 $H_A: \beta_6 \neq 0$ $t_{crit} = 2.575$ +2

$|t_{stat}| < t_{crit} \Rightarrow$ Fail to reject the null. +2

e.) The variables *Sibs* and *Brthord* take on only integer values, and thus taking derivatives is a bit coarse. So, you decide to leave them out and see what happens to other estimates. The results are below:

```
Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)        5.403359   0.129296 xxxxxxxxxxxxxxxxxx
educ               0.062781   0.007983 xxxxxxxxxxxxxxxxxx
exper              0.018796   0.004041 xxxxxxxxxxxxxxxxxx
tenure             0.009691   0.003032 xxxxxxxxxxxxxxxxxx
feduc             -0.001786   0.010475 xxxxxxxxxxxxxxxxxx
I(meduc + feduc)   0.013567   0.006404 xxxxxxxxxxxxxxxxxx
---
Residual standard error: 0.3745 on 657 degrees of freedom
Multiple R-squared: 0.1806,   Adjusted R-squared: 0.1744
F-statistic: 28.96 on 5 and 657 DF, SSR = 92.17
```

Do the variables *Sibs* and *Brthord* have a joint effect on wages? Please state your null and alternative hypotheses, and test the null against the alternative at the 95% level. **(10 Points)**

+1 H_0: $\beta_4 = \beta_5 = 0$

+1 H_A: H_0 not true

$SSR_{uR} = 91.84$

$SSR_R = 92.17$

$q = 2$

$df_{uR} = 655$

$$F_{stat} = \frac{\frac{SSR_R - SSR_{uR}}{q}}{\frac{SSR_{uR}}{df_{uR}}} = \frac{\frac{92.17 - 91.84}{2}}{\frac{91.84}{655}} = 1.176$$ +5

$F_{crit} = 3$

$F_{stat} \not> F_{crit}$

Fail to reject H_0!

+1

+2

Problem 2 (15 Points)

The *Residential Energy Consumption Survey* is put out by the US Department of Energy every few years. It surveys a representative sample of residents, their energy use, their appliance ownership, and their characteristics (income, family size, etc…). Using the 2005 version of the survey, and restricting the sample to California residents, I estimate the following equation:

$$\log(KWH) = \beta_0 + \beta_1 \log(Income) + \beta_2 Size + u$$

Here, *KWH* is kilowatt-hours of energy consumption, *Income* is household income, and *Size* is the number of people in the household. The results from estimating the above equation are as follows:

```
Coefficients:
             Estimate Std. Error  t value Pr(>|t|)
(Intercept)  5.52078    0.38881  xxxxxxxxxxxxxxxxxx
log(Income)  0.26806    0.03710  xxxxxxxxxxxxxxxxxx
Size         0.09560    0.01719  xxxxxxxxxxxxxxxxxx
---
Residual standard error: 0.5533 on 405 degrees of freedom
Multiple R-squared: 0.1929, Adjusted R-squared: 0.1889
F-statistic:  48.4 on 2 and 405 DF, SSR = 123.97
```

a.) Do the variables of the model explain *log(KWH)*? Please state your null and alternative hypotheses, and test the null against the alternative at the 95% level **(5 Points)**.

H_0: $\beta_1 = \beta_2 = 0$ + 1/2

H_1: H_0 not true + 1/2

+1/2 $F_{stat} = 48.4$

+1/2 $F_{crit} = 3$

$F_{stat} > F_{crit}$ + 3/2

Reject H_0 in favor of H_1

The variables of the model are a significant determinant of the log(KWH) + 3/2

b.) I wish to predict energy consumption for a family that earns $100,000 a year and has 5 people in the household. Please derive a new equation that allows me to generate this prediction and a standard error for the prediction. Show your work!!! **(10 Points)**

$$\Theta = B_0 + B_1 \log(100{,}000) + B_2 \cdot 5 + z$$

$$\Rightarrow B_0 = \Theta - B_1 \log(100{,}000) - B_2 \cdot 5 + z$$

$$\log(KWH) = B_0 + B_1 \log(Income) + B_2 \cdot Size + u$$

$$\log(KWH) = \Theta - B_1 \log(100{,}000) - B_2 \cdot 5 + B_1 \log(Income) + B_2 Size + u$$

+6

$$\log KWH = \Theta + B_1(\log(Income) - \log(100{,}000)) + B_2(SIZE - 5) + u$$

$\log\left(\frac{Income}{100{,}000}\right)$ ok