ECON 4706

Assignment 1: due September 25

October 2, 2014

Reminder

- Attach the cover sheet and staple your pages together
- Write your answers following the order of the questions
- Provide the Stata output and the scatterplot of y against x for all the models you estimate. Do some formatting, I showed you how to do it!

Problem 1 [15 points]

Use the data in `SLEEP75.dta` to study whether there is a trade off between the time spent sleeping per week and the time spent in paid work. Estimate the following model

$$sleep = \beta_0 + \beta_1 totwrk + u$$

where *sleep* is minutes spent sleeping at night per week and *totwrk* is total minutes worked during the week.

i (10) Report your results in equation form along with the number of obs. and R^2 as I have done in my lecture slides. What does the intercept in this equation mean?

ii (5) If *totwrk* increases by 2 hours per week, how much is *sleep* estimated to fall?

Problem 2 [25 points]

For the population of firms in the chemical industry, let *rd* denote annual R&D expenditures and let *sales* denote annual sales (both are in millions of dollars)

i (10) Write down a model (not an estimated equation) that implies a constant elasticity between *rd* and *sales*. Which parameter is the elasticity?

ii (10) Now, estimate the model using the data in `RDCHEM.dta`. Report your results in equation form along with the number of obs. and R^2 as I have done in my lecture slides.

iii (5) What is the estimated elasticity of *rd* with respect to *sales*? Explain in words what this elasticity means.

Problem 3 [30 points]

We want to explore the relationship between the math pass rate *math*10 and spending per student *expend*.

i (10) Do you think each additional dollar spent has the same effect on the rate, or does a diminishing effect is more appropriate. Explain with brevity and precision.

ii (5) In the population model

$$math10 = \beta_0 + \beta_1 \, log(expend) + u$$

argue that $\beta_1/10$ is the percentage point change in *math*10 given a 10% increase in *expend*.

iii (10) Use the data in `MEAP93.dta` to estimate the model from (ii). Report your results in equation form along with the number of obs. and R^2 as I have done in my lecture slides.

iv (5) If spending increases by 10%, what is the estimated percentage point increase in *math*10?

Problem 4 [30 points]

Use the data in `WAGE2.dta` to estimate a simple regression explaining monthly salary (*wage*) in terms of IQ score (*IQ*)

i (6) Find the average salary and average *IQ* in the sample. What is the sample standard deviation of *IQ*? (IQ scores are standardized so that the average in the population is 100 with a standard population equal to 15.)

ii (12) Estimate a simple regression model where a 1-point increase in *IQ* changes *wage* by a constant dollar amount. Use this model to find the predicted increase in *wage* for an increase in *IQ* of 15 points. Does *IQ* explain most of the variation in *wage*?

iii (12) Now estimate a model where each 1-point increase in *IQ* has the same percentage effect on *wage*. If *IQ* increases by 15 points, what is the approximate percentage increase in predicted *wage*?

Problem 1: Answers

i The estimated equation is

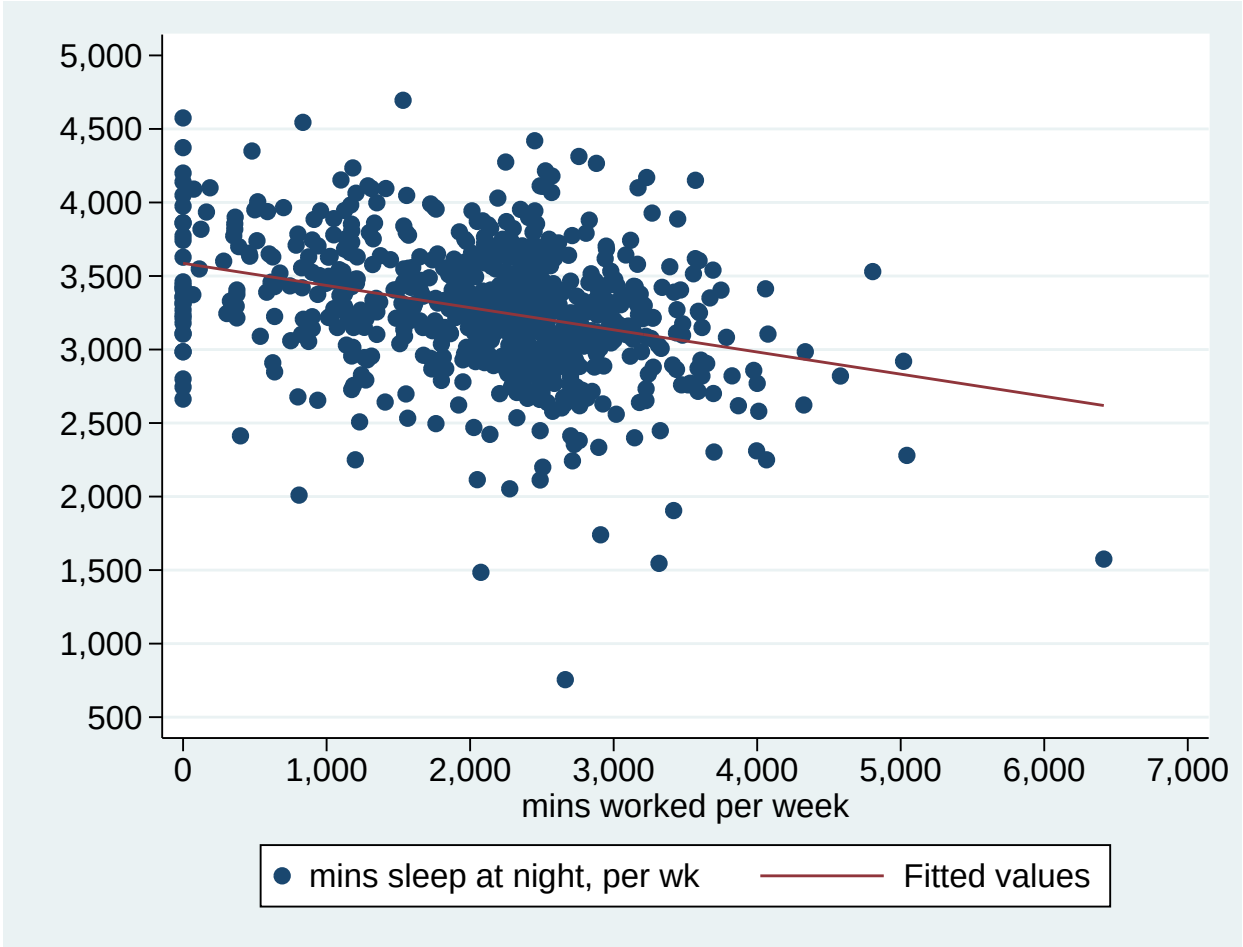
$$\widehat{sleep} = 3,586.4 - 0.151 totwrk$$

$$n = 706, \;\; R^2 = 0.103$$

The intercept implies that the estimated amount of sleep per week for someone who does not work is 3,586.4 minutes or about 59.77 hours. This is around 8.5 hours per night.

ii If someone works two more hours per week then $\Delta totwrk = 120$—since *totwrk* is measured in minutes—and so $\Delta\widehat{sleep} = -0.151(120) = -18.12$ minutes. This is only a few minutes per night. If someone were to work one more hour on each of the five working days, $\Delta\widehat{sleep} = -0.151(300) = -45.3$ minutes, which is about 5 minutes a night

Problem 1: Answers



Problem 1: Answers

```
regress sleep totwrk
```

```
      Source |       SS       df       MS              Number of obs =     706
-------------+------------------------------           F(  1,   704) =   81.09
       Model |  14381717.2     1  14381717.2           Prob > F      =  0.0000
    Residual |   124858119   704  177355.282           R-squared     =  0.1033
-------------+------------------------------           Adj R-squared =  0.1020
       Total |   139239836   705  197503.313           Root MSE      =  421.14

------------------------------------------------------------------------------
       sleep |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      totwrk |  -.1507458   .0167403    -9.00   0.000    -.1836126    -.117879
       _cons |   3586.377   38.91243    92.17   0.000     3509.979    3662.775
------------------------------------------------------------------------------
```

Problem 2: Answers

i The constant elasticity model is a log-log model of the form

$$log(rd) = \beta_0 + \beta_1 log(sales) + u$$

where β_1 is the elasticity of *rd* with respect to *sales*.

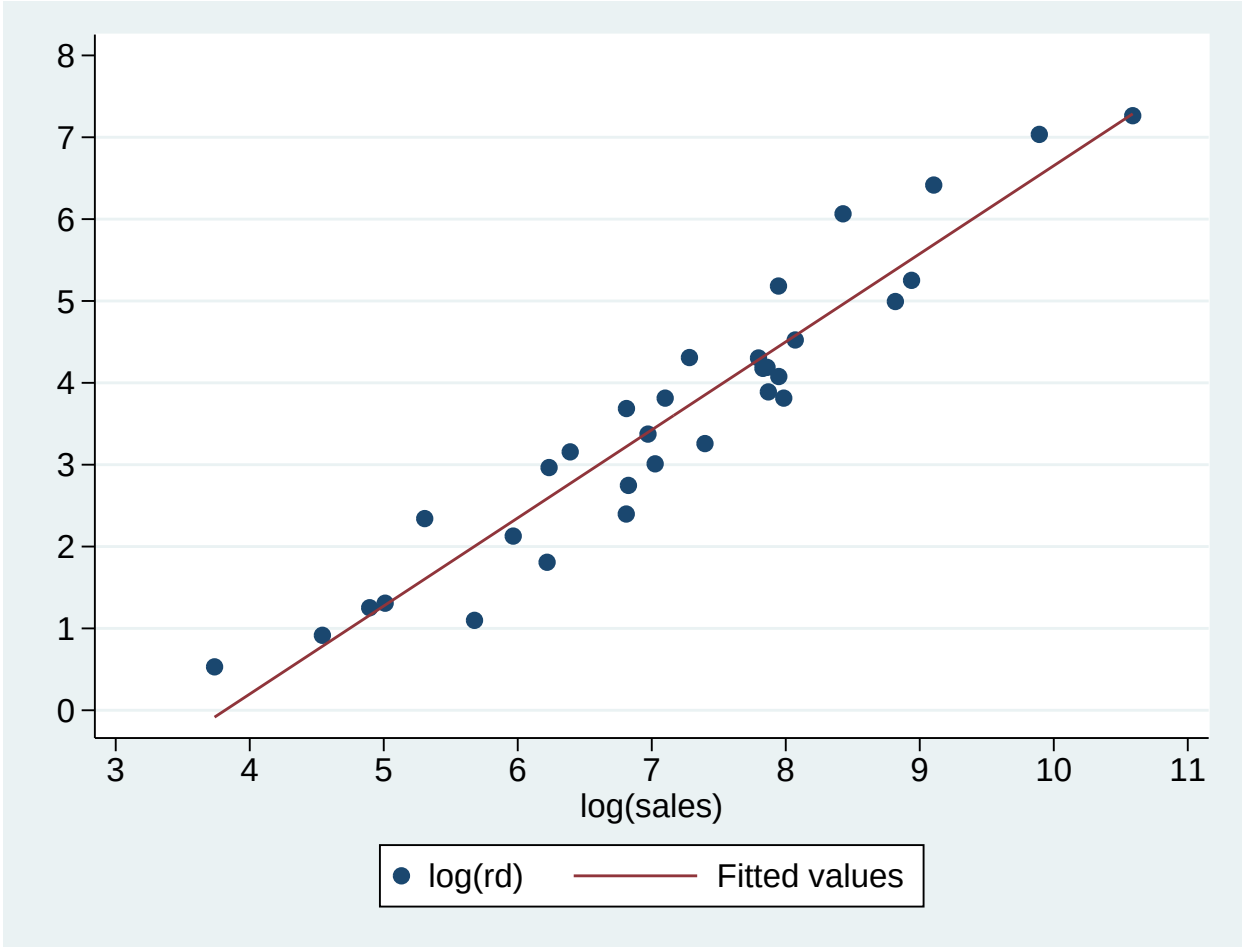
ii The estimated equation is

$$\widehat{log(rd)} = -4.105 + 1.076 log(sales)$$

$$n = 32, \;\; R^2 = 0.910$$

iii The estimated elasticity of *rd* with respect to *sales* is 1.076, which is just above one. In this case, a 1% increase in *sales* will increase *rd* by about 1.08%

Problem 2: Answers



Problem 2: Answers

```
regress lrd lsales
```

```
      Source |       SS       df       MS              Number of obs =      32
-------------+------------------------------           F(  1,    30) =  302.72
       Model |  84.8395785     1  84.8395785            Prob > F      =  0.0000
    Residual |  8.40768588    30  .280256196           R-squared     =  0.9098
-------------+------------------------------           Adj R-squared =  0.9068
       Total |  93.2472644    31  3.00797627           Root MSE      =  .52939

------------------------------------------------------------------------------
         lrd |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lsales |   1.075731   .0618275    17.40   0.000     .9494619    1.201999
       _cons |  -4.104722   .4527678    -9.07   0.000    -5.029398   -3.180047
------------------------------------------------------------------------------
```

Problem 3: Answers

i It seems plausible that another dollar of spending has a larger effect for low-spending schools than for high-spending schools.

At low-spending schools, more money can go toward purchasing more books, computers, and for hiring better qualified teachers.

At high levels of spending, we would expend little, if any, effect because the high-spending schools already have high-quality teachers, nice facilities, plenty of books, and so on.

ii If we take changes, as usual, we have

$$\Delta math10 = \beta_1 \Delta log(expend) \approx \frac{\beta_1}{100} \%\Delta expend$$

Therefore, if $\%\Delta expend = 10$, then $\Delta math10 = \beta_1 / 10$

Problem 3: Answers

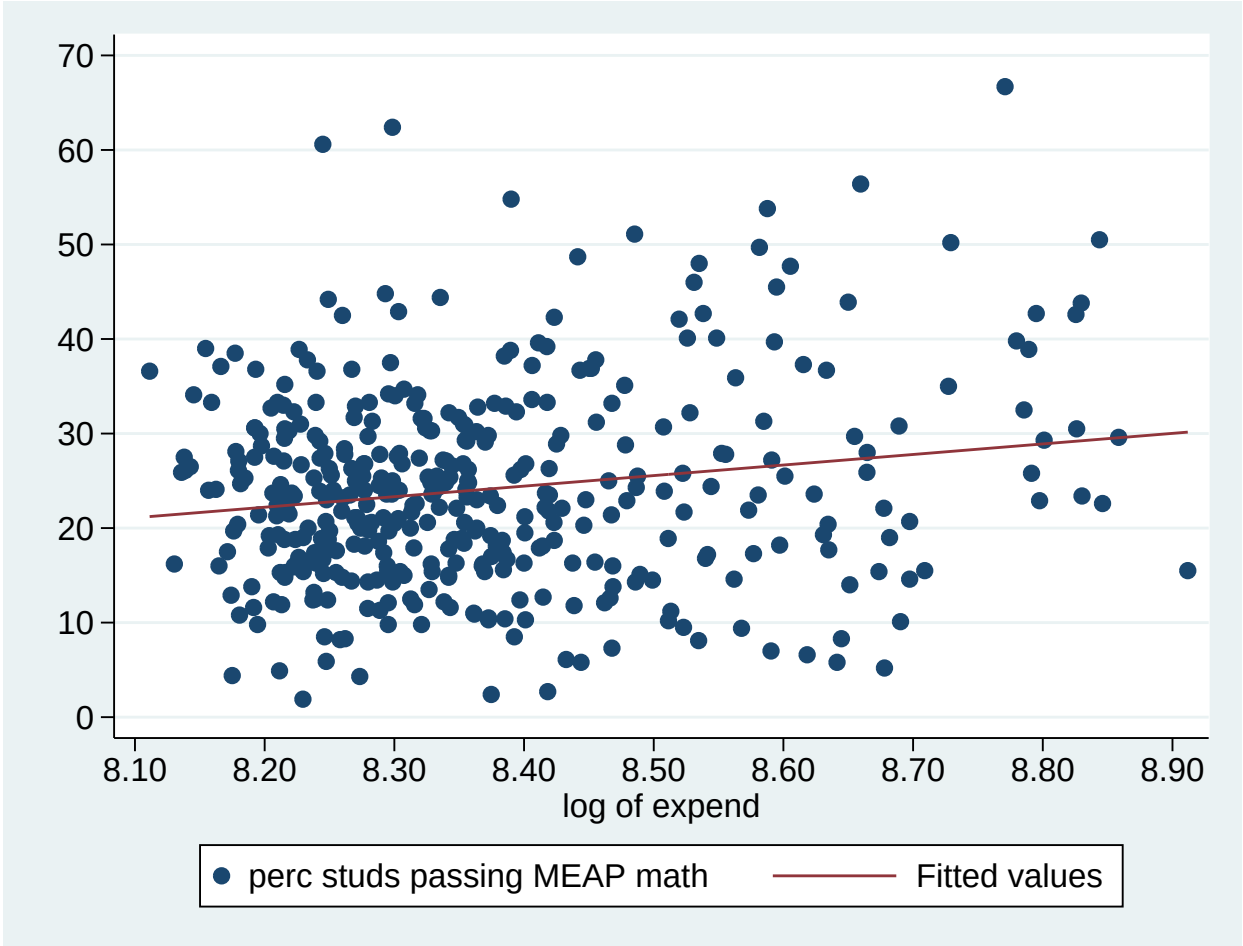
iii The estimated equation is

$$\widehat{math10} = -69.34 + 11.16 log(expend)$$

$$n = 408, \quad R^2 = 0.297$$

iv If *expend* increases by 10 percent, *math*10 increases by about 1.1 percentage points. This is not a huge effect, but it is not trivial for low-spending schools, where a 10 percent increase in spending might be a fairly small dollar amount.

Problem 3: Answers



Problem 3: Answers

```
regress math10 lexpend
```

```
      Source |       SS       df       MS              Number of obs =     408
-------------+------------------------------           F(  1,   406) =   12.41
       Model |  1329.42517     1  1329.42517           Prob > F      =  0.0005
    Residual |  43487.7553   406  107.112698           R-squared     =  0.0297
-------------+------------------------------           Adj R-squared =  0.0273
       Total |  44817.1805   407  110.115923           Root MSE      =   10.35

------------------------------------------------------------------------------
     math10 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lexpend |   11.16439   3.169011     3.52   0.000     4.934677    17.39411
       _cons |   -69.3411   26.53013    -2.61   0.009    -121.4947   -17.18753
------------------------------------------------------------------------------
```

Problem 4: Answers

i The average salary is \$957.95 and the average IQ is about 101.28. The sample std. deviation of IQ is about 15.05, which is pretty close to the population value of 15.

ii We should estimate a level-level model

$$\widehat{wage} = 116.99 + 8.30IQ$$

$$n = 935, \;\; R^2 = 0.096$$

An increase in IQ of 15 increases predicted $wage$ by 8.30(15)=\$124.50. IQ explains less than 10% of the total variation in $wage$

iii We should now estimate a log-level model

$$\widehat{log(wage)} = 5.89 + 0.0088IQ$$

$$n = 935, \;\; R^2 = 0.099$$

If $\Delta IQ = 15$ then $\Delta\widehat{log(wage)} = .0088(15) = .132$, which is the (approximate) proportionate change in predicted wage. The percentage increase is therefore approximately 13.2.

Problem 4: Answers

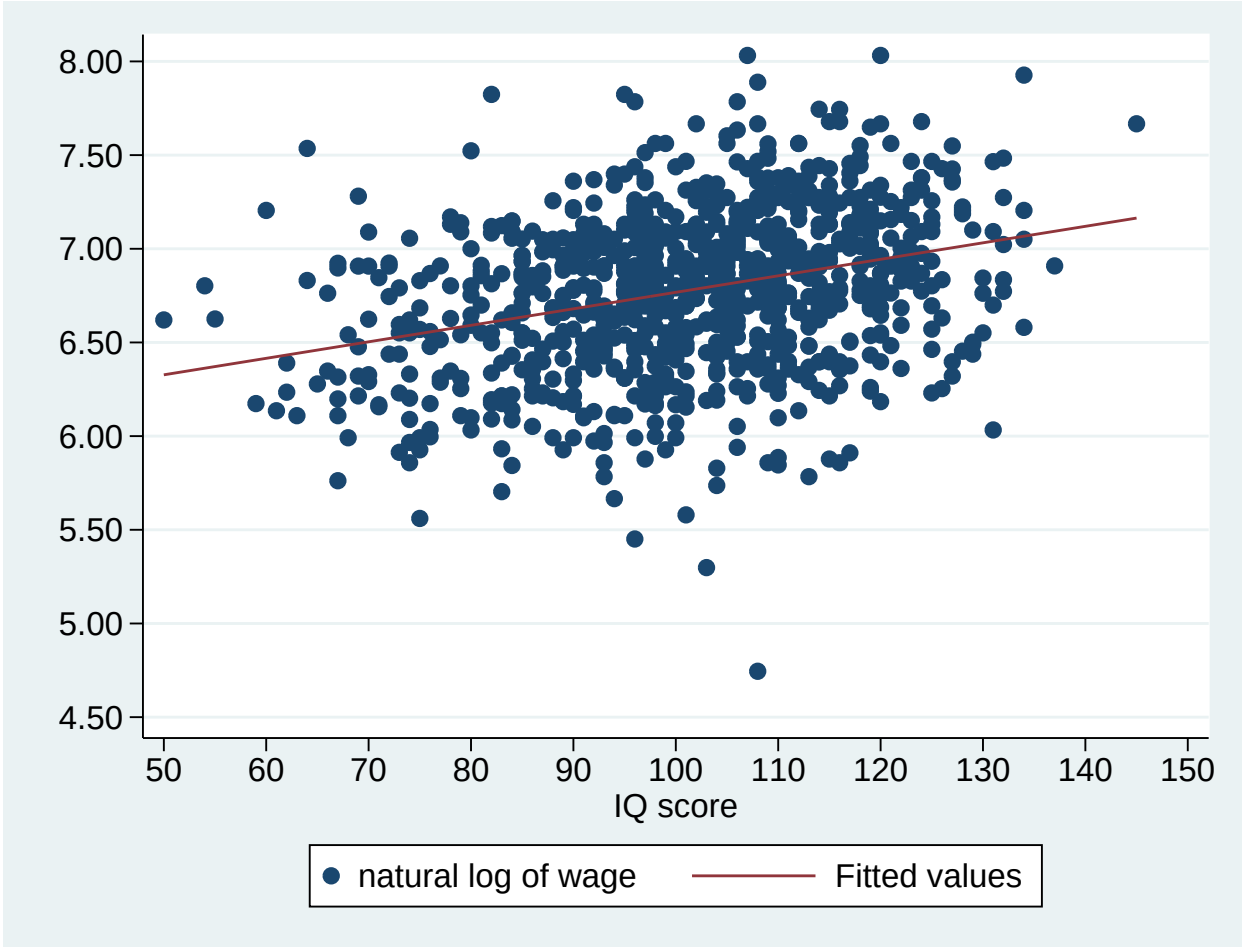
Problem 4: Answers

```
regress wage IQ
```

```
      Source |       SS       df       MS              Number of obs =     935
-------------+------------------------------           F(  1,   933) =   98.55
       Model |  14589782.6     1  14589782.6           Prob > F      =  0.0000
    Residual |   138126386   933  148045.429           R-squared     =  0.0955
-------------+------------------------------           Adj R-squared =  0.0946
       Total |   152716168   934  163507.675           Root MSE      =  384.77

------------------------------------------------------------------------------
        wage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          IQ |   8.303064   .8363951     9.93   0.000     6.661631    9.944498
       _cons |   116.9916   85.64153     1.37   0.172    -51.08078    285.0639
------------------------------------------------------------------------------
```

Problem 4: Answers



Problem 4: Answers

```
regress lwage IQ
```

```
      Source |       SS       df       MS              Number of obs =     935
-------------+------------------------------           F(  1,   933) =  102.62
       Model |  16.4150939     1  16.4150939           Prob > F      =  0.0000
    Residual |  149.241189   933  .159958402           R-squared     =  0.0991
-------------+------------------------------           Adj R-squared =  0.0981
       Total |  165.656283   934  .177362188           Root MSE      =  .39995

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          IQ |   .0088072   .0008694    10.13   0.000      .007101    .0105134
       _cons |   5.886994   .0890206    66.13   0.000     5.712291    6.061698
------------------------------------------------------------------------------
```