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Homework 4

1a. Comparing we should get:

$\beta_0^* = \beta_0 + \beta_1\omega_0 + \beta_3\gamma_0 + \beta_4\theta_0$

$\beta_2^* = \beta_1\omega_1 + \beta_2 + \beta_3\gamma_1 + \beta_4\theta_1$

Omitted Variable Bias are:

$\beta_0^* = \beta_1\omega_0 + \beta_3\gamma_0 + \beta_4\theta_0$

$\beta_2^* = \beta_1\omega_1 + \beta_3\gamma_1 + \beta_4\theta_1$

b. Putting in the values of the parameter we get a predicted Bias for β_2:

0.4*3+(-2.4*0.5)+3.1*0=0

2a. The coefficients for β_1 is the coefficient of Minutes per game, β_2 is the coefficient of height and β_3 is the coefficient of talent. We know that an NBA player who plays more minutes and have their height and talent higher comparatively to their peers, will have a better chance of scoring more points. Thus we'd expect β_1, β_2, β_3 to all be positive.

b. The correlation I expect between talent and minutes should be positive. For example, if I am managing the team and wanted certain players to play in order to win, I'd want more talented players to play more minutes in order to score more points to win. If I play less talented players more minutes or more talented players less minutes, my expected score would be lower than if I had more talented players play more minutes. So there must be a positive correlation between talent and minutes, since talent is omitted, we expect β_1 will go up.

c. Since taller people have an easier time making it to the NBA as opposed to shorter players even if they aren't as talented as the shorter players. This will cause a bias for β_2, which is the coefficient for height, taller players will have a higher coefficient than shorter players. Mathematically suppose our coefficient for height is 1.2, and our taller player (A) is 80 inches and our shorter player (B) is 70 inches, if we plug in these values for height into our regression, we get, $\widehat{points} = \beta_0 + \beta_1 Minutes + 1.2ln(height)$, if we hold all else equal, the difference in the expected points will be 0.162.

d. Two reasons why researchers may omit a variable in their regression is because of the lack of qualitative research done on the topic or change in R^2 was not properly observed.

3a. With each year of experience the hourly wage of a male worker will be increased by \$0.15. With each year of experience the hourly wage of a female worker will be increased by \$0.10.

b. At zero level of experience male and female worker will have the same level of wage.

c. $\frac{d_{wage}}{d_{female}} = -1.75 + 0.1exp + 1.5col$

The wage gap of being a female with no experience or education is -1.75.

With no degree and 5 years of experience is -1.25.

With a degree and 5 years of experience is .25.

d. $\widehat{wage} = 7.10 - 1.75Fem + 2.50Col + 1.50Fem * Col$ (w/ Col & w/oExp)

$\widehat{wage} = 7.10 - 1.75Fem + 0.15Exp + 0.10Fem * Exp$ (w/Exp & w/o college)

How many years of experience would it take to earn the same wage as with college.

$\widehat{wage} = 7.10 - 1.75(1) + 2.50(1) + 1.5(1)(1)$ subbing in 1 for Col and Fem

$\widehat{wage} = 9.35$

$\widehat{wage} = 7.10 - 1.75(1) + 0.15Exp + 0.10(1) * Exp$ subbin in 1 for Fem

$\widehat{wage} = 5.35 + .25Exp$

Exp = 16 years

4a. S.d. of the sample mean:

$\frac{\sigma}{\sqrt{n}} = \frac{20450}{\sqrt{100}} = 2045$

b. Test $\mu < 32000$ with normal dist^n with 10% level

Hypothesis test:

H_0: $\mu = 32000$

H_a: $\mu < 32000$

Test Statistic z* = $\frac{\bar{x}-\mu}{\sigma/\sqrt{n}} = \frac{30755-32000}{20450/\sqrt{100}} = -0.61$

(P-value Approach)

P-value = P(Z<-0.61)=0.2709(from z-table)

P-value = 0.2709

Since 0.2709 $\geq$ 0.1, we fail to reject the null hypothesis

c. Test: $\mu \neq 33000$ with normal dist^n

Hypothesis test:

H_0: $\mu = 33000$

H_A: $\mu \neq 33000$

Test Statistic z* = $\frac{\bar{x}-\mu}{\sigma/\sqrt{n}} = \frac{30755-33000}{20450/\sqrt{100}} = -1.10$

(P-value Approach):

P-value = P(Z < -1.1 or Z > 1.1)

P-value = 2* P(Z<-1.1) = 2*0.1357= 0.2714

Since 0.2714 $\geq$ 0.1 we fail to reject the null hypothesis

d. 95% CI

$\bar{x} \pm Z_{\alpha/2} \times \frac{\sigma}{\sqrt{n}}$

30,755 + 1.96 $\times \frac{20450}{\sqrt{100}}$ =34763.2

30,755 - 1.96 $\times \frac{20450}{\sqrt{100}}$ = 26746.8

95% Confidence Interval: (26746.8, 34763.2)

5a. **reg wage IQ**

```
      Source |       SS           df       MS      Number of obs   =       901
-------------+----------------------------------   F(1, 899)       =     93.38
       Model |  557036.315         1  557036.315   Prob > F        =    0.0000
```

```
    Residual |  5362814.38       899  5965.31077   R-squared       =    0.0941
-------------+----------------------------------   Adj R-squared   =    0.0931
       Total |   5919850.7       900  6577.61189   Root MSE        =    77.235

------------------------------------------------------------------------------
        wage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          IQ |   1.651079   .1708609     9.66   0.000     1.315747    1.986412
       _cons |   1024.364   17.46236    58.66   0.000     990.0925    1058.636
------------------------------------------------------------------------------
```

Wage = 1024.364 + 1.651*IQ + u

Strong and positive coefficient, each additional unit of IQ, increases wage by $1.651.

b. **gen IQwithnoise# (1-5) = rnormal (0,50)**

reg wage IQwithnoise1

```
      Source |       SS           df       MS      Number of obs   =       901
-------------+----------------------------------   F(1, 899)       =      0.40
       Model |  2642.86562         1  2642.86562   Prob > F        =    0.5265
    Residual |  5917207.83       899  6581.98869   R-squared       =    0.0004
-------------+----------------------------------   Adj R-squared   =   -0.0007
       Total |   5919850.7       900  6577.61189   Root MSE        =    81.129

------------------------------------------------------------------------------
        wage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
IQwithnoise1 |  -.0341326   .0538655    -0.63   0.526    -.1398494    .0715842
       _cons |   1191.249   2.702952   440.72   0.000     1185.944    1196.554
------------------------------------------------------------------------------
```

reg wage IQwithnoise2

```
      Source |       SS           df       MS      Number of obs   =       901
-------------+----------------------------------   F(1, 899)       =      0.34
       Model |  2210.42265         1  2210.42265   Prob > F        =    0.5624
    Residual |  5917640.27       899  6582.46972   R-squared       =    0.0004
-------------+----------------------------------   Adj R-squared   =   -0.0007
       Total |   5919850.7       900  6577.61189   Root MSE        =    81.132

------------------------------------------------------------------------------
        wage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
IQwithnoise2 |   .0328728   .0567275     0.58   0.562     -.078461    .1442066
       _cons |   1191.336   2.705625   440.32   0.000     1186.026    1196.646
------------------------------------------------------------------------------
```

reg wage IQwithnoise3

```
      Source |       SS           df       MS      Number of obs   =       901
-------------+----------------------------------   F(1, 899)       =      0.03
       Model |  166.772735         1  166.772735   Prob > F        =    0.8736
    Residual |  5919683.92       899  6584.74296   R-squared       =    0.0000
-------------+----------------------------------   Adj R-squared   =   -0.0011
       Total |   5919850.7       900  6577.61189   Root MSE        =    81.146
```

```
------------------------------------------------------------------------------
        wage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
IQwithnoise3 |  -.0084542   .0531224    -0.16   0.874    -.1127126    .0958042
       _cons |   1191.271   2.703588   440.63   0.000     1185.965    1196.578
------------------------------------------------------------------------------
```

reg wage IQwithnoise4

```
      Source |       SS           df       MS      Number of obs   =       901
-------------+----------------------------------   F(1, 899)       =      1.19
       Model |   7812.0895         1   7812.0895   Prob > F        =    0.2760
    Residual |  5912038.61       899  6576.23872   R-squared       =    0.0013
-------------+----------------------------------   Adj R-squared   =    0.0002
       Total |   5919850.7       900  6577.61189   Root MSE        =    81.094

------------------------------------------------------------------------------
        wage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
IQwithnoise4 |   .0601501   .0551876     1.09   0.276    -.0481614    .1684616
       _cons |   1191.257   2.701646   440.94   0.000     1185.955    1196.559
------------------------------------------------------------------------------
```

reg wage IQwithnoise5

```
      Source |       SS           df       MS      Number of obs   =       901
-------------+----------------------------------   F(1, 899)       =      0.05
       Model |   314.09296         1   314.09296   Prob > F        =    0.8272
    Residual |   5919536.6       899  6584.57909   R-squared       =    0.0001
-------------+----------------------------------   Adj R-squared   =   -0.0011
       Total |   5919850.7       900  6577.61189   Root MSE        =    81.145

------------------------------------------------------------------------------
        wage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
IQwithnoise5 |  -.0119117   .0545393    -0.22   0.827    -.1189509    .0951274
       _cons |   1191.269   2.703373   440.66   0.000     1185.963    1196.574
------------------------------------------------------------------------------
```

C. The coefficients in part B compared to our original estimate using true value of IQ in part A shows there's some variation in IQ

d.

5a. reg salary sales roe ros indus finance consprod

```
      Source |       SS           df       MS      Number of obs   =       209
-------------+----------------------------------   F(6, 202)       =      2.97
       Model |  31762665.5         6  5293777.58   Prob > F        =    0.0084
    Residual |   359970317       202  1782031.27   R-squared       =    0.0811
-------------+----------------------------------   Adj R-squared   =    0.0538
       Total |   391732982       208  1883331.64   Root MSE        =    1334.9

------------------------------------------------------------------------------
      salary |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
       sales |   .0111722   .0090017     1.24   0.216    -.0065773    .0289216
         roe |   7.970479   12.62133     0.63   0.528    -16.91598    32.85694
         ros |  -2.142566   1.492172    -1.44   0.153    -5.084797    .7996658
       indus |   279.7675   291.5297     0.96   0.338    -295.0642    854.5992
     finance |    552.465    300.598     1.84   0.068    -40.24739    1145.177
    consprod |   948.1143   322.5469     2.94   0.004     312.1236    1584.105
       _cons |   715.7507   276.0282     2.59   0.010     171.4845    1260.017
------------------------------------------------------------------------------
```

Salary = 715.75 + 0.011*Sales + 7.970*ROE - 2.143*ROS + 279.768*Indus + 552.465*Finance + 948.114*Consprod + u

An additional sale will increase the salary by $0.011 with ceteris paribus assuming that everything is held constant.

b. $t_{95\%}$= 1.962

c. **ttest roe == 10, level(90)**

```
One-sample t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [90% Conf. Interval]
---------+--------------------------------------------------------------------
     roe |     209    17.18421    .5892376    8.518509    16.21066    18.15776
------------------------------------------------------------------------------
    mean = mean(roe)                                              t =  12.1924
Ho: mean = 10                                    degrees of freedom =      208

    Ha: mean < 10               Ha: mean != 10               Ha: mean > 10
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

Fail to reject the null hypothesis that return on equity (roe) has an effect that is equal to 10 at the 90% level. 0% chance that we would get this sample mean if true mean were 10.

test _b[roe]=10

```
 ( 1)  roe = 10

       F(  1,   202) =    0.03
            Prob > F =    0.8724
```

d. **reg salary sales roe ros indus finance consprod**

```
      Source |       SS           df       MS      Number of obs   =       209
-------------+----------------------------------   F(6, 202)       =      2.97
       Model |  31762665.5         6  5293777.58   Prob > F        =    0.0084
    Residual |   359970317       202  1782031.27   R-squared       =    0.0811
-------------+----------------------------------   Adj R-squared   =    0.0538
       Total |   391732982       208  1883331.64   Root MSE        =    1334.9

------------------------------------------------------------------------------
      salary |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       sales |   .0111722   .0090017     1.24   0.216    -.0065773    .0289216
```

```
         roe |   7.970479   12.62133     0.63   0.528    -16.91598    32.85694
         ros |  -2.142566   1.492172    -1.44   0.153    -5.084797    .7996658
       indus |   279.7675   291.5297     0.96   0.338    -295.0642    854.5992
     finance |    552.465    300.598     1.84   0.068    -40.24739    1145.177
    consprod |   948.1143   322.5469     2.94   0.004     312.1236    1584.105
       _cons |   715.7507   276.0282     2.59   0.010     171.4845    1260.017
------------------------------------------------------------------------------
```

test indus finance consprod

```
 ( 1)  indus = 0
 ( 2)  finance = 0
 ( 3)  consprod = 0

       F(  3,   202) =    3.60
            Prob > F =    0.0144
```

reg salary sales roe ros

```
      Source |       SS           df       MS      Number of obs   =       209
-------------+----------------------------------   F(3, 205)       =      2.25
       Model |  12501859.4         3  4167286.46   Prob > F        =    0.0834
    Residual |   379231123       205  1849907.92   R-squared       =    0.0319
-------------+----------------------------------   Adj R-squared   =    0.0177
       Total |   391732982       208  1883331.64   Root MSE        =    1360.1

------------------------------------------------------------------------------
      salary |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       sales |   .0154825   .0089539     1.73   0.085    -.0021711    .0331361
         roe |   22.00331   11.51655     1.91   0.057    -.7027663    44.70939
         ros |  -1.105191    1.45024    -0.76   0.447     -3.96449    1.754108
       _cons |   864.1175   228.3997     3.78   0.000     413.8038    1314.431
------------------------------------------------------------------------------
```