# Econometrics Homework 2

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February 20, 2018

**Questions 2, 3, and 9 from Chapter 4 on pp. 141-143**

**Question 2. Consider an equation to explain the salaries of CEOs in terms of annual firms sales, return on equity (roe, in percentage form), and return on the firm's stock (ros, in percentage form):** $log(salary) = \beta_0 + \beta_1 log(sales) + \beta_2 roe + \beta_3 ros + u$

**(i) In terms of the model parameters, state the null hypothesis that, after controlling for *sales* and *roe*, *ros* has no effect on CEO salary. State the alternative that better stock market performance increases a CEO's salary.**

$H_0 : \beta_3 = 0$

$H_1 : \beta_3 > 0$

**(ii) Using the data in CEOSAL1, the following equation was obtained by OLS:**

$log(s\hat{a}lary) = 4.32 + .280 log(sales) + .0174 roe + .00024 ros$

**(.32) (.035) (.0041) (.00054)**

**n=209,** $R^2$**=.283**

**By what percentage is *salary* predicted to increase if *ros* increases by 50 points? Does *ros* have a practically large effect on *salary*?**

$.00024(50) = 0.012$ $0.012(100) = 1.2 practically a small effect on salary.$

**(iii) Test the null hypothesis that *ros* has no effect on *salary* against the alternative that *ros* has a positive effect. Carry out the test at the 10% significance level.**

$t\hat{\beta} = \frac{.00024}{.00054} = 0.4\bar{4}$ and the $c = 1.282$ because of the degrees of freedom at a 10% significance level.That is, $n - k - 1 = 209 - 3 - 1 = 205$ which is greater than the largest numerical significance level on the critical values table (ie, use infinity). This means that we fail to reject the null at a 10% significance level. For all intensive purposes, the relationship between ros and salary is practically indistinguishable from zero.

**(iv) Would you include *ros* in a final model explaining CEO compensation in terms of firm performance? Explain.**

Including *ros* might not be a negative generally as its relationship is almost zero, however, this depends on its correlation with other variables.

**Question 3. The variable *rdintens* is expenditures on research and development (R&D) as a percentage of sales. Sales are measured in millions of dollars. The variable *profmarg* is profits**

**as a percentage of sales. Using the data in RDCHEM for 32 firms in the chemical industry, the following equation is estimated:**

$\hat{rdintens} = .472 + .321 log(sales) + .050 profmarg$

**(1.369) (.216) (.046)**

**n=32,** $R^2 = .099$

**(i) Interpret the coefficient on log(*sales*). In particular, if sales increases by 10%, what is the estimated percentage point change in *rdintens*? Is this an economically large effect?**

If sales goes upward by 10%, rdintens will increased by approximately .0321 percentage points ($\frac{.321}{100}$) which shows that the sales change is not practically large.

**(ii) Test the hypothesis that R&D intensity does not change with sales against the alternative that does increase with sales. Do the test at the 5% and 10% levels.**

$t = \frac{.321}{.216} \approx 1.486$ The degrees of freedom are $n - k - 1 = 32 - 2 - 1 = 29$ which means using the critical values table, c=1.699 at a 5% significance level and c=1.311 at a 10% significance level. This means at 5% significance level, we can reject since $1.699 > 1.486$ and we cannot reject at a 10% significance level as $1.311 < 1.486$.

**(iii) Interpret the coefficient on *profmarg*. Is it economically large?**

The coefficient is not economically large. For instance, a 1% increase in *profmarg* only lends to a 0.05% increase in *rdintens*.

**(iv) Does profmarg have a statistically significant effect on rdintens?**

$t = \frac{\hat{\beta_1} - \hat{\beta_2}}{SE(\hat{\beta_1} - \hat{\beta_2})} = \frac{0.05 - 0}{.046} \approx 1.087$ That answer is no since the t statistic is below the 10% critical value for the one-tailed test.

**Question 9. In Problem 3 in Chapter 3, we estimated the equation**

$\hat{sleep} = 3638.25 - .148 totwrk - 11.13 educ + 2.20 age$

**(112.28) (.017) (5.88) (1.45)**

**n=706,** $R^2 = .113$

**where we now report standard errors along the estimates.**

**(i) Is either *educ* or *age* individually significant at the 5% level against a two-sided alternative? Show your work**.

$t_{educ} = \frac{\hat{\beta_1} - \hat{\beta_2}}{SE(\hat{\beta_1} - \hat{\beta_2})} = \frac{-11.13 + 0}{5.88} \approx -1.893$ and the critical value is 1.96 found by the critical values table when $n - k - 1 = 706 - 3 - 1 = 702$. This means that since the absolute value of $1.893 < 1.96$, we fail to reject the null which is $H_0 : \beta_{educ} = 0$ at the 5% significance level.

$t_{age} = \frac{\hat{\beta_1} - \hat{\beta_2}}{SE(\hat{\beta_1} - \hat{\beta_2})} = \frac{2.20 - 0}{1.45} \approx 1.517$ and the critical value is 1.96 found by the critical values table with 702 degrees of freedom. Accordingly, 1.517<1.96 meaning that we fail to reject the null $H_0 : \beta_{age} = 0$. Both variables are not statistically significant at a 5% significance level.

**(ii) Dropping *educ* and *age* from the equation gives**

$\hat{sleep} = 3586.38 - .151 totwrk$

**(38.91) (.017)**

**n=706,** $R^2 = .103$

**Are *educ* and *age* jointly significant in the original equation at the 5% level? Justify your answer.**

$F = \frac{(R_{ur}^2 - R_r^2)/q}{(1-R_{ur}^2)/df_{ur}} = \frac{(.113-.103)/2}{(1-.113)/(702)} = \frac{0.01/(2)}{0.887(1/702)} = 0.005/0.00126353 = 3.96$

The 5% critical value is c=3.00 with infinite degrees of freedom. This means that *educ* and *age* are jointly significant in the original equation.

**(iii) Does including *educ* and *age* in the model greatly affect the estimated tradeoff between sleeping and working?**

No it doesn't. While the variables are jointly significant, including the variables only change the coefficient on *totwrk* from -.151 to -1.48 which is practically small.

**(iv) Suppose that the sleep equation contains heteroskedasticity. What does this mean about the tests computed in parts (i) and (ii)?**

If heteroskedasticity existed, then the test computed in those parts are not valid and the results are biased.