Introductory Econometrics
Lecture 4: Hypothesis Testing

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1.

Consider an equation to explain salaries of CEOs in terms of annual firm sales return on equity (`roe` in percentage form) and return on the firm's stock (`ros` in percentage form):

$$\log(\text{salary}) = \beta_0 + \beta_1 \log(\text{sales}) + \beta_2 \text{roe} + \beta_3 \text{ros} + u$$

- 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.

- Using the data in `CEOSAL1.RAW` the following equation was obtained by OLS:

$$\log(\text{salary}) = 4.32 + 0.280 \log(\text{sales}) + 0.0174\text{roe} + 0.00024\text{ros}$$

$$(0.32) \quad (0.035) \quad (0.0041) \quad (0.00054)$$

$$n = 209 \quad R^2 = 0.283$$

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

- 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.

- Would you include `ros` in a final model explaining CEO compensation in terms of firm performance? Explain.

2.

The variable `rdintens` is expenditures on research and development (RD) 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.RAW` for 32 firms in the chemical industry the following equation is estimated:

$$\text{rdintens} = 0.472 + 0.321\log(\text{sales}) + 0.050\text{profmarg}$$

$$(1.369) \quad (0.216) \quad (0.046)$$

$$n = 32 \quad R^2 = 0.099$$

- 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?

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

- Does `profmarg` have a statistically significant effect on `rdintens`?

3.

Are rent rates influenced by the student population in a college town? Let `rent` be the average monthly rent paid on rental units in a college town in the United States. Let `pop` denote the total city population, `avginc` the average city income, and `pctstu` the student population as a percentage of the total population. One model to test for a relationship is

$$\log(\text{rent}) = \beta_0 + \beta_1\log(\text{pop}) + \beta_2\log(\text{avginc}) + \beta_3\text{pctstu} + u$$

- State the null hypothesis that size of the student body relative to the population has no ceteris paribus effect on monthly rents. State the alternative that there is an effect.

- What signs do you expect for β_1 and β_2?

- The equation estimated using 1990 data from `RENTAL.RAW` for 64 college towns is:

$$\log(\text{rent}) = 0.043 + 0.066\log(\text{pop}) + 0.507\log(\text{avginc}) + 0.0056\text{pctstu}$$

$$(0.844) \quad (0.039) \quad (0.081) \quad (0.0017)$$

$$n = 64 \quad R^2 = 0.458$$

What is wrong with the statement: "A 10% increase in population is associated with about a 6.6% increase in rent"?

- Test the hypothesis stated in part (a.) at the 1% level.