Introduction to Econometrics

Chapter 3

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3 Multiple linear regression: estimation and properties

3.2 Obtaining the OLS estimates, interpretation of the coefficients, and other characteristics

EXAMPLE 3.1 Quantifying the influence of age and wage on absenteeism in the firm Buenosaires (file absent)

$$absent = \beta_1 + \beta_2 age + \beta_3 tenure + \beta_4 wage + u$$

$$\widehat{absent_i} = \underset{(1.603)}{14.413} - \underset{(0.048)}{0.096}\, age_i - \underset{(0.067)}{0.078}\, tenure_i - \underset{(0.007)}{0.036}\, wage_i$$

$$R^2 = 0.694 \qquad n = 48$$

EXAMPLE 3.2 Demand for hotel services (file hostel)

$$\ln(hostel) = \beta_1 + \beta_2 \ln(inc) + \beta_3 hhsize + u$$

$$\widehat{\ln(hostel_i)} = -27.36 + 4.442 \ln(inc_i) - 0.523 hhsize_i$$

$$R^2 = 0.738 \quad n = 40$$

EXAMPLE 3.3 A hedonic regression for cars (file hedcarsp)

$$\ln(price) = \beta_1 + \beta_2 volume + \beta_3\, fueleff + u$$

$$\widehat{\ln(price_i)} = 14.97 + 0.0956 volume_i - 0.1608\, fueleff_i$$

$$R^2 = 0.765 \quad n = 214$$

3.2 Obtaining the OLS estimates, interpretation of the coefficients, and other characteristics

EXAMPLE 3.4 *Sales* and advertising: the case of Lydia E. Pinkham (file pinkham)

$$\lambda V_{t-1} = \alpha\lambda + \beta_1 \lambda P_{t-1} + \beta_1 \lambda^2 P_{t-2} + \beta_1 \lambda^3 P_{t-3} + \cdots + \lambda u_{t-1}$$

$$\widehat{sales_t} = 138.7 + 0.3288 advexp + 0.7593 sales_{t-1}$$

$$R^2 = 0.877 \quad n = 53$$

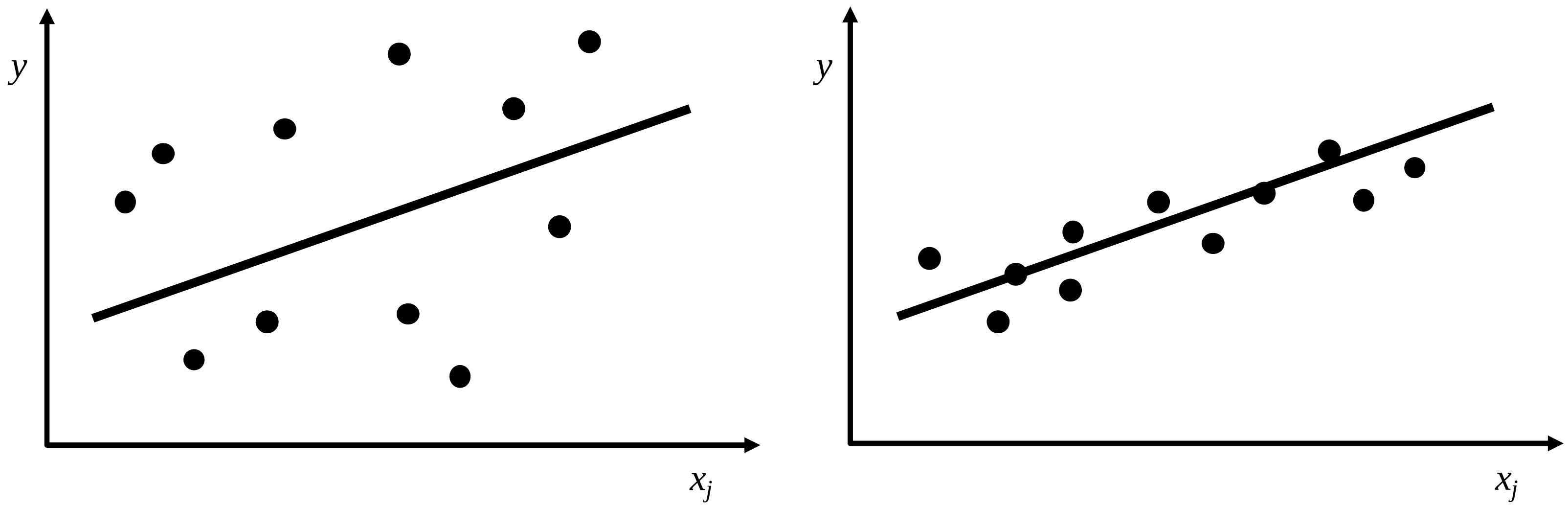
The sum of the cumulative effects of advertising expenditures on *sales*:

$$\frac{\hat{\beta}_1}{1-\hat{\lambda}} = \frac{0.3288}{1-0.7593} = 1.3660$$

Periods of time required to reach half of the total effects:

$$\hat{h}(0.5) = \frac{\ln(1-0.5)}{\ln(0.7593)} = 2.5172$$

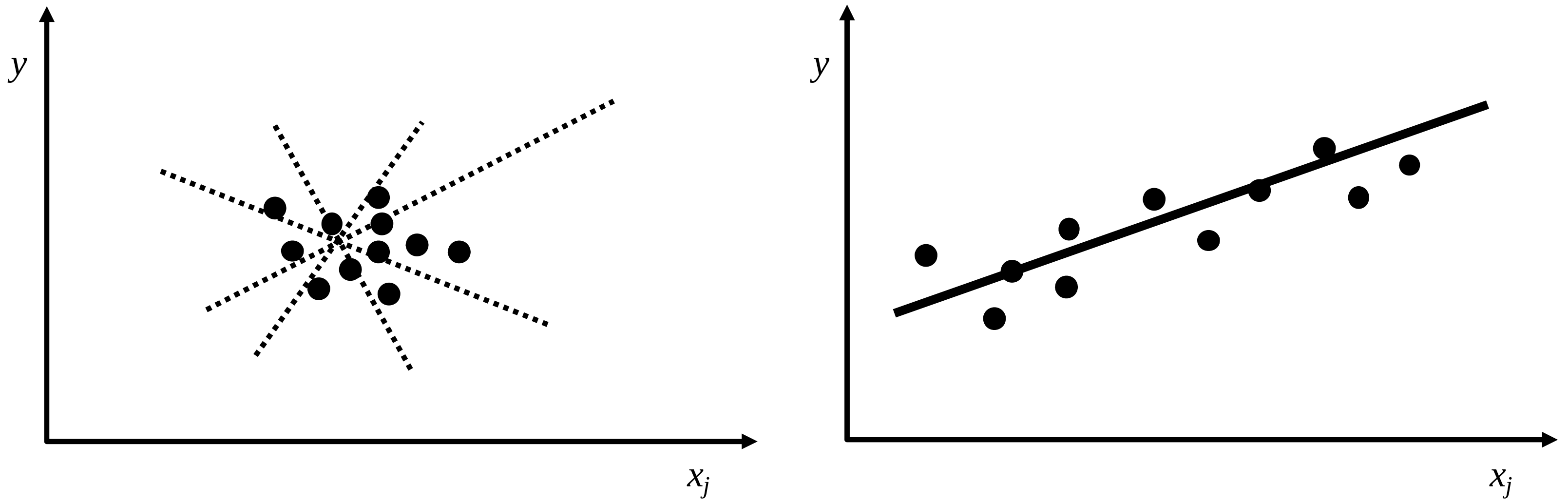
3.3 Assumptions and statistical properties of the *OLS* estimators



a) $\hat{\sigma}^2$ **big** **b)** $\hat{\sigma}^2$ **small**

FIGURE 3.1. Influence of $\hat{\sigma}^2$ **on the estimator of the variance..**

3.3 Assumptions and statistical properties of the *OLS* estimators



a) S_j^2 small b) S_j^2 big

FIGURE 3.2. Influence of S_j^2 on the estimator of the variance..

3.4 More on functional forms

Example 3.5 *Salary* and *tenure* (file ceosal2)

$$\widehat{\ln(salary_i)} = \underset{(0.086)}{6.246} + \underset{(0.0001)}{0.0006}\, profits_i + \underset{(0.0156)}{0.0440}\, ceoten_i - \underset{(0.00052)}{0.0012}\, ceoten_i^2$$

$$R^2 = 0.1976 \quad n = 177$$

Marginal effect of *ceoten* on salary, expressed in percentage:

$$\widehat{me_{salary/ceoten}}\% = 4.40 - 2 \times 0.12 ceoten$$

Example 3.6 The marginal effect in a *cost* function (file costfunc)

$$\widehat{cost_i} = \underset{(1.602)}{29.16} + \underset{(0.2167)}{2.316}\, output_i - \underset{(0.0081)}{0.0914}\, output_i^2 + \underset{(0.000086)}{0.0013}\, output_i^3$$

$$R^2 = 0.9984 \quad n = 11$$

Marginal *cost* :

$$\widehat{marcost_i} = 2.316 - 2 \times 0.0914 output_i + 3 \times 0.0013 output_i^2$$

Example 3.7 Selection of the best model (file demand)

Alternative models:

$$
\begin{array}{ll}
1) & dairy = \beta_1 + \beta_2 inc + u \\
2) & dairy = \beta_1 + \beta_2 \ln(inc) + u \\
3) & dairy = \beta_1 + \beta_2 inc + \beta_3 punder5 + u \\
4) & dairy = \beta_2 inc + \beta_3 punder5 + u \\
5) & dairy = \beta_1 + \beta_2 inc + \beta_3 hhsize + u \\
6) & \ln(dairy) = \beta_1 + \beta_2 inc + u \\
7) & \ln(dairy) = \beta_1 + \beta_2 inc + \beta_3 punder5 + u \\
8) & \ln(dairy) = \beta_2 inc + \beta_3 punder5 + u
\end{array}
$$

$$n = 40 \qquad \overline{\ln(dairy)} = 2.3719$$

Corrected *AIC* for model 6)

$$AIC_C = AIC + 2\overline{\ln(Y)} = 0.2794 + 2 \times 2.3719 = 5.0232$$

3.5 Goodness-of-fit and selection of regressors

TABLE 3.1. Measures of goodness of fit for eight models.

Model number	1	2	3	4	5	6	7	8
Regressand	*dairy*	*dairy*	*dairy*	*dairy*	*dairy*	ln(*dairy*)	ln(*dairy*)	ln(*dairy*)
Regressors	*intercept* *inc*	*intercept* ln(*inc*)	*intercept* *inc* *punder5*	*inc* *punder5*	*intercept* *Inc* *househsize*	*intercept* *inc*	*intercept* *inc* *punder5*	*inc* *punder5*
R-squared	0.4584	0.4567	0.5599	0.5531	0.4598	0.4978	0.5986	-0.6813
Adjusted R-squared	0.4441	0.4424	0.5361	0.5413	0.4306	0.4846	0.5769	-0.7255
Akaike information criterion	5.2374	5.2404	5.0798	5.0452	5.2847	0.2794	0.1052	1.4877
Schwarz criterion	5.3219	5.3249	5.2065	5.1296	5.4113	0.3638	0.2319	1.5721
Corrected Akaike information criterion						5.0232	4.849	6.2314
Corrected Schwarz criterion						5.1076	4.9756	6.3159