

NOTATION FOR MULTIPLE LINEAR REGRESSION

Response variable Y (or y).

Predictor variables X_1, X_2, \dots, X_p .

Note:

1. This is a change in notation: the subscript *on the X's* now denotes a *different variable, not a different observation*.
2. p = number of predictor variables

So we would use x_1, x_2, \dots, x_p to denote the values of X_1, X_2, \dots, X_p at *one* observation (i.e., for one case).

For short:

$$\mathbf{X} \text{ (or } \underline{X} \text{ when handwritten)} = \begin{bmatrix} X_1 \\ X_2 \\ \cdot \\ \cdot \\ \cdot \\ X_p \end{bmatrix} \text{ (or } \begin{pmatrix} X_1 \\ X_2 \\ \cdot \\ \cdot \\ \cdot \\ X_p \end{pmatrix})$$

(to refer to the random variables)

$$\mathbf{x} \text{ (or } \underline{x} \text{)} = \begin{bmatrix} x_1 \\ x_2 \\ \cdot \\ \cdot \\ \cdot \\ x_p \end{bmatrix} \text{ (or } \begin{pmatrix} x_1 \\ x_2 \\ \cdot \\ \cdot \\ \cdot \\ x_p \end{pmatrix}) \text{ (to refer to specific values of the r.v.'s)}$$

Example:

$$\begin{aligned} E(Y|\mathbf{x}) \text{ (or } E(Y|\underline{x}) \text{)} &\text{ is short for } E(Y| x_1, x_2, \dots, x_p) \\ &= E(Y| X_1=x_1, X_2=x_2, \dots, X_p=x_p). \end{aligned}$$

To label data:

First observation: $x_{11}, x_{12}, \dots, x_{1p}, y_1$

Second observation: $x_{21}, x_{22}, \dots, x_{2p}, y_2$

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n^{th} observation: $x_{n1}, x_{n2}, \dots, x_{np}, y_n$

Thus:

- n still = number of observations
- subscript on y is same as before
- first subscript on x is the observation number
- second subscript on x is the variable number
- i.e., x_{ij} = value of the j^{th} predictor at the i^{th} observation.

For short:

$$\mathbf{x}_i \text{ (or } \underline{x}_i) = \begin{bmatrix} x_{i1} \\ x_{i2} \\ \cdot \\ \cdot \\ \cdot \\ x_{ip} \end{bmatrix} \text{ (or } \begin{pmatrix} x_{i1} \\ x_{i2} \\ \cdot \\ \cdot \\ \cdot \\ x_{ip} \end{pmatrix}) \text{ --}$$

the vector of values of the predictor variables at observation i .

The general goal of multiple regression:

Study how $Y|\mathbf{x}$ changes as \mathbf{x} changes.

Example: Bic Mac

Y = the cost of a Big Mac in various countries

X_i 's = various economic indicators.

We'll use Bread, TeachSal, TeachTax, BusFar, so $p = \underline{\quad}$.