

LAB. METEOROLOGICAL STATISTICS FOURTH STAGE

(The second Semester)

Department of Atmospheric Sciences

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Regression Analysis

Regression is defined as a statistical tool for estimating the relationship between the dependent variable (y) and one or more (independent) independent variables (x), building a model to assess the strength of the relationship, and modeling the future relationship between the variables.

Regression analysis makes predictions with many applications in different fields, as it is used to predict the value of (y) based on (x) from knowing the readings of the missing values, such as forecasting agricultural production, cold waves, heat waves, frost and extreme temperatures, as well as showing the extent of the influence of a variable (x) on (y).

The subject of regression is divided into 3 basic types: linear regression, multiple linear regression, and nonlinear regression. The most common models are simple linear regression and multiple linear regression.

Simple linear regression

Simple linear regression is a model that explain or predict the relationship between a dependent variable(Y) and an independent variable(X).

The simple linear model is expressed using the following equation:

$$y=a+b.x$$

Y = the variable that you are trying to predict (dependent variable).

X = the variable that you are using to predict Y (independent variable).

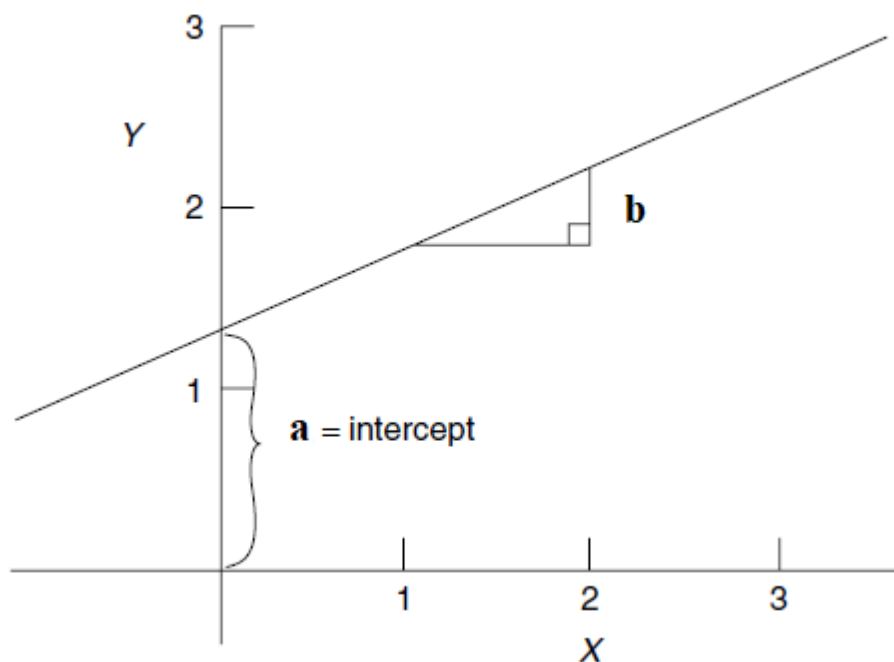
a = the intercept.

b = the slope.

$$b = \frac{n \sum xy - (\sum x)(\sum y)}{n \sum x^2 - (\sum x)^2}$$

$$a = \frac{\sum y - b \sum x}{n}$$

SIMPLE LINEAR REGRESSION



Multiple linear regression

Multiple linear regression analysis is essentially similar to the simple linear model, with the exception that multiple independent variables (X_1, X_2, X_3) are used in the model.

Example/study of an agricultural confinement (corn, wheat, rice) (a dependent variable (y) for the crop has more than one influence (variable x), such as soil fertility, weather conditions, water quantity, etc.

The mathematical representation for multiple linear regression is:

$$Y = a + bX_1 + cX_2 + dX_3$$

Where:

Y = the variable that you are trying to predict (dependent variable).

X_1, X_2, X_3 : Independent variables (the variables that you are using to predict Y)

a : Intercept.

b, c, d : Slopes.

Nonlinear Regression

It is a form of regression analysis and it is in the form of a curved line as if the value of y had a random variable, logarithmic or polynomial formulas, and other conditions that contradict linear regression.

Simple linear regression relates two variables (X and Y) with a straight line ($y = mx + b$), while nonlinear regression must generate a line (typically a curve) as if every value of Y was a random variable.

Example/ predict population growth over time, where the scatter graph shows a relationship.

Example / Calculate statistically the straight line equation for the dependent variable and the independent variable program and draw in the Excel?

| X | Y | XY | X² |
|------------|------------|-------------|----------------------|
| 55 | 14 | 770 | 3025 |
| 83 | 24 | 1992 | 6889 |
| 38 | 13 | 494 | 1444 |
| 61 | 16 | 976 | 3721 |
| 33 | 9 | 297 | 1089 |
| 49 | 15 | 735 | 2401 |
| 67 | 17 | 1139 | 4489 |
| 386 | 108 | 6403 | 23058 |

$$b = \frac{n \sum xy - (\sum x)(\sum y)}{n \sum x^2 - (\sum x)^2}$$

$$b = \frac{7(6403) - (386)(108)}{7(23058) - (386)^2}$$

$$b = 0.2525$$

$$a = \frac{\sum y - b \sum x}{n}$$

$$a = \frac{(108) - (0.2525)(386)}{7}$$

$$a = 1.5073$$

$$y = a + b.x$$

Example / Calculate statistically the equation of a straight line and draw it in the laboratory using Excel?

| | | | | | | |
|----------|----------|-----------|----------|-----------|----------|----------|
| X | 4 | 10 | 9 | 12 | 8 | 5 |
| Y | 2 | 6 | 8 | 11 | 5 | 4 |

Example / Calculate statistically the straight line equation for the dependent variable and the independent variable in the Excel program and calculate its value when it is 200?

| | | | | | |
|----------|------------|------------|------------|------------|------------|
| X | 50 | 75 | 95 | 120 | 150 |
| Y | 283 | 378 | 518 | 803 | 703 |

