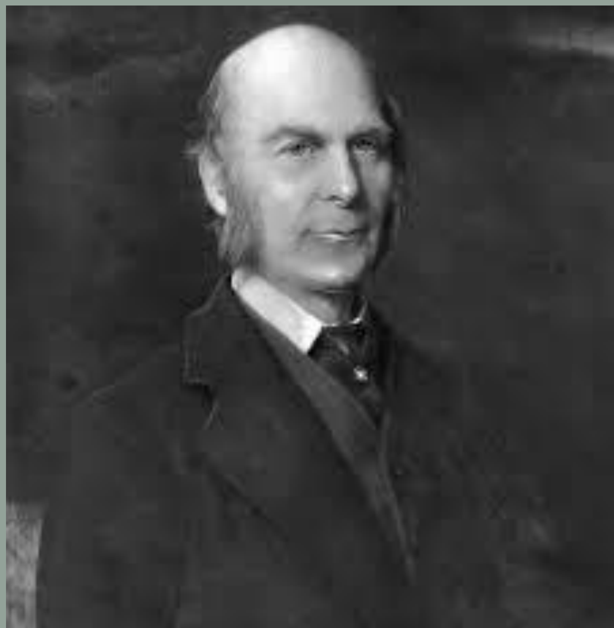
ICCPP-STATISTICS

- Linear Regression

Vishal Lohchab

Scientific Assistant of
Prof. Dr. Hans-Werner Gessmann
Director ICCPP International



Francis Galton (1822-1911)

Linear Regression

Definition

- Linear regression is the most widely used statistical technique; it is a way to model a relationship between two sets of variables.
- Linear regression is a linear approach to modelling the relationship between a scalar response and one or more explanatory variables.

Mostly Used Types

- Simple linear regression:

  1 dependent variable (interval or ratio),
  1 independent variable (interval or ratio or dichotomous).

- Multiple linear regression:

  1 dependent variable (interval or ratio),
  2+ independent variables (interval or ratio or dichotomous).

Formula

$$y = \alpha + \beta x$$

- ß = slope
- α = y-intercept
- Y = y- coordinate
- x = x-coordinate

Use of Linear Regression

- Linear regression is used to estimate the relationship between two quantitative variables. You can use simple linear regression when you want to know:
  How strong the relationship is between two variables (e.g. the relationship between rainfall and soil erosion).

Use of Multiple Linear Regression

- Multiple linear regression is used to estimate the relationship between two or more independent variables and one dependent variable.
- Multiple linear regression is a statistical technique that uses several explanatory variables to predict the outcome of a response variable.

Assumptions

1. Simple linear regression is a parametric test, meaning that it makes certain assumptions about the data.

These assumptions are:

Assumptions

- Homogeneity of variance (homoscedasticity): the size of the error in our prediction doesn't change significantly across the values of the independent variable.

Assumptions

- Independence of observations: the observations in the dataset were collected using statistically valid sampling methods, and there are no hidden relationships among observations.

Assumptions

- Normality: The data follows a normal distribution.
- The relationship between the independent and dependent variable is linear: the line of best fit through the data points is a straight line (rather than a curve or some sort of grouping factor).

How to Find a Linear Regression Equation: Steps

Step 1

Make a chart of your data, filling in the columns in the same way as you would fill in the chart if you were finding the Pearson's Correlation Coefficient.

How to Find a Linear Regression Equation: Steps

Step 1.1

SUBJECT	AGE X	GLUCOSE LEVEL Y	XY	X^2	Y^2
1	43	99	4257	1849	9801
2	21	65	1365	441	4225
3	25	79	1975	625	6241
4	42	75	3150	1764	5625
5	57	87	4959	3249	7569
6	59	81	4779	3481	6561
Σ	247	486	20485	11409	40022

How to Find a Linear Regression Equation: Steps

Step 1.2

From the table

$\Sigma x = 247$,

$\Sigma y = 486$,

$\Sigma xy = 20485$,

$\Sigma x2 = 11409$,

$\Sigma y2 = 40022$.

n is the sample size (6, in our case).

How to Find a Linear Regression Equation: Steps

Step 2

Use the following equations to find a and b.

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

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

a = 65.1416

b = .385225

How to Find a Linear Regression Equation: Steps

Step 2.1

Find a:

$((486 \times 11{,}409) - ((247 \times 20{,}485)) / 6\ (11{,}409) - 247^2)$

484979 / 7445

=**65.14**

How to Find a Linear Regression Equation: Steps

Step 2.2

Find b:

$(6(20,485) – (247 \times 486)) / (6 (11409) – 247^2)$

$(122,910 – 120,042) / 68,454 – 247^2$

2,868 / 7,445

= **.385225**

Solution Steps wise

Step 3

Insert the values into the equation.

y’ = a + bx

y’ = 65.14 + .385225x

+

Solution Steps wise

- That's how to find a linear regression equation by hand!

* Note that this example has a low correlation coefficient, and therefore wouldn't be too good at predicting anything.

References

https://en.wikipedia.org/wiki/Francis_Galton, date 30.11.21, 14:30 h MET

Edwards, A. L. An Introduction to Linear Regression and Correlation. San Francisco, CA: W. H. Freeman, 1976.

Edwards, A. L. Multiple Regression and the Analysis of Variance and Covariance. San Francisco, CA: W. H. Freeman, 1979.

Stephanie Glen. "Welcome to Statistics How To!“
From StatisticsHowTo.com: Elementary Statistics for the rest of us!
https://www.statisticshowto.com/, date 30.11.21, 14:30 h MET