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Analysis of Simple Correlation Coefficient by using Theoretical and MS-Excel Procedure for Gerebera (Plant Height and Plant Spread)

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A B S T R A C T

This work was attempted to find out simple correlation coefficient value between plant height and plant spread of 10 Gerebera plants. Correlation coefficient is applicable not only for Plant Height Vs Plant spread and it is applicable for plant yield Vs plant height, plant yield Vs infestation, fertilizer application Vs yield, price Vs demand of commodities, etc.

Introduction

Simple correlation is a measure of degree of linear relation between two continuous variables, X and Y. When a bivariate population is under consideration, there is generally a need to study the simultaneous between two variables. Karl Pearson in 1890 introduced correlation formula. Range of correlation coefficient is -1 to +1 (1, 2, 3).

Materials and Methods

Karl Pearson Correlation coefficient is denoted by r.

r^2 is called as coefficient of determination.

1-r^2 is called as coefficient of Non-determination (4, 5).

$$r = \frac{Cov(X,Y)}{\sqrt{Var(X)Var(Y)}} = \frac{\sum X_i Y_i - \frac{\sum X_i \sum Y_i}{n}}{\sqrt{\left(\sum X_i^2 - \frac{(\sum X_i)^2}{n}\right)\left(\sum Y_i^2 - \frac{(\sum Y_i)^2}{n}\right)}}$$

If r = 0, then there is no relation between two variables X and Y

If r = +1, then there exists perfect positive correlation between two variables X and Y

If r = -1, then there exists perfect negative correlation between two variables X and Y

If r lies between -1 and < 0, then there exists negative correlation between two variables X and Y.

If r lies between > 0 and < 1, then there exists positive correlation between two variables X and Y.

Table.1 If we consider the following data belongs to plant height and plant spread of 10 Gerbera plants

Plant height (cm)	Plant spread (cm)
39.93	**62.69**
43.30	**65.30**
41.43	**64.50**
41.36	**58.69**
55.03	**79.13**
46.50	**77.11**
39.23	**58.21**
41.96	**65.08**
39.84	**61.56**
40.90	**67.90**

Then analysis procedure of correlation coefficient is hereunder

Prepare the following table

X	Y	X^2	Y^2	XY
39.93	62.69	1594.40	3930.04	2503.21
43.30	65.30	1874.89	4264.09	2827.49
41.43	64.50	1716.44	4160.25	2672.24
41.36	58.69	1710.65	3444.52	2427.42
55.03	79.13	3028.30	6261.56	4354.52
46.50	77.11	2162.25	5945.95	3585.62
39.23	58.21	1538.99	3388.40	2283.58
41.96	65.08	1760.64	4235.41	2730.76
39.84	61.56	1587.23	3789.63	2452.55
40.90	67.90	1672.81	4610.41	2777.11
$\sum X = 429.48$	$\sum Y = 660.17$	$\sum X^2 = 18646.61$	$\sum Y^2 = 44030.26$	$\sum XY = 28614.49$

Correlation coefficient between X & Y is

$$r = \frac{Cov(X,Y)}{\sqrt{Var(X)Var(Y)}} = \frac{\sum X_i Y_i - \frac{\sum X_i \sum Y_i}{n}}{\sqrt{\left(\sum X_i^2 - \frac{(\sum X_i)^2}{n}\right)\left(\sum Y_i^2 - \frac{(\sum Y_i)^2}{n}\right)}}$$

$$= \frac{28614.49 - \frac{(429.48)(660.17)}{10}}{\sqrt{\left(18646.61 - \frac{(429.48)^2}{10}\right)\left(44030.26 - \frac{(660.17)^2}{10}\right)}}$$

$$= \frac{28614.49 - 28352.98}{\sqrt{(18646.61 - 18445.31)(44030.26 - 43582.44)}}$$

$$= \frac{261.51}{\sqrt{(201.30)(447.81)}} = \frac{261.51}{\sqrt{90146.14}} = \frac{261.51}{300.2435} = 0.8710$$

The value of coefficient of determination $(r)^2 = (0.8710)^2 = 0.7586$

Test of significance of correlation coefficient: t-test conducted

H_0: The population correlation coefficient $\rho = 0$

Statistic:

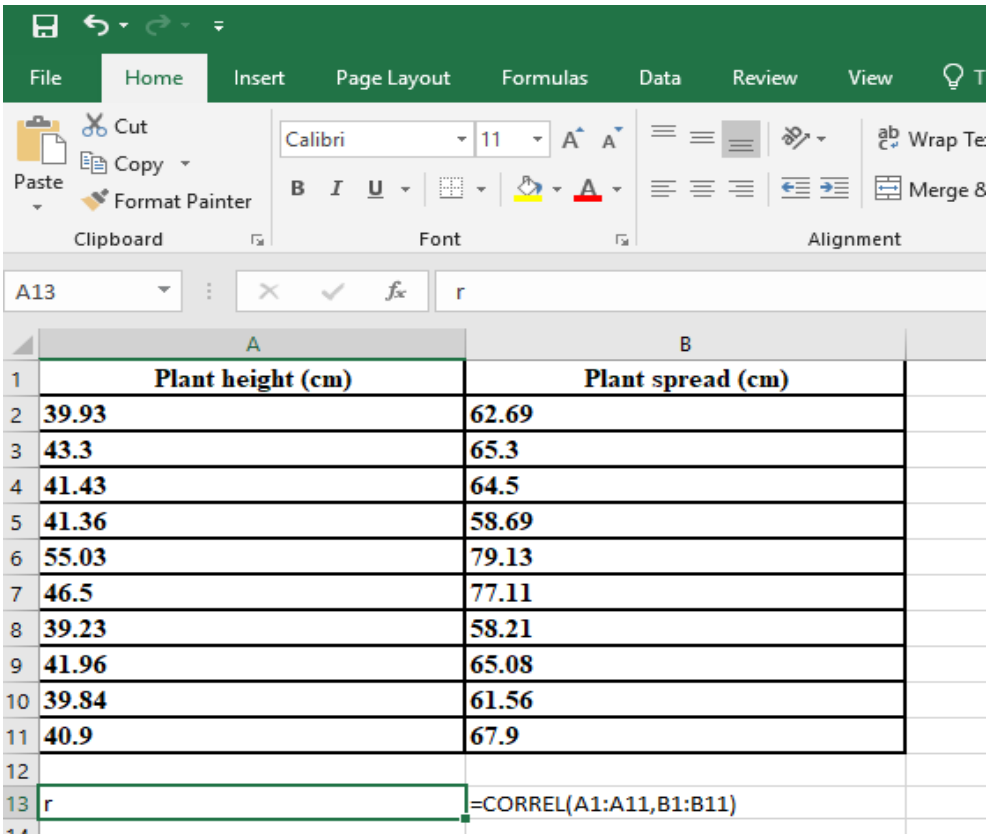
$$t = \frac{|r|\sqrt{n-2}}{\sqrt{1-r^2}} = \frac{|0.8710|\sqrt{10-2}}{\sqrt{1-0.8710^2}} = \frac{|0.8710|\sqrt{8}}{\sqrt{1-0.7586}}$$

$$= \frac{|0.8710|\sqrt{8}}{\sqrt{0.2414}} = \frac{0.8710x2.8214}{0.4913} = \frac{2.4574}{0.4913} = 5.0019 **$$

t-calculated value is 5.0019

Calculation of correlation coefficient value in MS-Excel

In MS-Excel sheet, enter data (plant height, plant spread) as below picture



	A	B
1	**Plant height (cm)**	**Plant spread (cm)**
2	**39.93**	**62.69**
3	**43.3**	**65.3**
4	**41.43**	**64.5**
5	**41.36**	**58.69**
6	**55.03**	**79.13**
7	**46.5**	**77.11**
8	**39.23**	**58.21**
9	**41.96**	**65.08**
10	**39.84**	**61.56**
11	**40.9**	**67.9**
12		
13	r	=CORREL(A1:A11,B1:B11)

In B13 cell, type formula
= CORREL (A1:A11, B1: B11)
automatically above formula gives correlation coefficient value

Results and Discussion

According to our problem, correlation coefficient(r) value is 0.8710. it indicates that, there exists positive correlation between plant height and plant spread. i.e. plant height and plant spread both variables are deviate in same direction.

r^2 x 100 = 0.8710^2 x 100 = 0.7586 x 100 = 75.86 $\simeq$ 76. It indicates out of 100 Gerebera plants, 76 gerebera plants have positive correlation between Plant height and plant spreads. Remaining 24 plants may be negative or zero.

From test of significance of correlation coefficient, t-calculated value is 5.0019

t-tabulated value at 5% level of significance with (n-2) = (10-2) = 8 d.f. is 2.3060

t-tabulated value at 1% level of significance with 8 d.f. is 3.3554

Hence, t-calculated value 5.0019 is greater than t-tabulated value 2.3060 and also greater than 3.3554. So we reject our Null Hypothesis at 1% level of significance. i.e. The population correlation coefficient $\rho \neq 0$.

It indicates, there exists highly significant correlation between Plant height and Plant spread of Gerebera plants.

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