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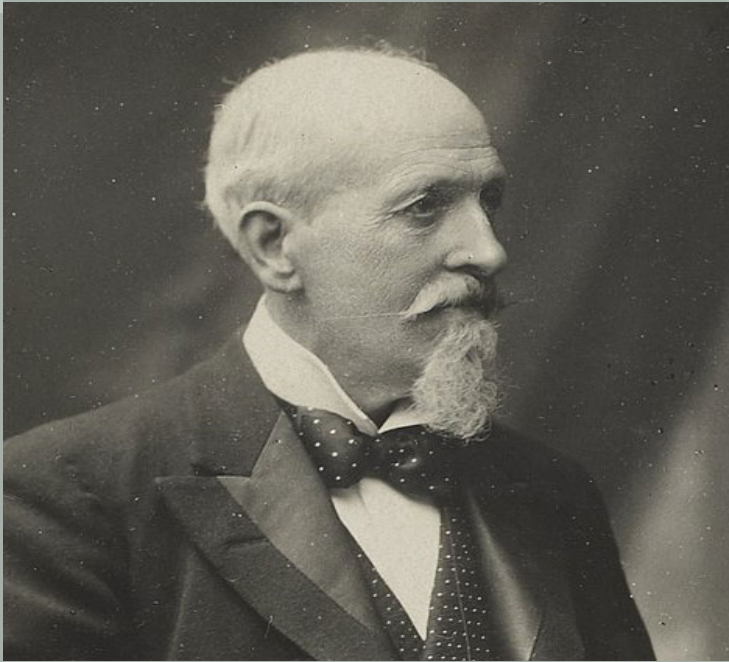
ICCPP-STATISTICS

- Spearman Rho

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Edmund Robert Spearman (1863-1945)

Spearman rho - Rank Correlation

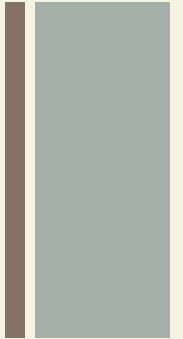
+ Spearman's Rho

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

ρ = Spearman's rank correlation coefficient

d_i = difference between the two ranks of each observation

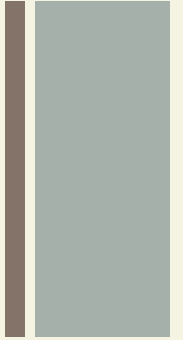
n = number of observations



The Spearman's rank coefficient of correlation is a nonparametric measurement

- (statistical dependence of ranking between two variables)
 - named after Charles Spearman, often denoted by the Greek letter ' ρ ' (rho)

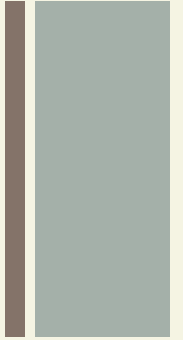
+ Assumptions



1.

Your data must be ordinal, interval or ratio.

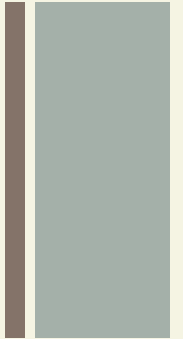
+ Assumptions



2.

Your data have to be monotonically related.

+ Assumptions



This means:

If one variable increases (or decreases), the other variable also increases (or decreases).

+ Example

The scores for nine students in physics and maths are as follows

Physics: 35, 23, 47, 17, 10, 43, 9, 6, 28

Mathematics: 30, 33, 45, 23, 8, 49, 12, 4, 31

+ Solution Step Wise

Step 1 Find the ranks for each individual subject. I used the Excel rank function to find the ranks. If you want to rank by hand, order the scores from greatest to smallest; assign the rank 1 to the highest score, 2 to the next highest and so on.

Physics	Rank	Math	Rank
35	3	30	5
23	5	33	3
47	1	45	2
17	6	23	6
10	7	8	8
43	2	49	1
9	8	12	7
6	9	4	9
28	4	31	4

+ Solution Step Wise

Step 2 Add a third column, d, to your data. d is the difference between the ranks. For example, the first student's physics rank is 3 and maths rank is 5, so the difference is 3. In a fourth column, square your d values.

Physics	Rank	Math	Rank	d	d squared
35	3	30	5	2	4
23	5	33	3	2	4
47	1	45	2	1	1
17	6	23	6	0	0
10	7	8	8	1	1
43	2	49	1	1	1
9	8	12	7	1	1
6	9	4	9	0	0
28	4	31	4	0	0

[4]

+ Solution Step Wise

Step 3 Sum (add up) all of your d-squared values.

$$4 + 4 + 1 + 0 + 1 + 1 + 1 + 0 + 0 = 12$$

You'll need this for the formula
($\sum d^2$ is "the sum of d-squared values").

+ Solution Step Wise

Step 4 Insert the values into the formula.

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

+ Solution Step Wise

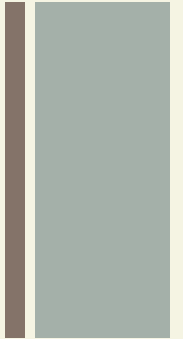
$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

$$\begin{aligned} &= 1 - (6*12)/(9(81-1)) \\ &= 1 - 72/720 \\ &= 1-0.1 \\ &= 0.9 \end{aligned}$$

The Spearman Rank Correlation for this set of data is 0.9



References



[1] Clef, T. (2013). *Exploratory Data Analysis in Business and Economics: An Introduction Using SPSS, Stata, and Excel*. Springer Science and Business Media.

[2] Kinnear and Gray (1999). *SPSS for Windows Made Simple*. Taylor and Francis.

[3] Rees, D. (2000). *Essential Statistics*. CRC Press.

[4] Stephanie Glen. "Welcome to Statistics How To!" From [StatisticsHowTo.com](https://www.statisticshowto.com/): Elementary Statistics for the rest of us! <https://www.statisticshowto.com/>