

## Looking at relationships: Spearman's coefficient of rank correlation

An absolute minimum of **7 pairs of data** is needed for Spearman's coefficient of rank correlation. The Spearman coefficient  $r_s$  is used to determine the strength and significance of any correlation and is calculated as follows:

$$r_s = 1 - \frac{6\sum D^2}{n^3 - n}$$

where:  $r_s$  = Spearman's coefficient of rank correlation  
 $D$  = the difference between ranks for each data pair  
 $n$  = the number of pairs of observations  
and  $\sum D^2$  = the sum of all the  $D$  values squared

Use the Spearman coefficient worksheet to lay out your data and calculate your  $r_s$  value

**Null hypothesis:** there is no correlation between .....

**Alternative hypothesis:** there is a significant correlation between.....

Now fill in the table below. Values are ranked giving the highest value rank 1 and so on. Where there are 2 or 3 tied values they are given the average of the ranks they would have had if they had not been tied. Use the  $r_x$  check and  $r_y$  check columns to keep track of your ranking procedure.

$r_x$ check	$r_y$ check	obs. no.	values of x	ranks of x values	values of y	ranks of y values	difference D ( $r_x - r_y$ )	Difference Squared ( $D^2$ )
		1						
		2						
		3						
		4						
		5						
		6						
		7						
		8						
		9						
		10						
		11						
		12						
		13						
		14						
		15						
		16						
		17						
		18						
		19						
		20						
		21						
		22						
		23						
		24						
		25						
If your rankings are correct this value should be zero →								
							sum of $D^2$ values, $\sum D^2 \rightarrow$	

In our analysis the number of pairs,  $n$ , =  and the sum of  $D^2$  values,  $\sum D^2 =$

**Calculating  $r_s$**

the number of pairs,  $n$ , =  so  $n^3$  =  and  $n^3 - n$  =

and the sum of  $D^2$  values,  $\sum D^2$  =  so  $6\sum D^2$  =

Now we can calculate the Spearman coefficient  $r_s$  :

$$r_s = 1 - \frac{6\sum D^2}{n^3 - n} = 1 - \left( \frac{\quad}{\quad} \right) = 1 - \quad \text{so } r_s = \quad$$

(don't worry if it is a negative value – this simply means that there is a negative correlation.)

Now compare your calculated  $r_s$  value with the critical value for  $r_s$  given below. All values are for the 5% probability level. If your calculated value is **the same as or greater (positively or negatively) than the critical value** then there is a **significant relationship** (at the 5% probability level) between your two data sets and you cannot accept your null hypothesis. **Beware though!** A correlation does not necessarily imply cause and effect; both variables could be affected by another, unknown, variable.

If your calculated value is **less (positively or negatively) than the critical value** then there is **no significant relationship** (at the 5% probability level) between your two data sets and your null hypothesis is accepted.

Table of critical values of the Spearman coefficient  $r_s$  at the 5% probability level

Number of pairs of data (n)	Critical value of $r_s$
5	1.000
6	0.886
7	0.786
8	0.738
9	0.683
10	0.648
12	0.591
14	0.544
16	0.506
18	0.475
20	0.450
22	0.428
24	0.409
26	0.392
28	0.377
30	0.364

Calculated value of  $r_s$  =  critical value of  $r_s$  =

So we accept  reject  null hypothesis at the 5% probability level.

Notes: