

## S 7 Mon.řtax correlation, contingentsCtable.

### EXAMPLE

#### A) CalcCet and interpretation of the coefficient pořseries correlations.

Determine the dependence between the quality of the modified IOWA Brace test (motor talent test) and the roundabout in the group of men Tv - Sv. The order in the execution of the rondata was compiled by the teacher SG.

Students	Brace-test	Rondát	$d_{and}$	$d_{and}^2$
AND	6	2	4	16
B	5	10	- 5	25
C	8	4	4	16
D	4	5	- 1	1
E	3	3	0	0
F	10	9	1	1
G	7	6	1	1
H	1	1	0	0
CH	2	8	- 6	36
AND	9	7	2	4
$\Sigma$ 10	-	-	-	100

$d_{and}$  = the difference between the two orders

$r_{with}$  = Spearman's rank correlation coefficient

$$= 1 - 6 \sum \frac{d_{and}^2}{(2n-1)} = 1 - \frac{6 \cdot 100}{10(10 \cdot 2 - 1)} = 0.394$$

#### B) Statistical significance:

In the case of a random selection from the basic set, we can calculate **Spearman's test** rank correlation and value determination  $\rho$  determine whether there is a statistically significant dependence.



After entering the data, marking them as serial and assigning categories (IBT, rondát), we continue through the selection *Analyzes* → *Regression* → *Correlation Matrix*



	IBT	Rondát
1	6	2
2	5	10
3	8	4
4	4	5
5	3	3
6	10	9
7	7	6
8	1	1
9	2	8
10	9	7

After assigning data to categories and selecting the Spearman test, the results are displayed in the right part.

		IBT	Rondát
IBT	Spearman's rho	—	—
	p-value	—	—
Rondát	Spearman's rho	0.394	—
	p-value	0.263	—

Note. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

### References

- [1] The jamovi project (2020). *jamovi*. (Version 1.2) <https://www.jamovi.org>.
- [2] R Core Team (2019). *R: A Language and environ* [Computer software]. Retrieved from <https://cr>

The value of the Spearman rank correlation coefficient is 0.394.  
 $p = 0.263$ . Value  $p > 0.05$ . Based on the stated values, we cannot claim that the stated dependence exists.

**C) Calculation procedure of (practical) significance (effect size)**

The square of the correlation coefficient is called **coefficient of determination** ( $r^2$ ). Its value tells us how many percent the observed factor contributes to the resulting dependence (Kerlinger, 1972).

Coefficient of determination  $r^2 = 0.394^2 = 0.155$

The quality of the road and the result of the Iowa Brace test, and vice versa, is only affected by 15.5%.

**TASK**

Find out if there is a dependence between the performance of your study group in the cycling time trial in Bukovina and the order in the credit orienteering race there. Data can be found in the table with the list of lectures and seminars (time trial and OB)

THEORY

Four-field and contingency table, 2

Four-field table:

Group	Phenomenon occurred	Phenomenon did not occur	$\Sigma$
1	(A <sub>0</sub> ) A	(B <sub>0</sub> ) B	A + B
2	(C <sub>0</sub> ) C	(D <sub>0</sub> ) D	C + D
$\Sigma$	A + C	B + D	N

expected frequencies:

$$e_{11} = \frac{(A+B)(A+C)}{N} \quad e_{12} = \frac{(A+B)(B+D)}{N}$$

$$e_{21} = \frac{(C+D)(A+C)}{N} \quad e_{22} = \frac{(C+D)(B+D)}{N}$$

Calculation:

$$\chi^2 = \frac{(O_{11} - E_{11})^2}{E_{11}} + \frac{(O_{12} - E_{12})^2}{E_{12}} + \frac{(O_{21} - E_{21})^2}{E_{21}} + \frac{(O_{22} - E_{22})^2}{E_{22}}$$

## EXAMPLE

These students have not been able to meet the requirements of gymnastics in the last year. Is there a difference between them? (Is success in gymnastics influenced by gender?)

1st step. ZŠ	They did it	They didn't make it	$\Sigma$
Women	80	6	86
Men	31	18	49
$\Sigma$	111	24	135



**Calculation:** We enter the data in one column according to gender and in the other column according to success (yes / no). We mark the data as nominal and name the columns (Gender / Success). Then we continue through the elections:

*Analyzes → Frequencies → Independent Samples ( 2 test of associations)*

The screenshot shows a software interface with a menu bar containing 'Data' and 'Analyses'. Below the menu bar are icons for various statistical tests: Exploration, T-Tests, ANOVA, Regression, Frequencies, Factor, and blandr. The 'Frequencies' icon is selected, and a dropdown menu is open, showing the following options:

- One Sample Proportion Tests
  - 2 Outcomes
    - Binomial test
  - N Outcomes
    - $\chi^2$  Goodness of fit
- Contingency Tables
- Independent Samples
  - $\chi^2$  test of association
- Paired Samples
  - McNemar test
- Log-Linear Regression

The background shows a data table with two columns: 'Pohlaví' (Gender) and 'Úspěšnost' (Success). The data rows are as follows:

	Pohlaví	Úspěšnost
1	žena	ano
2	žena	ano
3	žena	ano
4	žena	ano
5	žena	ano
6	žena	ano
7	žena	ano
8	žena	ano
9	žena	ano
10	žena	ano
11	žena	ano
12	žena	ano
13	žena	ano
14	žena	ano

We assign data to rows (*Rows*) and Columns and check the option 2

The screenshot shows the 'Contingency Tables' dialog box in Jamovi. The 'Rows' field contains 'Pohlaví' and the 'Columns' field contains 'Úspěšnost'. The 'Tests' section has the  $\chi^2$  test checked. The 'Comparative Measures (2x2 only)' section has 'Log odds ratio' and 'Odds ratio' unchecked. The output on the right shows the following contingency table:

Pohlaví	Úspěšnost		Total
	ano	ne	
žena	80	6	86
muž	31	18	49
Total	111	24	135

Below the contingency table is the  $\chi^2$  Tests table:

	Value	df	p
$\chi^2$	18.9	1	< .001
N	135		

The results are displayed on the right. The final value of the  $\chi^2$  test is 18.9  $p < 0.001$ . The difference between students is statistically significant, success in gymnastics is influenced by gender.

B) Calculation procedure **inE(practical)** importance (**effect size**)

Cramer's  $\phi$  is evaluated as follows:  $\phi$

0, 10 .... small effect

$\phi$  0, 30 .... medium effect

$\phi$  0, 50 .... large effect

It is calculated according to the formula for partial correlation  $= \sqrt{\lambda}$



For the calculation in the Jam program, check the option *Phi and Cramer's V*.

Tests		Comparative Measures (2x2 only)	
<input checked="" type="checkbox"/> $\chi^2$	<input type="checkbox"/> Log odds ratio		
<input type="checkbox"/> $\chi^2$ continuity correction	<input type="checkbox"/> Odds ratio		
<input type="checkbox"/> Likelihood ratio	<input type="checkbox"/> Relative risk		
<input type="checkbox"/> Fisher's exact test	<input type="checkbox"/> Confidence intervals		
	Interval <input type="text" value="95"/> %		

  

Nominal		Ordinal	
<input type="checkbox"/> Contingency coefficient	<input type="checkbox"/> Gamma		
<input checked="" type="checkbox"/> Phi and Cramer's V	<input type="checkbox"/> Kendall's tau-b		

  

$\chi^2$ Tests			
	Value	df	p
$\chi^2$	18.9	1	< .001
N	135		

  

Nominal	
	Value
Phi-coefficient	0.374
Cramer's V	0.374

The result (0.374) is greater than 0.3 and therefore the observed difference is also materially (practically) significant, we are talking about a medium effect.

## EXAMPLE PivotTable

We are interested in whether the marks from the Anthropomotorics exam are evenly distributed for about four consecutive years ( $H_0$ )

Years / stamp	Great	Very good	Good	$\Sigma$
2016	18	13	10	41
2017	23	13	12	48
2018	11	14	23	48
2019	8	16	29	53
$\Sigma$	60	56	74	190



When entering data, we proceed similarly to the four-field table.

The screenshot shows a software interface for analyzing contingency tables. On the left, there are sections for 'Rows' (Rok), 'Columns' (Hodnocení), 'Counts (optional)', and 'Layers'. Below these are 'Tests' (with  $\chi^2$  selected) and 'Comparative Measures (2x2 only)'. On the right, the 'Contingency Tables' section displays a table of counts, followed by  $\chi^2$  Tests (Value: 20.9, df: 6, p: 0.002) and Nominal measures (Phi-coefficient: NaN, Cramer's V: 0.235).

Rok	Hodnocení			Total
	Výborně	Velmi dobře	Dobře	
2016	18	13	10	41
2017	23	13	12	48
2018	11	14	23	48
2019	8	16	29	53
Total	60	56	74	190

  

	Value	df	p
$\chi^2$	20.9	6	0.002
N	190		

  

	Value
Phi-coefficient	NaN
Cramer's V	0.235

$p < 0.01$ . On the serpent of significance 99% ofwe reject the null hypothesis ( $H_0$ ) and we find that the marks are not evenly distributed in each year.

### B) INE(practical) importance (effect size)

The procedure is the same as the previous calculation for the four-field table.

Cramer's  $\phi = 0.235$  we can talk about a low / medium effect.

## TASK

Assess which of the study groups is better at acrobatics, when mastering the throw forward is considered a crucial element (address statistical and factual significance)

	He managed	He couldn't
TV-Z	21	11
TV-Ov	15	6