Statistical analysis represented by some non-parametric tests by adopting the Spss program

Preparation

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Specialization (applied statistics)

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References :

1- Prof. Dr. Saji Muhammad Hussain, Master's degree lecturer, University of Baghdad / College of Administration and Economics / Department of Statistics.

2- Sites from the internet.

The aim of the workshop

Identify to some of non-parametric tests as an alternative method for some of parametric tests with practical application .

What is the statistical test?

The statistical test can be summarized in three steps:

First: formulating the null and alternative hypotheses.

Second: Finding the test statistics.

Third: Decision making.

There are two types of statistical tests:

First: the parametric test: it is required that the variables of the random sample follow a specific distribution (normal distribution, for example), and that any parametric test that includes only one condition or more according to the type of test (the condition of homogeneity of variance, for example), is called the parametric test because the test is about the parameters of the distribution (The parameters of the normal distribution, for example) or the model (the parameters of the linear regression model, for example).

Second: The non-parametric test: it is adopted when the conditions of the parametric test are not verified, and it does not require a large sample size and is not affected by outlier values. Non-parametric tests can be adopted when the data are nominal or ordinal, noting that the parametric tests are more powerful when the required conditions are verified.

The following table shows some of the parametric statistical tests and their corresponding non-parametric tests.

Nonparametric Test	Parametric test	ت
Wilcoxon Test for One Sample	One Sample T Test	**1**
Mann-Whitney U Test	Un Paired- Samples T Test	**2**
Wilcoxon Signed Rank Test	Paired- Samples T Test	**3**
Kruskal – Wallis(H) Test	One - Way ANOVA (3 or more independent samples)	**4**
Friedman Test	Two - Way ANOVA (3 or more dependent samples)	**5**

Nonparametric Tests

1- Wilcoxon Test for One Sample

Example: Aphysician States that the median number of times he sees each of his patients during the year is five ,In order to evaluate the validity of this statements ,he randomly selects ten of his pationts and determines the number of office visits each of them made during the past year .he obtains the following values for the ten patients in his sample : 8,3,8,4,8,3,4,7,8,9. Do the data Support his contention that **the median number** of times he sees a patient is **five**?

Solution :

First : data entry and variable definition

	official_visits
1	8
2	3
3	8
4	4
5	8
6	3
7	4
8	7
9	8
10	9

Second: Wilcoxon test for one sample

Analyze ⟶ Nonparametric Tests ⟶ One Sample

On the **Fields** tab specify the variable(s) for which the one sample Wilcoxon test is desired .

On the **Settings** tab specify Customize tests , check the box for **Compare median to hypothesized (Wilcoxon signed – rank test)** , specify **the Hypothesized median value** and click **Run** .

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The median of official_visits equals 5.	One-Sample Wilcoxon Signed Rank Test	.089	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .050.

One-Sample Wilcoxon Signed Rank Test Summary

Total N	10
Test Statistic	44.000
Standard Error	9.715
Standardized Test Statistic	1.698
Asymptotic Sig.(2-sided test)	.089

2- Wilcoxon U Signed Rank Test

Example: A psychologist conducts a study to determine whether or not people exhibit more emotionality when they are exposed to sexually explicit words than when they are exposed to neutral words. Each of ten subjects is shown a list of 16 randomly arranged words, which are projected on to a screen one at a time for a period of five seconds. Eight of the words on the list are sexually explicit and eight of the words are neutral. As each word is projected on the screen, a subject is instructed to say the word softly to him or herself .As a subject dose this, sensors attached to the palms of the subject's hands record galvanic skin response (GSR) **,** which is used by the psychologist as a measure of emotionality. The psychologist computes two scores for each subject, one score for each of the experimental conditions: **Condition 1:** GSR/Explicit – The average GSR score for the eight sexually explicit words: **Condition 2:** GSR/Neutral – The average GSR score for the eight neutral words. The GSR/Explicit and GSR/Neutral scores of the ten subjects follow. (The higher the score, the higher the level of emotionality)

Subject	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Condition 1	9	2	1	4	6	4	7	8	5	1
Condition 2	8	2	3	2	3	0	4	5	4	0

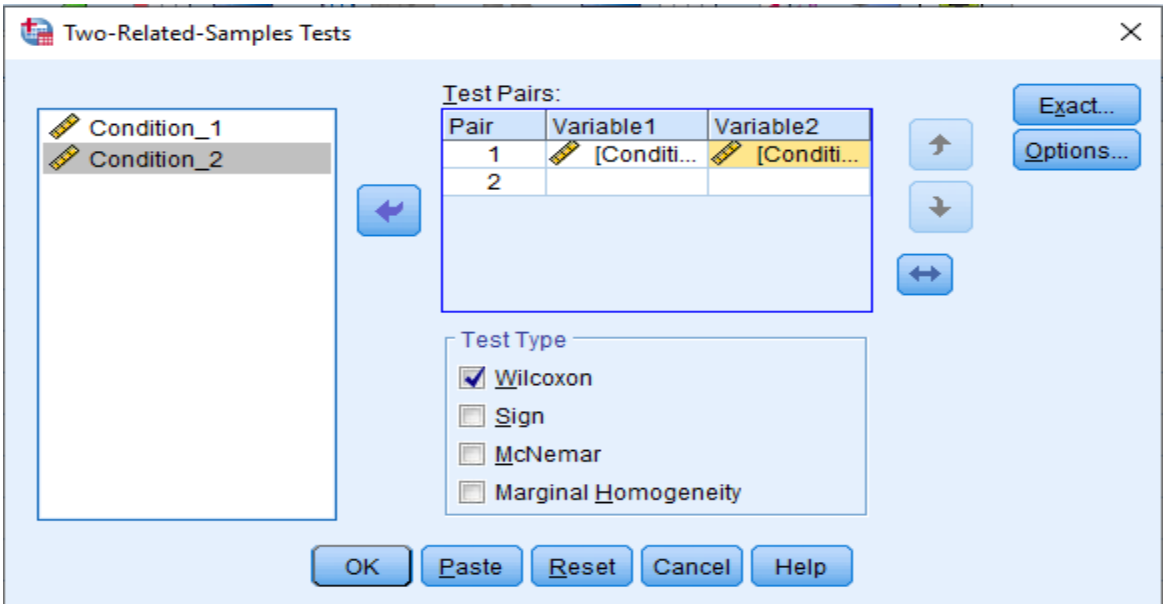
Solution:

First: data entry and variable definition

	Condition_1	Condition_2
1	9	8
2	2	2
3	1	3
4	4	2
5	6	3
6	4	0
7	7	4
8	8	5
9	5	4
10	1	0

Second: Wilcoxon test of two paired Samples

Analyze ⟶ Nonparametric Tests ⟶ Legacy Dialogs ⟶ 2 Related Samples



Test Statistics[a]

	Condition_2 - Condition_1
Z	-2.149[b]
Asymp. Sig. (2-tailed)	.032

Since **statistical significance of Z** equal to 0.039 & its less than 0.05 ,So reject H_0 & accept H_1

3- Mann-Whitney U Test

Example: Consider a randomized controlled trial evaluating a new anti-retroviral therapy for HIV. A pilot trial randomly assigned participants to either the treated or untreated groups (N=14). We want to assess the viral load (quantity of virus per milliliter of blood) in the treated versus the untreated groups.

The data are shown below:

Treated	540	670	1000	960	1200	4650	4200
Untreated	5000	4200	1300	900	7400	4500	7500

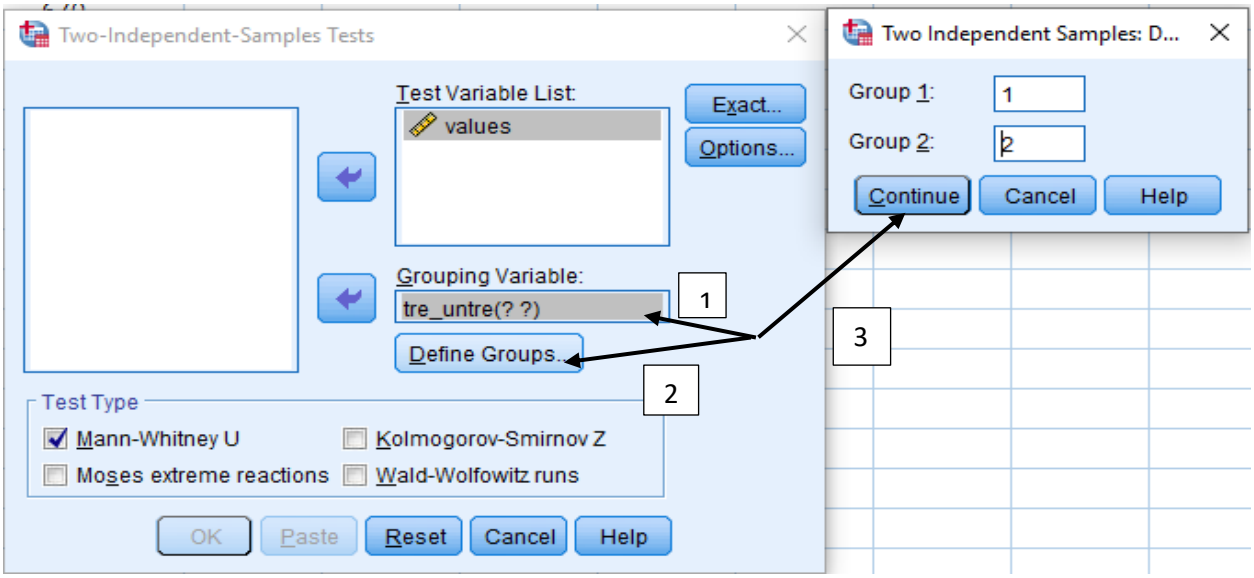
Solution:

First: data entry and variable definition

	tre_untre	values
1	1	540
2	1	670
3	1	1000
4	1	960
5	1	1200
6	1	4650
7	1	4200
8	2	5000
9	2	4200
10	2	1300
11	2	900
12	2	7400
13	2	4500
14	2	7500

Second: Mann-Whitney test for two independent samples:

Analyze ⟶ Nonparametric Tests ⟶ Lagacy Dialogs ⟶ 2 Independent Samples



Test Statistics[a]

	values
Mann-Whitney U	9.500
Wilcoxon W	37.500
Z	-1.919-
Asymp. Sig. (2-tailed)	.055
Exact Sig. [2*(1-tailed Sig.)]	.053[b]

reject Ho & accept H_1 (0.055>0.05), i.e: there is significant between two unpaired variables treated & untreated

4- Test Kruskal – Wallis(H)

Example: Does physical exercise alleviate depression? We find some depressed people and check that they are all equivalently depressed to begin with. Then we allocate each person randomly to one of three groups: no exercise, 20 minutes of jogging pre day; or 60 minutes of jogging per day. At the end of a month ,we ask each participant to rate how depressed they now feel , on a Likert that runs from 1 ("totally miserable ") through to 100 ("ecstatically happy").

Rating on depression scale

No exercise	23	26	51	49	58	37	29	44
Jogging for 20 minutes	22	27	39	29	46	48	49	65
Jogging for 60 minutes	59	66	38	49	56	60	56	62

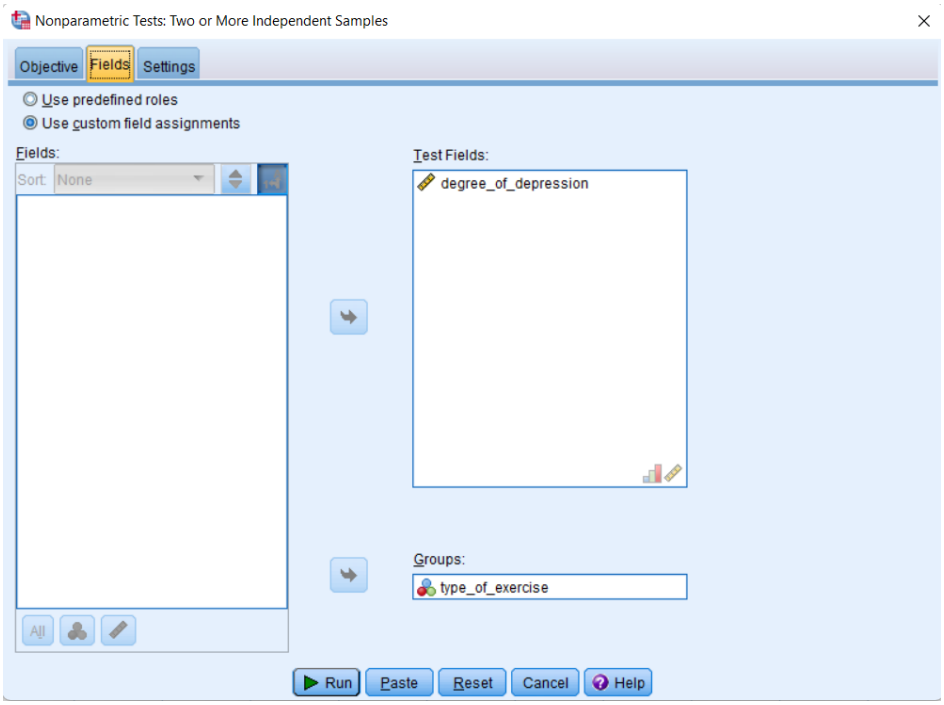
Solution:

First: data entry and variable definition

type_of_exercise	degree_of_depression
no exercise	23
no exercise	26
no exercise	51
no exercise	49
no exercise	58
no exercise	37
no exercise	29
no exercise	44
Jogging for 20 minutes	22
Jogging for 20 minutes	27
Jogging for 20 minutes	39

Second: Kruskal-Wallis test for more than two independent samples:

Analyze ⟶ Nonparametric Tests ⟶ indpendent Samples …



Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of degree_of_depression is the same across categories of type_of_exercise.	Independent-Samples Kruskal-Wallis Test	.026	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .050.

Pairwise Comparisons of type_of_exercise

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
no exercise-Jogging for 20 minutes	-.375	3.531	-.106	.915	1.000
no exercise-Jogging for 60 minutes	-8.437	3.531	-2.390	.017	.051
Jogging for 20 minutes-Jogging for 60 minutes	-8.062	3.531	-2.283	.022	.067

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

5- Friedman Test

Example: The following table shows the responses to the percentage decrease in saliva secretion in (16) laboratory animals after giving them different doses of (astrobita) (a substance to relieve spasm). The results were as follows:

dose level / animal sequence	A	B	C	D
1	29	48	75	100
2	72	30	57	100
3	70	100	92	96
4	54	35	27	99
5	90	43	33	81
6	17	40	30	81
7	74	100	90	100
8	6	34	24	81
9	16	39	29	79
10	52	34	33	96
11	8	42	40	79

12	29	47	45	99
13	71	100	98	100
14	7	33	100	79
15	68	99	40	93
16	70	30	100	99

Required: Finding significant differences for the responses of different doses at a significant level of 0.05?

Solution:

First: Define variables and enter data.

	A	B	C	D
1	29	48	75	100
2	72	30	57	100
3	70	100	92	96
4	54	35	27	99
5	90	43	33	81
6	17	40	30	81
7	74	100	90	100
8	6	34	24	81
9	16	39	29	79
10	52	34	33	96
11	8	42	40	79
12	29	47	45	99
13	71	100	98	100
14	7	33	100	79
15	68	99	40	93
16	70	30	100	99

Second: Friedman test for more than two related samples

Analyze ⟶ Nonparametric Tests ⟶ K Related Samples

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distributions of A, B, C and D are the same.	Related-Samples Friedman's Two-Way Analysis of Variance by Ranks	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .050.

Related-Samples Friedman's Two-Way Analysis of Variance by Ranks Summary

Total N	16
Test Statistic	20.734
Degree Of Freedom	3
Asymptotic Sig.(2-sided test)	.000

Pairwise Comparisons

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
A-C	-.375	.456	-.822	.411	1.000
A-B	-.937	.456	-2.054	.040	.240
A-D	-1.937	.456	-4.245	.000	.000
C-B	.563	.456	1.232	.218	1.000
C-D	-1.562	.456	-3.423	.001	.004
B-D	-1.000	.456	-2.191	.028	.171

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.