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Lab 10: Mann-Whiteny U Test

a) Small Sample

Test the hypothesis of no difference between the ages of male and female employees of a certain companey, using the Mann- Whiteny U test for the samples data below. Use $\alpha = 0.01$

Male	35	43	26	44	40	42	33	38	25	26
Female	30	41	34	31	36	32	25	47	28	24

Basic Steps for SPSS

1. Start the SPSS program. In the Data Editor window, type in the data.

2. Select Analyze Nonparametric tests Legacy Dialogs 2 independent sample.

3. Defined groups {Gender (1, 2)} Click Ok

Working Expression:

Step 1: Null Hypothesis(H_0): $Md_1 = Md_2$

i.e. no difference between the ages of male and female employees.

Step 2: Alternative Hypothesis(H_1): $Md_1 \neq Md_2$

i.e. significant difference between the ages of male and female employees.

Step 3: Test statistics:

Under H_0 test statistics is given by,

$2P = 0.384$

Step 4: Critical value:

For $\alpha = 0.1$ level of significance

Step 5: Decision and Conclusion:

$2P > \alpha$ i.e. $0.384 > 0.1$, accept H_0

Conclusion: There is no difference between the ages of male and female employees.

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Output:

Mann-Whitney Test

Ranks

	Gender	N	Mean Rank	Sum of Ranks
Age	Male	10	11.65	116.50
	Female	10	9.35	93.50
	Total	20		

Test Statistics[a]

	Age
Mann-Whitney U	38.500
Wilcoxon W	93.500
Z	-.870
Asymp. Sig. (2-tailed)	.384
Exact Sig. [2*(1-tailed Sig.)]	.393[b]

a. Grouping Variable: Gender

b. Not corrected for ties.

Interpretation: There is no difference between the ages of male and female employees.

b) Large Sample

The following are the scores which random samples of students from 2 minority groups obtained on a current event test:

Group I	73	82	39	68	91	75	89	67	50	86	57	65	70
Group II	51	42	36	53	88	59	49	66	25	64	18	76	74

Use Mann - Whiteny U test at the 0.05 level of sig. to test whether or not students from the two minority groups can be expected to score equally well on the test.

Basic Steps for SPSS

1. Start the SPSS program. In the Data Editor window, type in the data.

2. Select Analyze > Nonparametric tests > Legacy Dialogs > 2 independent sample.

3. Defined groups {Gender (1, 2)} Click Ok

Working Expression:

Step 1: Null Hypothesis(H_0): $Md_1 = Md_2$

i.e. no difference between the scores of the students from two groups.

Step 2: Alternative Hypothesis(H_1): $Md_1 \neq Md_2$

i.e. significant difference between the scores of the students from two groups.

Step 3: Test statistics:

Under H_0 test statistics is given by,

$2P = 0.038$

Step 4: Critical value:

For $\alpha = 0.05$ level of significance

Step 5: Decision and Conclusion:

$2P<\alpha$ i.e. $0.038<0.05$, accept H_1

Conclusion: There is significance difference between the scores of the students from two groups.

Output:

Mann-Whitney Test

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles 25th	50th (Median)	75th
Scores	26	62.0385	19.45761	18.00	91.00	49.7500	65.5000	75.2500
Group	26	1.5000	.50990	1.00	2.00	1.0000	1.5000	2.0000

Ranks

	Group	N	Mean Rank	Sum of Ranks
Scores	Group I	13	16.62	216.00
	Group II	13	10.38	135.00
	Total	26		

Test Statistics[a]

	Scores
Mann-Whitney U	44.000
Wilcoxon W	135.000
Z	-2.077
Asymp. Sig. (2-tailed)	.038
Exact Sig. [2*(1-tailed Sig.)]	.039[b]

a. Grouping Variable: Group

b. Not corrected for ties.

Interpretation: There is significance difference between the scores of the students from two groups.

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Lab 11: Median Test

a) Small Sample

Data below shows one week growth (in cm) of maize plant from two different localities

Sample I	10	11	8	8	14	-	-
Sample II	9	12	13	9	15	9	17

Test whether the two samples have come from the same population with respect to their medians. Use median test at 0.05 level of sig.

Basic Steps for SPSS

- Goto variable view and add the variables
- Goto the data view and add the data
- Click on Analyze tab > NonParametric Tests > Legacy Dialogs > k Independent Samples.

Working Expression:

Step 1: Null Hypothesis(H_0): $Md_1 = Md_2$

i.e. no significance difference between two samples.

Step 2: Alternative Hypothesis(H_1): $Md_1 \neq Md_2$

i.e. significance difference between two samples.

Step 3: Test statistics:

Under H_0 test statistics is given by,

$2P = 1$

Step 4: Critical value:

For $\alpha = 0.05$ level of significance.

Step 5: Decision and Conclusion:

$2P > \alpha$ i.e. $1 > 0.05$, accept H_0

Conclusion: There is no significance difference between two samples.

Output:

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles 25th	50th (Median)	75th
Value	12	11.2500	2.95804	8.00	17.00	9.0000	10.5000	13.7500
Samples	12	1.5833	.51493	1.00	2.00	1.0000	2.0000	2.0000

Median Test

Frequencies

		Samples	
		Sample I	Sample II
Value	> Median	2	4
	<= Median	3	3

Test Statistics[a]

	Value
N	12
Median	10.5000
Exact Sig.	1.000

a. Grouping Variable: Samples

Interpretation: There is no significance difference between two samples.

b) Large Sample

An IQ test was given to a randomly selected 15 male and 20 female students of a university. Their scores were recorded as follows:

male: 56 66 62 81 75 73 83 68 48 70 60 77 86 44 72

female: 63 77 65 71 74 60 76 61 67 72 64 65 55 89 45 53 68 73 50

Use median test to determine whether IQ of male and female students is same in the university. Given Md = 68

Basic Steps for SPSS

- Goto variable view and add the variables
- Goto the data view and add the data
- Click on Analyze tab > NonParametric Tests > Legacy Dialogs > k Independent Samples.

Working Expression:

Step 1: Null Hypothesis(H_0): $Md_1 = Md_2$

i.e. no significance difference between two samples.

Step 2: Alternative Hypothesis(H_1): $Md_1 \neq Md_2$

i.e. significance difference between two samples.

Step 3: Test statistics:

Under H_0 test statistics is given by,

χ^2_{cal} =0.695

Step 4: Critical value:

For $\alpha = 0.05$ level of significance,

$\chi^2_{tab} = 3.841$

Step 5: Decision and Conclusion:

$\chi^2_{cal} < \chi^2_{tab}$i.e. 0.659<3.841, accept H_0

Conclusion: There is no significance difference between two samples.

Output:

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles 25th	50th (Median)	75th
Scores	35	67.1429	11.31408	44.00	89.00	60.0000	68.0000	75.0000
Gender	35	1.5714	.50210	1.00	2.00	1.0000	2.0000	2.0000

Median Test

Frequencies

		Gender	
		Male	Female
Scores	> Median	8	8
	<= Median	7	12

Test Statistics[a]

		Scores
N		35
Median		68.0000
Chi-Square		.614
df		1
Asymp. Sig.		.433
Yates' Continuity Correction	Chi-Square	.194
	df	1
	Asymp. Sig.	.659

a. Grouping Variable: Gender

Interpretation: There is no significance difference between two samples.

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Lab 12: Wilcoxon Matched Pair Signed rank test

Use Wilcoxon matched pair signed rank test to determine the equality of effectiveness of two types of drugs in suppressing pain from following data.

Patient No.	Drug A	Drug B	Patient No.	Drug A	Drug B
1	6.5	3.5	11	5.4	5.4
2	3.7	3.7	12	4.0	4.1
3	3.9	4.7	13	5.7	4.1
4	6.7	5.0	14	3.9	4.2
5	6.2	5.6	15	3.6	3.7
6	6.7	4.3	16	4.9	4.1
7	6.1	5.4	17	3.9	5.4
8	4.3	5.8	18	5.8	3.7
9	5.5	4.3	19	4.9	4.1
10	6.8	4.3	20	4.9	4.1

Basic Steps for SPSS

1. Start the SPSS program. In the Data Editor window, type in the data.

2. Click on Analyze tab > NonParametric Tests > Legacy Dialogs > 2 Related Samples.

Working Expression:

Step 1: Null Hypothesis(H_0): $Md_1 = Md_2$

i.e. no difference between the two drugs effectiveness.

Step 2: Alternative Hypothesis(H_1): $Md_1 \neq Md_2$

i.e. significant difference between the effectiveness of the two drugs.

Step 3: Test statistics:

Under H_0 test statistics is given by,

P = 0.033

Step 4: Critical value:

For $\alpha = 0.1$ level of significance

Step 5: Decision and Conclusion:

$P<\alpha$ i.e. $0.033<0.05$, accept H_1

Conclusion: There is significant difference between the effectiveness of the two drugs.

Output:

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles 25th	50th (Median)	75th
DrugA	20	5.1700	1.11643	3.60	6.80	3.9250	5.1500	6.1750
DrugB	20	4.4750	.70850	3.50	5.80	4.1000	4.2500	5.3000

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
DrugB - DrugA	Negative Ranks	12[a]	11.21	134.50
	Positive Ranks	6[b]	6.08	36.50
	Ties	2[c]		
	Total	20		

a. DrugB < DrugA

b. DrugB > DrugA

c. DrugB = DrugA

Test Statistics

	DrugB - DrugA
Z	-2.137[b]
Asymp. Sig. (2-tailed)	.033

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

Interpretation: There is significant difference between the effectiveness of the two drugs.

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Lab 13: Friedman F test

A survey was conducted in four hospitals in a particular city to obtain the number of babies born over a 12 months' period. This time period was divided into four seasons to test the hypothesis that the birth rate is constant over all the four seasons. The results of the survey were as follows:

Hospital	No. of births			
	Winter	Spring	Summer	Fall
A	92	72	94	77
B	15	16	10	17
C	58	71	51	62
D	19	26	20	18

Analyze the data using Friedman two ANOVA test.

Basic Steps for SPSS

1. Start the SPSS program. In the Data Editor window, type in the data. (Hospital, ... and values {1, A.....} in hospital)

2. Select Analyze Nonparametric tests Legacy Dialogs K Related sample.

3. Click test variable and select test type.

4. Test type Friedman and Click OK

Working Expression:

Step 1: Null Hypothesis(H_0): $Md_1 = Md_2 = Md_3 = Md_4$

i.e. the birth rate is not constant over all the four seasons.

Step 2: Alternative Hypothesis(H_1): $Md_1 \neq Md_2 \neq Md_3 \neq Md_4$

i.e. the birth rate is constant over all the four seasons.

Step 3: Test statistics:

Under H_0 test statistics is given by,

$P = 0.9$

Step 4: Critical value:

For $\alpha = 0.05$ level of significance.

Step 5: Decision and Conclusion:

$2P > \alpha$ i.e. $1 > 0.05$, accept H_0

Conclusion: The birth rate is not constant over all the four seasons.

Output:

Friedman Test

Ranks

	Mean Rank
Winter	2.25
Spring	3.00
Summer	2.25
Fall	2.50

Test Statistics[a]

N	4
Chi-Square	.900
df	3
Asymp. Sig.	.825

a. Friedman Test

Interpretation: The birth rate is not constant over all the four seasons.

Lab 14: Simple Regression

Enter the following values in SPSS and find the regression equation of y on x:

X	1	2	3	4	5	6	7
Y	6	7	5	4	3	1	2

Basic Steps for SPSS

Enter values of the variables X and Y.

2. Select Analyze Regression Linear.

3. Move X into Independent(s) and Y into Depends(s). Then, Click Ok.

Working Expression:

Step 1: Null Hypothesis(H_0): $B_1 = 0$;

i.e. there is no linear relationship between dependent and independent variables.

Step 2: Alternative Hypothesis(H_1): $B_1 \neq 0$

i.e. there is linear relationship between dependent and independent variables.

Step 3: Test statistics:

Under H_0 test statistics is given by,

$F_{cal} = 31.296$

Step 4: Critical value:

For $\alpha = 0.05$ level of significance,

$F_{tab} = 6.607$

Step 5: Decision and Conclusion:

$F_{cal} > F_{tab}$,accept H_1

Conclusion: There is linear relationship between dependent and independent variables.

Using SPSS,

Regression line is Y = 7.714 - 0.929X

Output:

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	X[b]	.	Enter

a. Dependent Variable: Y

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.929[a]	.862	.835	.87831

a. Predictors: (Constant), X

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24.143	1	24.143	31.296	.003[b]
	Residual	3.857	5	.771		
	Total	28.000	6			

a. Dependent Variable: Y

b. Predictors: (Constant), X

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	7.714	.742		10.392	.000
	X	-.929	.166	-.929	-5.594	.003

a. Dependent Variable: Y

Interpretation: There is linear relationship between dependent and independent variables.

Lab 15: Simple Correlation

Enter the following values in SPSS and find the correlation between X and Y :

X	1	2	3	4	5	6	7
Y	6	7	5	4	3	1	2

Basic Steps for SPSS

- Enter the values of the variables X and Y.
- 2. Select Analyze Correlate Bivariate.
- 3. Move X and Y into Variable(s). Select (Pearson, Kendall's tau-b, Spearman). Then, Click Ok

Output:

Correlations

		X	Y
X	Pearson Correlation	1	-.929**
	Sig. (2-tailed)		.003
	N	7	7
Y	Pearson Correlation	-.929**	1
	Sig. (2-tailed)	.003	
	N	7	7

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

			X	Y
Kendall's tau_b	X	Correlation Coefficient	1.000	-.810*
		Sig. (2-tailed)	.	.011
		N	7	7
	Y	Correlation Coefficient	-.810*	1.000
		Sig. (2-tailed)	.011	.
		N	7	7
Spearman's rho	X	Correlation Coefficient	1.000	-.929**
		Sig. (2-tailed)	.	.003
		N	7	7
	Y	Correlation Coefficient	-.929**	1.000
		Sig. (2-tailed)	.003	.
		N	7	7

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).