

Practical No. 6 : Sign test and Wilcoxon signed rank test (paired case)

An experiment in a large store is designed in which, for one month, all deodorants are sold packaged in a box, and during a second month, all deodorants are removed from the box and sold without packaging. Is there a significant difference in the number of units of deodorant sold with and without the additional packaging? Let $\alpha = .05$.

Deodorant	Box	No Box
1	185	170
2	109	112
3	92	90
4	105	87
5	60	51
6	45	49
7	25	11
8	58	40
9	161	165
10	108	82
11	89	94
12	123	139
13	34	21
14	68	55
15	59	60
16	78	52

Enter this data in Minitab and generate the following report:

Question :

Does deodorant sell better in a box or without additional packaging?

Solution :

Step 1 : Type your data into the data pane of a worksheet. Make sure you put your data into columns. Use column header for "Deodorant", "Box", "No box" and "Difference". Type the "Deodorant" data into column C1, "Box" data into column C2 and "No box" data into column C3.

Step 2 : Right click the "Difference" column C4, choose "Formulas" then "Assign Formula to Column...". A "Assign Formula to C4 (Difference)" dialogue box will appear. In the "Expression:" box, choose "C2 Box" then put "-" sign and choose "C3 No box" from the table on the left. Click "OK". The "Difference" table will be filled.

Step 3 : To perform sign test, under the drop-down menu “STAT”, choose “Nonparametrics” then “1-Sample Sign...”. A “1-Sample Sign” dialogue box will appear. In the “Variables:” box, choose “C4 Difference” from the table on the left. Check the “Test median:” radio box, set it to 0.0 and set the “Alternative:” drop-down menu to “not equal”. Click “OK”.

Step 4 : To perform Wilcoxon signed rank test, under the drop-down menu “STAT”, choose “Nonparametrics” then “1-Sample Wilcoxon...”. A “1-Sample Wilcoxon” dialogue box will appear. In the “Variables:” box, choose “C4 Difference” from the table on the left. Check the “Test median:” radio box, set it to 0.0 and set the “Alternative:” drop-down menu to “not equal”. Click “OK”.

Step 5 : For the descriptive statistics, under the drop-down menu “Stat”, choose “Basic Statistics” then “Display Descriptive Statistics...”. A “Display Descriptive Statistics” dialogue box will appear. In the “Variables:” box, choose “C2 Box” and “C3 No box” from the table on the left. Click the “Statistics...” option. A “Display Descriptive Statistics: Statistics” dialogue box will appear. Check the “Mean”, “Standard deviation”, “Minimum”, “Maximum”, “First quartile”, “Median” and “Third quartile” checkboxes. Click “OK”. Click “OK” again.

Step 6 : For the boxplot of “Box” and “No box”, under the drop-down menu “Graph”, choose “Boxplot”. A “Boxplots” dialogue box will appear. Choose “Simple” under “Multiple Y’s”. Click “OK”. A “Boxplot: Multiple Y’s, Simple” dialogue box will appear. In the “Graph variables:” box, choose “C2 Box” and “C3 No box” from the table on the left. Click “OK”. The following boxplot will be generated.

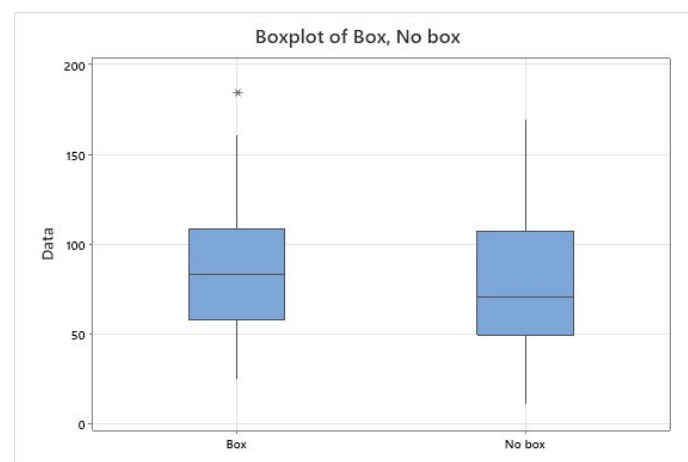


Fig 1 : Boxplot of Box and No Box

Interpretation :

The box and whisker plot shows that the distribution of no. of deodorant sold with box is symmetrical while the distribution of no. of deodorant sold without box is right skewed.

Descriptive Statistics :

Variable	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Box	87.4	43.9	25.0	58.3	83.5	108.8	185.0
No box	79.9	47.4	11.0	49.5	71.0	107.5	170.0

Interpretation :

The descriptive statistics shows that the average no. of units of deodorant sold with box is slightly higher (87.4) than sold without box (79.9). The variability of no. of units sold without box (47.4) is slightly higher than the variability of no. of units sold with box (43.9).

Sign Test :**Method :**

η : median of Difference

Hypothesis :

Null hypothesis $H_0: \eta = 0$

Alternative hypothesis $H_1: \eta \neq 0$

Test :

Sample	Number < 0	Number = 0	Number > 0	P-Value
Difference	6	0	10	0.454

Conclusion :

Since the p-value of sign test (0.454) > significance probability (0.05) we do not reject the null hypothesis that the number of units of deodorant sold with and without box is same.

Wilcoxon Signed Rank Test :**Method :**

η : median of Difference

Hypothesis :

Null hypothesis $H_0: \eta = 0$

Alternative hypothesis $H_1: \eta \neq 0$

Test :

Sample	N for Test	Wilcoxon Statistic	P-Value
Difference	16	105.00	0.059

Conclusion :

The Wilcoxon signed test also confirms that we do not have to reject the null hypothesis since p-value (0.054) > α -value (0.05).

Worksheet :

↓	C1	C2	C3	C4 ✓	C5
	Deodarane	Box	No box	Difference	
1	1	185	170	15	
2	2	109	112	-3	
3	3	92	90	2	
4	4	105	87	18	
5	5	60	51	9	
6	6	45	49	-4	
7	7	25	11	14	
8	8	58	40	18	
9	9	161	165	-4	
10	10	108	82	26	
11	11	89	94	-5	
12	12	123	139	-16	
13	13	34	21	13	
14	14	68	55	13	
15	15	59	60	-1	
16	16	78	52	26	