Chapter 4 - Minitab Details

Case 2.1.2. Continued. Anatomical Abnormalities Associated with Schizophrenia – An Observational Study *R&S p. 31-32 and p. 100-102*

Step 1: Copy the data into a Minitab Worksheet.

Use these steps:
File → Open Worksheet →Browse your local directory and upload the Excel file case0202.csv

The data will appear as two columns in Minitab with titles UNAFFECT and AFFECTED.

Step 2: Display Data similar to ***Display 2.2 in R&S p. 31***:
Go to Data →Display Data; Select C1 and then select C2, and click OK to produce a display on the output portion of your Minitab session as shown below:

```
Row   UNAFFECT   AFFECTED
 1       1.94       1.27
 2       1.44       1.63
 3       1.56       1.47
 4       1.58       1.39
 5       2.06       1.93
 6       1.66       1.26
 7       1.75       1.71
 8       1.77       1.67
 9       1.78       1.28
10       1.92       1.85
11       1.25       1.02
12       1.93       1.34
13       2.04       2.02
14       1.62       1.59
15       2.08       1.97
```

Next, create a column of Differences = UNAFFECT – AFFECTED. Click on Calc → Calculator; Under Store result in variable, type Difference; under Expression, type C1-C2; and click OK. A new variable called Difference will be created in C3.
Again, display all three columns by going to Data →Display Data; Select C1-C3.

```
Row   UNAFFECT   AFFECTED   Difference
 1       1.94       1.27     0.670000
 2       1.44       1.63    -0.190000
 3       1.56       1.47     0.090000
 4       1.58       1.39     0.190000
 5       2.06       1.93     0.130000
 6       1.66       1.26     0.400000
 7       1.75       1.71     0.040000
 8       1.77       1.67     0.100000
 9       1.78       1.28     0.500000
10       1.92       1.85     0.070000
11       1.25       1.02     0.230000
12       1.93       1.34     0.590000
13       2.04       2.02     0.020000
14       1.62       1.59     0.030000
15       2.08       1.97     0.110000
```

Step 3: Summary Statistics for the Difference

Go to Stat →Basic Statistics →Display Descriptive Statistics;

Select C3 Differences; click OK, to see this display on the output portion:

Descriptive Statistics: Difference

```
Variable   N N*   Mean SE Mean   StDev Minimum   Q1 Median   Q3
Difference   15   0 0.1987   0.0615 0.2383 -0.1900 0.0400 0.1100 0.4000

Variable   Maximum
Difference   0.6700
```

**Step 4:  Some graphs:**
Click on Graph→Boxplot→Select Difference;. Click OK, and see the following plot:
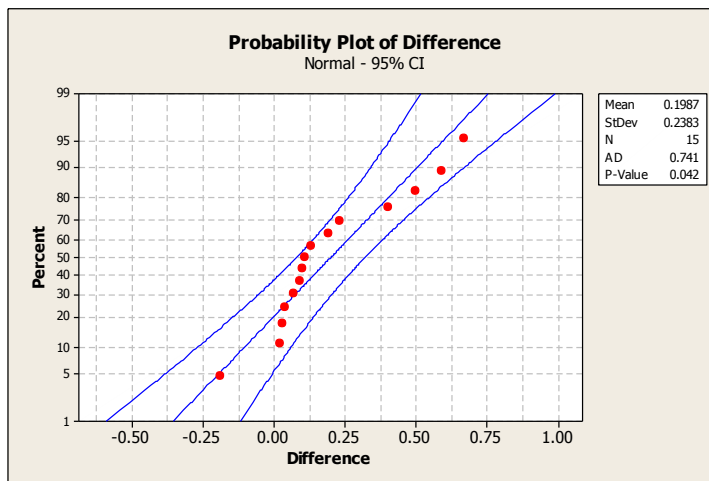


Boxplot of Difference
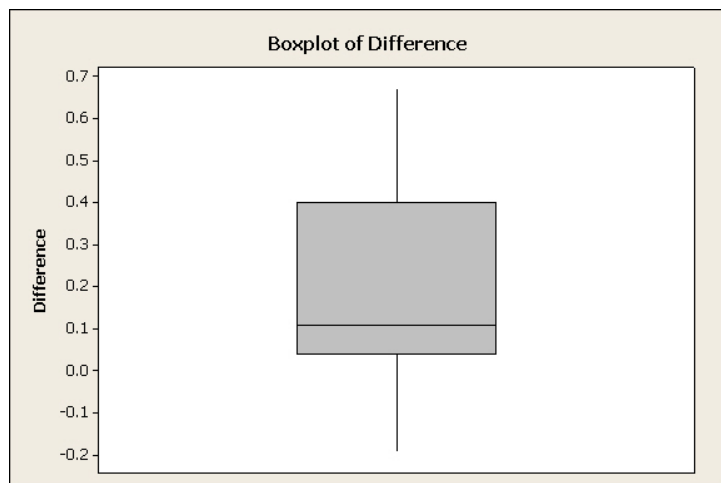
**Histograms:** Go to Graph→Histogram; Select Difference in the box on the left into the Graph variables box on the right; and click OK, to get this plot.

**Histogram of Difference**
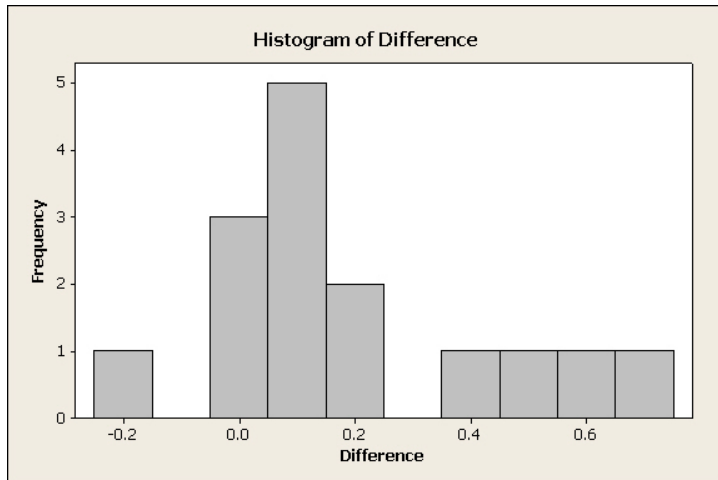
## Step 5: Normal Probability Plot

Go to Graphs → Probability Plot → Single; Select the variable Difference from the left into the right hand side box; and click OK.



**Probability Plot of Difference**
Normal - 95% CI

| | |
|---|---|
| Mean | 0.1987 |
| StDev | 0.2383 |
| N | 15 |
| AD | 0.741 |
| P-Value | 0.042 |

To carry out a Sign Test procedure on the Differences data, go to Stat →Nonparametrics →1-Sample Sign; insert C3 into the Variable window; click on Test median 0.0; Alternative not equal; click OK.

Note that for K=14 out of the 15 twins, the left hippocampus volume of the unaffected twin was larger than the left hippocampus volume of the affected twin. That is why you see Above =14, and Below =1. If there were no systematic difference between unaffected and affected persons, we would expect K to be about n/2 = 15/2. Whenever K is far away from n/2, the data provides evidence against the null hypothesis that the median of the difference data is zero.

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**Sign Test for Median: Difference**

```
Sign test of median =  0.00000 versus not = 0.00000

            N  Below  Equal  Above       P  Median
Difference  15      1      0     14  0.0010  0.1100
```

The p-value of the Sign test is p=0.001 < 0.05, so there is evidence to reject the null hypothesis at the 5% level of significance.

Sign CI: Difference

```
Sign confidence interval for median

                                       Confidence
                          Achieved      Interval
            N  Median  Confidence   Lower   Upper  Position
Difference  15  0.1100      0.8815  0.0700  0.2300         5
                            0.9500  0.0512  0.3365       NLI
                            0.9648  0.0400  0.4000         4
```

Sign Test for Median: Difference – Upper Tailed Test

```
Sign test of median =  0.00000 versus > 0.00000

            N  Below  Equal  Above       P  Median
Difference  15      1      0     14  0.0005  0.1100
```

Wilcoxon Sign-Rank test
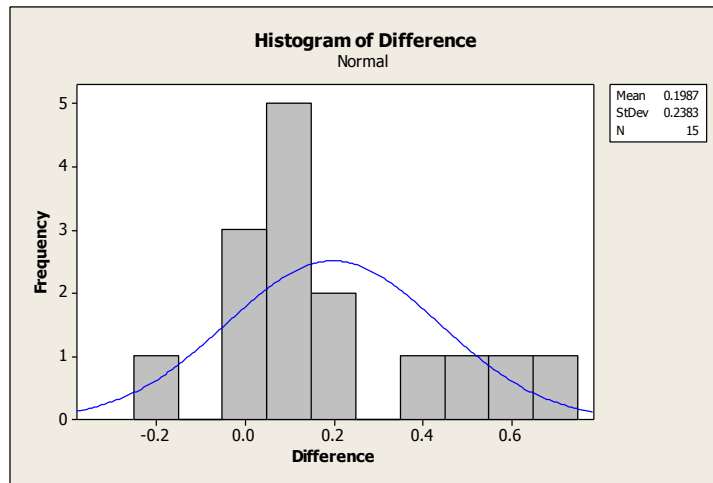
To carry out a Wilcoxon Signed Rank Test procedure on the Differences data, go to Stat →Nonparametrics →1-Sample Wilcoxon; insert C3 into the Variable window; click on Test median 0.0; Alternative not equal; click OK.

Wilcoxon Signed Rank Test: Difference

```
Test of median = 0.000000 versus median ≠ 0.000000

                   N for   Wilcoxon            Estimated
             N    Test    Statistic      P      Median
Difference   15    15       110.5     0.005     0.1575
```

Wilcoxon Signed Rank CI: Difference

```
                                          Confidence
                  Estimated    Achieved     Interval
             N      Median    Confidence  Lower  Upper
Difference   15     0.157        95.0     0.065  0.345
```

Wilcoxon Signed Rank Test: Difference - Upper tailed Test

```
Test of median = 0.000000 versus median > 0.000000

                   N for   Wilcoxon            Estimated
             N    Test    Statistic      P      Median
Difference   15    15       111.0     0.002     0.1575
```

Case 4.1.2. Cognitive Load Theory in Teaching –A Randomized Experiment. *R&S p. 87-88*

Mann-Whitney Test and CI: TIME_CONVENTIONAL, TIME_MODIFIED

```
                   N  Median
TIME_CONVENTIONAL  14  235.00
TIME_MODIFIED      14  106.00


Point estimate for ETA1-ETA2 is 94.00
95.4 Percent CI for ETA1-ETA2 is (57.00,160.01)
W = 269.0
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.0013
The test is significant at 0.0013 (adjusted for ties)
```

Details of Steps taken for the computation of W.

1. *Obtain the ranks of the combined samples*.
   In Minitab, Go to Calc → Calculator, select Rank(C1), output into C3.

```
Row    TIME  TREATMT        CENSOR  Rank
  1   68.00  MODIFIED         0.00   1.0
  2   70.00  MODIFIED         0.00   2.0
  3   73.00  MODIFIED         0.00   3.0
  4   75.00  MODIFIED         0.00   4.0
  5   77.00  MODIFIED         0.00   5.0
  6   80.00  MODIFIED         0.00   6.5
  7   80.00  MODIFIED         0.00   6.5
  8  132.00  MODIFIED         0.00   9.0
  9  148.00  MODIFIED         0.00  12.0
 10  155.00  MODIFIED         0.00  14.0
 11  183.00  MODIFIED         0.00  17.0
 12  197.00  MODIFIED         0.00  18.0
 13  206.00  MODIFIED         0.00  19.0
 14  210.00  MODIFIED         0.00  20.0
 15  130.00  CONVENTIONAL     0.00   8.0
 16  139.00  CONVENTIONAL     0.00  10.0
 17  146.00  CONVENTIONAL     0.00  11.0
 18  150.00  CONVENTIONAL     0.00  13.0
 19  161.00  CONVENTIONAL     0.00  15.0
 20  177.00  CONVENTIONAL     0.00  16.0
 21  228.00  CONVENTIONAL     0.00  21.0
 22  242.00  CONVENTIONAL     0.00  22.0
 23  265.00  CONVENTIONAL     0.00  23.0
 24  300.00  CONVENTIONAL     1.00  26.0
 25  300.00  CONVENTIONAL     1.00  26.0
 26  300.00  CONVENTIONAL     1.00  26.0
 27  300.00  CONVENTIONAL     1.00  26.0
 28  300.00  CONVENTIONAL     1.00  26.0
```

2. ***Unstack the ranks in C3 by Treatmt column.*** Unstacked ranks by the two approaches are shown in Column 2 and Column 3.

```
Row   Rank_CONVENTIONAL   Rank_MODIFIED   RankSum_Conv   RankSum_Mod
 1                  8              1.0            269            137
 2                 10              2.0
 3                 11              3.0
 4                 13              4.0
 5                 15              5.0
 6                 16              6.5
 7                 21              6.5
 8                 22              9.0
 9                 23             12.0
10                 26             14.0
11                 26             17.0
12                 26             18.0
13                 26             19.0
14                 26             20.0
```

3. ***Compute the sum of the ranks in column 2 and column 3 above.*** Go to Calc, Calculator and select SUM(Rank_CONVENTIONAL) and SUM(Rank_MODIFIED) to get the values W = 269, and 137 respectively. ***See R&S Display 4.5.***

   Note: R&SDisplay 4.8 shows the C.I. for (Time_Modified – Time_Conventional) as (-159, -58); again this interval does not include zero.