# Chapter 2 – Minitab Details

## Case 2.1.2. Anatomical Abnormalities Associated with Schizophrenia-an Observational Study.

**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

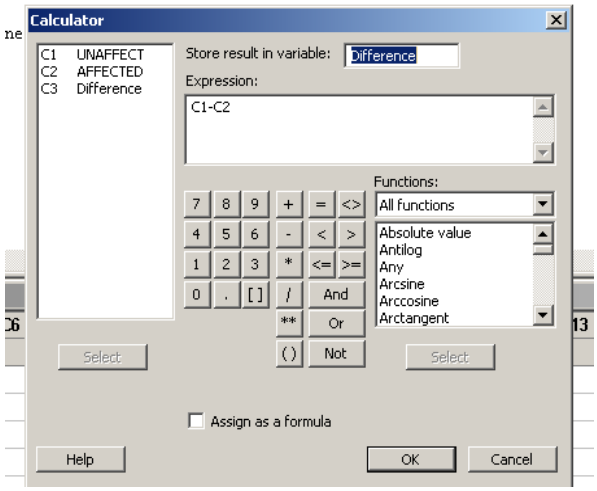
The data will appear as two columns in Minitab with titles UNAFFECT and AFFECTED.

**Step 2: Display Data** similar to ***Display 2.2 in R&S p. 30***:

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, say 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;

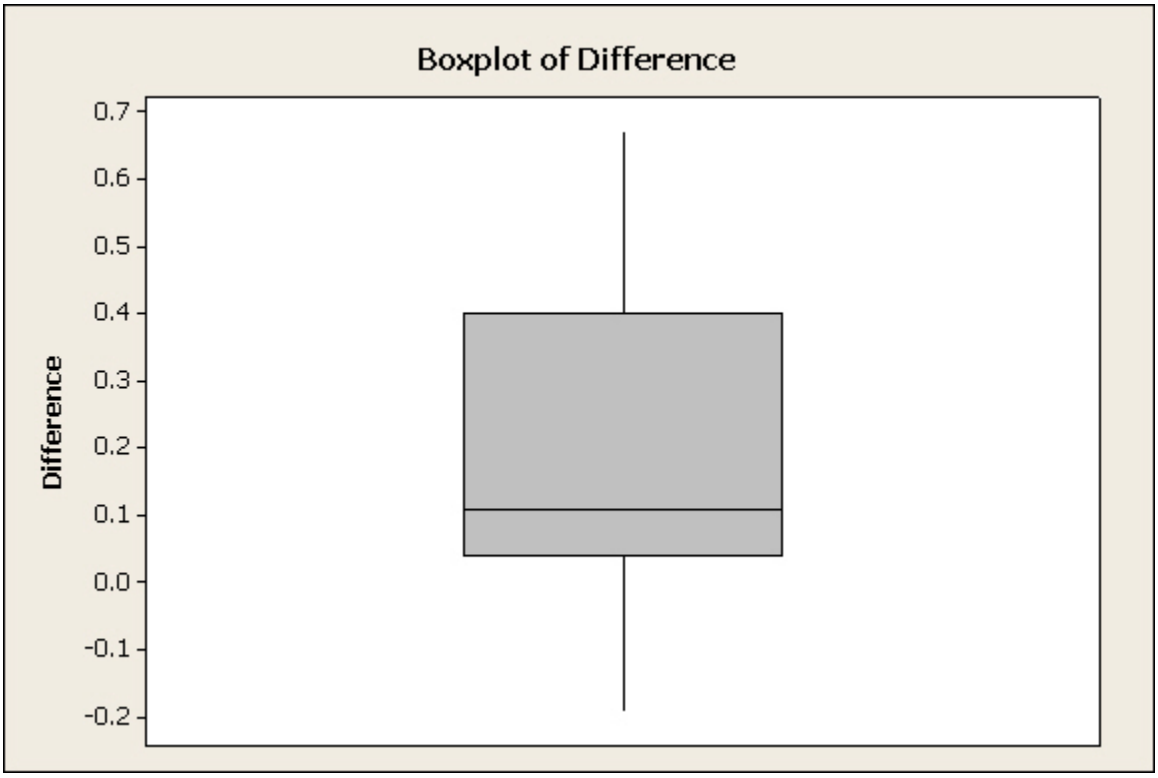
Select C3 Differences; click OK, to see this display on the output portion:

### Descriptive Statistics: Difference

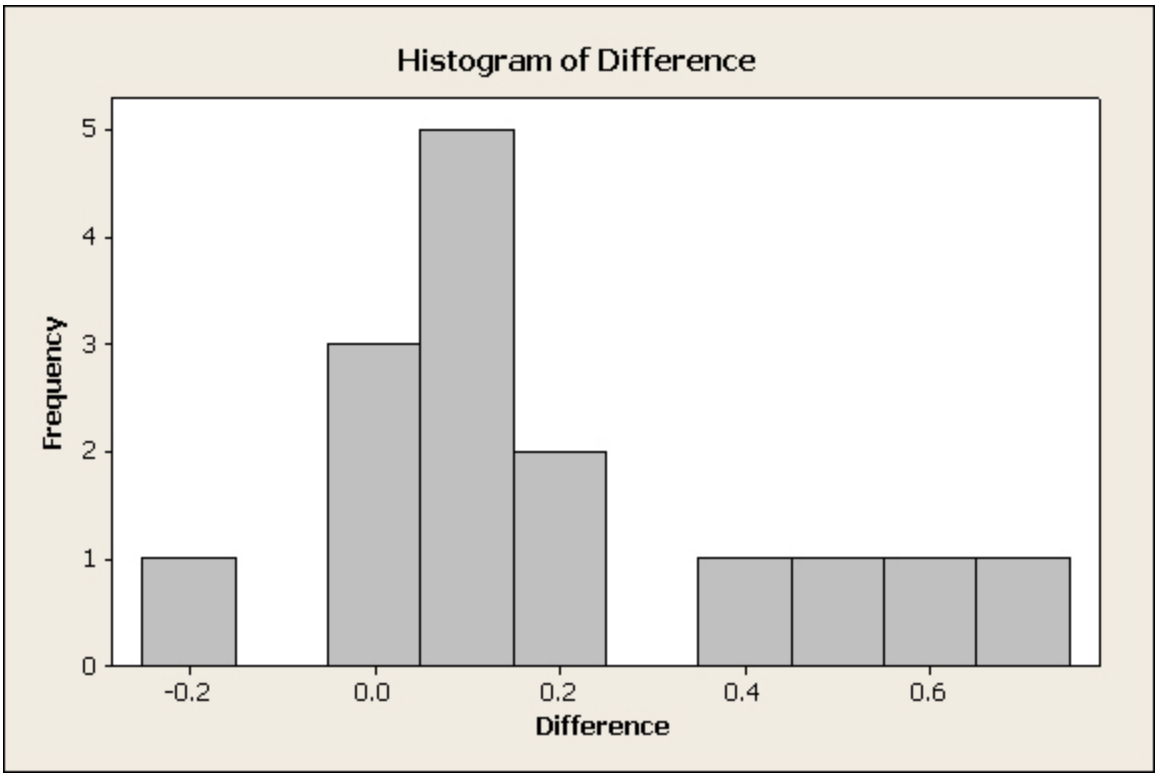
| Variable | N | N* | Mean | SE Mean | StDev | Minimum | Q1 | Median | Q3 |
|---|---|---|---|---|---|---|---|---|---|
| Difference | 15 | 0 | 0.1987 | 0.0615 | 0.2383 | -0.1900 | 0.0400 | 0.1100 | 0.4000 |

| Variable | Maximum |
|---|---|
| Difference | 0.6700 |

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

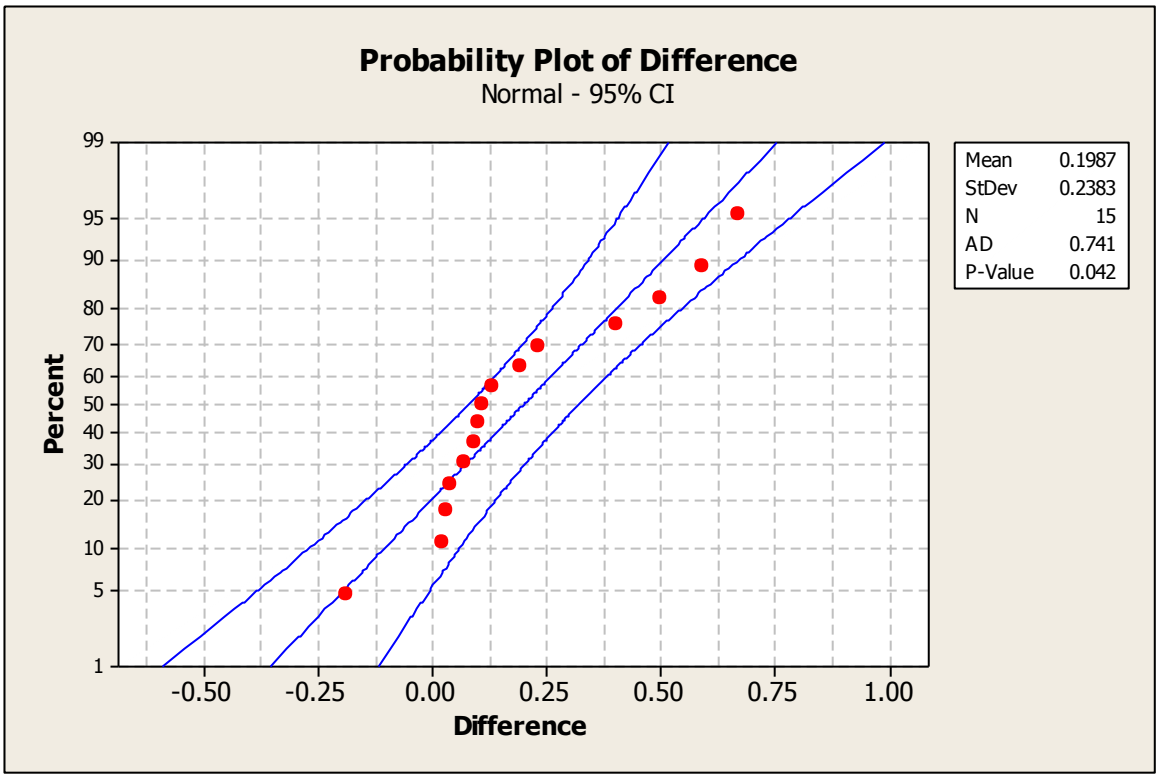



**Histograms:** Go to Graph→Histogram; Select Difference in the box on the left into the Graph variables box on the right; and click OK, to get this plot.




**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.




**Step 6: Paired t-test and C.I.**

Go to Stat →Basic Statistics → 1-sample t; select C3 Difference into Samples in Columns on the right; click Perform Hypothesized test, with Hypothesized Mean 0; and click OK, to see the following output.

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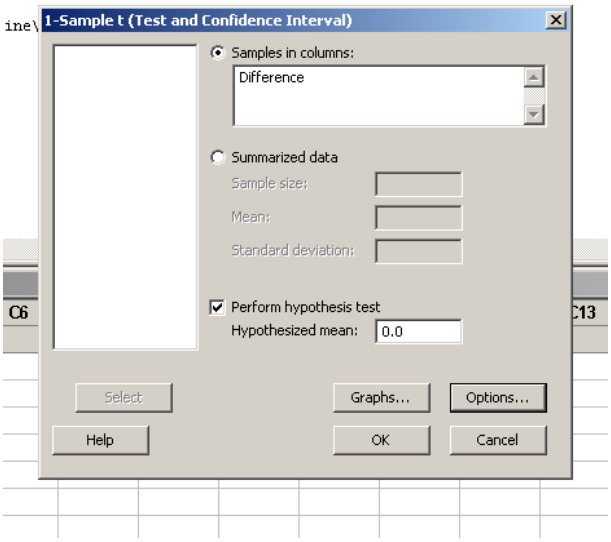
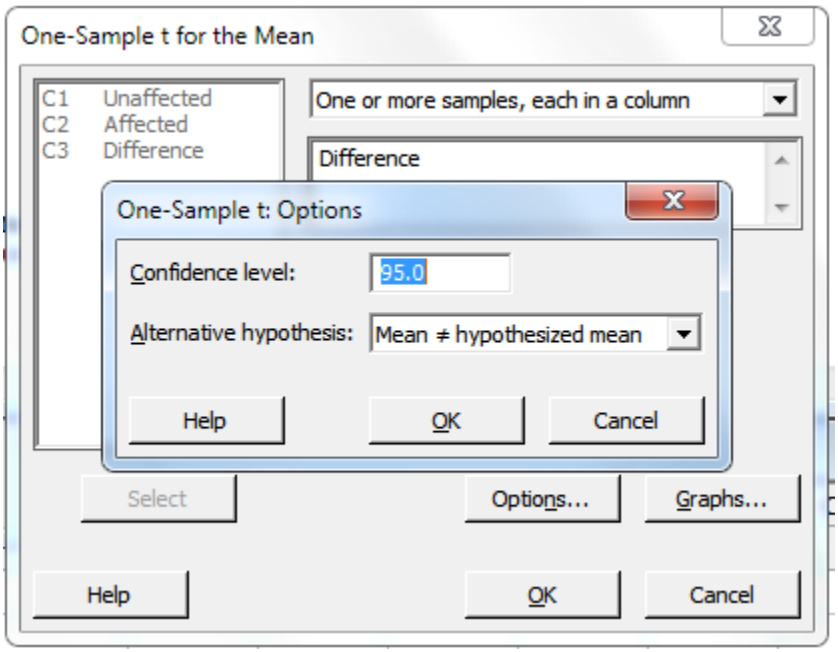


**One-Sample T: Difference**

```
Test of mu = 0 vs not = 0


Variable      N    Mean   StDev  SE Mean        95% CI           T      P
Difference   15  0.1987  0.2383   0.0615  (0.0667, 0.3306)  3.23  0.006
```

To see the 95% C.I for the mean of Differences, again click on Stat →Basic Statistics → 1-sample t; select C3 Difference into Samples in Columns on the right; but don't click on Perform Hypothesized test. This will give you the following result.




**One-Sample T: Difference**

```
Variable      N    Mean   StDev  SE Mean        95% CI
Difference   15  0.1987  0.2383   0.0615  (0.0667, 0.3306)
```

**Step 7: Discussion of Results and Scope of Inference:**

The observed p-value of the test is 0.006, which is less than the pre-chosen level of significance $\alpha = 0.05$. Therefore, we reject the null hypothesis at the 5% level of significance. Also, note that the 95% C.I for $\mu$ does not include the null hypothesis value of 0, which leads to the same conclusion.

## Case 2.1.1. Darwin's Theory on Natural Selection – an Observational Study.

**Step 1: Copy the data into a Minitab Worksheet**: use these steps: File → Open Worksheet →Browse your local directory and upload the csv file case0201.csv. The data consists of Year in C1 (1976 or 1978) and Depth in C2.

### Data Display

| Row | Year | Depth |
|---|---|---|
| 1 | 1976 | 6.2 |
| 2 | 1976 | 6.8 |
| 3 | 1976 | 7.1 |
| 4 | 1976 | 7.1 |
| 5 | 1976 | 7.4 |
| 6 | 1976 | 7.8 |
| 7 | 1976 | 7.9 |
| 8 | 1976 | 8.0 |
| 9 | 1976 | 8.2 |
| 10 | 1976 | 8.4 |
| 11 | 1976 | 8.4 |
| 12 | 1976 | 8.4 |
| 13 | 1976 | 8.5 |
| 14 | 1976 | 8.5 |
| 15 | 1976 | 8.5 |
| 16 | 1976 | 8.5 |
| 17 | 1976 | 8.6 |
| 18 | 1976 | 8.7 |
| 19 | 1976 | 8.7 |
| 20 | 1976 | 8.7 |
| 21 | 1976 | 8.9 |
| 22 | 1976 | 8.9 |
| 23 | 1976 | 8.9 |
| 24 | 1976 | 8.9 |
| 25 | 1976 | 8.9 |
| 26 | 1976 | 9.0 |
| 27 | 1976 | 9.0 |
| 28 | 1976 | 9.0 |
| 29 | 1976 | 9.0 |
| 30 | 1976 | 9.0 |
| 31 | 1976 | 9.1 |
| 32 | 1976 | 9.1 |
| 33 | 1976 | 9.1 |
| 34 | 1976 | 9.1 |
| 35 | 1976 | 9.1 |
| 36 | 1976 | 9.2 |
| 37 | 1976 | 9.3 |
| 38 | 1976 | 9.4 |
| 39 | 1976 | 9.4 |
| 40 | 1976 | 9.4 |
| 41 | 1976 | 9.5 |
| 42 | 1976 | 9.5 |
| 43 | 1976 | 9.6 |
| 44 | 1976 | 9.7 |
| 45 | 1976 | 9.7 |
| 46 | 1976 | 9.7 |
| 47 | 1976 | 9.7 |
| 48 | 1976 | 9.8 |
| 49 | 1976 | 9.8 |

| | | |
|---|---|---|
| 50 | 1976 | 9.8 |
| 51 | 1976 | 9.8 |
| 52 | 1976 | 9.8 |
| 53 | 1976 | 9.9 |
| 54 | 1976 | 9.9 |
| 55 | 1976 | 9.9 |
| 56 | 1976 | 9.9 |
| 57 | 1976 | 9.9 |
| 58 | 1976 | 10.0 |
| 59 | 1976 | 10.0 |
| 60 | 1976 | 10.0 |
| 61 | 1976 | 10.1 |
| 62 | 1976 | 10.1 |
| 63 | 1976 | 10.1 |
| 64 | 1976 | 10.1 |
| 65 | 1976 | 10.1 |
| 66 | 1976 | 10.1 |
| 67 | 1976 | 10.2 |
| 68 | 1976 | 10.2 |
| 69 | 1976 | 10.3 |
| 70 | 1976 | 10.3 |
| 71 | 1976 | 10.3 |
| 72 | 1976 | 10.4 |
| 73 | 1976 | 10.4 |
| 74 | 1976 | 10.4 |
| 75 | 1976 | 10.4 |
| 76 | 1976 | 10.5 |
| 77 | 1976 | 10.5 |
| 78 | 1976 | 10.5 |
| 79 | 1976 | 10.5 |
| 80 | 1976 | 10.5 |
| 81 | 1976 | 10.6 |
| 82 | 1976 | 10.6 |
| 83 | 1976 | 10.6 |
| 84 | 1976 | 10.7 |
| 85 | 1976 | 10.8 |
| 86 | 1976 | 11.0 |
| 87 | 1976 | 11.4 |
| 88 | 1976 | 11.4 |
| 89 | 1976 | 11.7 |
| 90 | 1978 | 7.1 |
| 91 | 1978 | 7.9 |
| 92 | 1978 | 8.0 |
| 93 | 1978 | 8.4 |
| 94 | 1978 | 8.4 |
| 95 | 1978 | 8.7 |
| 96 | 1978 | 8.7 |
| 97 | 1978 | 8.8 |
| 98 | 1978 | 9.0 |
| 99 | 1978 | 9.0 |
| 100 | 1978 | 9.1 |
| 101 | 1978 | 9.1 |
| 102 | 1978 | 9.1 |
| 103 | 1978 | 9.2 |
| 104 | 1978 | 9.3 |
| 105 | 1978 | 9.3 |
| 106 | 1978 | 9.4 |
| 107 | 1978 | 9.4 |
| 108 | 1978 | 9.5 |
| 109 | 1978 | 9.6 |
| 110 | 1978 | 9.6 |
| 111 | 1978 | 9.6 |
| 112 | 1978 | 9.6 |

| | | |
|---|---|---|
| 113 | 1978 | 9.6 |
| 114 | 1978 | 9.6 |
| 115 | 1978 | 9.7 |
| 116 | 1978 | 9.7 |
| 117 | 1978 | 9.7 |
| 118 | 1978 | 9.7 |
| 119 | 1978 | 9.8 |
| 120 | 1978 | 9.9 |
| 121 | 1978 | 9.9 |
| 122 | 1978 | 9.9 |
| 123 | 1978 | 9.9 |
| 124 | 1978 | 10.0 |
| 125 | 1978 | 10.0 |
| 126 | 1978 | 10.0 |
| 127 | 1978 | 10.2 |
| 128 | 1978 | 10.2 |
| 129 | 1978 | 10.2 |
| 130 | 1978 | 10.2 |
| 131 | 1978 | 10.2 |
| 132 | 1978 | 10.3 |
| 133 | 1978 | 10.3 |
| 134 | 1978 | 10.3 |
| 135 | 1978 | 10.3 |
| 136 | 1978 | 10.3 |
| 137 | 1978 | 10.3 |
| 138 | 1978 | 10.4 |
| 139 | 1978 | 10.4 |
| 140 | 1978 | 10.4 |
| 141 | 1978 | 10.4 |
| 142 | 1978 | 10.5 |
| 143 | 1978 | 10.5 |
| 144 | 1978 | 10.5 |
| 145 | 1978 | 10.5 |
| 146 | 1978 | 10.5 |
| 147 | 1978 | 10.5 |
| 148 | 1978 | 10.6 |
| 149 | 1978 | 10.6 |
| 150 | 1978 | 10.6 |
| 151 | 1978 | 10.6 |
| 152 | 1978 | 10.6 |
| 153 | 1978 | 10.7 |
| 154 | 1978 | 10.7 |
| 155 | 1978 | 10.7 |
| 156 | 1978 | 10.7 |
| 157 | 1978 | 10.7 |
| 158 | 1978 | 10.8 |
| 159 | 1978 | 10.9 |
| 160 | 1978 | 10.9 |
| 161 | 1978 | 10.9 |
| 162 | 1978 | 11.0 |
| 163 | 1978 | 11.0 |
| 164 | 1978 | 11.0 |
| 165 | 1978 | 11.0 |
| 166 | 1978 | 11.1 |
| 167 | 1978 | 11.1 |
| 168 | 1978 | 11.1 |
| 169 | 1978 | 11.1 |
| 170 | 1978 | 11.3 |
| 171 | 1978 | 11.4 |
| 172 | 1978 | 11.4 |
| 173 | 1978 | 11.4 |
| 174 | 1978 | 11.4 |
| 175 | 1978 | 11.5 |

| | | |
|---|---|---|
| 176 | 1978 | 11.6 |
| 177 | 1978 | 11.6 |
| 178 | 1978 | 11.7 |

**Step 2:** you can un-stack the data. To do this, go to Data → Unstack Columns →select variable C2 Depth into the window/box labeled Unstack the Data in;

Select C1 Year into the window/box labeled Using Subscripts in; Store un-stacked data: click on After last column in use;

Un-tick Name the Columns containing the un-stacked data; click OK.

This will create 2 new columns in your worksheet, C3 and C4, which are titled Depth_1976 and Depth_1978.

**Step 3: Display Unstacked Data**

**Data Display**

| Row | Depth_1976 | Depth_1978 |
|---|---|---|
| 1 | 6.2 | 7.1 |
| 2 | 6.8 | 7.9 |
| 3 | 7.1 | 8.0 |
| 4 | 7.1 | 8.4 |
| 5 | 7.4 | 8.4 |
| 6 | 7.8 | 8.7 |
| 7 | 7.9 | 8.7 |
| 8 | 8.0 | 8.8 |
| 9 | 8.2 | 9.0 |
| 10 | 8.4 | 9.0 |
| 11 | 8.4 | 9.1 |
| 12 | 8.4 | 9.1 |
| 13 | 8.5 | 9.1 |
| 14 | 8.5 | 9.2 |
| 15 | 8.5 | 9.3 |
| 16 | 8.5 | 9.3 |
| 17 | 8.6 | 9.4 |
| 18 | 8.7 | 9.4 |
| 19 | 8.7 | 9.5 |
| 20 | 8.7 | 9.6 |
| 21 | 8.9 | 9.6 |
| 22 | 8.9 | 9.6 |
| 23 | 8.9 | 9.6 |
| 24 | 8.9 | 9.6 |
| 25 | 8.9 | 9.6 |
| 26 | 9.0 | 9.7 |
| 27 | 9.0 | 9.7 |
| 28 | 9.0 | 9.7 |
| 29 | 9.0 | 9.7 |
| 30 | 9.0 | 9.8 |
| 31 | 9.1 | 9.9 |
| 32 | 9.1 | 9.9 |
| 33 | 9.1 | 9.9 |
| 34 | 9.1 | 9.9 |
| 35 | 9.1 | 10.0 |
| 36 | 9.2 | 10.0 |

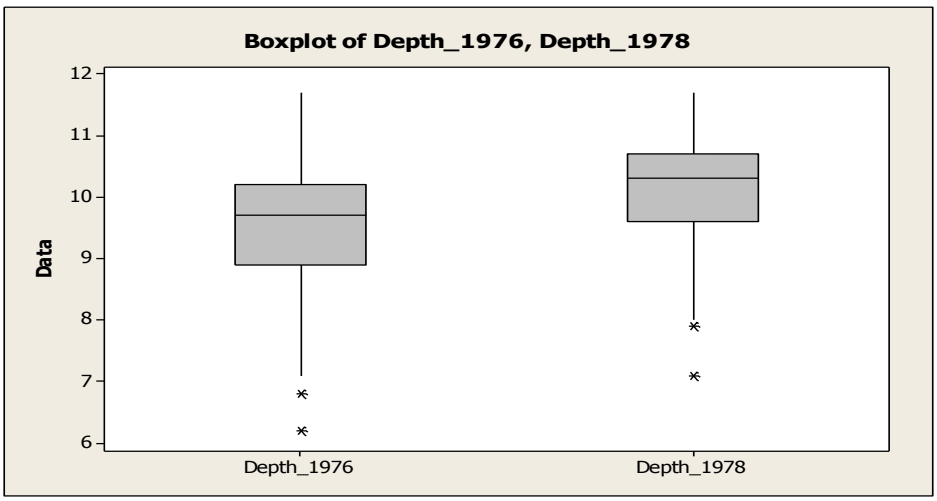
| | | |
|---|---|---|
| 37 | 9.3 | 10.0 |
| 38 | 9.4 | 10.2 |
| 39 | 9.4 | 10.2 |
| 40 | 9.4 | 10.2 |
| 41 | 9.5 | 10.2 |
| 42 | 9.5 | 10.2 |
| 43 | 9.6 | 10.3 |
| 44 | 9.7 | 10.3 |
| 45 | 9.7 | 10.3 |
| 46 | 9.7 | 10.3 |
| 47 | 9.7 | 10.3 |
| 48 | 9.8 | 10.3 |
| 49 | 9.8 | 10.4 |
| 50 | 9.8 | 10.4 |
| 51 | 9.8 | 10.4 |
| 52 | 9.8 | 10.4 |
| 53 | 9.9 | 10.5 |
| 54 | 9.9 | 10.5 |
| 55 | 9.9 | 10.5 |
| 56 | 9.9 | 10.5 |
| 57 | 9.9 | 10.5 |
| 58 | 10.0 | 10.5 |
| 59 | 10.0 | 10.6 |
| 60 | 10.0 | 10.6 |
| 61 | 10.1 | 10.6 |
| 62 | 10.1 | 10.6 |
| 63 | 10.1 | 10.6 |
| 64 | 10.1 | 10.7 |
| 65 | 10.1 | 10.7 |
| 66 | 10.1 | 10.7 |
| 67 | 10.2 | 10.7 |
| 68 | 10.2 | 10.7 |
| 69 | 10.3 | 10.8 |
| 70 | 10.3 | 10.9 |
| 71 | 10.3 | 10.9 |
| 72 | 10.4 | 10.9 |
| 73 | 10.4 | 11.0 |
| 74 | 10.4 | 11.0 |
| 75 | 10.4 | 11.0 |
| 76 | 10.5 | 11.0 |
| 77 | 10.5 | 11.1 |
| 78 | 10.5 | 11.1 |
| 79 | 10.5 | 11.1 |
| 80 | 10.5 | 11.1 |
| 81 | 10.6 | 11.3 |
| 82 | 10.6 | 11.4 |
| 83 | 10.6 | 11.4 |
| 84 | 10.7 | 11.4 |
| 85 | 10.8 | 11.4 |
| 86 | 11.0 | 11.5 |
| 87 | 11.4 | 11.6 |
| 88 | 11.4 | 11.6 |
| 89 | 11.7 | 11.7 |

**Step 4: Summary Statistics for both groups:**
Go to Stat →Basic Statistics →Display Descriptive Statistics; select Depth_1976 and Depth_1978; click OK, to see this display on the output portion:

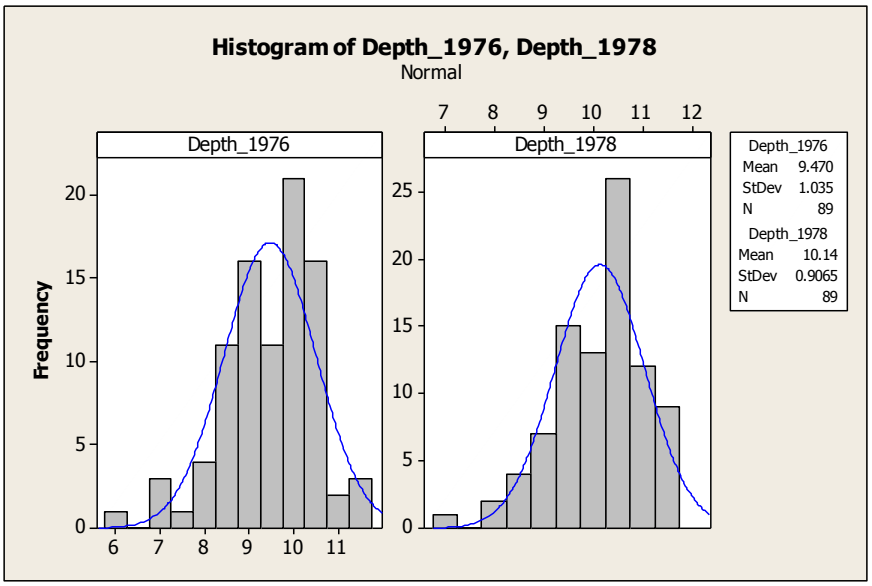
**Descriptive Statistics: Depth_1976, Depth_1978**

| Variable | N | N* | Mean | SE Mean | StDev | Minimum | Q1 | Median | Q3 | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth_1976 | 89 | 0 | 9.470 | 0.110 | 1.035 | 6.200 | 8.900 | 9.700 | 10.200 | 11.700 |
| Depth_1978 | 89 | 0 | 10.138 | 0.0961 | 0.906 | 7.100 | 9.600 | 10.300 | 10.700 | 11.700 |

**Step 5: Some graphs: Side-by-side Box-plots.**
Click on Graph→Boxplot→Select One Y with Groups; Select Depth from the left window/box, and see it appear in the box Graph Variables on the right. Next, click on the box on the right, Categorical Variables for Grouping; select Year from the left box, and see it appear in the box Categorical Variables for Grouping on the right. Click OK, and see the following plot:

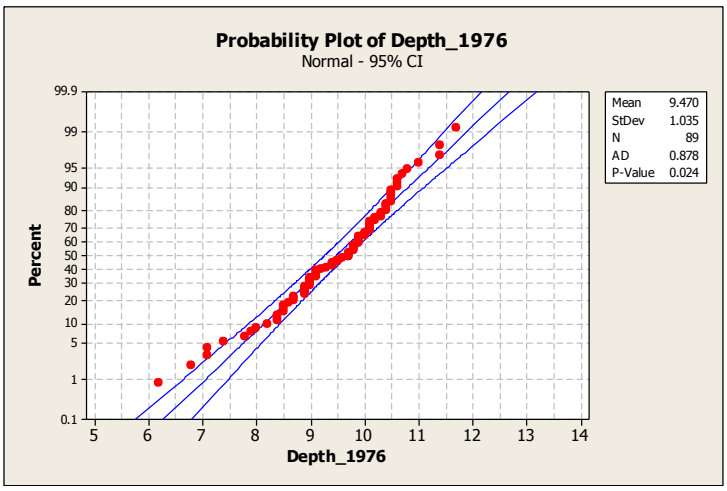


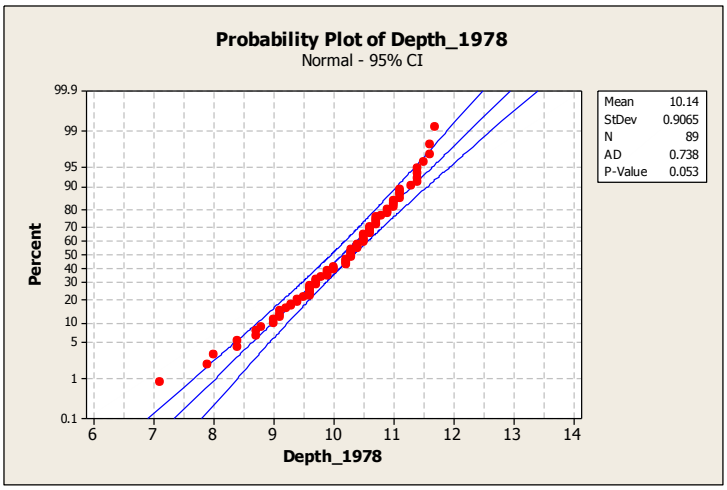

**Histograms:** Go to Graph→Histogram; select With fit; Select Depth_1976 and Depth_1978 in the box on the left into the Graph variables box on the right; select Multiple Graphs in separate panels on the same graph; and click OK, to get this plot.



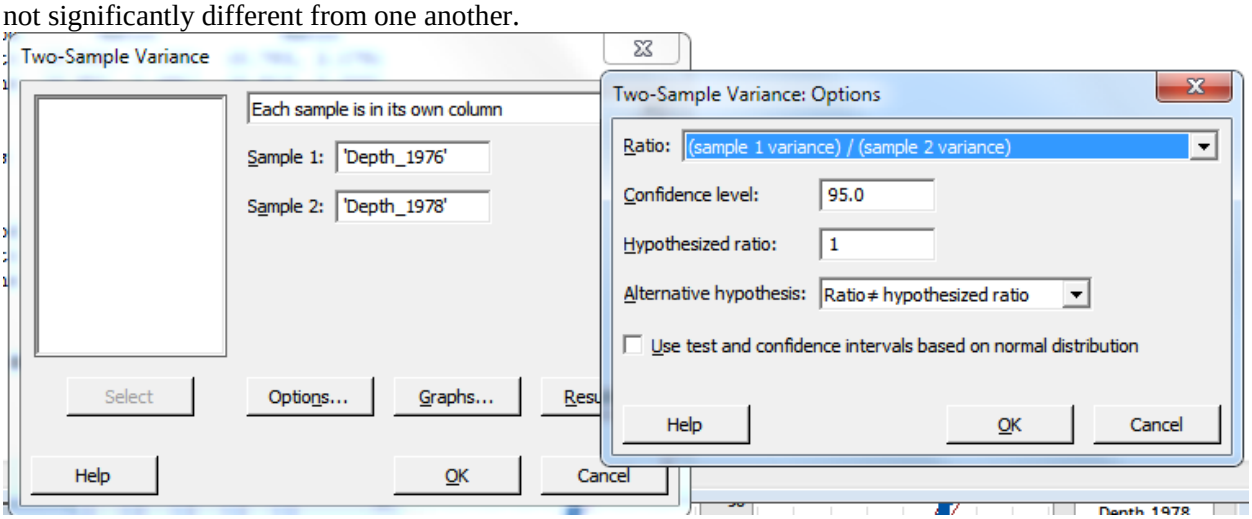

**Step 6: Two-sample t-test:** We will check whether the 2-sample pooled t-test is valid here. First, verify the normality and equality of variances assumptions.

**Normal Probability Plot** : Go to Graphs → Probability Plot → Single; Select the two variables from the left into the right hand side box; select Multiple Graphs – in separate panels of the same graph and click OK. The points in each plots lie approximately along straight line, and lie within the confidence bands. We may assume that the data is approximately normal in both cases, although there is some curvature at the ends (indicating some departure from normality).






**Test for equal variances (needs normality assumption on both samples to be valid)**
Go to Stat →Basic Statistics →2 Variances; select two variables into the box on the right; click on Options and Hypothesized Ratio, select Variance 1/Variance 2 and click OK. The F-statistic which is the ratio of sample variances is 1.304, and the 95% C.I. for the Variance Ratio is (0.857, 1.987), which includes the null hypothesis value of 1. The p-value of the test is 0.214 > 0.05. Hence we conclude that the data does not provide evidence to reject H0. So we may assume that the two population variances are not significantly different from one another.

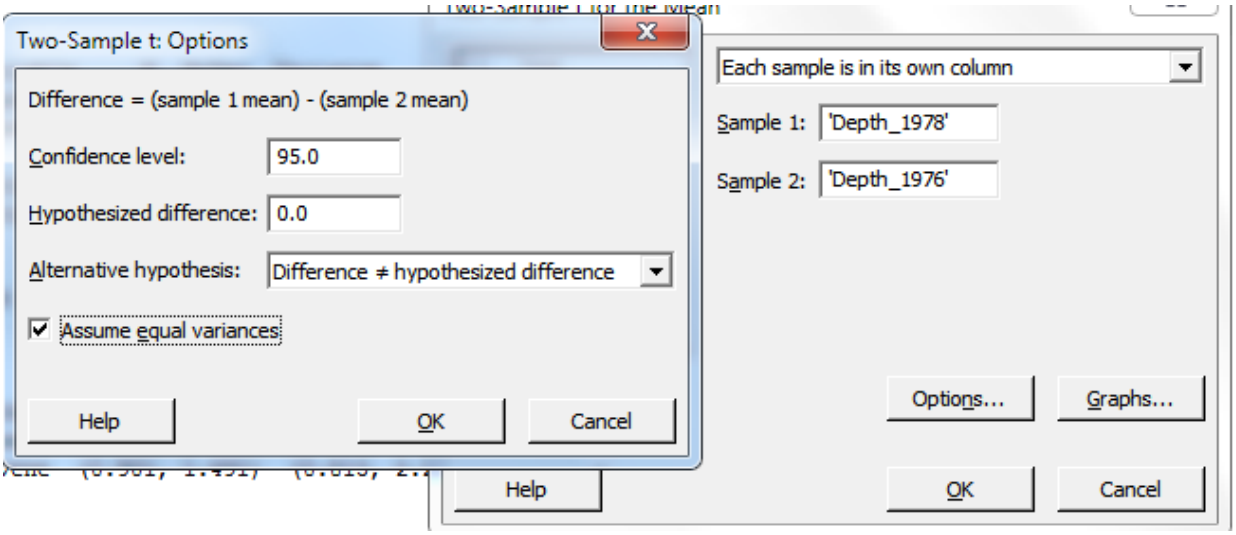


## Test and CI for Two Variances: Depth_1976, Depth_1978

```
Method

Null hypothesis         Variance(Depth_1976) / Variance(Depth_1978) = 1
Alternative hypothesis  Variance(Depth_1976) / Variance(Depth_1978) ≠ 1
Significance level      α = 0.05


Statistics

                                      95% CI for
Variable     N  StDev  Variance      Variances
Depth_1976  89  1.035     1.072  (0.769, 1.561)
Depth_1978  89  0.906     0.822  (0.589, 1.198)

Ratio of standard deviations = 1.142
Ratio of variances = 1.304


95% Confidence Intervals

                            CI for
         CI for StDev      Variance
Method       Ratio           Ratio
Bonett  (0.885, 1.475)  (0.783, 2.175)
Levene  (0.901, 1.491)  (0.813, 2.222)


Tests

                       Test
Method  DF1  DF2  Statistic  P-Value
Bonett    1    —       1.10    0.293
Levene    1  176       1.36    0.245
```

**Two-sample t-test :** we will do the pooled 2-sample t-test here **(needs normality and equal variances assumptions to be valid)**

Go to Stat →Basic Statistics →2-Sample t; Select Samples in two different columns; Select  in the window/box for the First group, and select  group into the window/box for the Second group; select Assume equal variances, and click OK to see the following display in the Output area:




**Two-Sample T-Test and CI: Depth_1978, Depth_1976**

```
Two-sample T for Depth_1978 vs Depth_1976

             N    Mean  StDev  SE Mean
Depth_1978  89  10.138  0.906    0.096
Depth_1976  89    9.47   1.04     0.11


Difference = mu (Depth_1978) - mu (Depth_1976)
Estimate for difference:  0.669
95% CI for difference:  (0.381, 0.956)
T-Test of difference = 0 (vs not =): T-Value = 4.58  P-Value = 0.000  DF = 176
Both use Pooled StDev = 0.9730
```