Example 1: One Way ANOVA in MINITAB

A consumer group wants to compare a new brand of wax (Brand-X) to two leading brands (Sureglow and Microsheen) in terms of Effectiveness of wax. Following data is collected for this purpose:

Brand	Effectiveness	Brand	Effectiveness	Brand	Effectiveness
Sureglow	93	Mirrorsheen	90	Brand_X	105
Sureglow	96	Mirrorsheen	97	Brand_X	91
Sureglow	87	Mirrorsheen	91	Brand_X	95
Sureglow	91	Mirrorsheen	94	Brand_X	107
Sureglow	88	Mirrorsheen	100	Brand_X	90
Sureglow	85	Mirrorsheen	95	Brand_X	96
Sureglow	88	Mirrorsheen	88	Brand_X	92
Sureglow	91	Mirrorsheen	92	Brand_X	94
Sureglow	82	Mirrorsheen	94	Brand_X	84
Sureglow	91	Mirrorsheen	89	Brand_X	86
Sureglow	86	Mirrorsheen	96	Brand_X	82
Sureglow	93	Mirrorsheen	91	Brand_X	91
Sureglow	91	Mirrorsheen	97	Brand_X	106
Sureglow	87	Mirrorsheen	92	Brand_X	90
Sureglow	88	Mirrorsheen	92	Brand_X	91
				Brand_X	92
				Brand_X	91
				Brand_X	106
				Brand_X	98
				Brand_X	97
				Brand_X	80
				Brand_X	97
				Brand_X	91
				Brand_X	99
				Brand_X	86

To test the null hypothesis of equal mean effectiveness for the three brands of wax, the data is first converted to Group Format which will have 2 columns, Brand and Effectiveness.
To run the One-Way ANOVA procedure in MINITAB, open the data file WaxEffectiveness.xlsx in MINITAB, and then click the following sequence:

Stat/ANOVA//One-WAY (see Figure 1a)

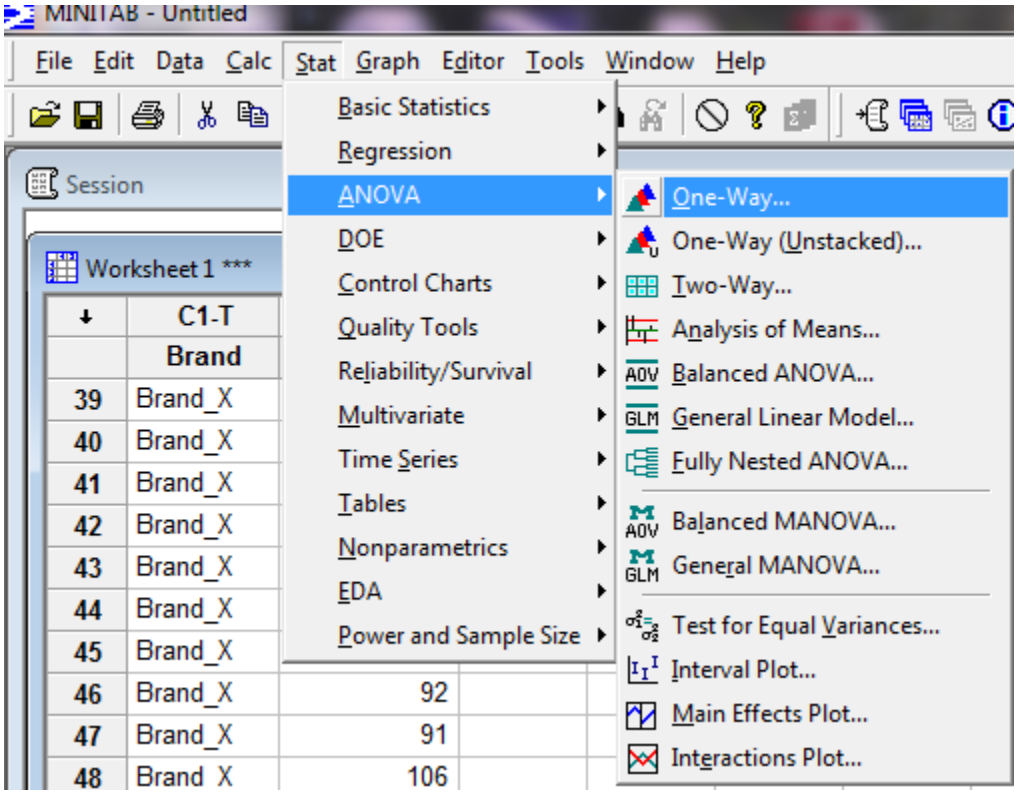


Figure 1a: Running One-WAY ANOVA in MINITAB

This will open the window shown in Figure 1b. Select Effectiveness as the Response, and Brand as the Factor (see Figure 21b), click on Graphs then select 'Four in One (Figure 1c), then click OK.

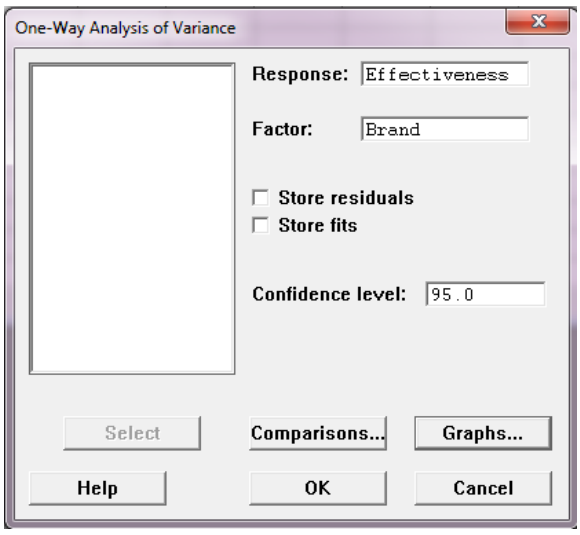


Figure 3b: Selecting Variables in One-WAY ANOVA in MINITAB

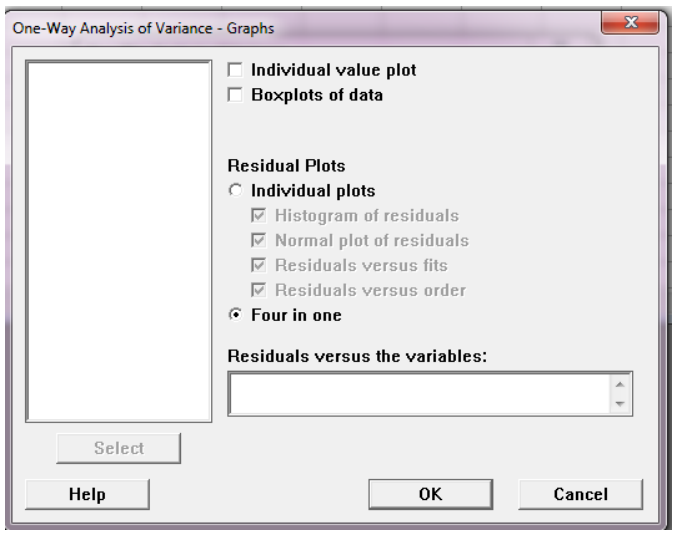


Figure 2a: Residual Plots in MINITAB

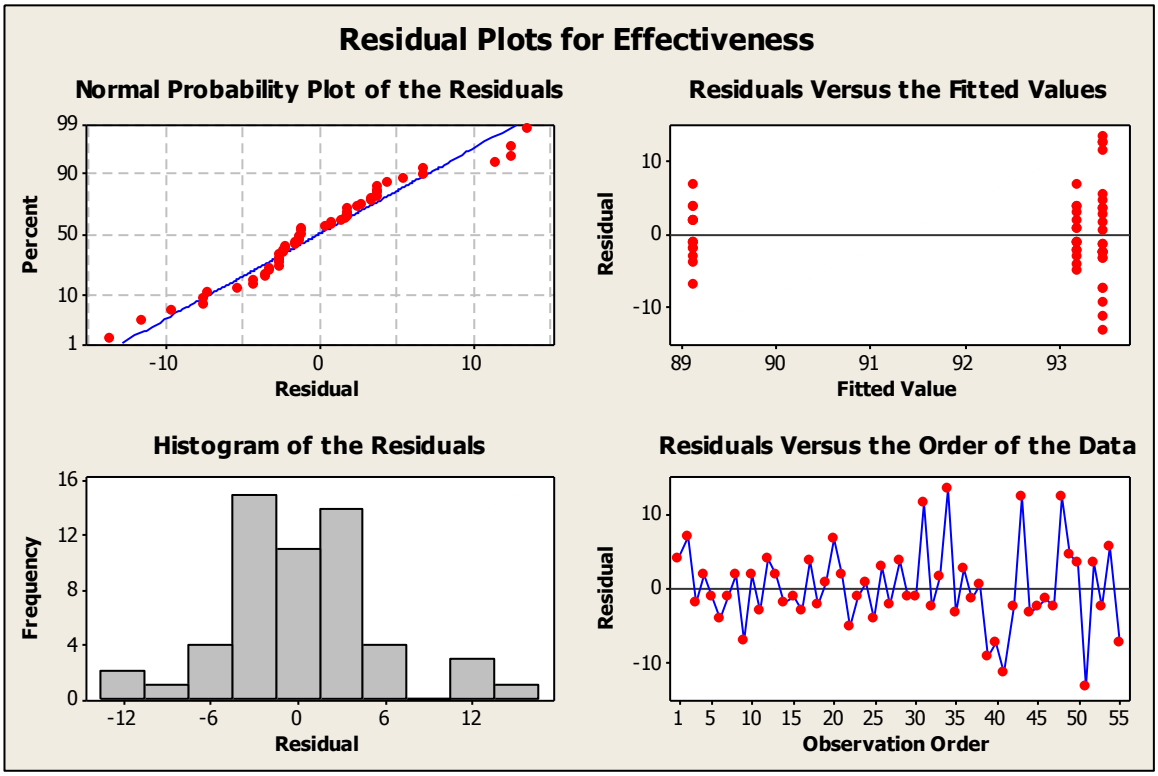
The output is shown below.

One-way ANOVA: Effectiveness versus Brand

```
Source  DF      SS     MS     F      P
Brand    2   197.0   98.5  3.15  0.051  (P > .05, so the null hypothesis of equal means
Error   52  1626.4   31.3                is not rejected.)
Total   54  1823.4

S = 5.593   R-Sq = 10.80%   R-Sq(adj) = 7.37%

                                  Individual 95% CIs For Mean Based on
                                  Pooled StDev
Level          N    Mean  StDev  -----+---------+---------+---------+----
Brand_X       25  93.480  7.326                     (--------*--------)
Mirrorsheen   15  93.200  3.342                  (-----------*----------)
Sureglow      15  89.133  3.603  (-----------*----------)
                                  -----+---------+---------+---------+----
                                    87.5      90.0      92.5      95.0
```



The residual plots show that the residuals are normally distributed, and hence the results of ANOVA are valid.

Example 2: Two Way ANOVA in MINITAB

Following table shows drying time of concrete obtained from a set of 12 experiments conducted at 3 levels of CONCRETE amounts, and 2 levels of WATER amounts.

CONCRETE(CUPS)	WATER(CUPS)	TIME(MINUTES)
1.5	0.25	23
1.5	0.25	21
1.5	0.5	153
1.5	0.5	161
1.75	0.25	25
1.75	0.25	27
1.75	0.5	159
1.75	0.5	171
2	0.25	29
2	0.25	31
2	0.5	183
2	0.5	187

Test if the factors CONCRETE and WATER have an effect on mean drying time.

To run the 2-Way ANOVA in SPSS, you first have to create a data file in the following format (see file Concrete.xlsx):

CONCRETE	WATER	TIME
1	1	23
1	1	21
1	2	153
1	2	161
2	1	25
2	1	27
2	2	159
2	2	171
3	1	29
3	1	31
3	2	183
3	2	187

Open the data file Concrete.xlsx in SPSS, and click on the following sequence:

Stat/ANOVA/Two-Way (Figure 2a)
Then select Time as the Response, Concrete as Row factor, and Water as Column factor (Figure 2b), click on Graphs and select 'Four in One' (Figure 2c), then click OK.

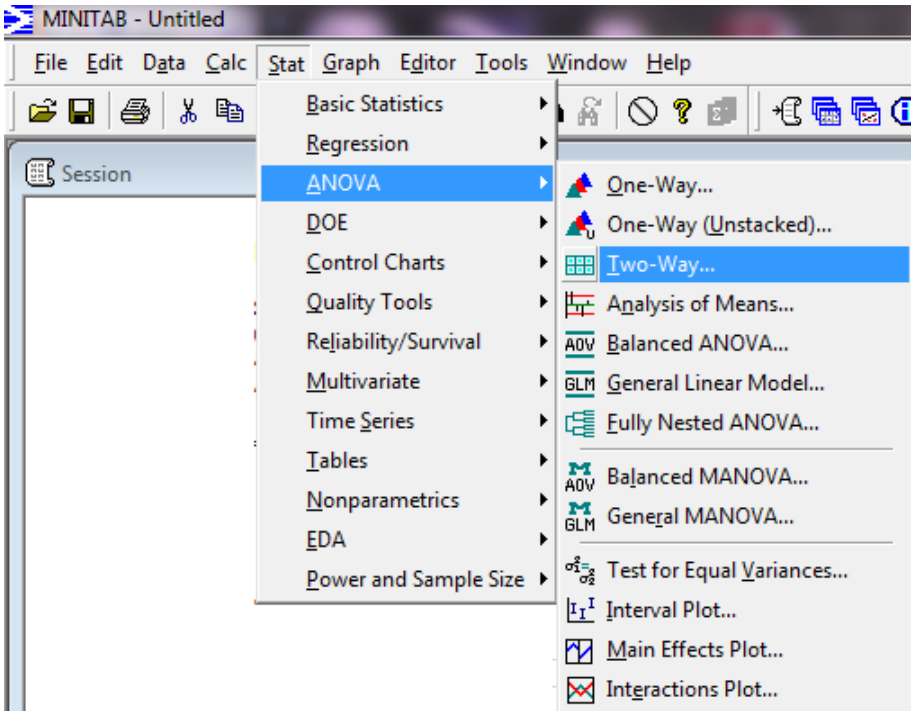


Figure 2b: Running Two-Way ANOVA in MINITAB

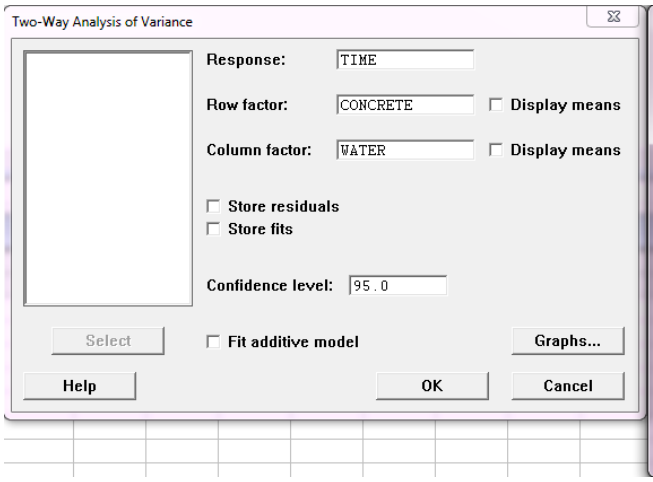


Figure 2b: Selecting Variables

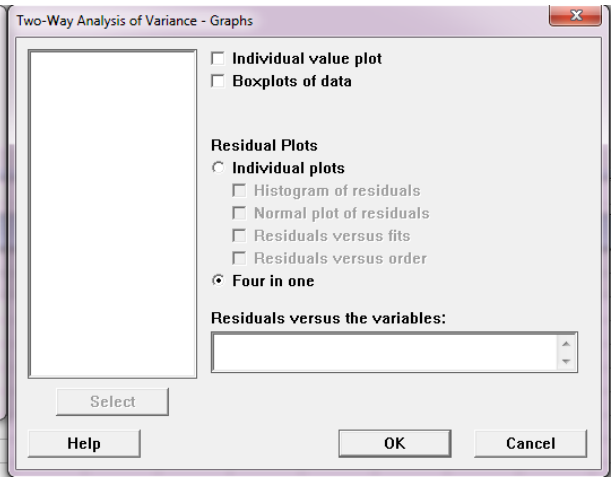


Figure 2b: Selecting Residual Plots

Output from MINITAB is shown below. The residual plots (Figure 2d) indicate that the residuals are normally distributed.

Two-way ANOVA: TIME versus CONCRETE, WATER

Source	DF	SS	MS	F	P
CONCRETE	2	672	336.0	17.08	0.003
WATER	1	61347	61347.0	3119.34	0.000
Interaction	2	224	112.0	5.69	0.041
Error	6	118	19.7		
Total	11	62361			

CONCRETE significant
WATER significant
INTERACTION significant

S = 4.435 R-Sq = 99.81% R-Sq(adj) = 99.65%

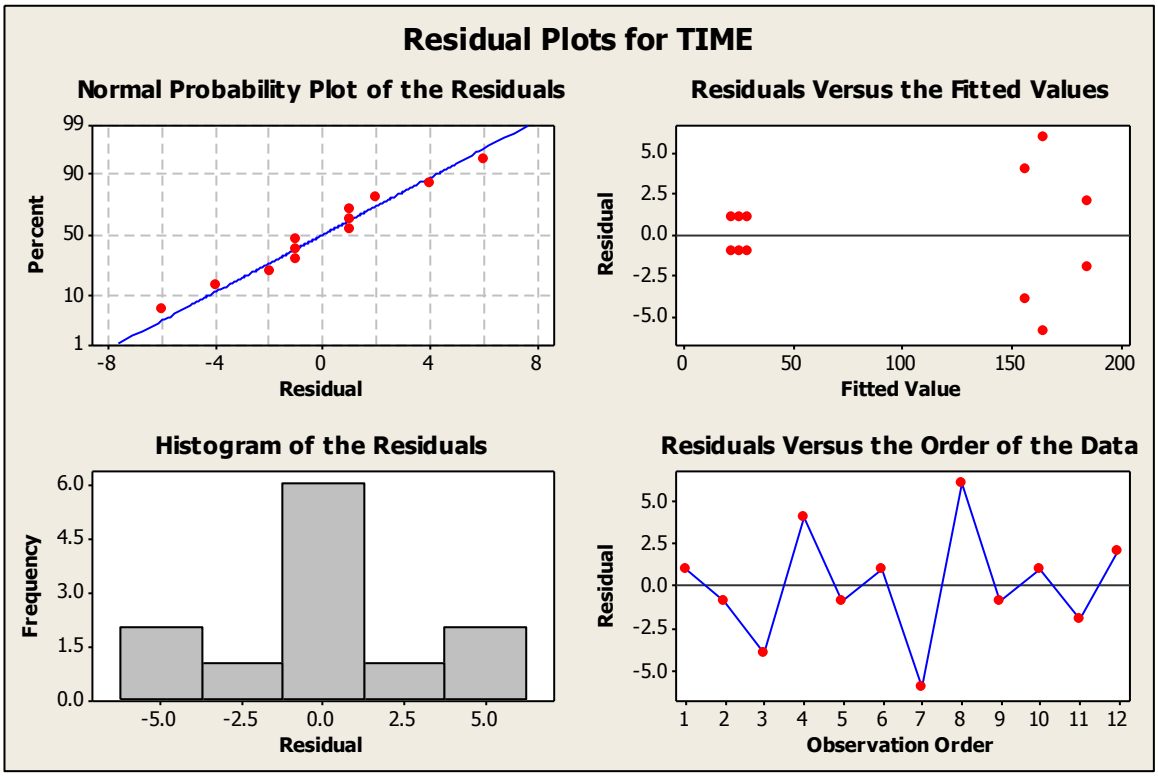


Figure 2d: Residual plots