

7.7. Parametric two-way ANOVA with equal numbers of replicates

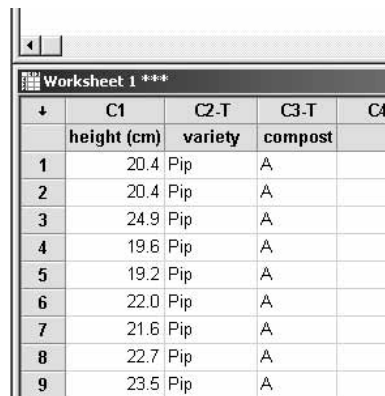
EXAMPLE 7.5. The weaning of *Cosmos atrosaguineus* var. ‘Pip’ and var. ‘Christopher’ onto one of four composts following propagation by tissue culture

BOX 7.8. How to carry out a two-way parametric ANOVA with equal replicates

Step 1. Enter your data into the worksheet section of the Minitab display. The actual measurements go in the first column, the variety (‘Pip’ or ‘Christopher’) goes in the second column, and the compost used (A, B, C, or D) goes in the third column. (Actually the ordering of the columns doesn’t matter: you will select them appropriately later.)

(Note that this test only works in Minitab for balanced data, i.e. data where you have equal numbers of measurements for each combination of treatments.)

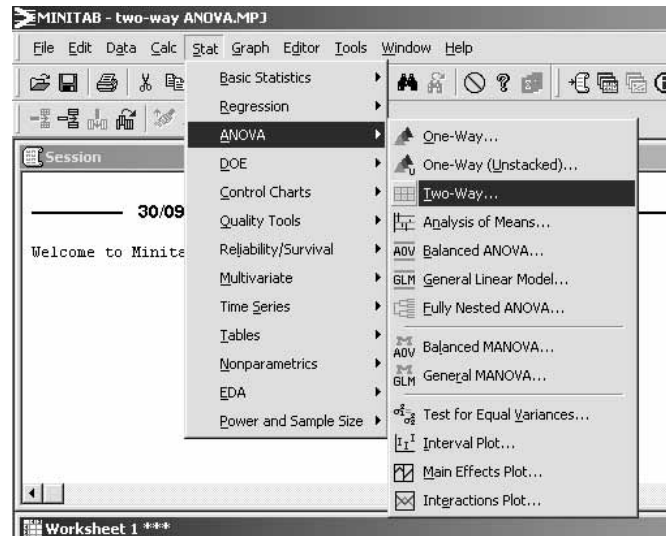
Obviously there will be a lot of repeated entries in the ‘variety’ and ‘compost’ columns: you can copy an entry down a column by hovering the cursor over the bottom right-hand corner of a cell until it changes from an open horizontal-vertical cross into an addition sign; when this happens, hold down the left mouse button, and drag the cursor down as far as you need.



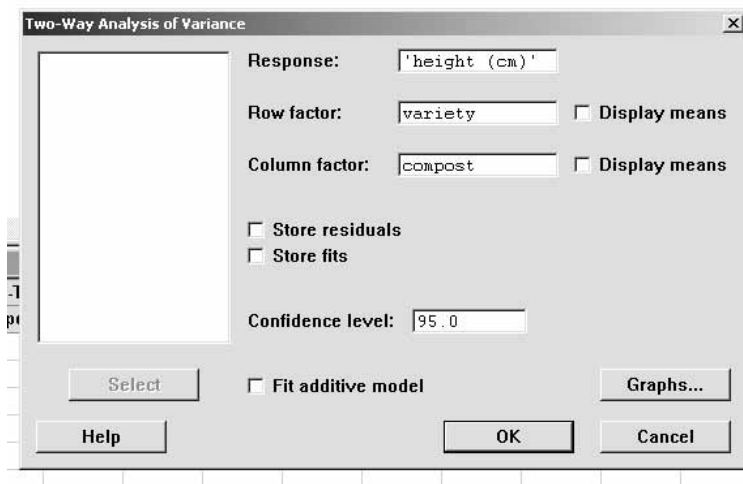
The screenshot shows a Minitab worksheet titled 'Worksheet 1 ***'. The data is organized into columns: C1 (height (cm)), C2-T (variety), C3-T (compost), and C4. The rows contain the following data:

	C1	C2-T	C3-T	C4
	height (cm)	variety	compost	
1	20.4	Pip	A	
2	20.4	Pip	A	
3	24.9	Pip	A	
4	19.6	Pip	A	
5	19.2	Pip	A	
6	22.0	Pip	A	
7	21.6	Pip	A	
8	22.7	Pip	A	
9	23.5	Pip	A	

Step 2. Perform the test. Go to ‘Stat’, ‘ANOVA’, ‘Two-Way’.



Transfer the data across into the appropriate windows by highlighting it and clicking on ‘Select’. The ‘Response’ is the plantlet height, because this is what is responding to both the variety and the compost used. Because of the way Table 7.8 has been set out, we have chosen ‘variety’ as the row factor and ‘compost’ as the column factor, but these could be interchanged without changing the outcome of the test.



Click on ‘OK’. The results will appear in the ‘Session’ window.

Two-way ANOVA: height (cm) versus variety, compost

Source	DF	SS	MS	F	P
variety	1	607.75	607.753	39.26	0.000
compost	3	59.87	19.957	1.29	0.285
Interaction	3	114.95	38.316	2.47	0.068
Error	72	1114.71	15.482		
Total	79	1897.29			

$S = 3.935$ $R\text{-Sq} = 41.25\%$ $R\text{-Sq}(\text{adj}) = 35.53\%$

Step 3. Decide what the results mean.

For the variety, the F value is 39.26 and the corresponding p value is smaller than 0.001: this means there is a very significant difference between the heights of the plantlets of the two varieties, at a significance better than $p = 0.001$.

For the compost, the F value is 1.29, and the corresponding p value is 0.285. This means that there is no significant difference ($p = 0.05$) between the heights of the plantlets weaned on different composts.

For the interaction between the compost and the variety, the F value is 2.5 and the p value is 0.068: this means that there is no significant interaction at $p = 0.05$.