

# Instructions for carrying out statistical procedures and tests using Minitab

These instructions are closely linked to the author's book:

Essential Statistics for the Pharmaceutical Sciences  
John Wiley & Sons Ltd <http://eu.wiley.com>  
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For all references to chapters or tables, see the above book.

**Using Minitab to add a Tukey's test to a  
one-way analysis of variance**

## Using Minitab to perform a add a Tukey's test to a one-way analysis of variance

**Example: Table 13.1 Effect of catalyst on yield (Percentage of theoretical maximum)**

For the general theory of Tukey's test, see Chapter 13.

Enter the data exactly as described for a [one-analysis of variance](#).

Follow the menus Stat / ANOVA / One-Way ...

Complete the boxes for Response and Factor as for [one-way analysis of variance](#).

Click on the 'Comparisons ...' button and select 'Tukey's family error rate:'.

The output will then be as with the ANOVA alone, but with the following additional material (See next page):

Tukey 95% Simultaneous Confidence Intervals  
 All Pairwise Comparisons among Levels of Catalyst

Individual confidence level = 99.28%

Catalyst = Ir subtracted from:

Catalyst	Lower	Center	Upper	
Pd	3.6419	5.5000	7.3581	(---*---)
Pd/Ir	-0.0781	1.7800	3.6381	(---*---)
Pt	-3.0381	-1.1800	0.6781	(---*---)
Rh	-2.5981	-0.7400	1.1181	(---*---)

-5.0      0.0      5.0      10.0

Catalyst = Pd subtracted from:

Catalyst	Lower	Center	Upper	
Pd/Ir	-5.5781	-3.7200	-1.8619	(---*---)
Pt	-8.5381	-6.6800	-4.8219	(---*---)
Rh	-8.0981	-6.2400	-4.3819	(---*---)

-5.0      0.0      5.0      10.0

Catalyst = Pd/Ir subtracted from:

Catalyst	Lower	Center	Upper	
Pt	-4.8181	-2.9600	-1.1019	(---*---)
Rh	-4.3781	-2.5200	-0.6619	(---*---)

-5.0      0.0      5.0      10.0

Catalyst = Pt subtracted from:

Catalyst	Lower	Center	Upper	
Rh	-1.4181	0.4400	2.2981	(---*---)

-5.0      0.0      5.0      10.0

Then first block of output (Yellow background) contrasts Iridium with the other four catalysts. Results are presented both numerically and diagrammatically. The results refer to the difference between each pair of catalysts.

The lines ...

Catalyst	Lower	Center	Upper
Pd	3.6419	5.5000	7.3581

tell us that when Iridium is compared to Palladium the confidence interval for the difference between them has Lower and Upper limits of +3.6419 and +7.3581 percentage points. As this range excludes zero, the contrast is significant. Reading further along that line, there is a representation of the confidence interval that can again be seen not to include zero. The next three lines of this block of output compares Iridium against the Palladium/Iridium alloy, Platinum and Rhodium. None of these contrasts is significant.

The following three blocks of output (Blue, grey and green backgrounds) show contrasts versus Palladium, Palladium/Iridium alloy and Platinum.

See Chapter 13 for detailed interpretation of the results.