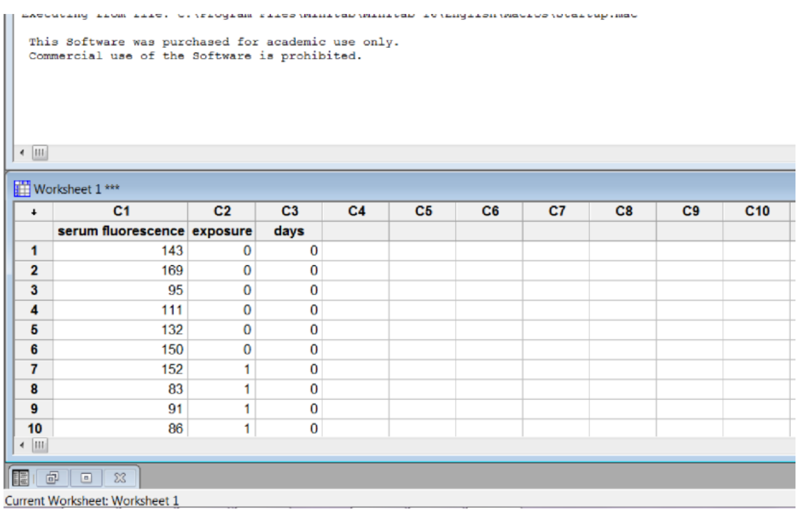
Minitab Tutorial for Factorial design (CRD-ab)

For this experiment we will have a 2 factor factorial design with each factor having 2 levels..

<u>Problem description</u>

Nitrogen dioxide (NO2) is an automobile emission pollutant, but less is known about its effects than those of other pollutants, such as particulate matter. Several animal models have been studied to gain an understanding of the effects of NO2. Sherwin and Layfield (1976) studied protein leakage in the lungs of mice exposed to 0.5 part per million (ppm) NO2 for 10, 12, and 14 days. Half of a total group of 36 animals were exposed to the NO2; the other half served as controls. Control and experimental animals were matched on the basis of weight, but this aspect will be ignored in the analysis since the matching did not appear to influence the results. The response is the percent of serum fluorescence. High serum fluorescence values indicate a greater protein leakage and some kind of insult to the lung tissue.

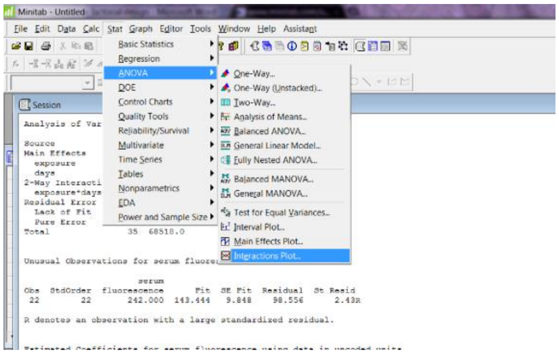
	Serum fluorescence		
	10 Days	12 Days	14 days
Control	143	179	76
	169	160	40
	95	87	119
	111	115	72
	132	171	163
	150	146	78
Exposed	152	141	119
	83	132	104
	91	201	125
	86	242	147
	150	209	200
	108	114	178



↓	C1 serum fluorescence	C2 exposure	C3 days	C4	C5	C6	C7	C8	C9	C10
1	143	0	0							
2	169	0	0							
3	95	0	0							
4	111	0	0							
5	132	0	0							
6	150	0	0							
7	152	1	0							
8	83	1	0							
9	91	1	0							
10	86	1	0							

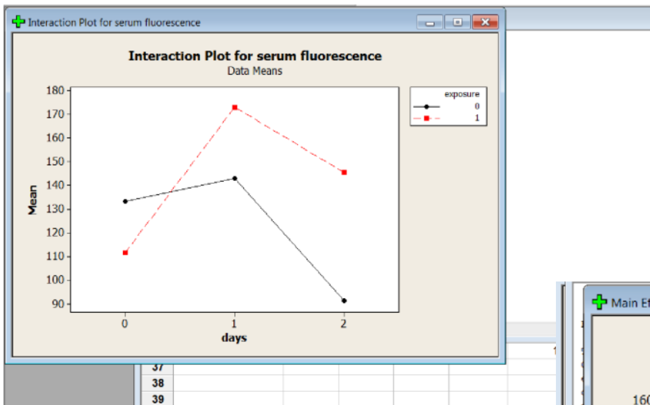
In Minitab, the data should be entered the following manner.

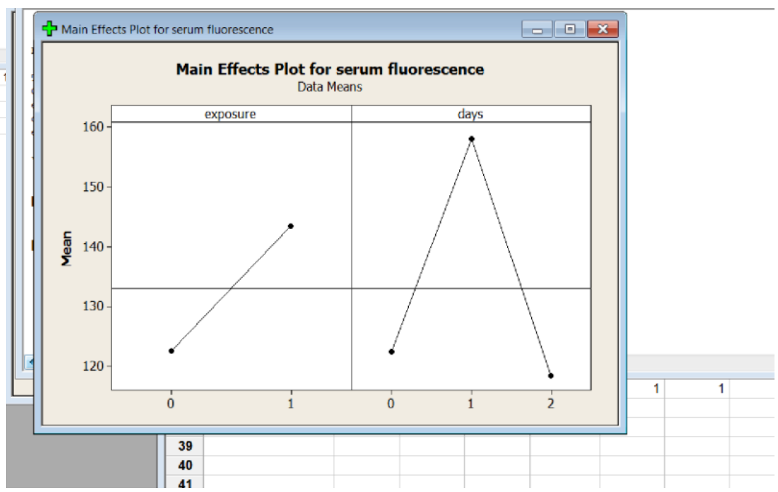
Here, 0 marks control, 1 marks exposed. 0 marks 10 days, 1 marks 12 days, 2 marks 14 days.



<u>Plots</u>

1. Interaction plot
   - **a. Stat ➤ ANOVA ➤ Interaction plots**
   - b. Select response variable, **serum florescence** and factors, **days** and **exposure**
   - c. Select OK
2. Main Effect plots
   - a. **Stat ➤ ANOVA ➤ Main effect plots**
   - b. Select response variable, **serum florescence** and factor, whichever one you wish to create a plot for. You can select both **exposure** and **days**.
   - c. Select OK





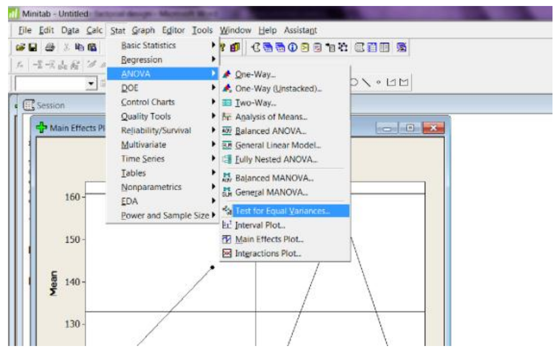
<u>Homogeniety of Variance test</u>

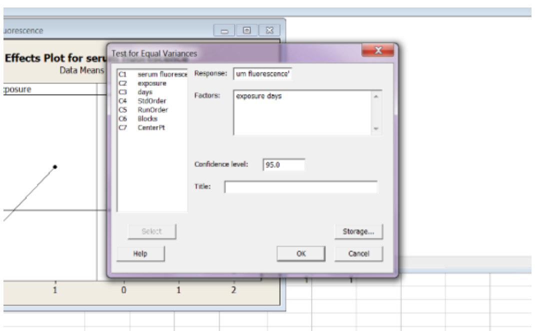
Besides the usual descriptive statistics you will see output for Levene's test of equal variance. Without going into the details of the test it checks the null hypothesis of equal variances using F test.

$$H_o : \sigma_1^2 = \sigma_2^2 = \sigma_3^2 = \sigma_4^2$$

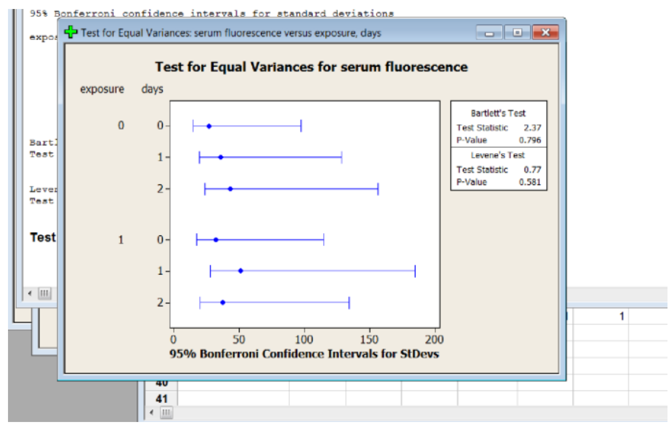
H_A : At least one variance is different

1. Select **Stat ➤ ANOVA ➤ Test for Equal Variances**
2. Again, select variables. The response variable is **serum florescence** and the factors are **exposure** and **days.**





3. Select OK



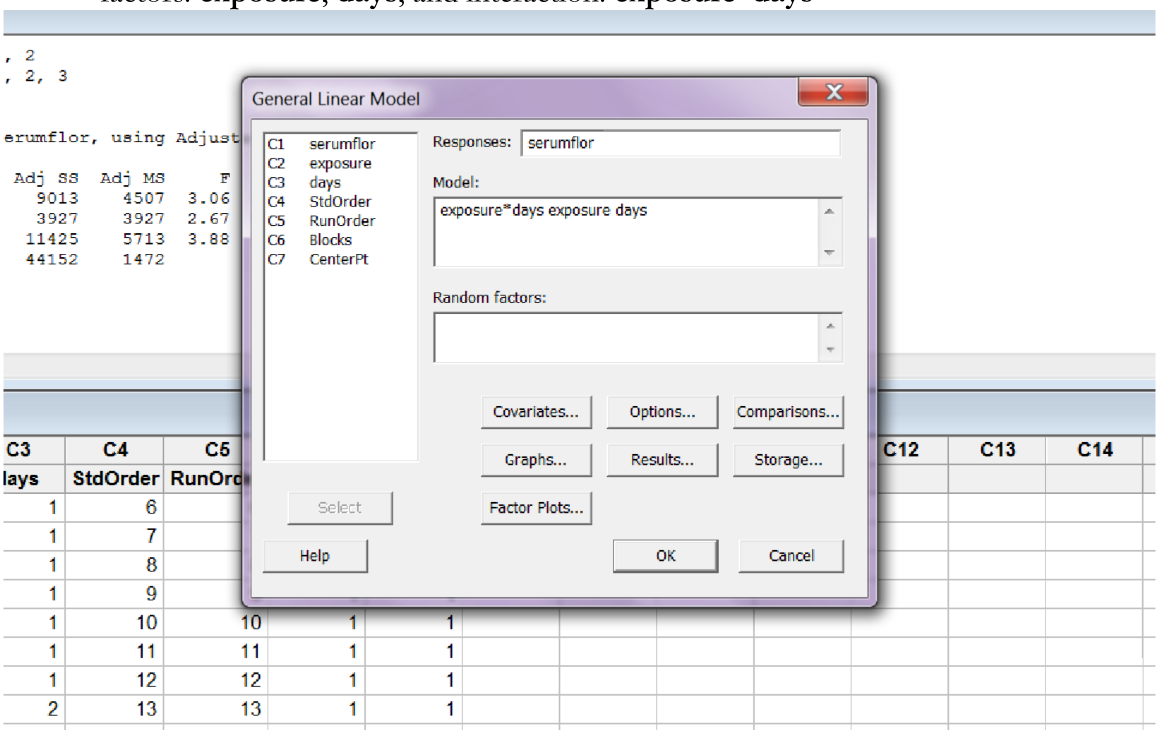
Interpreting the results:

The output provides a p value. Recall, we reject the null hypothesis when p < .05. In this case, p = 796 which is larger than alpha = 05. This means we fail to reject the null and can assume equal variances.

Analysis of Factorial Design

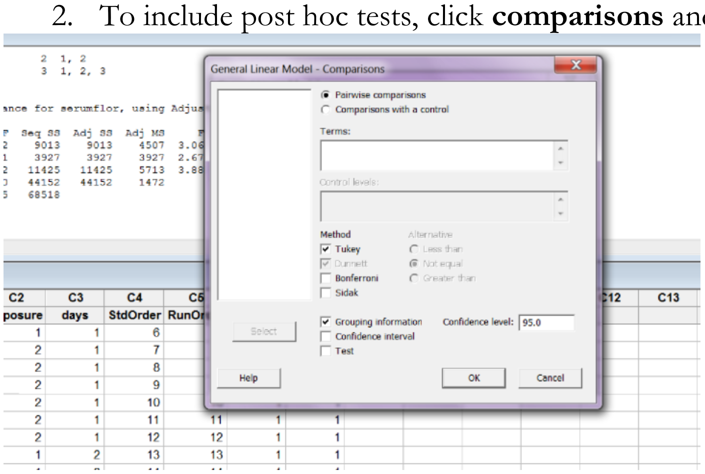
In Minitab, to analyze a factorial design you have to first create a factorial desing. To do this, you go to **Stat ➤ ANOVA ➤ General Linear Model**

1. Select appropriate variables. Response: **serumflor** (renamed **serum florescence**), factors: **exposure**, **days**, and interaction: **exposure*days**

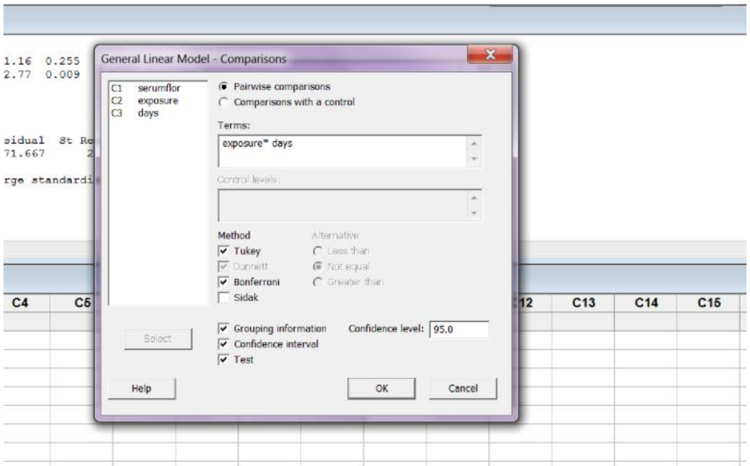


Because you are also interested in the interaction between exposure and days, make sure to put exposure*days in as a factor.

2. To include post hoc tests, click **comparisons** and select **Tukeys**

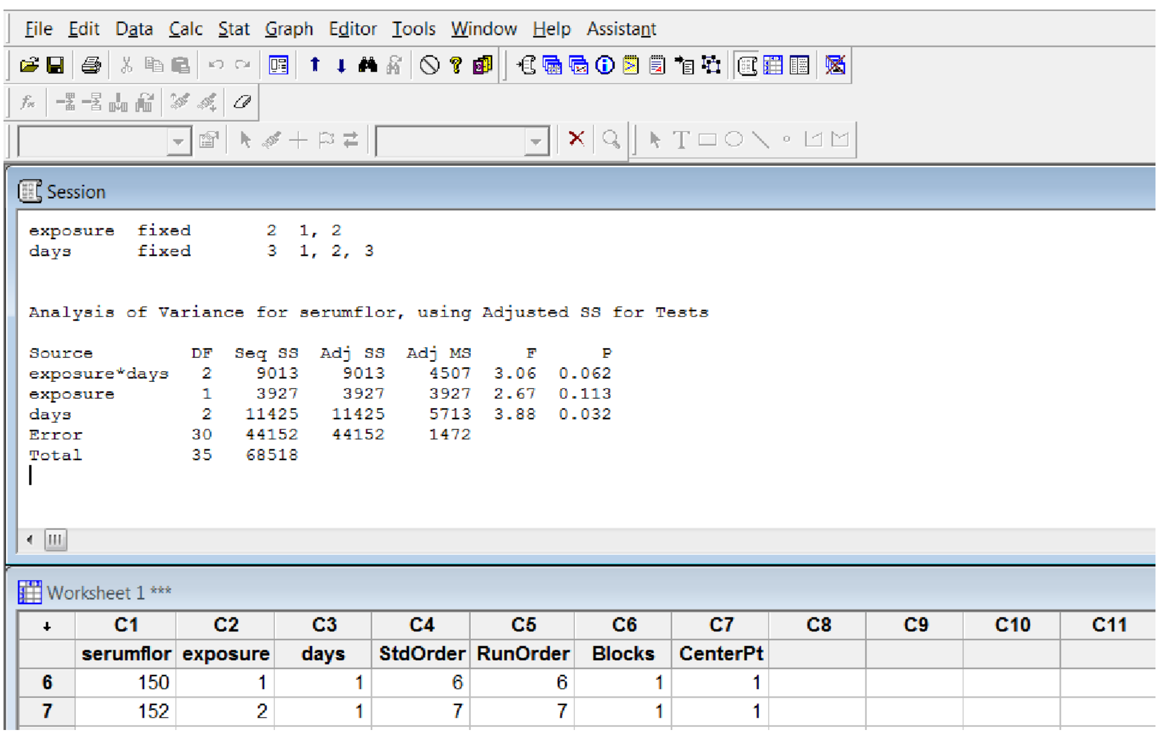


3. Select appropriate “terms” – in this case, the interaction of **exposure*days**



4. NOTE: You can include Bonferroni as well. Then select OK

5. For results, look at the portion of the output titled Analysis of Variance for serum florescence.



To interpret the results, first consider the interaction effect of exposure*days. The p value of the interaction is 032, which is less than alpha = 05 meaning the interaction of exposure * days is significant. This means that both factors should remain in the design.

Post hoc results are also given: