Analysis of Variance

ANOVA

F-Test

Analysis of Variance

- Data sets are often succinctly described by giving their Mean (for a description of the center) and Standard Deviation (to describe the variation)
- Variance is the square of the Standard Deviation
- The **F-test** is used to determine if there is a Statistically Significant difference among three or more Means

Analysis of Variance

- ANOVA test is used to test the difference of means among three or more independent normally distributed samples

- **Example**
  - There are three types of training given to our workers. Do they result in different effects on worker performance?

Analysis of Variance

Criteria for using the ANOVA test

- Normally distributed quantitative samples
- The groups have assumed equal variances
- Testing the difference among three or more means

$$F = \frac{MST}{MSE}$$

= **F score**

Analysis of Variance

Null Hypothesis: There is No difference among different means

Alternative Hypothesis: At least one mean differs from the rest of other means

Analysis of Variance

There are 3 types of ANOVA

- **1-Way Single Factor**
- 2-Way without Replication
- 2-Way with Replication

Analysis of Variance

A researcher wishes to try **three different techniques** *to lower blood pressure of individuals diagnosed with high blood pressure*. The subjects are randomly assigned to three groups; the first group takes **medication**, the second group **exercises**, and the third group follows **a special diet**.

After four weeks, the reduction in each person's blood pressure is recorded.

Analysis of Variance

Medication	Exercise	Diet
10	6	5
12	8	9
9	3	12
15	0	8
13	2	4

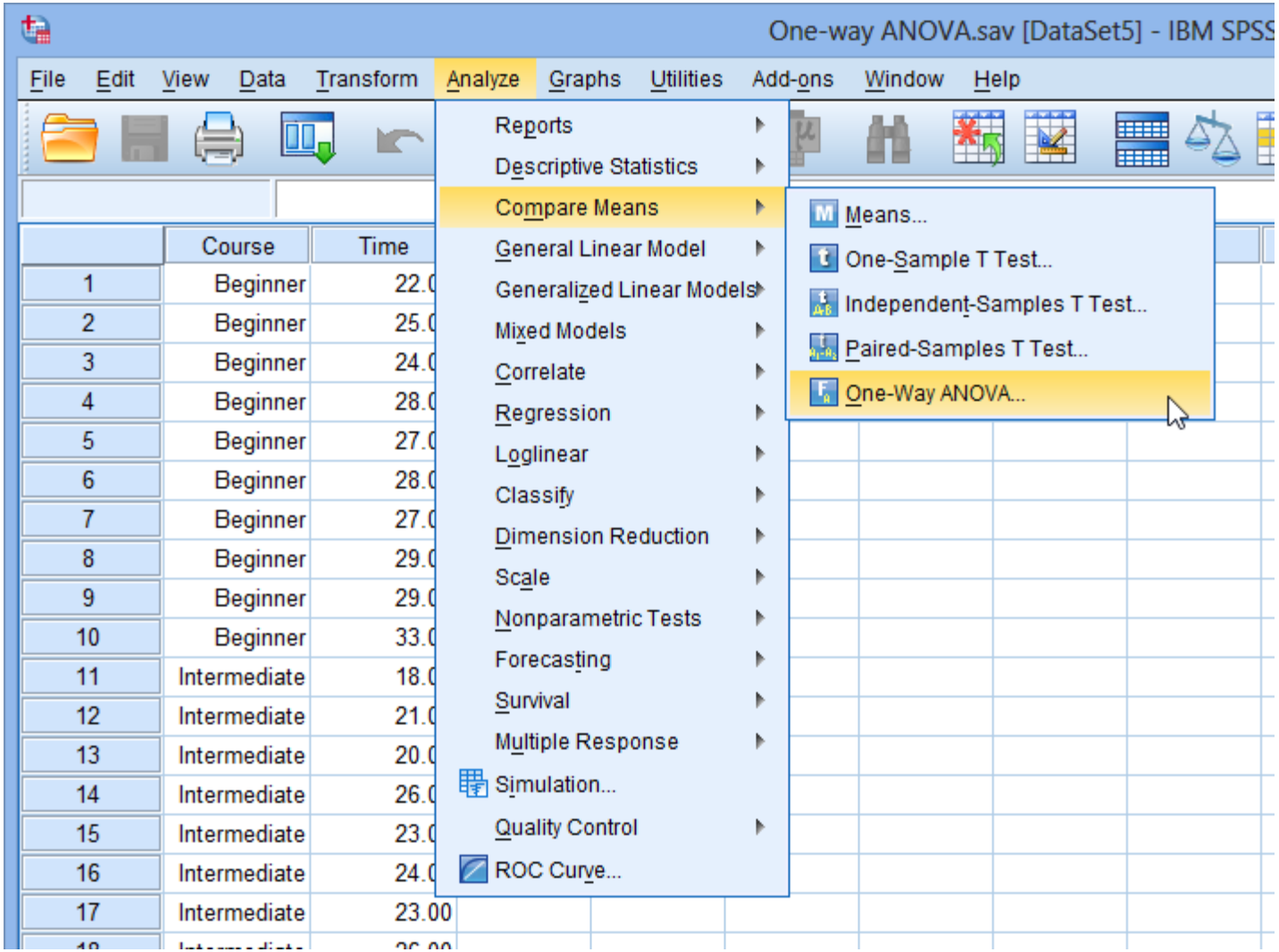
Analysis of Variance

Post-hoc Test

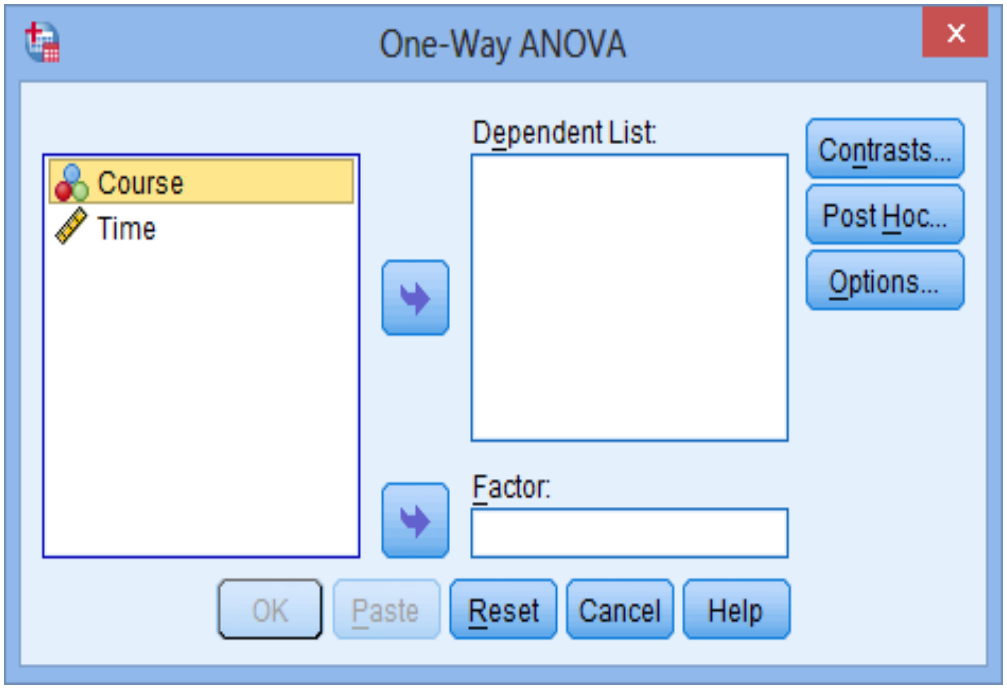
Post hoc tests are designed for situations in which the researcher has already obtained a significant F-test with a factor that consists of three or more means and additional exploration of the differences among means is needed to provide specific information on which means are significantly different from each other

Least Square Difference (LSD)

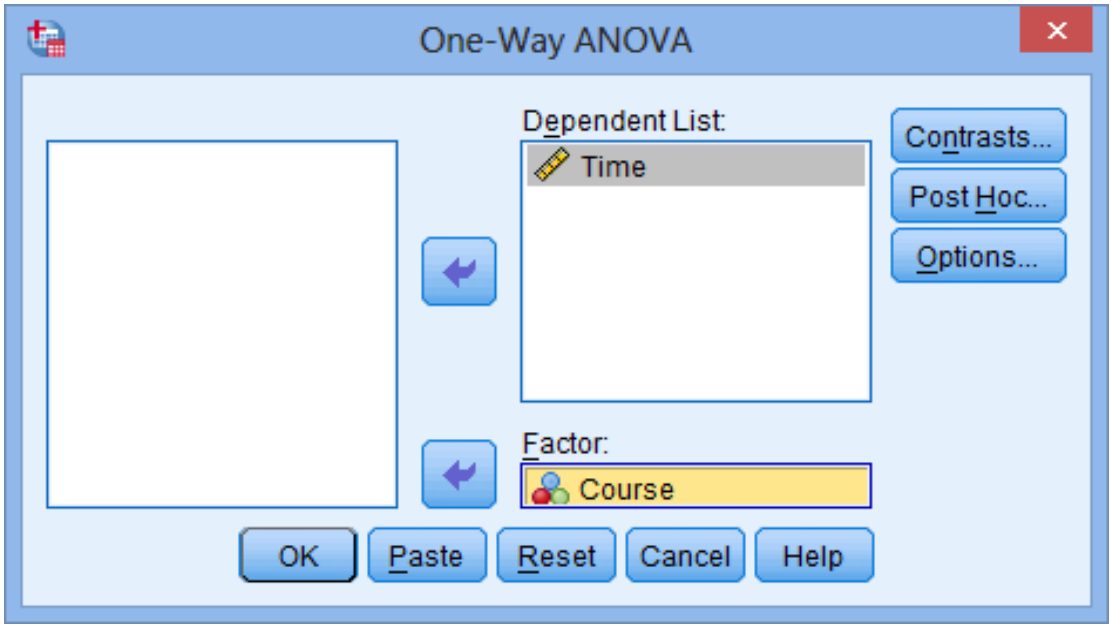
Analysis of Variance



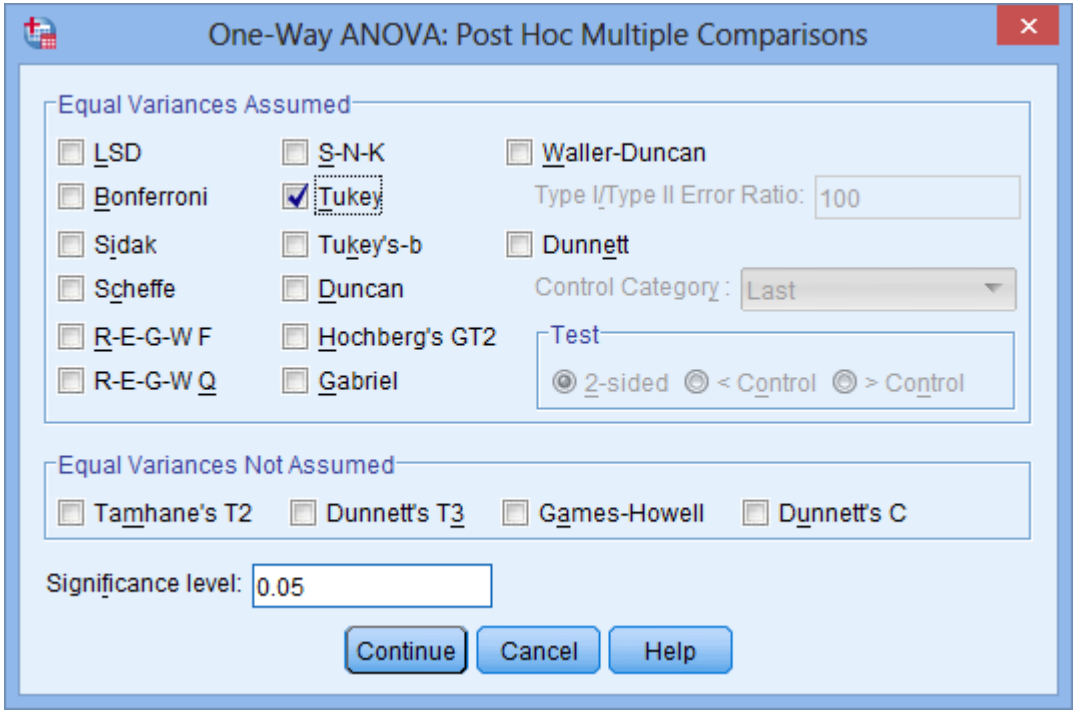
Analysis of Variance



Analysis of Variance



Analysis of Variance



You are planning an experiment that will involve 4 equally sized groups, including 3 experimental groups and a control. Each group will contain (n) observations.

Your expectation is that each of the 3 experimental treatments will have approximately the same effect, and that this effect will be small over the control

	Control	Exp1	Exp2	Exp3
1	118	107	133	134
2	121	165	154	176
3	97	121	91	171
4	86	126	63	159
5	118	87	62	118
6	45	135	164	125
7	119	83	96	100
8	92	100	129	60
9	91	144	128	163
10	72	119	105	111