

ANOVA

ANalysis Of VAriance

ANOVA

- ▶ ANOVA is a statistical method used to compare the means of 2 or more groups
- ▶ t-test can be used to compare 2 groups

ANOVA Hypotheses

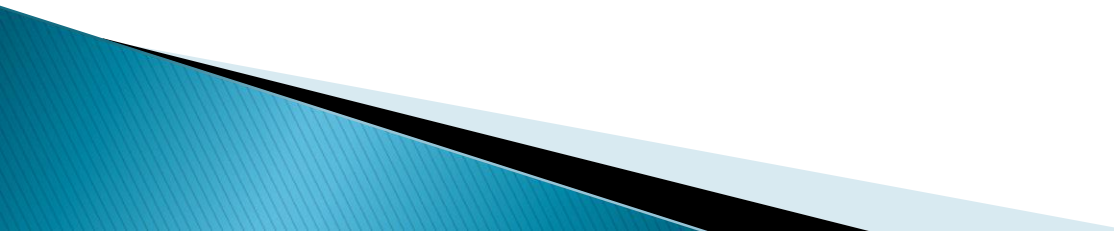
- ▶ *Null hypothesis*: Groups means are equal (no variation in means of groups)

$$H_0: \mu_1 = \mu_2 = \dots = \mu_p$$

- ▶ *Alternative hypothesis*: At least, one group mean is different from other groups

$$H_1: \text{All } \mu \text{ are not equal}$$

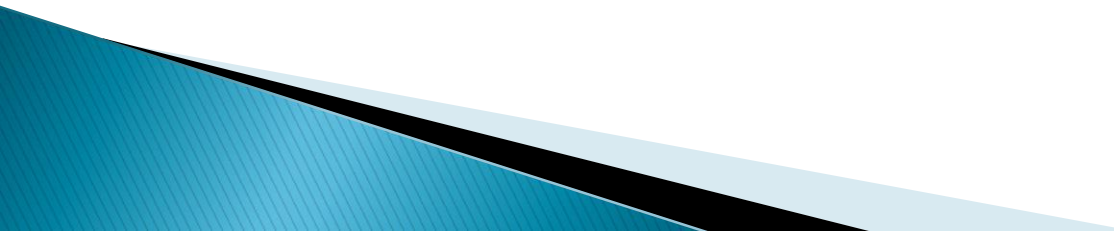

Assumptions

- ▶ The observations are obtained independently and randomly from the population defined by the factor levels
 - ▶ The data for each factor level is normally distributed
 - ▶ Independence of cases: the sample cases should be independent of each other
 - ▶ Homogeneity of variance: Homogeneity means that the variance among the groups should be approximately equal
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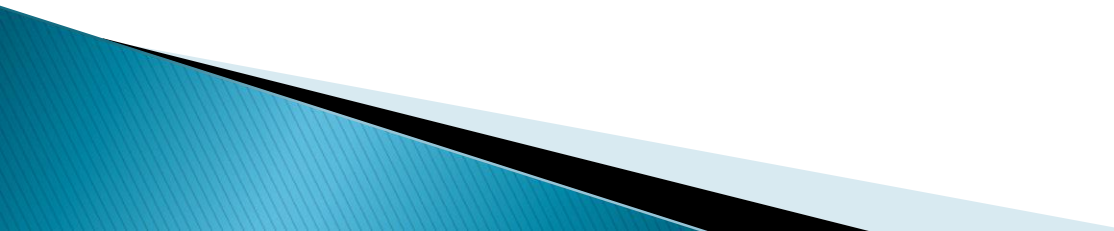
Types of ANOVA



One Way Anova

- ▶ One-way ANOVA is generally the most used method of performing the ANOVA test. It is also referred to as one-factor ANOVA, between-subjects ANOVA, and an independent factor ANOVA.
 - ▶ It is used to compare the means of two independent groups using the F-distribution.
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Two-way ANOVA

- ▶ Two-way ANOVA is carried out when you have two independent variables. It is an extension of one-way ANOVA.
 - ▶ You can use the two-way ANOVA test when your experiment has a quantitative outcome and there are two independent variables.
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Two-way ANOVA

- ▶ **Two-way ANOVA with replication**

- ▶ It is performed when there are two groups and the members of these groups are doing more than one thing

- ▶ **Two-way ANOVA without replication**

- ▶ This is used when you have only one group but you are double-testing that group.

N-Way ANOVA


- ▶ A researcher can also use more than two independent variables, and this is an n-way ANOVA (with n being the number of independent variables you have), aka MANOVA Test.

Advantages of MANOVA vs. ANOVA

Multiple Dependent Variables

- ▶ The MANOVA can measure multiple dependent variables, while the ANOVA only allows for one

Simultaneous testing

- ▶ Because the MANOVA tests multiple dependent variables at once, you're testing the effects of the independent variables simultaneously.
 - ▶ Running multiple ANOVA tests on each variable not only takes more time, but increases the risk of type I statistical errors.
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Disadvantages of MANOVA vs. ANOVA

- ▶ The test is more complex to run than a single ANOVA, and your results can be more ambiguous
- ▶ One degree of freedom is lost with the addition of each new variable.