Analysis of Variance (ANOVA)

BUS 735: Business Decision Making and Research

1

1.1 Goals

Goals

- Specific goals:

  - Learn how to compare means and medians among more than two groups.

- Learning objectives:

  - LO1: Be able to construct and test hypotheses using a variety of bivariate statistical methods to compare characteristics between two populations.

  - LO3: Be able to construct and use analysis of variance and analysis of covariance models to construct and test hypotheses considering complex relationships among multiple variables.

  - LO6: Be able to use standard computer packages such as R to conduct the quantitative analyses described in the learning objectives above.

2 One-Way Analysis of Variance

2.1 Variance Decomposition

One-Way ANOVA

- Testing for differences among means: two or more groups

- Extension of independent samples t-test for differences in means

- Uses measures of *variance* to measure for differences in *means*.

- Variance Decomposition:

  - **Among-group variation**: variability due to differences among groups, aka **explained** variation.

– **Within-group variation**: variability within each of the groups, aka **unexplained** variation.

2.2 Assumptions

Assumptions behind One-way ANOVA F-test

- Randomness: random assignment to groups independently of the outcome

- Independence: individuals in each group are independent from individuals other groups

- Sufficiently large (?) sample size, or else population has normal distribution.

- Homogeneity of variance: the variances of each of the K groups must be equal ($\sigma_1^2 = \sigma_2^2 = ...\sigma_K^2$).

3 Kruskal-Wallis Test: Non-parametric Test

3.1 Non-parametric "ANOVA"

Non-parametric One-way ANOVA

- Kruskal-Wallis Rank Test: non-parametric technique for differences in the *medians* among two or more groups

- Like Mann-Whitney U-test: uses ranks

- Null hypothesis: All groups have the same center of distribution

- Alternative hypothesis: At least one of the groups has a different center of distribution

3.2 Assumptions

Assumptions for Kruskal-Wallis Test

- Random assignment: random assignment to groups is independent of the outcome variable

- Independence: individuals in each group are independent from individuals in another group

- Only the location (i.e. the center) of the distributions differ among the groups, distributions otherwise have the same shape