

Chapter 11 ANOVA (Analysis of Variance)

- 1) Application of ANOVA: it applies to bivariate statistics when the independent variable is discrete with more than 2 groups (3, 4, 5....) and the dependent variable is interval/ratio
- 2) ANOVA includes both the measure of strength (eta-square) and the measure of significance (F ratio)
- 3) ANOVA processes
 - A) Null hypothesis: independent variable has nothing to do with the dependent variable
 - B) Calculating all the means

$$\bar{X}_T = \frac{\sum X_i}{N}$$

$$\bar{X}_G = \frac{\sum X_i \text{ for that group}}{N \text{ for that group}}$$

C) Calculating the total sum of square

$$\text{Total sum of square } (SS_{Total}) = \sum (X_i - \bar{X}_T)^2$$

D) Calculating the between sum of square

$$\text{Total sum of square } (SS_{Between}) = \sum (\bar{X}_G - \bar{X}_T)^2 \times N_G$$

E) Because of the decomposition

$$\sum (X_i - \bar{X}_T)^2 = \sum (\bar{X}_G - \bar{X}_T)^2 \times N_G + \sum (X_i - \bar{X}_G)^2$$

$$\sum (X_i - \bar{X}_G)^2 = \sum (X_i - \bar{X}_T)^2 - \sum (\bar{X}_G - \bar{X}_T)^2$$

$\sum (X_i - \bar{X}_G)^2$ is called within sum of square: SS_{within}

F) Calculating degree of freedom (df)

$$df_{between} = k - 1 \quad k: \text{the total number of groups in the independent variable}$$

$$df_{within} = N - k \quad N: \text{the total number of cases in the sample}$$

G) Calculating the mean sum of square (MSS)

$$\text{MSS for between: } MSS_{between} = \frac{SS_{between}}{(k-1)}$$

$$\text{MSS for within: } MSS_{within} = \frac{SS_{within}}{(N-k)}$$

H) calculating the f ratio

$$F_{df_{between}, df_{within}} = \frac{MSS_{between}}{MSS_{within}}$$

I) determine the p value

J) decision regarding the null hypothesis, type of error committed

K) calculating the eta-square (E^2)

$$E^2 = \frac{SS_{between}}{SS_{total}}$$

L) interpret the eta-square

Eta-square is PRE: knowing independent variable reduces errors in estimating the value of dependent variable by X%,

$$0 \leq E^2 \leq 1 \text{ or } 100\%$$

4) ANOVA table

ANOVA TABLE

	Sum of square	df	MSS	f	p	Eta-square
Between	$\sum (\bar{X}_G - \bar{X}_T)^2 \times N_G$	$K - 1$	$\frac{SS_{between}}{(k - 1)}$	$\frac{MSS_{between}}{MSS_{within}}$		$\frac{SS_{between}}{SS_{total}}$
Within	$SS_{Total} - SS_{between}$	$N - K$	$\frac{SS_{within}}{(N - k)}$			
total	$\sum (X_i - \bar{X}_T)^2$					