Research Methods

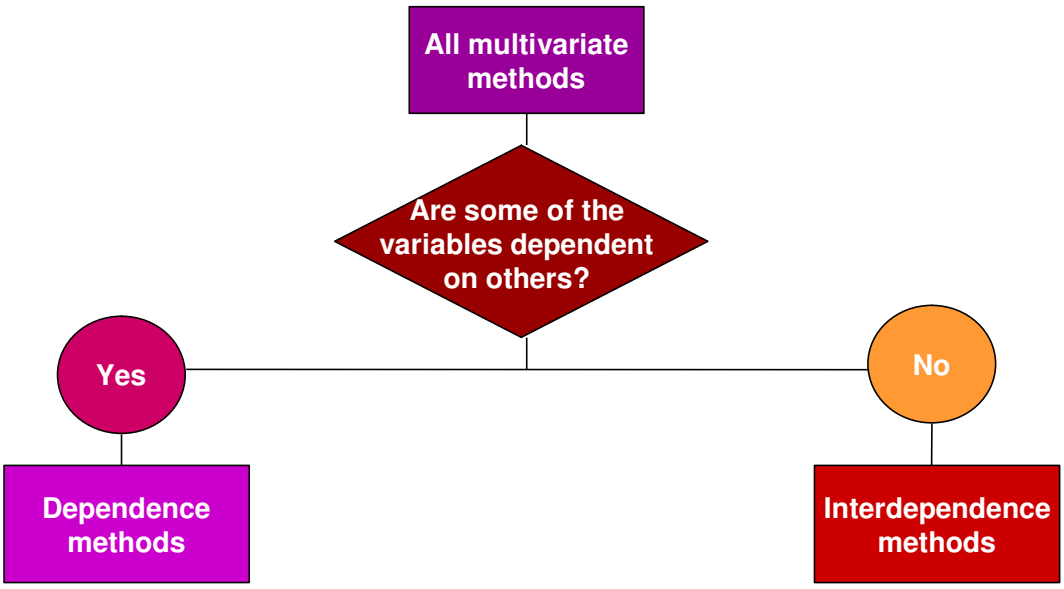
William G. Zikmund

Multivariate Analysis

Multivariate Statistical Analysis

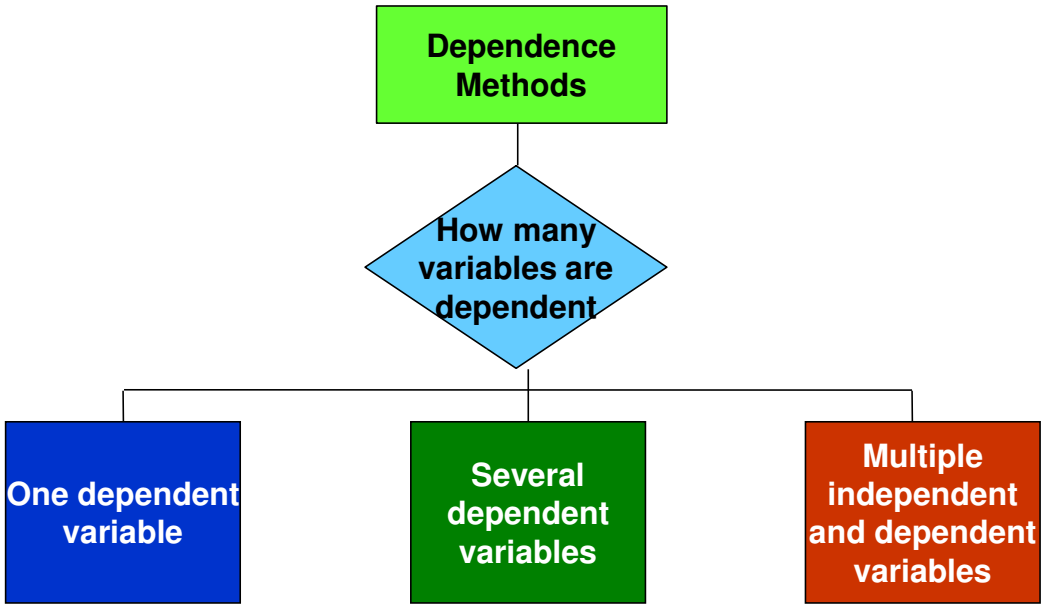
- Statistical methods that allow the simultaneous investigation of more than two variables

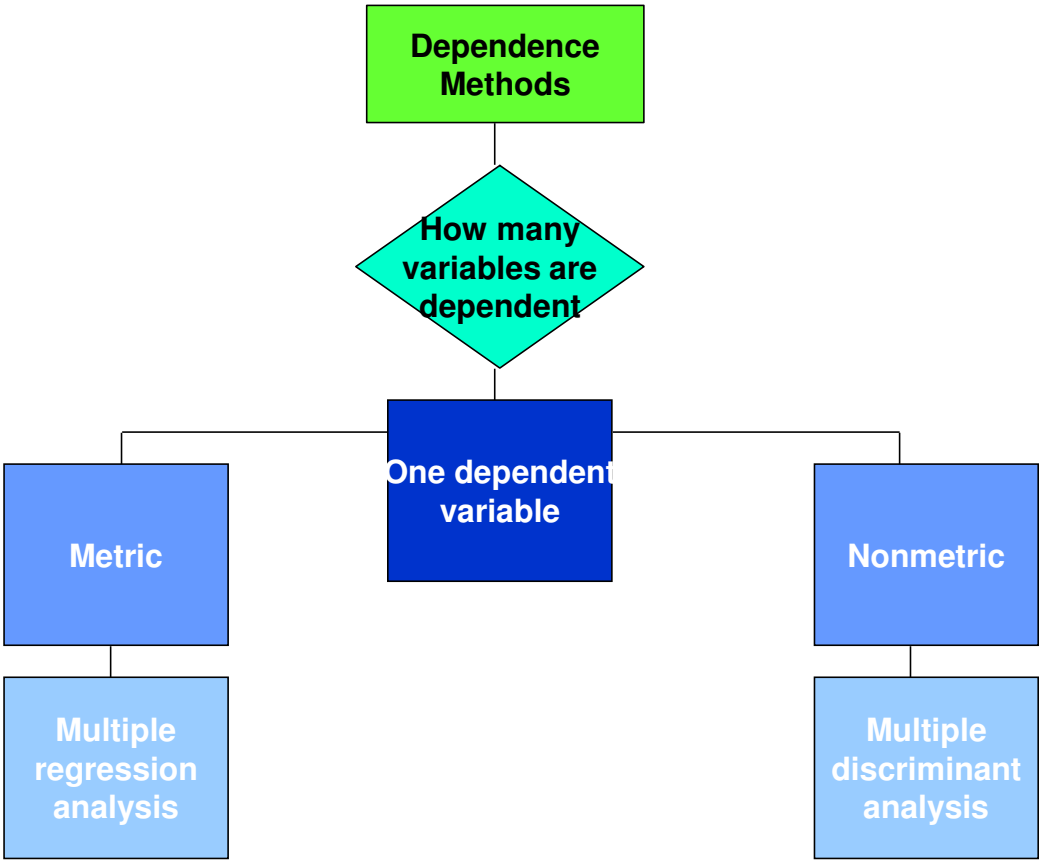
A Classification of Selected Multivariate Methods

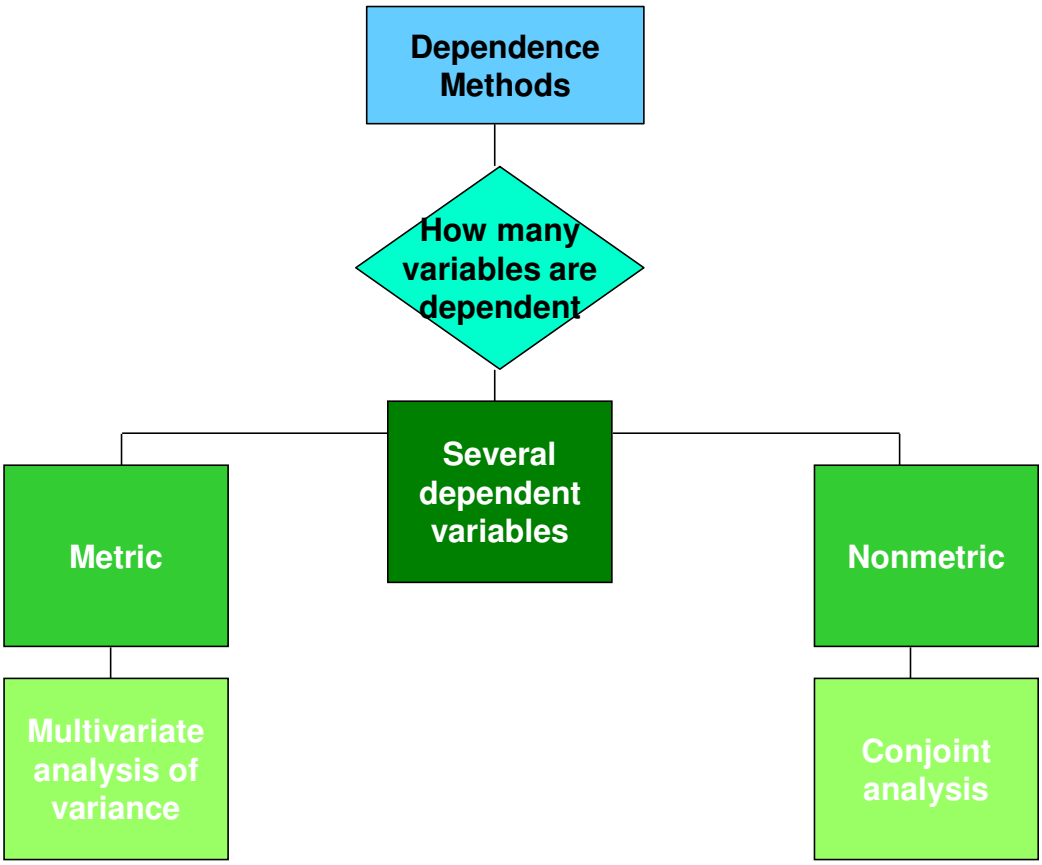


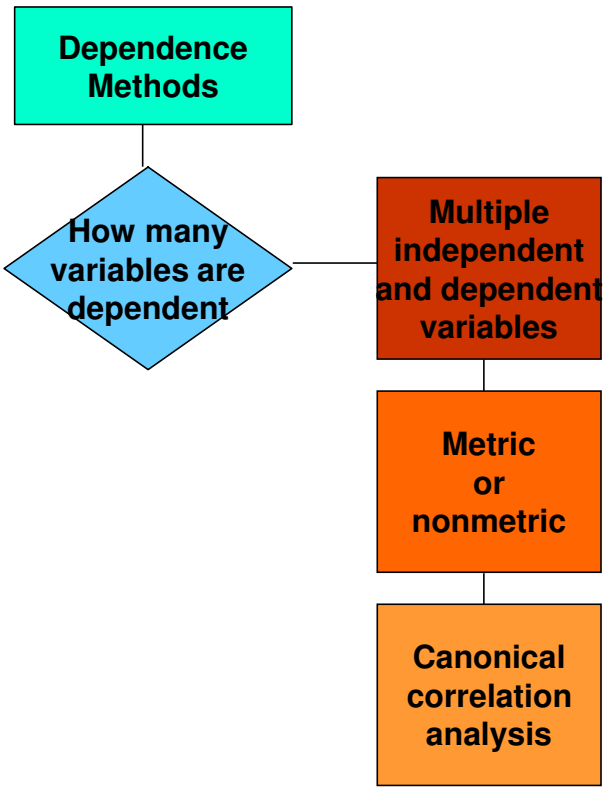
Dependence Methods

- A category of multivariate statistical techniques; dependence methods explain or predict a dependent variable(s) on the basis of two or more independent variables


Dependence Methods
How many variables are dependent
One dependent variable
Several dependent variables
Multiple independent and dependent variables

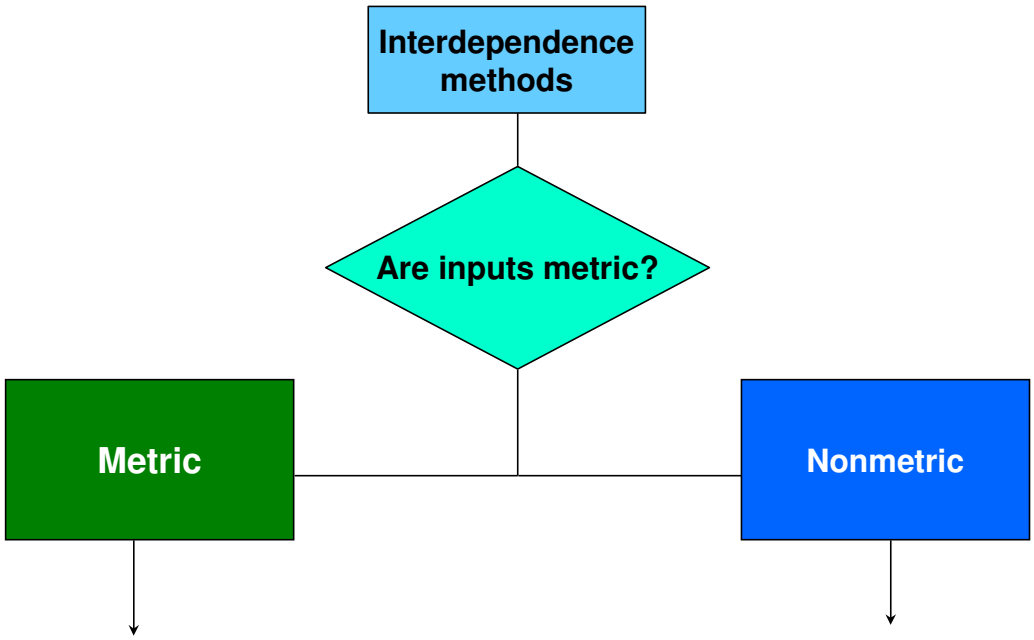

Dependence Methods
How many variables are dependent
One dependent variable
Metric
Nonmetric
Multiple regression analysis
Multiple discriminant analysis

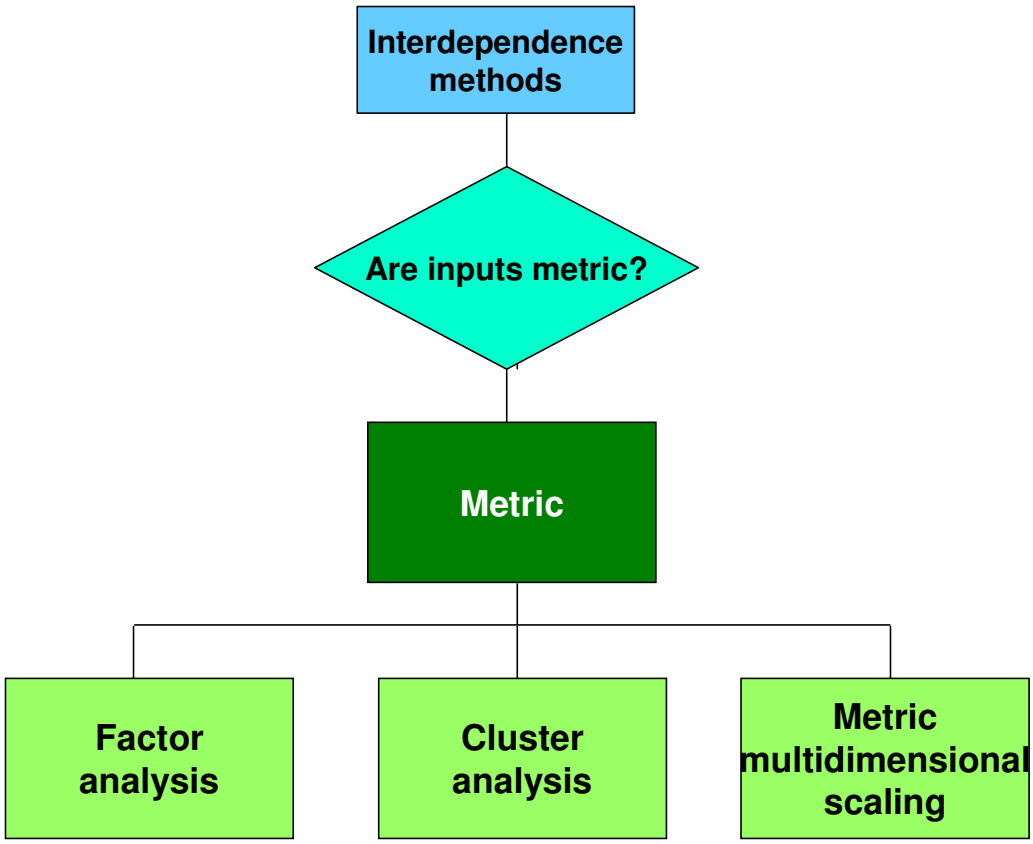

Dependence Methods
How many variables are dependent
Several dependent variables
Metric
Nonmetric
Multivariate analysis of variance
Conjoint analysis

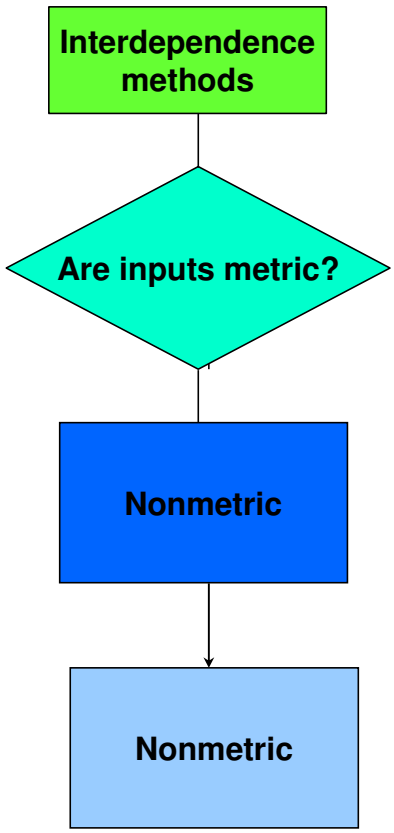

Dependence Methods
How many variables are dependent
Multiple independent and dependent variables
Metric or nonmetric
Canonical correlation analysis

Interdependence Methods

- A category of multivariate statistical techniques; interdependence methods give meaning to a set of variables or seek to group things together




Interdependence methods
Are inputs metric?
Metric
Factor analysis
Cluster analysis
Metric multidimensional scaling


Interdependence methods
Are inputs metric?
Nonmetric
Nonmetric

Multiple Regression

- An extension of bivariate regression
- Allows for the simultaneous investigation
  - two or more independent variables
  - a single interval-scaled dependent variable

Multiple Regression Equation

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 ... + \beta_n X_n$$

Multiple Regression Analysis

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_n X_n$$

Coefficients of Partial Regression

β_1

Independent variables correlated with one another

The % of the variance in the dependent variable that is explained by a single independent variable, holding other independent variables constant

Coefficient of Multiple Determination

- R^2
- The % of the variance in the dependent variable that is explained by the variation in the independent variables.

Statistical Results of a Multiple Regression

- $Y = 102.18 + .387X_1 + 115.2X_2 + 6.73X_3$
- Coefficient of multiple determination (R^2) .845
- F-value 14.6

F-Test

$$F = \frac{(SSr)/k}{(SSe)/(n-k-1)}$$

Degrees of Freedom (d.f.) are Calculated as Follows:

- d.f. for the numerator = k
- for the denominator = n - k - 1

Degrees of Freedom

- k = number of independent variables
- n = number of observations or respondents

F-test

$$F = \frac{(SSr)/k}{(SSe)/(n-k-1)}$$

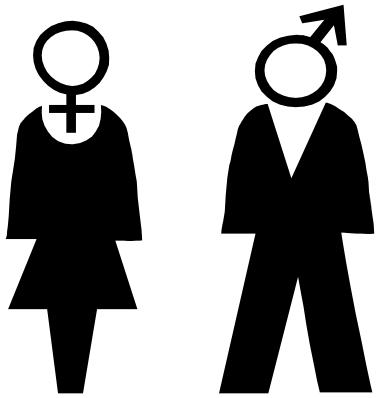
where

k = number of independent variables

n = number of observations

Multiple Discriminant Analysis

- A statistical technique for predicting the probability of objects belonging in two or more mutually exclusive categories (dependent variable) based on several independent variables



$$Z_i = b_1X_{1i} + b_2X_{2i} + \ldots + b_nX_{ni}$$

- where
- Z_i = ith applicant's discriminant score
- b_n = discriminant coefficient for the nth variable
- X_{ni} = applicant's value on the nth independent variable

Discriminant Analysis

$$Z_i = b_1 X_{1i} + b_2 X_{2i} + \ldots\ldots\ldots + b_n X_{ni}$$

Discriminant Analysis

X_{ji} = applicant's value on the jth independent variable

b_j = discriminant coefficient for the j^{th} variable

Z_i = i^{th} applicant's discriminant score

Canonical Correlation

- Two or more criterion variables (dependent variables)
- Multiple predictor variables (independent variables)
- An extension of multiple regression
- Linear association between two sets of variables

Canonical Correlation

- $Z = a_1X_1 + a_2X_2 + \ldots + a_nX_n$
- $W = b_1Y_1 + b_2Y_2 + \ldots + b_nY_n$

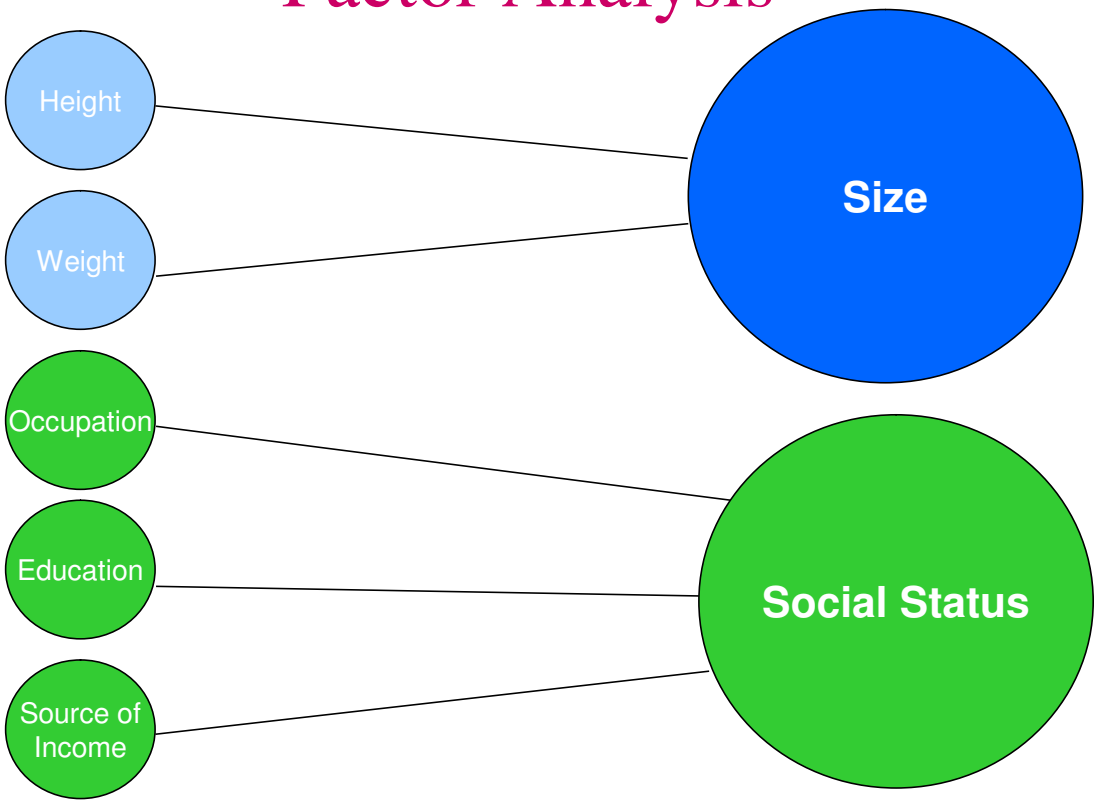
Factor Analysis

- Summarize the information in a large number of variables
- Into a smaller number of factors
- Several factor-analytical techniques

Factor Analysis

- A type of analysis used to discern the underlying dimensions or regularity in phenomena. Its general purpose is to summarize the information contained in a large number of variables into a smaller number of factors.

Factor Analysis



Cluster Analysis

- A body of techniques with the purpose of classifying individuals or objects into a small number of mutually exclusive groups, ensuring that there will be as much likeness within groups and as much difference among groups as possible

Multidimensional Scaling

- A statistical technique that measures objects in multidimensional space on the basis of respondents' judgments of the similarity of objects

Multivariate Analysis of Variance (MANOVA)

- A statistical technique that provides a simultaneous significance test of mean difference between groups for two or more dependent variables