Multivariate Analysis of Covariance (MANCOVA)

Multivariate analysis of covariance (MANCOVA) is a statistical technique that is the extension of analysis of covariance (ANCOVA). Basically, it is the multivariate analysis of variance (MANOVA) with a covariate(s). In MANCOVA, we assess for statistical differences on multiple continuous dependent variables by an independent grouping variable, while controlling for a third variable called the covariate; multiple covariates can be used, depending on the sample size. Covariates are added so that it can reduce error terms and so that the analysis eliminates the covariates’ effect on the relationship between the independent grouping variable and the continuous dependent variables.

Questions answered:

Do the various school assessments vary by grade level after controlling for gender?

Do the rates of graduation among certain state universities differ by degree type after controlling for tuition costs?

Which diseases are better treated, if at all, by either X drug or Y drug after controlling for length of disease and participant age?

Assumptions:

In multivariate analysis of covariance (MANCOVA), all assumptions are the same as in MANOVA, but one more additional assumption is related to covariate:

1. **Independent Random Sampling**: MANCOVA assumes that the observations are independent of one another, there is not any pattern for the selection of the sample, and that the sample is completely random.
2. **Level and Measurement of the Variables**: MANCOVA assumes that the independent variables are categorical and the dependent variables are continuous or scale variables. Covariates can be either continuous, ordinal, or dichotomous.
3. **Absence of multicollinearity**: The dependent variables cannot be too correlated to each other. Tabachnick & Fidell (2012) suggest that no correlation should be above $r = .90$.
4. **Normality**: Multivariate normality is present in the data.
5. **Homogeneity of Variance**: Variance between groups is equal.
6. **Relationship between covariate(s) and dependent variables**: in choosing what covariates to use, it is common practice to assess if a statistical relationship exists between the covariate(s) and the dependent variables; this can be done through correlation analyses.

Key concepts and terms:
• **Levene's Test of Equality of Variance**: Used to examine whether or not the variance between independent variable groups are equal; also known as homogeneity of variance. Non-significant values of Levene’s test indicate equal variance between groups.

• **Box’s M Test**: Used to know the equality of covariance between the groups. This is the equivalent of a multivariate homogeneity of variance. Usually, significance for this test is determined at \( ? = .001 \) because this test is considered highly sensitive.

• **Partial eta square**: Partial eta square \((?^2)\) shows how much variance is explained by the independent variable. It is used as the effect size for the MANOVA model.

• **Post hoc test**: If there is a significant difference between groups, then post hoc tests are performed to determine where the significant differences lie (i.e., which specific independent variable level significantly differs from another).

• **Multivariate F-statistics**: The \(F\) statistic is derived by essentially dividing the means sum of the square \((SS)\) for the source variable by the source variable mean error \((ME \text{ or } MSE)\).

• **Covariate**: A Covariate is basically a control variable, which is uncorrelated with the independent variables and correlated with the dependent variables. Covariates are used to reduce the error term.

SPSS: The following steps have to be performed for multivariate analysis of covariance (MANCOVA):

- **SPSS**: the MANCOVACan be performed using the analysis menu, selecting the “GLM” option, and then choosing the “Multivariate” option from the GLM option.

*For assistance with conducting a MANCOVA or other quantitative analyses [click here](#).*

**Resources**


Related Pages:

[Conduct and Interpret a One-Way MANCOVA](#)

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