MACOVA v.s. ANCOVA

We now have two choices: 1, multiple ANCOVA; 2, MACOVA followed by ANCOVA; 3, MACOVA

ANCOVA is the extension of ANOVA, MACOVA is the extension of MANOVA

The primary reason for conducting a MANOVA or an ANOVA is to determine if there are any treatment variable effects; in our one-way layout, this amounts simply to determining (by a statistical test) if any group differences exist.

A justification often given for conducting a MANOVA as a preliminary to multiple ANOVAS is to control for Type I error probability (see, Leary and Altmaier, 1980). If the MANOVA yields significance, then one has a license to carry out the multiple ANOVAS (with the data interpretation being based on the results of the ANOVAS).

Situations where MANOVA is appropriate:

1. To test if there are any overall (interaction, main) effects present. When the response variables are correlated with each other, it can give greater power.

2. To determine outcome variable subsets that account for group separation.

3. To determine the relative contribution to group separation of the outcome variables in the final subset.

4. To identify underlying constructs associated with the obtained MANOVA results.

Situations where multiple ANOVAs are appropriate:

1. To study the effects of some treatment variable or variables on conceptually independent outcome variables. In such a situation one would be interested in how a treatment variable affects each of the outcome variables. Here, there would be no interest in seeking any linear composite of the outcome variables; an underlying construct is of no concern. In particular, an underlying construct would perhaps be of little interest when each outcome variable is from an unrelated domain.

2. To explore new treatment-outcome variable bivariate relationships. Such situations would exist when new treatment and outcome variables are being studied, and the effects of the former on the latter are being investigated so as to reach some tentative, nonconfirmatory conclusions. This might be of greater interest in status studies, as opposed to true experimental studies.

3. To reexamine bivariate relationships within a multivariate context. In this case, separate univariate analysis results can be obtained for comparison purposes, in addition to a multivariate analysis if the latter is appropriate and desirable

4. To select a comparison group in designing a study. These analyses might be considered in an in-situ design for the purpose of a comparative evaluation of a project. In this situation, evidence of comparability may be obtained via multiple informal ("eyeball") tests or formal statistical tests

It should be recognized, however, that because of the nature of behavioral science variables, redundant information will usually be obtained with multiple ANOVAs. For example, suppose Variable 1 yields univariate significance and that Variable 2 is highly correlated with Variable 1. Significance yielded by Variable 2, then, would not be a new result.

Type I Error Protection

Use of conventional levels of Type I error probabilities for each test in a series of statistical tests may yield an unacceptably high Type I error probability across all of the tests (the "experimentwise error rate").

We can employ the usual univariate test statistics with an adjustment to the *overall* Type I error probability. One approach is to use an additive (Bonferroni) inequality: For tests, the alpha level for each test () is given by the overall alpha level () divided by m. A second approach is to use a multiplicative inequality (Sidak, 1967): For tests, , is found by taking 1 minus the th root of the complement of (see Games, 1977). The per-test , constant across the tests, that are found using the two approaches are, for most practical purposes, the same.

References:

Huberty, C. J., & Morris, J. D. (1992). Multivariate analysis versus multiple univariate analyses.

Huang, F. L. (2020). MANOVA: A Procedure Whose Time Has Passed? Gifted Child Quarterly, 64(1), 56–60.

The introduction of ANCOVA

**Overview**

Analysis of covariance (ANCOVA) is a statistical technique that blends analysis of variance and linear regression analysis. It is a more sophisticated method of testing the significance of differences among group means because it adjusts scores on the dependent variable to remove the effect of confounding variables. ANCOVA is based on inclusion of additional variables (known as covariates) into the model that may be influencing scores on the dependent variable. (Covariance simply means the degree to which two variables vary together – the dependent variable covaries with other variables.) This lets the researcher account for inter-group variation associated not with the "treatment" itself, but from extraneous factors on the dependent variable, the covariate(s). ANCOVA can control one or more covariates at the same time.

The purpose of ANCOVA, then, is the following: to increase the precision of comparison between groups by reducing within-group error variance; and, to “adjust” comparisons between groups for imbalances by eliminating confounding variables.

**Covariates**

Covariates need to be chosen carefully and should have the following qualities:

Continuous (at interval or ratio level, such as anxiety scores) or dichotomous (such as male/ female); reliable measurement; correlate significantly with the dependent variable; linear relationship with dependent variable; not highly correlated with one another (should not overlap in influence); and relationship with dependent variable the same for each of the groups (homogeneity of regression slopes).

Each covariate should contribute uniquely to the variance. The covariate must be measured before the intervention is performed. Correct analysis requires that the covariate not be influenced by the treatment – it therefore must be measured prior to treatment.

ANCOVA tests whether certain factors have an effect on the outcome variable after removing the covariate effects. It is capable of removing the obscuring effects of pre-existing individual differences among subjects. It allows the researcher to compensate for systematic biases among the samples. The inclusion of covariates can also increase statistical power because it accounts for some of the variability.

**Assumptions**

Independence of observations

Normality – the distributions of the residuals are normal.

Equality (or "homogeneity") of variances, called homoscedasticity—the variance of data in groups should be the same

The dependent variable and covariates should be continuous variables

The covariates should be linearly related to the dependent variable at each level of the independent variable.

The covariate and the independent variable shouldn’t interact.

Data should be homoscedastic of Y for each value of X.

**Model**

In your study, there is only one factor: Treatment, with two levels.

Treatment: Treatment group and waitlist group

One covariable: the pre-test value of the dependent variable.

The value of response in group which receive treatment is:

is the main effect of treatment, is the value of covariant for participant in group .

**Hypothesis**

Hypothesis 1:

Null:

Alternative:

**Statistics**

Text

Description automatically generated

**Apply in SPSS**

One-way ANCOVA in SPSS Statistics:

<https://statistics.laerd.com/spss-tutorials/ancova-using-spss-statistics.php>