WHAT ARE THE ASSUMPTIONS FOR USING MANOVA?

Before using MANOVA, there are **FIVE** main assumptions that need to be met:

a) CELL SIZES

- You need to have more subjects in each cell than the number of Dependent Variables. This requirement is most easily met in most studies. Generally, if the cell size is greater than 30, assumptions of normality and equal variances are of less concern.
- If cells sizes are small and unequal, then assumption testing is more critical. Although equal cell size is ideal, it is not essential.
- It will cause problems if the ratio between two cell sizes is more than 1:1.5.

b) DEPENDENCE

- A very basic assumption that is often violated is the **lack of independence** among observations or subjects. How does this happen? This can happen when you test a group of subjects twice over a period of time (as in the case of a pre-test and posttest). In other words, the scores obtained are somewhat similar which means **there is a lack of independence** in the subjects.
- Also, when having large groups of subjects responding to a questionnaire or test and if the room is noisy or instructions are confusing, it may cause a subset of subjects to give answers that are somewhat correlated, especially if they have common experiences. This means **there is a lack of independence in the subjects**.
- It should be admitted that there are no statistical procedures to ensure independence, so you should ensure that when subjects respond to tests or questionnaires that independence is enhanced.

c) LINEARITY

- There should be a linear relationships between any two Dependent Variables, i.e. there should be a linear relationship Self-Esteem and Parental Bonding. You can use within-cell scatterplots to test this assumption. If you find the presence if any nonlinear relationship between the Dependent Variables, then you have to make the decision whether they need to be incorporated into the Dependent Variable set. On the other hand, the Dependent Variables should not have high multicollinearity because it indicates redundancy in the dependent variables.

d) HOMOGENEITY OF VARIANCE-COVARIANCE

- Here we are concerned with differences in the amount of variance of one group (say High Income group) versus another group (say Low Income group) for the **same** Dependent Variables (say Self-Esteem and Parental Bonding).
- MANOVA makes the assumption that the within-group matrices are equal. If the subjects in each of the groups are approximately equal, the robustness of the MANOVA tests is guaranteed. In other words, if you violate this assumption, the impact is minimal if the number of subjects in each cell is equal.
- On the other hand if the subjects in each cell is **unequal**, you should examine the Equality of Covariance Matrices using Box's M test.
- If the Box's M Test shows p <.05, the covariances are significantly different and the null hypothesis is NOT rejected.
- If the Box's M Test shows p >.05, the covariances are not significantly different and the null hypothesis is rejected. Here we can say that the assumption of homoscedasticity is upheld.
- Is should be noted that Box's M test is exteremely sensitive to violations of normality. So, some researchers test the Box's M statistic at p=.001, especially when the sample sizes are unequal.,

e) NORMALITY

- MANOVA is sensitive to violations of multiivariate normality. To test for multivariate normality the ***Mahalanobis distance*** is used. This test identifies multivariate outliers which influence normality. An alpha level of .001 is recommended.

SELF-CHECK

a) What you understand by the 'dependence' assumption for MANOVA?

b) Why is 'homogeneity of variance-covariance' assumption important for MANOVA?
c) What test is used for the normality assumption?