

# Chapter X

## Mutidimensional Scaling

### ABSTRACT

*This chapter discusses multidimensional scaling (MDS) procedures. MDS is a class of multivariate statistical techniques/procedures to produce two or three dimensional pictures of data (geometric configuration of points) using proximities among any kind of objects as input. Three SAS procedures (MDS, PLOT, and G3D) are necessary to convert the author cocitation frequency matrix to two or three dimensional pictures of data. The distance matrix produced earlier by using xmacro.sas and distnew.sas programs should be converted to a coordinate matrix, to produce two-dimensional plots, and annotated three-dimensional scatter diagrams. This chapter also discusses how to label data points on a plot. The annotate facility in the SAS system produces figures with the name of the author on each data point. The PROC MDS procedure includes many of the features of the ALSCAL procedure.*

### INTRODUCTION

This chapter discusses multidimensional scaling (MDS) procedures. MDS is a class of multivariate statistical techniques/procedures to produce two or three dimensional pictures of data (geometric configuration of points) using proximities among any kind of objects as input. The purposes of MDS are to help researchers identify the “hidden structures” in the data and visualize relationships among/within the hidden structures to give clearer explanations of these relationships to others (Hair, Anderson, & Tatham, 1987; Joseph B. Kruskal & Wish, 1990). Three SAS procedures (MDS, PLOT, and G3D) are necessary to convert the author cocitation frequency matrix to two or three dimensional pictures of data.

The distance matrix produced earlier by using *xmacro.sas* and *distnew.sas* programs (SAS version 8) or the distance procedures (version 9) should be converted to a coordinate matrix. The coordinate matrix is used to produce two-dimensional plots and annotated three-dimensional scatter diagrams. A distance matrix is the input to the multidimensional scaling procedure, PROC MDS, of the SAS system (version 9.1.3). The PLOT and G3D procedures process the coordinate matrix to visualize the similarity and dissimilarity within each group of an academic discipline as well as the similarity and dissimilarity among the various subspecialties within an academic discipline. In ACA study, 3D scatter plots without labels on data points provide little information for the ACA researchers. This chapter also explains how to label data points on a plot. The annotate facility in the SAS system produces figures with the name of the author on each data point. The PROC MDS procedure includes many of the features of the ALSCAL procedure (F. W. Young, Lewyckyj, & Takane, 1986) and some features of the MLSCALE procedure (Ramsay, 1986) (SAS Institute Inc., 1992).

## THE MDS PROCEDURE

Multidimensional scaling is a multivariate statistical analysis tool for examining proximity data among any kind of object. Proximity data consist of one or more square symmetric or asymmetric matrices of similarities or dissimilarities between *objects* or *stimuli* (Joseph B. Kruskal & Wish, 1978, pp. 7-11). The MDS outputs consist of a spatial representation of data which shows underlying relationships on a two or three dimensional map. The MDS map helps visualize relationships more clearly using the ratio of distances on a map to corresponding data values such as a map of a country showing cities. The magnitude of the number indicates how similar/dissimilar two objects are.

### Similarity/Proximity Measures

How should the inter-object similarity be measured? Numerous ways of measuring inter-object similarity exist. The non-metric data measures the distance by directly ranking the objects from most preferred to least preferred (preference data) and using the pairwise comparison (similarity data) to determine which items are most similar/dissimilar to each other (all pairs of these objects can be compared).

To measure proximities among authors, the correlations among authors are used most frequently. Correlations are used as proximities by MDS procedures (Joseph B. Kruskal & Wish, 1978). The author cocitation frequency is metric data. As in the PROC Cluster procedure, the cocitation frequency matrix must be converted

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