

## **Market Structure Analysis: Cluster Analysis & Perceptual Mapping**

Market structure analysis or segmentation seeks to identify and profile subgroups of a given population. POPULUS has conducted numerous segmentation studies for a wide variety of clients involving a wide range of products, services, and institutions. POPULUS has been on the cutting edge in the development of sophisticated techniques for the analysis of market segmentation data and graphic presentation of the analytical results.

### **Cluster Analysis**

Cluster analysis is a set of techniques for separating objects into mutually exclusive groups such that the groups are relatively homogeneous. It is concerned with classification and is part of the field of numerical taxonomy.

A problem faced by many users of cluster analysis is that every cluster analysis always produces clusters, whether there is any underlying structure in the data or not. Given the natural tendency to read meaning into even the most random of patterns, that fact that a solution seems reasonable is no guarantee that the results would be reproducible with a different sample or a different set of variables.

Sawtooth Software's Convergent Cluster Analysis (CCA) program addresses this problem by using a k-means method of determining clusters that involves iterating from random but strategically chosen starting points. The analyst specifies the number of clusters to be defined. Each solution proceeds automatically with these steps:

- 1) A set of "starting points" is determined. There are as many starting points as clusters desired.
- 2) Each respondent is classified into a group corresponding to the starting point to which he or she is most similar.
- 3) The averages to each variable are computed for the respondents in each group. These averages replace the starting points.
- 4) Steps 2 and 3 are repeated until no respondents are reclassified from the previous iteration.

The resulting cluster solutions can be evaluated using common sense judgment as well as measures of reliability and discrimination:

Common sense judgment assesses the face validity of each analytical solution, based upon existing knowledge of the subject category.

Reliability, defined as consistent cluster recovery, can be measured using several methods: split-sample correlations, reproducibility, and stability. By "reproducibility" is meant the percent of the sample re-clustered together in a subsequent solution that has the same number of clusters. Stability takes reproducibility one step further. By

“stability” is meant the degree to which cluster members are re-clustered in solutions with different numbers ( $k-1$  or  $k+1$ ) of clusters.

By “discrimination” is meant the extent to which clusters are different from one another. A measure of discrimination can provide evidence of actual cluster structure: between-cluster differentiation relative to within-cluster similarity.

## Perceptual Mapping

Perceptual mapping has been used as a strategic management tool for about thirty years. It offers a unique ability to communicate market structure analysis—i.e., the complex relationships among marketplace competitors and the criteria used by buyers in making purchase decisions and recommendations. Its powerful graphic simplicity appeals to senior management and can stimulate discussion and strategic thinking at all levels of all types of organizations.

All mapping techniques attempt to show the comparative differences in how products or services are rated on a given set of attributes. The validity of a map depends on both the overall set of attributes and brands in the study as well as the subset of attributes and brands evaluated by each respondent.

Most studies suffer from too many attributes. Manufacturers and service providers see hundreds of ways in which their products and services differ—or might differ—from those of their competitors. In most studies it is usually desirable (or necessary) to select a subset of attributes from respondents to rate.

POPULUS employs multiple discriminant analysis of respondent attribute ratings to produce perceptual maps. This analysis finds the optimal weighted combination of all the attributes which would produce the highest F ratio of between-product/service to within-product/service variation. That weighted combination of attributes becomes the first dimension of the map. Then a second weighted combination of attributes is found which has the next highest F ratio, subject to the constraint that this combination be uncorrelated with the first. The lack of correlation permits the plotting of the two dimensions graphically at right angles.

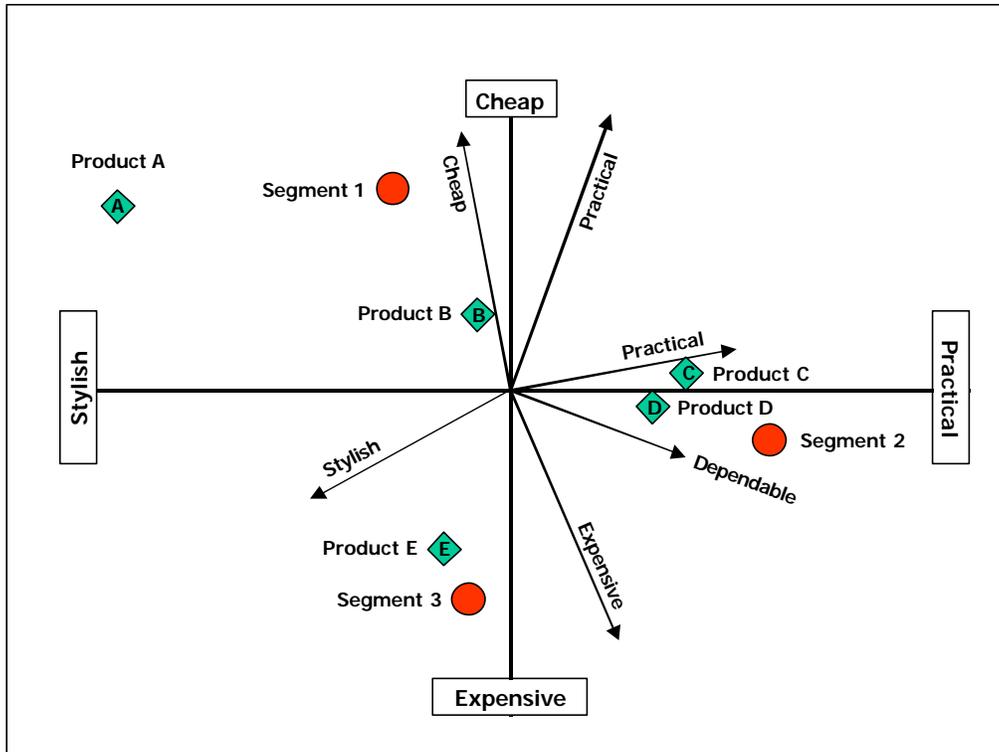
Once the weighted combination of attributes defining each dimension are determined, it is possible to compute the average score of each product or service on each dimension. Those scores are used to plot the positions of the products or services in the representational space. The averages for all products are zero on each attribute and also each dimension. Geometrically, this means that the “center of gravity” of all the product/service points lies at the center of the space.

Each attribute is plotted as a vector from the origin to a point which has as its coordinates the correlation of the attribute with the dimensions. This means that an attribute which contributes heavily to a dimension, and is therefore highly correlated with that dimension, appears on the map as an arrow pointing nearly in the same direction as the dimension.

The length of an attribute vector is equal to the square root of the sum of its squared correlations with the dimensions. The relative length of an attribute vector in any two

dimensional space is an indication of the extent to which that attribute is “accounted” for by those two dimensions

Products or services with vague, undifferentiated images, or those about which respondents disagree, lie near the center of the space. Those products / services with highest averages on an attribute are farthest from the center of the space in the direction of its vector, and those products / services with lowest averages on an attribute are farthest from the center of the space in the opposite direction.



In the map above, products as well as market segments have been plotted in the perceptual space.

Perceptual maps offer insightful and—even after many years of use—innovative perspectives for a wide range of market research objectives.