# MULTI DIMENSIONAL SCALING

**Introduction:**
Multidimensional scaling (MDS) allows a researcher to measure an object in more than one dimension at a time. The basic assumption of MDS is that people perceive an object or a set of objects as being more or less similar to one another on a number of dimensions - usually uncorrelated with each other.

The virtue of MDS lies in it's ability in scaling the "psychological" distances called dissimilarities and convert them into a multidimensional map. The consumer is presumed to have a type of "mental map" in which they view pairs of objects near each other as *similar* and pairs of objects far from each other as *dissimilar*. The mental map may not be explicitly visualised - MDS helps in converting the implicit visualisation into explicit dimensions.

Depending on the relative distances amongst a pair of points, varying degrees of dissimilarities could be imagined. MDS assumes that the respondent is able to provide either numerical measures of his perceived degree of dissimilarity for all pair of entities; or less stringently provide ordinal measure of dissimilarity. Given the responses MDS can be used to construct a physical map in one or more dimension whose inter-point distances are most consistent with the input data.

MDS **does not** explain perception. It only provides a useful representation of a set of subjective judgement about the extent to which respondent views various pairs of entities as being dissimilar.

**Types of MDS:**
MDS technique can be basically of two types - *metric* and *non-metric*. In **metric MDS** the initial data is either in ratio or interval scale. In **non-metric MDS** the initial data is in terms of ranks. The object of both the technique is to find simultaneously the number of dimensions and the configurations (or patterns) of point in that dimensions - so that the calculated inter-point distances most closely match the input data. MDS techniques can be for all practical purposes find exact solutions and both metric and non-metric MDS normally do generate similar solutions - provided the input data in different forms is consistent.

**Applications of MDS:**
To date, most MDS studies have been of a pilot type or diagnostic in nature - useful for managers to get some feel for how the brand is positioned in the minds of consumers vis-à-vis competing brands. Some areas in which MDS has been successfully used are - perception mapping for beers, soft drinks, fast moving consumer goods, sales and service perceptions etc.

**Limitations of MDS:**
MDS methods still suffer from a number of limitations. For example in the case of non-metric data, all the MDS techniques are subject to the problem of *local optima* and *degenerate solutions*. In such a situations the output of MDS becomes meaningless even though statistical validity is achieved.

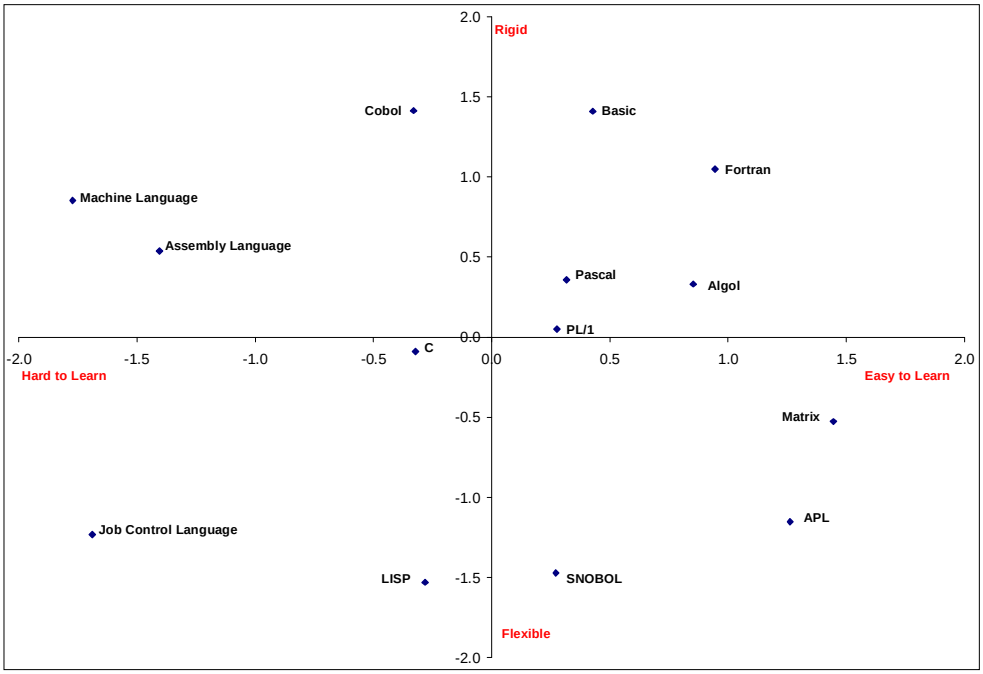
Metric MDS are more robust than non-metric MDS and produce good maps in all but highly unusual situations. Dimension interpretation - the main work of MDS - is based on highly subjective questioning of the interviewers. The same set of people, under different investigator or a different set-up may give different results.

**MDS and Factor Analysis:**
Even thought MDS and Factor analysis address similar issues in market research there exists a fundamental difference between the two methods. Factor analysis requires that the underlying data are distributed as multivariate normal and that the relationships are linear. MDS imposes no such restriction. As long as the rank ordering of distance (or dissimilarities) in the matrix is meaningful MDS can be used. In terms of resultant differences, factor analysis tends to extract more factors (dimensions) than MDS. However MDS yields more readily interpretable solutions. Most importantly MDS can be applied to any kind of distances or similarities; while factor analysis requires that a correlation matrix first be computed. MDS can be based on subjects direct assessment of dissimilarities (or similarities) between stimuli, while factor analysis requires the subjects to rate those stimuli on some list of attributes - for which the factor analysis is performed. In sum, MDS methods are *potentially* applicable to a wider variety research problems because input data (dissimilarity measure) can be obtained in any number of ways; whereas factor analysis requires special construct to capture the required data.

**A Sample Output:**

Computer Programmers were asked to rate the following programming languages on a 7 point scale. One of the scale used was the relative difficulty in learning the language and the second scale was the rigidity or flexibility in implementing the language. The distances as computed by MDS is given below.

| Programming Language | Dimension 1 | Dimension 2 |
|---|---|---|
| Machine Language | -1.77174 | 0.85284 |
| Job Control Language | -1.68841 | -1.23198 |
| Assembly Language | -1.40590 | 0.53708 |
| COBOL | -0.33095 | 1.41547 |
| C | -0.32178 | -0.08880 |
| Lisp | -0.28235 | -1.53022 |
| Snobol | 0.27152 | -1.47339 |
| PL/1 | 0.27679 | 0.05056 |
| Pascal | 0.31766 | 0.35636 |
| Basic | 0.42803 | 1.41161 |
| Algol | 0.85337 | 0.33197 |
| Fortran | 0.94531 | 1.04935 |
| APL | 1.26291 | -1.15379 |
| Matrix | 1.44556 | -0.52707 |




Where Dimension 1 is the dissimilarity score on learning difficulty. The negative the score the more difficult to learn the language. Dimension 2 is the dissimilarity score on flexibility offered on programming. The more positive the score the more rigid / inflexible the language in actual implementation. The Perception map is given on the side.

**Exercise:**

The following is the dissimilarity scores for seven brands of international perfumes in the market. You are the marketing manager for ***Nightlife*** brand of perfume. Dimension 1 is the score on fullness of the perfume. The more positive the score the more light the perfume. Dimension 2 is the score on long lastingness of the perfume. The more positive the score the more long lasting the perfume. Plot the perception map of the perfumes and based on the perception map suggest communication strategies to be followed by your organisation.

| Brand | Dim 1 | Dim 2 |
|---|---|---|
| De Lux | + 1.590 | - 0.572 |
| Divine | + 0.033 | - 0.004 |
| Dusk | - 0.173 | + 0.195 |
| Nightlife | - 0.985 | - 0.003 |

| Brand | Dim 1 | Dim 2 |
|---|---|---|
| Sensation | - 0.458 | - 0.922 |
| Temptation | - 0.420 | + 0.682 |
| Dangerous | - 1.311 | + 1.087 |
| Nocturnal | + 0.054 | + 0.036 |