

MDS:

MDS is only one of the many techniques that can be used for perceptual mapping.

- The inputs obtained could be for objects, individuals, brands, corporations or countries.
- As a thumb rule, objects are grouped together.
- The grouped objects are usually evaluated and compared with each other so that they can coexist on a spatial map.

Difference between MDS and PCA

	MDS	PCA
Purpose	To observe similarity or dissimilarity in a high dimensional data space	Reduce dimensionality of data while retaining maximum information
Method	Low dimensional representation of spatial observations	Finds a new coordinate system that explains the maximum variability in the data
Input	Similarity or dissimilarity matrix	Data matrix
Output	Scatter plot	Principal Components and variance explained
Properties preserved	Distance relationships between the observations	Maximum variance of the data
Advantages	Visual representation of relationships between observations	Good for removing noise and data interpretation

MDS Objective:

1. Which products and services are frequently bought together
2. Brands that are lumped into the same category by customers
3. Which Attribute importance and performance tends to be connected

Process:

1. Formulating the problem
2. Obtaining data: Preference (rank order), Perceived data – Direct (similarity judgement) or derived (attribute rating)
3. Selection of MDS procedure: Category of data (perceived/preference), type of data (metric, non-metric), level of data (individual, aggregate)
4. Deciding the # of dimensions: Domain knowledge, Scree plot (elbow) of stress vs. no. of dimensions, Interpretability of spatial map, ease of use
5. Labelling and interpretation: Statistical tools (regression), subjective opinion of respondents (criteria used or labelling of dimensions by them), objective characteristics
6. Assess reliability and validity: R squared (goodness of fit >0.6), stress (badness of fit <10%)

Use case 1:

Multidimensional scaling (MDS) is a statistical technique used to analyze and visualize similarities and differences in data. In the field of psychology, MDS can be used to understand how people perceive and categorize different stimuli.

One sample use case of MDS in psychology is to study the concept of social distance. Social distance refers to the degree of closeness or distance people feel towards others based on their social category, such as race, ethnicity, or nationality.

Researchers can use MDS to create a visual representation of how people perceive social distance between different groups. They can ask participants to rate the degree of social distance they feel towards members of different groups and then use MDS to create a map of how these groups are perceived in relation to each other.

For example, a study might ask participants to rate their level of social distance towards members of different ethnic groups. The MDS analysis could then reveal that certain groups are perceived as closer together (i.e. more similar) than others, indicating that participants perceive those groups as having more in common. This information can help researchers better understand how people perceive social categories and how those perceptions might affect behavior and attitudes.

MDS Process:

1. Formulating the problem: The first step in using MDS is to define the research question or problem that the analysis aims to address. In the example of social distance, the problem is to understand how people perceive and categorize different ethnic groups based on their level of social distance.
2. Obtaining data: The next step is to collect data from participants that reflects their preferences or perceptions. In the case of social distance, this might involve asking participants to rank order their preferences for different ethnic groups or provide similarity judgments between groups.
3. Selection of MDS procedure: Depending on the type of data collected, the researcher will need to select the appropriate MDS procedure. For example, if the data are based on perceived similarities, then non-metric MDS might be appropriate, while if the data are based on preference rankings, then metric MDS might be more appropriate.
4. Deciding the # of dimensions: The researcher needs to decide on the number of dimensions to use in the MDS analysis. This can be based on domain knowledge or by analyzing the Scree plot of stress versus the number of dimensions. The aim is to strike a balance between achieving a good fit (low stress) and producing an interpretable spatial map.
5. Labelling and interpretation: Once the MDS analysis is complete, the researcher needs to label and interpret the dimensions. This can be done using statistical tools such as regression or by using the subjective opinions of respondents. The aim is to provide a meaningful interpretation of the dimensions that can help to answer the research question.
6. Assess reliability and validity: Finally, the researcher needs to assess the reliability and validity of the MDS analysis. This can be done by examining the goodness of fit (R-squared) and the stress

of the spatial map. A good fit ($R\text{-squared} > 0.6$) and low stress (less than 10%) indicate that the MDS analysis is reliable and valid.

Use Case 2:

Multidimensional scaling (MDS) can be used in the field of business for a wide range of applications, including product positioning, brand perception, customer segmentation, and market research. Here is an example use case of MDS in business:

Problem: A company wants to understand how its customers perceive its product line and how they compare it to its competitors.

Process:

1. **Formulating the problem:** The problem is to understand how customers perceive the company's product line and how they compare it to its competitors.
2. **Obtaining data:** The company can collect data from customers using surveys or focus groups. The data can include preference rankings of the company's products and those of its competitors, as well as attribute ratings of each product.
3. **Selection of MDS procedure:** Based on the type of data collected, the company can select the appropriate MDS procedure. If the data are based on preference rankings, then metric MDS might be appropriate, while if the data are based on attribute ratings, then non-metric MDS might be more appropriate.
4. **Deciding the # of dimensions:** The company needs to decide on the number of dimensions to use in the MDS analysis. This can be based on domain knowledge or by analyzing the Scree plot of stress versus the number of dimensions. The aim is to strike a balance between achieving a good fit (low stress) and producing an interpretable spatial map.
5. **Labelling and interpretation:** Once the MDS analysis is complete, the company needs to label and interpret the dimensions. This can be done using statistical tools such as regression or by using the subjective opinions of respondents. The aim is to provide a meaningful interpretation of the dimensions that can help the company to make informed business decisions.
6. **Assess reliability and validity:** Finally, the company needs to assess the reliability and validity of the MDS analysis. This can be done by examining the goodness of fit ($R\text{-squared}$) and the stress of the spatial map. A good fit ($R\text{-squared} > 0.6$) and low stress (less than 10%) indicate that the MDS analysis is reliable and valid.

Based on the MDS analysis, the company can gain insights into how customers perceive its products and how they compare them to its competitors. This information can help the company to make informed decisions about product positioning, marketing strategies, and customer segmentation. For example, if the MDS analysis reveals that customers perceive the company's products as being similar to its competitors' products, the company may need to focus on developing a more distinct brand identity to differentiate itself from the competition.

Other multivariate techniques that can solve this problem:

Yes, there are several other multivariate techniques that can be used to solve the problem of understanding how customers perceive a company's product line and how they compare it to its competitors. Some of the common techniques used in market research include:

1. **Factor Analysis:** Factor analysis is a technique used to identify underlying dimensions or factors that explain the variance in a set of variables. In the context of product perception, factor analysis can be used to identify the key attributes that customers consider when evaluating different products.
2. **Cluster Analysis:** Cluster analysis is a technique used to group similar objects or individuals into clusters based on their similarity or dissimilarity. In the context of product perception, cluster analysis can be used to group customers into segments based on their preferences and perceptions of different products.
3. **Conjoint Analysis:** Conjoint analysis is a technique used to determine the relative importance of different attributes in a product or service. In the context of product perception, conjoint analysis can be used to identify the key features and attributes that drive customer preferences and purchase decisions.
4. **Discriminant Analysis:** Discriminant analysis is a technique used to identify the variables that best discriminate between two or more groups. In the context of product perception, discriminant analysis can be used to identify the variables that differentiate between customers who prefer one product over another.

Each of these multivariate techniques has its strengths and limitations, and the choice of technique will depend on the specific research question and data available.

To identify the underlying dimensions or factors that explain the variance in a set of variables related to product perception, then **factor analysis** might be the most appropriate technique.

On the other hand, if the goal is to group customers into segments based on their preferences and perceptions of different products, then **cluster analysis** might be the most appropriate technique.

Conjoint analysis might be the most appropriate technique if the goal is to identify the key features and attributes that drive customer preferences and purchase decisions.

Discriminant analysis might be useful if the goal is to identify the variables that differentiate between customers who prefer one product over another.

In general, the choice of technique should be based on a careful consideration of the research question, the data available, and the strengths and limitations of each technique. It may also be helpful to consult with a statistician or data analyst who has expertise in multivariate techniques to determine the most appropriate approach.