Dr. Shashi Shekhar Mishra: Hello and welcome to another session of this course marketing management part 1. We are in the concluding session of this third module capturing market insight, so this is week 4 session 6 of this course.

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Dr. Shashi Shekhar Mishra: So in the last class we started discussing about data collection preparation and analysis.

Hypothesis Testing

- The intent of hypothesis testing is formally examine two opposing conjectures (hypotheses), H_0 and H_a

- These two hypotheses are mutual exclusive and exhaustive in a way that rejection of one leads to acceptance of other.

- Evidences are gathered to determine which one to be accepted

Dr. Shashi Shekhar Mishra: And I have talked about the hypothesis testing part and then I have talked about the null hypothesis and the alternate hypothesis, the utility of the null hypothesis where in if it is being falsified.
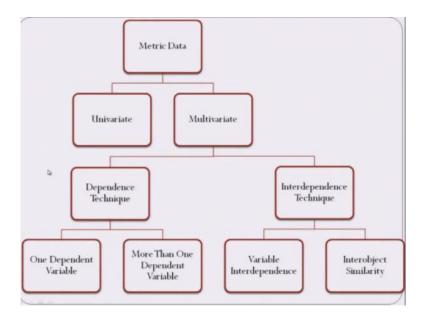
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Errors in Hypothesis Testing

Reality

Decision	H_0 is true	H_0 is false
Reject H_0	Type I error	Correct conclusion
Retain H_0	Correct conclusion	Type II error

Dr. Shashi Shekhar Mishra: It allows you to inference that H_1 is true, that researchers argument is validated. Now I talked about the errors in hypothesis testing part where you have a two by two matrix when you reject a hypothesis which was true it is called type 1 error and when you retain a hypothesis.
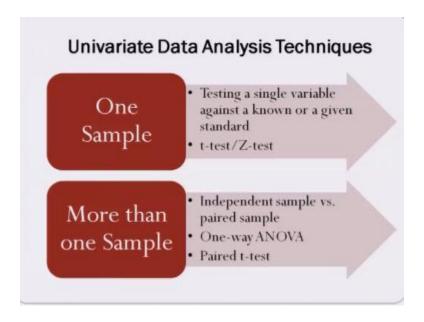
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Dr. Shashi Shekhar Mishra: Null hypothesis when in fact it was a false it is called as type 2 error.

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Dr. Shashi Shekhar Mishra: And then I started talking about the data analysis in particular I talked about the univariate data analysis, I talked about.

Dr. Shashi Shekhar Mishra: One-way analysis of variance that is ANOVA and I started talking.

t-test

A univariate hypothesis test using the t distribution, which is used when the standard deviation is unknown and the sample size is small (Malhotra, 2006).

Dr. Shashi Shekhar Mishra: About.

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Analysis of variance (ANOVA)

- Employed as test of means for two or more populations. The null hypothesis is tested for all means being equal.

- Dependent variable s metric

- Independent variables are **Categorical** and often termed as **factors**.

- When only one independent variable is present, the test is called **One-way analysis of variance.**
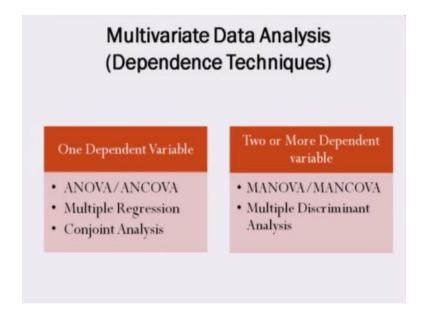
Dr. Shashi Shekhar Mishra: I gave you an example.

Testing the Advertising Copy

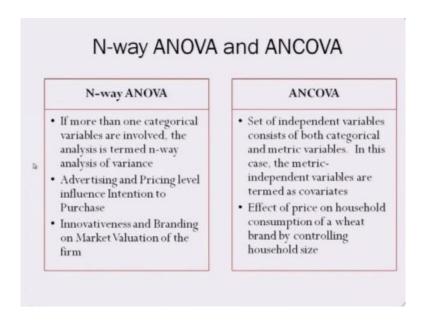| Respondent No.	Advertising Copy	Intention to Purchase
1	1	10
2	1	9
3	1	10
4	1	8
5	1	9
6	1	8
7	1	8
8	1	7
9	1	9
10	1	6
11	2	5
12	2	7
13	2	6
14	2	4
15	2	5
16	2	8
17	2	9
18	2	7
19	2	7
20	2	6
21	3	4
22	3	5
23	3	5
24	3	6
25	3	4
26	3	2
27	3	3
28	3	2
29	3	1
30	3	2

Dr. Shashi Shekhar Mishra: About this advertising copy and its independent variable advertising copy and its effect on intention to purchase.

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Dr. Shashi Shekhar Mishra: I started talking about the dependence techniques and we have finished at this point.

N-way ANOVA and ANCOVA

N-way ANOVA	ANCOVA
• If more than one categorical variables are involved, the analysis is termed n-way analysis of variance • Advertising and Pricing level influence Intention to Purchase • Innovativeness and Branding on Market Valuation of the firm	• Set of independent variables consists of both categorical and metric variables. In this case, the metric-independent variables are termed as covariates • Effect of price on household consumption of a wheat brand by controlling household size

Dr. Shashi Shekhar Mishra: Where we have discussed what is n-way ANOVA and what is ANCOVA. So n-way ANOVA is basically when you have more than one categorical independent variable then it is called n-way ANOVA and when you have the one of the independent variable in this analysis of variance as a matrix variable than it is called ANCOVA. Sometimes it is important to basically control the effect of some of the variables like household size in the example of effect of price on household consumption of a cereal.

So there the controller this is this control is required and that is why this ANCOVA is very useful in those cases, so moving from there.

MANOVA and MANCOVA

- Similar to ANOVA, except that instead of one metric dependent variable, we have two or more.
- H_0: Vectors of means on multiple dependent variables are equal across groups.
- MANCOVA is suited when two or more dependent variables that are correlated.

Dr. Shashi Shekhar Mishra: We talk about further MANOVA and MANCOVA so when you have a just one dependent variable you can use ANOVA and ANCOVA depending on the type of independent variable. However when you have more than one dependent variable then you can basically you have to use the MANOVA and the null hypothesis in the case of the MONOVA is that vectors of means on multiple dependent variables are equal across groups and when these dependent variables are correlated this, this, this analysis is called as MANCOVA.

Correlation and Multiple Regression Analysis

- **Correlation**: strength of association between two metric variables, assumes linear relationship between two
- **Regression**: relationship exist between IV-DV, degree of variation in DV being explained by IV, structure of relationship
- **Bivariate regression model** $Y_i = \beta_0 + \beta_1 X_i + e_i$
- **Multiple regression model**
$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots + \beta_k X_k + e$$

Dr. Shashi Shekhar Mishra: Talking about another dependence technique which is one of the most commonly used marketing research technique to analyze the data where you have correlation and regression. Correlation is basically the strength of a, examination of strength of association between two metric variables and what is assumed here is that these two metric variables are linearly correlated.

They are basically they have a linear relationship between two. Now the coming onto this regression analysis the relationship exists between independent variable and dependent variable. Now what happens in the regression is that we are interested in to measure how much the variation independent variable is being explained by the independent variable or independent variables depending on whether it is a bivariate regression or it is a multivariate regression

Bivariate regression is when only one independent variable is there and when you have more than one independent variable in the regression module you call it as multiple regression as they are shown in this two equations

Correlation and Multiple Regression Analysis

- **Correlation**: strength of association between two metric variables, assumes linear relationship between two
- **Regression**: relationship exist between IV-DV, degree of variation in DV being explained by IV, structure of relationship
- **Bivariate regression model** $Y_i = \beta_0 + \beta_1 X_i + e_i$
- **Multiple regression model**

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots + \beta_k X_k + e$$

Dr. Shashi Shekhar Mishra: Of bivariate regression module and the multivariate regression module. One of the biggest utility of this regression analysis is that you are able to get the information that what is the form or the structure of relationship between independent variable and the dependent variable, and based on that form or the structure of relationship the values of the dependent variable can be predicted from the values of the independent variable. Depending on the variables like the price or the advertisement or some of the other marketing mix variable you can basically predict the value of the demand.

One of the biggest application of this regression is in the demand forecasting kind of analysis, where this regression method is used. Now we talked about ANOVA where the independent variable was category column.

We talked about regression where independent variable and in ANOVA the dependent variable was metering. Now in the regression analysis we have dependent variable and independent variable, both were metric variable. However there are cases where analysis involves where the dependent variable is in the form of a categorical variable and the independent variable are in the form of metric scale.

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Discriminant Analysis

- The criterion variable (DV) is categorical and the predictor variables (IV) are interval in nature.

$$D = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + \ldots + b_i X_i$$

where
- D = Discriminant score
- b's = Discriminant coefficient
- X's = Predictor Variable
- Linear combination of IV to best discriminate the categories of DV
- Differing importance of predictor variables

Dr. Shashi Shekhar Mishra: So there discriminant analysis is commonly employed and the discriminant analysis, it is similar to like a regression equation as shown in the previous slide.

Correlation and Multiple Regression Analysis

- **Correlation**: strength of association between two metric variables, assumes linear relationship between two
- **Regression**: relationship exist between IV-DV, degree of variation in DV being explained by IV, structure of relationship
- **Bivariate regression model** $Y_i = \beta_0 + \beta_1 X_i + e_i$
- **Multiple regression model**
  $$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_k X_k + e$$

Dr. Shashi Shekhar Mishra: However you see that instead of why notation that is being used is D.

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Discriminant Analysis

- The criterion variable (DV) is categorical and the predictor variables (IV) are interval in nature.

$$D = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_rX_r$$

where

D = Discriminant score

b's = Discriminant coefficient

X's = Predictor Variable

- Linear combination of IV to best discriminate the categories of DV
- Differing importance of predictor variables

Dr. Shashi Shekhar Mishra: Because instead of metric variable your dependent variable is in the form is in the form of a categorical variable or the categories that exist, the utility of this discriminant analysis is that these categories can be distinguished or can be understood, or differences across the categories can be predicted or understood based on the values of the independent variables.

And what more you can understood from the discriminant analysis is, that you can understand the varying level of the importance of these different independent variables.

Discriminant Analysis

- The criterion variable (DV) is categorical and the predictor variables (IV) are interval in nature.

$$D = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + \ldots + b_i X_i$$

where

D = Discriminant score

b's = Discriminant coefficient

X's = Predictor Variable

- Linear combination of IV to best discriminate the categories of DV
- Differing importance of predictor variables

Dr. Shashi Shekhar Mishra: So like in this discriminant analysis equation, if I have if I have the data and if I can analyze I can tell which of these independent variable X1, X2, X3.

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Discriminant Analysis

- The criterion variable (DV) is categorical and the predictor variables (IV) are interval in nature.

$$D = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + \ldots + b_i X_i$$
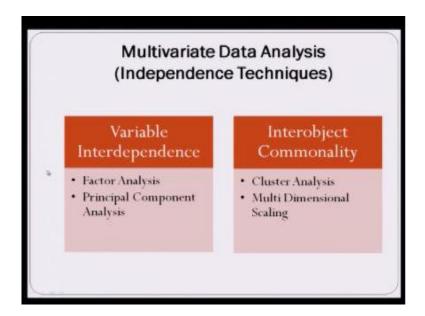
where

D = Discriminant score

b's = Discriminant coefficient

X's = Predictor Variable

- Linear combination of IV to best discriminate the categories of DV
- Differing importance of predictor variables

Dr. Shashi Shekhar Mishra: Or Xi is more important and one of the utility of this discriminant analysis is, or probably quite often it is used, is that as I will explain it through an example that it could also be used to understand the differences across the categories. Now you see you have a dependent variable which is amount of a expenditure that family makes on a monthly basis on the movies.

And you have a independent variable, couple of independent variable here in the form of income attitude towards entertainment, family size, time spent together, these are these are some of the independent variables which are basically the predictor of amount on that a family spend on the movie, you can see that the amount spent on the movies in the three categories, high, medium, or low.

And this independent variables are on the metric scale. Now when you, when you basically solve this, this discriminant of function you will be able to calculate the value of B1, B2, B3, and B4 since we have four variables. And depending on the value of the coefficient you can basically say which one is more important and which one is less important.

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Discriminant Analysis

- The criterion variable (DV) is categorical and the predictor variables (IV) are interval in nature.

$$D = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + \ldots + b_r X_r$$

where

D = Discriminant score
b's = Discriminant coefficient
X's = Predictor Variable

- Linear combination of IV to best discriminate the categories of DV
- Differing importance of predictor variables
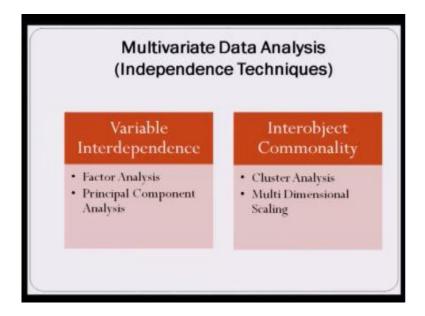
Dr. Shashi Shekhar Mishra: So basically that from the, from there you can draw the inferences to, that can help you in the decision-making process.

Dr. Shashi Shekhar Mishra: Now talking about multivariate data analysis techniques that, that are based on the independence techniques that is there, there are two types where variables are interdependent.

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Dr. Shashi Shekhar Mishra: And where the objects have commonality that inter object similarity. So variable interdependence techniques are primarily in the form.

Dr. Shashi Shekhar Mishra: Of a factor analysis, factor analysis is a class of techniques for data reduction and summarization, I will explain to you through the one of the examples of, how this factor analysis is used in the marketing research, however the factor analysis is used to recognize underlying dimensions that explains the correlation among a set of variables.

Dr. Shashi Shekhar Mishra: Initial variables now you will see that in this factor analysis that your initial variable have high correlation and you try to basically combine or you try to discover or you try to identify the underlying factors that is basically the that is responsible for, for the variation or the correlation across these variables. Now you will you will see that since is it is a data reduction technique that number of factors identified will be less than the original number of variables.

And that each factor should explain individually more variants that is being explained by the individual variables.

Benefit			
On time	0.81	0.07	0.13
Comfortable seat	0.21	0.13	0.90
Sufficient Leg space	0.05	0.05	0.84
Tasty Food	0.12	0.78	0.09
Frequently my friends travel	0.06	0.87	0.15
Courteous staff	0.20	0.75	0.10
New Aircraft	0.95	0.03	0.05
FF Program	0.11	0.92	0.16
Suits my schedule	0.93	0.02	0.04

Dr. Shashi Shekhar Mishra: Now here I have an example from the airlines industries, as you can see on this table customers were asked to rate the benefits from the airlines on these nine attributes like on-time performance how important it is to, to their choice of a particular airlines, comfortable seat, sufficient leg space, tasty food, frequently my friend travel so how your boss or colleagues or the friends are traveling by the same airlines.

Then you have courteous staff, what is the life of the aircraft, average life of the aircraft, whether the airlines is using new aircraft or old aircraft, how important is that, then frequent flyer program, then suitability to my schedule. So these are basically nine criteria's based which were used to examine the choices of the respondent and you can see that once they have given their responses factor analysis is being performed.

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Benefit	Features		
On time	0.81	0.07	0.13
Comfortable seat	0.21	0.18	0.90
Sufficient Leg space	0.05	0.05	0.84
Tasty Food	0.12	0.78	0.09
Frequently my friends travel	0.06	0.87	0.15
Courteous staff	0.20	0.75	0.10
New Aircraft	0.95	0.05	0.05
FF Program	0.11	0.92	0.16
Suits my schedule	0.93	0.02	0.04

Dr. Shashi Shekhar Mishra: And you can see that in this table that this, this one is I am not going too much detail into the statistics part but you will see that on-time performance, sufficient, on-time performance, new aircraft and suits my schedule are the benefits which are loaded on this factor 1 which is, which I have labeled as features.

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Benefit	Features	Flying Incentive	
On time	**0.81**	0.07	0.15
Comfortable seat	0.21	0.15	**0.90**
Sufficient Leg space	0.05	0.05	**0.84**
Tasty Food	0.12	0.78	0.09
Frequently my friends travel	0.06	0.87	0.15
Courteous staff	0.70	0.75	0.10
New Aircraft	**0.95**	0.05	0.05
FF Program	0.11	0.92	0.16
Suits my schedule	**0.93**	0.02	0.04

Dr. Shashi Shekhar Mishra: You have factor 2, which is like tasty food, frequently my friends travel, courteous staff, and the frequent flyer program. These are the combined attributes which are of similar type and they are captured in this flying incentive factor. Then you have third type of factor which is convenience and under which you have.

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Benefit	Features	Flying Incentive	Convenience
On time	0.81	0.07	0.13
Comfortable seat	0.21	0.18	0.90
Sufficient Leg space	0.05	0.05	0.84
Tasty Food	0.12	0.78	0.09
Frequently my friends travel	0.06	0.87	0.15
Courteous staff	0.20	0.75	0.10
New Aircraft	0.95	0.05	0.05
FF Program	0.11	0.92	0.16
Suits my schedule	0.93	0.02	0.04

Dr. Shashi Shekhar Mishra: Comfortable seats and sufficient leg space, I have summarized the results here.

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Features	Flying Incentive	Convenience
On time	Tasty Food	Comfortable seat
New Aircraft	Frequently my friends travel	Sufficient Leg space
Suits my schedule	Courteous staff	
	FF Program	

Dr. Shashi Shekhar Mishra: That within features you will see that three attributes are combined together, that is on time new aircraft and suits my schedule, so these are basically the functional or benefit or featured related benefit that is expected from an airlines by the customers. You have second type of benefits in the form of flying incentive that is tasty foods, frequently my friends travel, courteous staff and frequent flyer program and then you have in the convenience factors, you have a comfortable seats, sufficient leg space.

Now you can see that instead of having nine individual variables, you can capture more I mean you can capture almost.

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| Features	Flying Incentive	Convenience
On time	Tasty Food	Comfortable seat
New Aircraft	Frequently my friends travel	Sufficient Leg space
Suits my schedule	Courteous staff	
	FF Program	
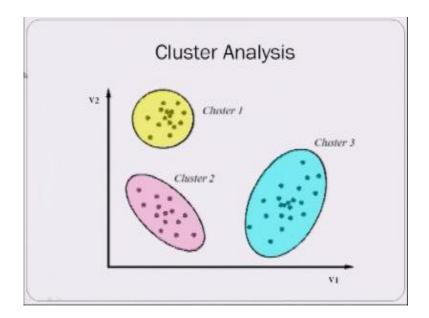
Dr. Shashi Shekhar Mishra: Equal amount of information through these three factors for further analysis and, and you can use this basically to segment the market to basically come out with the segmentation scheme in the market and also to understand what will be the, what is what should be the positioning inside the specific segments in that market. Now you see if, if this is one segment that as we call as feature seeking segment then you have to position your lines based on these, these parameters if you are basically targeting a segment which is, which is flyer, seeking flying incentive then you have to focus on these four benefits and when you are targeting a segment which is convenient seeking, then you need to focus on the comfortable seats and the sufficient leg space.

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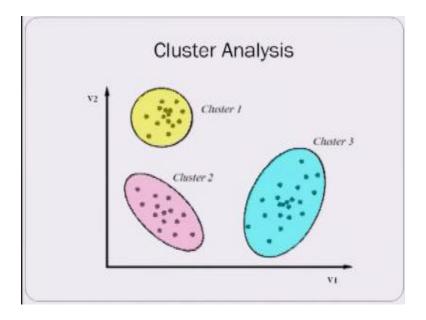
Dr. Shashi Shekhar Mishra: So this was about factor analysis, the, another class of techniques which is very commonly used is a cluster analysis to classify your objects or cases. What is cluster analysis, cluster analysis is to classify objects or cases into relatively homogeneous groups called clusters. Objects in each clusters tends to be similar to each other and dissimilar to objects in the other cluster.

Dr. Shashi Shekhar Mishra: I will explain it to you that this is the total number of objects in an analysis and now you will see that these objects have been classified on two variables like v1 and v2.

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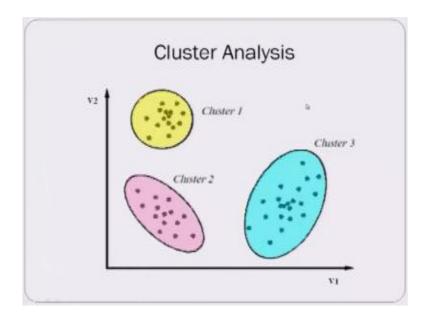
Dr. Shashi Shekhar Mishra: And now you see that or probably.

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Features	Flying Incentive	Convenience
On time	Tasty Food	Comfortable seat
New Aircraft	Frequently my friends travel	Sufficient Leg space
Suits my schedule	Courteous staff	
	FF Program	
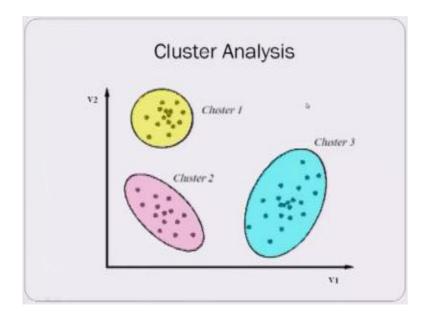
Dr. Shashi Shekhar Mishra: I can relate it with the previous example, if you, if you have the, the combined score of each of the respondent on these three factors, features, flying incentive and convenience you can come out with a basically a 3D plot that v1, v2, v3 and all the three respond.

Dr. Shashi Shekhar Mishra: All the three variables on three-dimensional scale and each of these respondents in that survey can be located on that and you will find out that you will find out by the cluster analysis that you have cluster of customers located together. You can see that within a clusters the units are basically homogeneous and across the clusters they are far away or.

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Dr. Shashi Shekhar Mishra: They are heterogeneous across the clusters. The cluster analysis biggest application is in the segmentation of the market and then coming out with the suitable marketing program to the cluster needs, specific cluster needs.

Dr. Shashi Shekhar Mishra: The, another important type of technique which is used in marketing research is conjoint analysis. Conjoint analysis attempts to determine the relative importance consumers attach to salient attributes and the utilities they attach to the levels of the attributes. I will explain to you the basic thought behind the conjoint analysis is that each product is conceptualized as a bundle of benefits and corresponding to those benefits there are different level for each benefit. Like if I talk about the status symbol as a benefit from a car.

So you see that a status symbol from a basic car or a basically hatchback module is, is very low. On the other side when we go into the sedan segment or SUV segment then it is on a medium scale and when we talk about luxury cars then probably it is the highest level. So you see that corresponding to the different level of this status symbol you have different products, so when you combine the different levels of various benefits in a product, you get the different kind of profiles.

Now what happens in this conjoint analysis is we try to calculate the importance of each of these attributes and we try to calculate the utility corresponding to the each attributes different levels.

Dr. Shashi Shekhar Mishra: I will explain it to you through an example, however the basic equation is that any product seen as a bundle of benefits and you see the total utility of the product is being conceptualized here as
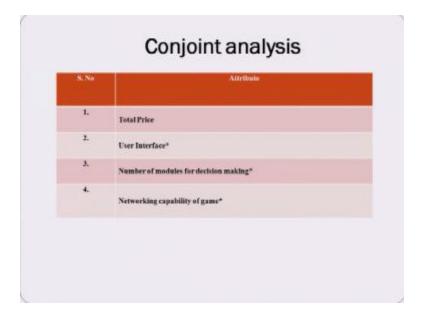
Dr. Shashi Shekhar Mishra: The sum of the utility corresponding to the different benefits and their levels of the benefits in a product, an example
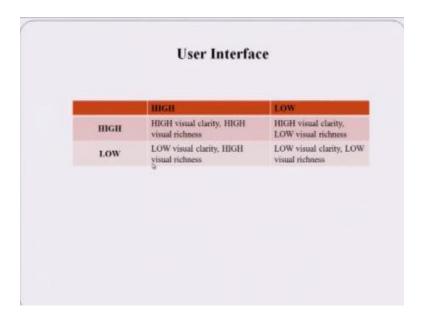
Dr. Shashi Shekhar Mishra: Which is my own students work and I can explain to you here is that this person has worked on the design of the business simulation games which is the best profile or the profile of highest utility from the business simulation games, so he has basically four benefits or four attribute that is total price, user interface, number of modules for design making, networking capability of games. Now you see with corresponding to each of these attributes

Dr. Shashi Shekhar Mishra: You have a different levels of those attribute like this total price has three levels that one time involve payment of thirty five thousand rupees to 1 lakh and a maximum of 20 teams allowed at a time, then you have a second level of this second type of pricing, then you have the third type of pricing level for this attribute, similarly user interfaces

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User Interface

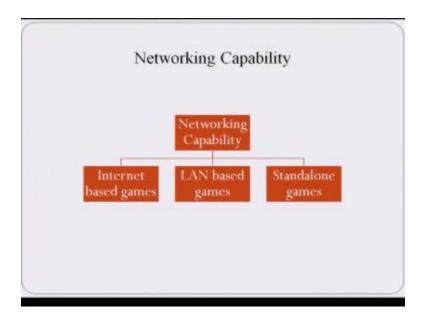|	HIGH	LOW
HIGH	HIGH visual clarity, HIGH visual richness	HIGH visual clarity, LOW visual richness
LOW	LOW visual clarity, HIGH visual richness	LOW visual clarity, LOW visual richness

Dr. Shashi Shekhar Mishra: Two by two and then you have that means four level of four type of user interface level

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Number of modules included

Module for Decision Making	Frequency of module
Marketing	20
Finance	20
HR	14
Accounting	12
TQM	10
Research & Development	8
Operations and SCM	8
Production	8
e-Commerce	7
International Issues e.g. Political Changes etc.	5
Customer Relationship Management	5
Live Economic Conditions like Stock Exchange etc.	4
Mergers & Acquisitions	2
Business Partner Negotiations	2

Base Level

DR. Shashi Shekhar Mishra: Number of modules is basically three types, there are three levels of number of module, that is basic level, standard level, and the advance level, you have

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Dr. Shashi Shekhar Mishra: With respect to networking capability of a business emulation game you have three types of games, internet-based games, land-based game, and a standalone game. Now you want to calculate what is the importance level of these four attributes and corresponding to those attributes important level what is the utility of each of these different levels? Now you see

Relative Importance Values

Attributes	Importance values	Expert Survey
Networking Capability	53.11	3.6
User Interface	27.79	3.8
Subscription/Purchase Fees	11.965	4
Number of modules for decision making	7.135	3.6

Dr. Shashi Shekhar Mishra: That the importance level of each of them has been calculated and the network capabilities found to be the most important attribute then you have a user interface and then total prize and the number of modules, so you can see that networking capability is the most important and corresponding to the networking capability you can also calculate the utility corresponding to each of different level.

The use of this kind of analysis is that once you get the utility corresponding to each level of important attributes you can come out with a optimal product design which customers will want in a particular segment of the market

Dr. Shashi Shekhar Mishra: And the last technique that I am going to talk about is multidimensional scaling and in multidimensional scaling we captured the respondents perception or their preferences to basically represent them in a special, especially by means of visual display

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Dr. Shashi Shekhar Mishra: The perceived relationship among stimuli are represented as geometric relationship among points in the multidimensional space and you will
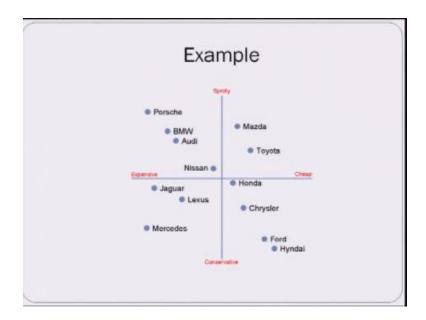
Multidimensional Scaling (MDS)

- Representation of perceptions / preferences of respondents spatially by means of a visual display.

- The perceived relationships among stimuli are represented as geometric relationships among points in multidimensional space.

- The graphical representation. The axes of the spatial map are assumed to denote the psychological bases or underlying dimensions respondents use to form perceptions and preferences for stimuli.

Dr. Shashi Shekhar Mishra: See that the graphical representation this is a, this relationship are explained in the visual display form in the spatial space, the exercise of the spatial map are assumed to denote the psychological bases or underlying dimensions respondents use to form perceptions and preferences for stimuli.
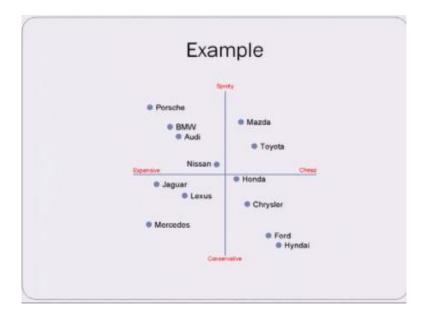
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Dr Shashi Shekhar Mishra: Now I will give you an example like if I asked a respondent or the potential car buyers about the similarity of the different car brands as shown in this figure that what is the level of similarity of any two brands taken at a time and then based on that data I can create a sort of this perceptual map or I can look into the important attributes of car purchase and if I capture the data about each of these car brands.

I can basically come out with this kind of perceptual map where I can see that the different brands can be put on a two-dimensional space and you see that the two dimension are basically that one corresponds to sporty and the conservative and the two extremes are sporty in the conservative type, and the other is basically based on the price of the car that is expensive versus cheap. So you see that this is a basically a possible type of a perceptual map of the different brands available in the market.

This is a basically an imaginary database on which this perceptual map has been created, you will find out that in multi dimensional scaling most of the times we try to create a two-dimensional or max three dimensional map because it is easier to visualize a two-dimensional or at max three-dimensional map. Going beyond that is not possible for us.

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Dr. Shashi Shekhar Mishra: To understand most of the times you will see that the two dimensional maps are used, so with this multi dimensional technique I conclude this module of this marketing management course that is capturing market insight and when we will meet in the next week we will start with another module on buyer behavior of this course marketing management, since then thank you.