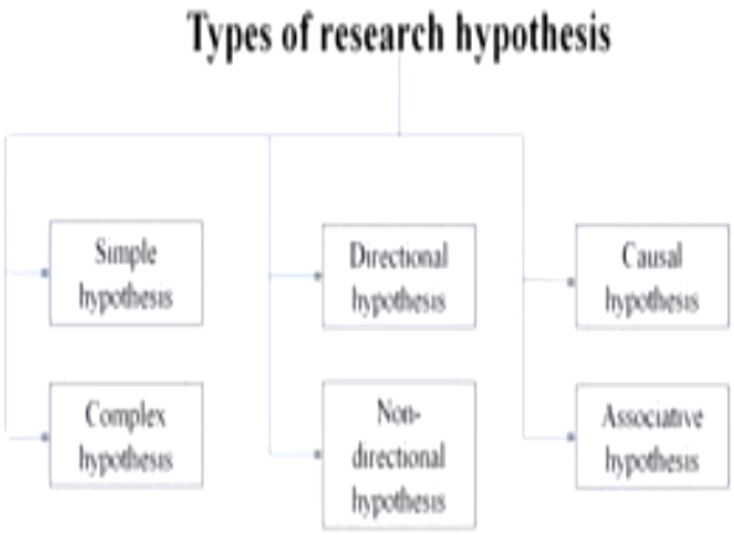
Marketing Research and Analysis-II (Application Oriented)
Prof. Jogendra Kumar Nayak
Department of Management Studies
Indian Institute of Technology – Roorkee

Lecture – 8
Hypothesis and Research Question – II
(with real life example)

Welcome friends to the lecture series of my course on Marketing Research and Analysis II part which is the application oriented part. So in the last class, we were discussing about the hypothesis. So as I said what is the hypothesis and research question and today also may be we will be carrying on the same and we will be getting into the hypothesis development and what things to be taken care of while deciding hypothesis or developing a hypothesis. So welcome again to the class.

(Refer Slide Time: 01:11)



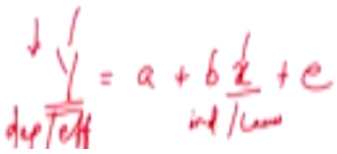
So these are some of the types of research hypothesis. As you can see so there we says hypothesis is simple or it is a complex hypothesis, is it a directional hypothesis or a non-directional hypothesis, causal hypothesis, associative hypothesis. So several ways, this is for learning. So let us see one by one.

(Refer Slide Time: 01:27)

Simple hypothesis

- Predicts relationship between the independent and dependent variable
- **Example:** Two hourly positions changing of a fully bedridden patient will prevent bedsore

The statement shows that there exists a relationship between 2 hourly positioning and bedsore prevention



So what is a simple hypothesis right. It predicts the relationship between the independent and the dependent variable. Now what is this independent and dependent variable. I am sure many of you are aware of it, but for some who are new, for them let us understand it this way. An independent variable is the one which is the cause. For example y = a + b x + e. So now this y is my dependent variable, is the effect, dependent or effect, and x is my independent or cause. So that means, I am saying that x causes y.

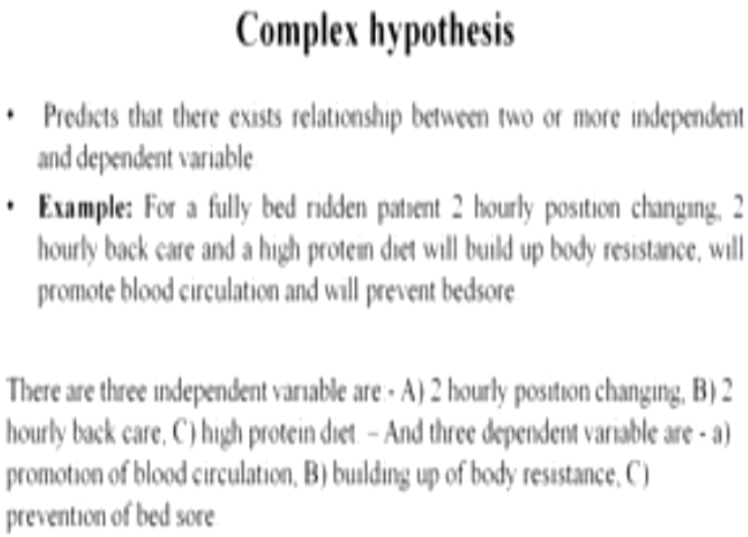
So this relationship, now what is the relationship, is it like when this grows this also grows or when this grows this falls, so what is the relationship, so we are trying, is it a linear relationship or is it a nonlinear relationship, is there only one independent variable or there are multiple independent variables. So it predicts simply the relationship between the independent and the dependent variable. Example 2 hourly positions changing of a fully bedridden patient, this is taken from a hospital case, prevents bedsore.

For example, it says every 2 hours if the position of the patient is changed, then it will help in preventing bedsore. This is a hypothesis, that means it is said that 2 hours is the time period, at least if you change the patient's position, sleeping position every 2 hours, then the chances of developing bedsores will be minimized. The statement shows that there exists a relationship between 2 hourly positioning and bedsore prevention. So is it true or not is to be tested. This is a simple hypothesis.

You can develop many such simple hypotheses. For example you can also say for example an increase in advertisement will lead to an increase in sales. I feel that an increase in

advertisement will lead to an increase in sales, so it is a hypothesis, simple hypothesis. Is it complex, if it there is simple it is to be complex

(Refer Slide Time: 03:52)



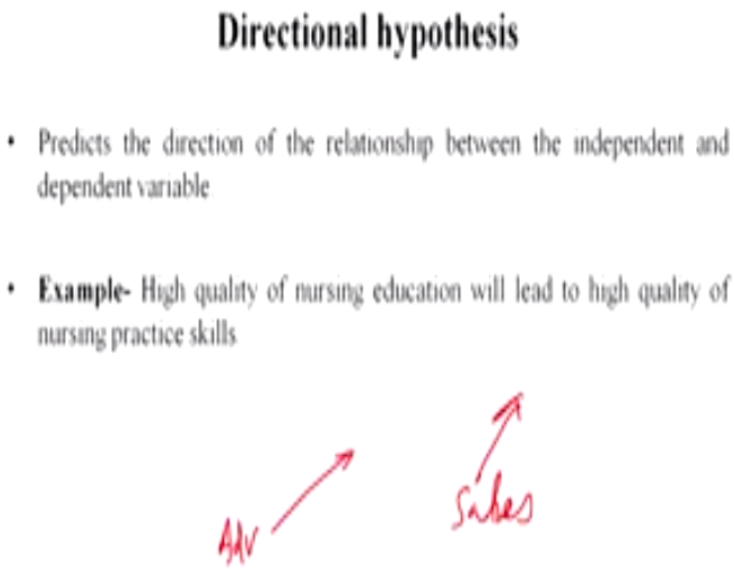
What is a complex hypothesis. Take an example, let us see. It predicts that there exists relationship between 2 or more independent and dependent variable. There are not 1 dependent and 1 independent now, there are more number of independent variables or dependent variables. Let us take an example, same example continues. For a fully bedridden patient 2 hourly position changing, 2 hourly back care and a high protein diet will build up the body resistance, will promote blood circulation and will thus prevent bedsore.

So in this case, you see the number of variables dependent or independent they have now changed. It is not 1 and 1, 2, but it is more than 2 now. So in this case you see there are 3 independent, you just please try to see from yourself by reading this example how many independent and dependent variables are there. So as it says there are 3 independent variables, what are they, 2 hourly position changing one, second 2 hourly back care, back care could be like massaging or trying to give some treatment or something, third high protein diet.

What is the dependent variable, let us say 3 dependent variables are promotion of blood circulation, is the blood circulation improving, building up the body resistance, is the body resistance changing, that means let us say immunity or something you can say is it changing, is it leading to a prevention of bedsore. So 3 independent and 3 dependent variables. So in

such a condition where you have to study 3 independent and 3 dependent variables at the same time, may be it is considered to be a complex hypothesis.

(Refer Slide Time: 05:39)



Next directional hypothesis. Direct as the word suggests it gives us a direction. So it moves towards one way, it predicts the relation, the direction of the relationship between the independent and the dependent variable. Now as I said let say if advertisement grows, will sales grow or not. Now I am saying will sales grow or not, let says sales is growing, so there is a relationship, which is let us say positive relationship and it is linearly extending forward.

High quality of nursing education will lead to high quality of nursing practice skills, similar from the example, so what is same? High quality of nursing education that means if you give better nursing education with let us say good demonstration and good practical exposure, all it will lead to a high quality of nursing practice skills, then they would develop into a better nurses, they care, treat patients in a more subtle and even a much better way than the ones who have not been given the high quality of education and this is applicable to all places, all educational places.

(Refer Slide Time: 07:01)

Non-directional hypothesis

- Predicts the relationship between the independent variable and the dependent variable but does not specific the directional of the relationship

- **Example**- teacher student relationship influence student's learning

Let us see the next non-directional. So there is no direction. It predicts the relationship between the independent variable and the dependent variable, but does not specify the direction of the relationship. Let us see. Now take this case, teacher student relationship influence student's learning. Now which direction is it going, is it although we assume that the relationship is positive, then it will be improving, it is not so good it will have a negative effect, but then they does not specify any relationship in this case clearly.

So if I take it to for example several other situations of life, then when I am not saying, it can fall either way, it can go to the negative side, it would go to the positive side.

(Refer Slide Time: 07:51)

Causal hypothesis

- Predicts a cause and effects relationship or interaction between the independent variable and dependent variable. This hypothesis predicts the effect of the independent variable on the dependent variable

- In this the independent variable is the experimental or treatment variable. The dependent variable is the outcome variable

- **Example** – Early postoperative ambulation will lead to prompt recovery

$$(y) = a + b_1x_1 + b_2x_2 + b_3x_1x_2$$

The next is causal hypothesis. Predicts a cause and effect relationship, it is a cause and effect, as I said the dependent and independent for example or interaction between the independent

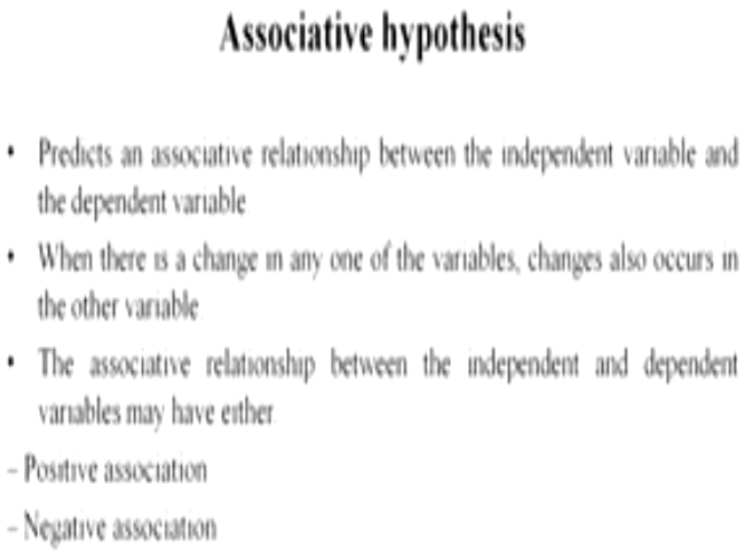
variable and the dependent variable. So this hypothesis predicts the effect of the independent variable on the dependent variable. Now it predicts is it for example as I was saying $y = a + b_1 x_1$, let say there are 2 variables $b_2 x_2$.

So is it that whatever y is getting effected, whatever score you are getting for y is it the effect of only x_1 and x_2 or there might be something like there is a third effect b_3 $b_1 x_1$. So then there is an interaction effect, we say there is because these 2 independent variables are some way connected, there is some relationship, there could be an interaction effect. For example let me give you this example, interaction effect. Somebody comes to my class, a boy enters into my class and he is sitting in the class, he is behaving in one way.

Suddenly his friend comes to the class and now finding his friend there, he becomes very happy and they started talking and that disturbs me for my class. So in such a situation both are individually when they come they do not create any problem for me, but when they come to sit together they are creating an interaction effect which is not very positive for me in this case. So in this the independent variable is the experimental or treatment variable though dependent variable is the outcome variable, the cause and effect as I said.

So the effect is the dependent variable, the cause is the independent variable. Example, early postoperative ambulation will lead to prompt recovery. So that means if early you are taking care, then thus recovery of the patient will also become very fast. So before the surgery or before when you take care, precaution is better than cure we say. So if you have taken enough precaution then the after the patient's surgery is over, then he will recover fast, now that means we are trying to connect something okay.

(Refer Slide Time: 10:28)



Next is associative hypothesis. What it says prediction associative relationship, associative relationship between the independent variable and the dependent variable. When there is a change in any one of the variable, change also occurs in the other variable. The associative relationship between the independent and the dependent may have either positive or negative association. It is something like when I said if fuel prize is increasing, sales of cars is decreasing, so negative association.

If the teacher gives more examples, more students come to attend his class, positive association. Example marketing research for investigation for comfort foods, whether certain foods provide comfort under different situation in people's lives. This is a marketing research case, do certain foods provide comfort to people in different situations in their lives. For example, does chicken soup make people feel better on a rainy day or when they have a cold partially because they may have eaten chicken soup during the same season.

When they were growing up, may be when they were growing up and they had ever suffered from cold or fever or something their mother must have given them chicken soup or some vegetarian hot soup. So we are saying is there any association because scientifically we have not proven anything, so we are saying is there any association between the two?

(Refer slide time: 12:12)

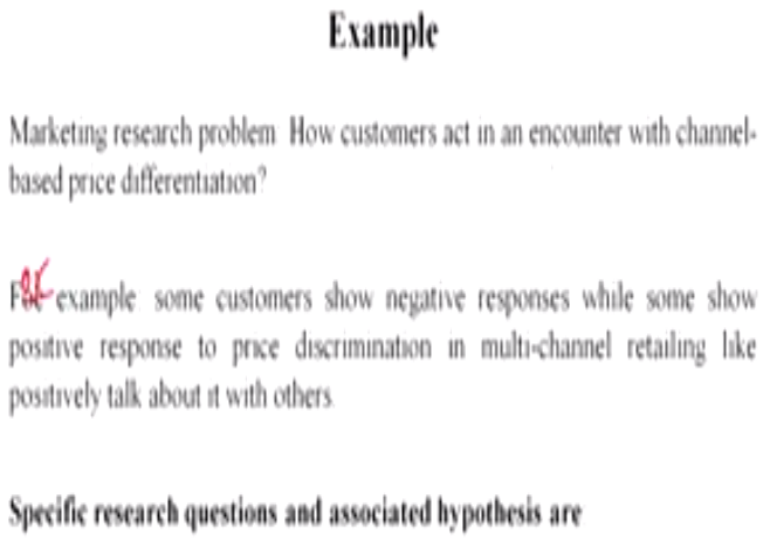
RESEARCH QUESTION	RESEARCH HYPOTHESIS
RQ1: What foods are considered to be comfort foods?	**H1**: Potato chips are considered comfort food **H2**: Ice cream is considered comfort food
RQ2: When do people eat comfort foods?	**H3**: People eat comfort foods when they are in a good mood **H4**: People eat comfort foods when they are in a bad mood
RQ3: How do people become attached to comfort foods?	**H5**: People are attached to comfort foods that are consistent with their personality **H6**: People are attached to comfort foods because of past associations

Specific research questions and associative hypothesis are let us say, so some research question research hypothesis both at the same time, let us see this question first one. What foods are considered to be comfort foods? Taking the Q from the last case. Research hypothesis says potato chips are considered comfort food, hypothesis ice cream is considered comfort food, now this is to be tested, we do not know empirically proven.

Second research question when do people eat comfort foods, what is the time, when, what situation people eat comfort foods? When they are in a good mood that is a hypothesis, I am drawing hypothesis that when they are in a good mood then only they consume comfort foods. People eat comfort food when they are in a bad mood. So either of the two, so this is a hypothesis. Third research question, how do people become attached to the comfort foods? People are attached to comfort foods that are consistent with their personality.

So you are a person may be somebody is a mild person or every happy go lucky and every charming person very very cute kind of a personality may be he loves food which are cold which are like ice cream sweets and some people suppose, I do not know it could be grossly wrong also, but I am thinking my logical extension is if somebody is a very aggressive guy, he would go for food which are little hot and spicy. So this is something like we are predicting or we are hypothesing.

(Refer Slide Time: 13:47)



So marketing research problem. How customers act in an encounter with channel-based price differentiation? This is an example. Some customers show negative responses while some show positive response to price discrimination in multi-channel retailing like positively talk about it with others. Let us see this again. Marketing research problem how customers act in an encounter with channel-based price, so different channels of sales are there, so may be direct you buy it from the manufacturer or you buy it through a retailer through a distributor or anything.

So some customers show negative responses while some show positive responses to price discrimination, that means they say why should the price differ because the product is the same, so if it being sold from the manufacturer or the retailer how does it matter. So some are negatively responding, some say oh no there is a logic because obviously the length is increasing and more people are included, so the profits of the company will decrease, so they may have to increase the cost.

(Refer Slide Time: 15:04)

RESEARCH QUESTION	RESEARCH HYPOTHESIS
RQ1: What is the effect of price differentiation on customers' perception process?	**H1:** Price differentiation with higher online price negatively affects fairness perception
RQ2: What is the effect of price differentiation on customers?	**H2:** Price differentiation with higher online price negatively affects purchase intentions **H3:** Price differentiation with higher online price negatively affects word-of-mouth intentions
RQ3: What is the effect of size of price difference?	**H4:** Price differentiation with lower online price negatively affects fairness perception in case of a high price difference but not in case of a low price difference

So let us see this specific research question and associative hypothesis again. Connected to the last example, this example let us see this. What is the effect of price differentiation on customer's perception process. This is an example with the research question which is assigned what is the effect of price differentiation on customer's perception process. Now hypothesis is price differentiation with higher online price negatively affects fairness perception, that means let us understand it again.

Price differentiation with higher online price negatively affects fairness perception. What is the effect of price differentiation on customers? Now for the second research question the hypothesis goes like this price differentiation with higher online price negatively affects purchase intentions, so if you are increasing it, then there is a negative effect, people might not buy. Price differentiation with higher online price negatively affects word-of-mouth, so the word-of-mouth also intentions get negatively affected. Similarly what is the effect of size of price difference?

So here price differentiation with lower online price negatively affects fairness perception in case of a high price difference but not in case of a low price difference I think if you go through, it may be, it is slightly sounding you know longer but let us see this. What is the effect of size of price difference. Suppose there is a significantly large difference in the price from when you go across the channels.

For example, it says price differentiation with lower online price that means when you are buying online, you buy at a lower price negatively affects the fairness perception. People feel

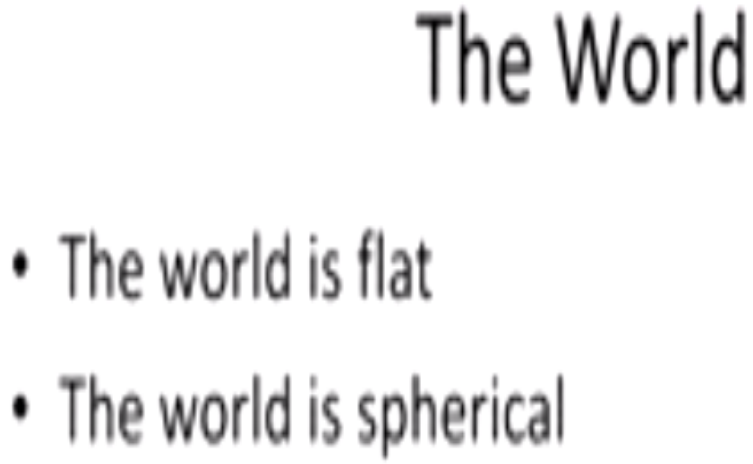
that because, actually this is one of the research we are doing currently so that is why it has been made, we are trying to find out when the same product is being purchased online and the same product is being purchased offline and we say let say the online price is lesser than the offline price, do people feel that it is unfair to do that or they feel there is nothing unfair in it.

So this is what we are trying to find out okay. So this research hypothesis we are currently doing this work, this is a case of, I cannot share much but it is on pricing effects on different channels according to the channels, so does the price effect the consumer psyche. So till now, we have understood basically clearly about what is hypothesis and research question and the different types of hypothesis, characters of good hypothesis and all these things.

(Refer Slide Time: 17:52)

Now I am taking you to the next part which is hypothesis development. Now you are getting into development of the hypothesis

(Refer Slide Time: 17:56)



The first is the world is flat, the world is spherical, so what is this, 2 statements? If you remember long long time back, they used to say the world is flat. So even Columbus when he started he thought, he was said, he was discouraged in moving because they thought if he goes to the end of the world then the world will get over and he will fall off, but then we found it is not that, the world is rather spherical or round right. So the first thing was also a hypothesis and the second today what we try to prove.

So what is the statistical hypothesis or is this only hypothesis which are the statistical connection to it. So to reach statistical decision, I am sure all of you who are listening to me at the moment, you are interested. You are taking this course because you are either doing some research work or you are interested to publish something or you are going to teach somebody, so you want to clarify. So question is when you are using statistics, you are mostly doing a statistical test and trying to justify whether your claim is correct or not.

(Refer Slide Time: 19:18)

- **Statistical hypothesis:** To reach statistical decisions, it is useful to make assumptions or guesses about the populations involved. Such assumptions, which may or may not be true are called *statistical hypothesis* and in general, are statements about the probability distributions of the population.

- The hypothesis is made about the value of some parameter, but the only facts available to estimate the true parameter(measure of the target population) are those provided by a sample.

μ, σ

- If the sample statistic differs from the hypothesis made about the population parameter, a decision must be made as to whether or not this difference is significant. If it is, the hypothesis is rejected. If not, it must be accepted. Hence the term **"tests of hypothesis".**

$\mu_1 \neq \mu_2 \neq \mu_3$.

So to reach a statistical decision, it is useful to make assumptions or guesses about the populations involved. Such assumptions which may or may not be true are called statistical hypothesis and in general are statements about the probability distributions of the population. So what kind of a distribution is it, is it a normal, is it a binomial, is it a Poisson distribution, what kind of a distribution is it following.

So the hypothesis is made about the value of some parameter, now what is this parameter, so some people get confused but the only facts available to estimate the true parameters, that means what is this parameter, it is a measure of the target population, please go through this it is a measure of the target population. Now what is the measure, it could be the standard deviation, so it could be some statistical figure that is connected or linked to the population.

So what you are saying the hypothesis made about, the value of some parameter, but the only fact available to estimate the true parameters are those provided by a sample. Since you cannot do a census, a survey, you are depending on a sample. So this sample will try to help you in giving a prediction or interpreting the population. So this is the whole idea about research. Research is very simple, just to understand that from the sample we go and interpret the population.

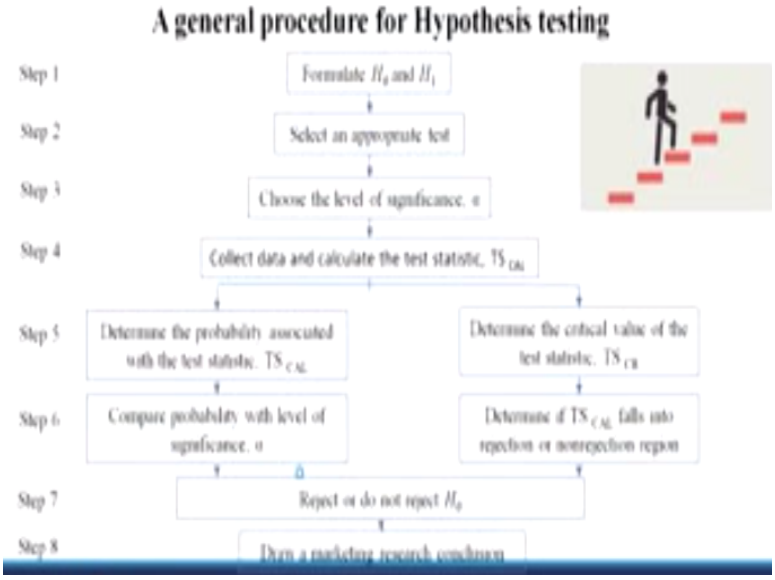
If the sample statistics differs from the hypothesis made about the population parameter, a decision must be made as to whether or not this difference is significant, as I said suppose the difference is very small or from the look if you see the difference is very small, but can you say it is significant or not. If you say oh no, it is very small difference but then it might not be

true. It could be a significant difference, but your eyes are getting perplexed or even confused, by looking at it you are getting confused, so may not be true.

So mathematically or statistically, you have to prove whatever data is being given to you is this statistically different, whether the means of the two samples or the means of whatever samples you have in hand are they statistically different, that means is μ_1 is different from μ_2 or equal to, is not equal to μ_2, is not equal to μ_3, so it goes on right. So the point is how is it different. So if it is, then we will go to the second part which is higher mean or lower mean or something, but is it different or not okay.

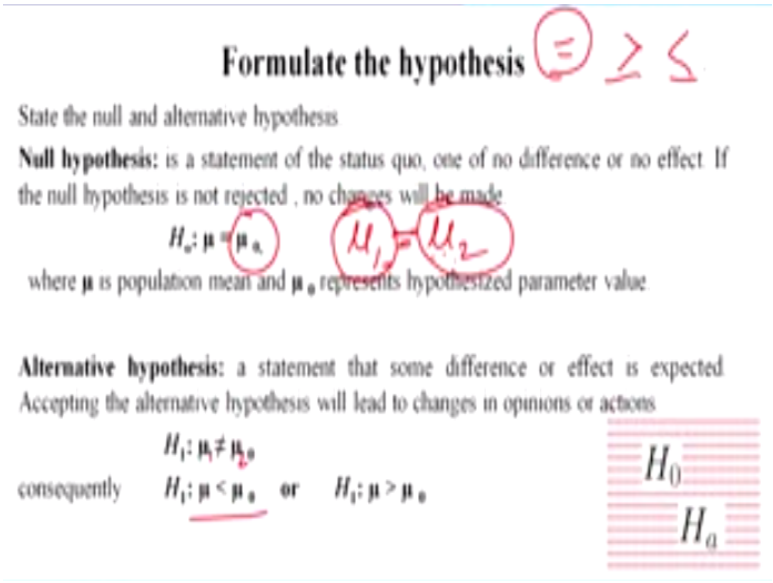
If it is, the hypothesis is rejected, if not it must be accepted. So test of hypothesis, we will slowly get into it. So let us see the development. So when you say if it is significant, the hypothesis is rejected, what is the hypothesis then?

(Refer Slide Time: 22:09)



So how do you test a hypothesis. First step, formulate the H_0 and H_1. Now before actually I should, what I can do is I can come back to this slide little later on.

(Refer Slide Time: 22:23)



So formulate the hypothesis. Let us see this, we will take that slide later on because that is the overall step. So how to formulate the hypothesis, state the null and the alternative hypotheses. So the formulate hypothesis H_0 and H_1, H_0 is your null and H_1 is your alternative hypothesis. So what is this null hypothesis, it is a statement of the status quo. Status quo means that is something that is happening or it is going on as it is, so one of no difference or no effect, there is no difference or no effect or an equal to case, a case of equal to, a = b, the mean of class 1 section B = to the mean of class 1 section C.

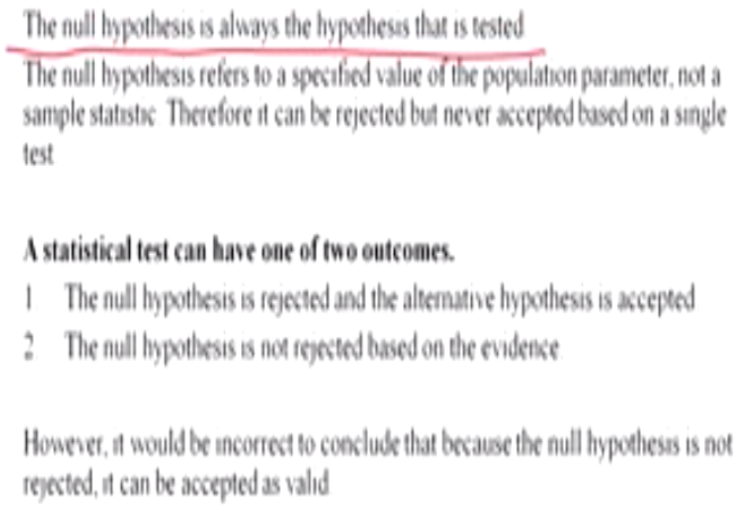
If the null hypothesis is not rejected, no changes will be made. What is it saying, so if the null hypothesis is not rejected, no changes will be made, so you are going to continue as it is, so you are saying yes the mean of class 1B = the mean of class 1C where mu is the population mean and mu0 represents the hypothesized population parameter. Sometimes you can understand basically it is from the sample we are trying to say whether the population and the sample are trying to explain each other or not.

Now next one let us say is alternative. What is alternative hypothesis? Now this is for example you can understand this part is the null hypothesis as it says the μ_1 as I said earlier if you remember $\mu_1 = \mu_2$. So μ_1 may be the one mean and the second sample's mean is the μ_2 right. So where we are saying these 2 means are not different in nature correct. Alternative hypothesis, a statement that some difference exists, some difference or effect is expected. So what is it saying.

Now H1 is μ is not equal to μ_0. So these are let us say μ_1 and μ_2 in my case. So you can take it this way. So I am saying that means what μ_1 is not equal to μ_2 or in simple terms μ_1 is or μ less than μ_0 or μ is greater than μ_0. So 2 conditions can occur. When you are trying to test a hypothesis, you are developing the null hypothesis. The null hypothesis says there is no difference okay and the alternative says there is a difference. So the difference could be out of the 3, is equal to case is gone in the null right, so what is left.

See there are 3 cases; is equal to, greater than or less than. So in the null, this case has already been over for this situation. Now remains these 2, so it could be either a case of greater than or less than, so either way, it is both of them fall into the alternative side, so that is why we are saying it is not equal to case.

(Refer Slide Time: 25:39)



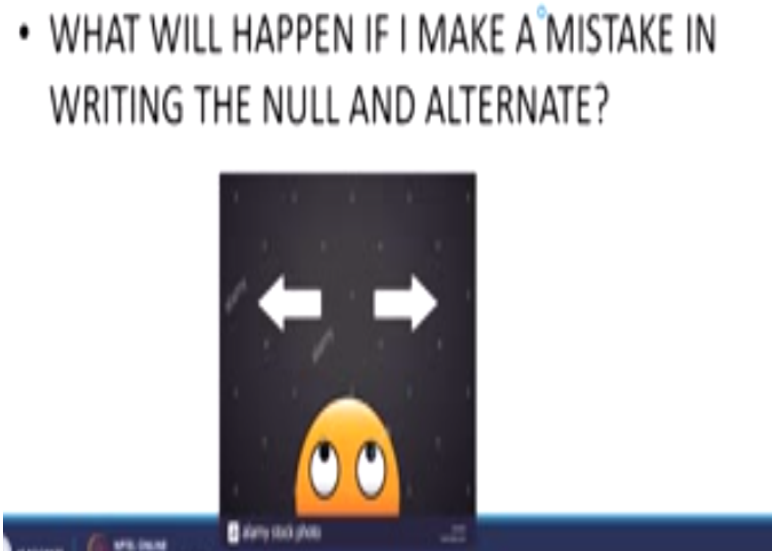
The null hypothesis is always the hypothesis that is tested, you are testing that hypothesis. It refers to a specified value of the population parameter, not a sample statistic, now therefore it can be rejected but never accepted. Yeah this is very important to understand, you can never ever say that the null hypothesis is accepted, please remember this, it is wrong to say that. It can be rejected, yes you can reject, but you cannot say it is accepted because by through a single effort or single study, 1 or 2 study, you can never claim that the null hypothesis is accepted or it is true right.

So a statistical test can have only 2 outcomes as it is now understood. The null hypothesis is rejected and the alternate is accepted or the null hypothesis is not rejected based on the evidence. Is it clear, I hope it is getting clear to you that null hypothesis is either to be

rejected, that means you cannot accept it because 1 test 2 test does not because the population parameter has to be taken. So you are not doing a study on a census of the entire population.

So what you are doing is you are doing only on a sample and trying to reflect from the sample about the population, so the null hypothesis is rejected but not accepted, and the alternate hypothesis what we are saying is to be accepted. However, it would be incorrect to conclude that because the null hypothesis is not rejected it can be accepted, which I just explained so you cannot say that.

(Refer Slide Time: 27:17)

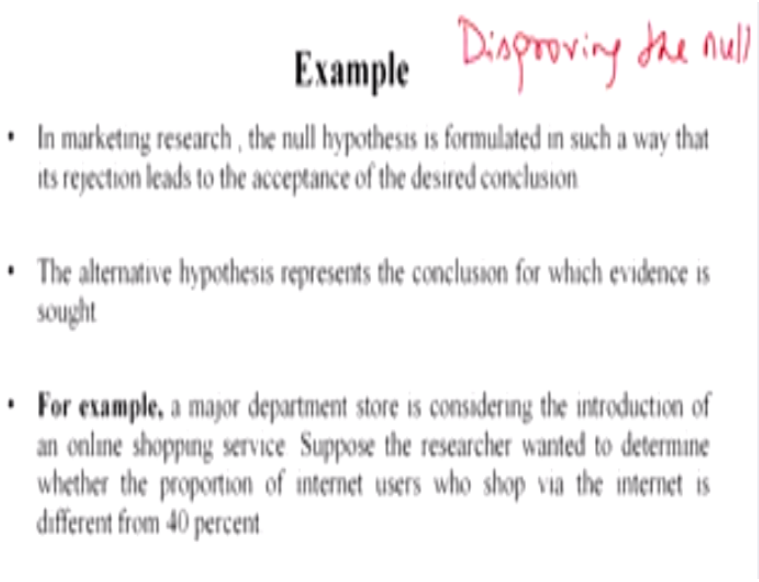


What will happen if I make a mistake in writing the null and alternate hypothesis? So this is a question that always come to the mind of a researcher and this is very important to understand. Now why is it important. So what happens if I wrongly write the null as the alternate and the alternate as the null. What will happen? What will go wrong? After all is the sky going to fall? No, the question is, it is wrong. Why it is wrong? How do you understand it is wrong?

The question is if you go to the last slide again, let me show you what did I write here, the null hypothesis is always the hypothesis that is tested, you do not test the alternate hypothesis. You are testing the null hypothesis, so if you are testing the null hypothesis and you have written the alternate hypothesis as the null hypothesis, so that means you have now tested the alternate hypothesis and whatever has come you are predicting it for as the null so that means your entire thing has gone upside down.

It is entirely wrong because what you are testing now should not have been tested, you should have tested the other one. So developing a hypothesis is where you need your logic very strongly because if you have developed your hypothesis correctly, other things will fall into place, that is not a worry, but if you have developed the hypothesis wrongly, then your entire thing can be questionable, is wrong in fact.

(Refer Slide Time: 28:51)



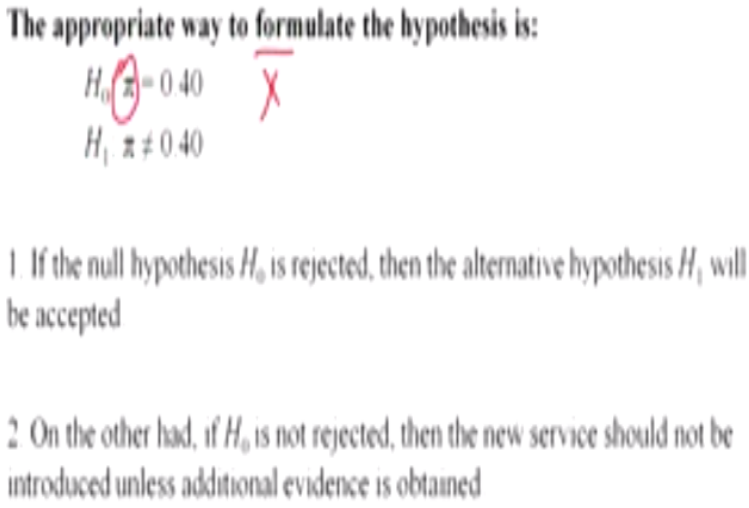
In marketing research this is a case the null hypothesis is formulated in such a way that its rejection leads to the acceptance of the desired conclusion. For example, let us take this example. This is also important the alternate hypothesis represents the conclusion. See as a researcher, your idea or you are always interested in disproving the null hypothesis, please remember, you are interested in disproving the null. So you know I sometimes say in my classes also you should be behaving like Sherlock Holmes, you should not be accepting the fact that is given to you.

So you should always be skeptical, doubtful and trying to question. So when you question, when you get the other thing, then you realize well the null was actually wrong and you then after only searching you could find that instead of the null the alternate is actually true. So this is very important that you have always a questioning mind so that you reject the null. So disproving the null is of vital consequence for every researcher. A major department store is considering the introduction of an online shopping service.

What it is doing, it is considering the introduction of an online shopping service. Suppose the researcher wanted to determine whether the proportion of internet users who shop via the

internet is different from 40% or not. So kindly you write what could be null and alternate in this case, take a seconds pause and try to write it on your own.

(Refer Slide Time: 30:34)



So the appropriate way to formulate the hypothesis is, now what is this π, π is the population parameter, this is the population parameter. So the alternative for the population mean parameter is you have we say X bar for the sample. So sample is represented as X bar, mean or sample. So it says the $\pi = 0.4$. So the mean of the population is somewhere at 40%, I think 40% right. So online shoppers are 40% and what is my alternate, no, well, it is not equal to.

Here, you see I am not trying to say whether it is more or it is less, I do not know, but I am saying it is not 40%, you have given a point estimate of 40 and now I am not agreeing to that. I am saying no, it is not equal to 40. So if the null hypothesis is rejected, then the alternate hypothesis will be accepted, obviously right. On the other hand if its zero is not rejected, then new service should not be introduced. So the company feels that store feels at least 40% people are using online services for example.

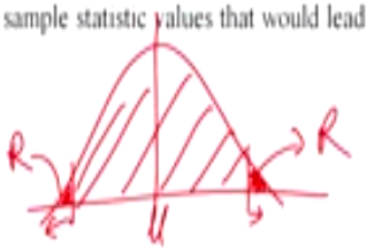
Now this 40% may be a value that they keep in mind. If at least 40% people are not there, then there is no point of introducing a new service right. So what they are doing is they are trying to test it, so that is why this value of 40% has come there. Now if your hypothesis null hypothesis this one is not rejected, then the question is why should you introduce the new service, it is unnecessarily a cost to the company. So then the new service should not be introduced unless additional evidence is obtained.

(Refer Slide Time: 32:43)

DIRECTION OF THE HYPOTHESIS TEST

- The location of rejection region (or area) under the sampling distribution curve determines the direction of the hypothesis test,
- i.e. either lower tailed or upper tailed of the sampling distribution of relevant sample statistic being tested

- It indicates the range of sample statistic values that would lead to a rejection of the null hypothesis



Direction of the hypothesis test. What is the direction of the test. So once you have introduced the null and alternate, then you should know which direction is it moving. So the location of the rejection region, let say so this is my mu, as you all know that in the normal distribution the mean, median and mode all lie in the middle. So what I am saying is let us say this point and this point, this is beyond this and beyond this, it to be rejected. So this is my rejection, this is my rejection. So what is the acceptance, now acceptance is this point.

So the location of the rejection region, this part right and this part, under the sampling distribution curve determines the direction of the hypothesis test. That means what, either I can go to the left side the lower tail or upper the right side of the test. Now for example, I do not require in some cases, I am not interested in the left side, I am only interested to know whether gold prices are increasing, I am not interested in whether they are falling or not or art and paintings their prices are increasing, so I am interested only in this side.

Sometimes, I am thinking are commodity prices are decreasing, so I am not interested in this part, maybe I am interested in only this part, the left side. So in such situations, I am sure of the direction of the test, but there can be conditions where I am not sure of the direction of the test and that is why I say may be it goes both sides, this side and this side, it could be either side. So there, I am two directional or no directional I would say and the hypothesis is developed that way.

Well what I am going to do is I am going to stop here and in the next session, we will continue with hypothesis development and the different things involved that you should be

taking care of in hypothesis development, so we will look into those things. I hope today's session is clear and understand alternate hypothesis also clearly and you do not shuffle it altogether differently, so that it can become a very big mistake. So thank you so much for the day and I hope you have a nice day. All the luck. Thank you so much.