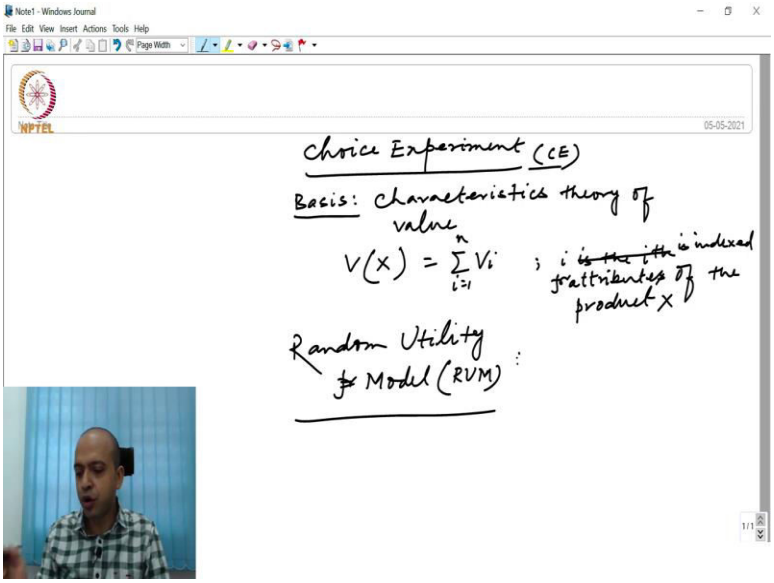
Environmental and Resource Economics
Professor Sabuj Kumar Mandal
Department of Humanities and Social Studies
Indian Institute of Technology, Madras
Economic Valuation of Environmental Goods and Services - Different Valuation Approaches – Part 8

(Refer Slide Time: 00:14)



Welcome to our discussion on Economic Valuation of Environment. And in our last class we completed our discussion on Contingent Valuation Method. And today we are going to start our discussion on another valuation technique under the Stated Preference Approach, which is Choice Experiment. That is what we are going to discuss today. Choice Experiment, in short CE.

Now, at the very outset I would say that this particular technique, Choice Experiment, it is based on Characteristics Theory of Value. What is the basis of this particular technique? It is Characteristics Theory of Value. What is this Characteristics Theory of Value? This particular theory says that value of a product or value of a service is the sum total of the value of its different attributes.

For example, if we think about a value of a car. A car is nothing but a summation of different attributes; its engine, its size, or its color, its gear whether it is automatic or manual, so on and so forth. Any product in that sense is basically, we can think of, we can think of any product is a summation of different attributes. And if we can estimate the value of its different attributes individually and then the sum of the value of its different attributes is the value of the product.

That is what the Characteristics Theory of Value says. And that is the basis of this Choice Experiment.

So notationally, what we can say that value of a product, let us say X is basically sum of Vi where i running from 1 to n, where i is the ith attributes of the product X. So, i is ith attribute of the product X. So this means this is nothing but V1 plus V2 plus V dot dot dot Vn. If we assume there are n number of such attributes of the commodity or product X then it is basically, value of X is the summation of Vi, where I, Vi is, i is the, sorry Vi, where i is indexed for attributes. So I will say that i is indexed for attribute of the product, and Vi is the value of the ith attribute of the product X. That is what this means.

So this particular technique, even though nowadays is widely used in the context of valuing environmental goods and services, it was originally proposed to be used in market research. What does it mean? Suppose a company would like to introduce a new product which is an improvement over its existing product. For example, let us say Hyundai is trying to introduce a new vehicle in the market over its existing product.

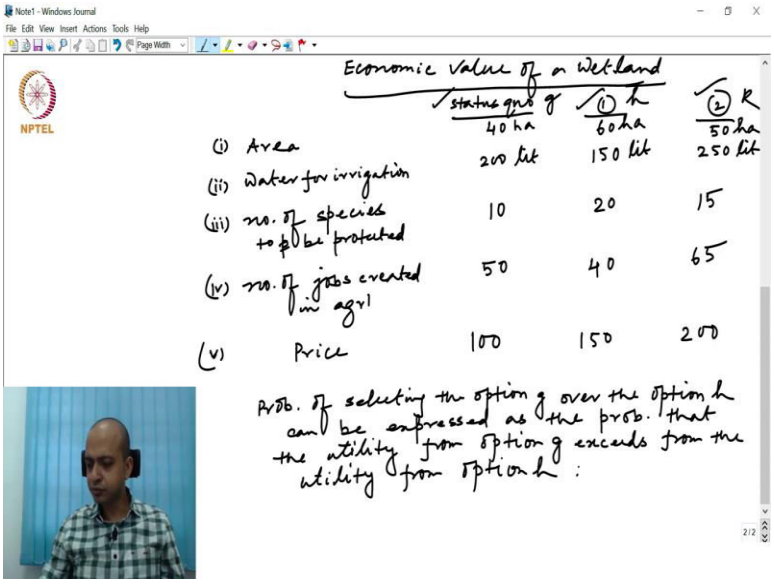
Now the company wants to know, in the new product which attribute should be emphasized more. So that means which attributes generates more utility to the consumer. So that means should the company emphasize more on the engine, should they make it more powerful? Should the company emphasize more on the design of the vehicle? Should the company emphasize more on the color? Should the company emphasizes more on, let us say, other facilities like whether it has Bluetooth connectivity, whether it is GPS systems, so on and so forth.

Now how the company will decide? The company will then conduct a survey where they will create different scenarios and they will fix different level for each of its attributes. So that means what are the attributes here? Engine, size of the vehicle, design, color and other technical features. And then they will fix in different levels for each and every attributes. And then they will ask the respondents which particular scenario or which particular option they will select.

Based on that a random utility model or RUM, a random utility framework or random utility model RUM is used as a theoretical framework to estimate consumers willingness to pay for its different attributes. And then from the willingness to pay for a particular attribute it is possible to estimate the total willingness to pay for the product.

So that is why it was originally proposed for this type of market survey. And in today's world it is now used for valuing environmental goods and services in the context of Stated Preference Approach, that means in the context of valuing non-marketed goods and services.

(Refer Slide Time: 08:07)



Now, we will explain this random utility framework and this Choice Experiment, the Choice Experiment technique based on the random utility model by taking an example of a wetland. Let us say we are trying to estimate economic value of a wetland. Now, as we have already discussed, wetland as an environmental resource, it has different competing needs. Wetland can be used as a source of irrigation water. Wetland can be used as a source of water bodies to maintain flora and fauna.

Now, if we use the wetland as a source of water for irrigation purpose, so obviously the level of water would be less in the water body? And in that case you will be able to protect less number of endangered species, but if we use more water for irrigation that will create more jobs for irrigation-related or agriculture-related activities. So a policy maker then has to decide the optimal size of the wetland based on which particular attributes generates more value to the stakeholders?

In this case, what we will do? We will describe wetland as a sum of its different attributes and then we will try to estimate the total willingness to pay for the wetland as a sum total of the WTP for its different attributes? So let us say that a wetland is characterized by five of such attributes.

What is the first attribute? First attribute it is a, let us say, area of the wetland? And this is, let us say first attribute. Second attribute is, let us say, water for irrigation. Third attribute is, let us say, number of endangered species to be protected. And then fourth attribute is that number of jobs created in agriculture. And the last attribute should always be the price. What is the price that we are asking the respondents to pay?

So these are the five attributes. And then in Choice Experiment, the first scenario is always the status quo. Then let us say this is scenario 1. Let us say, this is scenario 2. So this is status quo, scenario 1 and scenario 2.

So in status quo area is let us say, 40 hectare. That is the present size of water body. And then in status quo situation let us say, the wetland supplies 200 liters of, that is a hypothetical figure actually, let us say 200 liter of water for irrigation purpose. How many species you can actually protect? Let us say you can protect 10 species. How many job you can create? 50. And what is the price that I am asking? 100.

So that means the first step in any Choice Experiment is to design, is to define product in terms of several attributes. And then we have to specify a level. These 40, 200, 10, 50 100, these are all levels attached with these different attributes.

Now in scenario 1, let us say the hectare is 60. That means the size of the wetland has increased but irrigation, water for irrigation supply is coming down from 200 to 150. And how many species you can protect? 20. How many jobs you can create? 40. What is the payment? 150.

Now if you look at, since the irrigation water supply is coming down from 200 to 150, we assume that number of jobs created is coming down from 50 to 40 but number of species are actually increased from 10 to 20 since you have increased the size of the water body, of the wetland from 40 hectare to 60 hectare. And we are asking the respondents to pay 150 for scenario 1 compared to the status quo situation.

Then in scenario 2 actually, the size is 50 hectare. Then water supply has increased from 200 to 250. And then the number of species that you can protect is actually 15. And then number of jobs is actually 65. Why 65, because water supply has increased from 200 to 250 and then we are asking the respondents to pay 200.

So, that means, here we have created three scenarios. First scenario is status quo; scenario 1 and scenario 2. So now the respondents, we are asking the respondents to select one of these scenarios. As compared to the Contingent Valuation Method, here we are not asking the respondents what is your willingness to pay. Rather the willingness to pay, or the price is already given, is already attached with each of these scenarios. Here it is 100. Here it is 150. Here it is 200.

Now when the respondents are thinking whether to take the status quo situation or scenario 1 or scenario 2 the respondents has to make; the respondents, they have to make some kind of tradeoff between these attributes against money.

So that means if the respondents are thinking to take scenario 1 as compared to status quo, what is the advantage? 20 additional hectare of the wetland, that means size, the respondents are getting more size of the wetland. The respondents are protecting more species. But number of jobs created going down. Number of water supply for irrigation is going down.

So the respondents will think does it make sense to pay 50 additional rupees as compared to the status quo to have 20 additional hectare in size and 10 additional species to be protected by sacrificing 10 jobs and 50 liters of water supply for irrigation.

Similarly, compared to the status quo when the respondents are thinking scenario 2, what is happening? Area of the wetland has increased from 40 to 50. Water supply has increased from 200 to 250. Number of species increased from 10 to 15. Number of jobs created from 50 to 65. And, that means level of each of these attributes has increased. But consumer, they have to pay double the amount as compared to the status quo situation.

So, the respondents will think, does it makes sense to pay these additional 100 rupees to get 10 additional hectare, 50 additional liters of water, 5 additional number of species, 15 additional jobs. So respondents, they have to make a tradeoff between money and against all these attributes.

So, based on their utility or preference; let us say this is option g, and this is option h, this is option k. There are three options g, h and k. So that means, what we can say, whether the

respondent will select option h or g, that depends on which particular option generates more utility to the respondent.

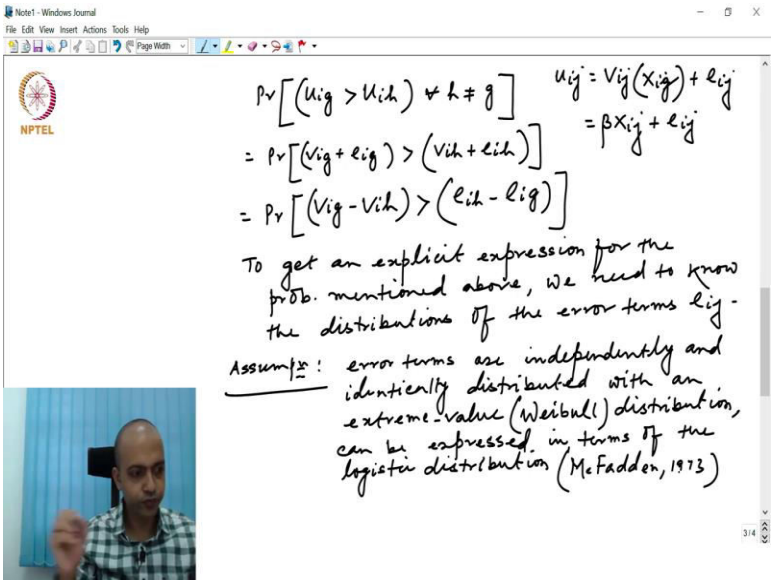
So that means this can be expressed, so that means what we can say that probability of selecting a particular option, let us say g over the option h can be expressed as a probability that the utility out of this gth option is greater than the utility derived from the h option, which is very simple.

So that means what we can say that probability of selecting the option g over the option h can be expressed as the probability that the utility from option g exceeds from the utility from option h, which is very simple. So this is like our previous Contingent Valuation Method.

In Contingent Valuation Method what we are thinking? That whether the respondent will say yes or no for particular bid amount; that depends on whether the utility after payment of a specific amount is greater than the utility what the respondent was deriving in the status quo situation.

Here the same thing. We have designed difference scenarios and we are asking the respondents to select either scenario g or h or k, where g is called the status quo situation. In Choice Experiment we have to always stick to, always keep one option as the status quo. So, then the probability that the respondent will select g over h can be always expressed as the probability that the utility derived from the gth option is greater than the utility derived from the ith option, which is very simple and easy to understand.

(Refer Slide Time: 22:10)



Now, this probability that means in notation what we can write that probability u ij that means the utility derived by the ith individual from the jth alternative is greater than u ih for all h not equals to g. Very simple. This is nothing but probability, and now this utility here what this u ij, like what we discussed earlier in the context of Contingent Valuation Method, this utility has basically two components. This u ij is having two components. One is called V ij which we can observe, that is again a function of X ij, ig, sorry X ij plus an error term.

Now, what is X actually? X here is little different from the way what we introduced earlier. X is basically the attributes. These are the attributes 1, 2, 3, 4, 5. These are the attributes and j is the attributes, level of attributes in a particular option. So that means j here is these; 40, 200, 10 for a particular option. This is let us say, jth option. This is hth option. This is kth option, right, or scenario.

So what you can understand? Utility is a function of V ij which is observable plus some random error e ij. And this V ij is a linear function of X ij plus e ij. So X is basically the attribute at jth scenario. So that means level of attributes at jth scenario we can say more correctly.

So that means this probability is nothing, but if we write, this u ig is then nothing but V ig plus e ig, which should be greater than V ih plus e ih, which is nothing but probability that V ig minus V ih is greater than e ih minus e ig.

Now, for estimation purpose, that means for econometric estimation what we need to know? We need to get an explicit form of this probability. Unless we get an explicit expression for this probability it is not possible to estimate this. How will you estimate this probability econometrically? Because this is an implicit function. This implicit function needs to be explicitly mentioned for econometric estimation.

So that means to get an explicit expression for the probability mentioned above, we need to know the distributions of the error terms e ij. The distribution needs to be known. Otherwise we cannot get an explicit expression for this probability. And unless we get an explicit expression for this probability we cannot estimate this econometrically.

Now what is the assumption we make about the distribution? The assumption is that, we make some assumption about the distribution. So we assume that e ij, error terms, are independently and identically distributed with an extreme value distribution. And this extreme value distribution is also known as Weibull distribution, W e i b u l l distribution, which can be expressed, this extreme value distribution can be expressed in terms of the logistic distribution as suggested by McFadden.