Introduction to Environmental Economics
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Lecture - 34
Travel Cost Method

Hello everyone. Today we will be discussing the last method under this travel cost this reveal preference method that is the Travel Cost Method. So, in the travel cost method as you understand, it is a it is one of these methods under this reveal preference method, we will be discussing in detail that what is the background of the travel cost method, what are the origins and what are the assumptions that we need to take into account and also the dimensions and different types of travel costs and models that we need to discuss.

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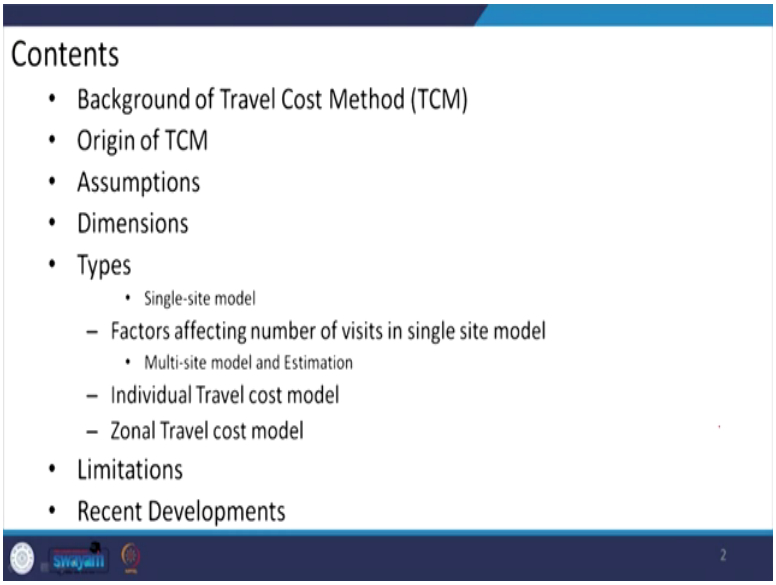

So, under the types we will be discoing what is single site model and under travel cost method and what is multiple site model and how we are going to estimate, how we need to model it and also we will be talking about what is individual travel cost method and what is zonal travel cost method. So, based on the understanding of this typologies of travel cost method in general, we will be discussing what are the limitations of this method and along with the recent developments in this method.

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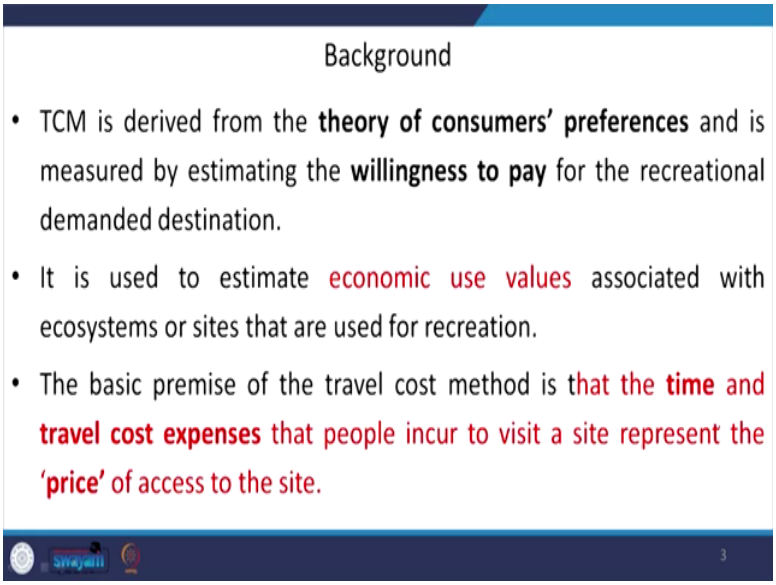

So, let us understand the background of this method. As you understand this reveal preference methods are generally applicable to estimate the huge value of the environment, TCM is also doing the same assignments. And more over the TCM is used in estimating the willingness to pay especially for the recreational demanded destination or the site where the recreational

activities are performed. And again the very premise of the travel cost method is that we need to take into account the value of the time and the travel cost expenses.

And the value of the time and travel cost expenses they are representing or they are the proxy's for the price to access a particular a recreational site.

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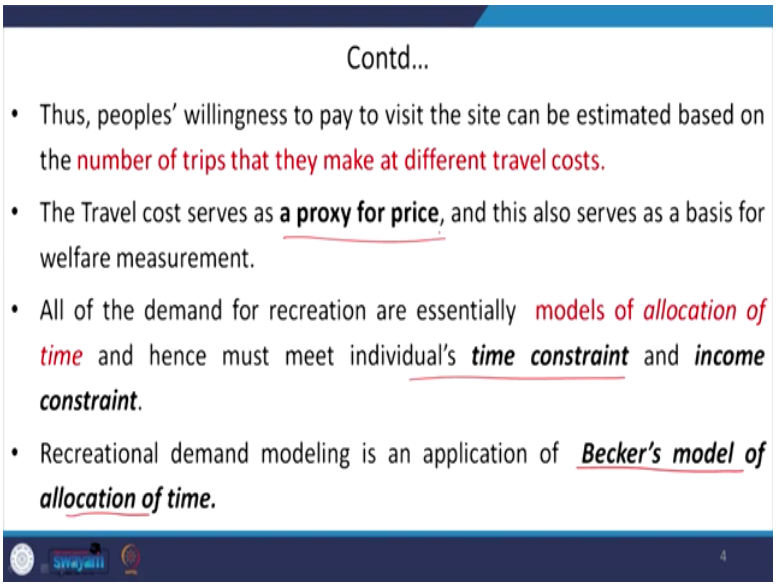

And when we are actually going to these under finings the theoretical framework of this travel cost method, we need to take into account that these travel cost model is based on the application of the Becker's model of allocation of time. So, here we are talking about the Becker's model of allocation of time. So, in if you try to understand the Becker's model, so, it was basically talking about a theory of allocation of time. So, he talked about this theory of allocation of time in an 1965 and based on this understanding he tried to find out how the household times are been allocated and how it can be valued. In this recreational demand we

are also talking about this model of allocation of time and here in allocation of time we are talking about the individual time constraint as well as the income constraint into account.

And as you understand this travel cost the very generic thing is that, the travel cost is serving as a proxy for the price right. And here how we are demanding or how we are estimating the willingness to pay? Here the willingness to pay is estimated or it is based on the number of trips or number of times the and the visitors they visit and the that particular site are different travel cost may be per year or may be 5 years. So, taking into account this theory theoretical framework, the travel cost method or the framework has been modeled.

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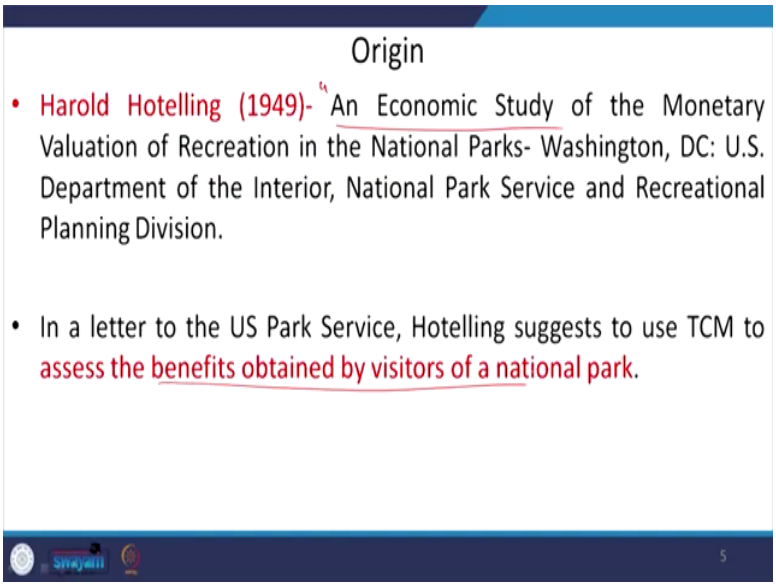

But if you are going to the detail so, for the origin is concerned, we can go back to 1949 Harold Hotelling times.

So, for the first time Harold Hotelling he produced a report to the national US national Park Service and recreational planning divisions stating what is the value of the recreational value of a national park. So, the report titled the An Economic Study of the Monetary Valuation of Recreation in the National Parks. And from there the very travel cost method was originated and it actually talked about the benefits that the visitors they are obtaining from using the recreational attributes from a national park.

So, in related to the US Park Service, Hotelling suggested that we can use a model that is known as the travel cost model to analyze the benefits how the visitors they are assigning and how the visitors they are getting the benefits from a national parks.

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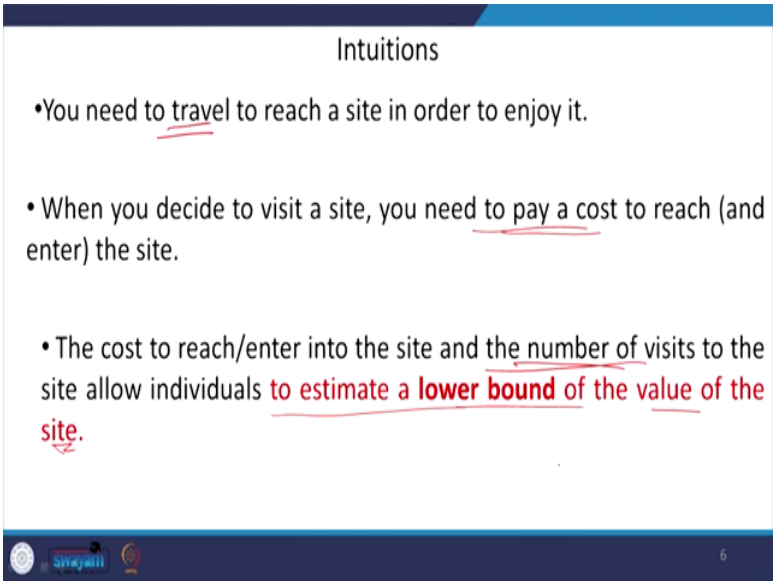

So, it is a kind of public policy, he talked about in order to get in order to have a value of the National Park Service. And his report is based on certain intuitions. So, what are the

intuitions of this travel cost method he talked about in 1945 in 1949? So, for the first time he talked about that this travel cost method is based on common observation or intuition. The first one is that, we need to travel to a particular site in order to have the recreation or in order to enjoy that particular site. So, the basic thing that the visitors they need to do is to travel, we need to travel.

So, for travelling we need to incur certain cost. So, that is why the visitors need to pay a cost to reach the site. And the third thing third intuition he is making in the travel cost method is that, when the traveler or visitor is spending his time and money in order to reach the site. So, the number of visits he is making to that particular site. So, it is actually displaying the lower bound of the value of the site for that individual. So, how many times a person is paying a visit to x site right in a year? It actually displays a lower bound of the value of that site for these for that person only.

So, in this way he, we can actually make a make what is the value of a particular recreational site to different visitors.

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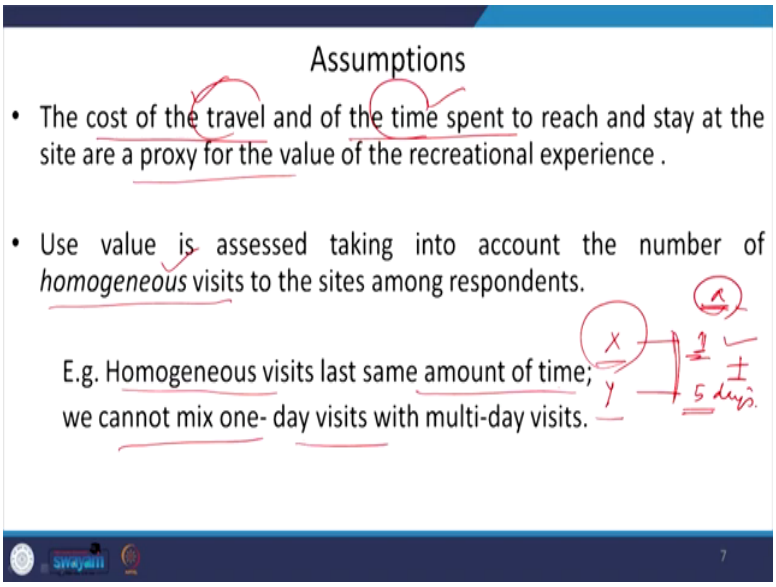

So, based on these intuitions, now for modeling this travel cost method we need to have certain assumptions. So, what are the assumptions we need to take into account? The first thing that we need to take into account is that, the cost of the travel and the time spent both the travel cost expenditure that actually we are spending in terms of monetary units and also the time we are spending that must be taken into account and these two, the travel cost and the travel time they are actually serving as the proxy for the value of the recreational experience, the visitors are obtaining from respective recreational sites and moreover as you understand that recreational this reveal preference methods deal with deals with the use value.

So, here the use value can be analyzed take into account, the number of homogenous visits to that particular site among the different visitors. So, what is this homogenous visits? Because we are saying the assumption is that in travel cost method we need to take into account those number of visits which are set with the homogenous visits by the travelers or visitors. So,

what is homogenous visits? That means, in a in case of homogenous visits we need to take into account the amount of time. So that means, if a particular individual or visitor is paying to a visit let us say A recreational site for one day he is spending one day. And second visitor is there he is Y and he is also spending that particular site, but he is spending the at that particular site for let us say 5 days right.

So, in order to measure what is the value of that particular site we cannot actually take into account, their decisions or they how these two visitors they are valuing this site. So, one is for one is only staying over there in order to enjoy for 1 day and another person is staying for 5 days. So, in that case it cannot be a homogenous visits rather than it is a heterogeneous visits.

So, in order to estimate the value of this particular recreational site, we cannot actually makes the number of visits with respect to homogenous visits and heterogeneous visits. So, we need to only take into account the homogenous visits. So, whose over is whose over is actually spending at this site for only 1 day we are take into account for our analysis only.

So, we cannot make 1 day with multiple days visit for modeling the travel cost here.

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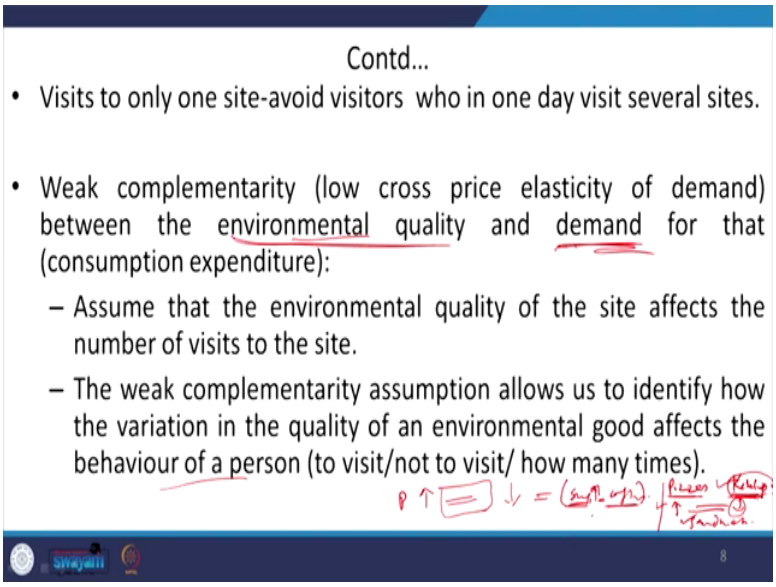

And another assumptions that we may we need to take into account is the existence of weak complementarity between the environmental quality and demand for the environmental quality. So, what is weak complementarity? So, in general we say that in case of complementarity, we need to understand that when the price of the first good increases when the price of first good increases, if the demand for the second good decreases right then we are saying that there exists some kind of complementarity.

So example is that, let us say sugar and coffee right. So, it may happen that when the price of sugar is increasing, it may have impact on the demand for the coffee because we generally take coffee with sugar. So, this is something like different nowadays sugarless coffees has been demanded that is something different thing, but we are assuming that coffee is always demanded with sugar.

So, in this case sugar and coffee can be the example of complementarity, but what is weak complementarity? So, weak complementarity can happen. So, when we do have a low cost price elasticity of demand. So, technically defined when we are finding low cost price elasticity of demand or low cost elasticity of demand, then you are saying there exists weak complementarity. So, in this case we are taking into account weak complementarity between this environmental quality and demand goods.

So, first of all understand what is this weak complementarity with respect to now our which is technically defined as the low cost price elasticity of demand. So, here we can take into account let us say the case of pizzas with ketchups right. So, when and you understand that when the price of pizzas are increasing in this case you are saying that the demand for ketchup can be decreased.

So, if this is the case, then here in case of weak complementarity it should happen that in because we understand there exists some complementary relation. So, this will happen, but in case of these if there is some relations like that, this ketchup is also demanded for taking sandwich right. So, in that case what will happen, although price of pizzas will be increasing, but it will not be its repercussion will not be reflected in the ketchups demand because this ketchup is also demanded for taking the sandwich right.

So, in this case the price of pizzas increase in price of pizza may not reflect in the demand for ketchups right. So, this is the case of the weak complementarity, although the complementarity relationship is existing between these two goods, but still it is a case of weak complementarity of goods. So, likewise in this case environmental quality and demand we are assuming a weak complementarity not very high cross price elasticity of demand to exist.

So, in this case we can assume that the environmental quality of the site, it can affect the number of visit to the site, but not very strongly. And this weak complementarity assumption it can allow us to identify how the variation in the quality of an environmental good can affect the behavior of a particular person right that whether to visit or if visiting is not actually a

very stricter sense it is not affected, then you can say whether how it is how it is impacting the visit.

Suppose, say earlier when the quality of the environment it is very it was very good, the in the frequency of visit is very high right. So, may be 10 times in a year the visitors were visiting when the environmental quality let set to a particular marine beach. So, when the quality of this marine beach is very good, then people used to visit often, but now we are saying that because the quality of this beach now is has been degregade that is why people may prefer to visit less right.

So, earlier if the average visitation rate is 10 times for a year, now it has decreased to only once. So, this is a case that the weak complimentary assumption, it can identify how the variation in the quality of an environmental good it can also affect the behavior of a person whether to visit or not to visit and if they are visiting at all then they may reduce or may increase the their visitations.

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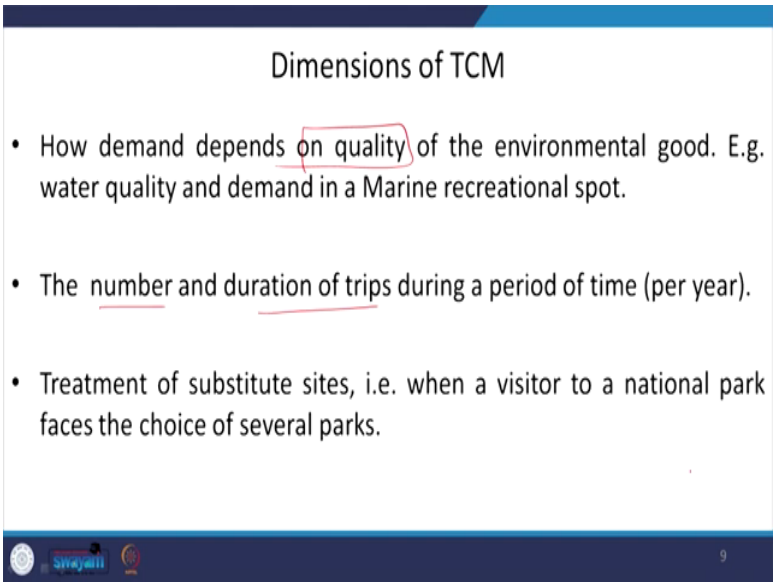

So, based on these assumptions, now we can talk about three dimensions of the travel cost model. So, first thing that we must understand that how demand is depending on the quality of the environmental good right.

So, let us say that if the environmental quality or even the water quality of a particular marine recreational spot is good, then the demand for this marine recreational spot will be increasing. Then the first thing that we are saying that the demand will be depending on the quality of the environmental good and the second thing that we are also talking about that the very number and duration of trips during a period of time that must be considered may be per year that how many times we are actually paying a visit. And the third one that we must take into account in the travel cost model is the statement of the substitute sites. So, whether there is, is there any other alternatives sites available to with that particular site in discussions.

So, when a visitor to a national park faces the choices of many so, many alternatives like other national parks are also existing in that locality, then we need to actually take into account this substitute site for estimating the true value of this recreational value of that particular site in discussions.

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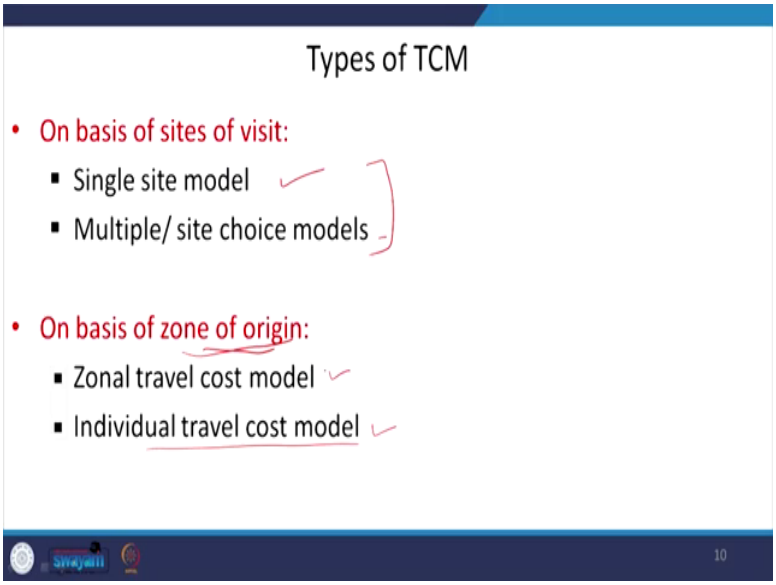

So, based on this dimensions that what are the three dimensions that we must take into account in the travel cost method? So, here we can actually have a framework. So, for the typology of the travel cost method is concerned. So, we can divide this travel cost model broadly into two categories, the based on the sites of visits and based on the zone of origin. So, when you are talking about the travel cost methods based on the sites of visits, we can analyze the travel cost method in terms of single site model that whether the visitors are

paying a paying a visit to a particular site or there are so, many alternatives sites existing. And the second one is multiple site or alternative sites.

So, where the choice is available and the visitors may go for choice that which site to visit. So, based on this understanding we can; however, travel cost model framework. And the second category of the travel cost model can be on the based on the zone of origin. So, in the in terms of zone of origin we can also discuss the travel cost method in terms of the individual travel cost method where, irrespective the of the zone of origin that from which zone the visitor is belonging we can take into account the behavioral factors that are affecting the travel and number of travel of that particular individual. So, if it is so, it is known as the individual travel cost model.

Likewise in case of the zone zonal travel cost model, we are not talking about the individual travellers characteristics rather than we are we are talking about the zonal characteristics of the travellers that from which zone from which locality the travellers are coming to a particular recreational site in discussions.

So, now, let us discuss the first one that is single site model. So, in case of the single site model as you understand, the demand for recreation of a particular visitor is estimated during a period. So, preferably a year or for 5 years.

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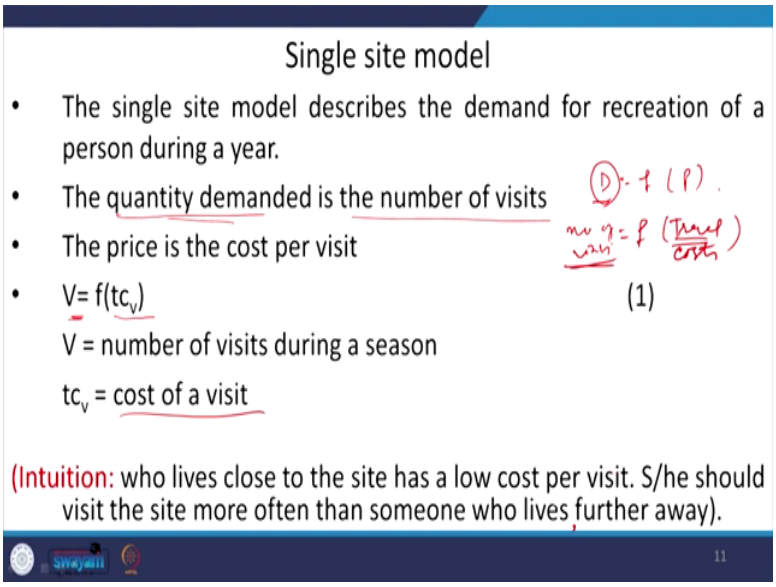

So, here the quantity demanded is nothing, but it is expressed in terms of the number of visits how many times a particular visitor is visiting to that particular recreational sites in a year. Whether 2 times 5 times 10 times or how many times. So, that is the demand the visitor is putting on that recreational as part.

So, here take into account the same demand price relationship. So, as you understand that demand is a function of price right. So, here if you are taking into account the demand as the number of visits. So, now, number of visits will be a function of the price. So, what will be the price for the number of visits? So, it will be in terms of the travel cost, the visitor should be in incurring during their travel. So, simply say that take into account this price demand relationship, you can express this a functions that v equal to a function of t c v. So; that

means, that is number of sites sorry the number of visits the visitor is paying a visit to this particular site depends upon the cost of the cost of these visit.

So, here the very intuition that we are taking into account that if the visitors are leaving close to this site, then it has a low cost expenditure per visit. So, if the cost of visit is less then, obviously, the person would be interested to pay more number of times to visit that particular place and vice versa. That means, if a if a person is living away very away from that particular site then it is very likely that he or she would be paying less number of visit to that particular site in a year or in whatever the time duration in consideration.

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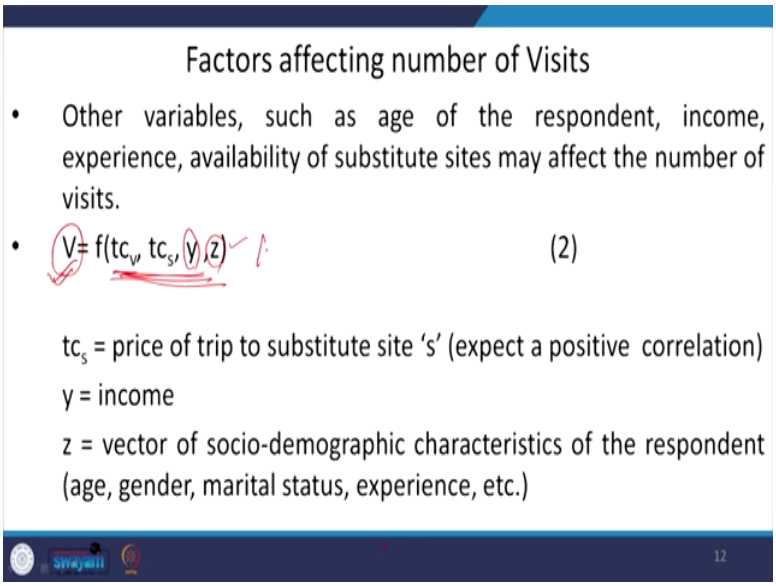

So, understanding this price demand relationship in case of this recreational destination, we can find out what are the factors affecting this number of visits. Why a visitor is visiting this

particular site let us say or twice a year and there are certain visitors they are paying a visit like 20 times in a year.

So, what are the factors that are that can affect and that can explain and this behavior of the number of visits of this visitors? So, here the literature in the travel cost model we explore and we found that, we can take into account certain variables in order to explain this behaviors. So, after getting into account all these variables into consideration, we can now say that the factors like. So, here V equal to number of visits to that particular sites.

So, it can be affected by the variables like the income, income of the individuals and the socio demographic characteristics of the individuals like what is the age of this particular person or what is the marital status or what is the gender whether she is male or female and what kind of experience is she is having. So, we need to take into account this vector of socio demographic characteristics of this person which is represented by Z in addition to his or her income.

Moreover, we need to take into account the travel cost to the substitute sites. So, if there is some alternative sites available and the visitor is only visiting to this particular site in considerations. So, apart from this we need to take into account the travel cost expenditure, that what is the medium of conveyance he is he is taking and what is the total cost he is incurring for visiting this place from the place of his residence. So, these factors are actually explaining that how many times the person would be would be paying a visit to this particular places.

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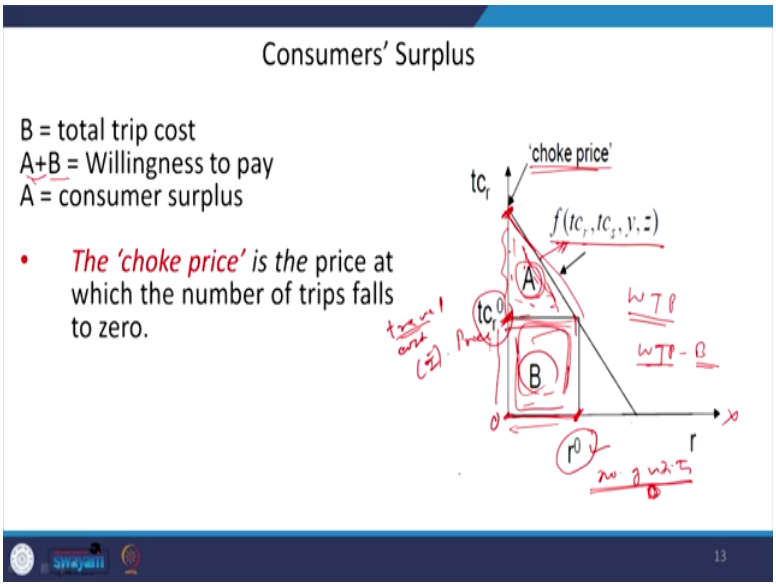

So, based on this understanding that what are the factors that can explain the behavior of this the visitors to visit the particular site, we can now estimate though the well being or consumers surplus or and also in terms of willingness to pay from this recreational demand.

So, as you understand that if we can systematically represent this in terms of a diagrammatic representation. So, here in the in the horizontal axis X, we are representing the number of visits and in the vertical axis we are measuring the travel cost in terms of monetary units let us say in terms of rupees. So, in the previous a slides what we have discussed? We have discussed the number of this is a demand functions, number of visits is a function of all these variables.

So, this demand function we have drawn right. So, this is number of number of visits. So, this demand and this is the travel cost. So, based on this understanding that now this will be this

function, this curve would be this functions. So, now, based on the very principles of the micro economics, what you can find we can find that at r 0 number of digits the travel cost incurred is t C r 0 right.

So, based on this understanding that now t C r 0 is the price for paying r 0 times of or r 0 number of visits to this particular site. So, based now we can find out that if the price is this much 0 t C r 0, then the total trip cost would be how much? For visiting this r 0 times to this particular site, then the trip cost would be this much this area which is represented by B. But the visitor he was actually willing to pay how much? This area plus this A area right for visiting the site r 0 times of visit to this particular place.

So, his willingness to pay now would be this area A plus B area this is nothing plus, but what you are saying? Willingness to pay in order to recreate in that particular site. But what is consumer surplus here? Say consumer surplus is your willingness to pay minus what exactly you are paying. So, what exactly you are paying is in terms of spending in terms of your travel cost. So, that is B right. So, willingness to pay that is A plus B minus B equal to your consumer surplus.

So, this area this triangle which is represented by A is your consumers surplus. Now you can understand what is the choke price here. So, what is the choke price? The price at which the number of trips it will be reduced to 0. So, number of trips. So, we are talking about this r 0 number of trips. So, when this r 0 number of trips will be reduced to 0 that will falling back. So, if the price for visit would be for our visit would be this much right.

So, at this price t C r your number of visits would be reduced to 0 and that is why this t C r price is known as the choke price, where the visitors would not be interested to visit at all because the travel cost or the a total expenditure is too high. So, in by explaining this we can also find out the consumer surplus from the from the equation 1 from the this demand function.

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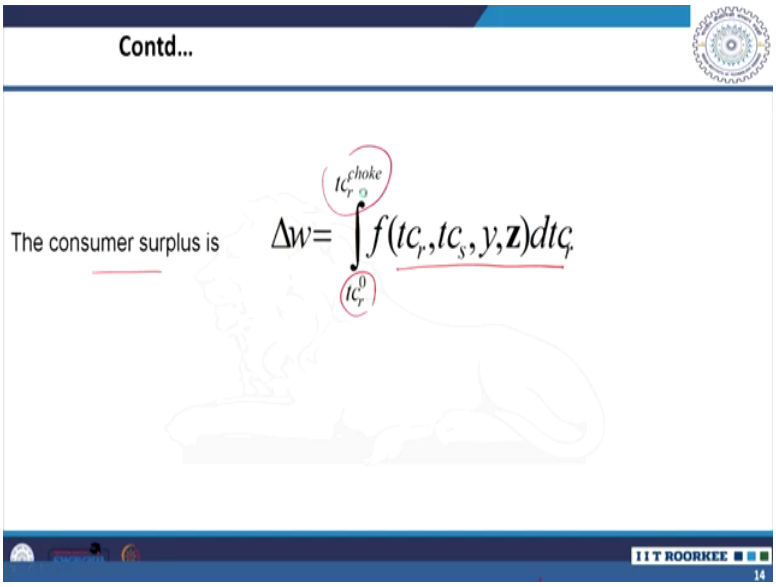

So, here what you are doing? We are just taking into account the integration of this demand functions by taking into account this definite integration t C r 0 to t C r from the choke price. So, if you are integrating this demand functions right and you are definite defining this limits from t C r 0 to t C r, then this area is known as the consumers surplus.

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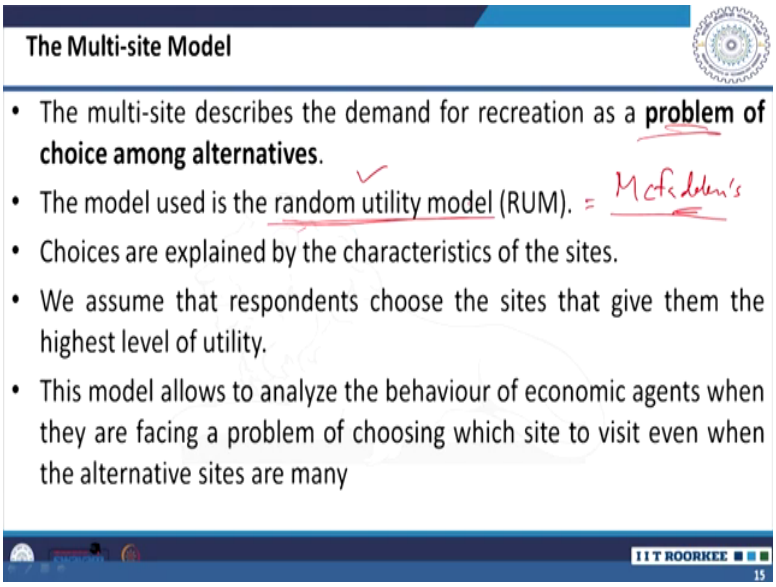

So, this is the case of your single site, now let us discuss about what happened to what happens in case of the multiple site; that means, the person is actually visiting a number of sites or number of similar sites. So, in case of this multiple sites, the demand for the recreation is a problem of choices right. So, which destinations the visitor need to visit and if this is a problem then it can be solved by using the random utility model.

So, you can just explode Mcfedelens Mcfedelens theory discrete theory. So, there you can actually find out that how to how to solve which destination to be to be visited based on this theoretical understanding of the random utility model. So, here what happens exactly? The choices are explained by explaining different characterization attributes of those sites and we assume that the respondents will be choosing those sites that will be giving them the highest number of utility right.

Based on this understanding this random utility model will be will be allowing us to analyze the very behavior of economic agents, when they are facing a problem of choosing or alternatives are be there and when alternatives would be many then which one is to be chosen.

So, that is what this model will be will be helping us to analyze. So, based on the second categorization of travel cost method that is whether it is the individual travel cost method or the zonal travel cost method.

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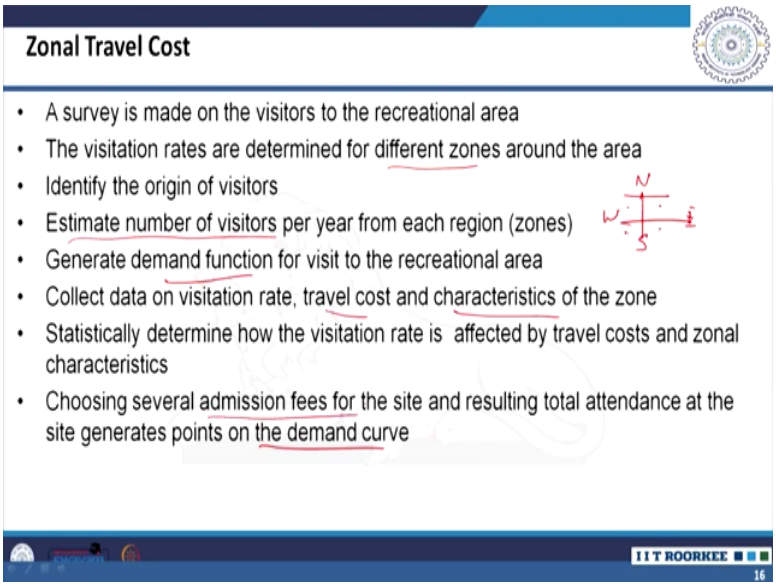

As you understand in individual travel cost method what we are what we are taking into account? We are just take into account the behavioral aspects of a particular individual traveler, that we have already discussed in terms of your single site model.

So, the similar can be applied to the individual site in discussions. But in case of the zonal travel cost we need to take into account the visitors from different zones right. So, now, the visitation rates can be determined by take into account different zones around those around that particular recreational area and we can identify the origin of the visitors. So, based on this identifications the we can also estimate the number of visitors per year from each zone of regions.

So, whether people are visiting let us say people are visiting this (Refer Time: 31:16) national park only from the northern region of India or southern region or western or eastern regions. So, based on this region analysis we can actually divide their origin of visitors and we can estimate the number of visitors per year from different zone zones.

So, based on this understanding we can also generate the demand functions, then we can collect the data on visitation rates that how many times from each of the zones from north south east or west that travelling to this particular national park per year based on their travel cost and different characteristics of the zones. And then we can statistically determine that how the visitation rate is affected by the travel cost and other zonal characteristics right. So, we can also take into account different admission fees or entry charges for the site and we can also get the demand curve based on this on this on different entry fees.

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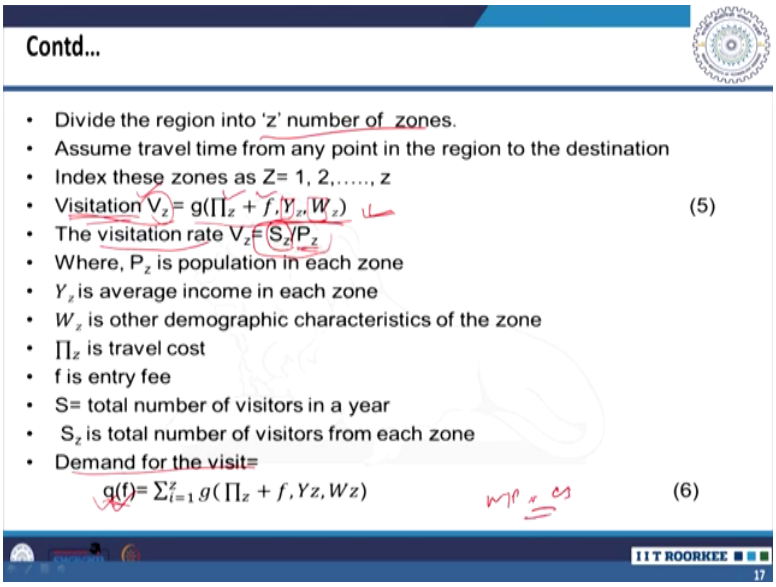

So, we can say that if you are dividing this these zones of origin of visitors into z number of zones then what we are doing? We are naming these that z stands for 1, 2 3 up to z right then we are the next task after finding after grouping this visitors in terms of different zones what we need to do is to find out the visitation rates.

So, in visitation rates as you understand that it will be affected or it will be influenced by certain variables. So, the visitation rates it is we can find out by dividing the number of visitors that is aged with the population in each of the zones. So, by doing the this exercise we can find out the visitation rate from each of the zones. Then we need to take into account the entry fee, the travel cost, then we need to take into account what is the average income from each zones and we need also the dataset from the other socio demographic characteristics of the zone.

So, now, based on this understanding we found we can actually express this visitation rates into in terms of this variables. After doing this exercise we can find the demand for the visit. So, demand for this visit we can find out from this function itself right.

So, once we are doing this demand for the visit we can actually find out what is the willingness to pay then we can also find out what is the consumer surplus from this demand functions.

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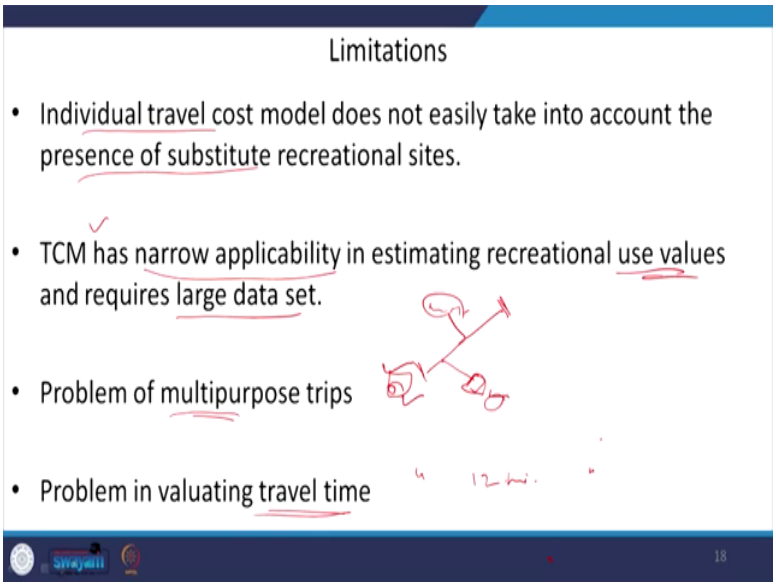

So, now this is the whole of the understanding that how the travel cost model would be looking like and what are the different components that we must take into account. And now let us talk about what are the limitations of this travel cost model as the as one of the methods under this reveal preference category.

So, the first limitations we are finding is that, this is only this can be this method can only be used in measuring the use value of the environment. So, this individual travel cost model it is not actually take into account the presence of substitute sites, because we understand that there may be some choices and in that case this individual travel cost model it is not successfully dealing this presence of substitute sites. Moreover this travel cost model is having a narrow applicability, because it is only applicable for using this for modeling this use values and moreover it is requiring a large number of dataset. As you understand we need to take into account what is the income level, what is the socio demographic characteristics, then how many times the person is paying a visit to this national park and what are the other cost is incurring during this travel.

So, we need to take into account a very large set of data in order to estimate this travel cost model. And moreover we do have this problem of multipurpose trips. So, what is multipurpose trips? That means, when you suppose say you are actually paying to this national park visit to this national park and during the same trip also you have your you met your friend you are planning you have already planned and you met your friend or during this same trip you also planned to attend a marriage function of your cousin right.

So; that means, that the very trip is the same trip and there we are attending a function, you are meeting your meeting a friend and you are also recreating in a national park. So, there we can actually it is very difficult to find out. So, what is the true value of the travel cost that we are putting only for this recreational visit?

And moreover in literature we have the travel cost we are finding a very difficult in evaluating the travel time, how to measure the time that this is the time you are you are spending. Let us say 12 hours you are spending in just in travel and what is the value for this travel how to measure it? So, there is a lot of controversy and debates on going in this travel time.

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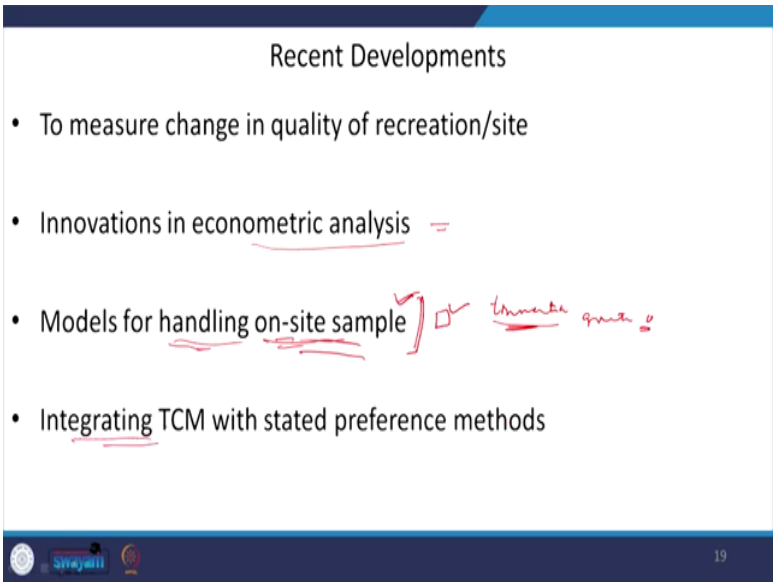

And in addition to these we have made some developments. So, the recent developments on this travel cost literature can be that, we can now measure the change in the quality of recreation or sites and there have been certain innovations in the econometric analysis, recent advancements are there and for example, we have developed that how do we handle the onsite sample; that means, when the person is paying a visit to that site and you are take into account his or her data and you are sampling this particular person on site, then there are certain issues like your saying the truncation problem will be there, then and how to deal with this truncation problem.

So, for this reason we can we have developed certain econometric analysis that in truncation problem when you are take into account the onsite data; that means, the how many times the the visitor would be visiting. So, it would be certainly greater than 0. Because this is the first

time when you are saying on site then; obviously, this is the first time at least you may actually visit n number of time, but at least the visitor would be visiting just 1.

So, this problem would be there in case of when you are counting the number of times the visitor is visiting that particular site and moreover in recent developments also we are finding we are integrating this stated preference method with travel cost method that can also be useful in validating the results.

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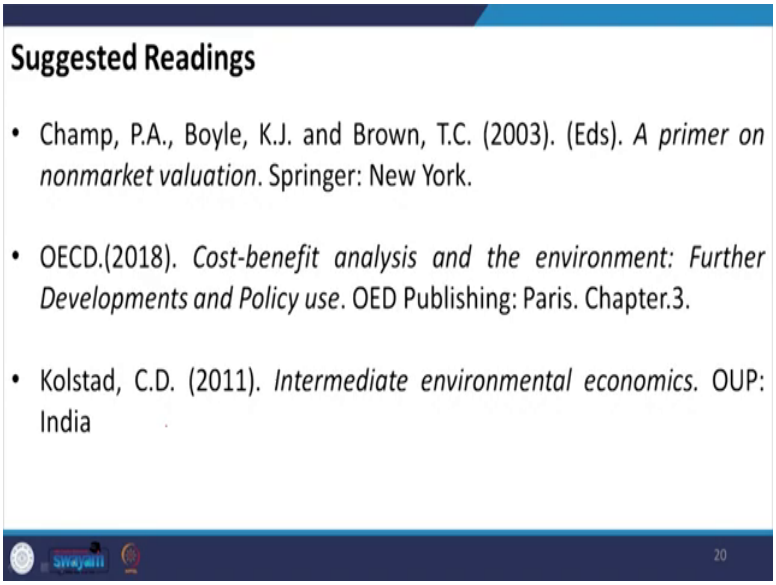

So, these are the suggested readings that you must actually go through in order to understand this travel cost model as a basic

Thank you very much.