Energy Resources, Economics and Environment
Professor Rangan Banerjee
Department of Energy Science and Engineering
Indian Institute of Technology, Bombay
Lecture 10
Preferences and Utility

We have looked at the resources. We have also looked at a model by which we can identify how the non-renewable resources would get utilized. We have just finished the Hotelling model. We now switch tracks, we are going to now move into Environmental Economics and we are going to look at how do we tradeoff between energy, development and environment. Before we do this, we need to understand some basics of demand and we will talk about preferences and utility. So, we will introduce some simple concepts where we talk about preferences and utility.

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Now, in general, in life we are always encountering choices and we have in these choices we always have preferences. So, when we talk in terms of economics, we would like to quantify these preferences. So, we would like to rank the preferences between bundles of goods and services so, to simplify things, we will look at two goods, x and y and we are talking of goods but it could be goods and bads, that means it could be pollution, it could be garbage, but in general let us look at if we are talking of two goods x and y, how do we choose between those goods and then we want to understand consumer choices and preferences.

This is a whole field in itself but we are just going to look at the basics of it and use it and quantify it and then use it to see how we can make tradeoffs between different choices. So, we look at it start with first looking at individual choices, and then we will come to when we aggregate these individual choices into a societal choice.

So for simplicity, let us look at two goods x and y, these goods could be wine and cheese, that is the examples which is taken in the book by Kolstad on Environmental Economics, pizzas and movies you will see if you look at different kinds of lectures which are available, people are talking about pizzas and movies and sometimes when you have a

fixed amount of money, which you want to spend and you want to enjoy a movie or you want to you want to see the movies or you want to have pizza or do you want to do both, and we look at that.

And in a similar fashion, we take these two goods as things that we can relate to, but we can translate that finally to resources, energy use and environment. In the case of preference relation, we have some properties.

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The first property is that there is completeness that means each individual knows his or her preference between a different set of goods. At most one can say that, we are indifferent, these two are equivalent, otherwise I prefer this to that or I prefer the other one and so on. So, it is not that we to be left ambiguous that is in terms of completeness of the choices. Then the second is that there is a transitivity we have, that means the preferences are rational.

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For instance, we create a suppose we say that you prefer, suppose I prefer apples to oranges. So, this symbol which says apple is preferred to orange and suppose orange is preferred to bananas. If the preference is rational then it will be transitive, that means if A is preferred to B and B is preferred to C then A is preferred to C which means that apple would be preferred to banana.

So, this is the second part we talked about completeness we talked about transitivity. The third assumption for preference relation, the property is non-satiation and this is not always correct assumption in real cases, but for the economic calculation, we say that more is better. That means, if you have, if you watch two movies it is preferred to watching one movie.

If you are having two pizza better than one pizza and so on. So, that the idea is that it is monotonicity, there is no satiation in actual practice, you know that after a point you stop, you do not have any hunger and you would not want to. So, there would be satiation but for all the in the economic utilities context, we talk of non-satiation.

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So, in the preference relations which we have, now we have the following possibilities. We had this sign where we talked about x preferred to y, this is a strict preference that means x is always preferred to y and the weak preference is where x is preferred to or equivalent to y this is a weak preference and x this is an indifference relations which means that the consumer feels x and y are equivalent and this is called indifference.

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So, with this we would like to introduce this concept of, we talked about transitivity and non-satiation, we would like to look at these preferences.

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So for instance, if we look at the, if you are talking of 3 points, in the case of A you have 1 movie and 2 pizzas, here we have 2 movies and 1 pizza and C is where you have 2 movies and 2 pizzas. As per the non-satiation C would be preferred to B and C would be preferred to A.

Between A and B, we have to then decide it will depend on the individual. And suppose, both are equivalent for the individual, then we can say that A and B we are indifferent to this, we can join a set of all points where which are equivalent to us and that is called the indifference curve. Of course, here we are talking of discrete values, but in general we can look at a continuous kind of curve.

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And this is the indifference curve is a set of consumption bundles that the consumer think are equally good. She or he are indifferent to the consumption bundles that means if you have consumption bundle X indifferent to Y, this set of these points is provided by an indifference curve and this X could have a whole set of different goods and Y could have another set of different goods.

Of course, we are looking at initially just looking at to simplify things, we are looking at two different goods and the combinations of that.

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So, for instance in that example that we talked of in pizzas and movies, if you said that 2, 1 and 1, 2 are equivalent, then we have an indifference curve here and this with 2-2 is on a different curve and the utility or the value that I get from this is higher than the value that I get from this.

So, this is based on the fact that there is non-satiation, so, the utility is a mathematical way to represent the value that the consumer assigns to a particular good or a bundle of goods and services and this the indifferent curve represents a locus of constant utility. And so, this is utility is equal to constant this is, and the utility increases in this direction so, this is the basic way in which we represent consumer choices.

And let us look at some of the characteristics of these indifference curves. So, let us look at this whether or not it is possible for two indifference curves to intersect, based on our initial principles, if you said all the points on this indifference curve will have the same amount of utility and all points on this indifference curve will have the same utility.

So, which means that if we take the point which is intersecting that is X and compare that with Y these would have the same value of utility. On the other hand, if we compare that with Z, Z will also have the same value of utility as X. But if you look at these two points, Y based on non-satiation the value of utility at Y is greater than that at Z, which means that we have violated this.

So, the indifference curves will not intersect, they will be, in general they will be parallel to each other, they will would intersect. So, this is not possible.

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The other thing is that, is it possible, let us look at this, it is not possible to have an upward sloping indifference curve, again this goes based on the fact that we have the non-satiation, also it is not possible to have a thick indifference curve.

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So, the way in which we will have in general utility shape of the indifference curve would be such that it would be convex, which means that instead of having a combination of two goods and services will have higher utility than the individual amounts of goods and services. So, this is the characteristic of convexity.

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Let us now define what is utility? Utility is an economic term referring to the total satisfaction received from consuming a good or service. In many cases we try to quantify some of these things by money, but in general we are looking at it as an expression by which we look at the satisfaction received from consuming a good or service.

So, if we, what is the utility that we have by consuming an apple or consuming an orange and we said this is dependent on the preferences, this is dependent the individuals choice and when we have this and we can quantify it, then we can look at two different individuals, their choices and look at the utilities which are obtained. So, in general the utility is a function of the amount of consumption, it is a mathematical representation of a preference relation.

There are many different possible utility functions and in the tutorial will give you these you can cross check, whether these are convex and whether they can represent the utility functions. And you can see these are some of the functions which are there and which have been used in literature, in mapping some of the utility.

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What are the properties of the utility functions? So, the first one is independence, the utility is dependent only on the choice between those goods. Completeness, we said that, yes, it maps the entire range of choices. Transitivity, we saw the transitivity of the preferences and now transitivity is therefore the utility function. Continuity and there is an, it is an increasing function with the u dash x greater than 0.

The other point which is to be remembered is that in general, in principle we consider them as ordinal not cardinal that means we rank our preferences, we say that an apple is

better than an orange or is preferred to an orange, but we do not say we will not like to say then an apple is 50 percent more than orange so, we do not convert it into that kind of thing. But in many cases, when you look at the kind of calculations is done this assumption is often relax.

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So with the result that you create something like a utility function we want to also now calculate the change in utility per unit of additional goods. So, that means we can look at what is del u by del x. And if you look at the change in utility per unit of additional good, the question is should this increase, decrease or remain constant? Think about any context and you can understand how this will change and there is this law of diminishing marginal utility.

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And that if you see, so for instance, there is this example which is given by Serrano and Feldman, where we are looking at and there is a rich tourist who is stranded in a desert, it is hypothetical context and there is a monopolist who has bottles of water and the tourist has 100 units of money available with her and we see that, you are really thirsty so, for the first bottle of water, you are willing to pay a significant amount, that means 25 units.

For the second bottle, you are willing to pay less for the third bottle even less and so on till the point so, basically what happens is for every additional good that we have, we are actually, the utility of that good diminishes. So, del u by del x actually decreases as it go, as you go ahead and so this is the law of diminishing marginal utility.

And we can also then see that what happens if we talk about two goods and we have a utility function of these goods.

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We have this curve where we are shown x, or let us put this as y and x and you have U as a function of x y, we have U as a function of x y, we want that we have a fixed amount of resources. That means for x, there is a price of x and there is a price of y and there is a final budget that we have.

So, we can say that we want to maximize the utility that we have, maximize U as a function of x, y subject to the total amount that we are willing to spend on both these goods. So you may have a budget on each of these, we can say that let us say Px into x, Py into y less than or equal to B. So, we want to maximize U x,y subject to the budget, the total expenditure on x and y should be less than the budget that we have.

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If we take that then we can create again the Lagrangian, which will be U xy plus lambda B minus Pxx. So, if we look at this we can differentiate this and what would we get? We would get del U by del x minus lambda Px equal to 0 by del y, del U by del y lambda Py is equal to 0. So, we can write this as lambda is equal to del U by del x by Px lambda is also equal to del U by del y by Py.

If we equate this, what would we get? We get and you can see this essentially what you will get is del U by del x by del U by del y is Px by Py.

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And this is essentially giving us the marginal rate of substitution and the marginal rate of substitution is the how much of x which we will marginal rate of substitution when we look at if we move on the utility curve and we have a change where the utility remains constant then this gets minus delta x2 by delta x1 and this will be marginal utility of 1 by marginal utility of 2, this is going to be equal to del U by del x1, by del U by del x2.

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So, this is the marginal rate of substitution, in the equation, in the utility curve that we had we get x y, then we had the utility curve, what we found with respect to the budget constraint is that you would have a line which is tangential to the utility curve, which is maximized and with the slope which is the ratio of the prices and this will give us the optimum point. And then with this now we can see that what happens if the prices change, what happens with the utility changes.

And in the tutorials will take a few examples where we can look at this, you can look at. Of course, in the case of indifference curve, we can we can also look at indifference between environment and resources and this is what we will go to.

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There are a number of different resources that you can use for this section. And you can look at the any of these, there is a book by Kolstad there is some lecture notes in the open coursework, in MIT and then the lecture notes in Serrano and Feldman. And this will give you an idea of preferences and utility.

We will next look at when we want to take these preferences and we want to aggregate these preferences and we want to look at societal choices and societal choices between environment and energy and resources and economics and we will link this all up in the next section. Before we do that, we are going to look at the philosophical basis by which we make decisions.

So, we will take a look at the different kinds of ways in which we can take philosophical decisions related to the environment, what are the kind of choices which are there, then we will look at the Kenneth Arrows theory of social choice.