

Business Data Management
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Utility: Cardinal vs. Ordinal Indifference Curves

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Consumer Behavior and Markets



So, last session we saw how data is important in understanding the working of an economy and we try to understand the economy in terms of production, consumption, distribution, and resource allocation. Today, we shall try and see some formal theories in terms of consumers' behavior and analyze markets in an economy.

When I say markets, what we shall do today is to see a typical market. From here we might actually extend our analysis to different types of markets later on. So, this is an interaction or a prelude to such an analysis.

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The Theory of Consumer Behavior



The principle assumption upon which the theory of consumer behavior and demand is built is:

a consumer attempts to allocate his/her limited money income among available goods and services so as to maximize his/her utility (satisfaction).

Useful for understanding the demand side of the market.

Utility - amount of satisfaction derived from the consumption of a commoditymeasurement units \Rightarrow utils



Now, let us start with a basic theory building in terms of how consumers behave. Now, the principle assumption upon which the theory of consumer behavior, as well as market demand, is built is that a consumer has very limited resources available, in terms of income, money that is available and the consumer has or would be interested to allocate this limited income among available goods and services to maximize his or her utility.

And if I put in other terms, it's satisfaction. So, the consumer's problem then is to utilize these resources that are available to a variety of goods and services, which he or she would like to consume. That is a kind of resource allocation problem as far as the consumer is concerned.

Now, this is extremely important in understanding the demand side of the market and from there to understand the demand side of the economy. Let us go in a very step-by-step manner in terms of understanding what the theoretical foundation for this demand analysis is. The concept with which we begin today is the concept of utility itself because the utility is the amount of satisfaction derived from the consumption of a commodity, and consumption then is a function of this utility.

We talked about many examples in our previous session in terms of how a typical household consumption basket varies across income groups. This variation across income groups is because consumers assign different utility or different levels of satisfaction across various consumption baskets.

We also know that this whole concept of satisfaction of you or utility is very subjective. And the differences in satisfaction across consumers are vastly different. So, we need to have a common denominator to measure that. And that is a big problem because there is no standard common denominator with which we can measure this, or there are no units with which we can measure this.

Hypothetically, let us take for the sake of convenience that utility can be measured in “utils”. So, utils is a unit for measuring utility, then our task becomes slightly easier, because a consumer would measure utility in terms of “utils” across different consumption baskets and then allocate the income accordingly. Let us push this argument a little forward.

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Theories of Consumer Choice



Utility Concepts:

- The Cardinal Utility Theory (TUC)

- Utility is measurable in a cardinal sense
- **cardinal utility** - assumes that we can assign values for utility. E.g., derive 100 utils from eating a slice of bread

- The Ordinal Utility Theory (TUO)

- Utility is measurable in an ordinal sense
- **ordinal utility approach** - does not assign values, instead works with a ranking of preferences.



If we are to understand the concept of utility, then within this framework of that there is some unit called “utils” then, there are two approaches to understanding: the cardinal utility theory and the ordinal utility theory. What is the difference between these two? Well, in the cardinal utility approach, utility is measurable in a cardinal sense. What do I mean by Cardinal sense?

We can assign values for the utility that are 100 utils can be derived from eating a slice of bread, 200 utils can be derived from having a cone ice cream. So, that is the cardinal approach. That is, I repeat that we can assign values for utility. In the ordinal utility approach, as the term itself denotes, it is measurable in an ordinal sense. What does that mean? It means that we cannot we are rather, we do not assign values; instead, we can rank our preferences.

And once when you rank preferences, we know our preferred choices. So, which should come first is a priority or a preference in our scheduled time. So, if I enjoy eating more ice

creams, rather, if I derive more utility from the consumption of ice creams, then my preference for ice creams over a slice of bread will be stated in my commodity basket that I am consuming. So, two broad approaches: the cardinal utility approach and the ordinal utility approach.

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The Cardinal Approach



Nineteenth century economists assumed that utility was measurable in a cardinal sense, which means that the difference between two measurements is itself numerically significant.

$$U_x = f(X), \quad U_y = f(Y), \dots$$

Utility is maximized when:

$$MU_x / MU_y = P_x / P_y$$



Now, let us take a closer look at each one of these. It is a very simple concept because we can build in terms of a demand curve. The Cardinal utility approach was actually put forth by economists of 19th century and assumed that utility is measurable. And there is a unit for anything to measure; we need a unit.

Which means that the difference in between the two measurements is in terms of a very significant numerical value. What do I mean by that? What I mean is that suppose I am consuming two commodities, X and Y. The utility, which I derive from consumption of X can be put as a function of X, how much I am consuming and the satisfaction that I am deriving. And I have another commodity that I am consuming Y, and the utility that I am deriving from that is a function of how much I am consuming of Y, then I will decide which one is giving me maximum utility.

But that is not a unilateral decision that I can take for two reasons. Reason number one is that I have limited income or limited resources with which I have to fulfill this consumption. So, I have to allocate these limited resources. Reason number two, this allocation of resources is a function of prices.

Some commodities have a higher price, and some commodities have a lower price. So, I do the allocation in terms of prices as well as the income that I have. Now, the cardinal approach then argues that well, there is a concept called marginal utility. We will look at the marginal utility of consumption and then look at the prices of commodities and then allocate my resources and arrive at a decision in terms of what I should be consuming. Let me explain this, what is this Marginal utility.

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The Cardinal Approach



- **Total utility (TU)** - the overall level of satisfaction derived from consuming a good or service

- **Marginal utility (MU)** additional satisfaction that an individual derives from consuming an *additional unit* of a good or service.

Formula :

$$\begin{aligned} MU &= \frac{\text{Change in total utility}}{\text{Change in quantity}} \\ &= \frac{\Delta TU}{\Delta Q} \end{aligned}$$



Now so, let us start with both concepts. There is a concept called Total utility, and then there is a concept called Marginal utility. Total utility is nothing but the overall satisfaction derived from consuming a good or service. Overall, I have a bundle for my satisfaction that is in our earlier example, 100 utils from the consumption of a slice of bread.

Now, marginal utility is nothing but the additional satisfaction that an individual derives from consuming an additional unit of goods or services. Why do we emphasize this? We emphasize this because, in real-life situations, a number of our decisions are taken at the margin. Remember, we talked about a concept called opportunity cost earlier?

That is, there is a trade-off in terms of resource utilization. And that is the opportunity costs. Now, if we are thinking about opportunity costs, then a lot of our decisions are taken in the margin. That is, I can use this resource for something else. But if I am going to use the resource for a particular consumption of a good or service, then I will value it at the margin.

So, marginal decisions are very important and in our daily lives, almost all our, decisions are taken at the margin. So marginal utility, then, is this additional satisfaction that an individual

derives from consuming an additional unit of goods or service. So, what is that change in total utility? In terms of changing the quantity consumed?

So, I consumed 3 slices of bread, and I have 300 utils from that. Will the 4th slice of bread increase my utility? Or will it remain the same? Or will it decrease my utility? We do not know. So the consumption decision of the 4th slice of the bread is the marginal concept that I am talking about which I would equate in terms of the change in total utility because of this change in consumption that I am having.

So this ΔTU or ΔU is the change in utility, and ΔQ is the change in consumption. So, what are we assuming here? We are assuming here that every additional unit of consumption would give you certain utilities; one. Two, we do not know whether this additional unit of consumption is adding to your utility? Or is it leading to a decline in your utility? That is why this decision is very important.

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The Cardinal Approach



- Law of Diminishing Marginal Utility (Return) = **As more and more of a good are consumed, the process of consumption will (at some point) yield smaller and smaller additions to utility**
- When the total utility maximum, marginal utility = 0
- When the total utility begins to decrease, the marginal utility = negative (-ve)



In this approach, we have a very interesting kind of possibility which is nothing but the Law of Diminishing Marginal Utility. The Law of Diminishing Marginal Utility states that, as more and more of a good is consumed, the process of consumption will reach a particular point where it yields smaller and smaller additions to utility. Let me take a minute to explain this.

When I consume my first unit or first a slice of bread, remember I am hungry, and I am going to consume my first slice of bread. The utility that I get from that is very high. The second slice of bread; well, good, I am happy. Third, I am almost full. When I go on consuming

more and more slices of bread well, the total utility reaches a maximum point beyond that it cannot increase because I am full now.

At that point, Marginal Utility is 0. So, we stop consumption. If you are not stopping consumption at that point, then marginal utility actually becomes negative. That is not good. And that is a problem of overconsumption. A lot of our decisions sometimes are at the margin, as I keep saying, but are taken into account of this possibility of negative marginal utility.

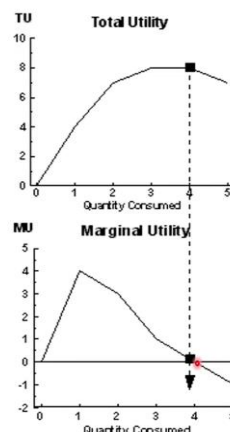
So, Cardinal approach then states that there is a law of diminishing marginal utility that as more and more of a good is consumed, in this process of consumption, the consumer would reach a particular point where the additional units of consumption would actually yield smaller and smaller utility. It becomes 0, and then it becomes negative.

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EXAMPLE

Number Purchased	Total Utility	Marginal Utility
0	0	0
1	4	4
2	7	3
3	8	1
4	8	0
5	7	-1



Let me just put up an example for this. So, I have purchased 5 units of a commodity here. And I have utility derived from the consumption of these 5 units. When I consume the first unit, I have 4, 4 units of utility and that is the total utility and the marginal is also that because only one unit is consumed. The Δ is not from 0 to 1 it is only 1.

When I consume the second unit, well, my total utility increases from 4 to 7, there is an increase, which means that my marginal utility is from 4, it has become 7. So, the Δ , in my earlier expression is 3 here. That is a change in the total utility. So, remember, the definition of marginal utility is that the change in total utility from an additional unit of consumption.

I go on. I consume 3 units, 4 units, 5 units. When I reach 3 units, my total utility is 8. Beyond that, 3 slices of bread my example, one that I cannot really eat. But I take one more slice. Again, there is no increase in total utility then my marginal utility becomes 0. Once when, this is the point when I should actually be stopping. Once when marginal utility becomes 0, I should stop consumption.

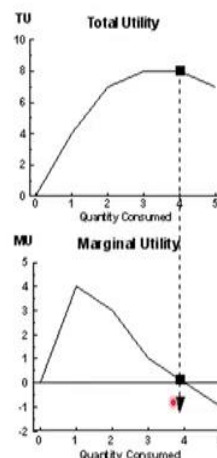
If I am not stopping consumption, then I reach a point where my total utility is actually declining, which means that marginal utility is becoming negative. And that is shown in this graph. Initially, the total utility is increasing, then it reaches a point where actually it is plateauing and after that, it slightly falls, and the marginal utility curve is mapped in line with the total utility, and then after that point, it becomes negative.

Now, I think this concept then is pretty straightforward because we can relate it easily with food consumption. In my example, the first slice of bread clarifies how much we can consume, and we cannot push food consumption beyond a point.

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The Cardinal Approach

- TU, in general, increases with Q
- At some point, TU can start falling with Q (see Q = 5)
- If TU is increasing, $MU > 0$
- From Q = 1 onwards, MU is declining
 \Rightarrow principle of diminishing marginal utility \Rightarrow As more and more of a good are consumed, the process of consumption will (at some point) yield smaller and smaller additions to utility



Now so, the idea then is that well, after a point, marginal utility starts falling. And there is a principle of diminishing marginal utility, that is, as more and more goods are consumed, the process of consumption will, at some point, yield smaller and smaller additions to utility. This is a real-life phenomenon. We do not need much of an explanation for that.

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Consumer Equilibrium

- So far, we have assumed that any amount of goods and services are always available for consumption
- In reality, consumers face constraints (income and prices):
 - Limited consumers income or budget
 - Goods can be obtained at a price
- Consumer's objective: to maximize his/her utility subject to income constraint
- 2 goods (X, Y)
- Prices P_x , P_y are fixed
- Consumer's income (I) is given



So, then we can actually find a point where the consumer is in equilibrium. So far, we have assumed that any amount of good or service is always available for consumption, but that is not correct because we have two constraints, that is, remember, we talked about, income and prices.

Prices are actually determined in the market, and income is actually fixed for the consumer. So, there is a limitation in terms of the consumer's income. So, the consumer has limited income or budget and the goods obtained are at a market price. Now, how will the consumer then allocate this income across commodities?

Remember, the consumption basket? There is a basket of commodities that the consumer is consuming. I am not going to stop my consumption only with one good; in real life, we consume so many things. So, let us consider two goods X and Y. Let us also consider that prices of X and Y are fixed, time being when I go to market, I know that this is the price that is the consumption thing that we are talking about. We also know that a consumer's income is given at a particular point in time and there is no variation.

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Consumer Equilibrium



• Optimizing condition:

• If
$$\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$$

$$\frac{MU_X}{P_X} > \frac{MU_Y}{P_Y}$$

⇒ spend more on good X and less of Y



So, there is an optimizing condition which we can derive where the consumer would be reaching a kind of an equilibrium point in consumption, when marginal utility from a commodity X by the price of X is equal to the marginal utility of another commodity Y by the price of Y. Rather, the ratio between marginal utilities and prices have an equilibrium in the market and that is a condition where the consumer derives maximum kind of satisfaction or utility.

So, it is a very, very simple kind of an expression, what am I trying to do here, I am trying to do here only one small thing that if you have prices that are given to you, and if incomes are also given to you, then you will allocate the resources in terms of the available prices of goods and services, and the decision is taken by taking into account the marginal utilities.

So, a consumer would then equate marginal utilities to price. Suppose I have to make a decision in terms of consuming apples and oranges. And let us also assume that the prices of apples are more than that of oranges. But I would consume both. I like both. That is, that is the basic problem of a consumer.

Now, I would equate price of apple to the marginal utility from consuming an additional unit of apple to the price of orange and the marginal utility from the consumption of an additional unit of orange and then I will decide whether I should consume 2 apples and 1 orange or 2 or apples and 5 oranges.

That is the equilibrium that we are talking about. One straightforward explanation that we can draw from this is that we will spend on particular goods that give maximum marginal utility

with a lesser price. So, if the marginal utility of X in terms of its price is higher, then we will spend more money on X and less money on Y.

I think that is the kind of decision, which as consumers we make every day when we go to the market, we look for the price and then we will decide whether should I buy more of a good or less of a good. I am just formalizing it in terms of some expressions here.

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The Ordinal Approach



Economists following the lead of Hicks, Slutsky and Pareto believe that utility is measurable in an ordinal sense—

the utility derived from consuming a good, such as X, is a function of the quantities of X and Y consumed by a consumer.

$$U = f(X, Y)$$

Ordinal Utility Theory (TUO)

—Can be measured in qualitative, not quantitative, but only lists the main options (indifference curves & budget line).

Rational human beings will choose to maximize the utility by selecting the highest utility

Different consumers, difference utilities.



Now, moving to the ordinal approach, ordinal approach is another group of economists who believed that well utility is measurable only in an ordinal sense. That is you can only rank your preferences because there is no units with which we can measure utility. So, the utility then is derived from the consumption of a good, such as X, for example, which is a function of the quantities of X and Y consumed by a consumer because a consumer is consuming different goods.

So, there is an overall utility, which we want to maximize which is a function of each of these goods that is consumed. Now, the ordinal utility theory argues that utility is a qualitative concept; you cannot attach a quantitative value to that. So you can only list your preferences, and these preferences can be ranked, and you can actually plot a curve out of these preferences, which we would call us the indifference curves. I will come to that in a minute.

Now, what is the basis for such a ranking of preferences? The basis for such a ranking of preferences is that, there is this concept of rationality. What is that? Consumers are rational and consumers would use maximum available information and then arrive at a decision. Put it in simple terms, what does it mean?

Before purchasing a product? We might ask 5 different sellers, what is the price of that? What am I doing there? I am actually gathering information about price there, then I will decide whether I should consume or not. That is the notion of rationality that I am talking, I am not going blindly and purchasing something, we would call such kind of consumers as little irrational consumers.

So, rational human beings will maximize their utility by selecting the highest possible utility with their available resources. That is an upper limit, given this upper limit in terms of income, they will choose what the maximum utility that I can achieve is. So, different consumers then will have different utilities. So, different individuals will have different preferences.

And that is exactly what we saw yesterday when we were looking at the consumption basket of different income groups. Recall our yesterday's discussions in terms of 3 different households of 3 different levels of income 15,000, 30,000 and 50,000 they had different consumption baskets, because they have different utilities for consumption of goods.

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INDIFFERENCE CURVE (IC)



- Curve where the points represent a combination of items when the consumer is at indifference situation (satisfaction).
- Axes: both axes refer to the quantity of goods
- For the combination that produces a higher level of satisfaction, the curves shift to the right (IC_2) from the first curve (IC_1)
- In contrast, the curves shift to the left (IC_{-1})



So, how do we really rank this? We rank it in terms of what we call as indifference curves and what are these indifference curves? These curves are representations of a combination of items, when the consumer is in an indifferent situation. Hence, certain combinations of goods would give me the same level of satisfaction. What do I mean by that?

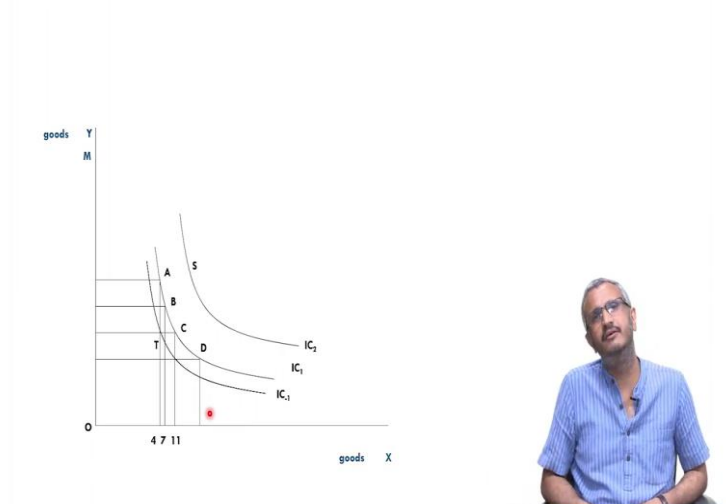
Well, I prefer to have idli and vada for breakfast. So, there is a combination of 2 idlis and one vada, which will give me some level of satisfaction. There is also another combination of 1

idli and 2 vada, which could also give me the same level of satisfaction some days. So, I will then look at these preferences, which give me the same level of satisfaction and then rank my preferences.

And this is plotted into a curve and that is called the indifference curve. So, let me put it a little more formally, indifference curves then give us the combination that produces the same level of satisfaction for the consumer. Higher indifference curves mean a higher level of satisfaction, lower indifference curves means a lower level of satisfaction. So please remember, a rational consumer would actually try and move to a higher indifference curve with their given income that is, his or her disposal.

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INDIFFERENCE CURVE



Now, let me show you a sample of this curve. These are some curves IC 1, IC 2 and IC-1. IC-1 is actually lower in terms of satisfaction, whereas IC 1 is higher and IC 2 is even higher, but unfortunately, my consumer does not have the income to reach IC 2.

Now, we can have different combinations of goods. For example, there is one combination of good called A, which is a combination of in terms of X and Y where we have two different goods. So, we find that there is one combination here called A. There is another combination of B, C, D. These are the different combinations that I was talking about.

Now, please remember, all these different combinations would give the same level of satisfaction. So, where do I place myself? I place myself depending on the prices of these goods. Please remember that I allocate my resource depending on the price there, should I buy more of, see both my earlier breakfast example shows that both gives me the same level

of satisfaction that is 2 idlis and 1 vada or 1 idli and 2 vada gives me the same level of satisfaction. Now, I allocate my resources, depending upon the price of idlis and vadas.

If vada is more costly, perhaps I will buy more idli, very simple, straightforward kind of reasoning there and that is exactly what these combinations that I am talking about A, B, C, and D are brought on these curves.

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PROPERTIES OF INDIFFERENCE CURVE



- **Downward sloping** from left to right: This shows an increase in quantity of certain good.
- **Convex to the origin**: the marginal rate of substitution (MRS) decreased
 - MRS = quantity of goods Y willing to substitute to obtain one unit of goods X & this substitution is to maintain its position at the same level of satisfaction
- **Do not cross (intersect)**: consumer preferences transitive
 - Eg : Quantities X and Y for the combination of A > a combination of B;
 \Rightarrow utility A > B *
 - When cross = C, so the utility A = C & B = C; \Rightarrow utility A = B = C. This is not transitive as above *
- **Different ICs show different level of satisfaction**. Far from the origin, the higher the satisfaction. *



So, there are some properties, and that is just to keep in mind how this preference ranking works, it is downward sloping, we saw that. That is what does it mean? It means that an increase in the quantity of a certain good will definitely decrease the quantity of some other good.

These are convex to the origin that is, if you want to have more of one good, you have to there is a trade-off; you have to give up some other good. They do not intersect because each of those indifference curves represents different bundles of satisfaction. So always, the idea is to move to the highest possible curve.

And, different curves show different levels of satisfaction. So, the higher the curve higher the level of satisfaction, so, as a consumer with limited income, consumers would like to move to higher and higher indifference curves.

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Markets and Competition



Market

- A group of buyers and sellers of a particular good or service

Buyers

- Determine the demand for the product

Sellers

- Determine the supply of the product



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Now, we do not, we do not go to the properties of this in-depth because we want to take this to the understanding of markets.