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Cardinal Utility Approach

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Unit No. & Title:	Unit – 2 Consumer Demand: Cardinal Utility Approach
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1. Introduction

The theory of demand or theory of consumer behaviour explains the relationship between the demand for a good or service and the factors determining it. The demand of an individual for a good depends upon its price, prices of related goods, change in income, tastes or preferences, etc.

The law of demand states that, 'all other things remaining same', there is inverse relationship between price and quantity demanded. Thus the law of demand implies a downward sloping demand curve. The law of demand can be explained with the help of a demand schedule and demand curve as presented in Diagram 1.

The demand schedule states that when the price of a good is Rs. 12 per unit, the consumer purchases 10 units of it. When the price decreases to Rs. 10, he would buys 20 units and so on. At Rs. 2 per unit, the consumer will buy 60 units of the good. The demand schedule, when presented graphically by plotting different combinations quantity demanded in relation to its price, would show a demand curve. The above demand schedule and demand curve state that there is an inverse relationship between the price of a good and the demand for it.

Table: Demand Schedule for an Individual Consumer

Price (Rs.)	Quantity Demanded
12	10
10	20
8	30
6	40
4	50
2	60

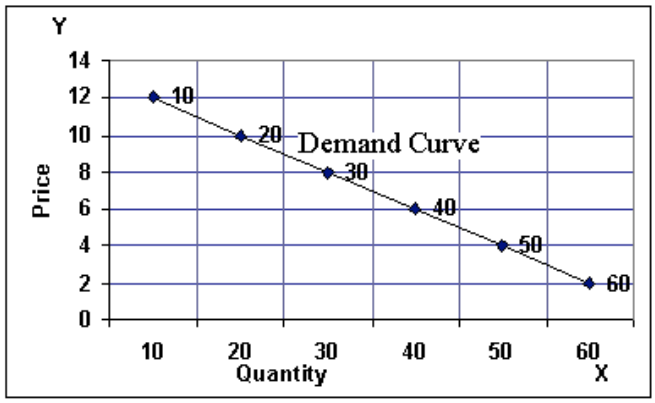

Diagram 1: Demand Schedule and Demand Curve

Why does demand curve slopes downward ?

The law of demand states that a fall in price of a good leads to an increase in its demand and vice versa.

Increase in consumers: There is another reason for the fall in the market demand curve for a good. That is, with the decrease in price, the good become cheaper it which induces many low-income consumers to enter into the market to buy the good.

2. Utility Theory

Utility means the want satisfying power of a commodity. Utility is subjective entity and resides in the minds of consumers.

Cardinal Utility

Cardinal approach to utility states that the goods and services that provide higher level of satisfaction will be assigned higher utils while the goods that provide lower level of satisfaction will be assigned lower utils.

Assumptions of the Cardinal Utility Approach

The principle of cardinal utility is based on the following assumptions:

1. Cardinal utility approach assumes that the utilities of commodities are numerically measurable.
2. Marginal utility of money is constant. This is necessary because money is used to measure utility of a commodity.
3. Utility derived from one commodity is independent from the utility derived from another commodity.
4. The marginal utility of a commodity diminishes as a person consumes more and more quantities of it.
5. Utility measurable by introspection.

Total Utility and Marginal Utility

Total utility refers to the total satisfaction, which a consumer derives from the consumption of all the units of a good, or service that he purchases at a given price during a particular period of time. When TU increases, the level of satisfaction of the consumer will also rise.

Marginal Utility theory examines the increase in the level satisfaction that a consumer gains from the consuming an extra unit of a good or service. When the marginal utility of a good is positive, it will lead to an increase in total utility. On the other hand when marginal utility form the consumption of a good or service becomes negative, then total utility will decrease.

The total utility (TU) function in quadratic form of is written as:

$$TU = aQ - bQ^2$$

$$MU = dTU / dQ = a - 2bQ$$

$$\text{Slope of MU} = dMU/dQ = -2b$$

By taking the successive values of Q, the relationship between MU and TU is represented in Table 2.

Table 2. Total Utility and Marginal Utility

Quantity	Total Utility	Marginal Utility
1	10	10
2	18	8
3	24	6
4	28	4
5	30	2
6	30	0
7	28	-2

In the above table TU is calculated by adding the successive marginal utilities of all the quantities of the good consumed. In other words, $TUn = U1 + U2 + \ldots\ldots\ldots + Un$

The relationship between TU and MU can be easily explained With the help of table 2 and diagram 2. The diagram shows that when a person consumes first unit of the good, the consumer gets high level of satisfaction. In the beginning the total utility and marginal utility are equal at 10 utils. When he consumes second unit, the MU decreases to 8 utils and the TU reaches the level of 18 units. Similarly when he consumes 6th unit of the commodity, the MU becomes zero and TU reaches the maximum level 30

units. Thereafter, when he consumes 7th unit of the commodity, the MU becomes negative i.e –2 due to which the TU declines from 30 to 28 units

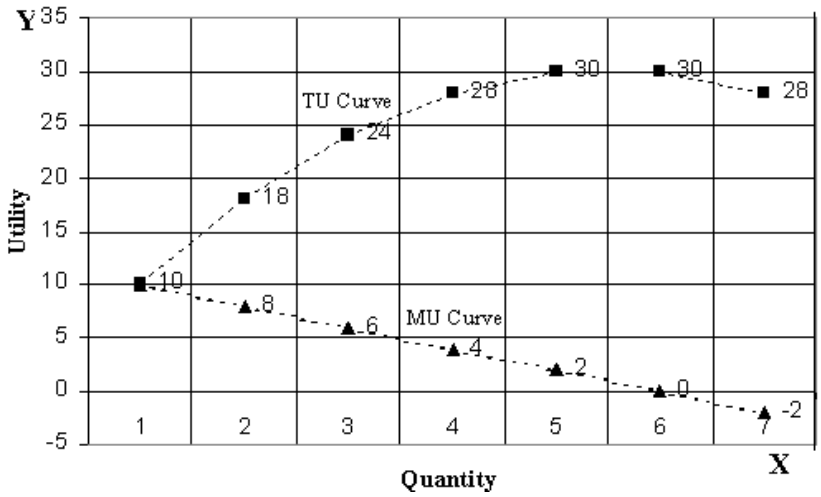

Diagram 2: Total Utility and Marginal Utility Curve

The diagrams shows that the MU curve has negative slope while the TC curve has positive-negative slope. Positive-negative slope takes place when initially the TU curve moves upward but subsequently it has the tendency to move downward. With the consumption of 6th unit, the MU becomes zero. When MU becomes zero the MU curve touches the X-axis and TU curve reaches its maximum level of 30 units, which is the saturation point. Thereafter the consumption of 7th unit will give negative MU due to which the MU curve moves below the X-axis which causes negative slope in TU curve.

Relationship Between Total Utility and Marginal Utility

Relationship between total utility (TU) and marginal utility (MU) can be established in the following way:

1. MU is the rate of change in TU.
2. When the MU increases, then TU increases at an increasing rate.
3. When the MU decreases, then TU increases at a decreasing rate.
4. When MU becomes zero, then TU is maximum and achieves a saturation point.
5. When MU becomes negative, then TU declines.

3. Laws of Cardinal Marginal Utility analysis

The law of Cardinal marginal utility states that marginal utility of a good falls as more units of it are consumed. With the above basic feature, the advocates of cardinal utility analysis have developed two laws, which occupy an important place in the theory of demand. They are (i) The law of diminishing marginal utility and (ii) the law of equi-marginal utility. These two laws will be discussed in the subsequent sections.

Law of Diminishing Marginal Utility

According to the Law of Diminishing Marginal Utility the marginal utility of a good falls as an individual consumes more units of it. Marshall who advocated the cardinal utility analysis stated the law of diminishing marginal utility as "The additional benefit which a person derives from a given increase of his stock of a thing diminishes with every increase in the stock that he already has."

In short the law of diminishing marginal utility states that total utility increases at a decreasing rate. A rational consumer will continue to consume a good or service so long its marginal utility remains positive. However if the consumer still continues to consume additional units of a good, then the MU becomes zero and subsequently negative.

Principle of Equi-marginal Utility

The law of equi-marginal utility is an extension of the law of diminishing marginal utility. In the words of Marshall, "If a person has a thing which can be put to several uses, he will distribute it among these uses in such a way that it has the same marginal utility in all". The law of equi-marginal utility is based on the fact that human wants are unlimited whereas the resources to satisfy these wants are limited. Therefore it becomes necessary for a rational consumer to identify the most urgent wants that can be satisfied with the limited money that he has.

In order to achieve maximum satisfaction out of the limited money (budget), a consumer is expected to carefully weigh the quantum of satisfaction obtained from each rupee that he spends. Therefore when he feels that a rupee spent on one good gives him more satisfaction than another good, then he will decide to spend more money on the former (first) good. This will go on till the quantum of satisfaction that he derived from the last rupee spent on the two goods is equal. This happens when he substitute some units of a good of greater utility for the purchase of certain units of another good which yield less utility.

Because of this substitution the MU of the former good will fall while the MU of the latter good will rise. This will continue until the MUs of both the goods are equalized. Due to this reason the law of Equi-marginal Utility is also called the Laws of Substitution.

Explanation of the Law of Equi-Marginal Utility

According to the law of equi-marginal utility, a consumer will be in equilibrium at that point where the utility derived from the last rupee spent on each good is equal.

Suppose a consumer has a budget of Rs 50/- to buy two goods X and Y. Also suppose that the marginal utility of money (MU_M)is constant such that is Rs. 1 gives 5 utils of MU. A rational consumer will spend his given budget on both goods X and Y in such a way so that he achieves maximum satisfaction or total utility (TU). Therefore, he will select that combination of goods at which the MU per rupee spent on each good equal the marginal utility of money (MU_M). Symbolically the consumer will be in equilibrium when

$$MUx/Px = MUy/Py = MU_M$$

Where MUx = Marginal utility of good X

MUy = Marginal utility of good Y

Px = Price of good X

Py = Price of good Y

MU_M = Marginal utility of money.

Thus MUx/Px and MUy/Py would give the marginal utilities money expenditure on goods X and Y respectively. The Law of Equi-

Marginal Utility can be explained with the help of the table 3 and Diagram 3.

Table 3: Marginal Utility of Goods Purchased and Marginal Utility of Expenditure

Units	Marginal Utility of X and Y			Marginal Utility of Expenditure	
	MU_X (Utils)	MU_Y (Utils)		MU_X/P_X (Units)	MU_Y/P_Y (Units)
1	50	36		10	9
2	45	32		9	8
3	40	28		8	7
4	35	24		7	6
5	30	**20**		6	**5**
6	**25**	16		**5**	4
7	20	12		4	3
8	15	8		3	2

The table shows how a rational consumer takes decisions about purchases of different quantities of both the goods X and Y. Assume that the consumer spends all his budget of Rs. 50 to purchase good X. Since the price of a unit of good X is Rs. 5, he can buy 10 units of X. Table shows the decline in MU derived from the purchase of each subsequent unit of good X due to the application of the law of diminishing marginal utility.

Alternatively assume that a consumer spends all his budget of Rs. 50 to purchase good Y. Since the price of a unit of good Y is Rs. 4, he can buy only 12 units of Y. In this case also the MU

derived from the purchase of each subsequent unit of good Y declines due to the application of the law of diminishing marginal utility.

Now a rational consumer plans to allocate his budget of Rs. 50 between both the goods X and Y. Since the first unit of good X gives him highest utility (50 utils), his first purchase would be X, which he buys at a given price of Rs. 5 per unit. The purchase of second and third units of X will also provide relatively higher utility for good X. Thus, his first choice will be to buy three units of good X. Since the fourth unit of X provides lower MU (35 utils) than the first unit of good Y (36 utils), the consumer will buy one unit of good Y at Rs. 4.

In diagram 3, the X-axis measures the units of goods X and Y measures the MU of money spent on X and Y. The consumer will achieve maximum level of satisfaction when he decides to buy 6 units of X and 5 units of Y and at that level the MU of money spent on each commodity is 5 utils.Thus, it can be concluded that a rational consumer would obtain maximum satisfaction when he equalizes the marginal utilities of goods that he purchases by substituting some units of one good for another.

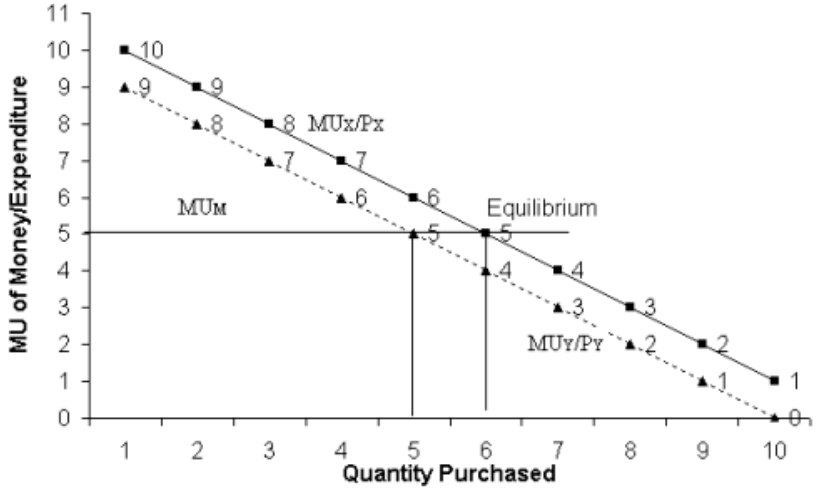

Diagram 3 Consumer Equilibrium as per Law of Equi-Marginal Utility

Table 4 shows the sequence of goods X and Y purchased by the consumer. He decided to by X as his first, second, third, fifth, seventh and ninth choice. And he decided to buy Y as his fourth, sixth, eighth, tenth and eleventh choice. It may be noted that for his eleventh choice both the goods X and Y provided him same level of satisfaction ie. 20 utils of MU. In such a situation the consumer has to use his own option and buy that choice is more economical. In the present case at the eleventh choice the consume is left with only Rs. 4 as he already spent Rs. 46 to buy earlier ten choices. Therefore he buys good Y and pays Rs.4 for his eleventh choice. This way he purchases 6 units of good X and 5 units of good Y and spends all the amount of his budget i.e. Rs. 50.

Table 4: Marginal and Total Utility of Goods Purchased

Particulars	MU as per Sequence of Purchase											Total Utility	Total Units Bought	Price per unit	Total Cost (Rs.)
Purchase	1	2	3	4	5	6	7	8	9	10	11				

Sequence														(Rs.)	
Good X	50	45	40		35		30		25		#	225	6	5	30
Good Y				36		32		28		24	20	140	5	4	20

#MU of X = 20 Utils.

Decision to buy based on MUs of both X and Y will provide maximum satisfaction. Thus total utility of 6 units of X would be 225 utils(50+45+40+35+30+25=225) and 5 units of Y would provide 140 utils (36+32+28+24+20=140). Thus total utility of all his purchases will give 365 utils. The satisfaction given by 6 units of X and 5 units of Y at different prices would be greater than any other combination. At this combination of transaction the he will equate his marginal utilities from the goods and money budget.

4. Derivation of Demand Curve

The consumer demand curve generally slopes downward due to the decrease in marginal utility that a consumer derive by consuming more of a good or service. Demand curve also has negative slope because a consumer want to obtain as much satisfaction as possible at the lowest possible price. Therefore when prices decrease consumers increase their purchases of that product and vice versa. With these basic premises, the founders of cardinal utility analysis have developed two laws viz. (i) Law of diminishing marginal utility and (ii) Law of equi-marginal utility.

These two laws occupy an important place in economic theory and have several applications and uses. With the help of these

two laws, the exponents of cardinal utility analysis have derived the law of demand.

Derivation of Demand Curve Under the Law of Diminishing Marginal Utility

The law of diminishing marginal utility states that so long the marginal utility of a good is higher than its price (MUx > Px), the consumer would demand more and more units of it till its marginal utility is equal to its price. Thus, the 'marginal utility equal's price' is the pre-condition of equilibrium. Diagram 4 clearly explains this argument.

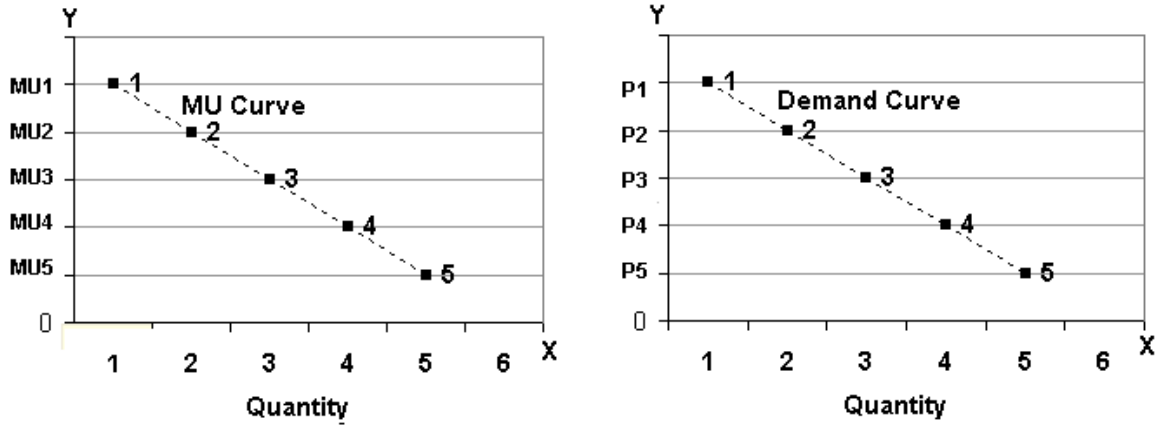

Diagram 4: Derivation of Demand Curve Under Law of Diminishing Marginal Utility

In diagram 4 the downward sloping curve represents the diminishing marginal utility of the goods measured in terms of money. Price is measured on Y-axis and Quantity purchased is measured on X-axis. Suppose a new product X is introduced in the market at OP1 price. At this price the consumer will be in

equilibrium when buys only one unit it because the MU of peoduct is MU1 which is equal to the given price OP1.

Now, if the price falls to OP2, the equality between the MU and the price will be disturbed. Marginal utility of money expenditure MU1 at quantity Q1 will be greater than the new price OP2. In order to equate the MU with the new price, the consumer will buy one more unit of X. It is evident from the diagram that when the consumer increases the quantity purchased to Q2 units X, the marginal utility of money expenditure on X falls to MU2 which equals with the new price OP2. Likewise when prices fall further, the consumer will buys more units of X in order to equate its marginal utility of money expenditure to the lower price. This way the downward sloping MU curve is transformed into a downward sloping demand curve.

Derivation of Demand Curve Under the Law of Equi-Marginal Utility

As discussed earlier, consumer equilibrium is attained when a consumer, while purchasing different goods, decides to select that combination of them at which the MU per rupee spent on each good equal the MU of money (MU_M). Symbolically in case of two goods X and Y, the consumer will be in equilibrium when

$$MUx/Px = MUy/Py = MU_M$$

In order to understand the derivation of demand curve under the law of equi-marginal utility, diagram 5 considers the demand for good X only. In the upper portion of the diagram, the Y-axis

represents the MU of money expenditure ie. MUx/Px while the X-axis represents the quantity of good X demanded. With a given level of income, the budget of the consumer is fixed and his marginal utility of money (MU_M) is equal to OH. The consumer buys OQ1 quantity of good X when the price is Px1 because at this price the MU of money OH is equal to MUx/Px1 and a point R on their intersection that measures the MU of money expenditure for OQ1 quantity of X.

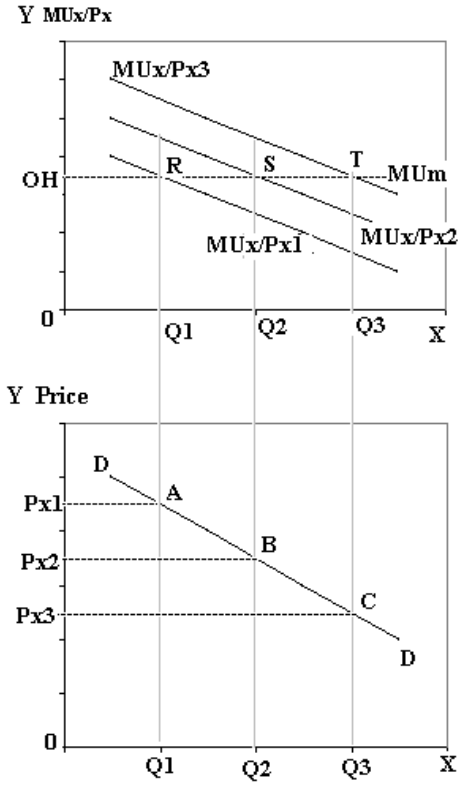

Diagram 5: Derivation of Demand Curve Under the Law of Equi-Marginal Utility

At the bottom of the diagram the demand curve for good X is derived. In this part of the diagram, the price is measured on Y-axis and quantity demanded is measured on X-axis. When the price of good X is Px1, it corresponds with the relevant MUx/Px1 curve, which is the MU of money expenditure on good X. Thus

the consumer would demand OQ1 quantity of good X at price Px1. Point A marked at the intersection of two perpendicular lines drawn through RQ1 and Px1 would be the first decisive mark for the derivation of the demand curve.

When price of X falls to Px2, the MUx/Px2 curve representing MU of money expenditure shifts upward to a new position. The consumer would buys OQ2 quantity of good X because at price Px2 the MU of money OH is equal to MUx/Px2. Point S on their intersection measures the MU of money expenditure for quantity OQ2 of X. In the lower part of the diagram a point B is marked at the intersection of the two perpendicular lines drawn through SQ2 and Px2 which is the second decisive mark for the derivation of the demand curve.

Similarly, when the price of X falls to Px3, the MUx/Px3 curve representing to MU of money expenditure shifts upward to a new position. The consumer would buys OQ3 quantity of good X because at this price the MU of money OH is equal to MUx/Px3. Point T on their intersection measures the MU of money expenditure for quantity OQ3. Point C marked at the intersection of the two perpendicular lines drawn through TQ3 and Px3 would be the third decisive mark to derive demand curve.

Similarly, if the price of good X change further, it will be possible to find the quantity demanded at the new prices. Thus, by drawing a line through points A, B and C, the demand curve DD for good X is derived. The demand curve DD slopes downward, which states that with every fall in the price of a good the demand for it will increase.

5. Summary

Let's conclude the session. Today we have discussed cardinal utility approach of consumer demand, derivation of demand curve and certain other related topics. Thank you.