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RESEARCH ARTICLE

WITH ACTUAL CLASS-ROOM TEACHING EXPERIENCE – APPLICATION OF MATHEMATICS IN ECONOMICS IS A NECESSITY RATHER THAN LUXURY

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ABSTRACT

Economics has emerged as a very important field of study helping individuals, firms, industry, government, nations etc. in order to allocate scare resources to their alternative uses to satisfy the maximum possible needs. Traditionally all the social science subjects including economics were studied without or with a very less application of mathematics (mostly limited to graphs and diagrams), but now a days mathematics has become an essential and integral part of economic theories and economic theories and economic models. Mathematical economics has become a very popular subject worldwide. Mathematics, economics and statistics are considered complimentary disciplines today. This case study is an outcome of actual class room teaching of Economics, where students did not have a background of mathematics. This case study also gives an idea that knowledge, understanding and application oriented skills for the solution of real life situation and problems are considered as the necessary outcome of a particular course.

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INTRODUCTION

The traditional theory of demand starts with the examination of the behaviour of the consumer. Since the market demand is assumed to be summation of the demands of individual consumers. The Cardinalist school postulated that utility can be measured. Under certainty (complete knowledge of market conditions and income levels over the planning period), some economists have suggested that utility can be measured in monetary units, by the amount of money the consumer is willing to sacrifice for another unit of commodity. The ordinalist school postulates that utility is not measurable, but is an ordinal magnitude. The consumer need not know in specific units the utility of various commodities to make his choice. It suffices for him to be able to rank the various baskets of goods according to the satisfaction that each bundle gives him. He must be able to determine his order of preference among the different bundle of goods.

Logic behind the Case Study

According to utility approach, consumer's equilibrium in purchase of a single good is attained at a point when MU in terms of money is equal to price and in purchase of two goods with unequal prices $\frac{MU_x}{P_x} = \frac{MU_y}{P_y}$ [eq. is attained].

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Maximisation of Utility
↓
With Limited Resources
↓
Consumer's Equlibrium
↓

Cardinal Utility Theory ↓	Ordinal Utility Theory ↓
1.Rationality-aims maximisation of utility subject to constraint imposed by his given income.	Rationality – Maximisation of utility under certainty.
2.Cardinal Utility- Utility is measured by the monetary units.	Utility is ordinal (ranking).
3.MU of money remain constant.	Preference are ranked in terms of indifference curves (convex to the origin- means diminishing marginal rate of substitution- the number of units of commodity Y which can be sacrificed for an additional unit of X is MRS but level of satisfaction remains the same.
4.MU of a commodity diminishes as the consumer acquires larger quantities of it.	U = f (q_1 , q_2 ---- q_n)
5.Utility is additive. U = U_1 (X_1) + U_2 (X_2) + ----- Independent utilities of various commodities- unrealistic assumption.	It is assumed that the consumer is consistent in his choice that is if in one period he chooses bundle A over B, he will not chooses B over A in another period. If bundle A is Preferred to B and B is preferred to C, Bundle A is preferred to C. A>B and B>C, then A>C.
6.Demand curve reflects graphically	

the relationship between the quantity demanded of a commodity and its price. Demand curve slopes downwards from left to right.

7.Units of the commodity are divisible.

Hence the demand curve as well as Indifference curve are both continuous Curve. Both are negative sloped.

↓

And the objective of maximisation of utility is establish at a point where the condition of proportionately hold good

$\frac{MU_A}{P_A} = \frac{MU_B}{P_B} =$ --------- = K (Constant)

=Marginal utility per unit of money

And for Indifference curve analysis

U = f(x, y) [U is constant at a particular indifference curve]

Hence $du = \frac{\partial U}{\partial x} \cdot dx + \frac{\partial U}{\partial y} \cdot dy$ [du = 0]

$0 = \frac{\partial U}{\partial x} \cdot dx + \frac{\partial U}{\partial y} \cdot dy$ or $\frac{dy}{dx} = -\frac{MU_x}{MU_y}$

Slope of a budget line = $-\frac{P_x}{P_y}$ (Negative Slope)

Hence $\frac{MU_x}{P_x} = \frac{MU_y}{P_y}$

Marginal utility is the additional utility (or satisfaction) derived from consumption of an additional unit of a commodity. Total utility is the total satisfaction derived by a consumer from consumption of all the units of a particular commodity.

$MU_1 = TU_1$
$MU_2 = TU_2 - TU_1$
$MU_3 = TU_3 - TU_2$

$MU_n = TU_n - TU_{n-1}$

If we add these equations $TU_n = MU_1 + MU_2 +$--------- $+MU_n$
$TU_n = \sum_{i=1}^{n} MU_i$

And MU = $\frac{\text{Change in TU}}{\text{Change of an additional unit of consumption}}$
$= \frac{\Delta TU}{\Delta Q}$

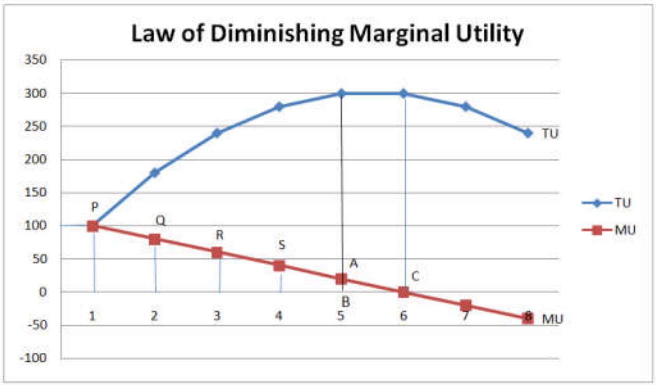
The basic law behind utility analysis is the law of diminishing MU (which is considered as a universal law but except the case of money). This law states (other things remaining the same) as more and more units of a commodity are consumed, marginal utility derived from successive units goes on diminishing. Let us proceed with a hypothetical example given in the table given below, when as the consumption of additional units of a commodity goes on, the additional units derived by the consumer goes on diminishing.

Table 1.

Hypothetical Example – Law of Diminishing MU
Units of CommodityMUTUPrice is Constant (in the market)

1---100----100----60 Units
2--- 80----180----60 Units
3--- 60----240----60 units
4--- 40----280----60 Units
5--- 20----300----60 Units
6--- 0----300----60 Units
7---- 20----280----60 Units
8---- 40----240----60 Units

[Note- This is an example of discrete series, because units of consumption of a commodity is being taken for integral values only (that is 1,2,---)]. Fractional Values have been ignored. Had this series been continuous, then it would have been valid for all integral and fractional values between1 to 8. The basic assumption in utility analysis is taken as the units of the commodity are divisible but here in this hypothetical example; we have completely ignored all fractional values and have taken only integral values.



On OX Axis – Units of Commodity
On OY Axis – Total Utility / Marginal Utility
Now TU = $\sum$ MU

$MU_1 = 100$	TU = 100
$MU_2 = 80$	$TU_2 = MU_1 + MU_2 = 180$
$MU_3 = 60$	$TU_3 = MU_1 + MU_2 + MU_3 = 240$
$MU_4 = 40$	$TU_4 = \sum_{i=1}^{4} MU_i = 280$
$MU_5 = 20$	$TU_5 = \sum_{i=1}^{5} MU_i = 300$
$MU_6 = 0$	$TU_6 = \sum_{i=1}^{6} MU_i = 300$

If we take
$TU_5 = \sum_{i=1}^{5} MU_i$ = Area OPAB = 300
$TU_6 = \sum_{i=1}^{6} MU_i$ = Area OPAC
Area OPAC = Area OPAB
Area OPAC = Area OPAB + Area of Triangle ABC
Hence logically area of Triangle
ABC = 0
(This is wrong, this area cannot be Zero)

This difficulty has arises only because we have proceeded with an example of discrete series and have applied on assuming it to be a continuous.

If the function is continuous, now the question of differentiation and integration both applies.

MU = $\frac{d\,(TU)}{dq}$ = Derivative of TU is MU
And TU is the integration of MU.

d TU = MU d_q
Apply integration both sides
$\int$ d TU = $\int$ MU d_q
OR TU = $\int$ MU d_q

Further, in our hypothetical example, we have proved that Total Utility is maximum when units of consumption are 5 as well as 6. Logically this cannot be true.

For Maxima, we know there are two conditions, one necessary and other as the sufficient.

1.First Derivation is Zero.

2.Second Derivation is negative.

TU = f (q), TU is a continuous.

TU being Maximum.
First derivation is zero

$\frac{\mathrm{d\,TU}}{\mathrm{dq}} = f'(q) = 0$

MU = 0 [Slope of TU]

And Second derivative

$\frac{d^2TU}{dq^2} = f''(q) < 0$

Slope of MU become negative.

The two conditions are satisfied only at one point when units of consumption = 6, here MU =0 and after that MU becomes negative. If the teacher and students both have basic knowledge of mathematics, economic theories and laws could be explained easily and with more clarity. TU is maximum only when the units of consumption are 6 and not 5.

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