

## APPLICATIONS OF THE LEARNING CURVE THEORY IN SERVICE SECTORS

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### ABSTRACT:

“The learning curve is a graphical device for picturing the rate of improvement in terms of a given criterion of efficiency, as a result of practice.”- Later, Arthur Bills.

When the production quantity of a given item is doubled the cost of that item decreases at a quantity rate. Theory of learning curve is formulated on the basis of this formula (The Institute of Chartered Accountants of India). Primary use of learning curve can be traced in aircraft industry but it can be used as a quantitative tool in many sectors. Applications include sectors like agriculture, marketing, banking, insurance etc. that are service sectors. Learning curve reduces costs and increases labour efficiency as the production varies every phase. So, it helps to manage issues like decreasing the labour cost proportionate to the output saving time and effort. The major advantage of the learning curve is it can be represented graphically and curves like steady curve, experience curve, diminishing curve etc. are significant to learn and understand better. The experience curve states that time taken to complete a task should be less, whereas the steady phase learning curve states that there is no more effectiveness in the curve just like a saturated point. The following article objective is to study the applications of the learning curve in service sector by creating models with applicable assumptions to generate empirical evidences for the purpose of the study.

**Key Words:** Learning Curve, Applications, Cost, service sectors

### INTRODUCTION:

The concept in 1885 of learning curve (LC) was introduced by Dr. Herman Ebbinghaus as the forgetting curve defining that as the new things are learnt, automatically influence to forget the old ones. In 1936 Theodore Paul Wright in his paper “Factors Affecting the Cost of Airplanes” states about how the efficiency of cost is proportionate to raw material, labour and overhead that are associated with final production. “A suitable relationship of labor, raw material, purchased material, and overhead has been used and by this method it is indicated that the curve will start out at eighty three percent, then change to eighty-five percent, then change to eighty-seven percent, and finally reach ninety percent. This change in slope is an indication of the relatively greater importance of material to labor as quantity increases.” (T.P. Wight 1936). Now it is clear that the learning curve has certain stages to process before it reaches the final stage and cumulative differences are reported for each and every stage. Even though the concepts of, increasing, decreasing, diminishing etc. are associated with the learning cover, the focus of our study relates to the service sector.

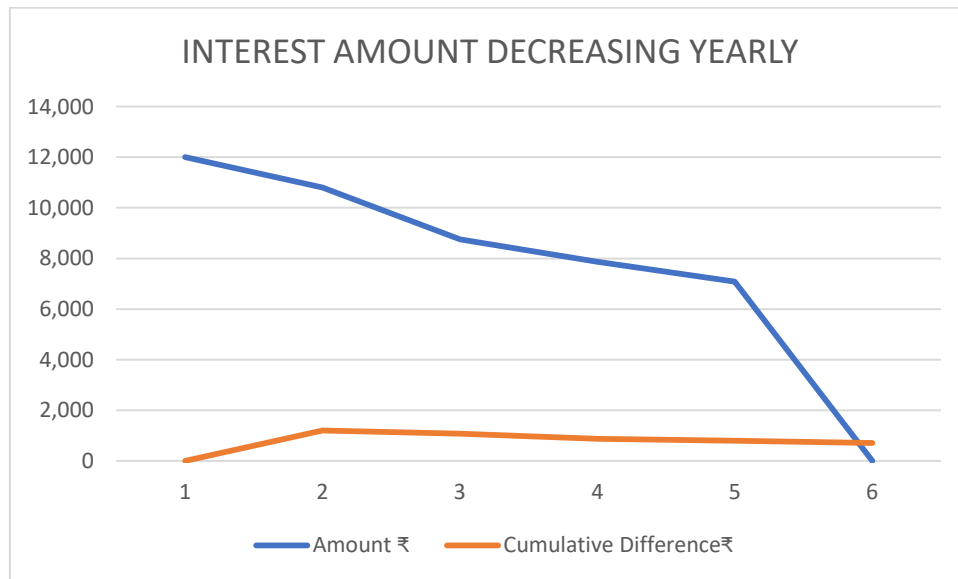
### Model A

A Digital Based Loan App provides the following scheme, that if the loan is repaid by the customer in time, then the interest will be decreased for the same amount of loan when he/she borrows next time. A top-up scheme will also be available to double the amount when the existing loan will be closed.

**1.1 Loan Amount details with interest rates decreasing as per the learning curve effect**

Consecutive Serial No	Loan Amount	Interest Rate in % for 12 months- (LC@90%)	Amount ₹	Cumulative Difference₹	Top up after every twelve months if instalments are paid regularly₹
1	1,00,000	1	12,000	-----	1,00,000
1	1,00,000	0.90	10,800	1200	1,00,000
2	1,00,000	0.729	8,748	1080	2,00,000
3	1,00,000	0.656	7,872	876	4,00,000
4	1,00,000	0.590	7,080	792	8,00,000
5	1,00,000	0.531	6,372	708	16,00,000

G.1 Graph of the interest rates



**Findings**

1. The graph shows that the interest rate decreases as per the learning curve effect.
2. As cumulative differences indicate that the differences will be lower compared of the 2 and 3 to 4 and 5.
3. The curve becomes steady and straightens its journey indicating the effect of the LC is no more that is called as the study curve.
4. The table can also be computed under the LC effect by doubling the amount for every consecutive year like 2lac, 4lac,8lac etc. for new proposal.

Explanation: In reality this kind of concept can be used by banks for top-up. Customers who pay the loan amount timely are entitled for such benefits. The learning curve rate can be changed like 80% or 75%, then for every quarter or bi- annual the loan amounts can be doubled.

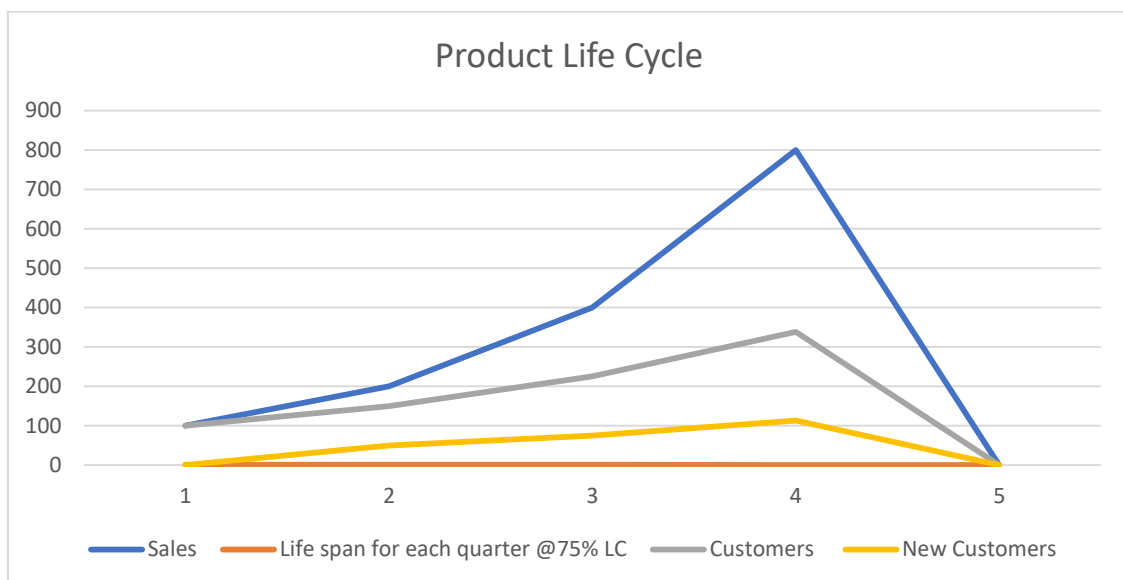
**Model B**

In Marketing we use four stages for the product life cycle. LC can be used effectively as a tool for generating empirical evidences with the assumptions that the product has many phases in reaching the saturated point. It is also assumed that market behaves in the same way irrespective of the risk factors.

### 1.2 Product life cycle (PLC) analysis subject to the learning curve effect

Phases of a product life cycle	Sales Units	Life span for each quarter @75% LC	Customers In a targeted market	New Customers
Development	100	1	100	-----
Introduction	200	0.75	150	50
Growth	400	0.5625	225	75
Maturity	800	0.4219	338	113
Decline	00	0.3164	00	00

**G.2 Graph of the PLC**



### Findings

1. The sales curve represents the maturity as highest and decline starts from that point.
2. The learning curve becomes straight, it is steady in its nature often called as steady curve.
3. The customers of the targeted market increase, phase by phase and decline after maturity
4. The new customer also decreases after maturity who have been increasing gradually in the beginning stages.
5. A single customer may buy the product several times in a single phase; so, customers are not proportionate to sales.

Explanation: The LC is 75% in the above example and that can be fixed to any level assuming the trend of the product, that can be explained very well with the graph derived from the calculations of

the LC. It is helpful to predict sales, count new customer, check sales in different phases and finally the effect of the learning curve on different products with their targeted markets.

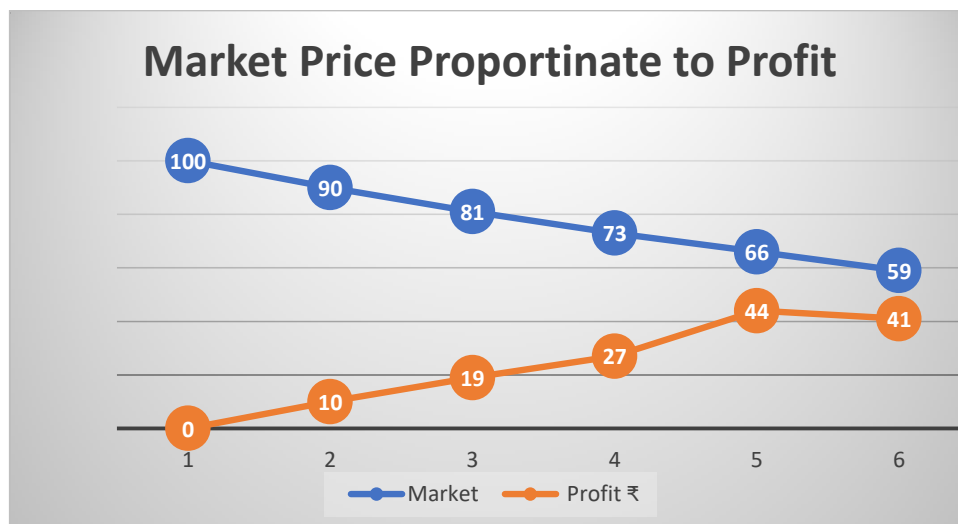
### Model C

In the option contract of the financial derivatives the buyer has the right to buy, but not the obligation. Basically, call and put are two types of the contracts in an option. Call provides the right to sell and investor makes profit if the market price exceeds the agreed price of the contract. In case of put, the right provided is to buy and investor makes money if the market price goes down than the agreed price of the contract. So, there are lot of strategies and models to predict the market behavior and using LC as a strategy/technique we will discuss the following model. Assuming that the market volatility will be @90% of the learning curve, the investor buys a put for ₹100 each.

#### 1.3 Profit earned in the volatile market

Days in a week	Strike Price of a single unit in ₹	Volatility of PUT@ 90% LC	Market Price in ₹	Profit ₹	If quantity is doubled	Profit after quantity is doubled in ₹
Monday	100	1	100	----	1	---
Tuesday	100	0.90	90	10	2	20
Wednesday	100	0.81	81	19	4	76
Thursday	100	0.73	73	27	8	216
Friday	100	0.66	66	44	16	704
Saturday	100	0.59	59	41	32	1312

G.3 Graph of the Derivative Prices of the put



## Findings

1. The experience curve states that ₹44 will be the ever highest recorded profit when the price comes down to ₹66 and further, it is the steady curve as the effect of the LC decreases and straightens its journey.
2. Put is profitable, if prices decrease in the market and when market price goes down against the strike price (agreed price).
3. Profit is directly proportionate to the market price.

### What will be the market price if the quantity is 5 units, which is in between 4 and 8 units?

$$Y = ax^{-b}$$

$a = ₹100$  the first price

$b = \frac{\text{Ln of the learning curve rate } 0.90}{\text{Ln of } 2}$

Ln of 2

$$b = \frac{-0.10536}{0.6931}$$

0.6931

$$b = 0.1520$$

$$\log y = \log a - b \times \log 5$$

$$= \log 100 - 0.1520 \times \log 5$$

$$= 2 - 0.1520 \times 0.6989$$

$$= 1.8938 \text{ (Antilog)}$$

$$= ₹78.3069 \text{ for 5 units.}$$

Explanation: Quantity doubled such as 2,4,6,8 etc. are easily calculated but when in between numbers like 3 or 5 are to be traced then,  $Y = ax^{-b}$  formula can be used to find out the answer.

## CONCLUSION

The applications of the learning curve are more technical and applying it is always an advantage for the service sector. In the coming days, the LC must be promoted for sectors like Banking and Insurance that can adopt a better strategy to serve their customers. In Marketing and Agriculture there are many advantages for adopting the LC. In manufacturing industries already, it is in use and service sectors should take that advantage. As a quantitative tool the Learning curve applications are not only effective but practically convince reduction of costs..

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