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Competitive Diffusion Based Modeling Framework for Adoption of Product Lines

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Summary: *For any brand/company, the aim of sustainability in the market brings competition into picture. A firm thus tries to capture all the possible potential buyers by providing a group of variety of products, thereby adopting the concept of product line. In today's cut throat competitive scenario, the concept of product line provides an opportunity for a firm to provide same kind of products with some variation at an altered pricing. In this study, we propose to understand the diffusion of competitive goods when product line is available in the market. The goal of the modeling framework is to observe shifting behaviour of customers and to predict the sales level in the presence of multiple products available together. Validation of the model has been done on real life sales data sets for automobile industries.*

Key words: *Adoption, product line, competitive diffusion.*

1. INTRODUCTION

A market consists of a mixture of various products that are produced by many manufacturers and used by distinct customers. An available product in the market plays different roles for manufactures and for the customers; where at one hand, producers produce products to convert them into the money (profit), customers on the other hand use products to convert their need into satisfaction. A customer being a special entity in the market, all manufactures put their best to create such a product which magnetise individuals towards them. To achieve various objectives such as earning profit, keeping existing customers happy, to expand the scale of new customers and to sustain for loner time, a brand has to come up with different valuable strategies.

Globalization has open doors (opportunities) for many manufacturers, where they have wide range of customers available in the marketplace. But, this also brings the high competition among brands. Competition stands as rivalry among all those brands that produce same kind of products with similar attributes at some different prices. Competition depends upon the types of the market i.e. if in case of monopoly market there would be no competition as there is single manufacturer that produces single product but in real scenario this is not the case. These days impure competition has taken over, where many manufactures are producing similar products with different characteristics at different prices. Hence different markets call different competitors. Furthermore, competitors can also be categorized on the basis of the products which they are dealing with. Classifications of the competitors are as follow [15]:

1. Direct Competitors: Those manufactures who are offering same type of product with same category. For example, Maruti and Hyundai are two well known brands which can be called direct competitors in the field of manufacturing cars as a product and four wheelers as category.
2. Indirect Competitors: In this class, manufactures serve their customer with the similar product but not exactly same. For instance, for Maruti manufactures which produces cars, an indirect competitor can be American automobiles brand that produces Jeep because they are not dealing with the same product but the same category.
3. Replacement Competitors: This type of producers do not fall in the same category instead they deal in totally different products and different category. Cycles' (or two wheelers) manufactures can be considered as replacement competitors as they are not producing any four wheelers and also not the same product (car).

Past studies have shown that inculcating competition factor into picture makes any study significantly more realistic. The learning curve (or "experience curve") is an important factor in industries but the nature of the competition depends critically on the information diffusion [12]. The very basic reason of applying different technologies by firms is evolution of a competitive market for a homogeneous product [9]. Fast technological progress carries large number of firms in the market that accelerate the high competition which generate the high speed of the diffusion of the product [6,18].

With the objective of earning more profits and to compete with other brands, a particular brand can hardly survive with a single product (though the multi-generation have been made time to time of that product). Hence, competition brings the necessity to come up with other products as well. Therefore, many brands produce a group of similar (or related) products that can be either totally a new product (which is new to the word) or the product which is new to the firm and also updating their existing product with new technologies, which help them to target new segment of the market (individuals) [5]. When a company employ the strategy to come up with the variety of products, it is called product mix (product portfolio or product assortment) and splitting of products into groups is termed as product line. This phenomenon is entitled as "Product Line", because when the brand (or a company) manufactures "a group of same related products" then that company has to divide their products on the basis of some specific attributes which depends upon company to company. For example, using Figure 1, a very well known company [2], which attracts audience in all over the world by providing new and high technology not only in one type of product. But it is working on the strategy of product mix i.e. a mixture of products of Operating Systems, Software, Tablets, MP3 players, and Mobile phones. And also they have defined them with new name as Mac, Software, iPad, iPod and iPhone respectively. These all are 5 different product lines of Apple Inc by which they are generating satisfaction among customers.

A particular product line may include different types of product and also different versions of the same product which is termed as "Multi-generational" products. A multi-generational product is a

product that comes periodically with some improvisation in the existing product in terms of advance technologies and new features as per the current requirements demanded by the customers. Various form of product line can be understood by means of Figure 1 again, Software product line consist with a set of different varieties of software which are based on different clusters i.e. for downloading audios, music, television stories etc. iTune application have been developed, whereas for the purpose of manipulation of the digital photographs, iPhoto have been build up, similarly for different usage and work they have developed different applications and its related software. This can be comprehended as different "product types" in single product line which is measured as length of a product line i.e. software product line has 6 length of different product types. But in case of iPhone product line, "iPhone 4" and "iPhone 4s" and "iPhone 5" and "iPhone 5s" are the example of multi-generated products which increases the depth of a particular "product type" within a product line.

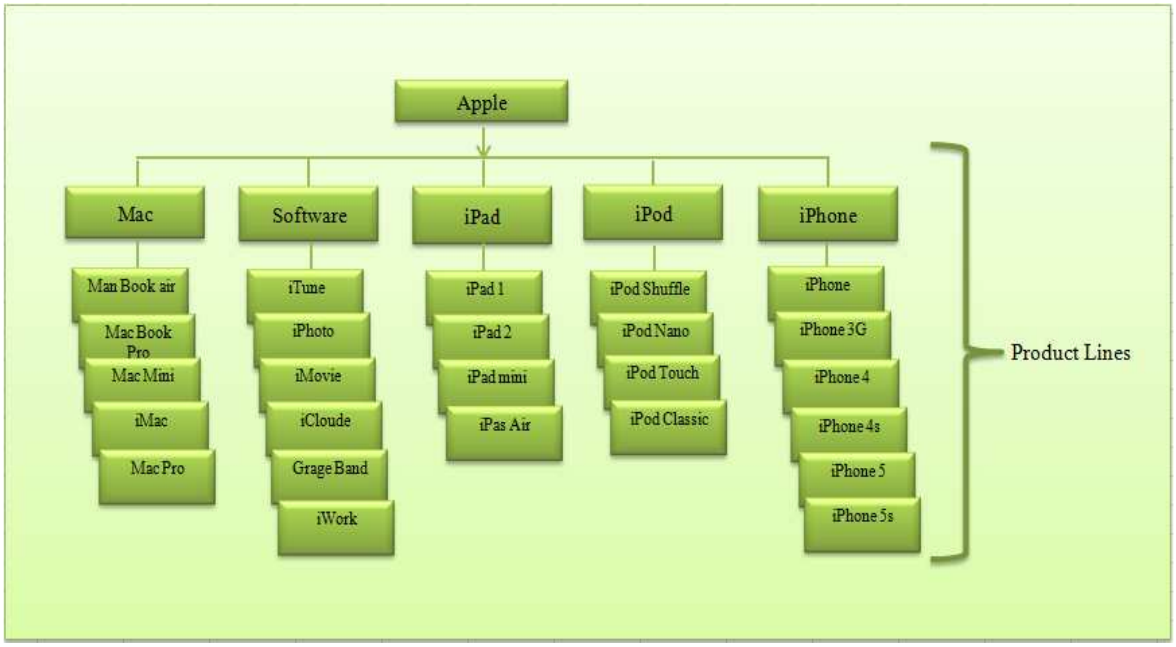

Figure 1. Apple and its product line

Employing the concept of the product line for any brand (may be small or big) has endowed with various benefits and advantages. It helps in capturing a large amount of audience and satisfy their needs which not only generate more profits but also increase loyalty of the customers because customer are getting all products at same place by same well known brand. Another major benefit of using product line is, when a product has reached to the last stage of its life cycle that is in the declining stage, and then on the same time there are other products available in the market of that product line which helps in avoiding loss of customers (or business) from its competitors.

Higher competition brings efficiency in terms of providing better quality in products and services, new strategies are developed with creative thinking to keep more focus on key customers and also help in motivating to maintain higher standards of customer services or innovations. Therefore, it becomes necessary for a brand to know the diffusion behaviour of the product in the market as it is competing with many other products. Since the product is also competing with those products which are manufactured by its own company therefore they have to employ such strategies which promote all their products present in the same product line so that a company should not be in loss [11,13] .

Diffusion of a product implies spreading of information of the new product that have launched in the market. The established diffusion model, [3] has followed a set of assumptions where one of the assumptions is that product is diffused in isolation that is competition is not present in the market. It is always easy to measure and predict the diffusion pattern of a single product. But now days such case does not exist; each and every brand has become rivals of each other to win the marketplace (or the individuals). With, this study, we have made an effort to relax this assumption and have predicted the diffusion pattern of the product which is competing with other products.

A new product or an innovation is either accepted or rejected by the audience. In other words, adopting behaviour of the adopters depends not only upon the awareness of the product but also on the quality, promotions, and services provided by other products of other brands which are acting as opponents in the same market place. In the pioneering work by Bass and in many of its extension based modeling, internal factors (i.e. coefficient of p) and external factors (i.e. coefficient of q) have always been focused in determining the sales growth of the sales but there are other factors also exists that is competitive factors that affect the sales of the market. A set of proposition have been developed by [19] that supply side competitive environment and the adopter industry competitive environment both affect diffusion of the new product. Therefore, in this modeling framework we have not only incorporated the basic factors (internal and external aspects) but also examined the sales pattern in the presence of the other products which are in the competition with a particular product.

In this study we have developed a model in the environment of impure competition with direct competitors, where product lines of different brands have been taken into consideration and evaluated the substitution behaviour of customers where each brand manufactures products (though similar in type and category but with different features) in the same product line and predicted the sales of each product.

Rest of the paper has been structured as follows: sections 2 discuss the mathematical modeling of diffusion of products based on Product lines and competitive brands. Section 3 is demonstrating the data analysis and a numerical illustration based on the proposed modeling. How this study can be useful for managers' perspective have been discussed in section 4. Section 5 and Section 6 have drawn conclusions and followed by references.

2. PRODUCT-LINE DIFFUSION MODELING IN COMPETITIVE ENVIRONMENT

Modeling based on the concept of product line is not recent but a smaller amount of contemplation has been given to this field. Many models [3,10] have been proposed in the past but they are specifically based on single product present in the market and moreover they do not explicitly talk about the concept of product line. Lately, mathematical formulations for finding the best marketing mix for each product in a product line that consist the factors like aggregate product group marketing mix, product interdependency, and competitive brand effects [22] have been thoroughly studied. Rivalry in the multi product using Product line has been presented by [4]. Furthermore, the concept proposed by [23] discuss regarding optimal timing for entry for a product line extension.

As we have discussed, that multi-generation of a product is a part of the product line where companies come up with additional features and benefits associated with the product. Literature has shown a wide research have been done on multi-generated products [17] have developed a foremost model, which defines how the potential customers of an existing product may substitute towards its more advanced product when it is launched in the market place [14] have defined a new category of "adopters" substitution behaviour i.e. *"leapfrogging"*, who may substitute towards the most recent version of the product by skipping the versions of the same product in between [7,8] have extended

the multi-generation concept by incorporated the notion of repeat purchaser termed as *"switching"* [1] has confirmed that Norton and Bass have implicitly incorporated the switching behaviour and also applicable on product-in-use in spite of number of product sold.

The broader class of the product line is creating similar products of the same category consist of altered features and attributes. Here, our modeling is based upon such class and competitive brand have also been adjoined to observe the adopting behaviour of the adopters. Here for the simplicity, two competitive brands of product line have been considered with the assumption that each brand offers two products in single product line. Uncertain behaviour of adopters classifies them in different classes of the adopters. Therefore, in this proposition we have defined 16 types of adopters as per their adoption behaviour. These number of types of adopters increases as number of products in the product line and numbers of product lines increases.

Categorization of types of adopters has been described in detail and also graphically represented in Figure 2 below. (Note: For ease we have used acronyms for Product 1 as P1, Product 2 as P2, Product Line 1 as PL1 and Product Line 2 as PL2 (Product line of competitive brand).

a) purchasers of P1 of PL1 - (Type 1)
b) purchasers of P2 of PL1 - (Type 2)
c) purchasers of P1 of PL2 - (Type 3)
d) purchasers of P2 of PL2 - (Type 4)

In the market, when many products are available of the same type of same category than the behaviour of the respondents becomes uncertain and they may divert from one product to another. Below we have described about those customers who belong to PL1 but may distract to other products.

e) Potential adopters of P1 from PL1 who deviate to P2 within the same product line - (Type 5)
f) Potential buyers of P1 of PL1 who would prefer its competitive brand's product i.e. P1 of the PL2 - (Type 6)
g) Where as if, potential buyer of P1 of PL1 would prefer another product (P2) of PL2 would fall in this category - (Type 7)
h) Likely adopters of P2 of PL1 who would move away to P1 of its same product line - (Type 8)
i) Expected adopter of P2 of PL1 who would favour to its competitive product i.e. P1 of PL2 - (Type 9)
j) On the other hand, potential adopters of P2 of PL1 who may decide to purchase P2 of PL2 - (Type 10)

This types of deviators belong from another product line of other brand such that PL2, whose potential adopters would deviate to other alternatives present in the market place. This behaviour can be understood as:

k) Probable buyers of P1 of PL2 who would prefer the product from the same product line of the same brand but different product which is P2 - (Type 11)
l) Expected adopters of P1 of PL2 who would deviate towards its rivalry product line and will go for P1 - (Type 12)
m) Similarly, potential purchaser of P1 of PL2 who would prefer P2 product of its competitive brand - (Type 13)
n) Possible adopters of P2 of PL2 who would choose P1 of the same brand. - (Type 14)

o) Expected adopter of P2 of PL2 who would favor P1 product which belong to PL1 - (Type 15)
p) Likewise, potential adopters of P2 of PL2, who would desire for its competitive product i.e. P2 - (Type 16)

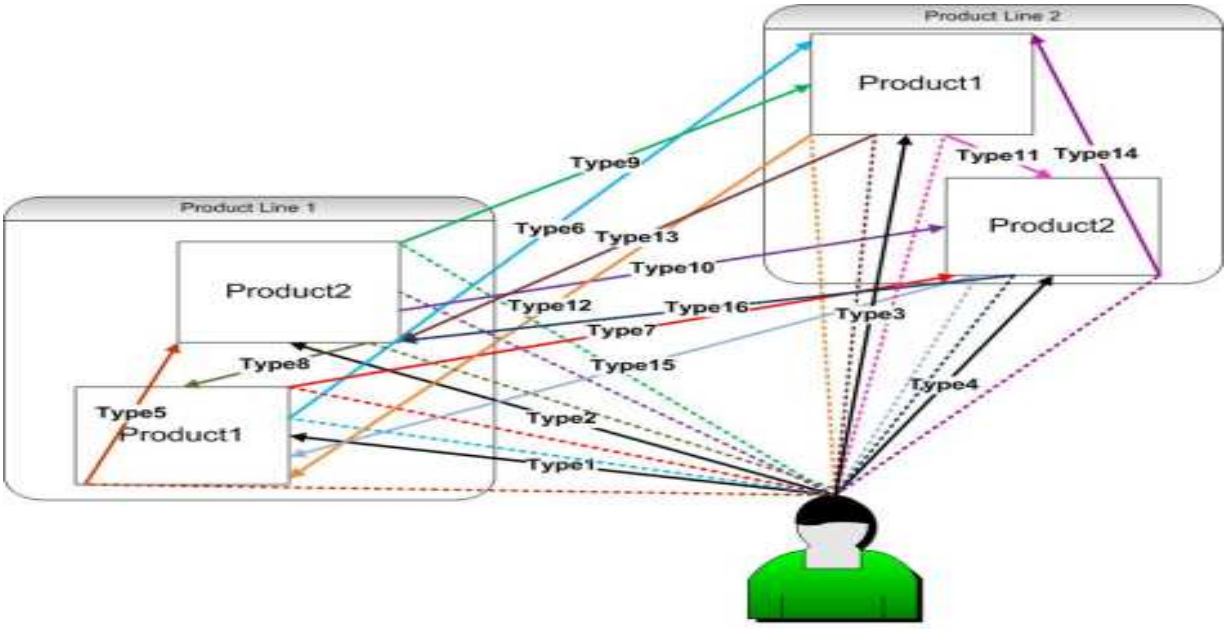

Figure 2. Relationship between Two Product Lines and its Related Products

As mentioned earlier, there are four types of products available in the market at the same time and there would be four different potential sizes for each product. Type 1 to Type 4 types of adopters are the representation of those adopters, it can also be understood from Table 1. In this table, PL1P1 represents adopters of Type 1, PL1P2 implies adopters of Type 2, PL2P1 corresponds to Type 3 buyers and similarly PL2P1 signifies for type 4 adopters. For better understanding the rest of types of adopters (Type 5 to Type 16) we have explained later.

Table 1. Types of Adopters (Type 1 to Type 4)

	Product Line 1	Product Line 2
Product 1	PL1P1	PL2P1
Product 2	PL1P2	PL2P1

This modeling framework is based upon some assumptions as mentioned below:
I. Adoptions for each product of each product line has followed density function of time (Bass Model)
II. Potential Adopters/buyers can be classified into two broad categories i.e. Purchaser and Deviators.
III. Exactly one unit of product can be purchased by any new adopter. No repeat purchase is possible in the given period.

Our study is based on predicting the behaviour of diffusion of any product competing with other products in the market place. Though in real scenario, a purchaser can buy two similar products in a same time period but this study have deliberately assumed that repeat purchase of similar product either from the other brands or from the same product line is not possible. Therefore assumption 4

has played an important role in this modeling framework. In the presence of the competitive products how any individual can behave or it can be said that when many options are available for the customers in the market at one time how substitution can affect diffusion of any product can be explained by using the Figure 2. Here, all types of adopters (Type 1 to Type 16) can be understood as: Each dark line is a representation of a purchase (i.e. the adopters of Type 1 to Type 4) and each dotted line symbolizing a chance of making purchase (that is the adopters of Type 5 to Typ16). Adopters of Type 5 to Type 16 are specifically named as "Deviators" because with the motive of purchasing a best product at reasonable price any customer may deviate from one product to another product. The actual sales of Product line 1 of Product 1 can thus be understood from the equation given below:

$$PL_1P_1(t) = (m_{11}.F_{11}) - (\alpha_1.m_{11}.F_{11}.F_{12}) - (\alpha_2.m_{11}.F_{11}.F_{21}) - (\alpha_3.m_{11}.F_{11}.F_{22}) + (\delta_1.m_{12}.F_{12}.F_{11}) + (\gamma_2.m_{21}.F_{21}.F_{11}) + (\sigma_2.m_{22}.F_{22}.F_{11}) \quad (1)$$

In Equation (1), $m_{11}.F_{11}$ are the potential adopters of Product Line 1 of Product 1, and α_1, α_2 and $\alpha_3\,(where, \alpha_3 = 1-\alpha_1-\alpha_2)$ are termed as competitive factors which is the rate of diversion from PL_1P_1 *to* PL_1P_2, PL_2P_1 *and* PL_2P_2 respectively. Therefore these values have been subtracted from the PL_1P_1. Similarly, there is a possibility of addition of some proportion of potential adopters of other products in this product (i.e. PL_1P_1), δ_1, γ_2 *and* σ_2 are the competitive factors of PL_1P_2, PL_2P_1 *and* PL_2P_2 respectively which would might increase the sales of PL_1P_1. Therefore, the components of Equation 1, $(\alpha_1.m_{11}.F_{11}.F_{12}), (\alpha_2.m_{11}.F_{11}.F_{21}), (\alpha_3.m_{11}.F_{11}.F_{22})$ can be understood and taken as Type 5, Type 6 and Type 7 (as discussed previously) respectively. Likewise, $(\delta_1.m_{12}.F_{12}.F_{11})$ value representing Type 8 adopters, that would be subtracted from PL_1P_2 and would add up in PL_1P_1. $(\gamma_2.m_{21}.F_{21}.F_{11})$ and $(\sigma_2.m_{22}.F_{22}.F_{11})$ represents Type 12 and Type 15 which decrease the sales of the PL2P1 and PL2P2 products respectively and would be adjoin in PL1P1.

Therefore, for (2+2) (i.e. 2 product lines and 2 products) the set of all four equations (as discussed for equation 1) can be written in the following manner:

$$PL_1P_1(t) = (m_{11}.F_{11}) - (\alpha_1.m_{11}.F_{11}.F_{12}) - (\alpha_2.m_{11}.F_{11}.F_{21}) - (\alpha_3.m_{11}.F_{11}.F_{22}) + (\delta_1.m_{12}.F_{12}.F_{11}) + (\gamma_2.m_{21}.F_{21}.F_{11}) + (\sigma_2.m_{22}.F_{22}.F_{11}) \quad (1)$$

$$PL_1P_2(t) = (m_{12}.F_{12}) - (\delta_1.m_{12}.F_{12}.F_{11}) - (\delta_2.m_{12}.F_{12}.F_{21}) - (\delta_3.m_{12}.F_{12}.F_{22}) + (\alpha_1.m_{11}.F_{11}.F_{12}) + (\gamma_3.m_{21}.F_{21}.F_{12}) + (\sigma_3.m_{22}.F_{22}.F_{12}) \quad (2)$$

$$PL_2P_1(t) = (m_{21}.F_{21}) - (\gamma_1.m_{21}.F_{21}.F_{22}) - (\gamma_2.m_{21}.F_{21}.F_{11}) - (\gamma_3.m_{21}.F_{21}.F_{12}) + (\sigma_1.m_{22}.F_{22}.F_{21}) + (\alpha_2.m_{11}.F_{11}.F_{21}) + (\delta_2.m_{12}.F_{12}.F_{21}) \quad (3)$$

$$PL_2P_2(t) = (m_{22}.F_{22}) - (\sigma_1.m_{22}.F_{22}.F_{21}) - (\sigma_2.m_{22}.F_{22}.F_{11}) - (\sigma_3.m_{22}.F_{22}.F_{12}) + (\gamma_1.m_{21}.F_{21}.F_{22}) + (\alpha_3.m_{11}.F_{11}.F_{22}) + (\delta_3.m_{12}.F_{12}.F_{22}) \quad (4)$$

With the help of these equations, remaining types of adopters can also be understood as Type 8 adopters would fall in the class $(\delta_1.m_{12}.F_{12}.F_{11})$ which implies adopters are deviated towards PL1P2 $\rightarrow$ PL1P1, Type 9 are those adopters who are deviating from PL1P2 $\rightarrow$ PL2P1

i.e. $(\delta_2.m_{12}.F_{12}.F_{21})$ and Type 10 $(\delta_3.m_{12}.F_{12}.F_{22})$ from PL1P2 $\rightarrow$ PL2P2. In the same way, for PL2, for product 1 $(\gamma_1.m_{21}.F_{21}.F_{22})$, $(\gamma_2.m_{21}.F_{21}.F_{11})$, $(\gamma_3.m_{21}.F_{21}.F_{12})$ are the Type 11, Type 12 and Type 13 who would shift to PL2P2, PL1P1 and PL1P2 respectively. And for Product 2, adopters of Type 14 are those who would move to PL2P1 (represented as $\sigma_1.m_{22}.F_{22}.F_{21}$), Type 15 are those who would move to PL1P1 (represented as $\sigma_2.m_{22}.F_{22}.F_{11}$) and Type 16 are those who would move to PL1P2 (represented as $\sigma_3.m_{22}.F_{22}.F_{12}$).

The proposed modeling can also be generalized up to y product lines consist of z products where, PL_iP_j represents the number of sales of i^{th} product line of j^{th} product where $i=1,2...y$ and $j=1,\ 2...z$ given time at t. m_{ij} is representing numbers of potential adopters of i^{th} product line of j^{th} product and F_{ij} is following bass model and $\lambda_{1k,}\ \lambda_{2k,}...\lambda_{(y+z)k}$ (where $k=(y+z)-1$) are the proportion of adopters of i^{th} product line of j^{th} product respectively, who divert from one product to another product. Equations can be written as:

$$PL_1P_{j'}(t)=(m_{1j'}.F_{1j'})-\sum_{j=2,k=1to\,z-1}^{z}(\lambda_{1k}.m_{1j'}.F_{1j'}.F_{1j})-\sum_{i=2}^{y}\sum_{j=1,k=z\,to\,(y+z-1)}^{z}(\lambda_{1k}.m_{1j'}.F_{1j'}.F_{ij})$$
$$+\sum_{j=2,k=1to\,z-1}^{z}(\lambda_{jk}.m_{1j}.F_{1j}.F_{1j'})+\sum_{i=2}^{y}\sum_{j=1,k=z\,to\,(y+z-1)}^{z}(\lambda_{jk}.m_{ij}.F_{ij}.F_{1j'}) \qquad \forall\ j'=1to\,z$$

to

$$PL_yP_{j'}(t)=(m_{yj'}.F_{yj'})-\sum_{j=2,k=1to\,z-1}^{z}(\lambda_{yk}.m_{yj'}.F_{yj'}.F_{yj})-\sum_{i=2}^{y}\sum_{j=1,k=z\,to\,(y+z-1)}^{z}(\lambda_{yk}.m_{yj'}.F_{yj'}.F_{ij})$$
$$+\sum_{j=2,k=1to\,z-1}^{z}(\lambda_{jk}.m_{yj}.F_{yj}.F_{yj'})+\sum_{i=1}^{y-1}\sum_{j=1,k=z\,to\,(y+z-1)}^{z}(\lambda_{jk}.m_{ij}.F_{ij}.F_{yj'}) \qquad \forall\ j'=1to\,z$$

Here *j* and *j'* both are representing number of products in any product line. In the next section, we have validated these equations and analyze the behaviour of the sales of the all products.

3. DATA ANALYSIS AND NUMERICAL ILLUSTRATION

For validation of the proposed model we have used cars sales data from two online sites [16,21]. Here, we have chosen two well known brands i.e. Hyundai Motors and Maruti Suzuki which are direct competitors of each other. Two products of four wheelers category for each brand are; for Hyundai Motors, P1 (Product 1) representing total sales of cars such as Santro, EON. And for Maruti, P1 is representing total sales of M800, A-star, Alto and Wagon R; because they consist with the same attributes like body style is hatchback, its engine displacement is normally up to 1.0 litre and its length is normally less than 3600 mm embedded with upto-5 seats. Whereas the P2 (Product 2) is bit different from the P1 as per their attributes like its body style can be - estate/hatch/notchback, its engine displacement is normally upto1.4 litre and its length is also bigger which is around between 3600-4000 mm and consists with upto-5 seats. Therefore, for Hyundai Motor P2 is total sales of cars such as i10.Getz, i20 and for Maruti Suzuki India Ltd cars are like Ritz, Swift and Estilo comes in this category.

Here, first product line is Hyundai Motors included with two products as described above, named as PL1P1 (H1) and PL1P2 (H2). Accordingly second product line is of another brand i.e. Maruti Suzuki which also have two products as PL2P1 (M1) and PL2P2 (M2). For estimating parameters of proposed model, we have used simultaneous non linear two stage least square by software package SAS [20]. Table 2 is representing the estimated values of diffusion parameters of these four products and comparison criteria's of these equations are shown in Table 3.

Table 2. Parameter estimation results

Technology	Product Line and its products	Parameters						
Equations (1 to 4)		m_{ij}	p_{ij}	q_{ij}	α_k	δ_k	γ_k	σ_k
Cars data	PL1P1(H1)	328744	0.0015	0.4001	-	0.0101	0.0001	0.3647
	PL1P2(H2)	1085432	0.0355	0.1010	0.4560	-	0.1990	0.2900
	PL2P1(M1)	427301	0.0379	0.1100	0.2310	0.0011	-	0.3453
	PL2P2(M2)	1056070	0.0106	0.0500	0.3130	0.9888	0.8009	-

Table 3. Comparison criteria

Criteria	Model			
Equation (1 to 4)	PL1P1(H1)	PL1P2(H2)	PL2P1(M1)	PL2P2(M2)
SSE	1.14E+10	4.99E+09	2.61E+10	1.20E+10
MSE	5.13E+08	2.25E+08	1.16E+09	5.43E+08
Root MSE	22659.4	14996.4	34034.8	23307.3
R-Square	0.9174	0.9834	0.9848	0.9744
Adj R-Sq	0.9142	0.9827	0.9845	0.9735

In Table 3, m_{ij} represents the respective market potential sizes of Hyundai and Maruti brands and their respective products. p_{ij} and q_{ij} are the coefficient of innovation and coefficient of imitations. The rest of the columns are the competitive factors by which the potential adopters are diverting from one product to another product. Here, it is worth to note that the sales of PL1P2(H2) and PL2P1(M1) is highly impacted by PL2P2(M2) product (as an competitor) because δ_3 *and* γ_3 is very large i.e. 0.9888 and 0.8009 respectively which implies that PL2P2(M2) is more preferred by the potential customers of PL1P2(H2) and PL2P1(M1) and the sales of them is decreasing with the rate of 0.9888 and 0.8009 from their respective products. Also in case of Hyundai Motors as a product line, for the product PL1P1 (H1), competitive factor of its own second product PL1P2 (H2) is higher (that is α_1 = 0.4560) than the other brand of products which can be analyzed that among the available two products of the Hyundai Motors's product line, second product is favored by the customers and Hyundai is making added profits from its another product i.e. PL1P2 (H2) which also help them to prevent its customers to go to the other brand's products (Maruti). Using Table 3, basis of values of SSE, MSE, Root MSE, R-Square and Adjusted R-square, where values of R-square is 0.9174, 0.9834, 0.9848 and 0.9744 and it can be observed that the proposed model is well fitted, which also can be seen graphically. Using Figure 3, clearly the graph represents an excellent fit between actual and predicted values of all four products.

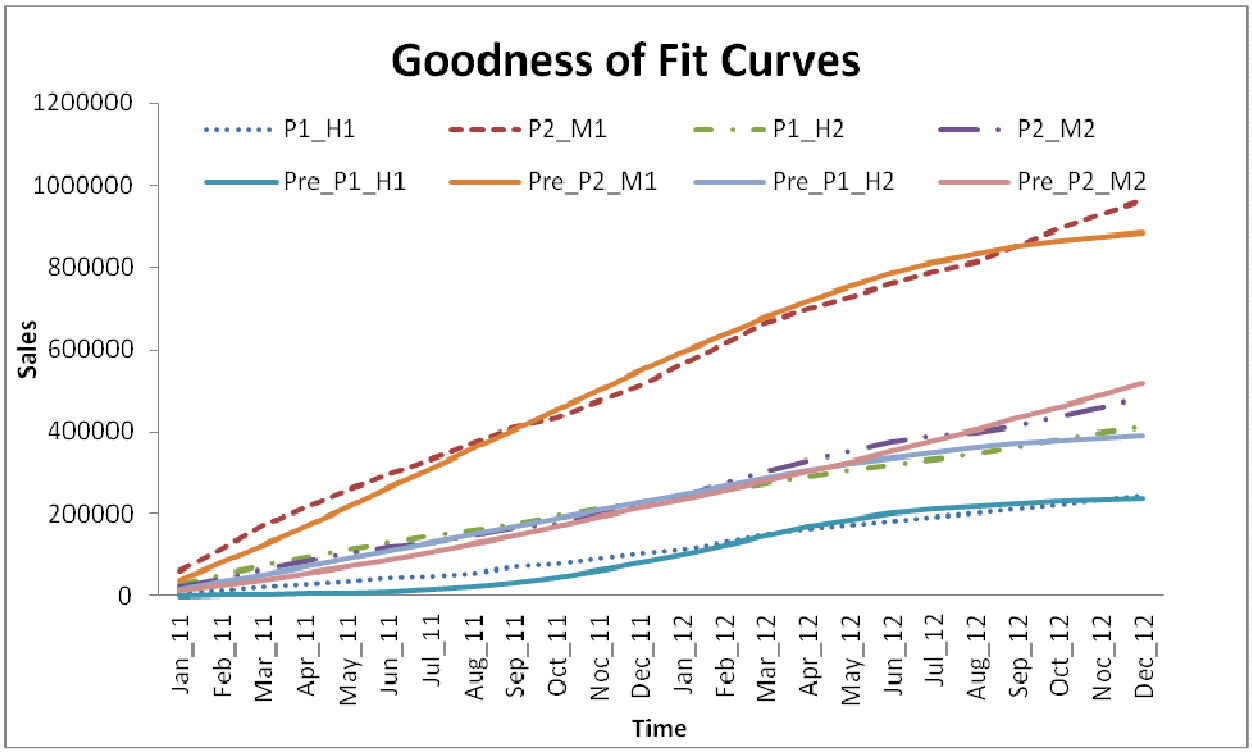

Figure 3. Goodness of fit curve of all four products

4. MANAGERIAL IMPLICATIONS

An organization always tries to make a comprehensive plan that unifies its entire marketing goals and come up with a perfect product mix which can serve and achieve maximum surplus potential and sustain the business. An abstract idea of using product line phenomena in such a big battling filed (market place) can be an outstanding plan. But for any company it should be important to observe how the diffusion of the product is impacted by not only from its competitive brand but also by its own related products. For instance as we have discussed in the case of Hyundai Motors in Table 2, where the rate of diversion (α_k) of potential buyers of H1 is maximum towards its own another product i.e. H2. This behaviour of deviators benefits to Hyundai only if H2 is generating more profits as compare to H1. And, how competition can influence the sales of one product can be understood by seeing the case of the H2, where maximum of its potentials customers are diverting (δ_k) to its competitive product that is M2. The possible reason of such behaviour of buyers can be that they all preferred "product type" over the brand. Therefore, they are diverting towards its similar type of product of other brand.

Therefore, it becomes necessary to observe and analyze the sales patterns of their existing product which are competing with other branded products. This study can act as a gizmo which aids any manager to discover the impact of the competitive factors on their respective products and can analyze the proportion of shifting from one product to another product. And also provides a mean to predict the sales not only of single product but can also evaluate the sales of their competitive brands present in the market place.

5. CONCLUSIONS

In this paper, we have made an effort to study the concept of the product line and the behaviour of the diffusion of the product in the presence of the competition. Here, we have also defined different types of adopters who behave differently (or may be called as deviators) when many same or related products are accessible at the same time and same place. Using the cars sales data of two big brands (i.e. Hyundai Motors and Maruti Suzuki), we could appropriately evaluate the patterns of the sales of all four types of cars and analyzed which car's presence has affected the sales of the other cars.

Hence, the proposed model is a helping hand for an organization to predict the sales of any product when product line and competition are there in the market together.

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