

Influence of Customer Attrition on Diffusion of Business Education Services

Nitin Sachdeva

Fortune Institute of International Business
New Delhi, Delhi, India
Email: nitin.sachdeva@fiib.edu.in

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Abstract

Innovation diffusion models have been developed by many researchers during the past few decades based on the famous Bass (1969) model. Several such diffusion models have been developed in consideration of price, marketing efforts etc., however, it is hardly seen that customer attrition (disadoption) can play a significant role in long term growth process of any new product or service. This paper defines two types of disadoption process, Type I disadoption and Type II disadoption process, representing disadopters from innovators and imitators, respectively. We illustrate that there is an increase in the market size along with the adoption of new product and this increase is addressed in this paper. The explicit mean value function for the two types of disadoption processes is derived in this paper. The thrust of the research is on studying the management educational services in the Delhi/NCR region of India and the impact of disadoption on the long term growth of such services. In order to validate the proposed modeling framework, we make use of different goodness-of-fit criteria on primary data collected from an institute in Delhi/NCR.

Keywords: Innovation diffusion modeling, Customer attrition, Disadoption, Educational services mean value function.

1. Introduction

In the past few decades, several products introduced into the markets have been services instead of traditional tangible goods, such as financial services, cell phones, satellite radio etc. With the advent of internet came many new services like whatsapp (quick messaging), e-commerce and several others, which were missing before 1980s. Services have traits in common with both durable goods and fast-moving consumer goods. As do sellers of fast moving consumer goods, service providers depend on repeat purchases for commercial success. The growth of the market for fast-moving consumer goods is usually attributed to advertising, promotion, and consumer trials; therefore, studies of such goods usually rely on frameworks such as stochastic choice models. Conversely, purchase decision making for services is governed by internal communication mechanisms, such as word of mouth and imitation (Murray, 1991; Wangenheim and Bayon, 2004). In this sense, services are similar to durable goods. However, a major difference between durable goods and services is the existence of the outward flow of customers, or customer attrition, which is when a customer decides to terminate the relationship with the provider. None of these services exist in the market where the customers do not leave during the initial stages of penetration or even at the later stages. During this initial period of product (service) diffusion into the market, customers either switch to competitors or leave the specific category of product. Thereby customer attrition, majorly its complement, customer retention, has been given significant attention by the managers as well as researchers in recent years after Reichheld (1996) derived that the long-term profits of a company is directly influenced by its customer retention rate. Attrition is mainly relevant to services that entail regular repurchases and in which customers develop long-term relationships with service providers (Berry, 1999).

With the general term “attrition,” we denote any case of a customer who terminates a relationship with a service provider. In competitive environments, such as those for mobile telephone, cable and satellite television, e-banking, and other subscriber-based services, attrition is an important operational measurement that is monitored regularly by service providers. Attrition rates are influenced by customer satisfaction (Bolton, 1998), competitive pressure (Oliver, 1999), switching costs (Burnham et al., 2003), and customer information on alternatives (Capraro et al., 2003).

However, the literature doesn’t provide for enough detailing on defining and modeling the effect of customer attrition on the growth of services. The entire existing diffusion modeling literature focuses upon the growth of specific category-level markets for unit purchase of consumer durable goods and not examining services and especially the influence of customer attrition (Bass, 1969; Mahajan et al., 2000).

The main goal of this article is to provide a quantitative framework that enables researchers and managers to understand how the dynamics of customer attrition really influences the diffusion of services in the market. The thrust of the research will be upon studying the educational services in the Delhi/NCR region of India and the impact of customer attrition on such services. The primary focus of the research is on understanding the management education service and how the customer attrition really impacts the long term growth of an educational institute.

In any given period, a firm can acquire customers from the pool of nonusers (which includes new customers and customers who disadopted the category in the past) and those who switch from a competitor (known as “churn”). Alternatively, the firm can lose customers to a competitor (churn) or to disadoption from the category. Although the dynamics are not trivial, our model is relatively simple and enables an in-depth analysis of the growth of services.

In this paper, two types of disadoption process are proposed in the development of new product growth models. Type I disadopters are the ones who independently disadopt the service without the influence of external agents. Further these are those customers who primarily adopted the service as innovators and later decided to disadopt it. Type II disadopters are those who disadopt primarily due to the influence of other similar disadopters. These are those customers who adopted the service as imitators and later disadopt it.

The rest of this article continues as follows: We briefly review the relevant literature regarding the empirical and theoretical aspects of attrition and service diffusion. Next, we present our model at the category level and its underlying assumptions and study the influence of disadoption on market growth. We then explore the competitive model and calculate the customer equity of seven brands of services in markets for mobile phones, online brokerages, online book retailers, and satellite radio providers and discuss their customer equity relative to a model without attrition and to stock market valuations. We conclude by discussing the theoretical and practical implications.

2. Two-Phase Disadoption Process Innovation Diffusion Model

Innovation diffusion models are widely applied in new product development to track the adoption of innovative products (services) based on product price, characteristics, quality, marketing efforts (Mahajan et al., 1990). As discussed in Section-1, two types of disadopters, Type I and

Type II, are identified and modelled in Phase I and Phase II, respectively. Fig. 1 gives us an intuitive description of adoption phases and its corresponding disadopters' type.

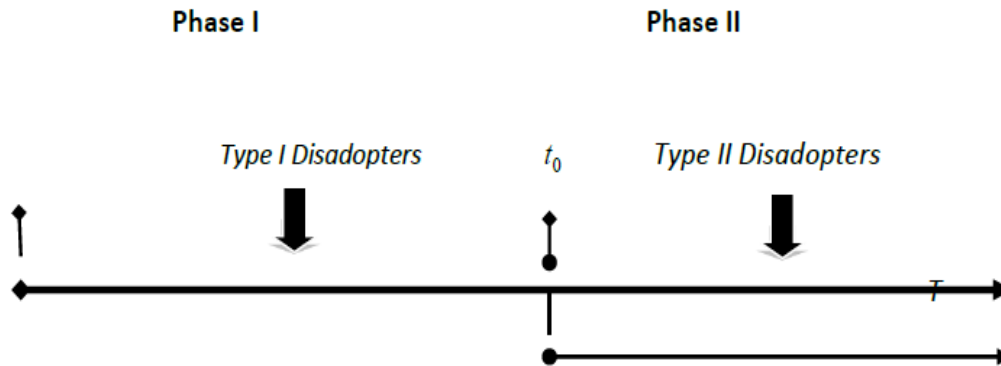


Fig. 1. Two phase disadoption process

Assumptions

- (i) The diffusion process is subject to adoption due to remaining number of adopters in the market.
- (ii) We consider a two phase diffusion process in which the potential adopters (disadopters) belongs to either innovators or imitators category.
- (iii) Adopters in Ist phase are all considered as innovators whereas in IInd phase the adopters are classified as imitators. Besides, the total market size (potential) is fixed.
- (iv) Number of innovators adopting in the time interval $[0, t_0]$ in the Ist phase is not proportional to the remaining number of innovators in that phase.
- (v) Number of imitators adopting in the time interval (t_0, ∞) in the IInd phase is not proportional to the remaining number of imitators in the IInd phase.
- (vi) In both phases, there exists a certain portion of disadopters. We assume disadoption rate function in the two phases as $c_1(t)$ and $c_2(t)$ respectively. Thus, in this paper, the rate of number of adopters is not proportional to the innovation adoption rate and the remaining number of adopters due to the disadopters in each phase.
- (vii) The adoption and disadoption rate are different in Phase I and Phase II. Since the type of adopters and the level of disadoption is not the same in Phase I and Phase II.
- (viii) Adopters in the two phases adopt the same product during the product life cycle completely differently from each other.
- (ix) Market potential doesn't change with time during the diffusion process.

Notations

- $m(t)$: Total number of adopters in the time interval $[0, t]$
 $N_1(t)$: Cumulative number of adopters in Phase I by time $t, t \in [0, t_0]$
 $N_2(t)$: Cumulative number of adopters in Phase II by time $t, t \in (t_0, \infty)$
 $m_1(t)$: Total number of adopters in Phase I

- $m_2(t)$: Total number of adopters in Phase II
 $b_1(t)$: Innovation adoption rate function in Phase I
 $b_2(t)$: Innovation adoption rate function in Phase II
 $c_1(t)$: Disadoption rate function in Phase I
 $c_2(t)$: Disadoption rate function in Phase II

Thus, the proposed two-phase disadopters' with increasing market potential is formulated as follows:

$$\begin{aligned} \frac{dN_1(t)}{dt} &= b_1(t)[m_1(t) - N_1(t)] - c_1(t)N_1(t), \quad t \leq t_0 \\ \frac{dN_2(t)}{dt} &= \frac{b_2(t)}{m_2(t)}N_2(t)[m_2(t) - N_2(t)] - c_2(t)N_2(t), \quad t > t_0 \end{aligned} \quad (1)$$

where $N_1(t)$ is the expected number of adopters in Phase I by time t , $t \in [0, t_0]$. $N_2(t)$ is the expected number of adopters in Phase II by time t , $t \in (t_0, \infty)$. $m_1(t)$ and $m_2(t)$ represent the total market potential in Phase I and Phase II, respectively. $b_1(t)$ and $b_2(t)$ denote the innovation adoption rate function in Phase I and Phase II, respectively. $c_1(t)$ and $c_2(t)$ describe the disadoption rate function in Phase I and Phase II, respectively.

Even Phase I and Phase II are explained as two disadoption process, however, they are still considered as an integrated part of new product development. The connection between Phase I and Phase II is the number of adopters at the end of Phase I is equal to the number of adopters at the beginning of Phase II. Therefore, we obtain

$$N_1(t_0) = N_2(t_0) \quad (2)$$

Note that we consider time point t_0 belongs to Phase I for the ease of parameter estimation.

Since innovation diffusion is an integrated adoption process, the total market potential in Phase II is the market potential in Phase I at time t_0 minus the number of adopters in Phase I at time t_0 . The expression of the market size in Phase II can be obtained by

$$m_2(t) = m_1(t_0) - N_1(t_0) \quad (3)$$

A. Phase I Disadoption Process

As shown in Fig. 1, innovators adopt the product in Phase I mainly as independent adopters gaining information on the innovation completely by themselves. During this phase, new adopters get added to the market to increase the market size and the total market potential is given by:

$$m_1(t) = m(1 + \alpha t), \quad a > 0, \alpha > 0 \quad (4)$$

The innovation adoption rate in Phase I is given by

$$b_1(t) = \frac{b_1}{1 + \beta e^{-b_1 t}}, b_1 > 0, \beta > 0 \quad (5)$$

Here, we assume that disadoption of services often affects the growth of a new service category. Also assuming that from a dynamic modeling point of view, the lost-for-good option is problematic because the constant disadoption leads to a zero level of adoption in the long run, regardless of the values of the rest of the parameters. This is inconsistent with both classical diffusion approaches and empirical data. In addition, anecdotal evidence supports the option that a customer might eventually return. Note that though a customer might theoretically return immediately after disadoption, read option typically takes a while because the customer's return is subject to the diffusion process. Thus, in our model, and consistent with calls to take customers' eventual return into account when modeling attrition (Rust et al., 2004), we assume that disadopting customers can rejoin.

The non-removable fault rate in Phase I is given by

$$c_1(t) = c_1, c_1 > 0 \quad (6)$$

Where, m is the initial market potential before introducing new adopters, $m_1(0) = 0$. α is the rate of increase in the market potential. b_1 is the asymptotic unit innovators adoption rate in Phase I and β is the parameter applied to determine the shape of the learning curve in Phase I. c_1 denotes the disadoption rate in Phase I because of several reasons for adopters to leave the services.

The initial condition for Phase I is described as follows

$$N_1(t=0) = 0 \quad (7)$$

We substitute (4), (5), (6) and (7) into the differential equation (8) for Phase I, which is present in (1)

$$\frac{dN_1(t)}{dt} = b_1(t)[m_1(t) - N_1(t)] - c_1(t)N_1(t) \quad (8)$$

The mean value function $N_1(t)$ is given by

$$N_1(t) = \frac{mb_1 \left[(b_1 + c_1)(1 + \alpha t) e^{(b_1 + c_1)t} - \alpha e^{(b_1 + c_1)t} + \alpha - b_1 - c_1 \right]}{(b_1 + c_1)^2 (\beta + e^{b_1 t}) e^{c_1 t}}, t \in [0, t_0] \quad (9)$$

B. Phase II Disadoption Process

Type II disadopters, defined as those who disadopt primarily due to the influence of other similar disadopters. These are those customers who adopted the service as imitators and later disadopt it. Note that there is no adoption of imitators in Phase I and hence no disadoption in Phase I take place because of type II disadoption process. Type II disadopters are expounded as dependent

disadopters, and therefore the sufficient condition for adopting during phase II, is the presence of adopters in Phase I.

As in equation (1), $\frac{b_2(t)}{m_2(t)} N_2(t) [m_2(t) - N_2(t)]$ explains the adoption process for dependent adopters. There also exists a small portion of adopters those disadopt during phase II. $c_2(t) N_2(t)$ denotes the number of disadopters which do not return back during Phase II.

The total market potential $m_2(t)$ can be obtained from equation (3):

$$m_2(t) = m_1(t_0) - N_1(t_0) = m(1 + \alpha t_0) - N_1(t_0) \quad (10)$$

The adoption rate function $b_2(t)$ in Phase II is described as

$$b_2(t) = \frac{b_2}{1 + \gamma e^{-b_2 t}}, b_2 > 0, \gamma > 0 \quad (11)$$

The disadoption rate function in Phase II is given by

$$c_2(t) = c_2, c_2 > 0 \quad (12)$$

where, b_2 is the asymptotic unit innovation adoption rate in Phase II and β determines the shape of the learning curve in Phase II. c_2 represents the disadoption rate in Phase II.

From (1), the innovation adoption model in the presence of disadopters is as follows:

$$\frac{dN_2(t)}{dt} = \frac{b_2(t)}{m_2(t)} N_2(t) [m_2(t) - N_2(t)] - c_2(t) N_2(t) \quad (13)$$

Substituting (2), (9), (10), (11) and (12) into the differential equation (13), we can obtain the mean value function $N_2(t)$ as follows:

$$N_2(t) = \frac{\gamma + e^{b_2 t}}{\frac{b_2 e^{c_2 t}}{[m(1 + \alpha t_0) - N_1(t_0)](b_2 - c_2)} \left[e^{(b_2 - c_2)t} - e^{(b_2 - c_2)t_0} \right] + \frac{\gamma + e^{b_2 t_0}}{N_1(t_0)}}, t \in [t_0, \infty) \quad (14)$$

$$\text{where, } N_1(t_0) = \frac{mb_1 \left[(b_1 + c_1)(1 + \alpha t_0) e^{(b_1 + c_1)t_0} - \alpha e^{(b_1 + c_1)t_0} + \alpha - b_1 - c_1 \right]}{(b_1 + c_1)^2 (\beta + e^{b_1 t_0}) e^{c_1 t_0}}$$

3. Empirical Data Analysis and Parameter Estimation

The proposed research is based on quantitative modeling of diffusion process of educational services in the Indian market. The research methodology adopted for this work can be summarized as follows: Overall design of this research is based on quantitative approach, meaning that a formal, objective, systematic process where admission data is used to validate the

proposed differential equation model in the lights of how customer attrition impacts diffusion of educational services in the market is carried out.

Following variables are used to carry out this study:

- (i) Independent Variable – Time
- (ii) Dependent Variable – Number of adopters of the product (services) – To be represented by number of admissions every year for the last 10 years. As part of the study we take into account the number of disadoptions (measure of customer attrition) that took place in the last 5 years from these educational institutes.

Research Method Employed - Documentary Analysis which involves studying part of the public domain freely accessible data and also some of the classified and confidential data not readily available to public access would also be required. For sourcing such classified data documents for our research work, we had an agreement with the data provider, which in our case is a business school in the Delhi/NCR region. The agreement contain as to how the content can/cannot be used and how confidentiality is to be preserved.

Data Collection Procedure - The education sector in India is one of the biggest in the world and there seems a vast variation amongst institutions within the country. From the perspective of studying the customer (student) retention and attrition in the business schools of Delhi/NCR region, institute was chosen on the basis of years of operation (age of the institute), batch size and institutes providing only PGDM course. The rationale behind choosing this institute was carefully read and the model performance criteria suggests the suitability and accuracy of the data.

Round of interviews with the admission experts in this business school were carried out to understand the process of customer segmentation and policies laid for their retention. Then on the basis of a formal contract, proposed model is applied on the admission and final degree award data of the institute.

Using the admission data and number of students finally awarded the diplomas in this institute, initial values of the parameters for the proposed model in equation (14) are obtained, Table 1.

Parameter	Estimate	Std. Error
m	1076	1.871E9
b ₁	1.772	2.060E6
b ₂	0.287	23.153
c ₁	0.015	9.412E4
c ₂	0.001	178.064
α	0.722	2.123E6
β	341.182	1.371E9
γ	0.00001	1.671

Table 1. Model parameter estimates

It is quite evident from Fig. 2 that the proposed model is quite significantly represents the adoption process in the presence of disadopters in business education sector.

In order to determine and examine the effectiveness of the proposed disadoption model, all major comparison criterions like MSE, SSE, Bias, AIC, Variance, RMSPE, MEOP, R² and Adjusted R² have been applied. Results of these criterions are presented in Fig. 3. It validates and supports the

hypothesis that our proposed model is able to fit into the business educational services and comes out to be a relatively simpler model to elucidate a complex phenomenon of disadoption in services. Also, it is quite significantly evident from the Fig. 1 that all across the data set our proposed model performs quite effectively and fits the data well.

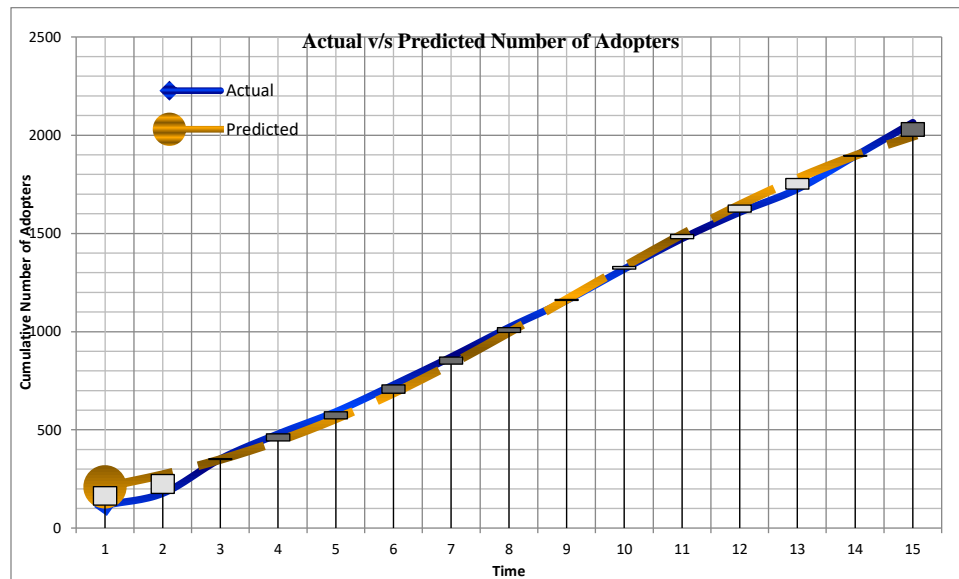


Fig. 2. Actual versus predicted number of adopters

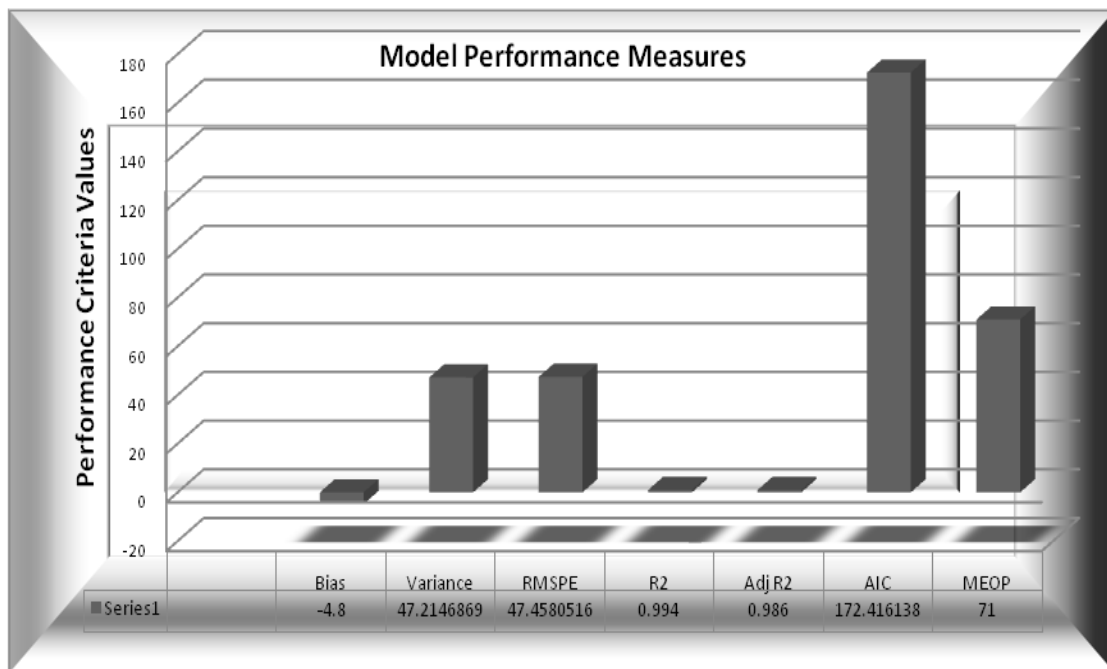


Fig. 3. Model performance measures

It is quite evident from Table 2 that most of the disadopters at any given time point belongs to Type I disadopters. This means majority of the students who join business schools by taking an independent decision, without consulting the effect of word of mouth advertisement, are the more probable ones to drop out. Average Type I disadoption for this institute is 12 students while average Type II disadopters during the same time interval is 2 students.

Time	Actual	Predicted	Cumulative Number of Innovators	Cumulative Type I Disadopters	Type I Disadopters	Cumulative Number of Imitators	Cumulative Type II Disadopters	Type II Disadopters
1	117	210	22.03	1	1	152.2944195	1	1
2	177	272	198.79	3	2	198.7916133	1	1
3	352	349	1100.13	17	14	257.8486669	1	1
4	479	443	2892.64	43	26	331.7928062	2	1
5	592	556	4280.25	64	21	422.7359756	2	1
6	729	687	5215.04	78	14	532.1579715	3	2
7	871	835	6019.91	90	12	660.3897297	3	1
8	1021	996	6797.07	102	12	806.1051455	4	3
9	1159	1164	7568.73	114	12	966.0024357	5	2
10	1319	1332	8339.33	125	11	1134.872688	6	3
11	1474	1495	9109.73	137	12	1306.160733	7	4
12	1608	1645	9880.09	148	11	1472.930167	7	3
13	1726	1780	10650.44	160	12	1628.950419	8	5
14	1894	1896	11420.80	171	11	1769.560474	9	4
15	2064	1994	12191.15	183	12	1892.078109	9	5

Table 2. Numerical measure of number of disadopters

4. Conclusions, Limitations and Future Research Directions

At the beginning of this paper, we discussed about the issues concerning diffusion of services. There is an inward flow of new adopters and customers who switch from competitors. There is also an outward stream of customers who either disadopt the category or defect to the competition. This complex situation results in analysing the growth of new services important. Therefore, such an analysis becomes essential for managers who want to understand the environment in which their services compete.

In this paper for the first time, an innovation diffusion model is described to accommodate this concept of disadopters on the basis of their adoption behaviour. Innovators adopt the product independent of other adopters whereas imitators tend to first acquire great deal of information about the services before finally making the decision to adopt. Our approach to categorize disadopters is relatively straight forward, and with a few simplifying assumptions, the proposed basic model has a closed-form solution. To demonstrate potential applications, an educational service provider is analyzed to express the disadoption of management education service offered by an institute in Delhi/NCR.

The services growth model proposed in this paper is based on certain specific assumptions related mainly to the nature of customer attrition. The assumptions were made to provide an analytical formulation and enable empirical estimations. However, extended models can be developed that relax some of these assumptions. Further to the proposed modelling framework, various applications of the proposed disadoption process in the areas of telecommunication, IT, retail sector, e-commerce etc. can be developed.

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