Chapter 6

Development of a New Model for New Products

6.1 INTRODUCTION

New-product development shapes the company's future. Improved or replacement products and services maintain or build sales; new-to-the-world products and services transform the industries and companies and change lives. But the low success rate of new products and services points to the many challenges they face. Companies are doing more than just talking about innovation. They are challenging industry norms and past conventions to develop new products and services that delight and engage consumers.

Marketers play a key role in new-product development by identifying and evaluating ideas and working with R&D and other areas in every stage of development new products range from new-to-the-world products that create an entirely new market to minor improvements or revisions of existing products. Most new-product activity is devoted to improving existing products

Fewer than 10 percent of all new products are truly innovative and new to the world. These products incur the greatest cost and risk. Although radical innovations hurt the company's bottom line in the short run, if they succeed they can create a greater sustainable competitive advantage than ordinary products and produce significant financial rewards as a result.

New products fail due to the overestimates of market size, high development costs, poor design or ineffectual performance, incorrect positioning, advertising, or price and insufficient distribution

Bass model is the most widely used method for forecasting the demand for new product, but it fails to take into account the repeat purchases rather only one time purchases are allowed. Also, it does not take into account the effect of promotions, reason being,

promotional offers came into existence only since last decade and they did not exist when Bass framed his model in 1969.

The Fourt-Woodlock equation is a market research tool to describe the total volume of consumer product purchases per year based on households which initially make trial purchases of the product and those households which make a repeat purchase within the first year. Since it includes the effects of initial trial and repeat rates, the equation is useful in new product development.

This chapter is organized in such a way that Section 6.2 discusses about the methodology for the formation of the model. Section 6.3 discusses about the modeling for forecasting new products and Section 6.4 discusses about the results obtained with the new model.

6.2 METHODOLOGY

The model, Modified Bass Model has been developed by merging together the Bass model and Fourt-Woodlock model and introducing a new parameter called the parameter of promotion in the Bass equation. This method can be used for the initial purchase as well as the repeat purchases optimistically.

PHASE 1:- DETERMINING THE TOTAL DEMAND

The overall market demand for the product that is going to be launched is calculated using the chain-ratio method i.e. dividing the entire population in to required categories by filtering at each step.

Total demand (n) =Population * percentage of income that will be spent on entertainment * percentage of that amount which will be spent on purchasing new products * expected percentage of that which will be spent on purchasing a product repeatedly.

PHASE 2: - DEMAND FORECASTING

6.2.A. BASS DIFFUSION MODEL: The probability that an initial purchase will be made at time T given that no purchase has yet been made is a linear function of number of previous buyers.

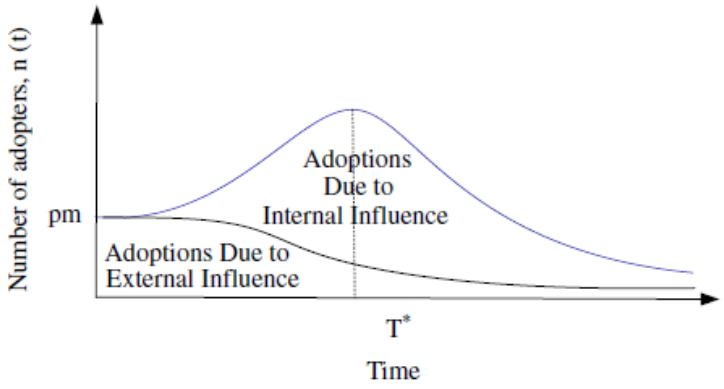

Figure 6.1 – The concept of Bass model.

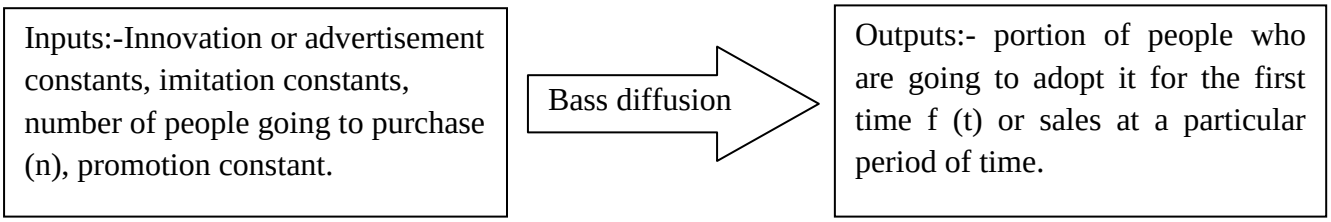

Figure 6.2 – Inputs and outputs for Bass model

The Modified Bass equation is given by

$$\frac{f(t)}{1 - F(t)} = p + qF(t)$$

$$\frac{f(t)}{1 - F(t)} = (p + qF(t))\ R\ (new\ constant)$$

p – Innovation constant , q- imitation constant , n- number of people willing to purchase , R- promotion constant, f (t) - Portion of people who are going to adopt it for the first time

where,

p is innovation constant = 0.03 (in general)
q is imitation constant = 0.38

The new promotion constant can be used to estimate the demand when a company introduces promotion for that particular new product.The reason for multiplying the constant R is that it increases the innovation and immitation costants by some factor at the time of promotion.

6.2.B FOURT- WOODLOCK MODEL: -

The bass model can be used for the products assuming that there will be only one time purchases. When it comes for consumer goods fourt woodlock model for repeat purchases can be used.

$V= (S (t) \times TU) + (m \times RR \times RU)$

V-volume of purchases per unit time , f(t) – people who adopt the product for the first time TU-trail units, m- people who are going to adopt more than one time , RR - repeats per repeater: the number of repeat purchases within that particular time. RU - number of repeat units purchased on each repeat event.

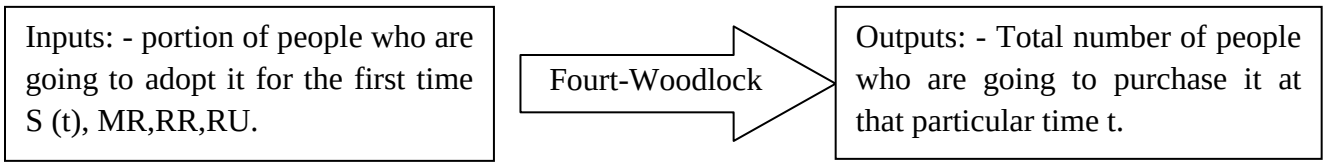

Figure 6.3 - Inputs and outputs for Fourt-Woodlock model

PHASE 3:- OPTIMISATION OF PARAMETERS

6.2.C. REGRESSION MODEL: - The parameters such as the actual demand and the forecasted demand is analysed using the regression equation.

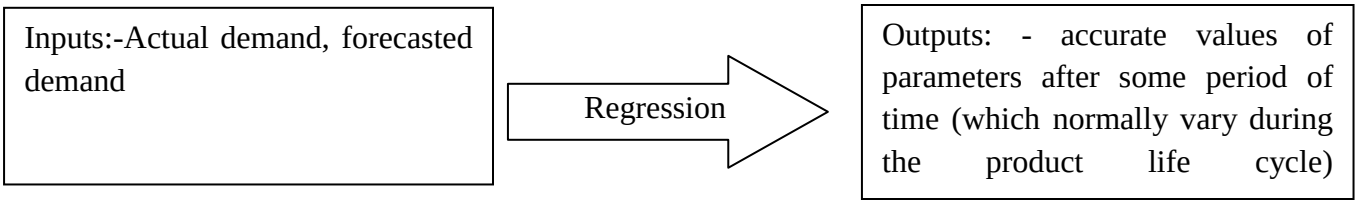

Figure 6.4 – Inputs and outputs for Regression analysis

6.3 MODELLING FOR NEW PRODUCT FORECASTING

From Bass principle "The portion of the potential market that adopts at time t given that that they have not adopted is a linear function of previous adopters."

$$\frac{f(t)}{1-F(t)} = p + \frac{q}{M}[A(t)]$$

An addition to above principle namely promotion constant 'R' may be useful to find the actual values of promotion and innovation constant during promotion periods

$$\frac{f(t)}{1-F(t)} = \left(p + \frac{q}{M}[A(t)]\right) R$$

-Eq. (1)

Let P = p × R, Q= q × R. The approximate value of R can be found by trial and error method.

Where

M is the total potential market

f(t) is the portion of potential market that adopts at time t

a(t) is the adopters at time t, a(t) = M × f(t) - Eq.(2)

F(t) is fraction of potential market that has adopted up to and including t

A(t) is the cumulative adopters at t, A(t) = M × F(t) - Eq.(3)

p and q are the innovation and imitation constant

R is the promotion constant

For finding the market potential chain-ratio method is used which involves multiplying a base number by several adjusting percentages.

Since both are the fractions of total potential market so f (t) varies as a time derivative of F (t). So,

$$f(t) = \frac{d\,[F(t)]}{dt}$$

-Eq. (4)

From Eq. (1)

$$M\big(f(t)\big) = \Big(\, PM + Q\,\big(A(t)\big)\Big)\big(1 - F(t)\big)$$

From Eq. (2)

$$a(t) = M\big(f(t)\big) = \Big(PM - PM \times F(t) + Q\,\big(A(t) - A(t) \times F(t)\big)\Big)$$

From Eq. (3)

$$M\big(f(t)\big) = \left(\, PM - P\,A(t) + Q\,\left(A(t) - A(t) \times \frac{A(t)}{M}\,\right)\right)$$

Dividing by M on both sides

$$f(t) = P - \frac{Q}{M^2}\big(A(t)\big)^2 + (Q - P)\frac{A(t)}{M}$$

$$f(t) = P + (Q - P)\,F(t) - Q[F(t)]^2$$

-Eq. (5)

From Eq. (4)

$$\frac{dF(t)}{d(t)} = P + (Q - P)\,F(t) - Q[F(t)]^2$$

By solving the above differential equation we get

$$F(t) = \frac{1 - e^{-(P+Q)t}}{1 + \frac{Q}{P}e^{-(P+Q)t}}$$

By derivating the above eq. wr.to t of above equation we get

$$f(t) = \frac{\frac{(P+Q)^2}{P}e^{-(P+Q)t}}{\left(1 + \frac{Q}{P}e^{-(P+Q)t}\right)^2}$$

Therefore expected number of sales or adopters during the promotion period

$$a(t) = M\,\frac{\frac{(P+Q)^2}{P}e^{-(P+Q)t}}{\left(1 + \frac{Q}{P}e^{-(P+Q)t}\right)^2}$$

When there are no promotions R value will be taken as 1.

The above equations are based on assumption that each adopter is assumed to make one and only one adoption. But in the case of repeated purchases Fourt-woodlock model is used.

Total volume of sales at time t is

$$\boldsymbol{V(t) = (a(t) \times TU) + (m \times RR \times RU)}$$

Whereas for the first period

$$\boldsymbol{V(t) = (a(t) \times TU)}$$

Where,

a (t) - The adopters at time t

TU - Trail units which means number of units of adoption at their initial purchase

m - Number of persons that are going to do repeat purchases which can be obtained from survey

RR - Repeat rate which means on an average how many times 'm' is doing repeat purchases in time t

RU - Repeat units which means number of units 'm' is going to purchase while doing repeat purchases.

As the parameters such as the innovation and imitation constant may vary with respect to time the approximate values of innovation and imitation constant could be estimated using linear regression analysis and it could be applied only after the first three periods by equating the actual sales.

From Eq.5

$$\boldsymbol{f(t) = P + (Q - P)\, F(t) - Q[F(t)]^2}$$

$$\boldsymbol{a(t) = PM + (Q - P)\, A(t) - \frac{Q}{M}[A(t)]^2}$$

Let PM= c, Q-P = b, -Q/M =a, A (t) = x, A (t) ^{2} =y

Therefore, the equation will be in the form of

$$\boldsymbol{a(t) = ax + by + c}$$

After getting the actual sales for consecutive four periods the above regression equation could be used for getting the values of a, b, c.

$$\boldsymbol{a(t_1) = a_1x + b_1y + c_1}$$
$$\boldsymbol{a(t_2) = a_2x + b_2y + c_2}$$
$$\boldsymbol{a(t_3) = a_3x + b_3y + c_3}$$

After solving the above three equations,

$$\boldsymbol{-PQ = ac, Q - P = b},$$
$$\boldsymbol{P = -\frac{ac}{Q}},$$
$$\boldsymbol{Q + \frac{ac}{Q} = b},$$
$$\boldsymbol{Q^2 - bQ + ac = 0},$$

$$\boldsymbol{Q = \frac{b \pm \sqrt{(b^2 - 4ac)}}{2}}$$

As there are three unknown variables, three equations are needed. By solving the actual sales of three consecutive periods the values of a, b, c could be found out and by using them the new values of P, Q could be found out which could be used for forecasting next period sales. The value of promotion constant R is calculated by,

$$\boldsymbol{R = \frac{P}{p} \approx \frac{Q}{q}}$$

The new product development starts with a survey. The desire of the people is observed. If so how much percentage of the population wishes to buy a new product if available in the market. These points are captured from the survey. If not much of the population is

interested in the product, going for the product development will lead to a loss. Hence that product may be dropped off.

The demand for the introductory period of the product is done without promotion as well as with promotional values of 1.05,1.1,1.15,1.2 along with the innovation and imitation constants.

The Sales for first few periods are calculated using the modified Bass model. The repeat purchase is considered in the next set of calculations and the Fourt-Woodlock equation is used for calculating the sales . The effect of sales with and without promotional values are captured.

The regression equations are used for calculating the sales after few periods of stabilasation and the sales for the consecutive periods are determined through the regression equations. The results are analysed and the impact of promotion is captured.

6.4 RESULTS AND ANALYSIS OF DEMAND FORECASTING MODEL FOR NEW PRODUCTS

The calculations are carried out for the introduction of new flavor of biscuits.

The sales for the few periods are calculated by considering that there will be a no repeat purchase.ie. No purchase for the second time. The calculations are done considering Promotion values such as 1.05, 1.1, 1.15 and 1.2 and also without promotion so that the impact promotion can be observed.

6.4.1 CALCULATION OF THE SALE FOR FEW PERIODS WITHOUT PROMOTIONAL VALUES

The sales for the first few periods without promotion are derived as shown below.

- Any chance of multiple or repeated purchases enter 1.)Y or 2.)N : 2

Enter the period of forecast: 1

Enter the values of innovation constant: 0.03

Enter the values of imitation constant: 0.38

Enter the value of promotion constant: 1

Enter the value of total market potential assuming one time purchase: 2500

Sales for the first period S (1): 75.00

- Any chance of multiple or repeated purchases enter 1.)Y or 2.)N : 2

Enter the period of forecast: 2

Enter the values of innovation constant: 0.03

Enter the values of imitation constant: 0.38

Enter the value of promotion constant: 1

Enter the value of total market potential assuming one time purchase: 2500

Sales for the second period S (2): 105.07

- Any chance of multiple or repeated purchases enter 1.)Y or 2.)N: 2

Enter the period of forecast: 3

Enter the values of innovation constant: 0.03

Enter the values of imitation constant: 0.38

Enter the value of promotion constant: 1

Enter the value of total market potential assuming one time purchase: 2500

Sales for the third period S (3): 142.55

- Any chance of multiple or repeated purchases enter 1.)Y or 2.)N : 2

Enter the period of forecast: 4

Enter the values of innovation constant: 0.03

Enter the values of imitation constant: 0.38

Enter the value of promotion constant: 1

Enter the value of total market potential assuming one time purchase: 2500

Sales for the fourth period S (4): 185.16

6.4.2 CALCULATION OF THE SALE FOR FEW PERIODS WITH PROMOTIONAL VALUES

The sales for the first few periods with promotion are derived as shown below.

- Any chance of multiple or repeated purchases enter 1.)Y or 2.)N: 2

Enter the period of forecast: 1

Enter the values of innovation constant: 0.03

Enter the values of imitation constant: 0.38

Enter the value of promotion constant: 1.2

Enter the value of total market potential assuming one time purchase: 2500

Sales for the first period S (1): 90.00

- Any chance of multiple or repeated purchases enter 1.)Y or 2.)N: 2

Enter the period of forecast: 2

Enter the values of innovation constant: 0.03

Enter the values of imitation constant: 0.38

Enter the value of promotion constant: 1.2

Enter the value of total market potential assuming one time purchase: 2500

Sales for the second period S (2): 134.41

- Any chance of multiple or repeated purchases enter 1.)Y or 2.)N : 2

Enter the period of forecast: 3

Enter the values of innovation constant: 0.03

Enter the values of imitation constant: 0.38

Enter the value of promotion constant: 1.2

Enter the value of total market potential assuming one time purchase: 2500

Sales for the third period S (3): 191.05

- Any chance of multiple or repeated purchases enter 1.)Y or 2.)N : 2

Enter the period of forecast: 4

Enter the values of innovation constant: 0.03

Enter the values of imitation constant: 0.38

Enter the value of promotion constant: 1.2

Enter the value of total market potential assuming one time purchase: 2500

Sales for the fourth period S (4): 253.24

The sales of the few periods without and with promotional values are shown in the Table 6.1. The values of promotion used are 1.05, 1.1, 1.15 and 1.2

Table 6.1 – Sales of few Periods with and without Promotions

R	**S0**	**S1**	**S2**	**S3**
Without R	75	105.07	142.55	185.16
1.05	78.75	112.11	153.97	201.29
1.1	82.5	119.31	165.86	218.03
1.15	86.25	126.78	178.22	235.37
1.2	90	134.41	191.05	253.24

6.4.3 CALCULATION OF THE SALE FOR FEW PERIODS CONSIDERING THE REPEAT PURCHASE OF A PRODUCT

The sales of the few periods are calculated considering that there will be a repeat purchase. The repeat purchase calculations are done by combining the bass model and the Fourt woodlock model. The values are shown in the Table 6.2.

Table 6.2 – Sales of few Periods considering repeat Purchase

R	V0	V1	V2	V3
Without R	195	255.147	330.102	415.33
1.05	202.5	269.23	352.95	447.58
1.1	210	283.7	376.73	481.07
1.15	217.5	298.56	401.45	515.74
1.2	225	313.82	427.11	551.49

6.4.4 CALCULATION OF THE SALE VALUES BY USING REGRESSION EQUATIONS

Once the sales for the periods are found, those values are used in the regression equations as follows for the sales of the consecutive periods. The new innovation and imitation constants are derived.

The values without promotional usage are shown below for calculating the sales of the consecutive period.

x + 75.00 y + 5625.00 z - 105.07 = 0

x + 180.07 y + 32425.20 z - 142.55 = 0

x + 322.62 y + 104083.66 z - 185.16 = 0

New innovation parameter : 0.038

New imitation parameter : 0.454

The expected sales for the next period : 314.95

New promotion Constant : 0.084

The regression equations are derived as below with the existing sales values and the sale for the next period is calculated. The promotional period is taken for this calculation and the sale value for the consecutive period is shown below.

The Regression Equations are

x + 90.00 y + 8100.00 z - 134.41 = 0

x + 224.41 y + 50359.84 z - 191.05 = 0

$x + 415.46\ y + 172607.01\ z - 253.24 = 0$

New innovation parameter : 0.047

New imitation parameter : 0.561

The expected sales for the next period : 412.71

New Promotion Constant : 0.083

New promotional values are determined and this value can be used for resetting the values as well as for future calculations.

The effect of promotion in the parent Bass equation was successfully incorporated by introducing necessary changes and performing modifications wherever required. Since it is a new product forecast, no historical time series data is available. Any formal time series procedure can only be used after a few observations become available. Once more information becomes available, these parameters can be re-set to a typical value.

The challenge was to merge the modified equations of Bass, Fourt-Woodlock together and undergo regression analysis and reset the associated parameters to a good approximation so that accurate demand forecasts could be achieved.