PROCESS OF FORECASTING THE MARKET SHARE AND PATIENT VOLUME OF A PRODUCT OVER A PERIOD

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfilment for the award of the degree of

Master of Business Administration (MBA)

In

Hospital and Health Management

By

Sanoj Varghese Chacko

Under the Supervision and Guidance of

Dr. Jagajeet Prasad Singh

2021

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled **"Process of forecasting the market share and patient volume of a product over a period" at PharmaACE Analytics, Pvt.Ltd, Pune India** is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

Sanoj Chacko

(Signature)

Name of Student: Sanoj Varghese Chacko

Date:

CERTIFICATE

This is to certify that **Sanoj Chacko** in partial fulfilment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur has successfully completed his internship **at PharmaACE Analytics Pvt. Ltd.** during 1**/02/2021 to 30/06/2021**.

Place: Pune
Date: 28/06/2021

Pooja Cornelius

For: PharmaACE ANALTICS PVT LTD

Name: Pooja Cornelius

Title: Lead- Human Resources

CERTIFICATE

This is to certify that dissertation titled **Process of forecasting the market share and patient volume of a product over a period** at **PharmaACE Analytics, Pvt Ltd, Pune, India,** is a record of the research work undertaken by (Name of Student) in partial fulfilment of the requirements for the award of the degree of MBA (Hospital and Health Management)/MBA (Pharmaceutical Management)/MBA (Rural Management) from the IIHMR University, Jaipur under my guidance and supervision and his approach to the research study has been sincere, scientific, and analytical.

Faculty Guide IIHMR University, Jaipur	School Dean IIHMR University, Jaipur
Date	Date

ABSTRACT

Introduction:

The pharmaceutical industry has been undergoing a phase of unprecedented growth over the past one year, owing to the needs either directly or indirectly caused by the current global situation. For good or for bad, this has led to massive investments and innovations to a customer base that has been long in want of it. This has always been the driving force of the pharmaceutical industry.

This project was carried out in the Psoriatic Arthritis market with the aim of forecasting the product share growth from inception to peak share period by utilising secondary research data as input. The software used for this purpose was MS Excel. The project was carried out at PharmaACE Analytics, Pvt Ltd, Pune as a part of the internship to understand the peak-share and time-to-peak-share methodology. The Study aims to:

1. To determine the history of market growth since the inception of the drug class.
2. To predict the patient volume share and market share of a product.

Methodology: The study area is the entire US market with the disease of interest being Psoriatic Arthritis based on secondary duration for the duration of 9 years from (2012-2017) .The study will be observational analytical. The study population for the same was selected the Psoriatic Arthritis patients who were either unresponsive to First line DMARD therapy or patients who were directly administered Biologic therapy for Psoriatic Arthritis for the US market for the duration of nine years from 2009- 2017.

Result: The methodology and framework used has been able to determine a viable product adoption curve that peaks at 14% in seven years of time, and thereby begins to decline. The product shares of the competitor products have been adjusted based on fair share theft. Patient volumes of Product were also estimated and showed a peak share patient volume of 123k (one hundred twenty-three thousand in the year 2016)

Conclusion: The new product forecasting model on comparison with the real-world data yields a response that is reasonably accurate for the initial years but gets skewed towards the latter part of the nine-year period. This a source of concern with the model, however it manages to estimate the target product shares and patient volumes with reasonable accuracy.

Key Words – Pharmaceutical Forecasting, Psoriatic Arthritis, Biologic Therapy

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Sanoj Varghese Chacko

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Chapter 1:Introduction

1.1: Introduction

Pharmaceutical Forecasting has been defined as the projection of sales of new drugs. Projections of sales of new drugs, especially of blockbuster drugs, are one of the most utilised applications of forecasting in the pharmaceutical industry today. Since time immemorial, the accuracy of forecasting has always tried to be judged, however, we lack such data, but have designed indicators for measuring the success rate of such endeavours. The best source of such data lies within companies itself, by calculating their earnings from a particular product or sales data. Moreover major successes or failures have always been highlighted in history, so to name a few – Motrin, Garamycin, Xanax are drugs that were touted to make sales of less than a hundred million but ended up making a fortune for their respective companies.[1]

The selection of any method of forecasting requires to take into consideration several factors – the context of the forecast, the accuracy and availability of historical data, the time duration for which the forecast is to be done etc.

There have been different methods by which classification of forecasting methods is done. One of the early sources of literature states that there are generally three types of forecasting – Qualitative techniques, time series analysis and projection and causal models.

1.Qualitative techniques – These techniques do not take into account the past data. Rather special events or qualitative data of any type is assessed and taken into account for.

2. Time series analysis – This method focusses entirely on historical data and its pattern. This method is used when historical data of several years together is available for a product or product line. Also in such cases, relationships and trends are both clear and stable.

3. Causal Models – Highly specific information and relationships between causal elements are considered.

A causal model is the most sophisticated of all the three models. Ideally, it measures the causal relationships and may also consider the pipeline considerations and market

survey information. Often in the absence of data, certain assumptions are made regarding the same and then reassessing if the assumptions are true.

Causal models can be further enumerated – Regression models, Econometric models, Economic Input-Output model, Diffusion Index, Life cycle analysis, Leading indicator.

Of these methods, the method considered ideal for an estimation of new product sales is the life cycle analysis, which is based upon S – Curves. The phases of product acceptance are prime to this method. The sales or patient share data is a minimum requirement to the use of this method, thereby making it less resource intensive.[3]

The two challenges involved while building a forecast are –

1. Determining the complexity or granularity that the model needs to carry. This is directly associated with the amount of data that flows through the model. This on the other hand is influenced by function of the said deliverable, which is determined by whether the model is meant to be used for – research & Development, finance function, or to drive resource allocation.
2. Secondly, the forecast model is strongly influenced by the varied time horizons that it spans. Models may be for long-term horizons or for a short-term focus. This in turn, implies a different choice of forecasting technique in each case.

In the following project, a new product forecast model forecasting the product share and patient volume using secondarily researched data has been done. The product belongs to a class of biologics, a new class of drugs that act on biomarkers and are organic in origin. The forecast model utilised is that of life cycle analysis. The rationale for the same is that the data utilised for the same can be accessed using public databases and therefore avoids using insurance claims data or historical data from commercial databases related to sales, prescription data or anonymous patient level data.

1.2 Research Questions

1. What is the process to forecast patient volume share and market share during the lifecycle of the drug since its introduction to the market?
2. How to compare the forecasted peak share and patient volume of the drug with its competitors?

1.3 Research Objectives

1. To determine the history of market growth since the inception of the drug class.
2. To predict the patient volume share and market share of a product.
3. To forecast the product peak market share and patient volume for client X.

Chapter 2: Review of Literature

The pharmaceutical industry is one of the most profitable businesses in todays' world with massive inroads and accomplishments being made both academically as well as commercially. In order to reap the best outputs from these developments, it is necessary to predict probable market trends products will take. A small error in judgement may result in a huge lapse or loss of revenue and subsequently affect the business.

A book titled "Forecasting for the pharmaceutical industry" by Arthur G Cook gives detailed insights into the tools and methods for new product forecasting. The process can be split by itself into three categories – representing the elements to design the market flow, to forecast the product and to monetise the same. The means used to effect this can be of two types depending upon the type of data – patient-based models, that follow a top-down approach where the entire population is evaluated and filters are applied to the same at various stages – prevalence, diagnosis, treatment and drug access rates. On the other hand, prescription-based models, use claims data from commercial databases, for the purpose of understanding the trends that a similar 'new product' may also exhibit. Neither of the two methods is better than the other, however, in the case of patient-based models, the forecasted results must be validated against actual observations in the market, while in the case of prescription-based models, the upper boundary of the market must be identified in order to limit market expansion.

The study titled, "Drivers of peak sales for pharmaceutical brands" by John. C Chambers published in the year 1965 in the Harvard Business Review, describes and analyses the data in order understand the drivers of height of peak sales and time-to-peak- sales in the pharmaceutical industry. Some of the findings of the study that are key to this project have been enumerated. The order of entry of a drug into a market is of key importance to determining its peak share and adoption speed. The later a particular drug enters the market, the faster is its adoption due to reduced resistance to buying. At the same the product shares for a late mover are also lower. Entry of more, increases the number of consumption experiences and allows consumers to choose from a variety of choices. The number of competitors is inversely related to the brands product share. The study itself conducted a descriptive analysis for over 45 brands for calcium channel and ACE inhibitors class drugs. The statistics given in this study were vital in determining what the ideal peak share and time to peak would be for the target drug in this study.

Another important literature that was helpful in this project was the McKinsey report "Pharma's First-to-market advantage" based upon data by EvaluatePharma which analyses brands from (1986 – 2012) to determine the average market share of drugs based upon their order of entry. The article evaluates situations where first mover advantage is evident and where it may appear to be weak.

The Paper "titled "Validity of the Product Life cycle" by Roland Polli and Victor Cook in the year 1969 also validates the usage of product life cycles for recommending the content of marketing programs throughout the lifecycle of the drug. He describes the product lifecycle stages as useful in utilising for the purpose of evaluation of a series of tactical and strategic considerations. This paper is a thorough validation to the concept of using product life cycles in order to predict future events with regards to patient share growth and volume.

Forecasting models can be designed based on the choice of data in two ways – a top-down approach and a bottom-up approach. These are otherwise also called patient-based approach and a prescription-based approach.

The patient-based approach involves defining the inclusion criteria for a particular cohort in a stepwise manner. At each step, a particular parameter is applied, these parameters being epidemiological in nature, or sometimes data derived from scientific studies or market reports.

The Steps involved can be enumerated as follows –

1. a measure of disease prevalence or incidence
2. an estimate of the number of patients who are symptomatic for the disease.
3. an estimate of number of patients who are correctly diagnosed for the disease.
4. an estimate of the number of patients who have access to healthcare.
5. an estimate of the number of patients who are being treated with drug therapy.

This is not a one-size-fits-all approach and can be adjusted depending upon the disease condition being forecasted. Ultimately, the net result is to convert the population of a given geography into the patients who currently receive prescription drug therapy in the same geography.[1]

Chapter 3: Methodology

3.1: Study Area

The study area is the entire US market with the disease of interest being Psoriatic Arthritis based on secondary research for the duration of 15 years from (2012-2017)

3.2: Study Design

The study will be observational analytical for the US Psoriatic Arthritis market and applicable to current and potential users of the said drug.

3.3: Study Duration

The study was carried out for 2 months from 2nd April to 2nd June 2021.

3.4: Study Population

The study population for the same was selected the Psoriatic Arthritis patients who were either unresponsive to First line DMARD therapy or patients who were directly administered Biologic therapy for Psoriatic Arthritis for the US market for the duration of nine years from 2009- 2017.

3.5: Inclusion Criteria

Patients above 20 years of age who are diagnosed for Psoriatic Arthritis and are on medication for either Psoriatic Arthritis alone or both Psoriasis and Psoriatic Arthritis.

3.6: Exclusion Criteria

Patient population who are –

1. Non-treated population for Psoriatic Arthritis
2. Patients below 20 years of age

3.7: Data Collection Method

Publicly Accessible Databases such as PubMed, Jama network, NIH Publications, US census data were utilised for the purpose of aggregating epidemiological data related to the disease condition and the drug class under study. Over 50 research papers dating between 1999 and 2020 meeting this criterion were shortlisted. Of these research papers

referring to study subjects outside the United States and data pertaining to subjects prior to 2003 were eliminated. Similarly, data related to drug class related product shares were also collected. A maximum of three research papers relating to every parameter was used. [6-10]

3.8: Plan of Analysis

The Plan of Analysis intends to create a forecast model using MS excel. The process would involve firstly, determining the eligible patient pool by applying the necessary population filters for the specified condition. This would entail applying prevalence rate, diagnosis rate, treatment rate (for Psoriatic Arthritis) and finally the patient share that is on the biologic class of drugs (Mild cases are treated for by NSAIDS).

Subsequently, the market share of drugs would be calculated using secondary research data up-to the year 2013, when the new product is launched. The forecast model would then extrapolate the patient volume and market share data based upon (analogue) uptake curves, (a minimum of three scenarios) for a period of 4 years. These will then be compared to the actual real-world data to check for any discrepancies or errors, which if present would be adjusted to best suit the model.

This model can then be forecast to a future time period and utilised for estimating the peak patient volume and peak market share.

Chapter 4: Results

The project dissertation followed a methodology that can be said to involve two steps – one that uses observational/ secondarily researched data from research papers/ literature reviews/ projected estimates or epidemiological values to determine the eligible data pool for the said disease indication. The second step involves analysis where the said data is analysed on a market level, where the market shares are collected or extracted from research papers pertaining to the biologic drug use market. The names of the drugs

Table 4.1: Representation of Patient Model Schematic flow and Corresponding Patient numbers on a YoY basis.

Parameters	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Pop (M)	288	291	294	297	299	301	304	306	309	311	313	316	319	320
Susceptible Pop (>20) (M)	207	210	212	215	217	219	221	223	226	229	232	234	237	239
Psoriasis Prevalence Rate	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Psoriasis Prevalent Pool (K)	6631	6713	6793	6875	6939	7005	7075	7138	7247	7330	7410	7499	7584	7632
PsA Pop (K)	1591	1611	1630	1650	1665	1681	1698	1713	1739	1759	1778	1800	1820	1832
Diagnosed PsA Pop (K)	1353	1369	1386	1403	1415	1429	1443	1456	1478	1495	1512	1530	1547	1557
Psoriatic Arthritis Treatment Rate	84.3%	84.3%	90.6%	90.6%	90.6%	90.6%	94.1%	94.1%	94.1%	94.1%	94.1%	94.1%	94.1%	94.1%
Psoriatic Arthritis Treated Pool (K)	1140	1155	1255	1270	1282	1294	1358	1370	1391	1407	1422	1439	1456	1465
Biologics Therapy Rate	37.8%	38.1%	38.5%	38.9%	39.3%	39.7%	40.1%	40.4%	40.8%	41.2%	41.6%	42.0%	42.4%	42.8%
DMARD Therapy Rate	57.2%	61.9%	61.5%	61.1%	60.7%	60.3%	57.6%	59.6%	59.2%	58.8%	58.4%	58.0%	57.6%	57.2%
DMARD Treated patients (K)	652	714	771	776	778	781	783	816	823	827	831	835	839	839
DMARD Switching Rate	31.1%	31.1%	31.1%	31.1%	31.1%	31.1%	31.1%	31.1%	31.1%	31.1%	31.1%	31.1%	31.1%	31.1%
DMARD Switching Patient Pool (K)	203	222	240	241	242	243	243	254	256	257	258	260	261	261
Total Biologics Eligible Patient pool (K)	649	643	706	734	745	755	787	798	822	836	849	863	877	887

have been blinded for the sake of privacy. The market shares of the competitor are then forecasted over the course of the launch and initial growth of the target drug. At this point the fair share principle is applied to determine the drug share of the target drug.

By assuming the linear drug growth curve as the ideal default curve, the same is used to project the shares and are modified according to the fair share principle applied drug shares to determine the final forecasted growth shares. Subsequently, the final patient volumes are also calculated and then compared to the actual values of the target as well as the competitor drugs for accuracy.

The Psoriatic Arthritis Market consisted mainly of Four major drugs namely – Product A, Product B, Product C and Product D. The Launch years of the first three drugs were 2002 for Product A and 2005 for the other two products C and D. Similarly, the launch year of the client drug was 2009.Keeping this in mind, the product shares since then,

were determined from secondary research.

This data has been represented in Table 4.2.

Table 4.2: Representing Secondary Research data with product shares through 13 years (2003-17)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Product A	2%	5%	26%	26%	37%	46%	46%	46%	30%	26%	26%	61%	53%	46%
Product B	91%	85%	59%	57%	50%	40%	40%	41%	51%	50%	51%	14%	23%	32%
Product A	6%	9%	15%	17%	13%	12%	7%	5%	8%	9%	7%	5%	6%	7%

Using the Actuals data obtained using secondary research, the YoY data for the duration of seven years, (2009-2017) are forecast using the FORECAST.LINEAR function.

Table 4.3: *Forecasted Product Shares of Competitor Products (Highlighted in Yellow)*

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Product A	2%	5%	26%	26%	34%	44%	40%	44%	47%	51%	55%	59%	62%	66%
Product B	92%	86%	59%	57%	53%	50%	47%	44%	41%	38%	35%	32%	29%	26%
Product C	6%	9%	15%	17%	14%	14%	13%	12%	11%	11%	10%	9%	8%	8%

The Product shares for Product D are then estimated, assuming them to have a linear Product Adoption curve. The Peak share is expected based on secondary research data to occur, with its peak share being realized in (8-10) years. Considering the product to be the fourth entrant in the market, it is also assumed/expected to peak at a product share of (13-16)% .

Table 4.4: *Linear Product Adoption Curve*

Linear Product Adoption Curve	Y 1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
	0%	2%	4%	6%	8%	10%	12%	14%	16%

Using the principle of Fair Share Theft, the proportion of share theft from each competing product is calculated. The principle works as such wherein if the ratio of product shares of A, B and C in the market is in the ratio x:y:z, then the Target product D, will get it shares from Product A in the proportion x/(x + y + z), from Product B in the ratio y/(x + y + z) and similarly for Product C.

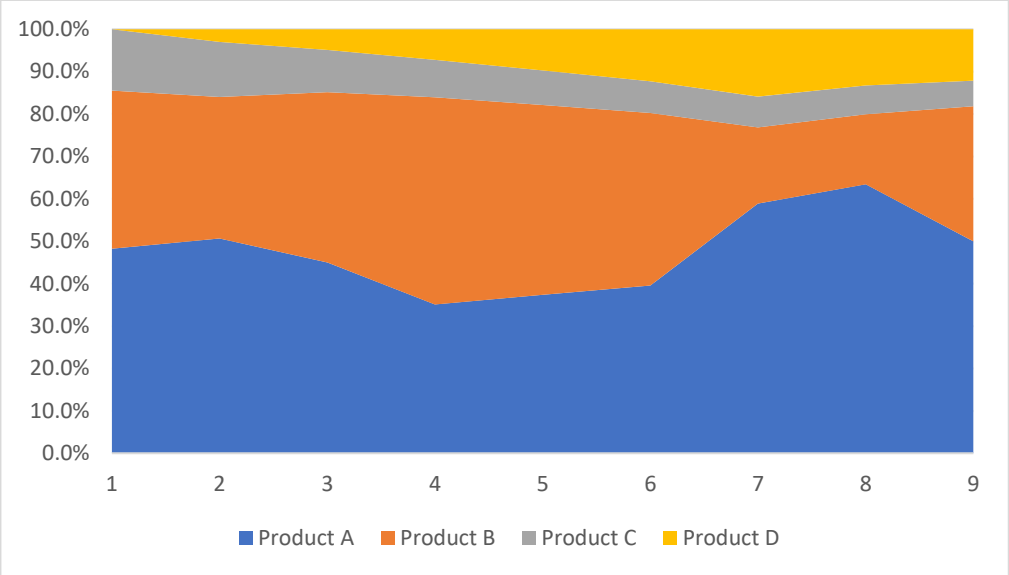

Figure 4.1 Forecast Product Shares (2009-2017)

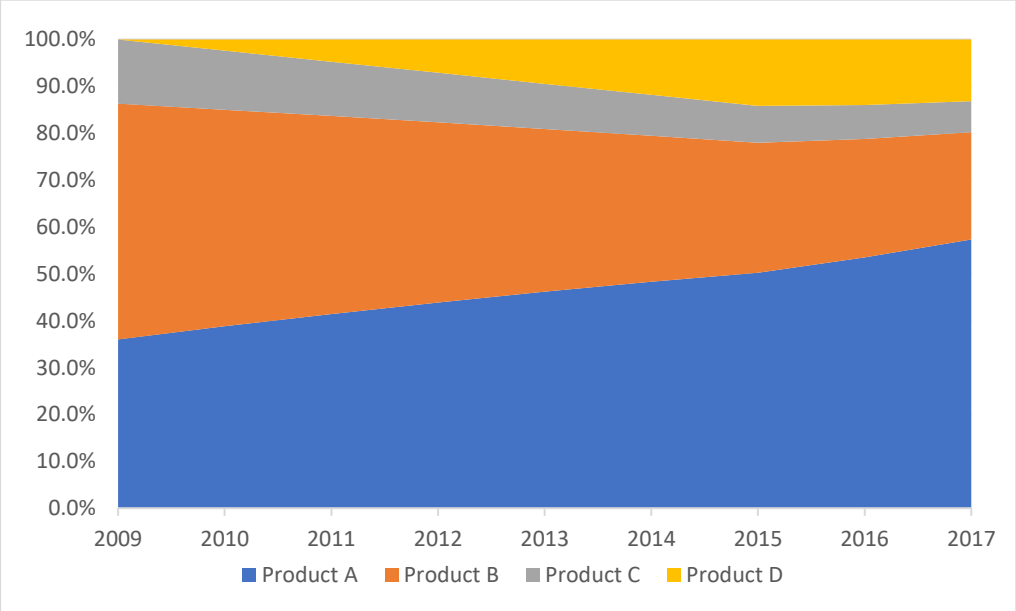

Figure 4.2: Product Shares-Actual's data (2009-2017)

These forecast values must then be compared with the actual values of the product shares.

The next step begets the application of three scenarios for the sake of including any of three probable chances of product adoption, namely a linear, an optimistic, and a pessimistic product uptake curve.

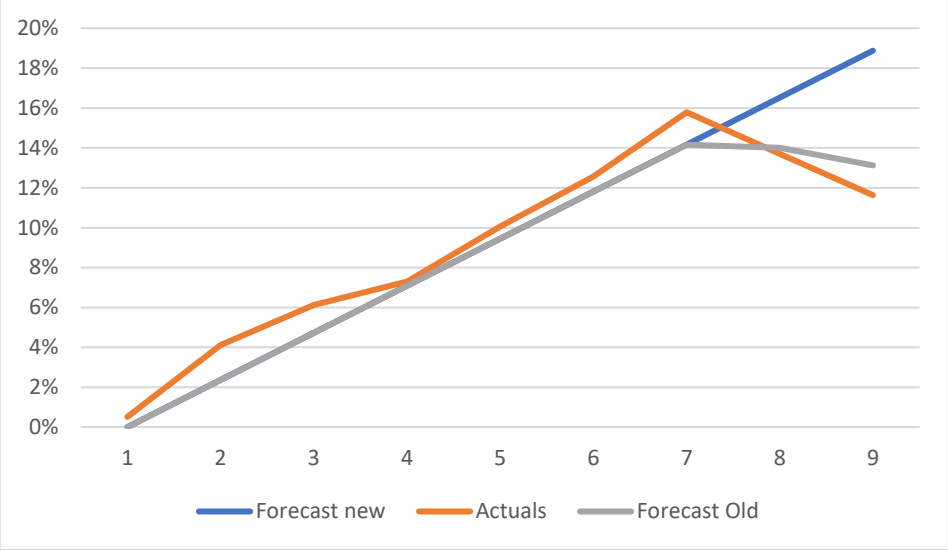

Fig 4.3: Forecast Product Adoption curve v/s Actual Product Adoption Curve

Scenario 1: Linear Adoption Curve

The Final Forecast adoption curve is obtained by adjusting for the error in between the two curve values as shown in Fig 1.

With the values thereby obtained we convert the same into patient volume numbers as shown in the following table.

Table 4.5: Patient Volume numbers as predicted by the Forecast Adoption Curve.

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Product A	272	305	331	361	386	410	433	469	509
Product B	380	364	337	316	290	265	239	221	203
Product C	103	99	92	87	81	74	68	63	59
Product D	0	19	38	58	79	100	122	123	116

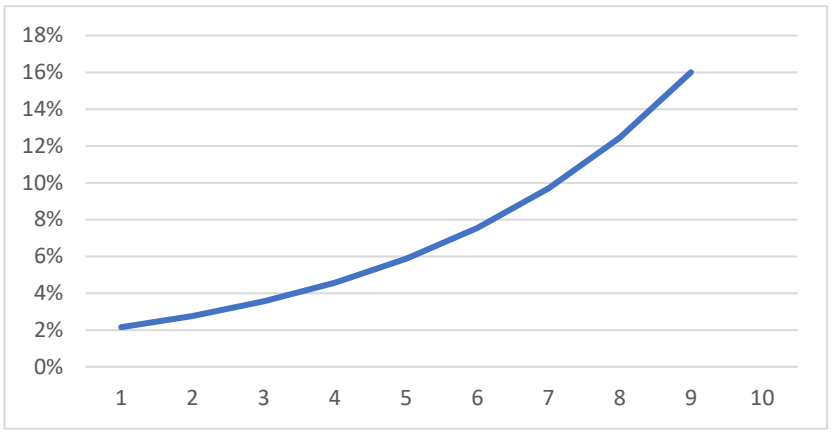

Figure 4.4; Pessimistic Scenario/Scenario 2:Slow Product Adoption Curve

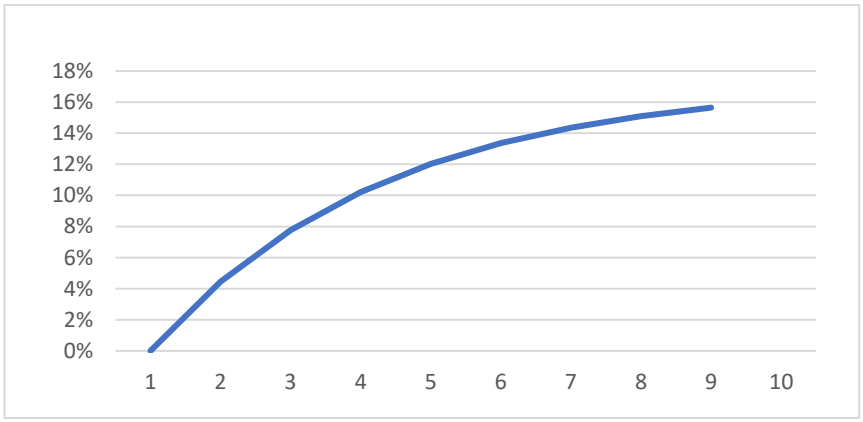

Figure 4.5: Optimistic Scenario/Scenario 3: Rapid Product Adoption Curve

Chapter 5: Discussion

The following forecast project was conducted on Psoriatic Arthritic population of the US, specifically focussing on the second line therapy of drugs – namely TNF-α inhibitors, Phosphodiesterase – 4 Inhibitors etc. This was done to understand the process of forecasting product shares over time and to obtain a preliminary estimation of the same over a given period, the rate of adoption and patient volumes.

The process calculated the eligible pool of patients for the therapy by applying population filters in the form of disease prevalence rate, treatment rate, diagnosis rate, switch therapy rate etc. This enabled in estimating a viable pool of patient growing from 600,000 to 800,000 over a period of 14 years. Additionally, secondary research also revealed a constantly growing awareness of the disease and its effective treatment strategies. This information is necessary for the purpose of estimating the peak curve and determining the presence of future competitors.

The study utilises the peak share methodology, which uses two basic yardsticks – the height-of-peak sales and time to peak. Both these parameters affect new product performance and hence are used in cases where it is necessary to estimate pharmaceutical firms' value.[2]A number of factors are known to affect the same out of which the most important are order of entry and Quality of the drug. By observing that the product in question is the fourth entrant in the said market, secondary research was conducted to observe general trends in the same.[4]

The Linear Product adoption curve is chosen as a template for forecasting due to its ideal nature distancing itself from providing a too optimistic or too pessimistic nature to the product shares.

The result of forecasting the share percentages of Product D gives a constantly growing product that peaks at 14%, in seven years and then undergoes a decline in its shares. The adjustment in error is done to accommodate for the decline in shares owing to presence of competitors and a rise in shares for Product B.

In this context it is important to bring into perspective the constantly changing share percentages of the competitor drugs Product A and B which are seen to peak in 2015 and 2013. Late Entrants generally tend to take shorter times-to-peak and smaller peak share percentages. This is owing to lowered buying resistance for a newer drug as

compared to a pioneer drug. The entry of new brands promote variety and enhancing marketing activity such as pricing, advertisement etc.[2]

Since market forces are unpredictable and external factors (like price controls, presence of competitors or greater coverage and affordability) can affect the forecast in a negative or positive manner, optimistic and pessimistic scenario assumptions in the form of rapid product adoption and slow product adoption were added and patient volume shares were calculated for all the three scenarios.(Navigating the intricacies of emerging markets)

Chapter 6: Conclusion

6.1: Conclusions

The Psoriatic Arthritis therapy market is a high revenue yielding one with ongoing research projects looking to improve the efficacy and safety of drugs while at the same time making them affordable and accessible. Therefore, it is of prime importance to estimate patient pool and treated patients in respective lines of therapy, as accurately as possible.

To this extent the above model has tried to utilise data available on the public database and create as close an estimate as possible. The study was conducted on excel by using simple linear forecast functions along with minor adjustments to incorporate efficiency. It must also be noted that unlike entire product lifecycles that the citations of this project endorse as well, the project aims only to estimate the same up-to the peak share. Any subsequent estimation would turn out to be inaccurate as further assumptions following competitor entry and other pipeline products would come into play, these would then complicate the model and not satisfy the original purpose of the study which is to elaborate the process of forecasting of a drug/product and determine the changes in its market share alongside its competitors.

6.2: Limitations

The study undertaken uses a prevalence-based modelling technique that is itself inherent with flaws in having to utilise epidemiological data estimates that are often assumed to remain constant over future periods as well. Another similar shortcoming surrounds having to set assumptions surrounding certain market forces; namely the presence of competitors, or the occurrence of a chance event that may not be predictable.

Secondly, the ambiguity surrounding the shaping of the adoption curves and the proposed acceptance of the product itself is another limitation that handicaps this approach. This again refers to the inability to look beyond already existing adoption curves such as the rapid adoption curve, slow adoption curve, etc.

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