DEVELOPMENT AND ANALYSIS OF INVENTORY MODEL FOR CANCER MEDICINE IN RAMATHIBODI HOSPITAL

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Thematic Paper
entitled

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ABSTRACT

This research presents the inventory management system of Ramathibodi Hospital and focuses specifically on the medicine warehouse of Ramathibodi Hospital regarding the medicines for cancer, which have a high usage value (group A) and are considered to be vital drugs (group V). The classification would use the methods of ABC Analysis and VEN Analysis, including the forecast of future demands, to determine the Economic Order Quantity (EOQ), Reorder Point, and Safety Stock. The data used in the analysis is secondary data recorded between January 2012 and December 2012.

The result was used to develop an inventory management model, by using Microsoft Excel to assist in the preparation of model and calculation parameters. The Economic Order Quantity (EOQ), Reorder Point, Safety Stock, ordering costs, carrying costs and average inventory were included in order to guide the development inventory management system of Ramathibodi Hospital and reduce the average inventory values of the current system.

KEY WORDS: CANCER MEDICINE / INVENTORY MODEL/VEN ANALYSIS/ABC ANALYSIS

87 pages

การวิเคราะห์และพัฒนาตัวแบบสำหรับการจัดการยาคงคลังในกลุ่มยารักษาโรคมะเร็งของโรงพยาบาลรามาธิบดี

DEVELOPMENT AND ANALYSIS OF INVENTORY MODEL FOR CANCER MEDICINE IN RAMATHIBODI HOSPITAL

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บทคัดย่อ

การศึกษาครั้งนี้เป็นการศึกษาการบริหารคลังยา ของโรงพยาบาลรามาธิบดี ซึ่งจะทำการศึกษาเฉพาะกลุ่มยารักษาโรคมะเร็ง ซึ่งเป็นกลุ่มยาที่มีมูลค่าการใช้สูง(กลุ่ม A) และเป็นยาที่มีความสำคัญต่อชีวิต (กลุ่ม V) โดยจะทำการวิเคราะห์จัดลำดับความสำคัญของยา โดยใช้วิธี ABC และ VEN Analysis และหาค่าพยากรณ์ความต้องการใช้ยาในอนาคต เพื่อนำไปคำนวณหาปริมาณการสั่งซื้อที่ประหยัด (EOQ) จุดสั่งซื้อ (Reorder Point) และปริมาณยาคงคลังสำรอง (Safety Stock) เพื่อนำไปจัดทำแบบบจำลองการจัดการสินค้าคงคลังโดยข้อมูลที่นำมาวิเคราะห์เป็นข้อมูลทุติยภูมิที่บันทึกไว้แล้วตั้งแต่เดือนมกราคม 2555 ถึง ธันวาคม 2555

ผลการศึกษา ได้จัดทำแบบจำลองการจัดการสินค้าคลงคลัง โดยใช้โปรแกรม Microsoft Excel มาช่วยในการจัดทำแบบจำลอง เพื่อช่วยการคำนวณค่าพารามิเตอร์ต่างๆ ปริมาณการสั่งซื้อที่ประหยัด จุดสั่งซื้อ ปริมาณยาคงคลังเฉลี่ย จำนวนครั้งของการสั่งซื้อ และปริมาณยาคงคลังเฉลี่ย เพื่อเป็นแนวทางในการพัฒนารูปแบบการบริหารพัสดุคงคลัง ของโรงพยาบาลรามาธิบดี และลดมูลค่าคงคลังเฉลี่ยของระบบปัจจุบัน

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CHAPTER I
INTRODUCTION

1.1 Background and Problem Statement

Warehouse stock control is a crucial task for every corporation to heed as problems in such control may result in losses to the corporation. In a manufacturing industry, inadequate raw material or parts for production would lead to a production halt, delayed completion and delivery of goods, loss of customer's trust, and losing the affected customer in the respective order. Thus, good control of warehouse stock involves efforts in minimizing the stocking budget to reduce costs and enhance the efficiency of the corporation's services. In the health care industry, medicines and medical supplies are of crucial importances in their services. A good control over medicine stock would help a hospital to reach the full efficiency in servicing its patients.

"Cancer" is a worldwide public health problem. The World Health Organization have found that cancer is one of the world's leading causes of fatality and is growing in magnitude as demonstrated in the following example: back in 2008, cancer caused 7.6 million deaths worldwide while in 2012, it was accountable for 8.2 million of such; Moreover, it was speculated that in 2030, it would cause 13 million deaths. From the information provided by the International Agency for Research in Cancer (IARC), the 3 most commonly diagnosed cancers are lung cancer (1.8 million cases), breast cancer (1.7 million cases), and colon cancer (1.4 million cases) while the 3 most deadly cancers are lung cancer (1.6 million deaths), liver cancer (0.8 million deaths), and stomach cancer (0.7 million deaths).

In Thailand, cancer is the number one cause of deaths, amounting higher than accidents and heart disease respectively. From the report of the Ministry of Public Health, 60,000 deaths are annually attributed to cancer, or the average of 7 deaths in each hour. The 5 most deadly cancers are liver cancer and cholangiocarcinoma, lung cancer, breast cancer, cervical cancer, and colon and rectal cancer. Classifying the

deaths by sex, it is found that in male patients, the 5 most deadly cancers are liver cancer and cholangiocarcinoma, lung cancer, colon and rectal cancer, oral and throat cancer, and Leukemia, while in female patients, the 5 most deadly cancers are liver cancer and cholangiocarcinoma, lung cancer, breast cancer, cervical cancer, and colon and rectal cancer. It was also reported that number of deaths relating to cancer showed a rising trend. (Reference: National Cancer Prevention and Control Plan (2013 – 2017))

The medicines for cancer are important supplies for cancer patients and they are highly costed. Good warehouse stock control would ensure adequate stock of medicine for patients while minimizing the costs to occur to the hospital.

1.2 Objectives

The objectives of this study are as follow:

1) To prioritize the importance of each medicine in Ramathibodi Hospital
2) To develop medicine warehouse management of Ramathibodi Hospital
3) To study current situation and issues in medicine warehouse management of Ramathibodi Hospital

1.3 Scope of Work

The scopes of this research consists of:

This study focuses specifically on medicine warehouse management of Ramathibodi Hospital regarding the medicines for cancer, which are of high usage value (group A) and considered vital drugs (group V). The classification would use the methods of ABC Analysis and VEN Analysis including the forecast of future demands to determine the Economic Order Quantity (EOQ), Reorder Point, and Safety Stock. The data used in analysis is secondary data recorded between January 2013 to December 2013.

1.4 Expectation Results

The expected outcomes of this study include:

1) To learn of the current situation and issues of medicine warehouse management of Ramathibodi hospital.

2) To make a guideline and conduct a development of medicine warehouse management to be used in the future in Ramathibodi Hospital.

3) To learn of the importance of each kind of medicine of Ramathibodi Hospital.

4) To have adequate medicines for the demands.

CHAPTER II
LITERATURE REVIEW

The researcher has studied from the following list of related researches as guidelines:

2.1 Medicine stock classification by value (ABC Analysis)

2.2 Medicine stock classification by importance (VEN Analysis)

2.3 Stock Management

2.4 Forecasting

2.5 Other related researches

2.1 Medicine stock classification by value (ABC Analysis)

ABC Analysis uses sales volume or margin portion of each item. Items within group A are few items with low SKU (Stock Keeping Unit) but promise high sales volume or margin portion. The items with lesser promise of sales volume or margin portion are categorized in group B and C in a relative order (Stock and Lambert, 2001).

James and Jerry (1998) stated in their book, "The Warehouse Management Handbook; the second edition" under the topic of Stock Location Assignment about criteria for the ABC Analysis that one of the widely used methods of item location management is based on the movement of the stock. It was indicated that 20% of the stock would contribute to 80% of the movement of the entire stock.

The stock within group A should be prioritized and monitored, as well as to be managed with close attention and stored in a location convenient for picking-up more than group B and C. However, it is possible to classify the items further such as dividing the items into 4 groups: A, B, C, and D, with the following criteria: items with movement or sales volume of 50% as group A; 30% as group B; 12% as group C and; 8% as group D.

2.2 Medicine Stock Classification by Importance (VEN Analysis)

VEN Analysis is a method of medicine stock classification according to the effects of the medicines. The medicines could be classified into the following groups:

V = Vital Medicines are medicines crucial for survival. Must always be available.

E = Essential Medicines are medicines of lesser importance than vital medicines but still essential. This group treats less severe cases comparing to vital medicines.

N = Non Essential Medicines are the least important medicines for minor diseases which are required in the stock.

2.3 Stock Management

Suchat (2004: 103) mentioned that method that involves the determination of Economic Order Quantity (EOQ) and Reorder Point (ROP) is the most rational method due to the use of economic theories as following:

2.3.1 Methods involving Economic Order Quantities

EOQ is based on the concept of minimizing the storage cost of the warehouse stocks, which increases proportionally to the amount of order. However, small multiple orders would also result in higher sum of fixed cost for each order and would occasionally cause the shortage of supply at hand. The shortage would in turn cause additional cost, which on occasions, could be higher than storage cost itself. Thus, it is a complex task to define the balance in between. The economists have made a formula to calculate the most economic order quantity. Such amount is indicated by the intersection of storage cost and order cost, as displayed in figure 2.1

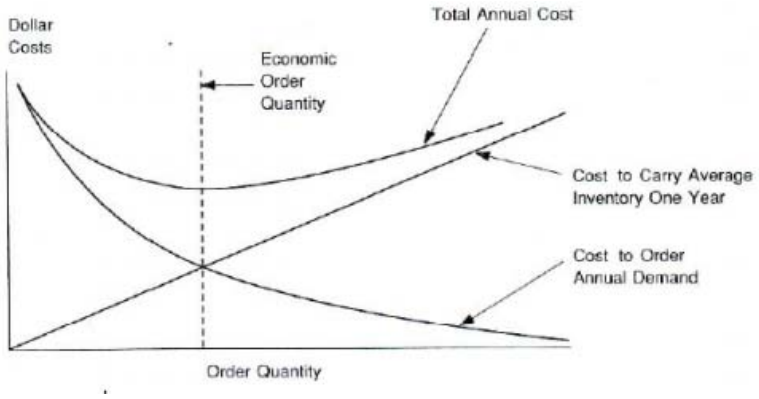

Figure 2.1 The Concept of EOQ

The EOQ can be calculated from the following formula. Given that:

$$EOQ = \frac{\sqrt{DP}}{IC}$$

A = Annual Demand, which can be forecasted from weekly or monthly demand (standard interval) according to each transaction.

CO = Cost of Order is 13, which is the cost of ordering 1 item by 1 order (CO within Thailand should range between 90 – 120 Baht) (Suchat, 2004:105).

C = Cost of Item (1 unit)

I = Investment Factor, which is a number calculated from percentage of storage cost to the cost of item (1 unit).

2.3.2 Reorder Point

For the Reorder Point (ROP) Suchat (2004:105) described it as the minimum amount of stock, which when the actual stock reaches it would call for a reorder of the item. The Lead Time need to be taken into consideration. Any demand that finishes the remaining supply or delay in delivery that occurs would cause a shortage and damage to follow. The Safety Stock establishment is meant to alleviate such issues.

Reorder Point (ROP) can be calculated by the formula

ROP = (d x LT) + SS

Given that d = rate of item depletion from the statistic collected from a period (depending on preferred method of forecasting) = annual demand/annual working days.

LT = Lead Time is the time required for each order, collected from statistic data.

SS = Safety Stock, which can be calculated by various methods. It will hereby be calculated with one appropriate to office supply: SS = Rate of Depletion x Safety Factor. Safety Factor may be different among the service levels and company's policies. If the policy calls for high service level, the Safety Factor would naturally increase in turn.

For an example, if there's expected annual sales of 1,000 pieces, where EOQ is 100 pieces, Lead Time is 5 days, working days amount 250 days and service level is 80%. ROP calculation:

ROP	= (d x LT) + SS
D	= 1000/250 = 4 pieces/day
LT	= 5 days
SS	= Service Level 80%
	= 1.05 = 4 X 1.05 = 4.2
	= 4 pieces
ROP	= (4 X 5) + 4
	= 24 pieces in stock

2.4 Forecasting

Forecasting is important to the stock management because data derived from forcasting could represent the demand of each item and enable the appropriate stocking of items in the warehouse. Demand forecasting could be done by various methods such as customer survey by forms, phone calls, or interview. However, this method requires high amount of budget and the accuracy of the data it can generate is a thing that managers should consider.

Moreover, the forecast may come from opinion of salesperson or experts in fields (Judgment Sampling). This method is fast and cheaper than the former but would also include personal biases.

2.4.1. Demand Forecasting and Planning

There are many methods used in forecasting the demands. In marketing, it considers sales promotion, pricing, competitors, and other factors. Production forcasting use the marketing and stock aspect of demand forecasting. In present, logistics usually involves forecasting the quantity to order, which supplier to purchase from, as well as perceived extent of item shortage in the operating area. In some organization, logistics is used in production planning. Thus, logistics must be used to relate the forecasting and planning in production and marketing.

2.4.2. Forecasting Technique

Forecasting can be described as an act of estimating or predicting future events or conditions while relying data, experience, or skills of the forecaster to define the trend or form of what could happen in the future.

The forecasting technique could be classified into 2 categories:

2.4.2.1. Qualitative Forecasting and;

2.4.2.2. Quantitative Forecasting

2.4.2.1. Qualitative Forecasting

This technique depends on experience, skills, and discretion of the expert who does such forecasting. This category of forecasting does not have is format, condition, or well-defined formula. In some cases, it might not even rely on historical occurrence.

2.4.2.2. Quantitative Forecasting

This technique requires mathematical and statistical knowledge in order to generate models or formulae to forecast future events. In this technique, adequate amount of quantitative or data of historical occurrence is crucial. It could be further divided into 2 sub-categories:

2.4.2.2.1 Time Series Method

This method uses the data of historical occurrence to determine the magnitude of changes in each period of time with the provision that the trend of changes is not time-dependent.

The Time Series Method consists of the following methods:

1) Moving Average

This method uses the average of recent data to forecast the next immediate period. This method give each data equal weight. The Formula for Moving Average is as below:

$$S_{(t+1)} = (X_{(1)}+X_{(t-1)}+...+X_{(t=N+1)})/N$$

Given $S_{(t+1)}$ = Predicted value at period t+1

X_t = Value at period t

N = Number of data

2) Exponential Smoothing

This method uses similar concept as the moving average: smoothing down the data to reduce variance. This method fixes the moving average's limitation about weighing of data by giving further back data less weight. The formula is as below:

$$S_{(t+1)} = 〖\alpha X〗_t+(1-\alpha) S_t$$

Given $S_{(t+1)} = S_t+\alpha(X_t+S_t) S_t$

A = Weight factor for error in forecasting. Ranges from 0 – 1

3) Higher Forms of Smoothing

This method is suitable for more complex set of data that has a defined trend. It reserves the advantages of regular smoothing method

but can be applied to each form of trends, even the seasonal trend, whereas only methods for linear and square data will be discussed in this topic.

(a) Double Moving Averages

This method starts with calculation of the normal moving average then find the average of the calculated average. This is meant to achieve more 'smoothness' and clearer trend of data comparing to the normal moving average. The formulae are as below:

$$S_t^{'} = (X_t+X_{(t-1)}+X_{(t-2)}+...+X_{(t-N+1)})/N$$

$$S_t^{''} = (S_t^{'}+S_{(t-1)}^{'}+...+S_{(t-N+1)}^{'})/N$$

$$a = 〖2S〗_t^{'}-S_t^{''}$$

$$b = 〖2/(N-1)(S〗_t^{'}-S_t^{''})$$

$$S_{(t+m)} = a+bm$$

Where $S_t^{'}$ = normal moving average = $\sum_{i=t-N+1}^{t} X_i/N$

$S_t^{''}$ = double moving averages

$S_{(t+m)}$ = m period(s) future forecasting

m = period of time forward of t

a = constant value, intercept of vertical axis at time t

b = forecasting value modifier

(b) Double Exponential Smoothing

This method is similar to the double moving average both in methodology and result but with advantages of time required and its suitability with horizontal linear pattern and directional pattern. The formulae are as below:

$$S_t^{'} = \alpha X_t+(1-\alpha)S_{(t-1)}^{'}$$

$$S_t^{'} = 〖\alpha S〗_t^{'}+(1-\alpha)S_{(t-1)}^{''}$$

$$a = 〖2S〗_t^{'}-S_t^{''}$$

$$b = 〖\alpha/(1-\alpha)(S〗_t^{'}-S_t^{''})$$

S_(t+m) = a+bm

α = Exponential smoothing coefficient

m = Period of time ahead being forecasted

(c) Winter' s Linear and Seasonal Exponential Smoothing

This method has equally good result comparing to double exponential smoothing method but with advantages of its suitability with seasonal pattern, directional pattern, or both. This method requires at least 2 seasons of data. This method consists of 3 parts: the smoothing factor (S_t), the trend factor (b_t), and the seasonal factor (I_t). The formulae are as below:

S_t = α X_t/I_(t-L) +(1-α)(S_(t-1)+b_(t-1))

b_t = (S_t-S_(t-1))+(1-y)b_(t-1)

S_t = β X_t/S_t +(1-β)I_(t-L)

X_t = Data at time t

S_t = Smoothing factor at time t

b_t = Slope of the data at time t

I_t = Seasonal factor at time t

L = Period of a season (amount of months or quarter)

α,y,β = Forecasting parameter. Ranges from 0 – 1.

It can be seen that the objective of Winter's forecast is similar to that of double exponential smoothing (both random and directional smoothing) but with seasonal parameter. Winter's method can be used to calculate the forecasted value with the following formula:

F_(t+m) = (S_t+b_t m)I_(t-L+m)

2.4.2.3 Casual of Exploratory Methods

This method use the relationship between the variants, can be used in any timeframe, and is very accurate. However, it requires a lot of data for analysis.

Patterns of Data

Choosing appropriate method for prediction should take the historical trend of the data into consideration. In general, there are 4 types of patterns:

1. Horizontal Pattern, characterized by non-stationary and unsystematic pattern within the horizontal plane

2. Trend Pattern, characterized by increase or decrease compared to time

3. Seasonal Pattern, characterized by recurring fluctuation due to seasons. The period might be 1 or 4 months and will be recurring.

4. Cyclical Pattern is similar to the seasonal pattern but each cycle would take longer than 1 year. This pattern is also more difficult to predict due to the uncertainty of the period.

2.5 Related research

Moore, Bykov, Savelli et al. (1997) studied and published manuals for patients of a medical facility. They aimed to provide adequate amount of manuals at the minimal cost. Due to the large number of medicine list, it was impossible to make all items available at all time. Thus, one process involved is prioritization of the medicine groups according to the ABC/VEN analysis according to the price, amount of usage, and importance of each medicine. ABC Analysis classified medicines into group A, B, and C in regards of the annual report, where medicines in group A are important for use and purchase. VEN Analysis classified medicines into group V, E, and N, where medicines in group V are vital drugs. The classification of 21 items by ABC Analysis and then VEN Analysis resulted in 8 items (79% of total sales volume) within group A. Out of these 8 items, 3 items are in group V (22.2% by value), 4 items are in group N (46.9% by value). 13 items (20.6% of total sales volume) are in group B and C. The result of such analysis can indicate the proportion of expense in medicines and can be used to make policies and modify proportion of budget arranged

for purchase of medicines, especially those in group V and reduce the purchase volume of non-essential (group N) medicines to save medicinal costs.

Ms. Chotika Tongsukchote (2009) studied warehouse stock management by ABC Analysis method of construction business. This study identified the group A stock with the value of use at 70 – 75% of all items and analyzed for the Economic Order Quantity (EOQ) comparing with each purchase order, ROP, and current warehouse stock cost of the company. The item with most "movement" was identified along with the current storage location compared to the ABC method's suggested location to reduce required moving distance. The analysis indicated 13 items are in group A, amounted 75.07 percent of entire current inventory budget. Proper management of items within group A will help saving costs greatly (by reducing item possession, times required to purchase, and storage cost). Locating items according to ABC method shall as well reduce the distance from rack to the store.

Pathumrat Kajornsrikiat (2014) studied medicine warehouse management of a private hospital to study the optimum quantity of medicine purchases, reorder point, and profit chances from reducing storage cost of stocked medicine. The entire list of medicines consisted of 889 items. 100 items from each group according to ABC Classification were then selected to find EOQ, ROP, total cost, earning before interest, taxes depreciation, and amortization margin: EBIDA Margin. Microsoft Excel was used to generate the models. The study found that the three models generated had different EOQ comparing to the actual situation. The differences were 98% in group A and 95% in both group B and C. The study also found that the three models generated had different ROP comparing to the actual situation. The differences were 96% in group A and B and 86% in group C. All had resulted in the cost reduction of 648,825.07 Baht and led to an increased earning before taxes, interest, and depreciation from 28.98 to 29.06 percent, given that the income remained the same.

Miss Patcharee ChuayPradit (2013) studied the management of a hardware retailer, Pathumthani. The researcher has found that over-stocking of inventories contributed to the inefficiency of the operation. The shop wanted to have all items available to the customers and each kind of item had high amount of SKU. The over-stocking affected the amount of storage cost due to its slow-movement. The

inappropriate storage location also caused difficulty and errors when retrieving items from the warehouse. The objective of this study was to develop an efficient warehouse stock management, that was, to control of storage amount to minimize storage cost while maintaining adequate supply to meet the demands. The study started by retrieving data of ordering cost (per order), number of orders, and storage, followed by analysis of EOQ, Safety Stock, ROP, Prioritizing based on ABC analysis, storage planning, and establishing visual control of all shelves respectively.

From the foregoing study, it was found that such renovation would enhance the efficiency of warehouse stock management by systemizing the reorder planning and further saving the cost. As examples, in the storage cost was reduced by 21% in the electrical department and 15% in the waterworks department.

CHAPTER III
RESEARCH METHODOLOGY

The research topic is "The development of drug stock management system of Ramathibodi Hospital". The objective of this research is to develop drug stock management of Ramathibodi Hospital as shown in figure 3.1.

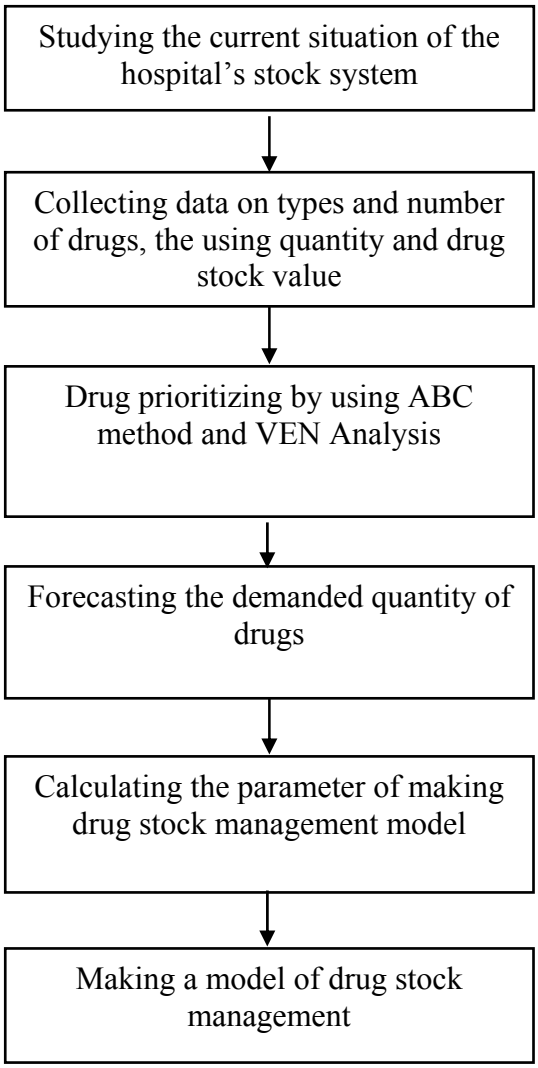

Figure 3.1 Research method

3.1 Studying the current situation of the hospital's stock system

The hospital's current working processes were studied such as ordering criteria, drug ordering process, document flow, estimation of drug orders and demanded quantity.

3.2 Collecting data on types and number of drugs, the using quantity and drug stock value

Statistic data was collected from the computers of Ramathibodi Hospital, as well as document and recorded reports.

Secondary data collected the information on drug stock management such as number and types of drug, the demanded quantity for each type of drugs, process and the quantity of time taken to procure drugs, and the number of days between ordering and receiving drugs.

Primary data collected the information on drug procurement process until receiving drug to be kept in stock and the costs related to drug stock management.

3.3 Drug prioritizing by using ABC method and VEN Analysis

Drug prioritizing by using ABC method and VEN Analysis indicates which type of drugs is important and needs more attention in managing stock more than other kinds of drugs.

Drug stock calculation according to ABC analysis method

1) Collecting data of the number of drugs used in each year and the unit price of each type of drugs

2) Calculating the value of each type of drugs used in each year

3) Arranging the value of drugs used in an order

4) Calculating the percentage of accumulated units

5) Plotting graph from the percentage and separating drugs into groups of A, B, and C

Distinguishing drugs according to VEN Analysis

3.4 Forecasting the demanded quantity of drugs

The demanded quantity of drugs is forecasted to know the quantity of drugs needed in the future, which will lead to appropriate planning and setting of stock management policy.

3.5 Calculating the parameter of drug stock management model

1) Ordering Costs

2) Carrying Costs

3)Lead Time

3.6 Making a model of drug stock

A model of appropriate drug stock management was made to be applied in drug stock management as follow:

1. Economic Order Quantity (EOQ)

$$EOQ = \frac{\sqrt{2DP}}{IC}$$

P = Purchase price per time (Baht/time)

I = Carrying cost (Baht/unit/year)

D = Annual demand quantity (unit/year)

C = Product unit price (Baht/unit)

IC = Unit annual carrying cost

2. Reorder Point

$$ROP = \overline{dLT} + ss$$

$\overline{dLT}$ = Average demand during lead time

$\bar{d}$ = Average demand in a period of time

LT = Average lead time

ss = Safety stock

3. Safety Stock

$$ss = Z\ \sigma_d \sqrt{LT/R}$$

Z = Constant by times of standard deviation of normal distribution (derived from setting service levels using the table of normal distribution)

σ_d = Standard deviation of demand in lead time

R = Period of time taken to collect data for calculating standard deviation

CHAPTER IV
RESULTS AND DISCUSSION

Analysis and development of inventory management model is an important step in developing medicine inventory management model of case study. Preliminary study indicated that most problems derived from unformed and a lack of efficient medicine inventory management method and resulted in high-cost of medicine inventory and cost of treatment. Meanwhile, some items of medicine were out of stock and not able to completely response to customer's demands, this affected to organization satisfaction and confidence. This chapter illustrated an analysis and modeling of suitable medicine inventory management which created easiness, avoided unnecessary medicine collection, reduce cost and expense in operation and able to sufficiently response to customer's demands. The procedures of analysis and development of inventory management model were conducted as research procedures as these following scopes:

4.1 Prioritization of medicine group using ABC and VEN analysis

The overall results in the opinion expression of the expert using infographics in health domain indicated the average and standard deviation (S.D.) from opinion assessment with below details.

The information analysis result of opinion assessment form from the experts using infographics in health domain as shown in Table 4.1 and Figure 4.1. An overall design aspect had average = 4.48 and S.D. = 0.69. When considering on the detail of alphabet size and font that are proper and easy to read had maximum average score = 4.71 and S.D. = 0.87 due to the use of excellent noticeable, remarkable and legible alphabets is, resulting in the readable contents without eyestrains. The overall designed was found to be aesthetic and attractive in reading with minimum average score = 4.33, S.D. = 0.70. In addition, when in-depth analyzing on data derived from

the experts, spotted background should not be used since it made the picture and alphabet excessively dazzled or harmonious with background. The focal point should be added into infographics.

4.1.1 Criteria for arranging the medicine inventory group using ABC analysis

The data adopted in medicine inventory arrangement using ABC analysis technique in this research is data of medicine used in 1 year, in the period of January 2013 to December 2013. The criteria used in arrangement of medicine group using ABC technique are:

Group A: High cost medicines, around 70-80% of total value.

Group B: Moderate cost medicines, around 15% of total value.

Group C: Low cost medicines, around 5-10% of total value.

4.1.2 Criteria for arranging the medicine inventory group using VEN Analysis

The medicine item data adopted in medicine inventory arrangement using VEN analysis were consisted of group A medicine items derived from ABC analysis which was finally classified by VEN analysis. This step required expert in academically analyzing importance of medicine by referred to the criteria of medicine inventory arrangement using VEN analysis which can be summarized as follows:

• Group V is for the items which are very important for life, needed for treatment, necessary such as vaccines, serum.

• Group E is for the items which are secondly important but necessary and those are the medicines treating symptom which is lower severity than group V.

• Group N is the items which are least important, used for a bit sick treatment but still to be kept storing.

The medicine groups adopted in this research was the medicine in group A and V. The preliminary analysis results indicated 255 items of group A medicine. In this amount, there were 83 medicine items belonged in group V, 292 items in group V and 2026 items in group N as shown in Table 4.1.

Table 4.1 Group A medicines classification using VEN Analysis technique

Item	Price	Annual use value	ABC Analysis	VEN Analysis
GLAP-T-	696.36	97,795,405.68	A	E
CELC-C-	49.07	90,343,120.49	A	N
GLIV-T-	914.88	66,640,774.08	A	E
PLAV-T-	72.53	58,747,994.46	A	N
TAAP-C-	1,490.36	54,708,134.88	A	V
LIPR3T-	41.13	48,562,232.13	A	N
PRGF1C-	107.00	48,014,752.00	A	E
TASN-C-	1,486.54	37,924,608.48	A	V
CRES1T-	34.36	36,030,686.28	A	N
LIPR1T-	32.10	34,873,086.90	A	N
ELOX-I-	11,199.36	34,270,041.60	A	V
HECT-I0	183.52	31,784,929.92	A	E
EZET-T-	36.61	30,946,835.71	A	N
LYRC-C-	42.99	30,834,319.56	A	N
SADN1C-	35.65	28,956,962.05	A	N
TACV1T-	2,023.39	25,510,901.12	A	V
MATR2I-	60,485.14	24,194,056.00	A	V
TAXT2I-	23,960.45	23,481,241.00	A	V
FOSP1T-	285.33	23,361,393.75	A	E
PRTX-W-	74.56	22,734,313.28	A	N
HARN1T-	28.03	22,442,948.28	A	N
EPRX-I-	1,284.00	22,021,884.00	A	V
ACTE1T-	293.09	21,308,815.36	A	E
RECM-I-	1,415.61	20,866,091.40	A	V
NEXV-T-	1,398.52	20,685,509.32	A	V
FORE-I-	18,056.25	20,548,012.50	A	V
VELC-I-	57,168.18	20,180,367.54	A	V

Table 4.1 Group A medicines classification using VEN Analysis technique (Cont.)

Item	Price	Annual use value	ABC Analysis	VEN Analysis
EXJA-T-	502.52	14,434,384.48	A	E
CADX-T-	20.33	14,135,042.40	A	N
TRCL-T-	1,605.00	15,184,905.00	A	V
CRES2T-	49.97	15,029,426.93	A	N
ENAN1I-	16,288.32	14,773,506.24	A	V
ENBL1I-	9,630.68	14,580,849.52	A	V
SIGL2T-	36.95	14,515,216.30	A	N
LIPR2T-	42.80	14,451,206.00	A	N
VIAT-W-	25.31	14,116,171.61	A	N
MERN2I-	793.43	13,855,668.09	A	E
ZOMT-I-	11,757.54	13,803,351.96	A	V
LANO-I-	620.60	13,799,661.60	A	E
ARMD-T-	134.70	13,494,246.00	A	E
VISL-Y-	313.62	13,432,971.84	A	E
BONV-T-	1,404.95	13,061,820.15	A	V
ALMT-I-	38,711.11	12,968,221.85	A	V
XELD2T-	125.96	12,770,202.68	A	E
PRVF2T-	41.27	12,317,279.12	A	N
SAIZ-I-	8,359.91	12,113,509.59	A	V
GEMZ2I-	9,958.20	11,900,049.00	A	V
COZA-T-	19.26	11,695,076.46	A	N
REMC-I-	24,792.44	11,677,239.24	A	V
CASD-T-	220.11	11,666,270.22	A	E
AMBS-I-	6,858.92	11,639,587.24	A	V
ARIP1T-	121.90	11,609,146.50	A	E
KEPP2T-	35.31	11,304,002.16	A	N
TYGC-I-	2,097.20	11,268,255.60	A	V

Table 4.1 Group A medicines classification using VEN Analysis technique (Cont.)

Item	Price	Annual use value	ABC Analysis	VEN Analysis
VALC-T-	1,044.89	10,690,269.59	A	V
MYFT2C-	87.38	10,618,592.36	A	N
LIAM-I1	6,446.42	10,578,575.22	A	V
SERM1T-	17.10	10,461,267.00	A	N
ENAN-I-	6,313.00	10,441,702.00	A	V
NASN-F1	658.05	10,407,718.80	A	E
PLAP-T1	72.06	10,301,985.84	A	N
ARIP-T-	121.90	10,269,099.80	A	E
PARI1T-	37.86	10,265,398.26	A	N
HEMX3I-	472.58	10,218,124.76	A	E
INVZ-I-	1,377.09	10,134,005.31	A	V
AFIN1T-	4,993.38	9,886,892.40	A	V
ULTR-T-	13.60	9,815,636.80	A	N
ACLS-I-	15,515.00	9,634,815.00	A	V
REVL3C-	12,037.50	9,605,925.00	A	V
TEAF-Y-	202.26	9,535,143.18	A	E
INTX1I0	32.10	9,515,114.10	A	N
XOLR-I-	17,832.16	9,201,394.56	A	V
AVAT-I-	9,788.40	9,161,942.40	A	V
NEXM1T-	36.70	9,020,933.40	A	N
NORV1T-	17.65	9,001,305.85	A	N
ARCX1T-	29.12	8,925,716.80	A	N
LYRC1C-	64.62	7,965,448.92	A	N
PLET1T-	36.44	7,960,463.76	A	N
IMMU1I-	4,058.49	7,934,347.95	A	V
MICC2F-	2,616.12	7,782,957.00	A	V
ALMT1I-	8,859.60	7,752,150.00	A	V

Table 4.1 Group A medicines classification using VEN Analysis technique (Cont.)

Item	Price	Annual use value	ABC Analysis	VEN Analysis
NOLD-T-	38.64	7,349,559.84	A	N
REYT3C-	312.75	7,333,049.25	A	E
ALPG-Y-	324.21	7,265,870.31	A	E
COZA1T-	21.22	7,221,526.74	A	N
VIDZ-I-	22,470.00	7,212,870.00	A	V
NERT1C-	24.32	7,146,359.04	A	N
TIEN-I-	496.48	7,086,755.52	A	E
AVAM-F-	599.20	7,076,552.00	A	E
SANL3I-	86,293.48	7,076,065.36	A	V
MYFT1C-	46.37	7,064,376.76	A	N
NCLO-T-	95.90	7,036,758.40	A	N
MADI1T-	7.41	7,018,537.11	A	N
ARAV1T-	68.09	6,994,068.62	A	N
CLEX2I-	241.73	6,934,750.24	A	E
CRAV1T-	72.22	6,915,281.66	A	N
MADI2T-	12.74	6,786,547.04	A	N
ENBL-I-	4,815.76	6,775,774.32	A	V
PLET-T-	19.05	6,705,199.95	A	N
ZOLO-T-	35.18	6,694,402.20	A	N
VORI-I-	6,099.00	6,629,613.00	A	V
NORV2T-	28.96	6,607,166.08	A	N
NEUT1I-	558.26	6,577,977.58	A	E
VYTO1T-	46.15	6,354,993.45	A	N
OXAL1I-	17,405.33	6,335,540.12	A	V
JANM1T-	22.79	6,277,414.34	A	N
NEBD-I-	4,725.83	6,223,918.11	A	V
ZEFF-T-	76.43	6,200,842.33	A	N

Table 4.1 Group A medicines classification using VEN Analysis technique (Cont.)

Item	Price	Annual use value	ABC Analysis	VEN Analysis
TRUV-T-	65.98	5,544,431.36	A	N
DIRL-I-	5,299.71	5,495,799.27	A	V
COCT2T-	100.00	5,453,800.00	A	N
FEMR-T-	126.75	5,431,744.50	A	E
GALM-T-	22.40	5,426,310.40	A	N
THMG-I-	8,359.01	5,316,330.36	A	V
MADP-T-	11.24	5,274,414.96	A	N
BLOP1T-	15.28	5,270,713.76	A	N
RECM1I-	2,889.00	5,257,980.00	A	V
GEMZ1I-	2,107.80	5,239,990.80	A	V
CASD1T-	545.43	5,194,129.89	A	E
ALUV-T-	24.97	5,144,843.77	A	N
BARA-T-	223.64	5,141,930.88	A	E
TACV-T-	2,211.61	5,106,607.49	A	V
BLOP2T-	24.27	5,097,525.18	A	N
CLOD-T-	16.37	5,084,554.74	A	N
ATRI-T-	83.67	5,081,948.46	A	N
ALBT1I-	1,339.44	5,037,633.84	A	V
SALZ-T-	4.24	5,002,445.28	A	N
MAXM-I-	351.31	5,000,195.23	A	E
EPRX4I-	3,190.12	4,982,967.44	A	V
ACTO1T-	33.88	4,954,407.92	A	N
PREN-I-	2,069.38	4,840,279.82	A	V
TOPX3T-	36.38	4,800,341.00	A	N
IVIG-I1	6,510.20	4,791,507.20	A	V
COSP-Y-	535.00	4,681,250.00	A	E
SERT2F-	492.68	4,672,084.44	A	E

Table 4.1 Group A medicines classification using VEN Analysis technique (Cont.)

Item	Price	Annual use value	ABC Analysis	VEN Analysis
SUFI-T-	19.45	3,950,314.45	A	N
DIVN-T-	13.84	3,946,088.48	A	N
DETR-C-	50.64	3,928,955.04	A	N
SPRY1T-	2,007.32	4,062,815.68	A	V
SIMU-I-	58,850.00	4,060,650.00	A	V
NERT3C-	12.84	4,029,949.56	A	N
ZITM-C-	55.88	3,955,801.08	A	N
MEGC1T-	83.74	3,952,611.74	A	N
NSS.-I7	16.05	3,921,994.05	A	N
HEMX4I-	987.78	3,890,865.42	A	E
ZYRT-T-	7.65	3,890,560.50	A	N
ALFA1C-	4.71	3,880,003.80	A	N
SPOR-S-	2,332.60	3,872,116.00	A	V
NOXA-N-	17,869.00	3,859,704.00	A	V
TAXL2I-	19,260.00	3,852,000.00	A	V
DINH1I1	1,669.20	3,834,152.40	A	V
NEPG-I-	867.31	3,790,144.70	A	E
EPRX9I-	1,423.38	3,740,642.64	A	V
STOC1C-	26.68	3,727,916.36	A	N
SUPL1T-	18.13	3,715,961.06	A	N
FLIX-F-	417.80	3,715,077.60	A	E
AZOP-Y-	388.41	3,679,019.52	A	E
CLEX1I-	198.68	3,664,652.60	A	E
ZOLL-I-	19,170.83	3,661,628.53	A	V
LIPO-I-	13,618.18	3,636,054.06	A	V

Table 4.1 Group A medicines classification using VEN Analysis technique (Cont.)

Item	Price	Annual use value	ABC Analysis	VEN Analysis
VIRE-T-	42.80	3,273,986.00	A	N
NODN-I-	5,029.00	3,268,850.00	A	V
JANM-T-	22.53	3,263,155.08	A	N
ARMS-T-	112.35	3,238,151.70	A	E
EXFG1T-	19.35	3,214,925.10	A	N
EUTP-I-	1,021.85	3,207,587.15	A	V
CLEX3I-	331.25	3,206,500.00	A	E
CONC1T-	5.84	3,170,115.52	A	N
TEMD2C-	6,213.28	3,143,919.68	A	V
EXEL1X-	141.22	3,509,034.56	A	E
LETZ-T1	141.61	3,501,590.47	A	E
TOPX2T-	23.00	3,496,805.00	A	N
ACTM-T-	33.86	3,450,638.74	A	N
DALC-I2	232.11	3,431,050.02	A	E
PREZ-T-	110.50	3,403,289.50	A	E
AUGM-I-	194.66	3,379,102.94	A	E
GLSM-W-	6.85	3,375,330.65	A	N
GABA1C-	3.68	3,333,009.12	A	N
CELC1T-	98.13	3,328,471.47	A	N
FASL1I-	15,247.50	3,308,707.50	A	V
DILA-T-	23.25	3,304,127.25	A	N
VFEN-I-	5,864.42	3,278,210.78	A	V
ACTR-I-	6,741.00	3,114,342.00	A	V
COTL-T-	41.73	3,111,722.64	A	N
CETC2T-	138.56	3,111,641.92	A	E
NSS.1I2	4.74	3,091,973.10	A	N

Table 4.1 Group A medicines classification using VEN Analysis technique

Item	Price	Annual use value	ABC Analysis	VEN Analysis
JANU-T-	45.21	20,099,100.12	A	N
ERBI-I-	12,384.42	19,691,227.80	A	V
HMAB-I-	695.21	18,647,617.83	A	E
SADN2C-	143.05	18,446,297.50	A	E
AVOD-C-	43.70	18,213,591.90	A	N
EBIX-T-	82.42	17,187,701.96	A	N
XATX-T-	25.68	16,995,306.48	A	N
IRES-T-	1,977.45	16,932,904.35	A	V
GAMR1I-	6,307.65	16,898,194.35	A	V
TAXL1I0	64.20	15,893,287.80	A	N
TAZC-I-	283.22	15,571,718.82	A	E
TASN1C-	913.32	8,698,459.68	A	E
RAPM-T-	260.81	8,634,897.48	A	E
CELB-C-	21.25	8,611,413.75	A	N
TAXT1I-	6,778.04	8,438,659.80	A	V
ARCX2T-	30.21	8,430,885.96	A	N
FOSM1T-	285.33	8,398,973.88	A	E
CEVT-T-	1,601.79	8,321,299.05	A	V
CAMP2I-	12,095.65	8,297,615.90	A	V
VFEN2T-	1,459.36	8,238,087.20	A	V
LYRC2C-	16.59	8,134,889.91	A	N
LUCT-I-	40,321.16	8,749,691.72	A	V
VORI-T-	1,605.00	4,659,315.00	A	V
REYT2C2	281.39	4,604,384.57	A	E
CAMP1I-	4,109.42	4,503,924.32	A	V
DAFL-T-	8.17	4,480,583.23	A	N

Table 4.1 Group A medicines classification using VEN Analysis technique

Item	Price	Annual use value	ABC Analysis	VEN Analysis
PRGF3C-	53.50	7,587,798.00	A	N
PROS-T-	45.91	7,574,277.71	A	N
SERQ1T-	29.20	7,562,391.20	A	N
NOSV1I-	22,363.00	7,491,605.00	A	V
EXEL2X-	139.64	7,432,897.56	A	E
SERE3F-	599.99	6,562,690.62	A	E
LEXP-T-	40.76	6,544,099.52	A	N
ISEN-T-	248.55	6,505,796.25	A	E
ZOCR1T-	32.10	6,399,488.10	A	N
AZTP-T-	11.08	6,395,353.84	A	N
VYTO-T-	42.69	6,357,095.97	A	N
SPIR-C-	33.09	6,008,151.30	A	N
XALT-Y-	388.09	6,004,140.39	A	E
HECT-I-	77,476.70	5,965,705.90	A	V
RECM2I-	8,667.00	5,962,896.00	A	V
CELF-Y-	217.21	5,950,033.53	A	E
ZAND-T-	16.66	5,877,747.96	A	N
DPAC-T-	12.02	5,794,253.02	A	N
REMN4C-	123.29	5,708,327.00	A	E
TELF2T-	15.24	5,623,575.24	A	N
EPRX5I-	1,872.74	4,897,215.10	A	V
SYBC2F1	984.40	4,381,564.40	A	E
NASC-F-	369.01	4,233,651.73	A	E
SERC1T-	5.64	4,169,347.44	A	N
GALV-T-	21.78	4,162,288.68	A	N
LOST-T-	1.07	4,160,281.98	A	N
DIVN1T-	19.37	4,093,190.92	A	N

Table 4.1 Group A medicines classification using VEN Analysis technique

Item	Price	Annual use value	ABC Analysis	VEN Analysis
MYON-T-	6.47	3,619,537.98	A	N
CYME-I-	1,498.52	3,609,934.68	A	V
FINA-T-	18.15	3,591,195.30	A	N
VETV-X-	1,450.23	3,589,319.25	A	V
MINR1T-	64.20	3,566,566.80	A	N
THAL-C-	558.44	3,539,392.72	A	E
PURG3I-	4,185.84	3,528,663.12	A	V
PLAQ-T-	10.03	3,523,177.92	A	N
DIMR1T-	12.23	3,518,901.21	A	N
OMAC-C-	31.85	3,518,246.55	A	N

4.1.3 Results of medicine group arrangement

Results of medicine inventory prioritization for 2574 items using ABC and VEN analysis were summarized as follows:

255 items of group A, 75.09% of medicine inventory value.

292 items of group B, 14.92% of medicine inventory value.

2026 items of group C, 9.99% of medicine inventory value.

After analyzed medicine importance, it was found that

276 items of group V, 27.96% of medicine inventory value.

583 items of group E, 26.03% of medicine inventory value.

1715 items of group N, 46.00% of medicine inventory value.

Table 4.2 Lists A and V drugs to be studied and modeled drug inventory. The specific cancer drugs.

Item	Quantity	Price	ABC	VEN
Glivec Access Program 100 mg	140,438	696.36	A	V
Tasigna Access Program 200 mg	36,708	1,490.36	A	V
Tasigna 200 mg	25,512	1,486.54	A	V
Eloxatin 50 mg	3,060	11,199.36	A	V
Tarceva 150 mg	12,608	2,023.39	A	V
Mabthera 500 mg 50 ml	400	60,485.14	A	V
Taxotere 80 mg	980	23,960.45	A	V
Nexavar 200 mg	14,791	1,398.52	A	V
Velcade 3.5 mg	353	57,168.18	A	V
Erbitux Inj.	1,590	12,384.42	A	V
Alimta 500 mg 20 ml	335	38,711.11	A	V
Gemzar 1 gm	1,195	9,958.20	A	V
Afinitor Tablet 10 mg	1,980	4,993.38	A	V
Revlimid Capsule 25 mg	798	12,037.50	A	V
Avastin 100 mg 4 ml	936	9,788.40	A	V
Taxotere 20 mg	1,245	6,778.04	A	V
Campto 100 mg	686	12,095.65	A	V
Alimta 100 mg inj.	875	8,859.60	A	V
Vidaza 100 mg	321	22,470.00	A	V
Oxalip 150 mg 30 ml	364	17,405.33	A	V
Sutent 12.5 mg	5,513	1,103.22	A	V
Herceptin 440 mg 20 ml	77	77,476.70	A	V
Gemzar 200 mg	2,486	2,107.80	A	V
Tarceva 100 mg	2,309	2,211.61	A	V
Sprycel 50 mg	2,024	2,007.32	A	V
Taxol 300 mg 50 ml	200	19,260.00	A	V
Lipo-dox 2 mg/ml 10 ml	267	13,618.18	A	V

4.2 Forecasting in amount of medicine demand

4.2.1 Forecasting and inventory management

From preliminary study in case study, it was found that was high average medicine inventory value about over 20 million baht a month, while some items were out of stock and couldn't be served to customer. Some causes arise in medicine inventory management were a lack of forecasting in medicine demand which the data could be applied in future planning in providing medicine. Due to forecasting in demand or forecasting in amount of medicine use is an important part in inventory management because forecasting is estimation of future customer's demand, particularly in changeable future activities. Therefore, this research employed forecasting technique in medicine demand for benefiting in adoption of predicted values in planning and defining suitable medicine inventory management policies.

The data employed in forecasting modeling are monthly data of historical amount of medicine use since January 2012 to December 2012, totally 12 months. Those data were employed in forecasting to produce forecasted valued of medicine use since January 2013 to December 2013 and further led to suitable medicine inventory management modeling.

4.2.2 Forecasting technique

The technique used in this research was Exponential Smoothing, due to this method is suitable for data which are slightly changed and this research would conduct the re-forecasting monthly regarded as short-term forecasting and that was suitable for using this technique. The Exponential Smoothing technique is the technique used in short-term forecasting (1-3 months) and that is complicated weighted moving averages but easy for use and slight historical data would be employed. The required new forecasting value = previous forecasted value + (actual previous demand – previous forecasted value) as this equation below:

$$F_t = F_{t-1} + \alpha (A_{t-1} - F_{t-1})$$

where F_t = required new forecasting value

F_{t-1} = previous forecasted value

α = smoothing constant, $0 \leq a \leq 1$

At-1 = previous actual demand

After taking forecasting model in forecasting of medicine use amount, the forecasted value of medicine use amount since January 2013 to December 2013 (12 months) is calculated. Table 4.4 illustrated an example of forecasted values calculation of Glivec Access Program 100 mg use amount.

Table 4.3 Forecasting of Glivec Access Program 100 mg

Date	A_{t-1}	A_t	F_{t-1}	F_t
January	8,590	13,300	8,590	9,532.00
February	13,300	11,244	9,532.00	9,874.40
March	11,244	9,186	9,874.40	9,736.72
April	9,186	11,804	9,736.72	10,150.18
May	11,804	15,066	10,150.18	11,133.34
June	15,066	10,123	11,133.34	10,931.27
July	10,123	18,064	10,931.27	12,357.82
August	18,064	11,558	12,357.82	12,197.85
September	11,558	11,118	12,197.85	11,981.88
October	11,118	16,017	11,981.88	12,788.91
November	16,017	12,198	12,788.91	12,670.73
December	12,198	760	12,670.73	10,288.58

Table 4.4 Comparison between actual and forecasted values since January 2013 to December 2013

Month	GLAP-T-		TAAP-C-		TASN-C-	
	Actual	Forecast	Actual	Forecast	Actual	Forecast
January	13,300	9,532	4,172	2,380	2,268	2,044
February	11,244	9,874	2,688	2,442	2,324	2,100
March	9,186	9,737	2,996	2,552	1,876	2,055
April	11,804	10,150	3,248	2,692	2,272	2,099
May	15,066	11,133	3,948	2,943	2,604	2,200
June	10,123	10,931	2,464	2,847	2,268	2,213
July	18,064	12,358	4,564	3,190	2,240	2,219
August	11,558	12,198	2,632	3,079	2,716	2,318
September	11,118	11,982	3,444	3,152	1,652	2,185
October	16,017	12,789	2,968	3,115	3,640	2,476
November	12,198	12,671	3,584	3,209	1,652	2,311
December	760	10,289	-	2,567	-	1,849

Table 4.4 Comparison between actual and forecasted values since January 2013 to December 2013 (Cont.)

Month	TACV1T-		MATR2I-		TAXT2I-	
	Actual	Forecast	Actual	Forecast	Actual	Forecast
January	1,029	947	35	34	96	73
February	993	956	31	34	73	73
March	902	945	38	34	75	73
April	1,067	969	44	36	97	78
May	1,182	1,012	52	39	85	79
June	1,188	1,047	26	37	111	86
July	1,404	1,119	34	36	91	87
August	835	1,062	43	38	61	82
September	1,565	1,162	30	36	75	80
October	1,195	1,169	35	36	101	84
November	1,130	1,161	29	34	106	89
December	118	953	3	28	9	73

Table 4.4 Comparison between actual and forecasted values since January 2013 to December 2013 (Cont.)

Month	VELC-I-		ERBI-I-		ALMT-I-	
	Actual	Forecast	Actual	Forecast	Actual	Forecast
January	19	30	174	157	35	35
February	30	30	167	159	24	33
March	22	29	135	154	36	33
April	33	29	143	152	30	33
May	39	31	188	159	31	32
June	18	29	163	160	34	33
July	21	27	168	162	30	32
August	24	27	111	151	24	31
September	38	29	112	144	25	29
October	57	34	124	140	27	29
November	49	37	101	132	30	29
December	3	30	4	106	9	25

Table 4.4 Comparison between actual and forecasted values since January 2013 to December 2013 (Cont.)

Month	AFIN1T-		REVL3C-		AVAT-I-	
	Actual	Forecast	Actual	Forecast	Actual	Forecast
January	30	36	105	55	69	63
February	-	28	63	56	76	66
March	30	29	21	49	72	67
April	107	44	84	56	76	69
May	75	51	63	58	86	72
June	135	67	84	63	104	79
July	246	103	42	59	101	83
August	195	122	84	64	110	89
September	324	162	63	64	63	83
October	347	199	126	76	91	85
November	330	225	63	73	65	81
December	161	212	-	59	23	69

Table 4.4 Comparison between actual and forecasted values since January 2013 to December 2013 (Cont.)

Month	CAMP2I-		ALMT1I-		VIDZ-I-	
	Actual	Forecast	Actual	Forecast	Actual	Forecast
January	58	59	88	85	21	14
February	58	59	61	80	42	19
March	53	58	90	82	66	29
April	56	57	79	81	26	28
May	63	58	76	80	35	30
June	52	57	86	81	28	29
July	52	56	85	82	21	28
August	50	55	67	79	14	25
September	56	55	62	76	10	22
October	75	59	81	77	18	21
November	103	68	79	77	33	23
December	10	56	21	66	7	20

Table 4.4 Comparison between actual and forecasted values since January 2013 to December 2013 (Cont.)

Month	SUTN-C-		HECT-I-		GEMZ1I-	
	Actual	Forecast	Actual	Forecast	Actual	Forecast
January	397	238	3	1	304	251
February	624	315	5	2	244	250
March	137	279	6	3	203	240
April	480	320	6	4	192	231
May	539	363	5	4	197	224
June	644	420	4	4	173	214
July	540	444	5	4	213	214
August	490	453	12	6	240	219
September	282	419	8	6	228	221
October	690	473	6	6	224	221
November	618	502	10	7	221	221
December	72	416	7	7	47	186

Table 4.4 Comparison between actual and forecasted values since January 2013 to December 2013 (Cont.)

Month	SPRY1T-		TAXL2I-		LIPO-I-	
	Actual	Forecast	Actual	Forecast	Actual	Forecast
January	120	142	10	6	22	29
February	180	150	14	8	23	28
March	180	156	8	8	17	26
April	180	161	12	9	25	26
May	324	193	24	12	23	25
June	180	191	15	12	41	28
July	180	189	24	15	20	27
August	250	201	21	16	24	26
September	190	199	17	16	18	24
October	60	171	23	18	24	24
November	180	173	28	20	21	24
December	-	138	4	16	9	21

Table 4.4 Comparison between actual and forecasted values since January 2013 to December 2013 (Cont.)

Month	OXAL1I-		TAXT1I-		GEMZ2I-	
	Actual	Forecast	Actual	Forecast	Actual	Forecast
January	41	32	121	82	139	123
February	36	33	89	83	106	120
March	38	34	99	86	99	115
April	38	35	110	91	96	112
May	27	33	130	99	95	108
June	32	33	128	105	78	102
July	37	34	110	106	108	103
August	27	32	121	109	110	105
September	24	31	107	108	122	108
October	31	31	122	111	107	108
November	30	31	94	108	109	108
December	3	25	14	89	26	92

Table 4.4 Comparison between actual and forecasted values since January 2013 to December 2013 (Cont.)

Month	NEXV-T-		ELOX-I-		TACV-T-	
	Actual	Forecast	Actual	Forecast	Forecast	Forecast
January	672	942	229	207	-	44
February	963	947	168	200	3	53
March	1,714	1,100	267	213	8	48
April	1,944	1,269	229	216	13	52
May	1,370	1,289	338	241	15	53
June	1,380	1,307	340	260	15	50
July	906	1,227	323	273	18	53
August	1,710	1,324	320	282	17	51
September	974	1,254	288	283	18	43
October	1,656	1,334	269	281	17	39
November	1,418	1,351	236	272	17	40
December	84	1,098	53	228	16	32

Table 4.4 Comparison between actual and forecasted values since January 2013 to December 2013 (Cont.)

Month	TEMD2C-		FASL1I-	
	Actual	Actual	Actual	Forecast
January	38	-	240	120
February	89	17	180	132
March	30	25	216	149
April	65	32	110	141
May	60	25	217	156
June	37	14	122	149
July	67	30	306	181
August	40	12	111	167
September	10	22	450	223
October	25	12	177	214
November	42	18	180	207
December	3	10	-	166

From Table 4.4, it was observed that there were differences when compared actual medicine use amount with forecasted values. It indicated the errors of forecasting results due to various factors and these errors would affect to actual demands arise in planning of providing future medicine inventory which probably greater or less than forecasted value. Therefore, to prevent the errors affecting to respond customer's demand all the time, it is necessary to define safety stock to prevent medicines out of stock due to uncertainty of demand amount and lead time which is discussed in next section.

4.3 Calculation of parameters used in medicine inventory management modeling

After prioritization of medicines using ABC/VEN analysis and conducted forecasting of medicine demand amount, the next step is suitable medicine inventory management modeling for case study by calculating economic order quantity, safety stock and reorder point. But prior to modeling, necessary parameters for modeling would be calculated.

4.3.1 Ordering Costs

4.3.2 Carrying Costs

4.3.3 Lead Time

4.3.1 Ordering Costs

4.3.1.1 Order documents cost, copying cost and acceptance of each time ordering must be documented in term of budget inspection of ordering approval reports, copying cost, issuing order, and acceptance report, all are average 30 baht a time.

4.3.1.2 Telephone and fax bills derive from ordering medicines. There are communications with dealers to inform advance purchasing demand, request for quotations, purchase order and following up. Each time ordering, there are twice telephone uses and once for fax, total cost is 9 baht a time. The ordering cost is total 39 baht a time.

4.3.2 Carrying costs

Carrying costs would vary by quantity and period of carrying that inventory. It is calculated as proportion of carrying to average medicine inventory value and that is carrying cost of case study arise since January 2013 to December 2013, clarified as follows:

Capital costs of case study are the paid capitals for medicine inventory compared with loan rate. The average value of medicine inventory carrying since January 2013 to December 2013was 3,535,347,777 baht per year, the current loan rate was 7.12% then the total capital was 251,716,762 a year.

Then, the proportion of average medicine inventory carrying = (251,716,762)/3,535,347,777

Or it could be expressed as 0.10 a year or 0.0083 a month or carrying cost was 10% of medicine inventory annual average value or 0.83% of medicine inventory monthly average value.

4.3.3 Lead Time

Ordering medicine of case study would be initiated from pharmacist records order list and proposes to The Administrative Committees for Medicine and Medical Supplies, Institute of Aviation Medicine, RTAF, for approval. After approved by the committees, the issue would be passed to administration department of the institute and the officer would issue the document of supplies demand and propose to office responsible in provision to collect medicine items and classify by company and compose the document to request for approval in purchasing and the purchase order would be issued by the director of institute. After approved, the officer would contact company's representatives to come taking the purchase order or fax the purchase order to the company.

After received document, the company would ship the items within 5 days. The process of acceptance would be conducted by the committees by considering in delivery note and transfer the medicines to storehouse. The period of ordering medicines of case study could be divided into 2 parts; documentation lead time and administration jobs of related units such as supplies request, purchase order, document of purchasing approval, etc. This lead time would take around 10 days and; advance lead time for dealer, this lead time takes 5 days to deliver items after received document included with 15 days of case study's lead time used in purchasing medicine to storehouse.

4.4 Modeling medicine inventory management

4.4.1 Economic Order Quantity (EOQ)

After calculated the costs involved in medicine inventory management, the Economic Order Quantity (EOQ) could also be calculated. The EOQ is the basic mathematical model used in answering questions of how many the items would be ordered. This model produces EOQ by considering in 2 costs, i.e. carrying cost and ordering cost. Currently, ordering medicine process of case study uses experiential estimation to provide sufficient medicine for trading in a period.

Economic Order Quantity (EOQ) could be calculated by equation 2.2 as below:

$$EOQ = \frac{\sqrt{DP}}{IC}$$

P = Purchasing cost per time (Baht/time)

I = Carrying cost in percentage of item value

D = Annual inventory use rate (unit/month)

Q = EOQ per time

C = Unit price (Baht/unit)

IC = Carrying cost per unit per month

The calculation of EOQ in this research was monthly EOQ calculation. The amount of each monthly medicine demand derived from forecasted values for carrying cost and ordering cost, calculated in 4.3.1, must also be monthly costs. For example of EOQ calculation, Glivec Access Program 100 mg was selected as case study example. The forecasted demand value in January 2013 was 9,532 tablets. When employed the parameters derived from 4.3 in EOQ calculation, the results were illustrated as follows:

Ordering cost, P = 1,135 Baht/time

Carrying cost, I = 0.0083/month

Amount of use in January 2013, D = 9,532 tablets

Unit price, C = 696.36 Baht

$$EOQ = \frac{\sqrt{DP}}{C}$$

= 9,465 tablets

The results of calculation indicated that the amount of ordering Glivec Access Program 100 mg which was most economized was 9,465 tablets, This amount led total costs which were carrying cost and minimum ordering cost were calculated as:

Ordering cost = 39 Baht

Carrying cost = 9,465 /2 x 0.0083 x 696.36 = 27,352.85 Baht

Total cost = 2,268.41 Baht

Table 4.5 EOQ calculation Glivec Access Program 100 mg

Month	Amount of use	Ordering cost	Carrying cost	Price	EOQ
January	9,532.00	39	27,390.57	696.36	9,464.56
February	9,874.40	39	27,877.48	696.36	9,633.05
March	9,736.72	39	27,682.72	696.36	9,565.65
April	10,150.18	39	28,263.55	696.36	9,766.64
May	11,133.34	39	29,598.90	696.36	10,228.71
June	10,931.27	39	29,329.42	696.36	10,135.46
July	12,357.82	39	31,182.04	696.36	10,776.54
August	12,197.85	39	30,979.83	696.36	10,706.56
September	11,981.88	39	30,704.69	696.36	10,611.35
October	12,788.91	39	31,720.58	696.36	10,962.89
November	12,670.73	39	31,573.86	696.36	10,912.12
December	10,288.58	39	28,455.32	696.36	9,833.00

4.4.2 Safety Stock

Safety stock is the amount of medicine which has to be stored to prevent out of stock resulted from variability of demand or lead time or both.

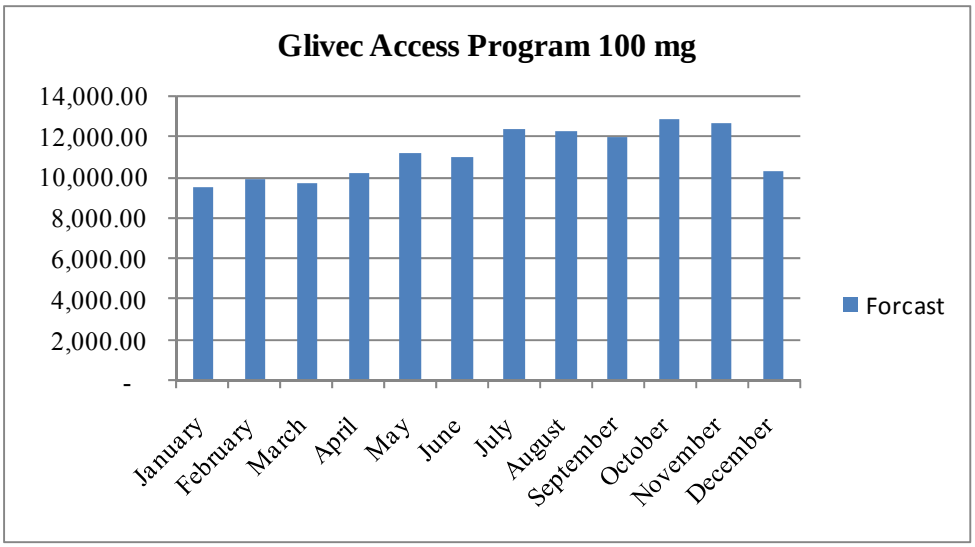

Figure 4.1 Amount of demand of Glivec Access Program 100 mg.

From figure 4.1 which displayed amount of use demand of Glivec Access Program 100 mg. it could be seen that medicine use demand of case study was probabilistic. Then, it must be provided defining amount of safety stock to prevent medicine out of stock and storing medicines were sufficient to be served to customers all the time. High amount of safety stock would reduce the out of stock risk but the carrying cost would be increased. Then, there should be examination of suitability between amount of safety stock and increasing cost. The determination of safety stock could be done by various methods such as management experiential determination, service level determination and minimum cost estimation while recognized the costs derived from out of stock. In this study, the author would determine the amount of safety stock using service level determination.

Analysis of general form demand pattern would be conducted by assuming that any variances of demand rate or period must probably be arranged in the normal distribution form. However, this is not strictly demand. That pattern is used for re-estimation of ordering point and the actual distribution may differ from normal distribution. This research inspected the distribution of medicine demand using Glivec

Access Program 100 mg. as example to examine which aspect of medicine demand distribution. The computer software was used as tool to test for obtaining the distribution of medicine demand by conducting the Kolmogorov-Smirnov test. The test result summarized that there was normal distribution.

The study in situation of demand or medicine use rate and lead time for medicine provision of case study indicated constant lead time but there was a variance for medicine use rate. Therefore, the amount of safety stock could be calculated as this equation:

$$SS - Z\sigma_d \frac{\sqrt{LT}}{R}$$

Where,

Z = Constant which is fold number of standard deviation of normal distribution

LT = Lead time

σ = Standard deviation of demand or use rate in a time unit

R = The period used in data collection for determination of standard deviation

The formula for safety stock calculation is Z multiplies by. The Z is constant value depending on acceptable risk of out of stock. Generally, it requires accepting low value of risk by defining Z to be greater. For considering Z value, we could find by searching the value of in normal distribution table as the standard deviation of demand in lead time and R is the period spent in data collection for determination of standard deviation.

This research has been defined the policy of medicine inventory management by calculating monthly ordering costs, carrying costs, EOQ, safety stock and reorder point. It means R which is period spent in data collection would equal to 1 month or 30 days.

The calculation of standard deviation of medicine demand (σ_d) would be conducted by Moving Variance (σ_d^2) method which uses moving average of actual demand summation minus the square of forecasted value or error in forecasting of that

month. In this place, the moving averages of previous 3 month were employed. The variance (σ_d^2) derived from this method would change in every month due to moving forward calculation which uses actual demand value and 1 set of previous forecasted values to calculate variance (σ_d^2) of that period and if there is a new additional actual demand and new forecasted value, the new variance (σ_d^2) would be able to be calculated.

This Moving Variance (σ_n^2) would produce truth-value which reflects current value and that is change by situation rather than calculating using one variance (σ_d^2) value for all year which affects to some monthly standard deviation of medicine demand which may greater or less than actual value. The formula used in calculation is:

$$\text{Moving Variance } (\sigma_d^2) = \frac{(X_{t-2} - F_{t-2})^2 + (X_{t-1} - F_{t-1})^2 + (X_t - F_t)^2}{3}$$

X_t = Amount of medicine demand at time t

F_t = Forecasted value at time t

The example of Moving Variance (σ_d^2) calculation using medicine demand data and forecasted value of Glivec Access Program 100 mg was shown in Table 4.6

Table 4.6 Moving Variance calculation Glivec Access Program 100 mg

Month	Actual value	Forecasted value	Moving Variance (σ_d^2)	σ_d
January	13,300.00	9,532.00	29,268,517.59	5,410.04
February	11,244.00	9,874.40	5,357,876.05	2,314.71
March	9,186.00	9,736.72	5,458,973.56	2,336.44
April	11,804.00	10,150.18	1,638,076.83	1,279.87
May	15,066.00	11,133.34	6,168,078.24	2,483.56
June	10,123.00	10,931.27	6,284,748.96	2,506.94
July	18,064.00	12,357.82	16,226,541.59	4,028.22
August	11,558.00	12,197.85	11,207,743.39	3,347.80
September	11,118.00	11,981.88	11,238,740.12	3,352.42
October	16,017.00	12,788.91	3,858,764.62	1,964.37
November	12,198.00	12,670.73	3,796,783.16	1,948.53
December	760.00	10,288.58	33,812,633.02	5,814.86

Defining service level

The content 4.4.2 discussed that safety stock used to prevent or reduce the chance of medicine out of stock due to unpredictable demand. Defining amount of safety stock is defining higher amount of medicine at order point as the amount of safety stock.

It could be observed that amount of safety stock is medicine inventory which increases for normal level to prevent out of stock and capable of sufficient amount of medicine to serve customers and reduce the occurrence of medicine out of stock or it means an increase of service level, likewise as increment of safety stock would result in higher service level.

Generally, defining service level would depend on how management or policy of that unit defines how high or low of service level or how is service level which would be acceptable. The service level of case study has been defined the target by key performance indicator of RTAF in the strategic issue of preserving national's security. The qualitative key performance indicator indicated that there must be 95% of RTAF officers whom obtained service, and that is the reason why research also used 95% of service level. If case study requires confidence in 95% of service level, it

means if yearly amount of medicine use is 100 tablets, 95 tablets could be served without out of stock.

Consider the example of safety stock calculation for Glivec Access Program 100 mg. in January 2012, the standard deviation of demand was 849.74 and the service level was defined at 95%

Lead time, LT = 15 days

Standard deviation of demand, = 5,410.04

Period spent in data collection, R = 30

Service level = 95%, after searched in normal distribution table then Z = 1.64485

Amount of safety stock $SS = Z\sigma_d \frac{\sqrt{LT}}{R}$

= 3,787.03 tablets

The results of calculation indicated that safety stock of Glivec Access Program 100 mg. in January 2013 would be at least 3,787.03 tablets in case of uncertainty in medicine use and preventing medicine out of stock. The amounts of medicine safety stock were shown in Table 4.7

Table 4.7 Safety stock of Glivec Access Program 100 mg. at 95% service level

Month	Z Service Level (95%)	σ_d	SS
January	1.64485	5,410.04	3,787.03
February	1.64485	2,314.71	1,620.30
March	1.64485	2,336.44	1,635.51
April	1.64485	1,279.87	895.91
May	1.64485	2,483.56	1,738.49
June	1.64485	2,506.94	1,754.86
July	1.64485	4,028.22	2,819.75
August	1.64485	3,347.80	2,343.46
September	1.64485	3,352.42	2,346.70
October	1.64485	1,964.37	1,375.06
November	1.64485	1,948.53	1,363.97
December	1.64485	5,814.86	4,070.40

Safety stock and service level

One factor of medicine inventory management is defining amount of safety stock which considers from suitable service level. Increasing of safety stock leads to higher carrying cost but the risk in medicine out of stock would be reduced. So, suitable defining service level means the service level defined for a balance of stock level of safety stock and minimum expected cost for out of stock.

4.4.3 Reorder point calculation

Amount of medicine inventory at reorder point depends on 2 factors: use rate and lead time. In reorder point calculation, we multiply use rate by lead time. But to prevent a lack of inventory, there should be an amount of reserved inventory for safety in case of variability of demand in lead time exists. It is necessary to store reserved inventory to prevent the out of stock condition. It could be calculated by equation 2.8 as below:

New reorder point = demand in lead time + reserved inventory

ROP + ss

$\bar{D}$ = Average demand rate per time unit

$\overline{LT}$ = Average lead time

ss = Reserved inventory

This system provides ordering medicines to storehouse at the point that medicine inventory is sufficient to be served in lead time. Ordering would be made by EOQ and demand in lead time is uncertain. If reorder point is underestimated, it may cause of medicine out of stock. With this reason, the service level of serving medicine has to be defined and it is defining of safety stock as previously described.

Consider the example of reorder point calculation for Glivec Access Program 100 mg. in January 2013 as below:

Forecasted value for monthly medicine demand in January 2013 = 3,758 tablets

Daily average demand rate, = 3,758/30 = 318 tablets/day

Lead time, $\overline{LT}$ = 15 days

Safety stock, ss = 3,787.03 tablets

Reorder point ROP = $\overline{DLT}$ + ss

= 318x 15 + 3,787.03

= 8,553.03 tablets

Calculation of reorder point which has indicated that when amount of medicine inventory was reduce to 8,553.03 tablets, reordering has to be made by ordering the same amount with EOQ (9,495 tablets) as calculated in 4.4.1 and amount of safety stock must be 3,787.07 tablets to prevent medicine out of stock due to uncertainty of medicine use rate.

Table 4.8 Calculation for reorder point of Glivec Access Program 100 mg.

Month	Forecasted Value	Average demand	Safety stock	Reorder point
January	9,532.00	317.73	3,787.03	8,553.03
February	9,874.40	329.15	1,620.30	6,557.50
March	9,736.72	324.56	1,635.51	6,503.87
April	10,150.18	338.34	895.91	5,971.00
May	11,133.34	371.11	1,738.49	7,305.16
June	10,931.27	364.38	1,754.86	7,220.49
July	12,357.82	411.93	2,819.75	3,041.57
August	12,197.85	406.60	2,343.46	8,442.39
September	11,981.88	370.60	2,346.70	8,337.64
October	12,788.91	426.30	1,375.06	7,769.52
November	12,670.73	422.36	1,363.97	7,699.34
December	10,288.58	342.95	4,070.40	9,214.69

The results derived from new developed model of medicine inventory management are EOQ, safety stock and reorder point. The derived data are monthly which allow us to simulate the situation of operating medicine inventory in case study. The required additional data are amount of medicine inventory in planning period (end of December 2012) which would be employed as initiative of situation. When the situation time is moving forward, medicine demand would be subtracted from stock. When amount of medicine in stock is reduced, equal to or lower than amount of medicine at reorder point, the medicines would be ordered to storehouse and distributed as amount of demand which was forecasted in each month accompanies with regular inspection of medicine inventory and compare medicine inventory with amount of medicine at reorder point. If amount of medicine inventory is equal to or lower than amount of medicine at reorder point, the medicines would be ordered as calculated amount (EOQ) and this process would be done repeatedly until January 2013 , which is the end of situation simulation cycle.

After completed the cycle of situation simulation, the numbers of medicine order must be checked and monthly average medicine inventory would be calculated for ordering costs, carrying costs and average inventory of case study.

4.5. Model Inventory

During all models provide new inventory. By increasing the cost of medication management including inventory. The cost of the order (Ordering Costs) costs of storage (Carrying Costs) and the average number of drug inventory (Average Inventory) into the model.

4.5.1 Carrying costs and average inventory

Carrying costs were calculated from summation of average inventory in each month multiplied by carrying cost per unit per month for amount of average inventory derived by using Microsoft Excel as modeled, initiated from amount of medicine inventory at situation initiative which was the end of December 2012.

For example, calculation of average inventory of Glivec Access Program 100 mg which its amount of inventory at the early of planning, December 2012 was 1,795 tablets and was used as initial data of situation. When the period of situation was moved forward in January 2013, the demand of Glivec Access Program 100 of case study, In January 2013, amount of inventory remained 1,795 tablets but the demand was 9,532 tablets, resulted in insufficiency. If no order made, the medicine would be out of stock and insufficient. The order has to be made in 1 EQQ or equal to 9,465 tablets and the total amount of medicine inventory was 11,260 tablets. When subtracted by amount of demand, the inventory was remained in 1,486 tablets.

When time moved forward, the model situation operation would be conducted as previously. The medicine would be distributed in each monthly period in the same amount with forecasted amount. The comparison between amount of inventory and amount at reorder point would be conducted. If the results indicated amount of inventory was lower than amount at reorder point of each time period, the order would be made. When situation moved forward until the end of December 2013,

it mean the end of situation and the amount of inventory at ended period would be checked.

From the calculation of medicine inventory management model of Glivec Access Program 100 mg, the amount of medicine inventory in each month was shown in Table 4.9

Table 4.9 Amount of medicine inventory of Glivec Access Program 100 mg. in each month

Month	Demand	EOQ	ROP	No. of EOQ	Inventory
January	9,532.00	9,464.56	8,553.03	1.00	1,727.56
February	9,874.40	9,633.05	6,557.50	1.00	1,486.20
March	9,736.72	9,565.65	6,503.87	1.00	1,315.13
April	10,150.18	9,766.64	5,971.00	1.00	931.60
May	11,133.34	10,228.71	7,305.16	1.00	26.97
June	10,931.27	10,135.46	7,220.49	2.00	9,366.62
July	12,357.82	10,776.54	3,041.57	1.00	7,785.34
August	12,197.85	10,706.56	8,442.39	1.00	6,294.05
September	11,981.88	10,611.35	8,337.64	1.00	4,923.52
October	12,788.91	10,962.89	7,769.52	1.00	3,097.50
November	12,670.73	10,912.12	7,699.34	1.00	1,338.89
December	10,288.58	9,833.00	9,214.69	1.00	883.31

The monthly amount of medicine inventory of Glivec Access Program 100 mg. derived from the table above would be employed in the calculation of carrying costs as follows:

4.5.2 Monthly medicine inventory value calculation

Average monthly medicine inventory value is value determination of medicine stored in stock by summing amount of medicine inventory at the early of period with amount at the end of period, divide by 2 and multiply by medicine unit price. This research would consider monthly amount. Then, the early of period is the

end of period in previous month or the early of this month and the end of period is amount of medicine at the end of this month as the equation below:

Average monthly medicine inventory value = Average monthly amount of medicine inventory x Unit price

Average monthly amount of medicine inventory = (Amount at the early of period+ Amount at the end of period)/2

Example of carrying costs calculation of Glivec Access Program 100 mg. In January 2013, the data derived from Table 4.8

Average monthly amount of medicine inventory = 1,728 tablets

Unit price of Glivec Access Program 100 mg. = 696.36 Baht/unit

Then, average monthly medicine inventory value = 1,728 x 696.36 = 1,203,001.30 Baht/month. The annual average value of medicine inventory was shown in Table 4.9

Table 4.10 Average monthly medicine inventory value of Glivec Access Program 100 mg. of the model

Month	Average amount of inventory	Unit price	Average value of inventory
January	1,727.56	696.36	1,203,001.30
February	1,486.20	696.36	1,034,931.71
March	1,315.13	696.36	915,807.08
April	931.60	696.36	648,725.79
May	26.97	696.36	18,779.39
June	9,366.62	696.36	6,522,541.24
July	7,785.34	696.36	5,421,399.12
August	6,294.05	696.36	4,382,921.71
September	4,923.52	696.36	3,428,539.72
October	3,097.50	696.36	2,156,973.05
November	1,338.89	696.36	932,348.13
December	883.31	696.36	615,099.28

4.5.3 Averaging carrying costs to Glivec Access Program 100 mg.

From the calculated carrying cost in 4.3.2, that was the carrying costs in the form of average carrying costs of all items. Therefore, to determine carrying cost of each item, averaging method of total carrying costs must be applied for each item as follows:

Annual average medicine inventory value of all items = 352,120,638.54 Baht

$$\text{Proportion of average carrying inventory} = \frac{\text{carrying cost}}{\text{Average amount of Inventory}}$$

= 0.10/year or 0.0083/month

Then, the proportion of average carrying inventory of Glivec Access Program 100 mg. is:

$$\frac{\text{carrying cost x value of the average monthly inventory of Glivec Access Program 100 mg}}{\text{Average amount of inventory x 12}}$$

Monthly average inventory value in January 2013 = 1,203,001.30

= 9,984.91 Baht/month

Therefore, carrying cost of Glivec Access Program 100 mg. in January 2013 was equal to 9,984.91 Baht and carrying costs in every month were shown in Table 4.10

Table 4.11 Carrying costs of Glivec Access Program 100 mg. of model

Month	Average amount of inventory	Average inventory value	Proportion of carrying	Carrying cost
January	1,727.56	1,203,001.30	0.0083	9,984.91
February	1,486.20	1,034,931.71	0.0083	8,589.93
March	1,315.13	915,807.08	0.0083	7,601.20
April	931.60	648,725.79	0.0083	5,384.42
May	26.97	18,779.39	0.0083	155.87
June	9,366.62	6,522,541.24	0.0083	54,137.09
July	7,785.34	5,421,399.12	0.0083	44,997.61
August	6,294.05	4,382,921.71	0.0083	36,378.25
September	4,923.52	3,428,539.72	0.0083	28,456.88
October	3,097.50	2,156,973.05	0.0083	17,902.88
November	1,338.89	932,348.13	0.0083	7,738.49
December	883.31	615,099.28	0.0083	5,105.32

From Table 4.11, carrying cost of Glivec Access Program 100 mg. in 1 year was 226,432.86 Baht and average inventory value was 27,281,067.52 Baht.

4.5.4 Calculation of ordering costs

Calculation of ordering costs arise when checked and found that amount of medicine in stock is equal to or lower than amount at reorder point and the provision department issues order to dealers.

Ordering costs is calculated from the number of orders multiplies by a time ordering cost.

Ordering cost = Number of orders x a time ordering cost

For example, calculation of ordering cost of Glivec Access Program 100 mg. in January 2013 to December 2013 using Microsoft Excel, the model indicated there were 13 times of ordering and ordering costs were shown in Table 4.12

Table 4.12 Ordering cost in each month which derived from model

Month	Number of ordering times (EOQ)	Cost per a time of ordering	Ordering cost
January	1.00	39	39
February	1.00	39	39
March	1.00	39	39
April	1.00	39	39
May	1.00	39	39
June	2.00	39	78
July	1.00	39	39
August	1.00	39	39
September	1.00	39	39
October	1.00	39	39
November	1.00	39	39
December	1.00	39	39

It was observed that in 1 year, there were 13 times of ordering Glivec Access Program 100 mg. Observed from Table 4.12, ordering Glivec Access Program 100 mg. derived from model caused 1 or 2 times ordering per month or zero at some months. Ordering would be made or not depends on new developed model always checks for amount of medicine inventory, the system immediately makes order if it was found that amount of inventory is lower than reorder point.

From Table 4.12, there were 13 times ordering, the ordering cost of Glivec Access Program 100 mg. in 1 year was equal to 13 x 39 = 507 Baht.

Total cost of inventory management of Glivec Access Program 100 mg. inventory management model in 1 year was equal to carrying cost plus ordering cost, finally was 226,432.86 + 507 = 226,939.86 Baht.

4.5.5 Carrying costs and average inventory

From collecting case study data, medicine inventory data was recognized and led to carrying costs calculation and average amount of inventory in case study current system. The data details were show in Table 4.13.

Table 4.13 Carrying costs of Glivec Access Program 100 mg.

Month	Average amount of inventory	Average inventory value	Carrying cost
January	1,728	1,203,001	9,985
February	1,486	1,034,932	8,590
March	1,315	915,807	7,601
April	932	648,726	5,384
May	27	18,779	156
June	9,367	6,522,541	54,137
July	7,785	5,421,399	44,998
August	6,294	4,382,922	36,378
September	4,924	3,428,540	28,457
October	3,097	2,156,973	17,903
November	1,339	932,348	7,738
December	883	615,099	5,105

Table 4.13 illustrated carrying cost of Glivec Access Program 100 mg. in 1 year derived from current inventory management system was 53,868 and annual average inventory value was 6,458,724 Baht.

The new developed model of case study medicine inventory management has been tested with some items. When required to apply this model to other items, it could be done by re-enter importing data as described in 4.5.2, such as forecasted medicine demand, unit price and amount of medicine inventory at the early of situation. After completed entering, Microsoft Excel would calculate until derive results as exporting data of model as 4.2.2, such as medicine inventory management

cost, average medicine inventory value. The example of applying the model to Glivec Access Program 100 mg. was shown in Table 4.14.

Due to there are many procedures for preliminary calculation of values for medicine inventory management model of case study, the research designed calculation tables using Microsoft Excel and the summary, calculated values used in modeling were shown in Appendix A.

Table 4.14 Model of Glivec Access Program 100 mg. inventory management

Glivec Access Program 100 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	13,300.00	9,532.00	3,787.03	8,553.03	39	0.0083	696.36	9,464.56	1,727.56	1,203,001.30	9,984.91
February	11,244.00	9,874.40	1,620.30	6,557.50	39	0.0083	696.36	9,633.05	1,486.20	1,034,931.71	8,589.93
March	9,186.00	9,736.72	1,635.51	6,503.87	39	0.0083	696.36	9,565.65	1,315.13	915,807.08	7,601.20
April	11,804.00	10,150.18	895.91	5,971.00	39	0.0083	696.36	9,766.64	931.60	648,725.79	5,384.42
May	15,066.00	11,133.34	1,738.49	7,305.16	39	0.0083	696.36	10,228.71	26.97	18,779.39	155.87
June	10,123.00	10,931.27	1,754.86	7,220.49	78	0.0083	696.36	10,135.46	9,366.62	6,522,541.24	54,137.09
July	18,064.00	12,357.82	2,819.75	3,041.57	39	0.0083	696.36	10,776.54	7,785.34	5,421,399.12	44,997.61
August	11,558.00	12,197.85	2,343.46	8,442.39	39	0.0083	696.36	10,706.56	6,294.05	4,382,921.71	36,378.25
September	11,118.00	11,981.88	2,346.70	8,337.64	39	0.0083	696.36	10,611.35	4,923.52	3,428,539.72	28,456.88
October	16,017.00	12,788.91	1,375.06	7,769.52	39	0.0083	696.36	10,962.89	3,097.50	2,156,973.05	17,902.88
November	12,198.00	12,670.73	1,363.97	7,699.34	39	0.0083	696.36	10,912.12	1,338.89	932,348.13	7,738.49
December	760.00	10,288.58	4,070.40	9,214.69	39	0.0083	696.36	9,833.00	883.31	615,099.28	5,105.32

The Table 4.14 is an example of medicine inventory management model which is new developed using Microsoft Excel. After enter values as 4.5.3 to the program, the results as 4.5.4 would be derived as follows:

1. X is actual medicine demand.
2. Forecast is forecasting value.
3. SS is safety stock.
4. ROP is reorder point value.
5. P, I, C is ordering cost per time, carrying cost per unit per time period and unit price, respectively.
6. EOQ, nEOQ is Economic order quantity and fold number of EOQ, respectively.
7. Inv/mth, Avg.Inv is monthly amount of inventory and average amount of inventory, respectively.

8. hld/mth is monthly carrying costs.

CHAPTER V
CONCLUSION

The research in development of inventory management system for medicine storage of Ramathibodi hospital purposed to propose guidelines and develop inventory management model of medicine storage, study in management of storage which experienced the problems derived from unformed and low efficiency inventory management which caused high cost of inventory and wasting of carrying costs. Meanwhile, some medicine items were out of stock and could not completely response to customer's demands which affected to organization satisfaction and confidence. The research was conducted as procedures, initiated by prioritization of medicine using ABC and VEN analysis, forecasting amount of medicine demand, calculation of parameters employed in inventory management modeling as well as efficiency evaluation of new developed inventory management system.

This thesis was a research of finding improvement guideline of inventory management as designed research procedures. The conclusion, recommendations and applications of research results were summarized and discussed in next section.

5.1 Conclusion

This research employed the principles of inventory management by applying EOQ model accompanied with reorder point in inventory management of case study. The results indicated that applying EOQ model accompanied with reorder point could control amount of medicine inventory, could define suitable reorder point and could reduce operation cost.

The research initiated by study in current condition, inventory management method of case study. It was observed that there was high amount of inventory which led to high average cost of inventory and high sunk cost in the form of inventory which led to high carrying cost. Meanwhile, there were medicines out of

stock and which could not serve to customers. The causes of problems were a lack of efficient model and inventory management method, leaning on experiences and skills in purchasing and checking amount of medicine, finally led to high cost of medicine inventory and wasting of carrying cost. The case of medicine out of stock was remained problem of insufficiently serving customers.

There were 2573 medicine items in case study inventory with 294,612,315 Baht/month of average inventory value in 2013. The researcher selected medicines by prioritizing medicines using ABC/VEN analysis. Criteria used were annual use value and results of medicine in treatment. Finally, there were 29 items of selected medicine.

Prioritization of medicine using ABC/VEN analysis allowed responsible person to give precedence to control, inspection and tally of medicine inventory suitably. The prioritization results indicated there were medicines arranged in group A, B, C and V, E, N, summarized as follows;

Table 5.1 Medicines classification using ABC Analysis technique and VEN Analysis technique

Group	Item	Proportion (%)	Value	Group	Item	Proportion (%)	Value
A	255	75.09%	2,654,692,645.40	V	276	27.96%	988,483,238.32
B	292	14.92%	527,473,888.26	E	583	26.03%	920,251,026.23
C	2026	9.99%	353,181,242.88	N	1715	46.00%	1,626,259,977.21

For the technique used in forecasting, the preliminary analysis of data indicated the trend of medicine distribution was seasonal pattern and amount of medicine use in each year was trend pattern. This research employed Winter's forecasting model due to this model is suitable for trend-seasonal data and the data were re-forecasted every month period.

Ordering costs calculation was consisted of order document cost, copying and acceptance cost, telephone and fax bills, and there was 39 Baht of cost per time.

Carrying cost calculation was consisted of capital costs and the carrying cost was 352,120,639 per year.

Economic Order Quantity (EOQ) is basic mathematical model used for answering how amount would be purchased. This model produces EOQ by considering 2 cost types: carrying cost and ordering cost.

Improvement of inventory management model of case study was done by using medicine inventory management model and assisted by adoption of Microsoft Excel to calculate EOQ, reorder point, safety stock, ordering costs, carrying costs and average inventory.

5.2 Suggestions

The research of medicine inventory management for Ramathibodi hospital consisted of many procedures and may cause of difficulties for actual implementation but some principles and theorems could be adopted such as inventory management using ABC/VEN analysis to prioritize the medicines by its importance and easy to control, inspect and cost-effective. It could be used to analyze for suitable amount of storage.

Demand forecasting helps inventory management to provide higher efficiency due to the characteristic of proactive work. The results from forecasting would be employed in advance demand planning and for purchasing decision making and medicine stock.

Efficient management of medicine inventory requires collaboration from every related unit by planning the cooperation between dispensary, The Administrative Committees of Medicines and Supplies, purchasing department, financial officers and financial department to provide efficient planning of purchasing, medicine stocking under low management budget.

The organization should adopt modern IT systems to assist in inventory management due to the inventory management always requires updated inventory status, rapid flow of data between units because of numerous medicine items to display actual medicine stock information, benefits for decision making of commanders and practitioners and importantly, users should have knowledge and understanding for highest benefit of system.

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APPENDIX

Model inventory management

Glivec Access Program 100 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	13,300.00	9,532	3,787	8,553	39	0.0083	696.36	9,465	1,728	1,203,001	9,985
February	11,244.00	9,874	1,620	6,557	39	0.0083	696.36	9,633	1,486	1,034,932	8,590
March	9,186.00	9,737	1,636	6,504	39	0.0083	696.36	9,566	1,315	915,807	7,601
April	11,804.00	10,150	896	5,971	39	0.0083	696.36	9,767	932	648,726	5,384
May	15,066.00	11,133	1,738	7,305	39	0.0083	696.36	10,229	27	18,779	156
June	10,123.00	10,931	1,755	7,220	78	0.0083	696.36	10,135	9,367	6,522,541	54,137
July	18,064.00	12,358	2,820	3,042	39	0.0083	696.36	10,777	7,785	5,421,399	44,998
August	11,558.00	12,198	2,343	8,442	39	0.0083	696.36	10,707	6,294	4,382,922	36,378
September	11,118.00	11,982	2,347	8,338	39	0.0083	696.36	10,611	4,924	3,428,540	28,457
October	16,017.00	12,789	1,375	7,770	39	0.0083	696.36	10,963	3,097	2,156,973	17,903
November	12,198.00	12,671	1,364	7,699	39	0.0083	696.36	10,912	1,339	932,348	7,738
December	760.00	10,289	4,070	9,215	39	0.0083	696.36	9,833	883	615,099	5,105

Tasigna Access Program 200 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	4,172.00	2,380	1,613	2,803	0	0.0083	1,490.36	4,729	3,441	5,128,774	42,569
February	2,688.00	2,442	731	1,952	0	0.0083	1,490.36	4,790	1,000	1,489,911	12,366
March	2,996.00	2,552	753	2,029	39	0.0083	1,490.36	4,898	3,345	4,985,087	41,376
April	3,248.00	2,692	304	1,650	0	0.0083	1,490.36	5,029	653	973,657	8,081
May	3,948.00	2,943	498	1,969	39	0.0083	1,490.36	5,259	2,969	4,425,356	36,730
June	2,464.00	2,847	380	1,804	0	0.0083	1,490.36	5,173	122	182,162	1,512
July	4,564.00	3,190	304	306	39	0.0083	1,490.36	5,476	2,407	3,587,900	29,780
August	2,632.00	3,079	622	2,162	39	0.0083	1,490.36	5,379	4,708	7,015,982	58,233
September	3,444.00	3,152	498	2,074	0	0.0083	1,490.36	5,442	1,556	2,318,630	19,245
October	2,968.00	3,115	612	2,169	39	0.0083	1,490.36	5,411	3,851	5,739,738	47,640
November	3,584.00	3,209	489	2,094	0	0.0083	1,490.36	5,491	642	957,400	7,946
December	0.00	2,567	881	2,165	39	0.0083	1,490.36	4,912	2,987	4,451,662	36,949

Tasigna 200 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	2,268.00	2,044	863	1,885	39	0.0083	1,486.54	4,383	2,661	3,955,341	32,829
February	2,324.00	2,100	128	1,178	0	0.0083	1,486.54	4,442	561	833,607	6,919
March	1,876.00	2,055	147	1,175	39	0.0083	1,486.54	4,395	2,900	4,311,459	35,785
April	2,272.00	2,099	135	1,185	9	0.0083	1,486.54	4,441	802	1,191,866	9,892
May	2,604.00	2,200	192	1,292	39	0.0083	1,486.54	4,547	3,149	4,680,674	38,850
June	2,268.00	2,213	169	1,276	0	0.0083	1,486.54	4,561	935	1,390,488	11,541
July	2,240.00	2,219	135	242	39	0.0083	1,486.54	4,566	3,283	4,880,179	40,505
August	2,716.00	2,318	240	1,399	0	0.0083	1,486.54	4,667	965	1,434,196	11,904
September	1,652.00	2,185	192	1,284	39	0.0083	1,486.54	4,531	3,311	4,922,232	40,855
October	3,640.00	2,476	224	1,462	9	0.0083	1,486.54	4,824	835	1,241,679	10,306
November	1,652.00	2,311	179	1,335	39	0.0083	1,486.54	4,660	3,185	4,733,919	39,292
December	0.00	1,849	206	1,131	0	0.0083	1,486.54	4,168	1,336	1,985,443	16,479

Eloxatin 50 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	229.00	207	68	172	39	0.0083	11,199.36	1,396	1,199	13,424,533	111,424
February	168.00	200	15	115	0	0.0083	11,199.36	1,369	999	11,190,036	92,877
March	267.00	213	27	133	0	0.0083	11,199.36	1,415	786	8,804,393	73,076
April	229.00	216	26	134	0	0.0083	11,199.36	1,425	570	6,382,948	52,978
May	338.00	241	45	166	0	0.0083	11,199.36	1,504	329	3,688,716	30,616
June	340.00	260	32	162	0	0.0083	11,199.36	1,565	69	771,773	6,406
July	323.00	273	26	116	39	0.0083	11,199.36	1,602	1,398	15,651,951	129,911
August	320.00	282	57	198	0	0.0083	11,199.36	1,629	1,115	12,489,566	103,663
September	288.00	283	45	187	0	0.0083	11,199.36	1,632	832	9,314,574	77,311
October	269.00	281	64	204	0	0.0083	11,199.36	1,624	551	6,172,056	51,228
November	236.00	272	51	187	0	0.0083	11,199.36	1,598	279	3,129,431	25,974
December	53.00	228	68	182	0	0.0083	11,199.36	1,464	51	576,618	4,786

Tarceva 150 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	1,029.00	947	282	755	39	0.0083	2,023.39	2,983	2,122	4,293,585	35,637
February	993.00	956	37	514	0	0.0083	2,023.39	2,997	1,166	2,359,467	19,584
March	902.00	945	40	513	0	0.0083	2,023.39	2,980	221	447,153	3,711
April	1,067.00	969	46	530	39	0.0083	2,023.39	3,018	2,270	4,592,933	38,121
May	1,182.00	1,012	81	587	0	0.0083	2,023.39	3,084	1,258	2,545,290	21,126
June	1,188.00	1,047	57	581	0	0.0083	2,023.39	3,137	211	426,417	3,539
July	1,404.00	1,119	46	140	39	0.0083	2,023.39	3,242	2,334	4,723,333	39,204
August	835.00	1,062	101	632	0	0.0083	2,023.39	3,159	1,273	2,574,814	21,371
September	1,565.00	1,162	81	662	0	0.0083	2,023.39	3,305	110	222,678	1,848
October	1,195.00	1,169	122	706	39	0.0083	2,023.39	3,314	2,256	4,563,804	37,880
November	1,130.00	1,161	98	678	0	0.0083	2,023.39	3,303	1,094	2,214,279	18,379
December	118.00	953	182	659	0	0.0083	2,023.39	2,992	142	286,907	2,381

Mabthera 500 mg 50 ml											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	35.00	34	10	27	39	0.0083	60,485.14	567	536	32,433,305	269,196
February	31.00	34	1	18	0	0.0083	60,485.14	562	503	30,403,423	252,348
March	38.00	34	2	19	0	0.0083	60,485.14	569	468	28,319,831	235,055
April	44.00	36	4	22	0	0.0083	60,485.14	585	432	26,120,688	216,802
May	52.00	39	6	26	0	0.0083	60,485.14	609	392	23,732,329	196,978
June	26.00	37	4	23	0	0.0083	60,485.14	588	356	21,507,118	178,509
July	34.00	36	4	11	0	0.0083	60,485.14	584	319	19,315,651	160,320
August	43.00	38	8	26	0	0.0083	60,485.14	594	282	17,042,304	141,451
September	30.00	36	6	24	0	0.0083	60,485.14	582	246	14,860,717	123,344
October	35.00	36	9	27	0	0.0083	60,485.14	580	210	12,692,051	105,344
November	29.00	34	7	25	0	0.0083	60,485.14	569	175	10,606,304	88,032
December	3.00	28	8	23	0	0.0083	60,485.14	515	147	8,901,415	73,882

Taxotere 80 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	96.00	73	26	**6**3	39	0.0083	23,960.45	827	759	18,193,896	151,009
February	73.00	73	9	46	0	0.0083	23,960.45	827	686	16,448,617	136,524
March	75.00	73	9	46	0	0.0083	23,960.45	830	613	14,692,987	121,952
April	97.00	78	8	47	0	0.0083	23,960.45	856	535	12,823,650	106,436
May	85.00	79	8	48	0	0.0083	23,960.45	864	456	10,920,853	90,643
June	111.00	86	10	52	0	0.0083	23,960.45	898	370	8,866,694	73,594
July	91.00	87	8	21	0	0.0083	23,960.45	903	283	6,787,286	56,334
August	61.00	82	10	51	0	0.0083	23,960.45	876	202	4,831,442	40,101
September	75.00	80	8	48	0	0.0083	23,960.45	869	121	2,907,360	24,131
October	101.00	84	16	58	0	0.0083	23,960.45	891	37	884,093	7,338
November	106.00	89	13	57	39	0.0083	23,960.45	913	861	20,639,975	171,312
December	9.00	73	13	50	0	0.0083	23,960.45	827	789	18,895,586	156,833

Nexavar 200 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	672.00	942	447	918	39	0.0083	1,398.52	2,976	2,189	3,060,733	25,404
February	963.00	947	109	583	0	0.0083	1,398.52	2,982	1,242	1,737,006	14,417
March	1,714.00	1,100	271	821	0	0.0083	1,398.52	3,215	142	198,612	1,648
April	1,944.00	1,269	369	1,003	39	0.0083	1,398.52	3,453	2,326	3,253,358	27,003
May	1,370.00	1,289	370	1,015	0	0.0083	1,398.52	3,481	1,037	1,450,595	12,040
June	1,380.00	1,307	461	1,115	39	0.0083	1,398.52	3,505	3,235	4,524,183	37,551
July	906.00	1,227	369	378	0	0.0083	1,398.52	3,396	2,008	2,808,210	23,308
August	1,710.00	1,324	463	1,125	0	0.0083	1,398.52	3,527	684	957,137	7,944
September	974.00	1,254	370	997	39	0.0083	1,398.52	3,432	2,863	4,004,159	33,235
October	1,656.00	1,334	345	1,013	0	0.0083	1,398.52	3,541	1,529	2,138,338	17,748
November	1,418.00	1,351	276	952	0	0.0083	1,398.52	3,563	178	249,060	2,067
December	84.00	1,098	171	720	39	0.0083	1,398.52	3,212	2,292	3,205,578	26,606

Velcade 3.5 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	19.00	30	13	28	39	0.0083	57,168.18	533	505	28,871,967	239,637
February	30.00	30	5	20	0	0.0083	57,168.18	532	475	27,147,774	225,327
March	22.00	29	5	20	0	0.0083	57,168.18	518	446	25,516,880	211,790
April	33.00	29	3	18	0	0.0083	57,168.18	526	417	23,834,855	197,829
May	39.00	31	4	20	0	0.0083	57,168.18	543	386	22,043,324	182,960
June	18.00	29	4	18	0	0.0083	57,168.18	519	357	20,404,293	169,356
July	21.00	27	3	30	0	0.0083	57,168.18	505	330	18,852,962	156,480
August	24.00	27	5	19	0	0.0083	57,168.18	499	303	17,337,489	143,901
September	38.00	29	4	19	0	0.0083	57,168.18	520	274	15,690,633	130,232
October	57.00	34	7	24	0	0.0083	57,168.18	569	240	13,721,432	113,888
November	49.00	37	6	24	0	0.0083	57,168.18	593	203	11,585,822	96,162
December	3.00	30	7	23	0	0.0083	57,168.18	535	172	9,843,033	81,697

Erbitux Inj.											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	174.00	157	44	122	39	0.0083	12,384.42	1,215	1,074	13,303,874	110,422
February	167.00	159	7	87	0	0.0083	12,384.42	1,223	915	11,332,770	94,062
March	135.00	154	11	88	0	0.0083	12,384.42	1,204	761	9,421,507	78,199
April	143.00	152	9	85	0	0.0083	12,384.42	1,195	609	7,538,302	62,568
May	188.00	159	14	94	0	0.0083	12,384.42	1,223	449	5,566,084	46,199
June	163.00	160	11	91	0	0.0083	12,384.42	1,226	289	3,584,578	29,752
July	168.00	162	9	9	0	0.0083	12,384.42	1,232	128	1,583,256	13,141
August	111.00	151	18	94	39	0.0083	12,384.42	1,193	1,169	14,483,423	120,212
September	112.00	144	14	86	0	0.0083	12,384.42	1,162	1,026	12,705,219	105,453
October	124.00	140	15	85	0	0.0083	12,384.42	1,146	886	10,975,522	91,097
November	101.00	132	12	78	0	0.0083	12,384.42	1,113	754	9,341,599	77,535
December	4.00	106	15	68	0	0.0083	12,384.42	1,000	648	8,024,553	66,604

Alimta 500 mg 20 ml											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	35.00	35	13	30	39	0.0083	38,711.11	574	541	20,943,163	173,828
February	24.00	33	4	20	0	0.0083	38,711.11	555	508	19,673,439	163,290
March	36.00	33	4	20	0	0.0083	38,711.11	561	475	18,378,939	152,545
April	30.00	33	4	20	0	0.0083	38,711.11	555	442	17,111,073	142,022
May	31.00	32	2	18	0	0.0083	38,711.11	552	410	15,856,771	131,611
June	34.00	33	5	21	0	0.0083	38,711.11	555	377	14,590,094	121,098
July	30.00	32	4	4	0	0.0083	38,711.11	550	345	13,344,486	110,759
August	24.00	31	2	17	0	0.0083	38,711.11	536	314	12,162,186	100,946
September	25.00	29	2	16	0	0.0083	38,711.11	526	285	11,022,790	91,489
October	27.00	29	2	16	0	0.0083	38,711.11	522	256	9,902,234	82,189
November	30.00	29	1	16	0	0.0083	38,711.11	523	227	8,773,522	72,820
December	9.00	25	1	14	0	0.0083	38,711.11	486	202	7,800,873	64,747

Gemzar 1 gm											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	139.00	123	45	106	39	0.0083	9,958.20	1,075	963	9,586,058	79,564
February	106.00	120	8	68	0	0.0083	9,958.20	1,060	843	8,395,057	69,679
March	99.00	115	11	69	0	0.0083	9,958.20	1,042	728	7,245,084	60,134
April	96.00	112	11	66	0	0.0083	9,958.20	1,024	616	6,133,908	50,911
May	95.00	108	11	65	0	0.0083	9,958.20	1,009	508	5,055,762	41,963
June	78.00	102	13	64	0	0.0083	9,958.20	980	405	4,037,897	33,515
July	108.00	103	11	11	0	0.0083	9,958.20	986	302	3,008,508	24,971
August	110.00	105	13	66	0	0.0083	9,958.20	992	197	1,965,916	16,317
September	122.00	108	11	65	0	0.0083	9,958.20	1,008	89	888,863	7,378
October	107.00	108	16	70	39	0.0083	9,958.20	1,007	988	9,842,985	81,697
November	109.00	108	13	67	0	0.0083	9,958.20	1,008	880	8,766,098	72,759
December	26.00	92	14	60	0	0.0083	9,958.20	928	789	7,852,806	65,178

Afinitor Tablet 10 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	30.00	36	9	27	39	0.0083	4,993.38	578	546	2,727,917	22,642
February	0.00	28	12	26	0	0.0083	4,993.38	517	518	2,585,705	21,461
March	30.00	29	12	26	0	0.0083	4,993.38	520	489	2,441,976	20,268
April	107.00	44	28	50	0	0.0083	4,993.38	646	445	2,220,134	18,427
May	75.00	51	27	52	0	0.0083	4,993.38	689	394	1,967,760	16,332
June	135.00	67	35	68	0	0.0083	4,993.38	796	327	1,631,039	13,538
July	246.00	103	28	28	0	0.0083	4,993.38	985	223	1,115,988	9,263
August	195.00	122	34	95	0	0.0083	4,993.38	1,069	102	509,206	4,226
September	324.00	162	27	108	39	0.0083	4,993.38	1,234	1,174	5,861,603	48,651
October	347.00	199	48	148	0	0.0083	4,993.38	1,368	975	4,867,865	40,403
November	330.00	225	39	151	0	0.0083	4,993.38	1,455	750	3,743,311	31,069
December	161.00	212	81	187	0	0.0083	4,993.38	1,413	537	2,682,882	22,268

Revlimid Capsule 25 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	105.00	55	38	65	39	0.0083	12,037.50	716	693	8,344,586	69,260
February	63.00	56	21	49	0	0.0083	12,037.50	727	637	7,667,116	63,637
March	21.00	49	24	48	0	0.0083	12,037.50	680	588	7,074,582	58,719
April	84.00	56	16	44	0	0.0083	12,037.50	727	532	6,398,325	53,106
May	63.00	58	16	45	0	0.0083	12,037.50	735	474	5,705,646	47,357
June	84.00	63	20	52	0	0.0083	12,037.50	768	411	4,949,274	41,079
July	42.00	59	16	16	0	0.0083	12,037.50	743	352	4,243,061	35,217
August	84.00	64	20	52	0	0.0083	12,037.50	774	289	3,475,860	28,850
September	63.00	64	16	48	0	0.0083	12,037.50	773	225	2,710,427	22,497
October	126.00	76	18	56	0	0.0083	12,037.50	846	149	1,794,736	14,896
November	63.00	73	14	51	0	0.0083	12,037.50	831	76	910,511	7,557
December	0.00	59	14	43	0	0.0083	12,037.50	743	17	203,130	1,686

Avastin 100 mg 4 ml											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	69.00	63	20	52	39	0.0083	9,788.40	772	710	6,954,516	57,722
February	76.00	66	5	38	0	0.0083	9,788.40	787	645	6,309,265	52,367
March	72.00	67	5	39	0	0.0083	9,788.40	794	577	5,652,111	46,913
April	76.00	69	5	40	0	0.0083	9,788.40	805	509	4,977,604	41,314
May	86.00	72	7	43	0	0.0083	9,788.40	824	436	4,269,638	35,438
June	104.00	79	7	46	0	0.0083	9,788.40	860	358	3,499,667	29,047
July	101.00	83	5	5	0	0.0083	9,788.40	884	274	2,685,964	22,293
August	110.00	89	8	52	0	0.0083	9,788.40	912	186	1,819,657	15,103
September	63.00	83	7	48	0	0.0083	9,788.40	885	102	1,003,277	8,327
October	91.00	85	15	57	0	0.0083	9,788.40	893	18	172,024	1,428
November	65.00	81	12	52	39	0.0083	9,788.40	872	809	7,916,582	65,708
December	23.00	69	17	52	0	0.0083	9,788.40	807	739	7,237,755	60,073

Taxotere 20 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	121.00	82	30	71	39	0.0083	6,778.04	877	800	5,422,218	45,004
February	89.00	83	16	58	0	0.0083	6,778.04	884	717	4,858,014	40,322
March	99.00	86	17	60	0	0.0083	6,778.04	901	630	4,272,446	35,461
April	110.00	91	9	55	0	0.0083	6,778.04	925	539	3,654,874	30,335
May	130.00	99	16	65	0	0.0083	6,778.04	964	440	2,984,588	24,772
June	128.00	105	12	64	0	0.0083	6,778.04	992	336	2,274,841	18,881
July	110.00	106	9	9	0	0.0083	6,778.04	997	230	1,557,926	12,931
August	121.00	109	19	74	0	0.0083	6,778.04	1,011	121	820,366	6,809
September	107.00	108	16	70	0	0.0083	6,778.04	1,010	13	85,268	708
October	122.00	111	22	77	39	0.0083	6,778.04	1,022	924	6,259,539	51,954
November	94.00	108	17	71	0	0.0083	6,778.04	1,006	816	5,529,342	45,894
December	14.00	89	20	64	0	0.0083	6,778.04	914	727	4,926,206	40,888

Campto 100 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	58.00	59	24	53	39	0.0083	12,095.65	743	691	8,352,725	69,328
February	58.00	59	0	30	0	0.0083	12,095.65	742	632	7,643,436	63,441
March	53.00	58	2	31	0	0.0083	12,095.65	735	574	6,947,791	57,667
April	56.00	57	2	31	0	0.0083	12,095.65	733	517	6,255,804	51,923
May	63.00	58	3	32	0	0.0083	12,095.65	741	459	5,549,809	46,063
June	52.00	57	2	31	0	0.0083	12,095.65	732	402	4,859,218	40,332
July	52.00	56	2	2	0	0.0083	12,095.65	726	346	4,180,951	34,702
August	50.00	55	3	31	0	0.0083	12,095.65	718	291	3,517,380	29,194
September	56.00	55	3	30	0	0.0083	12,095.65	720	236	2,851,053	23,664
October	75.00	59	4	33	0	0.0083	12,095.65	745	177	2,136,556	17,733
November	103.00	68	3	37	0	0.0083	12,095.65	799	109	1,315,788	10,921
December	10.00	56	4	32	0	0.0083	12,095.65	727	52	634,982	5,270

Alimta 100 mg inj.											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	88.00	85	27	70	39	0.0083	8,859.60	893	809	7,166,542	59,482
February	61.00	80	8	48	0	0.0083	8,859.60	867	729	6,457,420	53,597
March	90.00	82	8	49	0	0.0083	8,859.60	878	647	5,730,649	47,564
April	79.00	81	8	49	0	0.0083	8,859.60	875	565	5,009,251	41,577
May	76.00	80	4	44	0	0.0083	8,859.60	869	485	4,297,466	35,669
June	86.00	81	10	51	0	0.0083	8,859.60	875	404	3,575,654	29,678
July	85.00	82	8	8	0	0.0083	8,859.60	879	321	2,847,590	23,635
August	67.00	79	5	44	0	0.0083	8,859.60	862	242	2,146,421	17,815
September	62.00	76	4	42	0	0.0083	8,859.60	844	167	1,475,626	12,248
October	81.00	77	3	42	0	0.0083	8,859.60	849	90	795,465	6,602
November	79.00	77	3	41	0	0.0083	8,859.60	852	13	111,355	924
December	21.00	66	3	36	39	0.0083	8,859.60	787	734	6,502,866	53,974

Vidaza 100 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	21.00	14	3	10	39	0.0083	22,470.00	360	352	7,916,641	65,708
February	42.00	19	10	19	0	0.0083	22,470.00	427	333	7,479,824	62,083
March	66.00	29	18	32	0	0.0083	22,470.00	520	304	6,833,767	56,720
April	26.00	28	18	32	0	0.0083	22,470.00	515	276	6,200,077	51,461
May	35.00	30	15	30	0	0.0083	22,470.00	527	246	5,535,835	45,947
June	28.00	29	22	37	0	0.0083	22,470.00	524	217	4,878,609	40,492
July	21.00	28	18	18	0	0.0083	22,470.00	509	190	4,258,455	35,345
August	14.00	25	19	31	0	0.0083	22,470.00	484	165	3,699,415	30,705
September	10.00	22	15	26	0	0.0083	22,470.00	454	143	3,207,243	26,620
October	18.00	21	3	14	0	0.0083	22,470.00	446	122	2,732,614	22,681
November	33.00	23	2	14	0	0.0083	22,470.00	470	98	2,204,609	18,298
December	7.00	20	4	14	0	0.0083	22,470.00	436	78	1,750,746	14,531

Oxalip 150 mg 30 ml											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	41.00	32	4	20	39	0.0083	17,405.33	550	524	9,127,235	75,756
February	36.00	33	4	20	0	0.0083	17,405.33	557	491	8,553,555	70,995
March	38.00	34	4	21	0	0.0083	17,405.33	565	457	7,962,331	66,087
April	38.00	35	2	20	0	0.0083	17,405.33	572	423	7,357,071	61,064
May	27.00	33	3	20	0	0.0083	17,405.33	559	389	6,778,874	56,265
June	32.00	33	3	20	0	0.0083	17,405.33	557	356	6,204,923	51,501
July	37.00	34	2	2	0	0.0083	17,405.33	563	323	5,616,962	46,621
August	27.00	32	4	20	0	0.0083	17,405.33	552	290	5,052,605	41,937
September	24.00	31	3	19	0	0.0083	17,405.33	537	260	4,517,573	37,496
October	31.00	31	4	19	0	0.0083	17,405.33	538	229	3,981,635	33,048
November	30.00	31	3	18	0	0.0083	17,405.33	537	198	3,448,453	28,622
December	3.00	25	4	16	0	0.0083	17,405.33	486	173	3,011,464	24,995

Sutent 12.5 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	397.00	238	126	245	39	0.0083	1,103.22	1,495	1,313	1,448,646	12,024
February	624.00	315	140	298	0	0.0083	1,103.22	1,721	998	1,101,087	9,139
March	137.00	279	152	292	0	0.0083	1,103.22	1,620	719	792,813	6,580
April	480.00	320	152	312	0	0.0083	1,103.22	1,733	399	440,283	3,654
May	539.00	363	112	294	0	0.0083	1,103.22	1,848	36	39,333	326
June	644.00	420	190	400	0	0.0083	1,103.22	1,986	1,602	1,767,072	14,667
July	540.00	444	152	152	0	0.0083	1,103.22	2,042	1,158	1,277,640	10,604
August	490.00	453	140	367	0	0.0083	1,103.22	2,063	705	777,979	6,457
September	282.00	419	112	321	0	0.0083	1,103.22	1,984	286	316,028	2,623
October	690.00	473	165	402	39	0.0083	1,103.22	2,108	1,922	2,120,136	17,597
November	618.00	502	132	383	0	0.0083	1,103.22	2,172	1,420	1,566,334	13,001
December	72.00	416	152	360	0	0.0083	1,103.22	1,977	1,004	1,107,406	9,191

Herceptin 440 mg 20 ml											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	3.00	1	1	2	39	0.0083	77,476.70	115	114	8,855,768	73,503
February	5.00	2	1	2	0	0.0083	77,476.70	141	112	8,691,517	72,140
March	6.00	3	2	3	0	0.0083	77,476.70	165	109	8,467,145	70,277
April	6.00	4	2	4	0	0.0083	77,476.70	182	106	8,194,675	68,016
May	5.00	4	2	4	0	0.0083	77,476.70	189	102	7,899,222	65,564
June	4.00	4	2	4	0	0.0083	77,476.70	190	98	7,600,879	63,087
July	5.00	4	2	2	0	0.0083	77,476.70	196	94	7,284,727	60,463
August	12.00	6	2	5	0	0.0083	77,476.70	231	88	6,845,862	56,821
September	8.00	6	2	5	0	0.0083	77,476.70	240	82	6,370,807	52,878
October	6.00	6	1	4	0	0.0083	77,476.70	240	76	5,897,791	48,952
November	10.00	7	1	5	0	0.0083	77,476.70	254	69	5,364,424	44,525
December	7.00	7	1	4	0	0.0083	77,476.70	255	62	4,829,264	40,083

Gemzar 200 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	304.00	251	90	216	39	0.0083	2,107.80	1,536	1,304	2,749,095	22,817
February	244.00	250	21	146	0	0.0083	2,107.80	1,532	1,054	2,222,651	18,448
March	203.00	240	26	146	0	0.0083	2,107.80	1,503	814	1,715,919	14,242
April	192.00	231	22	137	0	0.0083	2,107.80	1,473	583	1,229,594	10,206
May	197.00	224	24	136	0	0.0083	2,107.80	1,451	359	757,487	6,287
June	173.00	214	27	134	0	0.0083	2,107.80	1,417	146	306,871	2,547
July	213.00	214	22	22	39	0.0083	2,107.80	1,417	1,349	2,843,115	23,598
August	240.00	219	30	140	0	0.0083	2,107.80	1,434	1,130	2,381,712	19,768
September	228.00	221	24	135	0	0.0083	2,107.80	1,440	909	1,916,475	15,907
October	224.00	221	32	142	0	0.0083	2,107.80	1,442	688	1,449,855	12,034
November	221.00	221	25	136	0	0.0083	2,107.80	1,442	467	983,395	8,162
December	47.00	186	25	118	0	0.0083	2,107.80	1,324	280	590,413	4,900

Tarceva 100 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	240.00	120	77	137	39	0.0083	2,211.61	1,062	982	2,172,768	18,034
February	180.00	132	52	118	0	0.0083	2,211.61	1,114	850	1,880,836	15,611
March	216.00	149	59	133	0	0.0083	2,211.61	1,183	702	1,551,748	12,880
April	110.00	141	36	106	0	0.0083	2,211.61	1,151	561	1,239,823	10,291
May	217.00	156	39	117	0	0.0083	2,211.61	1,212	404	894,298	7,423
June	122.00	149	45	119	0	0.0083	2,211.61	1,185	255	563,916	4,681
July	306.00	181	36	36	0	0.0083	2,211.61	1,303	74	164,259	1,363
August	111.00	167	48	132	39	0.0083	2,211.61	1,252	1,159	2,564,108	21,282
September	450.00	223	39	150	0	0.0083	2,211.61	1,449	936	2,070,005	17,181
October	177.00	214	37	144	0	0.0083	2,211.61	1,419	722	1,596,431	13,250
November	180.00	207	30	133	0	0.0083	2,211.61	1,396	515	1,137,954	9,445
December	0.00	166	72	155	0	0.0083	2,211.61	1,248	349	771,173	6,401

Sprycel 50 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	120.00	142	54	125	39	0.0083	2,007.32	1,157	1,030	2,068,369	17,167
February	180.00	150	15	90	0	0.0083	2,007.32	1,187	880	1,767,432	14,670
March	180.00	156	18	96	0	0.0083	2,007.32	1,211	725	1,454,418	12,072
April	180.00	161	17	98	0	0.0083	2,007.32	1,229	564	1,131,744	9,393
May	324.00	193	54	151	0	0.0083	2,007.32	1,348	370	743,530	6,171
June	180.00	191	22	117	0	0.0083	2,007.32	1,339	180	360,696	2,994
July	180.00	189	17	17	39	0.0083	2,007.32	1,331	1,322	2,654,355	22,031
August	250.00	201	68	168	0	0.0083	2,007.32	1,374	1,121	2,251,164	18,685
September	190.00	199	54	154	0	0.0083	2,007.32	1,366	923	1,852,333	15,374
October	60.00	171	67	152	0	0.0083	2,007.32	1,267	752	1,509,180	12,526
November	180.00	173	54	140	0	0.0083	2,007.32	1,274	579	1,162,395	9,648
December	0.00	138	66	135	0	0.0083	2,007.32	1,140	441	884,966	7,345

Taxol 300 mg 50 ml											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	10.00	6	4	7	39	0.0083	19,260.00	237	235	4,525,260	37,560
February	14.00	8	3	7	0	0.0083	19,260.00	267	227	4,378,884	36,345
March	8.00	8	3	7	0	0.0083	19,260.00	269	220	4,230,967	35,117
April	12.00	9	3	7	0	0.0083	19,260.00	283	211	4,066,410	33,751
May	24.00	12	5	11	0	0.0083	19,260.00	331	199	3,842,316	31,891
June	15.00	12	4	10	0	0.0083	19,260.00	340	187	3,605,261	29,924
July	24.00	15	3	3	0	0.0083	19,260.00	371	173	3,323,169	27,582
August	21.00	16	6	14	0	0.0083	19,260.00	387	157	3,016,603	25,038
September	17.00	16	5	13	0	0.0083	19,260.00	389	140	2,705,867	22,459
October	23.00	18	7	15	0	0.0083	19,260.00	406	123	2,368,681	19,660
November	28.00	20	5	15	0	0.0083	19,260.00	429	103	1,991,077	16,526
December	4.00	16	8	16	0	0.0083	19,260.00	394	87	1,673,586	13,891

Lipo-dox 2 mg/ml 10 ml											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	22.00	29	15	30	39	0.0083	13,618.18	524	500	6,804,204	56,475
February	23.00	28	4	18	0	0.0083	13,618.18	513	472	6,423,440	53,315
March	17.00	26	5	18	0	0.0083	13,618.18	492	446	6,072,527	50,402
April	25.00	26	4	17	0	0.0083	13,618.18	491	420	5,723,705	47,507
May	23.00	25	4	16	0	0.0083	13,618.18	486	395	5,382,004	44,671
June	41.00	28	5	19	0	0.0083	13,618.18	515	367	4,996,975	41,475
July	20.00	27	4	4	0	0.0083	13,618.18	500	340	4,634,478	38,466
August	24.00	26	5	18	0	0.0083	13,618.18	495	314	4,279,114	35,517
September	18.00	24	4	16	0	0.0083	13,618.18	480	290	3,945,797	32,750
October	24.00	24	7	19	0	0.0083	13,618.18	479	265	3,613,776	29,994
November	21.00	24	5	17	0	0.0083	13,618.18	472	242	3,290,963	27,315
December	9.00	21	7	18	0	0.0083	13,618.18	442	221	3,008,199	24,968

Faslodex inj.250 mg 5 ml											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	0.00	0	0	0	0	0.0083	15,247.50	0	0	0	0
February	17.00	3	5	7	39	0.0083	15,247.50	179	175	2,673,660	22,191
March	25.00	8	9	13	0	0.0083	15,247.50	269	168	2,555,949	21,214
April	32.00	13	12	18	0	0.0083	15,247.50	344	155	2,364,196	19,623
May	25.00	15	11	19	0	0.0083	15,247.50	376	140	2,134,557	17,717
June	14.00	15	15	22	0	0.0083	15,247.50	374	125	1,908,152	15,838
July	30.00	18	12	12	0	0.0083	15,247.50	410	107	1,635,543	13,575
August	12.00	17	14	22	0	0.0083	15,247.50	396	91	1,380,862	11,461
September	22.00	18	11	20	0	0.0083	15,247.50	409	73	1,110,029	9,213
October	12.00	17	11	19	0	0.0083	15,247.50	395	56	856,768	7,111
November	18.00	17	9	17	0	0.0083	15,247.50	398	39	599,268	4,974
December	10.00	16	8	16	0	0.0083	15,247.50	382	24	362,773	3,011

Temodal 100 mg											
Date	X	Forecast	SS	ROP	P	I	C	EOQ	Avg.Inv	Sub.total	hld/mth
January	38.00	44	34	56	39	0.0083	6,213.28	640	624	3,877,120	32,180
February	89.00	53	15	41	0	0.0083	6,213.28	704	571	3,549,805	29,463
March	30.00	48	17	41	0	0.0083	6,213.28	673	523	3,250,673	26,981
April	65.00	52	17	43	0	0.0083	6,213.28	696	472	2,930,594	24,324
May	60.00	53	10	36	0	0.0083	6,213.28	707	418	2,599,972	21,580
June	37.00	50	22	47	0	0.0083	6,213.28	685	368	2,289,496	19,003
July	67.00	53	17	17	0	0.0083	6,213.28	708	315	1,957,858	16,250
August	40.00	51	12	37	0	0.0083	6,213.28	690	264	1,642,840	13,636
September	10.00	43	10	31	0	0.0083	6,213.28	632	222	1,378,400	11,441
October	25.00	39	10	30	0	0.0083	6,213.28	606	183	1,135,781	9,427
November	42.00	40	8	28	0	0.0083	6,213.28	610	143	889,495	7,383
December	3.00	32	10	26	0	0.0083	6,213.28	551	111	688,738	5,717

BIOGRAPHY

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