

Study on Inventory Control Using ABC Analysis,
Forecasting and Economic Order Quantity at CIMS Hospital,
Ahmedabad

By

Palak Patel

*Dissertation submitted in partial fulfillment of the requirements of the degree
MBA Hospital and Health Management*

Academic year, 2017-2019



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TO WHOMSOEVER MAY CONCERN

This is to certify that Palak Patel, student of MBA Hospital and Health Management from The IIHMR University, Jaipur has undergone internship training at CIMS Hospital, Ahmedabad from 4th Feb 2019 to 3rd May 2019.

The Candidate has successfully carried out the study assigned to him during internship training and his approach to the study has been sincere, scientific and analytical.

The Internship is in fulfillment of the course requirements.

I wish him all success in all his future endeavors.

A handwritten signature in blue ink, likely belonging to the Dean, Academics and Student Affairs.

Dean, Academics and Student Affairs
The IIHMR University, Jaipur

15 May 19

A handwritten signature in blue ink, likely belonging to Mr. Mohan Bairwa, with the date '15-5-19' written next to it.

Mr. Mohan Bairwa
Asst. Professor
The IIHMR University, Jaipur

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled A study on inventory control using ABC analysis, Forecasting and Economic order quantity at CIMS hospital, Ahmedabad and submitted by (Name) Palak Patel Enrollment No 0619 under the supervision of Mr. Mohan Bairwa for award of MBA in Hospital and Health of the University carried out during the period from 4th Feb 2019 to 3rd May 2019 embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other institute or other similar institution of higher learning.


Signature

Ref: CIMS/TIC/19-20/04

3rd May, 2019

Certificate of Internship

To Whomsoever It May Concern

This is to certify that Ms. Palak Patel has successfully completed her Dissertation Training in Purchase and Supply Chain Department from 4th February 2019 to 3rd May 2019 at CIMS Hospital, Ahmedabad.

We wish her good luck for her better future.

For,

CIMS Hospital Pvt. Ltd.



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CIMS Hospital Pvt. Ltd.

Abstract

Title

A study on inventory control using ABC analysis, Forecasting and Economic order quantity at CIMS hospital, Ahmedabad

Author

Dr. Palak Patel

Background

At present, all the hospital maintains their own inventory management techniques, but they are still facing problem in achieving effective management. To attain the efficiency, the flow of medical items needs to be managed in all aspects to overcome overstocking, expiry, stock out, etc. Supply chain for hospital is the areas in which alternatives and compromise are not acceptable and organizations are pressurizing to give quality of care. The issue related stock out leads to profit loss as well as sales loss. Hospitals are searching for alternative ways to stay competitive by reducing cost to the organization. Economic order quantity is the methods to efficiently run the inventory. An EOQ could assist in deciding what would be the best optimal order quantity at lowest price. Essentially, the main purpose of the study is to suggest an effective forecasting model, which helps to reduce inventory stocks using Economic order quantity and ABC analysis. All the in- patient pharmacy's medical and surgical items will be analyzed from last two years also a cost estimation would be done to see the difference between the recommended method and Current forecasting method

Objective

To suggest an effective forecasting model, which helps to reduce inventory stock using Economic order quantity and ABC analysis.

Research Question

What are the alternative ways to reduce hospital's stock outs and loss of sales?

Methodology

Study Setting: This study took place at CIMS hospital, Ahmedabad from 15th February 2019 to 25th April 2019.

Sample size calculation: Monthly indent Items in patient pharmacy = 3194

Item category: A = $257/3194 = 8.04\%$

B = $565/3194 = 17.16\%$

C = $2372/3194 = 74.26\%$

Samples for analysis: Category A (257 items)

Items with regular demand = 12

Items with uncertain demand = 12

Sampling methods: Purposive sampling

Study type: Observational study

Research instruments: Data was collected directly from Management Information

System of CIMS hospital and Format to calculate forecasting
using excel (available in annexure)

Statistical methods employed: Least square regression

Seasonal index

Inclusion Criteria: Inpatients medical and surgical items

Exclusion Criteria: Outpatient Medical items

Discussion

After analysing the results, the current forecasting model showed that the hospital inventory holding cost was high due to excess storage of medical and surgical items as compared to proposed models. and the proposed forecasting and economic order quantity model shows reduction in overall total cost. For instance, the cost estimate table shows the total savings with each item. If the company proceeds in implementing the

recommended forecasting model along with the economic order quantity, it would help them save approximately Rs. 6,73,294 each quarter.

The recommended forecasting method aids the company in more accurate forecasting to their demand according to seasonal variations. The economic order quantity allows the company to reduce the inventory holding cost and optimise the order along with the forecasting model. As a result, the recommended method would ensure enough products are in stock, that would satisfy patient demand and reduce the cost.

Conclusion

The current model for forecasting used by CIMS hospital has some problems due to unproductive forecasting that leads to loss of sales and stock outs. In order to deal with this problem, also reduce stock outs, I have recommended an effective forecasting model of seasonal index along with Economic order quantity. The new proposed model of forecasting allows a more accurate results for different items according to seasonal variations. The economic order quantity helps us to decide optimum quantity for each product during the placement of order. The newly recommended method for forecasting and Economic order quantity will help to reduce hospital stock outs.

By suggesting an effective forecasting method of seasonal index providing, the results have shown improvements in forecasting as well as in cost reduction. The seasonal index forecasting method helps to reduce inventory holding cost around Rs. 60,555. So, if the CIMS hospital implements the recommended forecasting along with Economic order quantity model, it would reduce the total cost by approximately Rs. 6,73,294 each quarter, which is a big amount of cost reduction with effective model.

The problem CIMS hospital faces would be reduced by implementing the proposed forecasting and Economic order quantity model. This method of forecasting will ensure the optimum items quantity in stock, which would increase profit and reduce inventory holding cost by forecasting according to seasonal variations.

Acknowledgement

I am using this opportunity to express my gratitude to everyone who supported me during dissertation training. I am thankful for their aspiring guidance and advice during dissertation project work. I am sincerely grateful to them for sharing their truthful and illuminating views on number of issues related to the project

I express my warm thanks to **Mr. Anjal Patel** for their support and guidance at CIMS hospital.

I also gratefully thank to whole Management Department of the CIMS Hospital. I express my thankfulness to all staff of various DEPARTMENTS who participate in this study & gave their valuable time & support to make this project effective.

I would like to express a word of thanks to my mentor **Dr. Mohan Bairwa** for his guidance.

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List of Abbreviations

- EOQ: Economic Order Quantity
- CIMS: Care Institute of Medical Science
- JCI: Joint Commission International
- NABH: National Accreditation Board for Hospital and Healthcare Providers
- NABL: National Accreditation Board for Testing and Calibration Laboratory
- ACC: American Collage of Cardiology
- OT: Operation Theater
- ECMO: Extracorporeal Membrane Oxygenation
- ICU: Intensive Care Unit
- MRI: Magnetic Resonance Imaging
- CT: Computed Tomography
- OPD: Out Patient Department
- TMT: Tread Meal Test
- ECG: Electro Cardio Gram
- PFT: Pulmonary Function Test
- NICU: Neonatal Intensive Care Unit
- IVF: In Vitro Fertilization
- CSSD: Central Sterile Supply Department
- CCU: Critical care Unit
- CTOT: Clinical Trials in Organ Transplant

CHAPTER: 1 INTRODUCTION OF PROJECT

A study on inventory control using ABC analysis, Forecasting and Economic order quantity at CIMS hospital, Ahmedabad

Introduction

At present, all the hospital maintains their own inventory management techniques, but they are still facing problem in achieving effective management. To attain the efficiency, the flow of medical items needs to be managed in all aspects to overcome overstocking, expiry, stock out, etc. Supply chain for hospital is the areas in which alternatives and compromise are not acceptable and organizations are pressurizing to give quality of care. The issue related stock out leads to profit loss as well as sales loss. Hospitals are searching for alternative ways to stay competitive by reducing cost to the organization. Economic order quantity is the methods to efficiently run the inventory. An EOQ could assist in deciding what would be the best optimal order quantity at lowest price. Essentially, the main purpose of the study is to suggest an effective forecasting model, which helps to reduce inventory stocks using Economic order quantity and ABC analysis. All the in-patient pharmacy's medical and surgical items will be analyzed from last two years also a cost estimation would be done to see the difference between the recommended method and Current forecasting method

CHAPTER: 2 LITERATURE REVIEW

Literature review

Author	Type of study	Sample	Objective	Key findings
<u>M Devnani</u> , <u>AK Gupta</u> , and <u>R Nigah</u>	Observational study	The drug formulary of the hospital consisted of 421 items	- To analyze the annual consumption of items of pharmacy and expenditure incurred on them for the year 2007-08. - To evolve a priority system based on	On ABC analysis, 13.78% (58), 21.85% (92) and 64.37% (271) items were found to be A, B and C category items, respectively, amounting for 69.97% (Rs. 27,996,865), 19.95% (Rs. 7,981,331) and

			ABC and VED and ABC-VED matrix analysis. To identify the item categories requiring greater supervisory monitoring.	10.08% (Rs. 4,034,416) of ADE of the pharmacy
Sukhbir Singh, Anil Kumar Gupta, Latika , Mahesh Devnani	Observational study	The drug formulary of the Institute was consisted of 416 drugs	To conduct ABC, VED and ABC-VED matrix analysis of the	The total annual drug expenditure (ADE) of hospital pharmacy store in the year 2008-09 &

			pharmacy store of the tertiary care, teaching, research and referral institute of the Northern India to identify the categories of drugs needing strict management control.	2009-10 was Rs 6.04 crores and Rs 4.84 crores respectively. Therefore, it becomes important to apply scientific inventory management tools for optimum management of the drug stores, to set priorities in an optimum way, timely decision making in purchase of specific drugs and close
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				supervision on drug items belonging to important categories
Dr. Babu Krishnaraj, Meenakshi P K	Observational study	The drug store inventory of the hospital consists of total 132 items	To ensure that there is a need of adequate stock of required items.	The total monthly drug expenditure (MDE) of the pharmacy on items issued in 2016 was Rs.2,26,510. On ABC analysis, it was found that 40 (30.3%), 33 (25%) and 59 (44.7%) items belonged to A, B

				and C category respectively, accounting for Rs.1,59,548 (70.44%), Rs.46,438 (20.50%) and Rs.20,524 (9.06%) of MDE.
PITTAYACHAIC HOOPARA, ITTRARUKIJKA NPANICH	Analytical study	862 inventory items	To improve inventory management for medical supplies in the surgery department at a hospital	The result of improvement show that the variation, turnover rate and unnecessary cost were improved 21.97%, 5.00%, and 50.34% respectively

			.	y. Further study can be done by simulating inventory with forecast demand to find an appropriate inventory model.
Ngai-Hang Z. Leung, Ana Chen, Prashant Yadav, and Jérémie Gallien	Analytical study	Daily clinic storeroom stock levels of artemether-lumefantrine (AL) products in 2009–2010 were captured in 145 facilities through photography and manual transcription	• To characterize the impact of widespread inventory management policies on stock-outs of	• While almost no stock-outs of AL products were observed during Q4 2009 consistent with primary analysis, up to 30% of surveyed

		of paper forms, then used to determine historical stock-out levels and estimate demand patterns.	essential drugs in Zambia's health clinics and develop related recommendations.	facilities stocked out of some AL product during Q1 2010 despite ample inventory being simultaneously available at the national warehouse . Simulation experiments closely reproduced these results and linked them to the use of average past monthly issues and failure to capture
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				lead-time variability in current inventory control policies.
Yunila Dwi Putri Ariyanti, Mustafid, Oky Dwi Nurhayati	Observational study	The demand for food portion is divided into three serving times: morning, afternoon, and evening. Data was obtained from 212 days.	To build the system of forecasting and controlling the food supplies to determine the number of servings of food supplies in the next period	Forecasting values using alpha parameters 0.3 and 0.7 with a minimum forecasting error calculation using MAPE for alpha 0.7 with a value 12.81% for morning time, 11.59% during the day, and 10.96%

				night time. Forecasting result not only can be used to allocate food supplies but also to control stock of raw material food.
Carlos Miguel Ferreira Alves	Exploratory study	-	• To attempt to identify which forecasting algorithms will provide the best results when applied in a hospital context	• In an inventory management context, using RMSE instead of MAAPE could be more useful because larger errors are undesirable. When MAAPE

			.	metric is analyzed, machine learning algorithms only have better results for smooth and erratic categories. By interpreting the aggregated results, we clearly realize that the categorization was useful to conclude that some categories are easier to forecast than others due to their characteristics. • Another important
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				aspect for the algorithm decision is the computational complexity. Machine learning algorithms have larger execution times than statistical methods, which can be a negative factor when choosing an approach, even if this implies a reduction in accuracy.
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Sushanta Sengupta1, Ruma Dutta	Quantitative method.	-	To analyse demand forecast accuracy using Linear Regression function	It was also implemented that a good forecast does not only depend on the forecasting technique used but also on correct identification of demand function. The paper also provided a simple approach to identify the correct demand function without having a complex calculations or evaluation
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				technique.
Mahatme MS, Dakhale GN, Hiware SK, Shinde AT, Salve AM	Observational study	The drug formulary consisted of 210 items, out of which 165 were available	To consider always better control-vital, essential and desirable (ABC-VED) analysis with economic order quantity (EOQ), comparison of indexed cost	Due to inflation, total expenditure for the drugs is increased each year which supports the higher budgetary requirement for the forthcoming years. At the same time, forecasting of budget helps for better management

			and the actual cost, and to assess the expenditure for the forthcoming years.	nt of medical store. Hence, ABC- VED along with EOQ and integrated economic analysis optimizes the costs of medicare services besides making materials available to the patients which can increase the quality of healthcare services.
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P. O.Agada* and E. H. Ogwuche	Quantitative study	786 medical consumables	To implement a probability EOQ model for inventory management of drugs and medical consumables.	The EOQs and Reorder levels are 11 & 864, 24 and 810 and 34 & 786 units for the ordering costs of 2.5, 12.5 and 25 percent of drug actual costs per unit. It is hoped that this distribution will assist the hospital management in taking guided decision on the quantity of drug or hospital
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				consumable that should be ordered, given the associated ordering cost.
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CHAPTER: 3 OBJECTIVES, RESEARCHQUESTION AND RATIONAL

Objective

To suggest an effective forecasting model, which helps to reduce inventory stocks using Economic order quantity and ABC analysis.

Research questions

What are the alternative ways to reduce hospital's stock outs and loss of sales?

Rational

The current model for forecasting at CIMS hospital has problem, that leads to product stock outs due to ineffective forecasting. Because of that reason there were increasing in inventory holding cost. The simple average method is currently used by CIMS hospital, which takes last three months' average and decide the demand for next month. With simple average method trend is not taken into consideration. I have suggested the seasonal index method for the accurate forecasting and prevent stock outs.

CHAPTER: 4 METHODOLOGY

5.1 Study Setting

This study took place at CIMS hospital, Ahmedabad from 15th February 2019 to 25th April 2019. A 350 bedded, multi super specialty – CIMS (Care Institute of Medical Science) hospital is one of the best hospital of Ahmedabad (Gujarat) providing a range of diagnostic and treatment services. Delivering the highest standards of global healthcare, CIMS hospital is accredited by JCI (USA), NABH, NABL, ACC (USA), Green OT for providing quality healthcare and patient safety across India. CIMS hospital offers a combination of the most experienced doctors, latest technology and excellent infrastructure ensuring world class patient care and treatment. Gujarat's first digitized operation theaters and ICUs, First ECMO facility. Latest Cancer Radiation machines and Radiology – MRI and CT scan. Certified GREEN Operation Theaters: certifying for safe practices and environment friendly features such as low emission of carbon dioxide, infra-red rays and radiation within permissible limits. One of the most advanced ultra-modular and fully monitored emergency and trauma facility, Cardiac Transplant and Kidney Transplant.

5.2 Sample size calculation: Monthly indent Items in patient pharmacy = 3194

Item category: A = $257/3194 = 8.04\%$

B = $565/3194 = 17.16\%$

C = $2372/3194 = 74.26\%$

Samples for analysis: Category A (257 items)

Items with regular demand = 12

Items with uncertain demand = 12

5.3 Sampling methods: Purposive sampling

5.4. Study type: Observational study

5.5. Research instruments: Data was collected directly from Management Information System of CIMS hospital and Format to calculate forecasting using excel (available in annexure)

5.6 Statistical methods employed: Least square regression
Seasonal index

5.7 Inclusion Criteria: Inpatients medical and surgical items

5.8 Exclusion Criteria: Outpatient Medical items

5.9 Research procedures

The data of medical-surgical consumables, holding cost, ordering cost and per unit cost was provided by the hospital. The first step was to identify monthly indent items from inpatient pharmacy. To find which items need more attention compared to others, categories them into ABC category. Sort out the 3194 items in A, B and C category, then insert their historical demand (last 2 years' consumption) into an excel sheet to see the trend of particular item. Find out their future demand using seasonal index and least square regression method with formula. Then randomly select 12 items with regular demand and 12 items with uncertain demand.

Forecasting method

Simple average

This forecasting method was used in CIMS hospital. In this method they decide the demand quantity using last three months' consumption average of each item. They order the same quantity for the next month.

Seasonal Index

This method is used to find the accurate demand when there is a seasonal fluctuation with

the consumption patterns.

To calculate seasonal index....

We take the yearly average or quarterly sales.

Divide each quarterly sales figure by its yearly average.

Take the average of these index of each quarter to get seasonal index values.

Least square regression

$$Y = a + b x$$

Y – Dependent variable

a – y- intercept (value of Y when X=0)

b – Slope

X – independent variable

$$b = \frac{\sum xy - n \cdot \bar{x} \cdot \bar{y}}{\sum x^2 - n \cdot \bar{x}^2}$$

$$a = \bar{y} - b \cdot \bar{x}$$

In the seasonal index method demand is not constant, because of that this method is used to make seasonal adjustment from the previous year's consumption pattern. This indicates that to get accurate results some seasonal adjustment needed to be done. Each item went through some seasonal adjustment for accurate forecasting. Then a linear regression line was fitted to the demand after the data was plotted. Y-trend equation is used to calculate the forecast for 9th quarter. Quarter 9 then multiplied by the average seasonal index of 1st quarter. If we want to calculate the demand for quarter 3 then average seasonal index of quarter 3 will be used.

Economic Order Quantity

An EOQ is used to minimize stock outs and find the optimal order quantity while minimize total cost associated with each product. The holding cost and order cost are equal when the optimal order quantity is obtained. As mention in the literature review, all the variables needed in order to calculate the optimal order quantity.

Formula EOQ:

$$Q = \sqrt{\frac{2DS}{H}}$$

D= Demand

S= Ordering Cost

H= Holding Cost

For the current method, last three month's average (demand) was taken as an order quantity only. In proposed method Economic order quantity was calculated using above mentioned formula, and the recommended amount should be ordering each time to reduces the cost. Result shows that order quantity calculated by the current method is greater compared to recommended method.

Cost Estimates

Once the total cost was produced for all 24 items, the company's current method and the recommended EOQ, the cost estimates was calculated. There were two parts in the total quarter cost that was looked at closely in the calculations which were the holding cost and order cost. The current and the recommended methods show that both holding cost and order cost are associated to the 24 items.

CHAPTER: 5 RESULTS

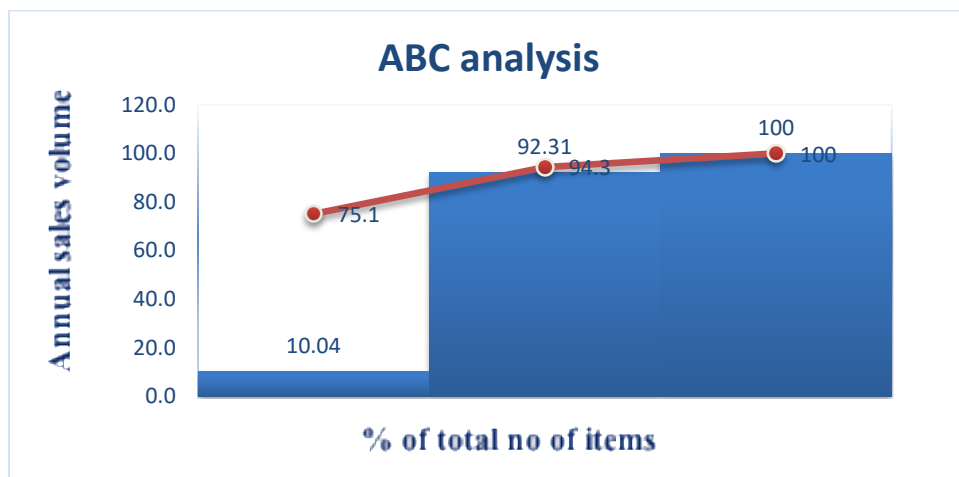


Figure: 1 ABC analysis of Inpatient and surgical items

Table 1 Seasonal index and forecasting Meronem

MERONEM 1GM INJ					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	183	187	220	0.81
	2	257	231	301	1.07
	3	197	385	355	1.22
	4	187	229	269	0.90

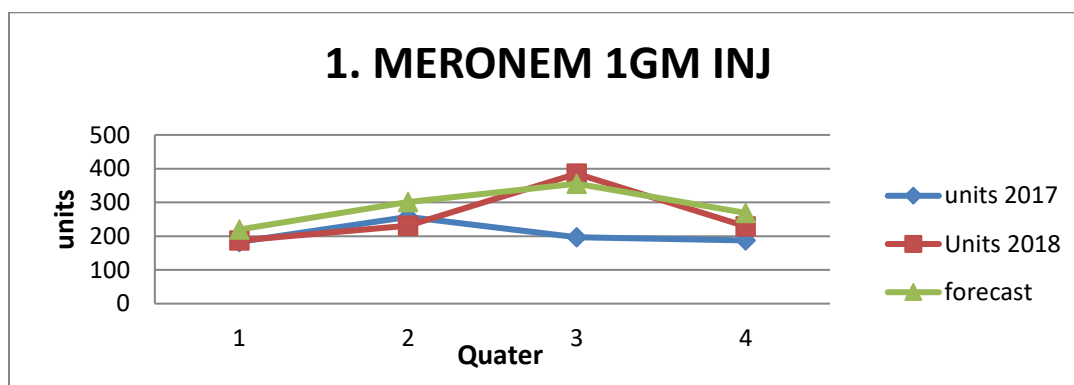


Figure 2 Seasonal index graph Meronem inj

Table 2 Seasonal index and forecasting Hospisept plus

HOSPISEPT PLUS 500ML					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	1075	1260	1248	0.84
	2	1477	1390	1561	1.04
	3	1068	1633	1480	0.97
	4	1749	1451	1796	1.16

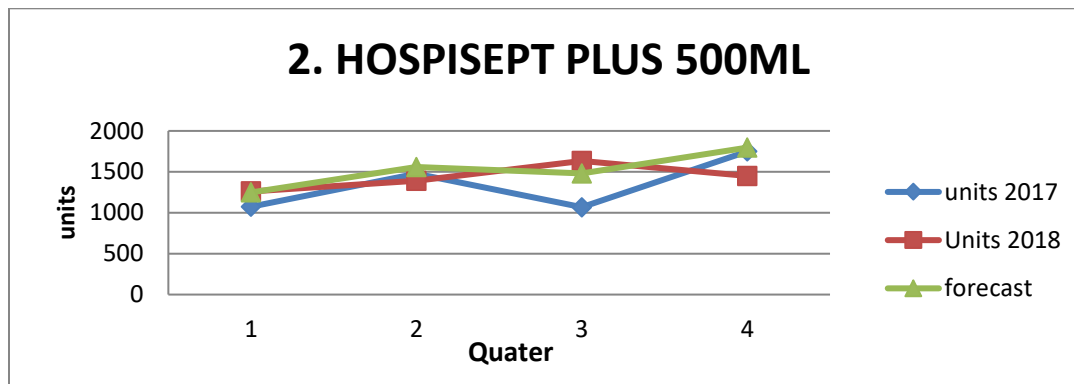


Figure 3 Seasonal index graph Hospisept plus

EXAMINATION GLOVES-M (LATEX)					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	30983	97475	133095	0.80
	2	30492	127064	167186	0.90
	3	35584	157676	221673	1.09
	4	47692	148881	271542	1.22

Table 3 Seasonal index and forecasting Examination gloves

3. EXAMINATION GLOVES-M (LATEX)

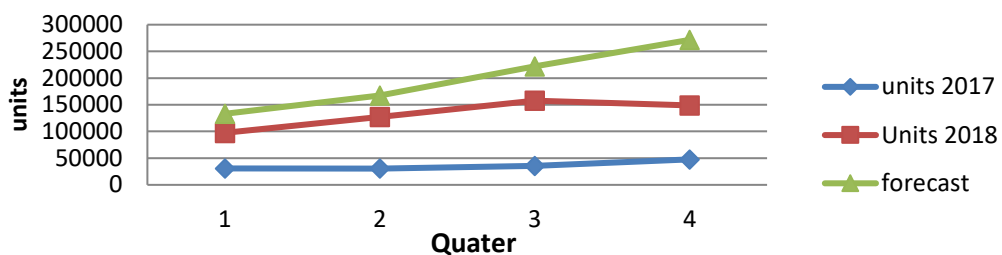


Figure 4 Seasonal index graph examination gloves

Table 4 Seasonal index and forecasting Dialyzer

DIALYZER F6 (ELISIO) 15M					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	243	341	388	0.88
	2	286	419	492	1.06
	3	294	431	532	1.09
	4	259	392	499	0.97

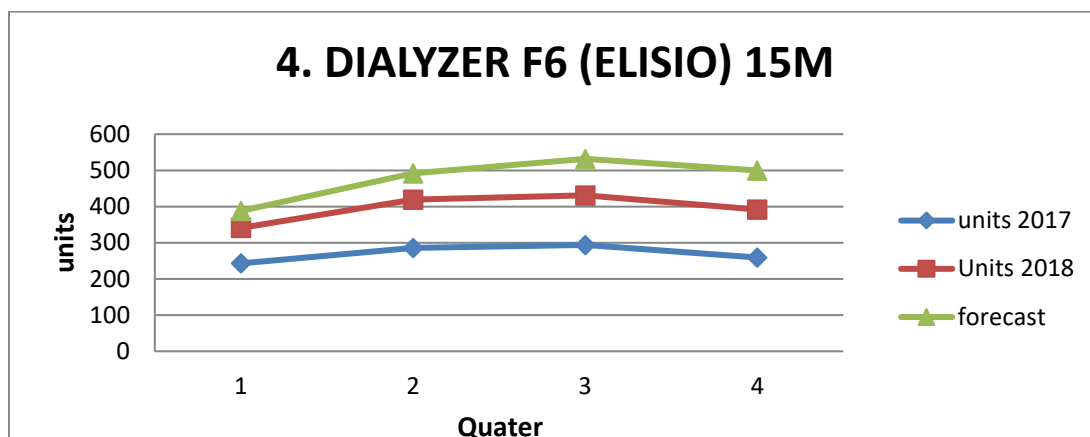


Figure 5 seasonal index graph Dialyzer

Table 5 Seasonal index and forecasting Nicostar inj

NICOSTAR-IV 48MG INJ					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	0.3	21.2	756	0.52
	2	0.3	807	1811	1.14
	3	0.3	912	2100	1.22
	4	0.3	789	2077	1.12

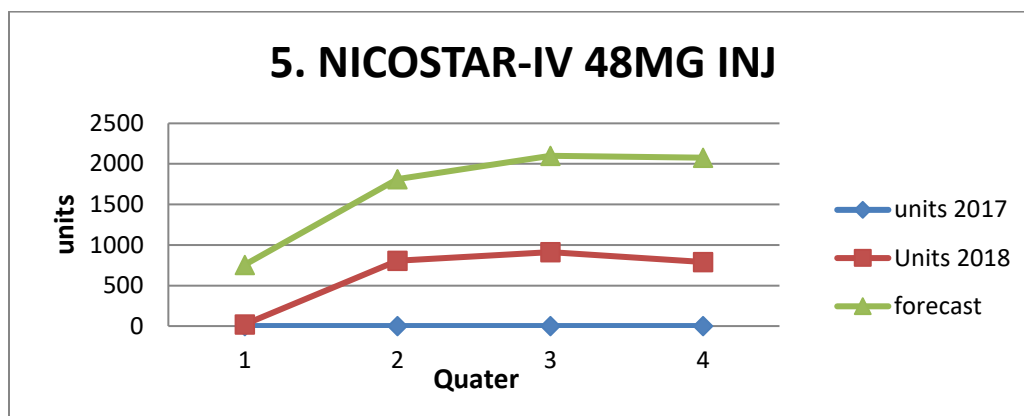


Figure 6 Seasonal index graph Nicostar inj

Table 6 Seasonal index and forecasting Levoflox infusion

LEVOFLOX INFUSION					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	161	129	168	0.80
	2	241	147	229	1.06
	3	184	247	271	1.22
	4	194	141	211	0.92

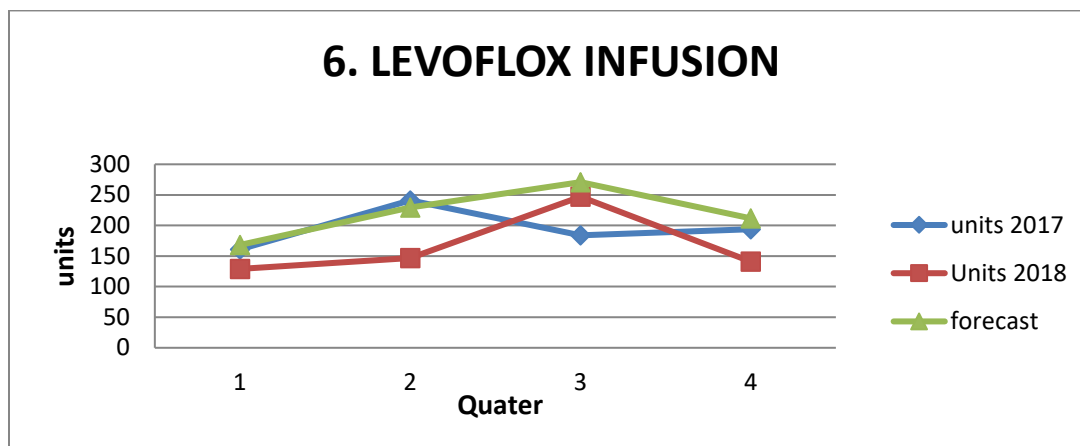


Figure 7 Seasonal index graph Levoflox infusion

Table 7 Seasonal index and forecasting Marlinton

MILRINEON 10MG/10ML INJ					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	173	196	198	0.92
	2	246	241	266	1.21
	3	149	227	206	0.93
	4	205	171	212	0.94

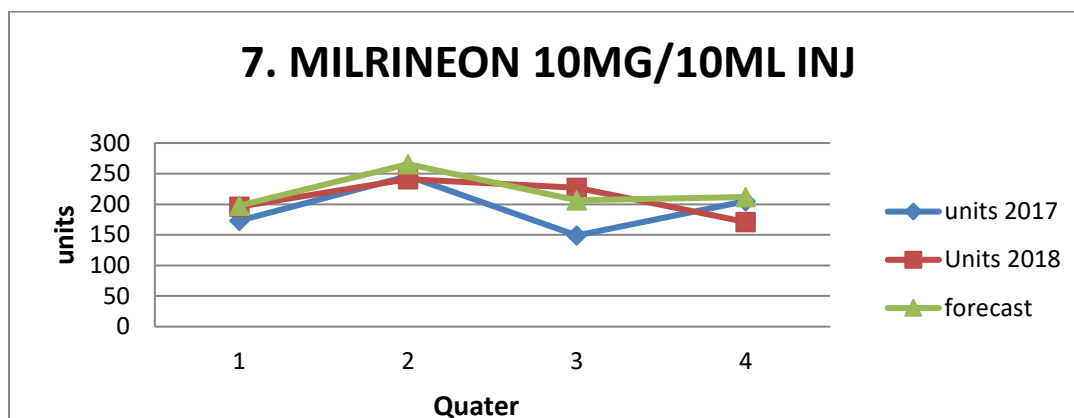


Figure 8 Seasonal index graph Milrineon inj

Table 8 Seasonal index and forecasting Dalacin

DALACIN-C 600MG INJ					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	181	176	204	0.92
	2	231	185	245	1.08
	3	255	249	304	1.31
	4	76	195	165	0.69

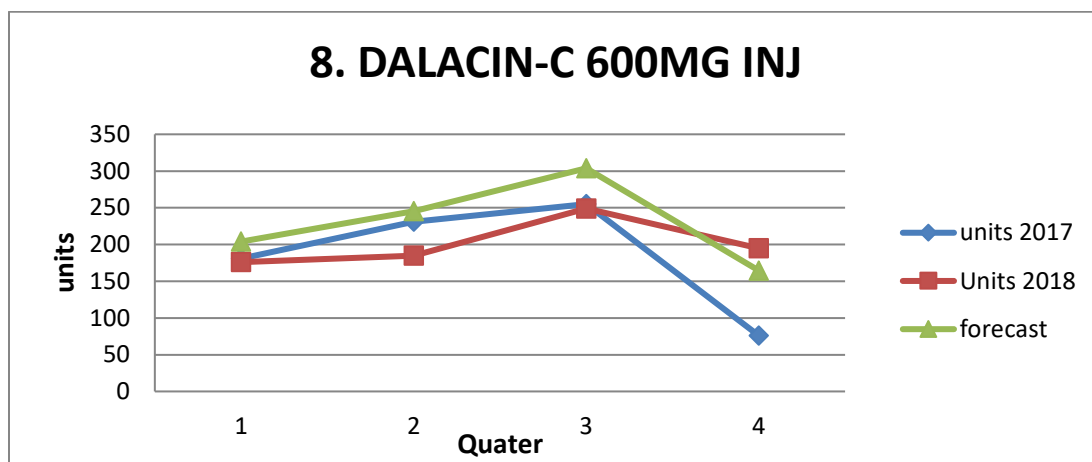


Figure 9 Seasonal index graph Dalacin inj

Table 9 Seasonal index and forecasting Emeset

EMESET 4 ML INJ					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	3160	3128	3334	0.95
	2	3582	3408	3755	1.05
	3	3147	4191	3966	1.10
	4	2933	3068	3297	0.90

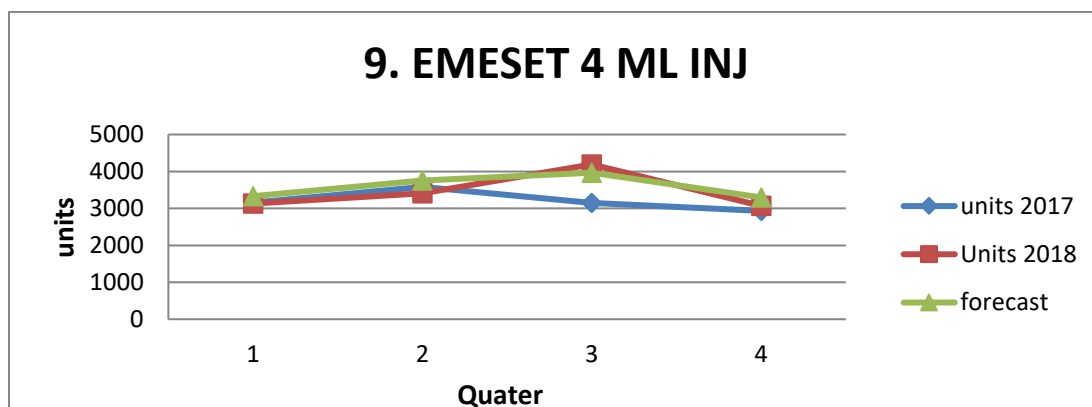


Figure10 Seasonal index graph Emset inj

Table 10 Seasonal index and forecasting Cort-s inj

Cort-S 100 mg Inj					
year	qtr.'s	units 2017	Units 2018	forecast	seasonal index
2017	1	365	360	375	0.91
	2	462	337	415	1.00
	3	454	403	449	1.08
	4	337	454	419	1.00

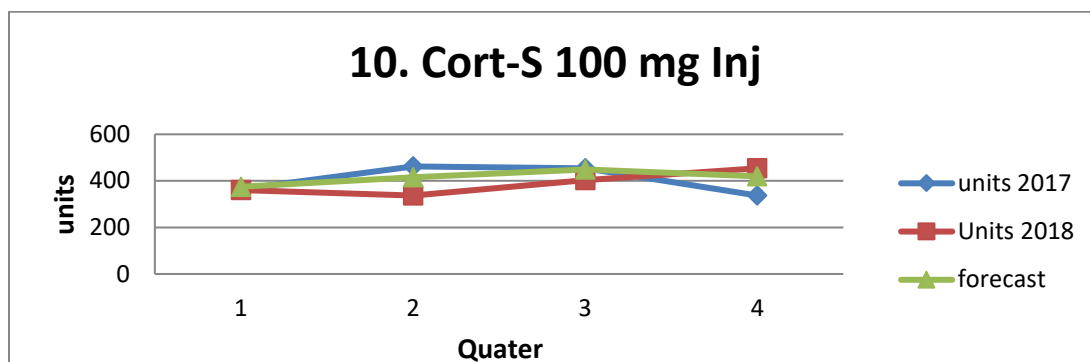


Figure 11 Seasonal index graph Cort-s inj

Table 11 Seasonal index and forecasting Vitcofol-c inj

VITCOFOL-C 1.5ML INJ					
year	qtr.'s	units 2017	Units 2018	forecast	seasonal index
2017	1	608	737	705	0.95
	2	901	646	812	1.08
	3	681	717	746	0.98
	4	745	657	753	0.98

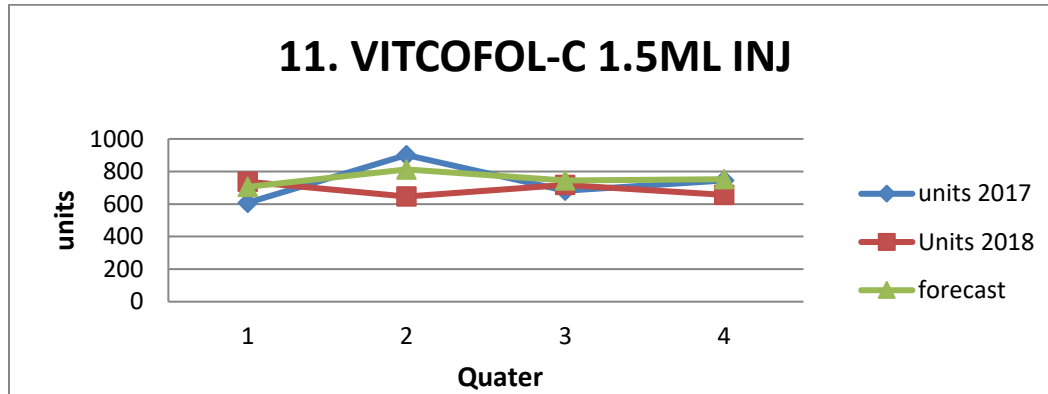


Figure 12 Seasonal index graph Vitcofol inj

Table 12 Seasonal index and forecasting M.V.I inj

M.V.I. 10ML INJ.					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	401	348	379	0.96
	2	494	416	462	1.16
	3	349	457	411	1.03
	4	335	330	340	0.85

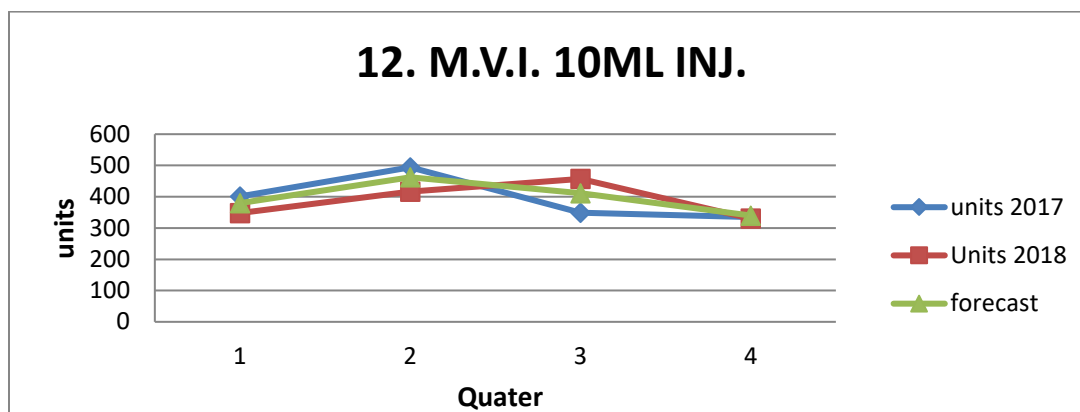


Figure 13 Seasonal index graph M.V.I inj

Table 13 Seasonal index and forecasting Xylistin forte plus IV

XYLISTIN FORTE PLUS 3MIU-IV					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	0.3	8	9	0.26
	2	34.1	8	26	0.70
	3	39	42.1	72	1.85
	4	79.1	5	49	1.20

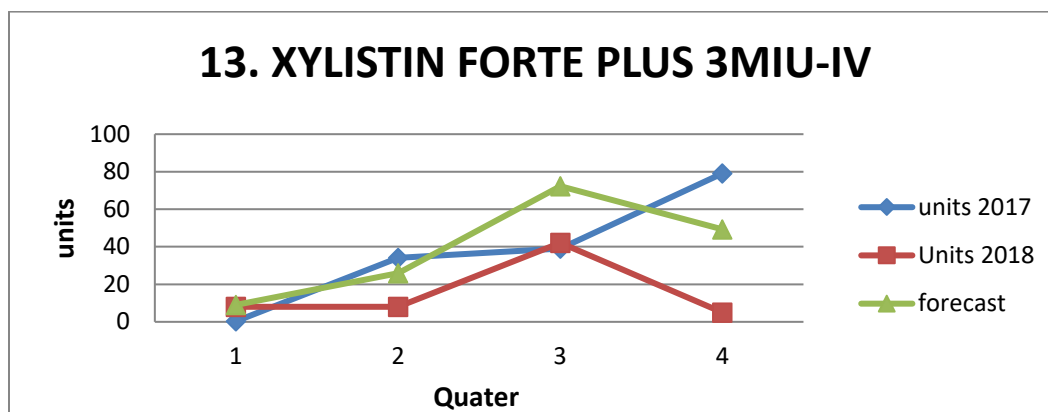


Figure 14 Seasonal index graph Xylistin forte plus-IV

Table 14 Seasonal index and forecasting Ambisome inj

AMBISOME 50MG INJ					
year	qtr.'s	units 2017	Units 2018	forecast	seasonal index
2017	1	12	60	121	1.04
	2	0	47	61	0.48
	3	42	25	248	1.78
	4	0	69	105	0.70

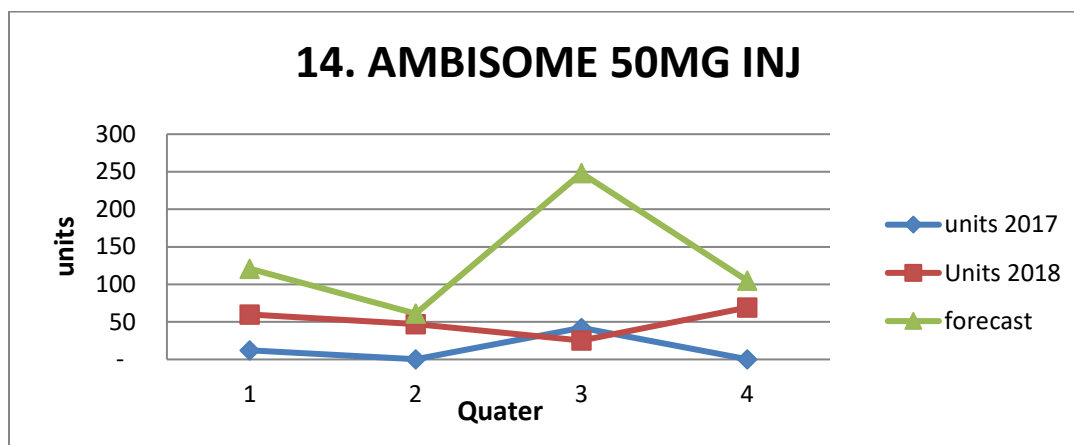


Figure 15 Seasonal index graph Ambisome inj

Table 15 Seasonal index and forecasting Fosfotas inj

FOSFOTAS 4G INJ					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	7	93	57	0.60
	2	89	33.1	79	0.80
	3	106	96	132	1.29
	4	93.1	112.2	138	1.30

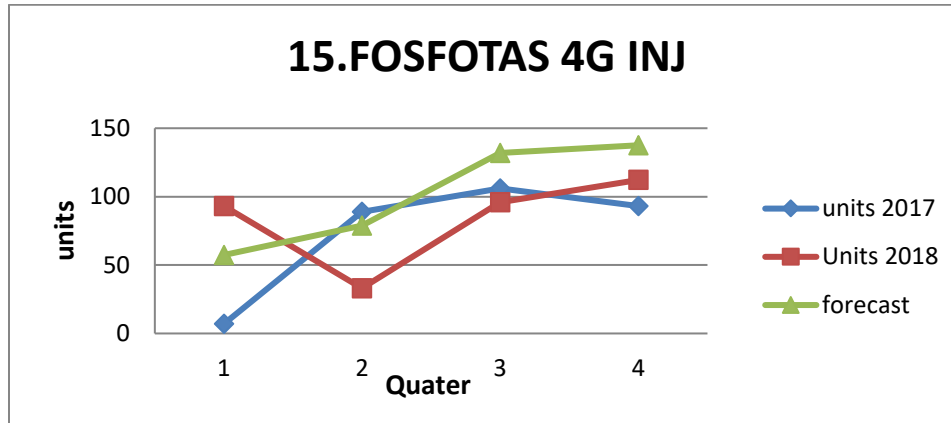


Figure 16 Seasonal index graph Fosfotas inj

Table 16 Seasonal index and forecasting Xylistin IV

XYLISTIN 1MIU IV					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	376	110	312	0.69
	2	319	167	338	0.71
	3	356	486	648	1.29
	4	428	437	689	1.31

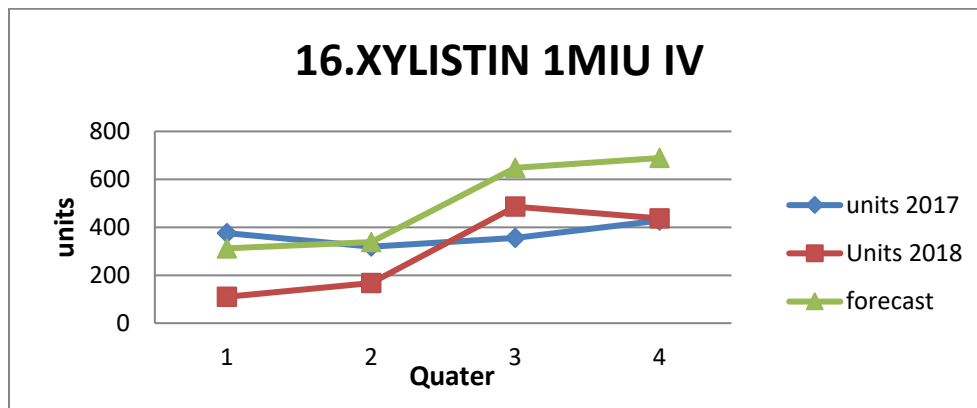


Figure 17 Seasonal index graph Xylistin IV

Table 17 Seasonal index and forecasting Amiodon inj

AMIODON 3ML INJ					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	1036	1164	2504	1.41
	2	328	999	1365	0.69
	3	129	1324	1378	0.64
	4	695	1585	2948	1.26

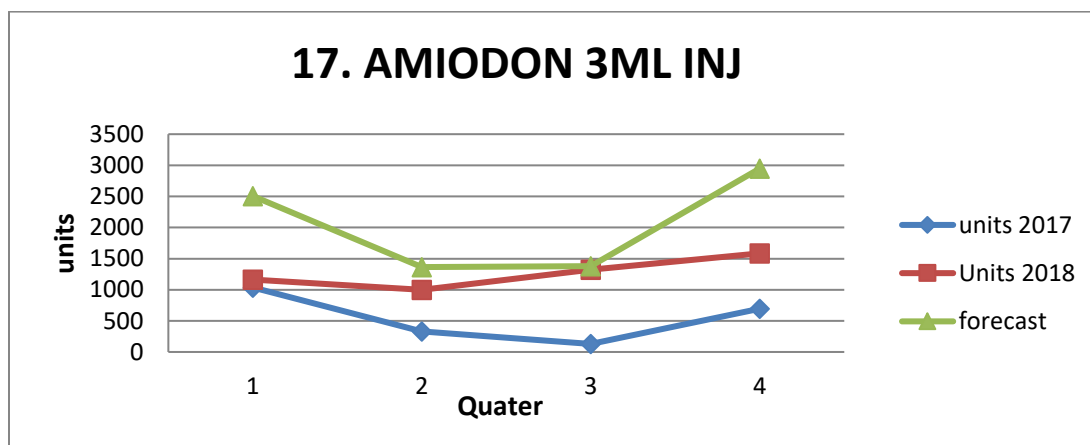


Figure 18 Seasonal index graph Amiodon inj

Table 18 Seasonal index and forecasting Dorilem inj

DORIKEM KIT 500MG INJ					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	33.1	6.2	28	0.91
	2	21.1	32.1	49	1.45
	3	31.2	0.3	25	0.68
	4	7.1	26.1	37	0.96

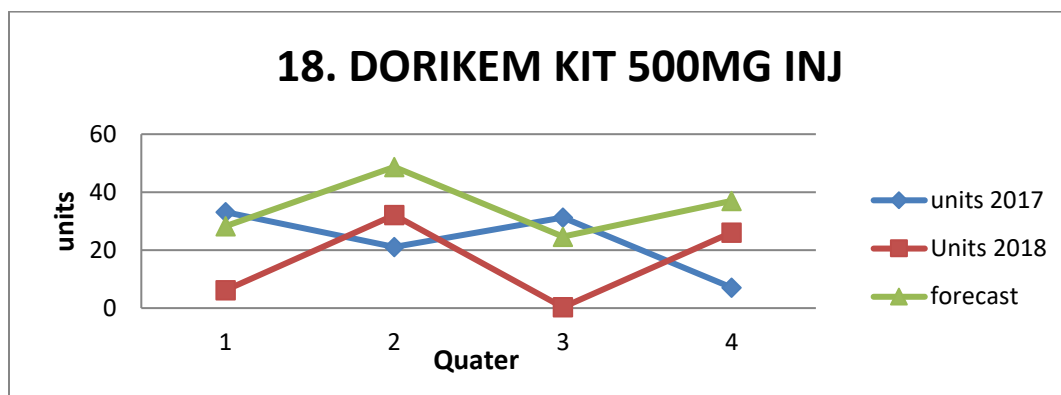


Figure 19 Seasonal index graph Dorikem inj

Table 19 Seasonal index and forecasting Antiflu caps

ANTIFLU 75MG CAPS					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	540	0.3	712	0.52
	2	630	400.2	1152	0.77
	3	10.2	2220	1499	0.93
	4	900.2	2220	3102	1.78

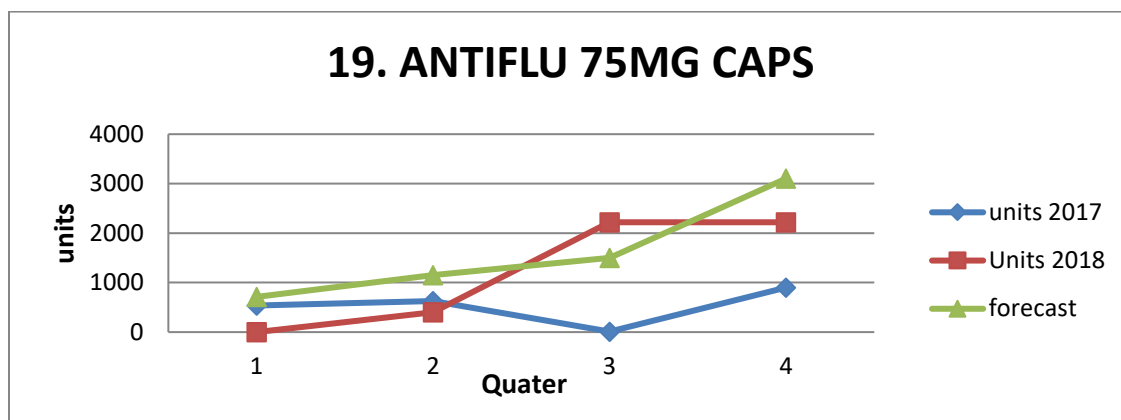


Figure 20 Seasonal index graph Antiflu caps

Table 20 Seasonal index and forecasting Axcer tab

AXCER 90MG TAB					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	1582	1124	1989	1.20
	2	1098	56.1	861	0.48
	3	844	533.2	1150	0.61
	4	1288	2469	3457	1.72

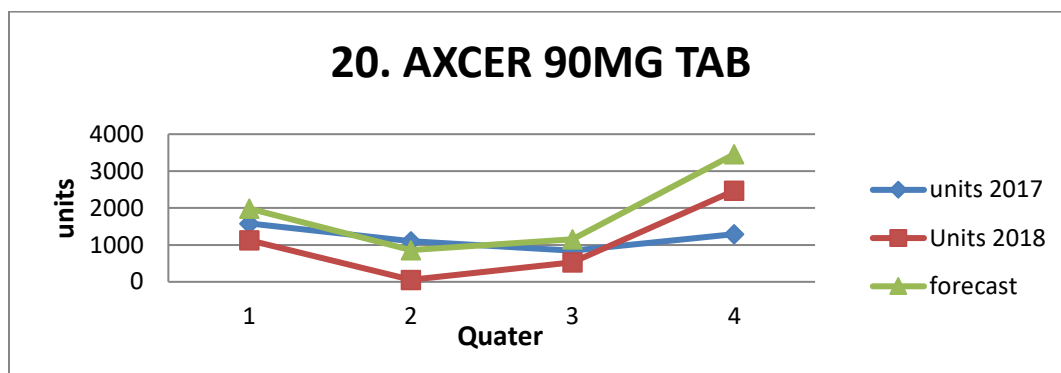


Figure 21 Seasonal index graph Axcer tab

Table 21 Seasonal index and forecasting Acivir- infusion inj

ACIVIR-INFUSION 500MG INJ					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	0.3	55	71	0.22
	2	0.3	95.2	133	0.38
	3	0.3	200	301	0.80
	4	87.1	156	1062	2.60

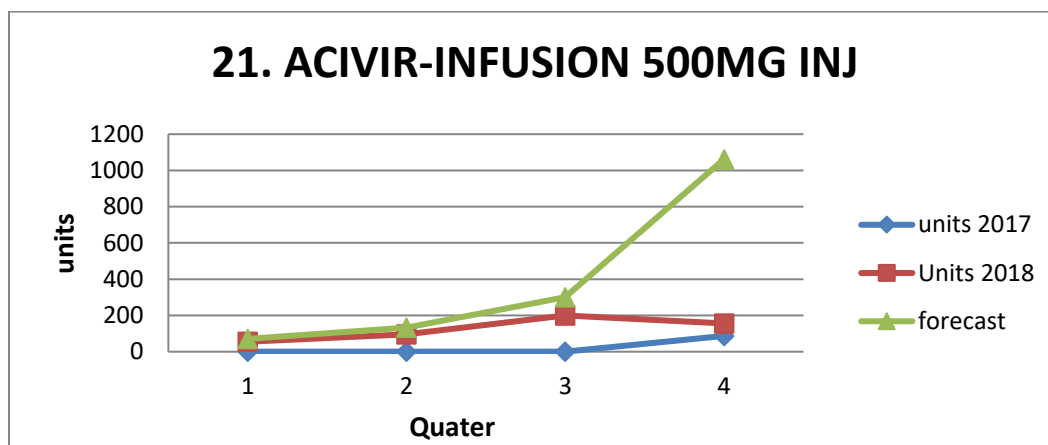


Figure 22 Seasonal index graph Acivir inj

Table 22 Seasonal index and forecasting Cetil inj

CETIL 1.5MG INJ					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	0.3	0.3	153	0.50
	2	0.3	17.1	186	0.56
	3	0.3	96.2	299	0.84
	4	0.3	459.2	808	2.10

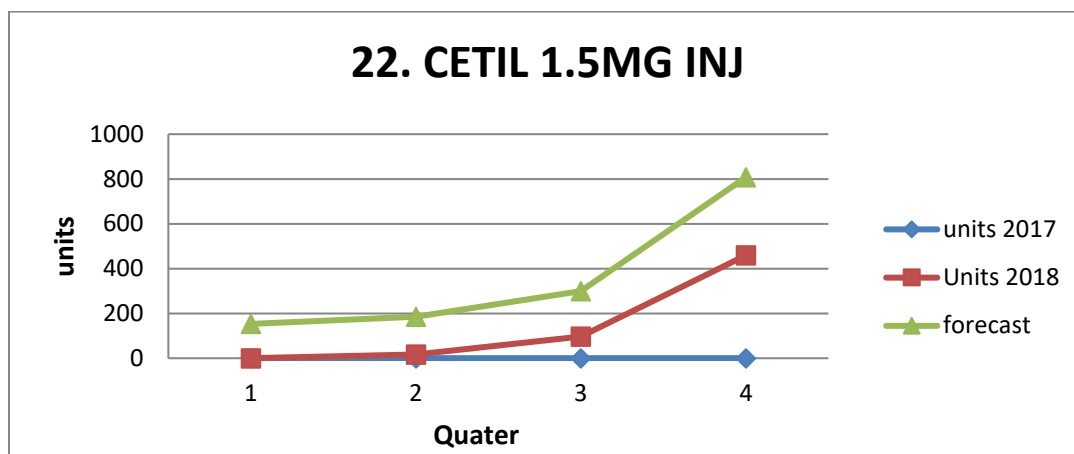


Figure 23 Seasonal index graph Cetil inj

Table 23 Seasonal index and forecasting Cetil tab

CETIL 500MG TAB					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	170	1120	1293	1.75
	2	0.3	1120	455	0.54
	3	20.1	1170	2061	0.71
	4	90.1	730	3124	1.00

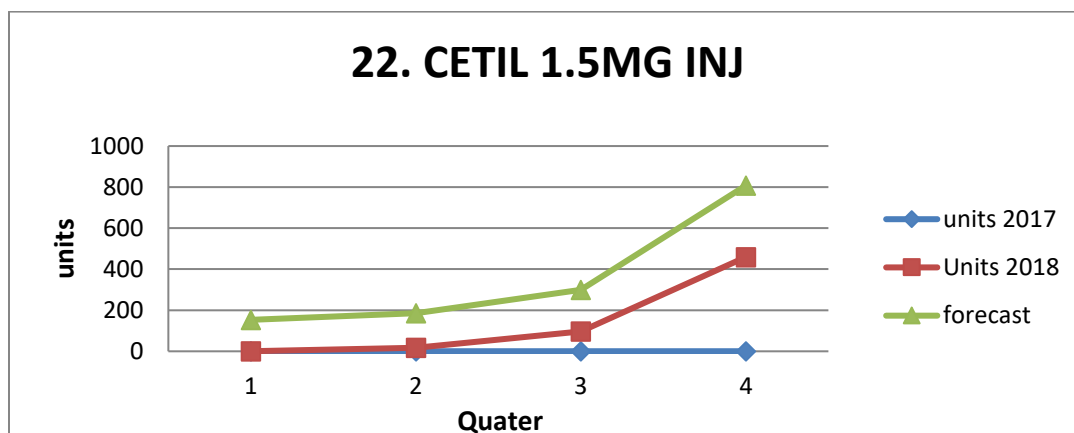


Figure 24 Seasonal index graph Cetil tab

Table 24 Seasonal index and forecasting Cetil tab

CETIL 500MG TAB					
Year	Qtr.'s	Units 2017	Units 2018	Forecast	Seasonal index
2017	1	170	1120	1293	1.75
	2	0.3	1120	455	0.54
	3	20.1	1170	2061	0.71
	4	90.1	730	3124	1.00

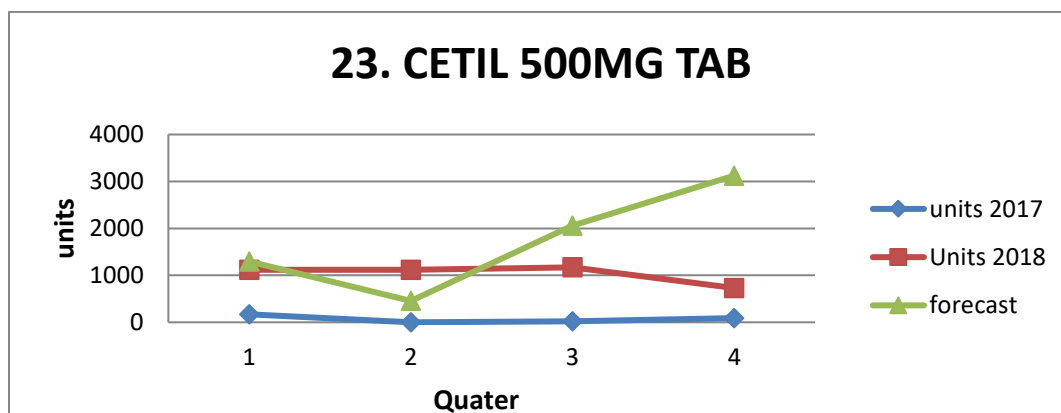


Figure 25 Seasonal index graph Cetil 500 mg tab

Table 25 Seasonal index and forecasting Kemoplat

KEMOPLAT 50MG 50ML					
year	qtr.'s	units 2017	Units 2018	forecast	seasonal index
2017	1	252	0.3	254	0.98
	2	209	0.3	232	0.81
	3	56.1	47.2	204	0.65
	4	0.3	170	530	1.56

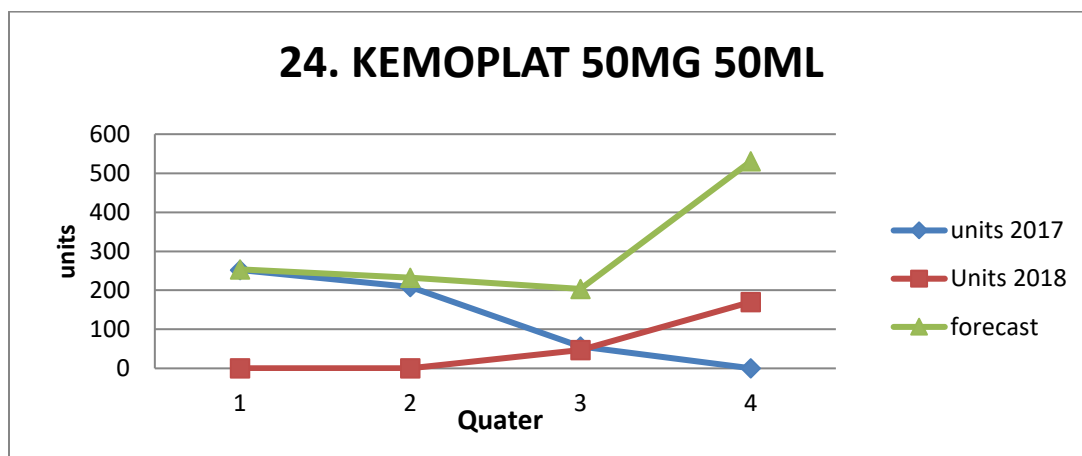


Figure 26 Seasonal index graph Kemoplat

Table 26 Current method EOQ

Current method										
	Ave Deman d	Per cost	Unit	Holdin g cost	Fixed order cost	EOQ	Qtr. HC	Qtr. OC	D.C	Total Cost
P1	76	1420		0.24	1510.8 8	76	13007.2 0	1510.88	108393 .3333	122911. 4
P2	484	107.14		0.24	144	484	6218.41	144.00	51820. 04667	58182.5
P3	49627	1.24		0.24	1.4	49627	7384.50	1.40	61537. 48	68923.4
P4	131	465		0.24	488.25	131	7291.20	488.25	60760	68539.5
P5	263	156.22		0.24	174.97	263	4930.30	174.97	41085. 86	46191.1
P6	47	35.73		0.24	40.02	47	201.52	40.02	1679.3 1	1920.8
P7	57	492		0.24	498.75	57	3365.28	498.75	28044	31908.0
P8	65	233		0.24	235.42	65	1817.40	235.42	15145	17197.8
P9	1023	7.8		0.24	8.74	1023	957.22	8.74	7976.8	8942.8
P10	151	20.7		0.24	21.76	151	375.91	21.76	3132.6	3530.3
P11	219	9.04		0.24	9.34	219	237.57	9.34	1979.7 6	2226.7
P12	110	13.4		0.24	14.3	110	176.88	14.30	1474	1665.2
P13	2	801.56		0.24	897.75	2	160.31	897.75	1335.9 33333	2394.0
P14	23	3078		0.24	3071.5 4	23	8618.40	3071.54	71820	83509.9
P15	37	1880		0.24	2217.6	37	8437.44	2217.60	70312	80967.0
P16	146	276.1		0.24	309.23	146	4826.23	309.23	40218. 56667	45354.0

P17	528	30.2	0.24	43.41	528	1914.68	43.41	15955. 66667	17913.8
P18	9	1145	0.24	1282.4	9	1195.38	1282.40	9961.5	12439.3
P19	740	36.7	0.24	41.14	740	3258.96	41.14	27158	30458.1
P20	823	54.9	0.24	60	823	5421.92	60.00	45182. 7	50664.6
P21	52	332.86	0.24	372.8	52	2077.05	372.80	17308. 72	19758.6
P22	153	95.63	0.24	101.75	153	1756.53	101.75	14637. 76533	16496.0
P23	243	61.1	0.24	68.58	243	1784.12	68.58	14867. 66667	16720.4
P24	57	242	0.24	288	57	1645.60	288.00	13713. 33333	15646.9
									824462

Table 27 Recommended method EOQ

Recommended method									
	Forecast	Per Unit cost	Holding cost	Fixed order cost	EOQ	Qtr. HC	Qtr. OC	D.C	Total Cost
P1	73	1420	0.24	4340	25.48	4340	4340	103934	112616.
P2	416	107.1	0.24	877.6	68.27	877.6	877.6	44578.17	46333.52
P3	44365	1.24	0.24	96.14	646	96.14	96.14	55012.69	55204.9686
P4	129	465	0.24	1877	33.64	1877	1877	60138.26	63892.4643
P5	252	156.2	0.24	908.9	48.49	908.9	908.9	39349.51	41167.4257
P6	56	35.73	0.24	98.07	22.87	98.07	98.07	2002.593	2198.7289
P7	66	492	0.24	1392.	23.59	1392.	1392.	32420.44	35206.3869
P8	78	233	0.24	718.7	25.70	718.7	718.7	18284.28	19721.6988
P9	1111	7.8	0.24	95.35	101.8	95.35	95.35	8669.123	8859.8292
P10	125	20.7	0.24	82.18	33.08	82.18	82.18	2586.290	2750.64739
P11	235	9.04	0.24	48.81	45.00	48.81	48.81	2125.717	2223.33881
P12	126	13.4	0.24	53.92	33.53	53.92	53.92	1694.164	1802.00095
P13	3	801.5	0.24	509.7	5.30	509.7	509.7	2411.819	3431.28045
P14	40	3078	0.24	6765.	18.32	6765	6765	124172.7	137703.141

P1 5	19	1880	0.24	3092.	13.71	3092.	3092.	35937.27	42122.2105
P1 6	104	276.1	0.24	1032.	31.16	1032.	1032	28725.86	30790.7567
P1 7	835	30.2	0.24	362.3	100.0	362.3	362.3	25210.98	25935.7766
P1 8	9	1145	0.24	1288	9.38	1288	1288	10789.83	13366.9833
P1 9	237	36.7	0.24	207.3	47.09	207.3	207.3	8710.133	9124.86305
P2 0	663	54.9	0.24	511.9	77.70	511.9	511.9	36397.57	37421.4173
P2 1	24	332.8	0.24	593.6	14.86	593.6	593.6	7877.686	9064.97970
P2 2	51	95.63	0.24	244.2	21.28	244.2	244.2	4884.799	5373.23896
P2 3	431	61.1	0.24	465.4	63.49	465.4	465.4	26327.70	27258.654
P2 4	85	242	0.24	841.4	28.98	841.4	841.4	20488.09	22171.0274
									755740

Table 28 Economic order quantity

Current method				Recommended method			
Qtr HC	Qtr OC	D.C	Total Cost	Qtr HC	Qtr OC	D.C	Total Cost
13007.20	1510.88	108393.3	122911	4340.97	4340.97	103934.93	112617
6218.41	144.00	51820.05	58182	877.67	877.67	44578.177	46334
7384.50	1.40	61537.48	68923	96.14	96.14	55012.697	55205
7291.20	488.25	60760	68539	1877.10	1877.10	60138.266	63892
4930.30	174.97	41085.86	46191	908.95	908.95	39349.517	41167
201.52	40.02	1679.31	1921	98.07	98.07	2002.5937	2199
3365.28	498.75	28044	31908	1392.97	1392.97	32420.448	35206
1817.40	235.42	15145	17198	718.71	718.71	18284.287	19722
957.22	8.74	7976.8	8943	95.35	95.35	8669.1234	8860
375.91	21.76	3132.6	3530	82.18	82.18	2586.2902	2751
237.57	9.34	1979.76	2227	48.81	48.81	2125.717	2223
176.88	14.30	1474	1665	53.92	53.92	1694.1643	1802
160.31	897.75	1335.933	2394	509.73	509.73	2411.8192	3431
8618.40	3071.54	71820	83510	6765.22	6765.22	124172.71	137703
8437.44	2217.60	70312	80967	3092.47	3092.47	35937.28	42122
4826.23	309.23	40218.57	45354	1032.45	1032.45	28725.862	30791
1914.68	43.41	15955.67	17914	362.39	362.39	25210.99	25936
1195.38	1282.40	9961.5	12439	1288.58	1288.58	10789.833	13367
3258.96	41.14	27158	30458	207.36	207.36	8710.1333	9125
5421.92	60.00	45182.7	50665	511.92	511.92	36397.576	37421
2077.05	372.80	17308.72	19759	593.65	593.65	7877.6867	9065
1756.53	101.75	14637.77	16496	244.22	244.22	4884.799	5373
1784.12	68.58	14867.67	16720	465.47	465.47	26327.706	27259
1645.60	288.00	13713.33	15647	841.47	841.47	20488.091	22171
			824462				755742

Table 29 Cost estimation of current and recommended method

Cost estimation: Total cost					
		Current method	Recommended method		
Holding cost	Order cost	cost of consumption	Holding cost	Order cost	cost of consumption
87060	11,902	7,25,500	26,505	26,505	7,02,730
		Overall cost		Overall cost	
		824462		755740	
		Total savings	6,73,294		

CHEPTEP: 6 DISCUSSION

After analysing the results, the current forecasting model showed that the hospital inventory holding cost was high due to excess storage of medical and surgical items as compared to proposed models. and the proposed forecasting and economic order quantity model shows reduction in overall total cost. For instance, the cost estimate table shows the total savings with each items. If the company proceeds in implementing the recommended forecasting model along with the economic order quantity, it would help them save approximately Rs. 6.73,294 each quarter.

The recommended forecasting method aids the company in more accurate forecasting to their demand according to seasonal variations. The economic order quantity allows the company to reduce the inventory holding cost and optimise the order along with the forecasting model. As a result, the recommended method would ensure enough products are in stock, that would satisfy patient demand and reduce the cost.

CHAPTER: 7 CONCLUSION

The current model for forecasting used by CIMS hospital has some problems due to unproductive forecasting that leads to lose of sales and stock outs. In order to deal with this problem, also reduce stock outs, I have recommended an effective forecasting model of seasonal index along with Economic order quantity. The new proposed model of forecasting allows a more accurate results for different items according to seasonal variations. The economic order quantity helps us to decide optimum quantity for each product during the placement of order. The newly recommended method for forecasting and Economic order quantity will helps to reduce hospital stock outs.

By suggesting an effective forecasting method of seasonal index providing, the results have shown improvements in forecasting as well as in cost reduction. The seasonal index forecasting method helps to reduce inventory holding cost around Rs. 60555. So, if the CIMS hospital implements the recommended forecasting along with Economic order quantity model, it would reduce the total cost by approximately Rs. 6,73,294 each quarter, which is a big amount of cost reduction with effective model.

The problem CIMS hospital faces would be reduced by implementing the proposed forecasting and Economic order quantity model. This method of forecasting will ensure the optimum items quantity in stock, which would increase profit and reduce inventory holding cost by forecasting according to seasonal variations.

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CHAPTER: 9 ANNEXURE

Consumption 2017-18, 2018-19	q1
	q2
	q3
	q4
	q5
	q6
	q7
	q8
(AVE 1)	Ave 2017-18 consumption
(AVE 2)	Ave 2018-19 consumption
ans 1	Q1/ave 1
	Q2/ave 1
	Q3/ave 1
	Q4/ave 1
ans 2	Q5ave 2
	Q6/ave 2
	Q7/ave 2
	Q8/ave 2
ans 1+ans 2	ans 1 (1) + ans 2 (1)
	ans 1 (2) + ans 2 (2)
	ans 1 (3) + ans 2 (3)
	ans 1 (4) + ans 2 (4)

	devide by (2)
ans 1+ ans 2/2 (seasonal index)	1
	2
	3
	4
deseasonalised value	DS 1
	DS 2
	DS 3
	DS 4
	DS 5
	DS 6
	DS 7
	DS 8
X	q1
	q2
	q3
	q4
	q5
	q6
	q7
	q8
Y	q1
	q2
	q3
	q4
	q5

	q6
	q7
	q8
X*y	1
	2
	3
	4
	5
	6
	7
	8
P	SUM X*Y
n*X ave	
Y ave	
Q	n*x ave *Y ave
R	
	P-Q
B	P-Q/R
X ave	
B*X ave	

Y ave-B*X
ave

A	Y ave-B*X ave
X (for forecast)	9

	10
	11
	12
B*X	9
	10
	11
	12
Y= A+ B*x	9
	10
	11
	12
actual demand	d1
	d2
	d3
	d4