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Sales Forecast, the Key Success Factor of Supply Chain Management in Tolid Daru Company (Using the Time Series Method)

[1]Homa Dorudi, [2]Ali Mansouri and [1]Hamid Jahani
[1]Department of Business Management, Islamic Azad University, Zanjan Branch, Zanjan, Iran
[2]Department of Business Management, Zanjan University, Zanjan, Iran

Abstract: The aim of the present research is to forecast the sales rate of Tolid Daru Company for next periods using time series analysis. This research is applied in objective and is descriptive quantitative in nature. Statistical population of research includes all the medical items produced by Tolid Daru Company and non-probabilistic method was used for collecting statistical sample. For analyzing the sales forecast data, the time series method during 2011-2015 and SPSS23 and EVIEWS9 software were used. The forecasted sales rate was listed separately for each medicine along with its optimal pattern. Also, the sales rate of the next months can be obtained according to the best pattern resulted based on the time series analysis and it can be used according to company's needs. The research results indicated that the sales rate of medical items can be forecasted.

Key words: Sales, sales forecast, supply chain management, statistical population, sales forecast data

INTRODUCTION

One of the new approaches that has been dominant in management in recent years is supply chain management. Supply chain is the complete process of providing goods and services for the final consumer; therefore, identifying the supply chain and applying it contributes to organizational excellence and better performance. One of the main issues of every supply chain is how to forecast future demands based on previous demands' information. The importance of sales (demand) forecast stems from the fact that the foundation of various activities such as production planning, inventory controland marketing is based on demand forecast information. If the demand forecast information is not accurate enough, substantial costs such as uselessness of production capacity, inventory maintenance costs, facing with useless surplus inventory (such as seasonal and perishable goods)and losing market share will be incurred on organizations performing in the supply chain (Pan *et al*., 2013). Considering the supply chain in general leads to maximization of the total profit of the chain and this finally maximizes the profit of every company performing in the chain. If the company is able to consider the rate of demand (sales) and inventory level of its downstream network as well as the inventory level of its upstream networkand also their preparation times; with such a wide vision, it can adjust its inventory levels and production timetable in a way that leads to maximum profit for the company and the chain. By investigating the studies conducted inside and outside of Iran, this issue becomes more evident. The results of Shafiee and Tarmast pointed out that supply chain management directly influences the competitive advantage and organizational performance. In his research, Fallah Roshan Ghalb indicated that all the provided factors and variables are effective in increasing macaroni sales. In addition, the research results of Razavi Haji indicate that given the situation considered for the issue, the best combination of forecast methods includes moving average linear regression exponential smoothing or linear regression exponential smoothing moving average and other combinations are less favorable. In a study, Hosseini and Safaee introduced the fuzzy network for newsprint sales forecast. The research results of Hashemi and Azam (2010) indicate that it is possible to forecast the sales and costs using the items of financial statements of companies listed in Tehran Stock Exchange. Ramos conducted a research named forecasting the sales of retailers to consumers using ARIMA Method. The results of ARIMA Model is close to nominal rate of sales for each of the one-stage and multi-stage processes. The research results of Aye *et al*. (2015) also indicate that nonlinear models outperform linear models in forecasting the research sample, regression models are effective in forecasting sales and trigonometric models are not

Corresponding Author: Homa Dorudi, Department of Business Management, Islamic Azad University, Zanjan Branch, Zanjan, Iran

effective in forecasting retail sales. Pan *et al.* (2013) conducted a survey named sales forecast using neural networks. The simulation results indicated that the effect of bullwhip phenomenon appears in chain upstream. Therefore, the advanced forecasting systems are an effective and efficient method in decreasing this negative phenomenon in clothing industry. Also, the research results of Michael J. David indicated that the appropriate supply chain is positively linked with company financial performance. In contrast, supply chain with heterogeneous environment has a negative relationship with company performance. In the research conducted by Yavuz Acar the supply chain was modeled using real demand data and simulation and optimization techniques using TC2 simulator software. The curves of exchange between total costs and customer services were used in order to compare exponential smoothing techniques. The results indicate that the damped trend method produces the best tradeoffs. In his research, Sebastian Thomassey indicated that the sales forecast for short and long term occurs by neural network method. On the one hand, according to research literature, the ultimate goal of health care systems and medical systems all over the world is primarily "promoting the health level" of the whole society. Certainly, there are other ultimate goals along with improving health indicators that have been considered in different models of health care and medical systems. Among intermediate objectives, access to medicines is more tangible than the present challenges. Internal pharmaceutical companies cannot innovate and endeavor in this area because of their inflexible structureand because of the limited market of these drugs today private companies are reluctant to enter this area or cannot afford it. These issues increase the importance of supply chain management debates in national pharmaceutical area. Planning strategic themes, Tolid Daru Company tries to create a future beyond the internal geographical borders by making difference and creating competitive advantage in the field of sales and marketing. Changing market conditions and the rules governing it such as technological changes, rules etc. have influenced the company performance. Given this competitive situation and market disorganization, it seems that instability in customers' taste and expectations has limited the company's ability to satisfy different groups of people and it increases the need to adopt and make changes and innovations in products and sales in order to reinforce the company's position in market competition. As we know, the competitive situation results from decreased prices and providing different products. On one side, Tolid Daru Company faces some limitations in various aspects; on the one hand, all the pharmaceutical products have expiration time and during this time limit, customers should access the products and consume them and the products must not be produced more than needed; on the other hand, maybe the limited production of some products faces more demand and the company loses the market to competitors because of inventory shortage and this issue may damage the company in long term. The points mentioned above indicate that sales forecast has become one of the main concerns of the company and the necessary measures should be considered for adopting effective methods in this regard. Despite great efforts, using the previous experiences' method for forecasting sales in Tolid Daru Company sometimes fails. Hence, the present research aims to answer this question: how can we forecast the sales which is one of the important factors in supply chain management's success using the analysis of time series?

MATERIALS AND METHODS

The present research is categorized as applied research regarding its objective and is a descriptive analytical and quantitative research regarding the methodology, for the research methodology is a mathematical model and it is cross-sectional in terms of time since data collection was conducted in a certain point of time. In addition, the analysis was done in organizational level and the analysis unit includes all the medical items produced. In order to collect data about theoretical backgrounds and research literature, library resources were widely used and these studies include investigating the related and available researches and theses, studying Persian and Latin articles and books, as well as using the internet to access the new findings. Additionally, in order to forecast the sales, the information gained from Tolid Daru sales offices were used. The statistical population includes all the medical items produced in Tolid Daru Company during 2011-2015, the information related to these medicines were given to the researcher by Tolid Daru sales center. The sampling process was performed in different methods based on various situations of research, available facilitiesand the situation of the related society. Since, the pattern of the present research is using time series, in order to estimate the medical items, among all the medicines produced by Tolid Daru Company by using non-probabilistic sampling method based on necessity and company's suggestion 20 medicines were used for forecast using time series. These 20 medicines that include all types of medicines in terms of diversity are the items for which the company has not yet found any pattern for sales forecast. Since, it is it possible that medicine sales have fluctuations in different

periods, sales information was collected monthly. On the other hand, the year 2011 was chosen as the basic year in order to estimate the data, since the practical work in this research is related to discrete time series. Generally, time series are divided into two categories of static and non-static and both of these are also divided to two sub-categories of continuous and discrete. For the discrete mode, most of our observations are obtained at equal distances from each other and considering the fact that successive observations are not independent, we can forecast the future values of the series using the previous values of the series. Studying the rate of previous sales is one of the important fundamentals of forecasting the demand. Changes in demand or sales can happen in different modes. In other words, every time series is comprised of 4 components.

Term component (T): This component shows the general increase or decrease in time.

Seasonal component (S): This component shows the seasonal changes of demand for products.

Cyclic component (C): This component shows the cyclic changes of demand, with a difference that the repetition period of the cycles lasts more than one year.

Incidental component (I): This component is related to the small changes that occur in demand and so many factors are involved in it.

In order to select the best pattern for time series, at first the durability of the data was investigated, then the ACF and PACF diagrams were drawn. After presenting the diagrams, their significant test was conducted using the Q statistic and the proper pattern was to be identified using the specified methods and indicators. It's worth noting that one of the most important criteria for selecting the pattern of time series is MAPE index. Hence, after specifying the appropriate pattern using the aforementioned methods, we start to test other possible models and this index is compared to the primary pattern, the one with less value in this index will be a better pattern. For inferential analysis of the data that were obtained using SPSS23, EVEIWS9, EXCEL2016 Software, at first after investigating the descriptive features of data and data normalization, we investigated the unit root of the variables and created durability in model variables. Finally, we will achieve the optimal model by precise investigation of the models.

RESULTS AND DISCUSSION

Descriptive statistics: According to Table 1 the data resulted from the descriptive statistic, the average monthly sales of vitamin A+D ointment 30 g is 117443.1, its standard deviation is 80524.52 and its data distribution is normal. Average monthly sales of Axar tablet 100 pcs is 49059.80, its SD is 37474.43 and its data distribution is normal. Average monthly sales of adult cold tablet 100pcs is 64107.05, its SD is 62409.15 and its data distribution is normal. Average monthly sales of A+D oral drops (pediatric) hml is 72352.09, its SD is 77766.10 and its data distribution is normal. Average monthly sales of Atenolol tablet 100 mg 100pcs is 42238.58, its SD is 3412314 and its data distribution is normal. Average monthly sale of Azithromycin suspension is 135338.2, its SD is 105727.9

Table 1: Results of the descriptive analysis of the data

Medicine code	Average monthly sales	Standard deviation	Data distribution	Diagramnumber
d-1	117443.1	80524.52	Normal Distribution	1-4
a-2	49059.80	37474.43	Normal	2-4
c-3	64107.05	62409.15	Normal	3-4
t-4	72352.09	77766.10	Normal	4-4
tc-5	42238.58	34123.14	Normal	4-5
az-6	135338.2	105727.9	Normal	4-6
ra-7	5028.78	49379.11	Normal	4-7
dc-8	29940.01	44212.97	Normal	4-8
es-9	109817.1	69890.34	Normal	4-9
dc-10	69544.98	53922.08	Normal	4-10
dic-11	92700.41	95753.87	Normal	4-11
an-12	162996.1	119967.5	Normal	4-12
ac-13	98744.90	88240.17	Normal	4-13
mel-14	154549.5	116865.1	Normal	4-14
Melo-15	32652.39	31831.47	Normal	4-15
ad-16	42697.43	41565.65	Normal	4-16
nef-17	20022.54	21682.94	Normal	4-17
es-18	46602.78	50002.70	Normal	4-18
add-19	83985.91	73672.80	Normal	4-19
jem-20	74599.17	66093.71	Normal	4-20
total-21	1549674	710914.1	Normal	4-21

Table 2: The results of the static test of the research variables

	Dicky-Fuller indicators		Phillips and prone indicator	
Research variables	Statistic	Error level	Statistic	Error level
a	-4.46	0.0008	-4.423	0.0009
ac	-5.056	0.0001	-5.118	0.0001
ad	-1.125	0.6976	-3.2592	0.0227
add	-1.0445	0.7294	-3.6806	0.0076t
an	-6.019	0.000	-6.0224	0.000
az	-3.6317	0.0087	-3.5019	0.012
C01	-4.8860	0.0002	-4.955	0.0002
D01	-2.341	0.1640	-3.7161	0.0069
dc	-8.516	0.000	-8.516	0.000
Dc01	-6.5310	0.000	-6.55	0.000
dic	-3.2549	0.0229	-3.2549	0.229
es	-5.7466	0.000	-5.8708	0.000
Es01	-4.5777	0.0006	-4.59	0.0005
jem	-5.8610	0.000	-6.005	0.000
melo	-3.6237	0.0088	-3.6159	0.0090
mel	-4.4381	0.0009	-4.438	0.0009
nef	-3.6429	0.0084	-3.606	0.0093
ra	-2.8276	0.0623	-5.575	0.000
T	-4.9670	0.0002	-4.9089	0.0002
TC	-3.57772	0.0037	-4.0704	0.0025
Total	-2.472069	0.1286	-2.418724	0.1422
Total (d)	-4.035732	0.0140	-2.472069	0.0173

and its data distribution is normal. Average monthly sales of burn ointment 30 g is 50281.78, its SD is 4937911 and data distribution is normal. Average monthly sales of Dispasmine ampoule 10pcs is 29940.01, its SD is 44212.97 and its data distribution is normal. Average monthly sales of Dicyclomine syrup 60 mL is 109817.1, its SD is 69890.34 and its data distribution is normal. The average monthly sales of Dextromethorphan syrup 60 mL is 69544.98, its SD is 53923.08 and its data distribution is normal. Average monthly sales of Diclofenac suppository 100 mg 10pcs is 9270041, its SD is 95753.82 and its data distribution is normal. Average monthly sales of Acetaminophen syrup 60ml is 162996.1, its SD is 119967.5 and its data distribution is normal. Average monthly sales of Acetaminophen oral drop 15 mL is 98744.90, its SD is 88240.17 and its data distribution is normal. Average monthly sales of Gemfibrozil capsule 100mg is 154549.5, its SD is 116865.1 and its data distribution is normal. Average monthly sales of Meloxicam tablet 7.5 mg, 30pcs is 32652.39, its SD is 31831.47 and its data distribution is normal. Average monthly sales of Meloxicam tablet 15 mg 30pcs is 42697.43, its SD is 41565.65 and its data distribution is normal. Average monthly sales of Naphazoline nasal dop 0.5% is 20022.54, its SD is 21682.94 and its data distribution is normal. Average monthly sales of Ranitidine oral drop 240 mL is 46602.78, its SD is 50002.70 and its data distribution is normal. Average monthly sales of Thermorub ointment 19 g is 83985.91, its SD is 73672.80 and its data distribution is normal. Average monthly sales of Thermorub ointment 38 g is 74599.17, its SD is 66093.71 and its data distribution is normal.

Data analysis

Investigating the unit root of the research variables: Table 2 shows the static test conducted for all the variables.

As it is indicated in the above table, all the values of the 4 year sales except the total sales is durable. The value of the total sales has also become durable after the primary differencing.

Inferential analysis of the research variables

Presenting time series model for the total amount of medicines: The point chart (Fig. 1) (time series) of this variable is as follows in Table 3.

It is indicated in the above chart that autocorrelations have descending exponential trend and partial autocorrelations were stopped in the first point. Additionally, given the non-durability of the time series, we should make the data durable and then fit the final model. This model was analyzed and fitted as ARIMA (0, 1, 0).

As it is indicated in the Table 4 and 5, in summing up the model fitness indicators the values of the indicators obtained for ARIMA (0, 1, 0) model are less than corresponding values for other models. Therefore, the model fits the data. Also, the most important indicator of Table 6 is MAPE index with value of 25.800 that is the least value among the other models investigated.

Summation and forecast: Sales and forecast models of the next period were obtained for statistical samples and are presented in the following Table 6.

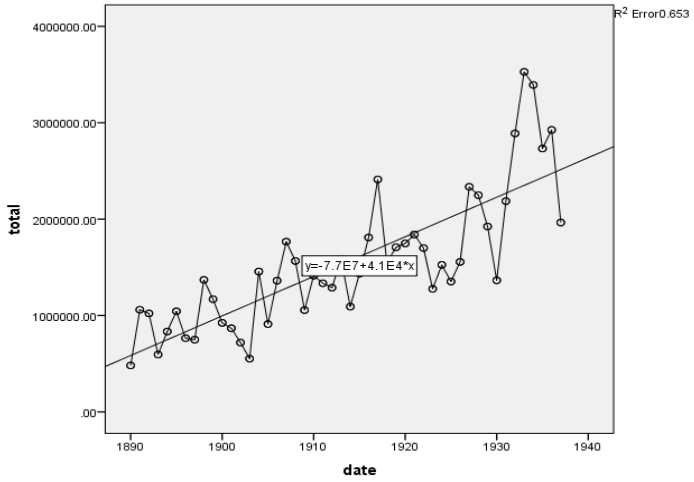

Fig. 1: Point-time series chart for medicine sales

Table 3: ACF and PACF diagrams for total sales with the table of the related values and significant test of the Ljung-Box statistic

Autocorrelation	Partial correlation	AC	PAC	Q-Stat.	Prob.
		0.778	0.778	30.899	0.000
		0.617	0.031	50.791	0.000
		0.516	0.067	64.988	0.000
		0.419	-0.022	74.573	0.000
		0.349	0.024	81.382	0.000
		0.326	0.088	87.453	0.000
		0.276	-0.044	91.918	0.000
		0.202	-0.076	94.375	0.000
		0.220	0.170	97.358	0.000
		0.170	-0.129	99.176	0.000
		0.146	0.059	100.56	0.000
		0.157	0.052	102.20	0.000
		0.110	-0.119	103.03	0.000
		0.064	0.002	103.32	0.000
		0.111	0.165	104.22	0.000
		0.095	-0.119	104.90	0.000
		0.056	0.002	105.14	0.000
		0.023	-0.110	105.19	0.000
		0.011	0.068	105.20	0.000
		0.039	-0.077	105.32	0.000

Table 5: ARIMA (0,1,0) Model with the resulted test coefficient

	Number of forecasters	Fitness statistic of the model	Ljung-box test of the Q statistic			Number of remotes
Model	(omissible)	Durable R^2	Statistic	Degree of freedom	Sig.	(omissible)
Model 1	0	-2, 220 E-16	12, 470	18	0. 822	0

Table 6: Values of the time series fitness indicators for total sales

Fitness statistics	Mean
Durable R^2	-2, 220 E-16
R^2	0.593
Root mean square error	447012.735
Mean absolute percentage error	25.800
Maximum absolute percentage error	76.770
Mean absolute deviation	364456.210
Maximum absolute deviation	991637.653
BIC Standardized awareness level (omissible)	26.103

According to the models, forecast of the next month's sales and total sales is as the following table that is presented with high and low confidence level (Table 7).

Table 7: Models estimated for product sales

Model description		
Model type	Model ID	
ARIMA (0,1,0)	Model_1	d
ARIMA (1,0,0)	Model_2	A
ARIMA (0,0,0)	Model_3	C
ARIMA (0,0,0)	Model_4	T
ARIMA (1,0,0)	Model_5	Tc
ARIMA (1,0,0)	Model_6	Az
ARIMA (0,1,0)	Model_7	Ra
ARIMA (0,0,0)	Model_8	Dc
ARIMA (0,0,0)	Model_9	Es
ARIMA (0,0,0)	Model_10	Dc
ARIMA (0,1,0)	Model_11	Dic

Table 7: Continue

Model description		
Model type	----------Model ID----------	
ARIMA (0,0,0)	Model_12	An
ARIMA (0,0,0)	Model_13	Ac
ARIMA (0,0,3)	Model_14	Mel
ARIMA (0,0,1)	Model_15	Melo
ARIMA (0,1,1)	Model_16	Ad
ARIMA (1,0,0)	Model_17	Nef
ARIMA (1,0,0)	Model_18	Es
ARIMA (2,0,0)	Model_19	Add
ARIMA (0,0,0)	Model_20	Jem
ARIMA (0,1,0)	Model_21	Total

Table 8: Vales of products sales forecast with high and low confidence level

LCL	UCL	Forecast	Model
0.253149	177.2801	25.18293	d-Model_1
-8768.1	294116.8	142674.3	a-Model_2
-49056.2	149619.7	50281.78	c-Model_3
-64224.6	232196.5	83985.91	t-Model_4
-63351.9	170429.2	53538.66	tc-Model_5
-19787.6	337708.2	158960.3	az-Model_6
3253.136	1268361	192593	ra-Model_7
-30784.1	250418.4	109817.1	dc-Model_8
-78347.4	404339.6	162996.1	es-Model_9
-38932.2	178022.2	69544.98	dc-Model_10
28623.13	2233657	454187.4	dic-Model_11
8365.17	133520.5	42359.12	an-Model_12
-26329	124448.6	49059.8	ac-Model_13
1945.088	149493.6	30461.71	mel-Model_14
3270.257	427845.6	77841.37	melo-Model_15
19823.96	906379.7	210391.1	ad-Model_16
1136.503	246610.9	40886.35	nef-Model_17
-69462.6	263230.5	96883.93	es-Model_18
24824.24	813909.5	206883.8	add-Model_19
-80552.7	389651.8	154549.5	jem-Model_20
1096985	2896565	1996775	total-Model_21

CONCLUSION

The present research aimed at forecasting the sales of Tolid Daru Company as a success factor in supply chain management using time series analysis. In this research, the sales rate of 20 medical items of this company's products during 2011-2015 were investigated. Consequently, the sales rate of the next month was obtained and according to the result it can be claimed that the main objective of the research was covered. This rate is listed in the following table separately for each medicine along with its optimal pattern. Also, the sales rate of the next months can be obtained according to the best pattern resulted based on time series analysis and it can be used according to company's needs. Supply chain is the complete process of providing goods and services for the final consumer. One of the main issues related to the supply chain is that 'how we can forecast the future sales based on the past information', since error in future estimations may be quite expensive. Here, the field of healthcare is one of the most important fields and supply chain of this field is of strategic importance. Given the importance of sales in the performance of pharmaceutical companies, the present research has forecasted the sales of the next period of Tolid Daru Company using the time series analysis method. In this research, the sales rate of 20 medical items produced by Tolid Daru Company during 2011-2015 were used as input data in sales forecasting. According to the results it can be concluded that in business level, forecasting helps every business develop a competitive advantage and use it as a key to success. Therefore, applying effective methods for forecasting in pharmaceutical companies seems absolutely vital and necessary. In addition, due to today's intense competition in business world between various industries, pharmaceutical companies can achieve their goals successfully only if they consider sales rate as well as supply chain management. Generally, the research results indicated that it is possible for the companies that perform in the competitive market and care about earning more income, to forecast the sales using the more precise methodsand doing so leads to obtaining competitive advantage.

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