Inventory Control System

Student(s)

Beliz Uslu, Deniz Topçuoğlu, Ece Özşener, Tilbe Yaldız, Tuğçe Yağmur Gencer

Faculty Member(s)

Güvenç Şahin

Company Advisor(s)

Çilem Aygül, Can Gündüz, Emir Caynak, Merve Özparpucu, Melis Bayar, Nuray Tezel Şengül Şahin

Sabancı Üniversitesi FACULTY OF ENGINEERING AND NATURAL SCIENCES

Evyap Sabun, Yag, Gliserin Sanayi ve Ticaret A.S.

INTRODUCTION

EVYAP is a manufacturer in various categories such as soap, shower-gels, shampoo, shaving products, skin care creams, scented cosmetics, baby diapers and toothpaste. In this project, the aim is to determine the most suitable inventory control policy for various groups of their products. The expected output of this project is to identify the parameters of appropriate policies for each project through a decision support system that adapts the results with new data.

The first step of the project is an implementation of ABC analysis in order to examine the priority of the products. Secondly, we have implemented different types of inventory control models theoretically and see which model is the best for the company's need. With the determination of the model, the decision support system is prepared to serve our purpose.

METHODOLOGY

ABC Analysis

In multiproduct inventory systems, not all products have same profitable value. Thus, it is important to differentiate profitable items from unprofitable items. The ABC analysis provides a mechanism for characterizing items that will have a substantial effect on total inventory cost. A traditional ABC analysis divides the whole product portfolio into three categories:

"A" with tight control on inventory records and reviews of forecasting, demand requirements, order quantities, safety stocks and cycle counts frequently

"B " with similar controls to A items however reviews are less frequent

"C " with simplest controls and least records

When a finer distinction is needed, more categories could be used. In our case, EVYAP wanted to insert an A+ category to follow that group specially.

For the analysis, we account for two criteria: realized demand and customer importance.

Sensitivity with respect to Customer Groups

EVYAP has eight different customer groups defined with their respective importance weights. We use histograms to observe whether the results of ABC analysis change or not. If there is a too much change in the sequence it shows coefficients play an important role during ABC analysis. Histograms are generated for all product groups to observe which groups is directly related with the coefficients.

Customer Name	Importance (%)
Customer 1	25%
Customer 2	8%
Customer 3	12%
Customer 4	12%
Customer 5	4%
Customer 6	4%
Customer 7	10%
Customer 8	25%

Table 1. Importance of customers

If we analyse product group 104 we can say that the change in sequence occurs at the lower levels of the sequence which means unimportant products are independent from the coefficients. In general, there are more than 40 products stay same. However, important products (listed at the beginning of the sequence) are affected by this change. When we applied histogram analysis to first %25 and %50 products, changing is high. Therefore, we proved that coefficients are important for product group 104.

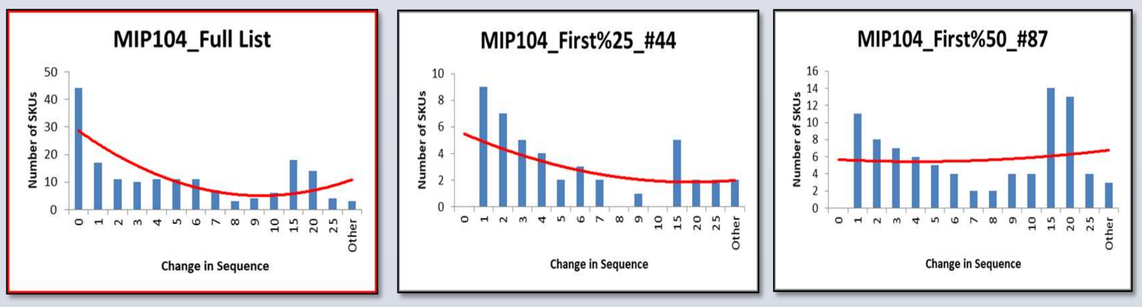


Table 2. Histogram of MIP 104

Distribution Fitting

The EOQ model supposes that the demand is stationary and known a priori; this assumption apparently does not hold for EVYAP data set. On the other hand, the standard models based on (Q,R) type policies are developed with a strong assumption on normality of the demand/sales data. In our study, we test, for each product, if this assumption is realistic enough.

The first step is to determine whether the data follows normal distribution through graphical technique named Probability Plot in Minitab. If the p-value is less than or equal to 0.05, the data do not follow the normal distribution.

The second step was to find the distribution type of non-normal data through the tool of Individual Distribution Identification in Minitab. As a result of this analysis, probability plot and goodness of fit tests are provided to identify an appropriate Johnson transformation was applied on data in order to transform them into normal distribution.

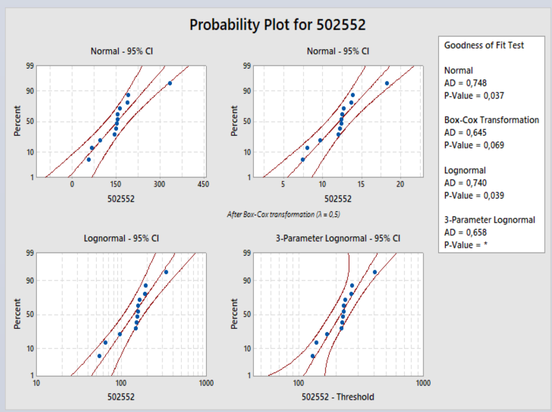


Table 3. Probability plot of SKU 502552

1. Calculation of EOQ Model

EOQ models finds the optimal solution that minimize holding and ordering cost. Most of the company use this method since it is easy to compute, does not require the data that is hard to obtain, gives a good overall idea.

2. Calculation of Optimal (Q, R) Model

The logic of Q,R Model is that start with initial amount of inventory R, when inventory level drops the level of R, place and order in the amount Q= R-r for bringing it to initial inventory position and choosing R to meet the demand during lead time is also important for this case.

3. Calculation of (Q, R) with Type 1 Service Level

Determination of penalty cost is an issue for the most companies due to intangible components that it includes. Thus, service level is an alternative substitute for this problem. Type 1 service level focuses on the probability of not stocking out during lead time. The main purpose is to determine R (reorder point) to satisfy given service level α by the company.

4. Twisted Q,R Model

The model is not stated in the textbooks or literature. We have combined different models and wanted to see whether the model helps us to improve our perspective. The remarkable point about the model is it does not suggest high quantity inventory levels like EOQ, and also does not give small quantities like optimal Q,R does. In addition, the model includes the company's desired service level into account. The different step from the Type I service level is we do not set Q= EOQ.

Instead, we use the following formula; $Q = \sqrt{\frac{2\lambda[K+pn(R)]}{h}}$

	EOQ	Optimal (Q,R) Model			(Q,R) with Type 1 Service Level				Twisted (Q,R) Model			
SKUs	Q	α	Q	R	α	Q	R	Z	α	Q	R	n (R)
506885	857.3	89%	886	189.8	97.5%	857.3	231.90	1.96	97.5%	862	231.90	0.55
505006	1522.3	94%	1544	491.9	98%	1522.3	515.08	2.05	98%	1529	515.08	0.37
501170	710.7	95%	746	484.4	97%	710.7	503.73	1.88	97%	729	503.73	0.95
506671	894.6	99%	958	955.2	97.5%	894.6	901.50	1.96	97.5%	1026	901.50	1.67
506682	313.3	97%	322	112.0	96.5%	313.3	111.58	1.81	96.5%	322	111.58	0.31

Table 4. Comparison of the models

Cost Comparison

Cost comparison is one of the important components while determining the method that applied to products.

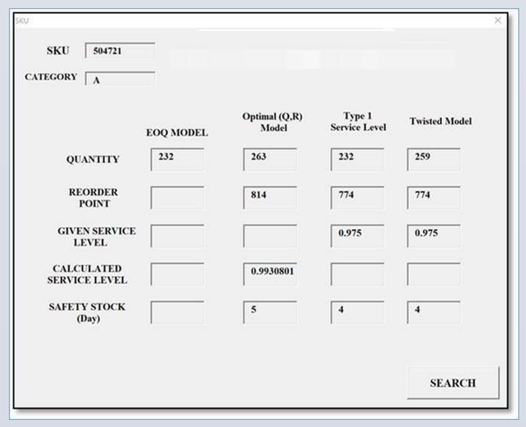
Kod	G(Q) EOQ	G(Q) Optimal Q,R	G(Q) Type 1	G(Q) Twisted Model
506885	7.665,4 ₺	440,15 ₺	429,30 ₺	429,30 ₺
505006	28.598,0 ₺	823,95 ₺	812,88 ₺	816,32 ₺
501170	32.342,9 ₺	597,78 ₺	573,78 ₺	586,54 ₺
506671	37.556,1 ₺	675,21 ₺	663,94 ₺	709,36 ₺
506682	5.189,8 ₺	189,98 ₺	185,35 ₺	190,05 ₺

Table 5. Cost analysis of models

We can say that EOQ gives the most expensive result since it requires high amount of inventory cost and by applying cost analysis we can eliminate EOQ Model.

Decision Support System

Decision support systems are systems that help users to ease their work. In our project, with the request of the company we wanted to use a decision support system that can calculate different models and show their results with comparison. We have decided to use Forms in the VBA Excel. As a starting step, we have created a main menu that would give option to user to be able to choose individual product calculations or calculated product list according to its category (MIP).



CONCLUSION

Consequently, the main purpose of the project is to determination of an inventory control policy which fulfills the firm's needs. First, priority of products was rated from A+ to C by the help of ABC Analysis. Second, based on the analysis, several inventory control models are implemented such as EOQ, Optimal (Q, R) Model, (Q, R) with Type 1 Service Level and Twisted (Q, R) Model. The (Q, R) model with Type 1 Service Level is decided as best method which matches with the companies desires. Thus, the safety stock level is determined as a unit of day, so that EVYAP can implement the results into their system. In addition, decision support mechanism was proposed by using Excel VBA Form. Result and comparison of EOQ, Optimal (Q, R) Model, (Q, R) with Type 1 Service Level and Twisted (Q, R) Model can be seen together from the Excel Form.

References

-INTERNATIONAL STRUCTURE. (n.d.). Retrieved from http://www.evyap.com.tr/en/

- Torabi, S. A., Hatefi, S. M., & Pay, B. S. (2012). *ABC inventory classification in the presence of both quantitative and qualitative criteria.* Computers & Industrial Engineering, 63(2), 530- 537.

- Kumar Dhal ,S (2016,July 21) .What is ABC analysis & its importance in Inventory Management. Retrieved from https://www.linkedin.com/pulse/what-abc-analysis-its-importance-inventory-management-dhal

-Nahmias, S. (1989), Production and Operation Analysis, New York, NY :McGraw-Hill