Optimization of The Amount of Facial Wash Production in PT. XYZ Using Linear Programming Method

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Abstract

The type of research used is descriptive research with a cross-sectional time horizon. This research used the Forecasting and Linear Programming methods in the POM QM software for Windows 4 to obtain the forecast and combination of production quantities to optimize production and maximize profits. Selection of the appropriate forecasting method is by selecting the method with the smallest MSE and MAD values. The results indicated that the appropriate method used for forecasting is the Linear Trend. Therefore, based on these data, in 2017, the demand for Facial Wash for Acne II was 116,871 bottles; Facial Wash for Sensitive Skin was 39,701 bottles, and Brightening Facial Wash was 28,797 bottles. By processing the data using Linear Programming in 2017, PT. XYZ produces Facial Wash for Acne II for 116,871 bottles, Facial Wash for Sensitive Skin for 39,701 bottles, and Brightening Facial Wash for 16,228 bottles and will gain a profit of Rp 3,281,444,000. The application of Linear Programming may assign a positive effect on PT. XYZ to optimize the production and gain maximum profit.

Keywords
Forecasting, Demand Forecasting, Linear Programming, Optimization, Profit Maximization

1. Introduction
In this study, the object used is PT XYZ, which is a company in the cosmetics field. PT XYZ manufactures various cosmetics, one of which is Facial Wash. Facial Wash Products at PT. XYZ has three types of facial wash with the highest number of requests: Facial Wash for Acne II, Facial Wash for Sensitive Skin, and Brightening Facial Wash, which is 100 ml per bottle.

PT XYZ said that it had made various efforts to run its business as well as possible, especially in the production department, meeting demand and increasing revenue. But in the production process carried out, PT XYZ often

experiences obstacles caused by fluctuations in demand that are uncertain. Until now, the company is still using the forecasting method by using sales history. The method used by the company is still inaccurate, causing the company to overproduction. PT XYZ must determine the combination of facial wash that must be produced optimally to not cause overproduction and achieve maximum profits in the future.
Based on the background above, the problem can be formulated as
 follows:

1.   What is the most accurate forecasting method for the 2017 period using the Forecasting method at PT. XYZ?
2.   What is the optimal combination of products that PT.XYZ must produce to get the maximum profit obtained in the 2017 period using the Linear Programming method?
The objectives of this research are as follows:

1.   To find out the most accurate forecasting method for the 2017 period using the Forecasting method at PT. XYZ.
2.   To find out the optimal combination of the number of products produced by PT. XYZ to get the maximum profit obtained in the 2017 period using the Linear Programming method.

According to (Heizer and Render 2012), forecasting is the art and science of estimating future events. This can be done by involving historical data retrieval and projecting it into the future with a form of the mathematical model. This can also be a subjective prediction of intuition. This can also be done using a combination of mathematical models tailored to a manager's good judgment.

And according to (Heizer and Render 2010), linear programming is a mathematical technique designed to help operations managers plan and make decisions relative to the trade-offs needed to allocate resources.

2. Methods
The research design describes the plan used as how, when, and where the data was obtained and measured and how the process of analyzing the data was obtained (Table 1).

Table 1. Research design

Research Purposes	Research Type	Research Methods	Analysis Unit	*Time Horizon*
T-1	Descriptive	Interview, Observation, Literature Study	(Organization) PT. XYZ	*Cross - Sectional*
T-2	Descriptive	Interview, Observation, Literature Study	(Organization) PT. XYZ	*Cross - Sectional*

Information:

T-1: To find out the most accurate forecasting method for the 2017 period using the Forecasting method at PT. XYZ.

T-2: To find out the optimal combination of the number of products produced by PT. XYZ to get the maximum profit obtained in the 2017 period using the Linear Programming method.

Data collection techniques used by researchers are:

·   The study was conducted by conducting interviews with the company relating to the problems faced by the company, namely overproduction, and to obtain information related to what methods will be used to provide the right solution for the company.

·   The study was conducted by observation to directly observe the activities carried out by companies related to research.

·   The study was conducted with several literature studies by collecting data and information from books, journals, articles, and websites that support this research to be used as a theoretical foundation in this research.

There are 2 analytical methods used to process research data using POM QM software for Windows 4, namely:

1.Forecasting

Forecasting is used to forecast the number of product requests in the future.

Steps in forecasting:

a.Collecting data to be processed namely demand data from January 2014 to December 2016.

b.Processing data using the POM QM application for Windows 4

c.Using Forecasting with the Naïve Approach, Moving Average, Exponential Smotthing, Exponential Smoothing with Trend and Linear Trend methods

d.Get the results of the MAD and MSE values

e.Compare the smallest MAD and MSE values to determine the method used

f.Find out how much 2017 demand forecasting for each type of facial wash

2.Linear Programming

According to Taha (2003, quoted by Haming et al., 2017: 26), a linear program is a method of analysis that is useful for finding optimal solutions to a problem, which has objective functions and constraint functions that are also linear.

The linear programming method has three main factors, namely:

a.Decision Variable

Determine what products will be produced and how many units of the product will be produced in a certain period.

b.Purpose Function

The objective function is the goal of each decision variable to achieve maximum profit.

c.Constraint Function

Constraint function is a constraint in a company that affects the operational environment.

3. Results and Discussion

3.1Comparison of forecast results for Facial Wash Acne II

Based on the results of calculations that have been done with the help of POM QM for Windows 4, we get a comparison of the results as in the Table 2:

Table 2. Comparison of Facial Wash Acne II Forecasting Results

Method	Forecast	MAD	MSE
Naive Approach	5520	1276.086	2479861.0
Moving Average	7382.333	1250.606	2869988.0
Exponential Smoothing	7079.321	1252.033	2626625.0
Exponential Smoothing with Trend	6012.07	1317.972	2652209.0

Linear Trend	9137.672	1139.741	2211593.0

Based on these comparisons, it can be concluded that the optimal forecasting method for Facial Wash for Acne II demand forecasting is to use the Linear Trend method to produce the smallest MAD and MSE values, where the MAD value is 1139,741, and the MSE value is 2211593.0.

Table 3. Facial Wash Acne II Data Calculation Results for 2017

Month	Request
January 2017	9137.672
February	9195.672
March	9253.672
April	9311.673
May	9369.673
June	9427.673
July	9485.674
August	9543.674
September	9601.674
October	9659.674
November	9717.675
December	9775.675
TOTAL	113480.081

Therefore, forecasting demand in 2017 for Facial Wash Acne II using the Linear Trend method is 113480.081.

3.2 Comparison of forecast results for Facial Wash Sensitive

Based on the results of calculations that have been done with the help of POM QM for Windows 4, we get a comparison of the results as in the Table 4:

Table 4. Comparison of Facial Wash Sensitive Forecasting Results

Method	*Forecast*	*MAD*	*MSE*
Naive Approach	2438	817.229	1015521.0
Moving Average	3203	702.02	835869.2
Exponential Smoothing	3111.392	689.946	749797.3
Exponential Smoothing with Trend	2958.663	749.275	858760.7
Linear Trend	3214.641	590.721	559374.6

Based on this comparison, it can be concluded that the optimal forecasting method for Facial Wash for Sensitive Skin demand forecasting is to use the Linear Trend method to produce the smallest MAD and MSE values, where the MAD value is 590,721, and the MSE value is 559374.6. (Table 4)

Table 5. Results of Calculation of Facial Wash Sensitive Data for 2017

Month	Request
January 2017	3214.641
February	3228.286
March	3241.93
April	3255.574
May	3269.219
June	3282.863
July	3296.507

August	3310.151
September	3323.796
October	3337.44
November	3351.084
December	3364.729
TOTAL	39476.22

Therefore, forecasting demand in 2017 for Facial Wash Sensitive using the Linear Trend method is 39476.22. (Table 5)

3.3 Comparison of forecast results for Facial Wash Brightening
Based on the results of calculations that have been done with the help of POM QM for Windows 4, we get a comparison of the results as in the Table 6:

Table 6. Comparison of Facial Wash Brightening Forecasting Results

Method	Forecast	MAD	MSE
Naive Approach	2315	431.771	351628.6
Moving Average	2018.333	418.697	291650.5
Exponential Smoothing	2151.796	407.108	263410
Exponential Smoothing with Trend	2187.465	422.126	303332.2
Linear Trend	2218.433	344.07	180364.5

Based on this comparison, it can be concluded that the optimal forecasting method for Brightening Facial Wash demand forecasting is to use the Linear Trend method to produce the lowest MAD and MSE values, where the MAD value is 344.07, and the MSE value is 180364.5.

Table 7. Calculation of Facial Wash Brightening Data for 2017

Month	Request
January 2017	2218.433
February	2247.421
March	2276.408
April	2305.396
May	2334.383
June	2363.37
July	2392.358
August	2421.345
September	2450.333
October	2479.32
November	2508.307
December	2537.295
TOTAL	28534.369

Therefore, forecasting demand in 2017 for Facial Wash Brightening using the Linear Trend method is 28534,369. (Table 7)

3.4 Forecasting Results Number of Requests for Facial Wash Acne II, Facial Wash Sensitive, Facial Wash Brightening in the 2017 Period with POM QM Calculation for Windows 4

The following are the results of forecasting the number of Facial Wash requests Table 8:

Table 8. Facial Wash Forecasting Results

Product	Forecasting Method	Forecasting Results
Facial Wash Acne II	*Linear Trend*	113481 bottle
Facial Wash Sensitive	*Linear Trend*	39477 bottle
Facial Wash Brightening	*Linear Trend*	28535 bottle

The results of forecasting demand for the 2017 period with the linear trend method will be one of the constraint functions in linear programming to optimize what must be produced.

3.5 Production Optimization Solution with POM QM For Windows 4

The following are the results of optimizing the production of PT. XYZ with linear programming Table 9.

Table 9. Production Optimization with POM QM For Windows 4

	FW Acne II	*FW Sensitive*	*FW Brightening*		RHS
Maximize	19800	17500	16800		
Production Capacity	1	1	1	$\leq$	172800
Biosulfur Fluid	0.006	0	0	$\leq$	6600
Comperlan KDT	0.0144	0.028	0.038	$\leq$	64800
Euxyl PE 9010	0.0048	0	0	$\leq$	4800
Texapon N705	0.1576	0.1	0.1	$\leq$	228000
DehytonKe-As	0.05	0.1	0.1	$\leq$	210000
Citric Acid	0.005	0.0003	0.001	$\leq$	2400
Edta 2 NA	0.001	0.001	0.001	$\leq$	3960
NaCl	0.022	0	0	$\leq$	4800
EcocerolGlyserin	0	0.03	0.03	$\leq$	91200
PhytoliquidComomile B6	0	0.005	0	$\leq$	6000
Nipoguard DMDMH	0	0.002	0.001	$\leq$	2400
Niacinamide PC	0	0	0.01	$\leq$	3120
Request for Facial Wash Acne II	1	0	0	$\leq$	113481
Request for Sensitive Facial Wash	0	1	0	$\leq$	39477
Request for Facial Wash Brightening	0	0	1	$\leq$	28535
Solutions	113481	39477	19842	Optimal	3,271,117,000

Based on the results of linear programming calculations using POM QM for Windows 4 to optimize production in the 2017 period: facial wash acne II, PT. XYZ should manufacture 113481 bottles, 39477 bottles of sensitive facial wash and 19842 bottles of brightening facial wash. By following the planning results for optimizing facial wash production for the 2017 period above, PT. XYZ can get a profit of Rp 3,271,117,000.

4. Conclusion

4.1 Conclusion
Based on research that has been done, the conclusions obtained are as follows:

1.The most optimal forecasting method for PT. XYZ for predicting the demand for a facial wash in the 2017 period is the linear trend method. Using the linear trend forecasting method, production results for the 2017 period are obtained with POM QM for Windows 4, 113481 bottles of Facial Wash Acne II, 39477 bottles of Facial Wash for sensitive skin, and 28535 bottles of Brightening Facial Wash.

2. By using the linear programming method, the optimal amount of production for the 2017 period with POM QM for Windows 4 is Facial Wash for Acne II was 113481 bottles, Facial Wash for Sensitive Skin was 39477 bottles and Brightening Facial Wash was 19842 bottles. As well as the total profits to be gained by PT. XYZ in 2017 is Rp. 3,271,117,000.

4.2 Suggestion
Based on this research, suggestions that researchers can provide to PT. XYZ is as follows:
1. For forecasting in the next period, PT. XYZ should use the linear trend method. This method can help companies find out the number of requests in the future. To optimize the amount of production and maximize profits, PT. XYZ should use the linear programming method.
2. Subject should analyze the company's current production system because there is a fairly large slack. If there is a large amount of Slack / Surplus, PT. XYZ can reduce this amount. This is done to prevent waste in the production process.

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