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## Forecasting Methods and Implementation of DRP (Distribution Requirement Planning) Methods in Determining the Master Production Schedule

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# Forecasting Methods and Implementation of DRP (Distribution Requirement Planning) Methods in Determining the Master Production Schedule

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**Abstract.** PT ABC President Indonesia is a manufacturing company engaged in the food sector by producing ABC noodles and Nu Greentea. At PT ABC President Indonesia, the production scheduling process is one of the main processes carried out to determine the number of products that must be produced. Based on the problems that occur regarding stock, it is proposed that the best forecasting method is based on the time series of each Distribution Centre (DC) and processing Distribution Centre (DC) requests using the Distribution Requirement Planning (DRP) method. Where the DRP method is used, so that the company can meet the demand of every DC so that there is no shortage of products and the production process continues to run without the company experiencing losses. In addition, with the use of DRP method there will be additional stock so that if there is a defect, the company still has stock remaining so that it can still meet the customer demands for each DC and the product distribution process runs more regularly.

**Keywords:** Forecasting Method, Distribution Requirement Planning Method, Stock.

## 1. Introduction

In this era, the industrial world is growing rapidly. This can be seen, where many manufacturing companies are engaged in various industrial fields. To be able to survive and compete with other manufacturing companies, a company must be able to produce products that have good quality and are able to maintain the level of satisfaction of customers towards the products produced by the company.

One way to maintain and compete with other companies is to create a good production system and one which is mutually integrated by considering many things. One of them considers the production scheduling carried out and the distribution flow carried out in a company. Production scheduling is one important aspect of a company where a good production scheduling strategy can minimize losses and increase customer satisfaction with the product being produced. One of the losses that can happen is that there are several requests from customers that cannot be fulfilled due to delay in the distribution process to customers. So, if there is an unfulfilled demand, it will reduce the level of corporate service to customers and can reduce the level of customer satisfaction with the product being produced. This could cause the possibility that customers will switch to competing products.

PT ABC President Indonesia is a manufacturing company that produces noodles and beverages such as Nu Greentea. In the world of the food industry, there are often uncertainties in the time and number of products ordered by customers. This results in an excess or lack of stock which was



sometimes experienced by PT ABC President Indonesia where PT ABC President Indonesia implemented the make to stock system. The existence of excess or lack of stock sometimes results in losses such as the existence of slow moving (products that are not distributed), non-fulfillment of customer demand, or the existence of products that cannot be consumed again. The importance of strategies in production scheduling can be used as a solution to overcome the problems that occur.

Therefore, in this study, the topic raised was about production scheduling planning by implementing the DRP method (Distribution Requirement Planning). The DRP method is a distribution planning method using several control parameters to calculate product requirements at each distribution point. The advantage of the DRP method is that the DRP method is centered on the demand of each depot or agent so that the production process will be scheduled based on requests from each depot or agent. Where using the DRP method can provide recommendations on the production master schedule and can overcome the stock issues at PT ABC President Indonesia.

## **2. Methods**

In this study, DRP (Distribution Requirement Planning) was used as a research model. DRP is Distribution resource planning (DRP) is a method used in business administration for planning orders within a supply chain. DRP enables the user to set certain inventory control parameters (like a safety stock) and calculate the time-phased inventory requirements. The method in this study consisted of: (1) preparation, (2) research design, and (3) data collection (4) data processing.

### *2.1. Preparation*

In the preparation phase in this study, identification of real conditions was conducted at PT ABC President Indonesia through observation (direct research in the field) as well as the interview process with parties from several. In addition, in this phase literature studies from books and research journals are carried out to discuss method used in this study, namely the forecasting techniques, DRP method, and MPS.

### *2.2. Research Design*

DRP is carried out to identify problems in the questions related to the topic of the issue to be discussed which focused on the problems regarding the existence of undistributed products experienced by PT ABC President Indonesia. By using DRP, product production is regulated to meet the demand until the next product production arrives for each distribution center. In making MPS using the DRP method, a forecast is needed from each DC to estimate the number of products that must be produced. With the determination of good forecast methods, the forecast has a lesser error value so there is no excess stock.

### *2.3. Data Collection*

This research was conducted at PT ABC President Indonesia by means of observation (direct research in the field) as well as the interview process with parties from several divisions on questions related to the topic of the issue to be discussed which focused on the problems regarding the existence of undistributed products experienced by PT ABC President Indonesia. The data collected consists of historical data requests, lead times of each distribution center, stock from each DC and available distribution centers.

### *2.4. Data Processing*

The first data processing is to determine the time series plot of each DC. The time series plot determination aims to find out the exact demand forecasting method in accordance with the available data. Then the forecasting process is carried out using the selected method. After forecasting process, the process of determining the proposed lot size for each DC is appropriate and continued with the calculation of the Master Production Schedule with the DRP method by considering the safety stock

and the remaining stock. Where the results of the data processing are the MPS proposal for the 2018 period for the production of Alfamart private label noodles.

### 3. Result and Discussion

The method used in the study is the DRP method but is closely related to the DRP method with forecasting. Because the data obtained from the company is only in the form of historical data requests per DC so that forecasting needs to be done first so that the existing data can be used for subsequent DRP calculations. The data collected was the data from distribution centre at PT ABC President Indonesia for Alfamart ABC private label noodles, and lead time data and inventory for each DC spread on the island of Java.

**Table 1.** Data Demand from each DC at Java Island

Bulan	DC 1	DC 2	DC 3	DC 4	DC 5	DC 6	DC 7	DC 8	DC 9	DC 10	Total
January	1636	795	392	840	448	400	336	1060	1976	736	8619
February	1674	1078	672	756	728	220	560	860	2228	1060	9836
March	2215	404	336	504	112	414	0	1260	2264	732	8241
April	1400	514	504	196	616	612	168	780	1274	898	6962
May	1588	1404	322	728	728	580	952	100	2382	2170	10954
June	3450	846	868	1008	504	0	168	1940	2072	420	11276
July	2276	1010	224	84	700	220	784	1080	1803	916	9097
August	1872	1538	560	468	476	220	504	760	1760	620	8778
September	1160	794	210	264	434	384	420	625	1386	328	6005
October	1244	630	336	416	0	212	56	251	2218	534	5897
November	908	1102	126	340	42	280	196	500	2575	1156	7225
December	1334	772	252	290	156	360	796	880	1348	202	6390

The above data was obtained from requests for each DC Alfamart for 2017.

**Table 2.** Lead Time Data

DC	Lead Time (month)	DC	Lead Time (month)
1	1	5	2
2	2	6	1
3	2	7	1
4	2	8	1
		9	1

The data above was the ordering time data from each DC to the time the product arrived at each DC.

**Table 3.** Project Data on Hand for Every DC

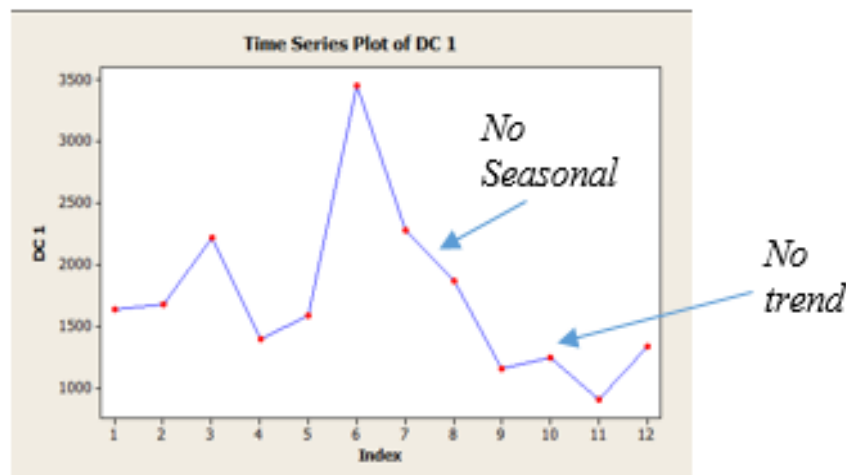
DC	Project On Hand	DC	Project On Hand
1	160	6	160
2	200	7	160
3	80	8	200
4	200	9	360
5	160	10	360

The data above shows the project on hand data that is owned by each DC where the data above is obtained from the product remaining in each DC at the end of 2017 (December 2017). Besides that, the other data needed to calculate the DRP method is that the lot used is Fixed Order Quantity (FOQ) of 40 pcs or multiples thereof for each order.

### 3.1. Forecasting

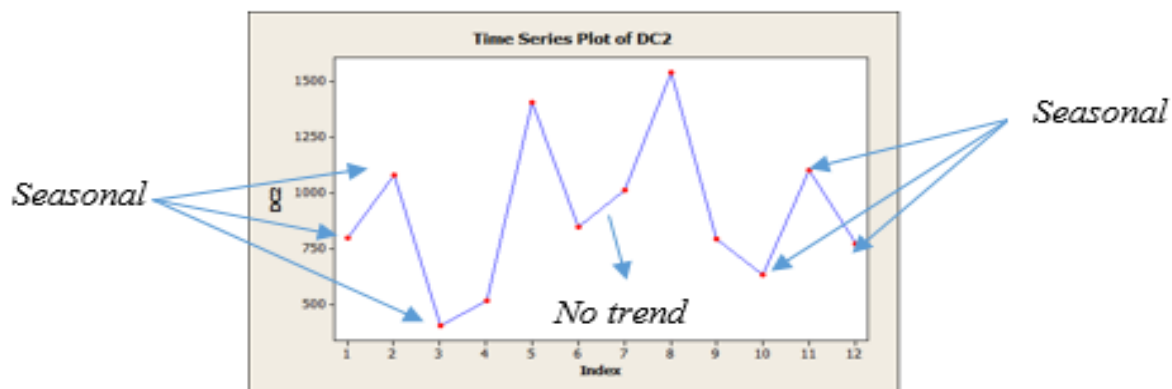
#### 3.1.1. Time Series Plot

Time Series is used to find out the graphic form of each DC to determine the correct forecasting method.



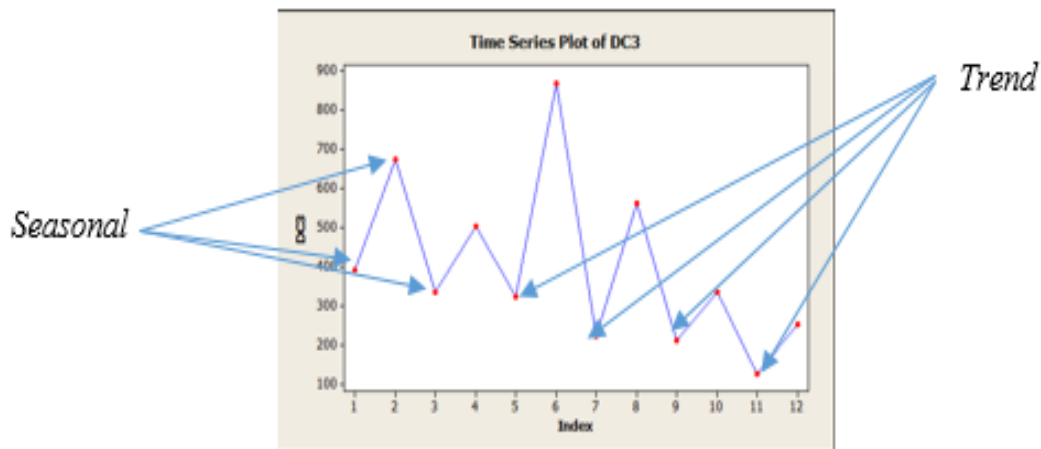
**Figure 1.** Time Series Plot DC 1

Based on the picture above, it can be seen that the form of the DC 1 time series plot graph shows the form of non-trendy data due to the absence of rising or falling and non-seasonal demand trends due to the absence of a repetitive pattern in the request data. This means forecasting methods that must be used are Moving Average and Single Exponential.



**Figure 2.** Time Series Plot DC 2

Based on the picture above, it can be seen that the form of the DC 2 time series plot graph shows the form of non-trendy and seasonal data with a period of 3 periods as in the 1-2-3 period and 10-11-12 period. Seasonal said despite having the same pattern at the end of the data, due to limited data taken only 12 periods so that there is a possibility of a repeat pattern that is not visible on this graph. This means that the forecasting method that must be used is Decomposition of Additive and Multiplicative and Winter Additive and Multiplicative.

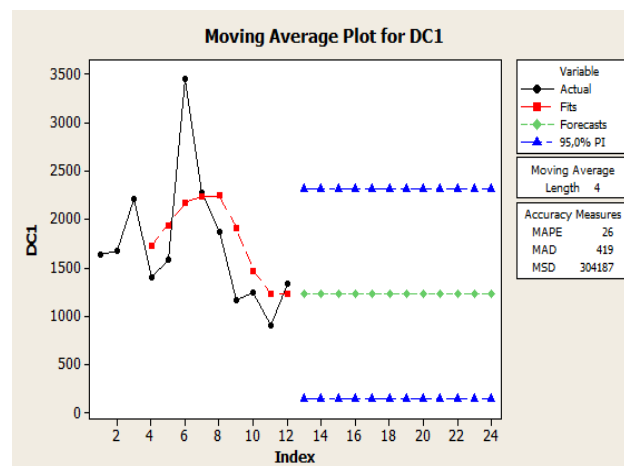


**Figure 3.** Time Series Plot DC 3

Based on the picture above, it can be seen that the shape of the DC 3 time series plot graph shows the form of trend (declining) data which can be seen in odd periods (1-3-5-7-9-11) which tends to decrease and seasonal with interval 2 period seen in the pattern of periods 1-2-3, 3-4-5, 5-6-7, 7-8-9, 9-10-11. This means that the forecasting method that must be used is Decomposition of Additive and Multiplicative and Winter Additive and Multiplicative.

### 3.1.2. Forecasting

Forecasting is done using MINTAB 17 software. Here are the results of forecasting:



**Figure 4.** Double Moving Average for DC 1

Forecasting results above, which must be considered, is the magnitude of the error value listed where the error values listed are MAPE, MAD, and MSD.

### 3.1.3. Accuracy

After forecasting, all the resulting error values are recapitulated and compared to what method has the smallest error value.

**Table 4.** Accuracy Table from DC 1

<i>Distribution Center 1</i>			
	<i>Moving Average</i>		<i>Single Exponential Smoothing</i>
	<i>Double Moving Average</i>	<i>Single Moving Average</i>	
<b>MAPE</b>	26	42	31
<b>MAD</b>	419	643	489
<b>MSD</b>	304187	730327	462683

Based on the recapitulation of DC 1 accuracy level it can be seen that the best forecasting method used for DC 1 is the Double Moving Average method because the error value of the Double Moving Average method is the smallest error value indicating that the error of the forecasting method is smaller than the 2 methods others.

**Table 5.** Results of Forecasting Every DC

Period	DC 1	DC 2	DC 3	DC 4	DC 5	DC 6	DC 7	DC 8	DC 9	DC 10
13	1229	723	115	350	198	292	331	549	1934	608
14	1229	1306	192	350	198	292	331	549	1934	608
15	1229	694	69	350	198	292	331	549	1934	608
16	1229	723	97	350	198	292	331	549	1934	608
17	1229	1306	24	350	198	292	331	549	1934	608
18	1229	694	2	350	198	292	331	549	1934	608
19	1229	723	0	350	198	292	331	549	1934	608
20	1229	1306	0	350	198	292	331	549	1934	608
21	1229	694	0	350	198	292	331	549	1934	608
22	1229	723	0	350	198	292	331	549	1934	608
23	1229	1306	0	350	198	292	331	549	1934	608
24	1229	694	0	350	198	292	331	549	1934	608

The table above is a request recapitulation table obtained from the MINITAB software according to the chosen forecasting method. For the period, it starts with the period 13-24 which indicates that the forecasting is forecasting for the period January - December 2018.

### 3.1.4. Distribution Requirement Planning (DRP)

**Table 6.** DRP Calculation Table for DC 1

<b>DRP DC 1</b>												
<b>FOQ = 40</b>		<b>Lead Time = 1</b>		<b>Safety Stock = 0</b>		<b>On Hand = 160</b>						
Periode	0	1	2	3	4	5	6	7	8	9	10	11
Gross Requirement		1229	1229	1229	1229	1229	1229	1229	1229	1229	1229	1229
Schedule Receipt		0	0	0	0	0	0	0	0	0	0	0
Project on Hand	160	11	22	33	4	15	26	37	8	19	30	1
Net Requirement		1069	1218	1207	1196	1225	1214	1203	1192	1221	1210	1199
Planned Order Receipt		1080	1240	1240	1200	1240	1240	1240	1200	1240	1240	1240
Planned Order Release	1080	1240	1240	1200	1240	1240	1240	1200	1240	1240	1200	1240

Calculation example:

- Gross Requirement: obtained from DC forecasting results 1
- Project on Hand: obtained from production at the end of 2017 for DC 1 for period 1
- Planned Order Receipt - Net Requirements =  $1080 - 1069 = 11$
- Net Requirement: Gross Requirement - Project on Hand =  $1229 - 160 = 1069$
- Planned Order Receipt: FOQ = 40 then multiples of 40 where  $40 \times 27 = 1080$
- Planned Order Release: Based on lead time (1 month).

Data in Table 6 describes the calculation of Distribution Requirement Planning for DC 1, where the data needed in this calculation is the gross requirement data, receipt schedule, and project on hand. Gross requirement is the number of requests from each DC obtained from the prediction that has been done previously with the chosen forecasting method. For the receipt schedule, a product that has been scheduled will be ordered by the company. In this case the receipt schedule is 0 because the company produces its own product without the presence of other companies to produce the noodle product. As for the project on hand, the stock available to the company is taken from the remaining production in the previous month. The results from Table 6 are scheduling of each distribution for each month by considering things like gross requirement data, receipt schedule, and project on hand and lot size of each distribution.

### 3.1.5. Master Production Schedule (MPS)

**Table 7. MPS Table**

MPS												
Quantity	1	2	3	4	5	6	7	8	9	10	11	12
	6320	6240	6840	6200	6280	6760	6160	6240	6760	6200	4960	0

MPS calculation is obtained from recapitulation of period 1 to period 12 by adding up each DC. Data in Table 7 is an MPS table where the MPS value is obtained from the combination of each DC where the merge is obtained by planned order release. The relation from tables 6 and 7 is that after the calculation of table 6, it is obtained that the planned order release from each DC is combined so that it becomes the total that must be produced in one month.

### 3.1.6. Analysis

Based on observations made at PT ABC President Indonesia, it can be seen that the current production scheduling process is still not optimal. It is said that it is not optimal because there are still several distribution centres that place orders simultaneously so that there is a bottleneck in the product distribution process and there are some DCs that are not fulfilled; the demand caused by the existing process has not been able to collect in line with existing requests.

Based on the problems at PT ABC President Indonesia above, the authors recommend Proposed Forecasting Methods and Implementation of the DRP Method (Distribution Requirement Planning) in Determining Production Master Schedules. In the forecasting method, the time series plot is carried out in advance on the request data to determine the trend pattern of demand data where there are 2 types of data plots, namely seasonal trend and data. For trend data are time series data where there is a tendency for demand to rise or fall. As for seasonal data, the data that is formed has a tendency to repeat over a period of time.

After determining the demand pattern using a time series plot, it can be known that the forecasting method is in accordance with the time series plot of each DC. For DC 1,4,5,6,7,8,9 and 10 because it has a non-trendy and non-seasonal pattern, the Moving Average and Single Exponential Smoothing forecasting methods are used. For DC 2 and 3 using the Decomposition and Winter methods.



Furthermore, data processing is performed using forecasting methods that are in accordance with the time series.

In the forecasting process, MINITAB software was used. In processing data by using this software, in addition to obtaining forecasting results, an error value from the forecasting is also obtained. This error value indicates the magnitude of the forecasting error or non-conformity that is carried out with the conditions that will occur in the future. Therefore, in choosing the best forecasting method, we need to pay attention to the error value where from all DCs look for a method that has the smallest error value where the error value used is MAPE, MAD and MSD which will show a more accurate level of data accuracy than forecasting data with use other methods. After forecasting it will proceed to the calculation using the DRP method.

The use of the DRP method is intended to collect all requests from each DC by considering the lead time, lot and the number of requests from each DC so that the company can meet the existing demand without stock out or stock shortage. Forecasting data on data processing is used as a gross requirement (GR) because the DRP method is assessed for the number of products to be produced for the next 1 year period where this assessment uses historical data one year earlier.

The period in DRP starts from period 0-12 but in reality the period starts in period 1 while the use of period 0 in the DRP method is due to the existence of project on hand which a stock before the commencement of production is. In DRP there is also a safety stock where the stock is a stock of deposits. However, in this case, the safety stock is assumed to be zero because the product produced is a food product whose storage period cannot be too long so that if used as a safety stock can cause risks such as expired products, product damage, and large storage costs.

The lot sizing method used for each DC is a fixed order quantity of 40 pcs. Where this determination is based on the agreement of the company with Alfamart where the order is at least 1 box where 1 box contains 40 pcs of ABC noodles. So the ordering process can be done by ordering 40 pcs of noodles or multiples. The results of this DRP are Production Master Schedule or MPS which is obtained from the sum of planned order releases for each DC in the same period.

Based on the research and analysis that has been done, the evaluation that must be done is the importance of the accuracy of forecasting methods and the use of the DRP method can affect the amount of product production each period. With the forecasting method and the proposed DRP method, it can minimize unmet demand for each DC.

#### 4. Conclusion

The best forecasting method to do on DC 1, 4, and 5,6,7,8,9,10 is Double Moving Average, DC 2 is Decomposition Additive and DC 3 is Multiplicative Decomposition. In the calculation of MPS with the DRP method, the results show that the number of production in period 1 is 6320 pcs, period 2 is 6240 pcs, period 3 is 6840 pcs, period 4 is 6200 pcs, period 5 is 6280 pcs, period 6 is 6760 pcs, period 7 is 6160 pcs, period 8 is 6240 pcs, period 9 is 6760, period 10 is 6200, and period 11 is 4960 pcs. By scheduling production using the DRP method, there is a stock due to the use of FOQ lot size so as to minimize the risk of not fulfilling the request if a defect occurs. Companies should forecast each DC so that more optimal forecasting is done. Production scheduling should be done per DC so that there is no miscalculation of product production. The limitations of the data in this study are due to historical data collection that was carried out only for 12 months. Suggestions for further research, it is better to take historical data for at least 2 years in order to see more clearly the time series plots available so that the results will be more optimal.

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