Moving Average Analysis of Plastic Production Yield in a Manufacturing Industry

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***Abstract*– This research work was used to address the problem of Analysis of the forecasting of plastic yield in Finoplastika manufacturing industry. Data on production yield were collected from the industry covering a period of three years. Forecasting based time series technique was applied to determine the optimum production yield in the industry and the behavior of the production system. Hence the model is fit for predicting the product total, since the coefficient of determination shows a strong relationship. The model was therefore used to suggest optimum monthly production output for different product types investigated. This will prevent the incident of under producing or over producing as identified.**

***Keywords*– Plastic, Production, Forecasting and Moving Average**

I. INTRODUCTION

Over the years, the company has made substantial progress. However there is no formalized way of determining what quantity of different products to be produced over any given period of time. This leads to inconsistencies in planning and production. To avoid any of these problems during production, there is a need to optimize in advance the quantity of products, in other to support decision making regarding quantity of the plastic products necessary for production in every month.

The objective of this report is to develop a time series technique and regression analysis in order:

- ✓ A "moving average" was developed from the data in order to predict the optimum production of product types investigated.
- ✓ To help us study the various components, that plays a major role in the decision making and market strategy.
- ✓ To optimize the Production planning system in the manufacturing industry.
- ✓ To make recommendation to the company based on the research findings.

Time-Series Forecasting: Univariate time series forecasting models make predictions by extrapolating the past behavior of the values of a particular single variable of interest (Moore & Weatherford, 2001). Successive observations in econometric time series are normally not independent and predictions may be made from previous observations (Chatfield, 1996). While exact forecasts are possible with deterministic time series, forecasts of stochastic time series are limited to "conditional statements about the future based on specific assumptions" (Chatfield, 1996). According to Armstrong (2001), "the basic assumption is that the variable will continue in the future as it has behaved in the past." Specifically, time series forecasts are appropriate for stochastic data where the underlying causes of variation – trend, cyclical behavior, seasonality, and irregular fluctuations – do not change significantly in time (Jenson, 2004). Hence, modeling is often more appropriate for short-term than for long-term forecasting.

Moving Average: one weakness of the naive method is that the forecast just traces the actual data, with a lag of one period; it does not smooth at all. But by expanding the amount of the historical data a forecast is based on, this difficulty can be overcome. A moving average forecast uses a number of the most recent actual data values in generating a forecast (Yaffee, 2000). The moving average forecast can be computed using the following equation:

$$F_t = MA_n = \frac{\sum_{i=1}^{n} A_{t-i}}{n}$$

Where, i= An index that corresponds to time periods

n= Number of periods (data points) in the moving average

A_i= Actual value in period $t - i$

MA=Moving average

F_t= Forecast for time period t

Weighted Moving Average: A weighted average is similar to a moving average, except that it assigns more weight to the most recent values in a time series.

In general,

$$F_t = W_n A_{t-n} + W_{n-1} A_{t-(n-1)} + w_1 A_{t-1}$$

For instance, the most recent value might be assigned a weight of .40, the next most recent value a weight of .30, the next after that a weight of .20, and the next after that a weight of .10. Note that the weights sum of 1.00 and that the heaviest weights are assigned to the most recent values (Delurgio, 1986).

Exponential Smoothing*: is* a sophisticated weighted averaging method that is still relatively easy to use and

understand. Each new forecast is based on the previous forecast plus a percentage of the difference between that forecast and the actual value of the series at that point. This is:
Next forecast = Previous forecast + α (Actual – Previous forecast)
Where (Actual – Previous forecast) represents the forecast error and α is a percentage of the error. More concisely,

$$F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1})$$

where F_t= Forecast for period t

F_{t-1}= Forecast for the previous period

α= Smoothing constant (represents the percentage of the forecast error)

A_{t-1}= Actual demand or sales for the previous period (Stevenson, 2005)

II. RESEARCH METHOD USED

The research method used in this work is a quantitative research approach. The data gathered were the daily record of plastic pipes production over the month for three years. The research method emphasis detailed analysis of the time series technique was also use to understand in details the analysis of the moving average that shows the optimization of the production yield of the data on monthly basis for a period of three years. The use of Minitab tool was applied for the development of various analyses and the achievement of the results.

Company Data Presentation: the company production quantity of the data is shown in Table 1.

Table 1: Presentation of 2009-2011 Monthly Data on Quantity of finished products of Finoplastika industries ltd, Nigeria

Year	*Month*	*PT*	*p1*	*p2*	*p3*	*p4*	*p5*	*p6*	*p7*	*p8*
2009	*Jan*	*50488*	*16526*	*3860*	*9618*	*15571*	*0*	*4493*	*420*	*0*
	Feb	*76031*	*29250*	*40*	*14773*	*10680*	*390*	*18718*	*2180*	*0*
	Mar	*74010*	*26666*	*9960*	*16571*	*11280*	*453*	*6740*	*2340*	*0*
	Apr	*123767*	*52029*	*10315*	*32339*	*11660*	*0*	*12940*	*4484*	*0*
	May	*70704*	*14160*	*17241*	*10788*	*14540*	*0*	*9560*	*4415*	*0*
	Jun	*47610*	*23087*	*2340*	*878*	*6146*	*0*	*8475*	*6684*	*0*
	Jul	*77654*	*29890*	*26785*	*15885*	*1140*	*0*	*3040*	*700*	*214*
	Aug	*61053*	*17981*	*20280*	*9062*	*1540*	*0*	*12140*	*50*	*0*
	Sep	*13538*	*3248*	*0*	*7570*	*2260*	*0*	*0*	*460*	*0*
	Oct	*21476*	*7045*	*7530*	*2611*	*2120*	*0*	*454*	*1716*	*0*
	Nov	*40561*	*16014*	*3768*	*5883*	*2980*	*0*	*6002*	*5914*	*0*
	Dec	*4871*	*3171*	*280*	*0*	*1160*	*0*	*260*	*0*	*0*
2010	*Jan*	*28462*	*7113*	*6311*	*8445*	*4693*	*0*	*1360*	*540*	*0*
	Feb	*16154*	*7284*	*0*	*4595*	*1760*	*0*	*390*	*2125*	*0*
	Mar	*70844*	*22119*	*24975*	*9535*	*7295*	*560*	*6340*	*20*	*0*
	Apr	*64666*	*21134*	*0*	*18843*	*15480*	*0*	*2930*	*6279*	*0*
	May	*46107*	*18848*	*4545*	*4497*	*4180*	*0*	*7760*	*6367*	*0*
	Jun	*49058*	*22172*	*4920*	*14296*	*2589*	*0*	*3733*	*1205*	*143*
	Jul	*33287*	*8767*	*13790*	*2351*	*2278*	*0*	*3040*	*3061*	*0*
	Aug	*37849*	*14790*	*1740*	*10885*	*3900*	*0*	*2080*	*4454*	*0*
	Sep	*29459*	*11975*	*0*	*15023*	*0*	*0*	*1360*	*1101*	*0*
	Oct	*25738*	*5518*	*2245*	*5049*	*1740*	*583*	*3760*	*6843*	*0*
	Nov	*35740*	*17532*	*1830*	*9948*	*3640*	*60*	*2730*	*0*	*0*
	Dec	*60455*	*18452*	*360*	*9489*	*8120*	*0*	*280*	*23754*	*0*
2011	*Jan*	*53480*	*22225*	*160*	*20184*	*3724*	*651*	*2860*	*2860*	*816*
	Feb	*31729*	*14123*	*2140*	*4721*	*5620*	*0*	*2340*	*1408*	*1377*
	Mar	*42625*	*14502*	*2200*	*11137*	*6680*	*262*	*7600*	*0*	*244*
	Apr	*36237*	*16014*	*910*	*1970*	*8880*	*0*	*4560*	*3497*	*406*
	May	*63066*	*24134*	*1062*	*21265*	*7720*	*255*	*8060*	*570*	*0*
	Jun	*60997*	*29097*	*5300*	*20838*	*16160*	*607*	*7750*	*0*	*0*
	Jul	*61892*	*16981*	*17170*	*6210*	*7500*	*605*	*10822*	*2604*	*0*
	Aug	*58988*	*17298*	*7545*	*11877*	*11420*	*733*	*6020*	*4095*	*0*
	Sep	*41820*	*5617*	*20085*	*2421*	*5980*	*277*	*6820*	*620*	*0*
	Oct	*69547*	*20631*	*5960*	*16326*	*6220*	*604*	*14310*	*5496*	*0*
	Nov	*11616*	*4391*	*0*	*1720*	*4173*	*52*	*1280*	*0*	*0*
	Dec	*29053*	*11909*	*1760*	*1706*	*6610*	*558*	*6510*	*0*	*0*

III. METHOD OF DATA ANALYSIS

In the method of data analysis, some group of data were analyzed by using moving average to optimize the production yield, seasonal influence and regression analysis to show the change in the independent that was explained in the dependent in the manufacturing industry. The use of minitab tool was made to test for the various analyses.

A. Estimation of Trend using a 12 month Centered Moving Average

Table 1 will be used to find the 'linear' trend line-storage for the monthly number of total products of the finished products. Since, the data exhibit a natural 12- monthly cycle, the method of moving average is used. Below is the summary of the moving average analysis using the Minitab.

Moving average

```
Data         pT
Length       36.0000
NMissing     0

Moving Average
Length: 12

Accuracy Measures
MAPE:        47
MAD:      14366
MSD:   3.15E+08
```

Row	Period	pT	MA	Predict	Error
1	1	50488	*	*	*
2	2	76031	*	*	*
3	3	74010	*	*	*
4	4	123767	*	*	*
5	5	70704	*	*	*
6	6	47610	*	*	*
7	7	77654	54229.2	*	*
8	8	61053	50816.5	*	*
9	9	13538	48189.8	*	*
10	10	21476	45595.3	*	*
11	11	40561	42107.9	*	*
12	12	4871	41143.3	*	*
13	13	28462	39355.0	*	*
14	14	16154	36539.6	54229.2	-38075.2
15	15	70844	36236.1	50816.5	20027.5
16	16	64666	37077.1	48189.8	16476.3
17	17	46107	37053.8	45595.3	511.7
18	18	49058	39168.9	42107.9	6950.1
19	19	33287	42527.3	41143.3	-7856.3
20	20	37849	44218.7	39355.0	-1506.0
21	21	29459	43691.9	36539.6	-7080.6
22	22	25738	41331.5	36236.1	-10498.1
23	23	35740	40853.6	37077.1	-1337.1
24	24	60455	42057.7	37053.8	23401.2
25	25	53480	43747.0	39168.9	14311.1
26	26	31729	45819.7	42527.3	-10798.3
27	27	42625	47215.5	44218.7	-1593.7
28	28	36237	49556.0	43691.9	-7454.9
29	29	63066	50376.2	41331.5	21734.5
30	30	60997	48062.6	40853.6	20143.4
31	31	61892	*	42057.7	19834.3
32	32	58988	*	43747.0	15241.0
33	33	41820	*	45819.7	-3999.7
34	34	69547	*	47215.5	22331.5
35	35	11616	*	49556.0	-37940.0
36	36	29053	*	50376.2	-21323.2

Moving average

```
Data         p1
Length       36.0000
NMissing     0

Moving Average
Length: 12

Accuracy Measures
MAPE:        54
MAD:       5388
MSD:   46170383
```

Row	Period	p1	MA	Predict	Error
1	1	16526	*	*	*
2	2	29250	*	*	*
3	3	26666	*	*	*
4	4	52029	*	*	*
5	5	14160	*	*	*
6	6	23087	*	*	*
7	7	29890	19530.0	*	*
8	8	17981	18222.6	*	*
9	9	3248	17117.9	*	*
10	10	7045	15641.1	*	*
11	11	16014	14549.2	*	*
12	12	3171	14706.4	*	*
13	13	7113	13788.1	*	*
14	14	7284	12775.0	19530.0	-12246.0
15	15	22119	13005.7	18222.6	3896.4
16	16	21134	13305.7	17117.9	4016.1
17	17	18848	13305.3	15641.1	3206.9
18	18	22172	14005.3	14549.2	7622.8
19	19	8767	15271.7	14706.4	-5939.4
20	20	14790	16186.3	13788.1	1001.9
21	21	11975	16153.9	12775.0	-800.0
22	22	5518	15623.2	13005.7	-7487.7
23	23	17532	15630.1	13305.7	4226.3
24	24	18452	16138.9	13305.3	5146.7
25	25	22225	16769.7	14005.3	8219.7
26	26	14123	17216.4	15271.7	-1148.7
27	27	14502	17056.0	16186.3	-1684.3
28	28	16014	17420.8	16153.9	-139.9
29	29	24134	17503.0	15623.2	8510.8
30	30	29097	16682.8	15630.1	13466.9
31	31	16981	*	16138.9	842.1
32	32	17298	*	16769.7	528.3
33	33	5617	*	17216.4	-11599.4
34	34	20631	*	17056.0	3575.0
35	35	4391	*	17420.8	-13029.8
36	36	11909	*	17503.0	-5594.0

Moving average

```
Data         p2
Length       36.0000
NMissing     0

Moving Average
Length: 12

Accuracy Measures
MAPE:       347
MAD:       5943
MSD:   53869968
```

Row	Period	p2	MA	Predict	Error
1	1	3860	*	*	*
2	2	40	*	*	*
3	3	9960	*	*	*

4	4	10315	*	*	*
5	5	17241	*	*	*
6	6	2340	*	*	*
7	7	26785	8635.38	*	*
8	8	20280	8735.83	*	*
9	9	0	9359.79	*	*
10	10	7530	9555.63	*	*
11	11	3768	8596.83	*	*
12	12	280	8175.33	*	*
13	13	6311	7741.38	*	*
14	14	0	6427.42	8635.38	-8635.4
15	15	24975	5654.92	8735.83	16239.2
16	16	0	5434.71	9359.79	-9359.8
17	17	4545	5133.75	9555.63	-5010.6
18	18	4920	5056.33	8596.83	-3676.8
19	19	13790	4803.38	8175.33	5614.7
20	20	1740	4636.25	7741.38	-6001.4
21	21	0	3776.46	6427.42	-6427.4
22	22	2245	2865.42	5654.92	-3409.9
23	23	1830	2758.21	5434.71	-3604.7
24	24	360	2628.92	5133.75	-4773.8
25	25	160	2785.58	5056.33	-4896.3
26	26	2140	3168.29	4803.38	-2663.4
27	27	2200	4247.04	4636.25	-2436.3
28	28	910	5238.71	3776.46	-2866.5
29	29	1062	5317.25	2865.42	-1803.4
30	30	5300	5299.33	2758.21	2541.8
31	31	17170	*	2628.92	14541.1
32	32	7545	*	2785.58	4759.4
33	33	20085	*	3168.29	16916.7
34	34	5960	*	4247.04	1713.0
35	35	0	*	5238.71	-5238.7
36	36	1760	*	5317.25	-3557.3

Moving average

Data p3
Length 36.0000
NMissing 0

Moving Average
Length: 12

Accuracy Measures
MAPE: 130
MAD: 5841
MSD: 46743842

Row	Period	p3	MA	Predict	Error
1	1	9618	*	*	*
2	2	14773	*	*	*
3	3	16571	*	*	*
4	4	32339	*	*	*
5	5	10788	*	*	*
6	6	878	*	*	*
7	7	15885	10449.3	*	*
8	8	9062	9976.3	*	*
9	9	7570	9259.1	*	*
10	10	2611	8403.6	*	*
11	11	5883	7579.1	*	*
12	12	0	7876.1	*	*
13	13	8445	7871.3	*	*
14	14	4595	7383.3	10449.3	-5854.3
15	15	9535	7769.8	9976.3	-441.3
16	16	18843	8181.9	9259.1	9583.9
17	17	4497	8452.9	8403.6	-3906.6
18	18	14296	9017.6	7579.1	6716.9
19	19	2351	9902.1	7876.1	-5525.1
20	20	10885	10396.5	7871.3	3013.8
21	21	15023	10468.5	7383.3	7639.7
22	22	5049	9832.2	7769.8	-2720.8
23	23	9948	9827.8	8181.9	1766.1
24	24	9489	10799.1	8452.9	1036.1
25	25	20184	11232.5	9017.6	11166.4
26	26	4721	11434.6	9902.1	-5181.1
27	27	11137	10950.8	10396.5	740.5
28	28	1970	10895.6	10468.5	-8498.5
29	29	21265	11022.7	9832.2	11432.8
30	30	20838	10355.5	9827.8	11010.2
31	31	6210	*	10799.1	-4589.1
32	32	11877	*	11232.5	644.5
33	33	2421	*	11434.6	-9013.6
34	34	16326	*	10950.8	5375.2
35	35	1720	*	10895.6	-9175.6
36	36	1706	*	11022.7	-9316.7

Moving average

Data p4
Length 36.0000
NMissing 0

Moving Average
Length: 12

Accuracy Measures
MAPE: 52
MAD: 2982
MSD: 17409189

Row	Period	p4	MA	Predict	Error
1	1	15571	*	*	*
2	2	10680	*	*	*
3	3	11280	*	*	*
4	4	11660	*	*	*
5	5	14540	*	*	*
6	6	6146	*	*	*
7	7	1140	6303.17	*	*
8	8	1540	5478.25	*	*
9	9	2260	4940.54	*	*
10	10	2120	4933.67	*	*
11	11	2980	4661.17	*	*
12	12	1160	4081.29	*	*
13	13	4693	3980.50	*	*
14	14	1760	4126.25	6303.17	-4543.2
15	15	7295	4130.42	5478.25	1816.8
16	16	15480	4020.42	4940.54	10539.5
17	17	4180	4032.08	4933.67	-753.7
18	18	2589	4349.58	4661.17	-2072.2
19	19	2278	4599.21	4081.29	-1803.3
20	20	3900	4719.67	3980.50	-80.5
21	21	0	4854.88	4126.25	-4126.3
22	22	1740	4554.25	4130.42	-2390.4
23	23	3640	4426.75	4020.42	-380.4
24	24	8120	5139.71	4032.08	4087.9
25	25	3724	5922.75	4349.58	-625.6
26	26	5620	6453.67	4599.21	1020.8
27	27	6680	7016.17	4719.67	1960.3
28	28	8880	7452.00	4854.88	4025.1
29	29	7720	7660.88	4554.25	3165.8
30	30	16160	7620.17	4426.75	11733.3
31	31	7500	*	5139.71	2360.3
32	32	11420	*	5922.75	5497.3
33	33	5980	*	6453.67	-473.7
34	34	6220	*	7016.17	-796.2
35	35	4173	*	7452.00	-3279.0
36	36	6610	*	7660.88	-1050.9

Moving average

Data p5
Length 36.0000
NMissing 0

Moving Average
Length: 12

Accuracy Measures
MAPE: 94.5
MAD: 206.2
MSD: 78431.8

Row	Period	p5	MA	Predict	Error
1	1	0	*	*	*
2	2	390	*	*	*
3	3	453	*	*	*
4	4	0	*	*	*
5	5	0	*	*	*
6	6	0	*	*	*
7	7	0	70.250	*	*
8	8	0	54.000	*	*
9	9	0	42.208	*	*
10	10	0	46.667	*	*
11	11	0	46.667	*	*
12	12	0	46.667	*	*
13	13	0	46.667	*	*
14	14	0	46.667	70.250	-70.250
15	15	560	46.667	54.000	506.000
16	16	0	70.958	42.208	-42.208
17	17	0	97.750	46.667	-46.667
18	18	0	100.250	46.667	-46.667
19	19	0	127.375	46.667	-46.667
20	20	0	154.500	46.667	-46.667
21	21	0	142.083	46.667	-46.667
22	22	583	129.667	46.667	536.333
23	23	60	140.292	70.958	-10.958
24	24	0	176.208	97.750	-97.750
25	25	651	226.708	100.250	550.750
26	26	0	282.458	127.375	-127.375
27	27	262	324.542	154.500	107.500
28	28	0	336.958	142.083	-142.083
29	29	255	337.500	129.667	125.333
30	30	607	360.417	140.292	466.708
31	31	605	*	176.208	428.792
32	32	733	*	226.708	506.292
33	33	277	*	282.458	-5.458
34	34	604	*	324.542	279.458
35	35	52	*	336.958	-284.958
36	36	558	*	337.500	220.500

Moving average
Data p6
Length 36.0000
NMissing 0

Moving Average
Length: 12

Accuracy Measures
MAPE: 167
MAD: 2674
MSD: 12873951

Row	Period	p6	MA	Predict	Error
1	1	4493	*	*	*
2	2	18718	*	*	*
3	3	6740	*	*	*
4	4	12940	*	*	*
5	5	9560	*	*	*
6	6	8475	*	*	*
7	7	3040	6771.29	*	*
8	8	12140	5877.08	*	*
9	9	0	5096.75	*	*
10	10	454	4663.00	*	*
11	11	6002	4170.92	*	*
12	12	260	3898.33	*	*
13	13	1360	3700.75	*	*
14	14	390	3281.58	6771.29	-6381.29
15	15	6340	2919.08	5877.08	462.92
16	16	2930	3113.50	5096.75	-2166.75
17	17	7760	3114.92	4663.00	3097.00
18	18	3733	2979.42	4170.92	-437.92
19	19	3040	3042.75	3898.33	-858.33
20	20	2080	3186.50	3700.75	-1620.75
21	21	1360	3320.25	3281.58	-1921.58
22	22	3760	3440.67	2919.08	840.92
23	23	2730	3521.08	3113.50	-383.50
24	24	280	3700.96	3114.92	-2834.92
25	25	2860	4192.58	2979.42	-119.42
26	26	2340	4681.00	3042.75	-702.75
27	27	7600	5072.67	3186.50	4413.50
28	28	4560	5739.75	3320.25	1239.75
29	29	8060	6118.92	3440.67	4619.33
30	30	7750	6318.08	3521.08	4228.92
31	31	10822	*	3700.96	7121.04
32	32	6020	*	4192.58	1827.42
33	33	6820	*	4681.00	2139.00
34	34	14310	*	5072.67	9237.33
35	35	1280	*	5739.75	-4459.75
36	36	6510	*	6118.92	391.08

Moving average
Data p7
Length 36.0000
NMissing 0

Moving Average
Length: 12

Accuracy Measures
MAPE: 800
MAD: 3344
MSD: 27072205

Row	Period	p7	MA	Predict	Error
1	1	420	*	*	*
2	2	2180	*	*	*
3	3	2340	*	*	*
4	4	4484	*	*	*
5	5	4415	*	*	*
6	6	6684	*	*	*
7	7	700	2451.92	*	*
8	8	50	2454.63	*	*
9	9	460	2355.67	*	*
10	10	1716	2333.79	*	*
11	11	5914	2489.92	*	*
12	12	0	2342.96	*	*
13	13	540	2213.04	*	*
14	14	2125	2494.92	2451.92	-326.9
15	15	20	2705.13	2454.63	-2434.6
16	16	6279	2945.46	2355.67	3923.3
17	17	6367	2912.67	2333.79	4033.2
18	18	1205	3656.00	2489.92	-1284.9
19	19	3061	4742.42	2342.96	718.0
20	20	4454	4809.21	2213.04	2241.0
21	21	1101	4778.50	2494.92	-1393.9
22	22	6843	4661.75	2705.13	4137.9
23	23	0	4304.29	2945.46	-2945.5
24	24	23754	4012.54	2912.67	20841.3
25	25	2860	3943.29	3656.00	-796.0
26	26	1408	3909.29	4742.42	-3334.4
27	27	0	3874.29	4809.21	-4809.2
28	28	3497	3798.13	4778.50	-1281.5
29	29	570	3742.00	4661.75	-4091.8
30	30	0	2752.25	4304.29	-4304.3
31	31	2604	*	4012.54	-1408.5
32	32	4095	*	3943.29	151.7
33	33	620	*	3909.29	-3289.3
34	34	5496	*	3874.29	1621.7
35	35	0	*	3798.13	-3798.1
36	36	0	*	3742.00	-3742.0

Moving average

```
Data        p8
Length      36.0000
NMissing    0

Moving Average
Length: 12

Accuracy Measures
MAPE:     75
MAD:     202
MSD:  128001
```

Row	Period	p8	MA	Predict	Error
1	1	0	*	*	*
2	2	0	*	*	*
3	3	0	*	*	*
4	4	0	*	*	*
5	5	0	*	*	*
6	6	0	*	*	*
7	7	214	17.833	*	*
8	8	0	17.833	*	*
9	9	0	17.833	*	*
10	10	0	17.833	*	*
11	11	0	17.833	*	*
12	12	0	23.792	*	*
13	13	0	20.833	*	*
14	14	0	11.917	17.833	-17.83
15	15	0	11.917	17.833	-17.83
16	16	0	11.917	17.833	-17.83
17	17	0	11.917	17.833	-17.83
18	18	143	11.917	17.833	125.17
19	19	0	45.917	23.792	-23.79
20	20	0	137.292	20.833	-20.83
21	21	0	204.833	11.917	-11.92
22	22	0	231.917	11.917	-11.92
23	23	0	248.833	11.917	-11.92
24	24	0	242.875	11.917	-11.92
25	25	816	236.917	11.917	804.08
26	26	1377	236.917	45.917	1331.08
27	27	244	236.917	137.292	106.71
28	28	406	236.917	204.833	201.17
29	29	0	236.917	231.917	-231.92
30	30	0	236.917	248.833	-248.83
31	31	0	*	242.875	-242.88
32	32	0	*	236.917	-236.92
33	33	0	*	236.917	-236.92
34	34	0	*	236.917	-236.92
35	35	0	*	236.917	-236.92
36	36	0	*	236.917	-236.92

Moving Average Plots for the Products

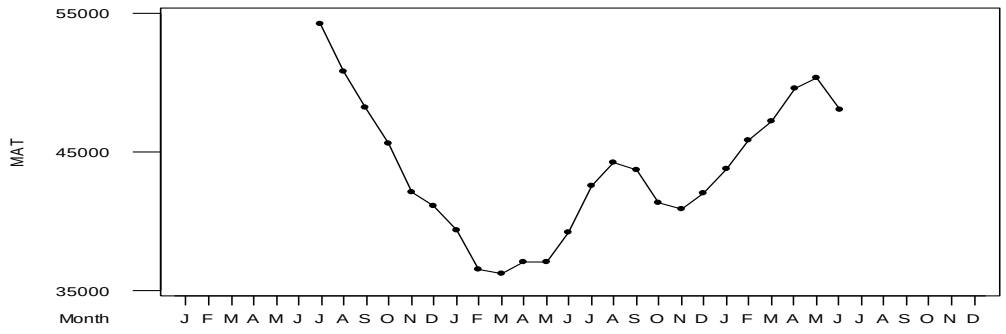

Figure 3: Moving Average for (PT) Data

Figure 3 is to show the moving average of the PT (i.e. production yield in units) product over a period of three years. It shows the average movement of the data over the period of time. When the moving average line is low, it means that there is small product of PT. But when it is high, it means that there is large quantity of the PT product.

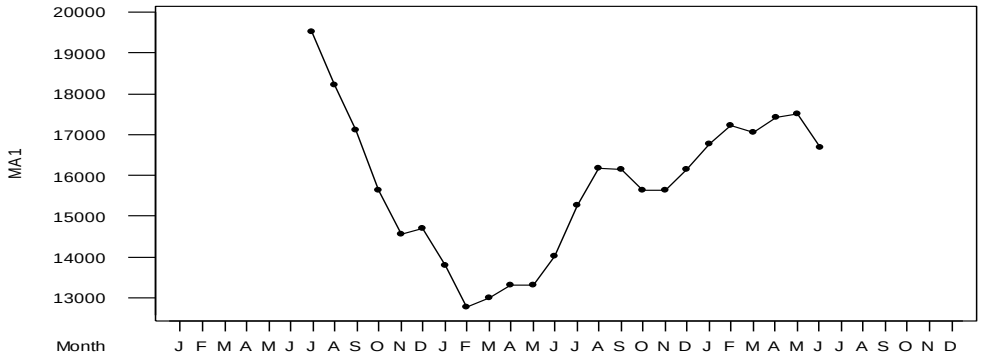

Figure 4: Moving Average for (P1) Data

Figure 4 is to show the moving average of the P1 (i.e. production yield in units) product over a period of three years. It shows the average movement of the data over the period of time. When the moving average line is low, it means that there is small product of P1. But when it is high, it means that there is large quantity of the P1 product.

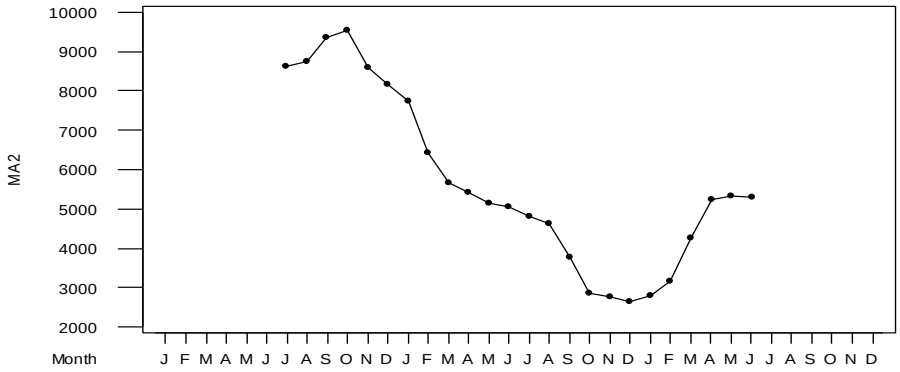

Figure 5: Moving Average for (P2) Data

Figure 5 is to show the moving average of the P2 (i.e. production yield in units) product over a period of three years. It shows the average movement of the data over the period of time. When the moving average line is low, it means that there is small product of P2. But when it is high, it means that there is large quantity of the P2 product.

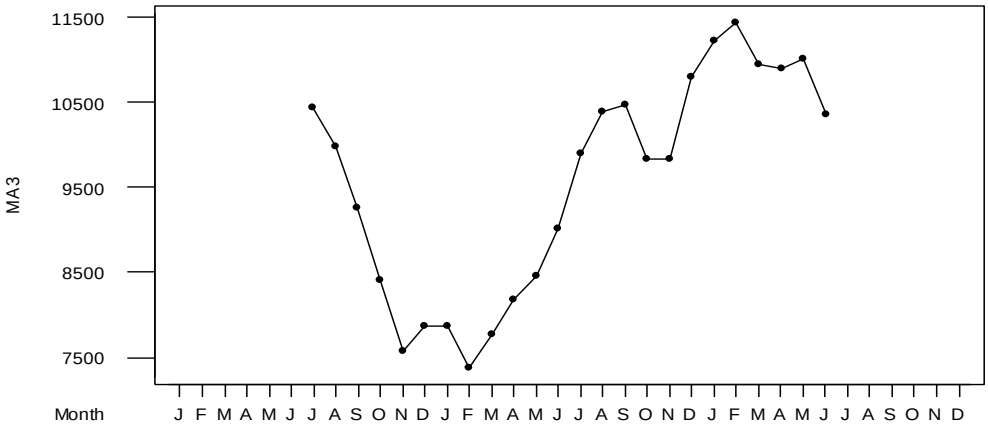

Figure 6: Moving Average for (P3) Data

Figure 6 is to show the moving average of the P3 (i.e. production yield in units) product over a period of three years. It shows the average movement of the data over the period of time. When the moving average line is low, it means that there is small product of P3. But when it is high, it means that there is large quantity of the P3 product.

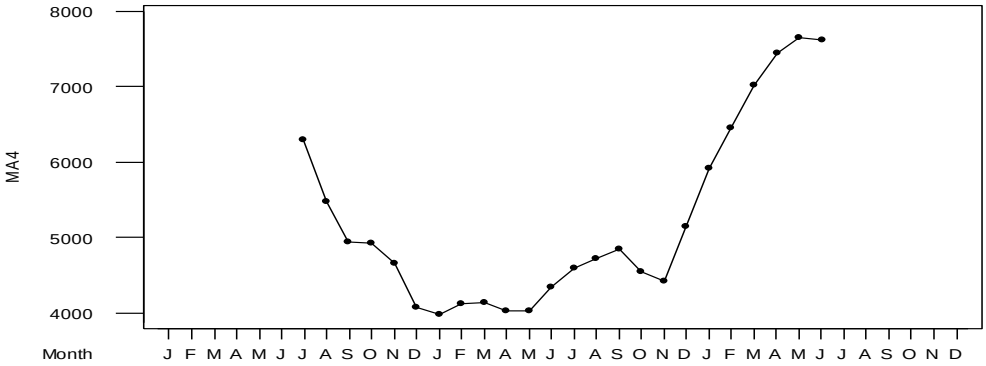

Figure 7: Moving Average for (P4) Data

Figure 7 is to show the moving average of the P4 (i.e. production yield in units) product over a period of three years. It shows the average movement of the data over the period of time. When the moving average line is low, it means that there is small product of P4. But when it is high, it means that there is large quantity of the P4 product.

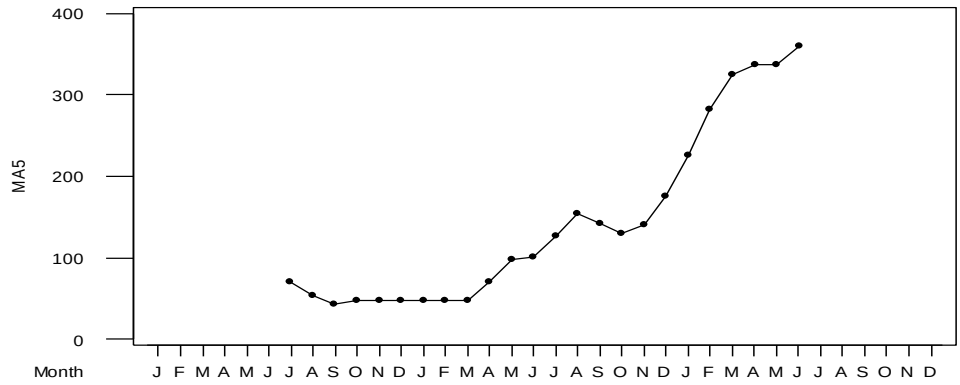

Figure 8: Moving Average for (P5) Data

Figure 8 is to show the moving average of the P5 (i.e., production yield in units) product over a period of three years. It shows the average movement of the data over the period of time. When the moving average line is low, it means that there is small product of P5. But when it is high, it means that there is large quantity of the P5 product.

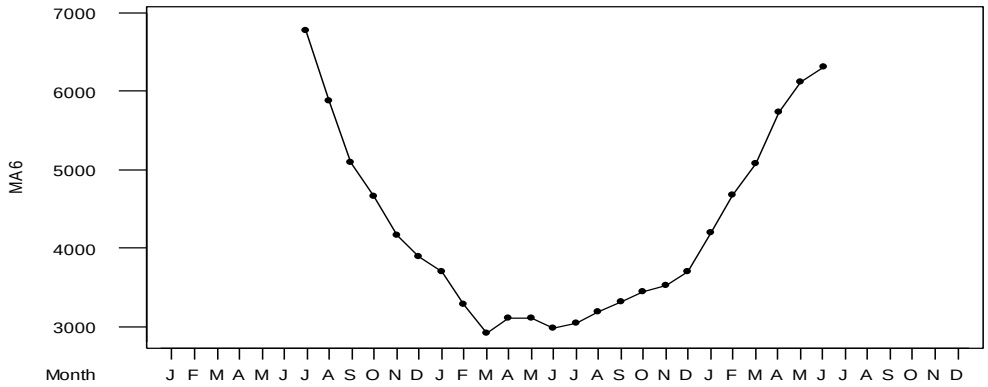

Figure 9: Moving Average for (P6) Data

Figure 9 is to show the moving average of the P6 (i.e. production yield in units) product over a period of three years. It shows the average movement of the data over the period of time. When the moving average line is low, it means that there is small product of P6. But when it is high, it means that there is large quantity of the P6 product.

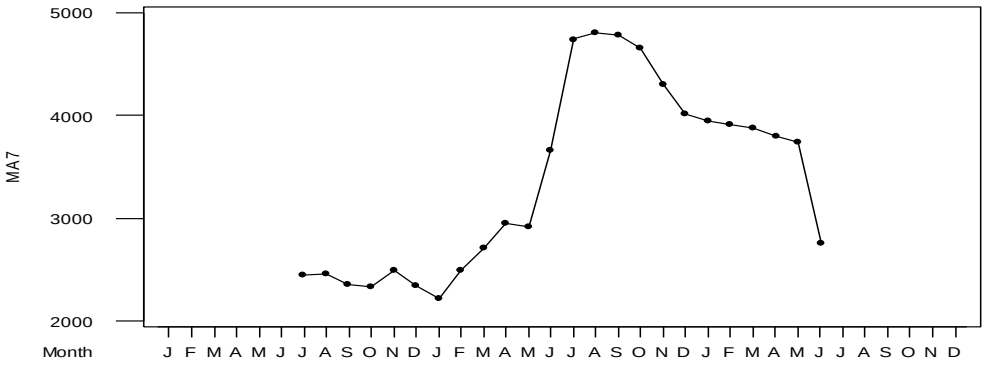

Figure 10: Moving Average for (P7) Data

Figure 10 is to show the moving average of the P7 (i.e. production yield in units) product over a period of three years. It shows the average movement of the data over the period of time. When the moving average line is low, it means that there is small product of P7. But when it is high, it means that there is large quantity of the P7 product.

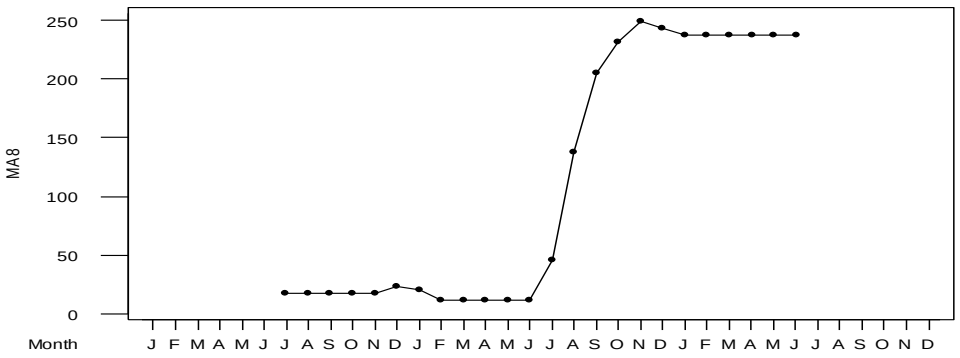

Figure 11: Moving Average for (P8) Data

Figure 11 is to show the moving average of the P8 (i.e. production yield in units) product over a period of three years. It shows the average movement of the data over the period of time. When the moving average line is low, it means that there is small product of P8. But when it is high, it means that there is large quantity of the P8 product.

Discussion of Results

This is based on the results found from the analysis, and also the tables and charts developed:

- ✓ Observe that the Table 1 shows the detailed summary of the 12 monthly centred moving averages and the trend analysis.
- ✓ Observed that the data was optimized for production yield on the monthly bases.

IV. CONCLUSION

In conclusion, a close examination of the production pattern and the behavior of the production system based on the data analyses shows that the production industry is organizing production with a clear focus to meet the customers' requirements and stiff competitors in the plastic manufacturing industry. However, greater percentages of the customers are not served as and when due leading to queues and waiting before customers are served. The tool developed can help the company to remedy this situation.

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