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Historical Data and the Use of Forecasting for Production Planning

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Abstract: This paper uses Minitab 15 statistical software to analyse past demand and production data in order to establish production and demand model and to provide for future forecast in demand and production. A fundamental study was carried out to ascertain the production and demand trend of Abeokuta based Danico Foods Limited. In the study, the month to month demand and production data for eight years (2002-2009) were obtained from planning and logistic department of Danico Foods Limited. A software package Minitab 15 was used to facilitate accurate and faster analysis of data, characterization of demand and production data using decomposition, which revealed the nature of seasonality, cyclical activity trend and noise. Production and demand model was developed. The correlation of model was established with coefficient of determination R^2 = 0.8126 and correlation coefficient = 0.901 which strongly affirm strong closeness between demand and production. On the whole, the results of the decomposition analysis clearly show the existence of remarkable linear trend in both production and demand pattern, the seasonal indices show that the highest point of sales were in the last quarter and these results were used to forecast the production and demand rate for the subsequent years 2010 and 2011. Above all a model that predicts production whenever demand is known is established and the trend equations provide for prediction of demand and production rates within the quarters.

Key words: Forecasting · Production planning and historical data · Decomposition · Time series

INTRODUCTION

Forecasting is the art of specifying meaningful information about the future and a large assortment of forecasting techniques has been developed over the years past, which has naturally led to studies comparing their forecasting abilities [1]. Again combining forecasts from two or more techniques (such as simple averaging) can dramatically improve forecast accuracy [2-5]. Vonderembse and White [6] also recognized the factors influencing the time series to be associated with secular trend that reflects forces that are responsible for growth or decline over a long period of time, seasonal variation, that reflect forces that act periodically in a fixed period of one year or less, cyclical fluctuations, that occur periodically in a fixed period of more than one year and random fluctuations. Forecasting and optimization have traditionally been approached as two distinct, essential components of inventory management while the random production is first estimated using historical data so that this forecast (either a point forecast of the future production or a forecast of the distribution) is used as input to the optimization module.

Most industrialists believe that the success or failure of their establishments depends to a large extent on inventory management but problem arises in this regard when companies over stock raw materials inventory as a result of dependence on forecasting methods that rely on judgmental approach and matching production with demand, which most often creates difficulties in planning to meet demand at any point in time; decision regarding how much should be produced/ordered for stocking and when should it be ordered. Obviously, this situation does not make room for effective and efficient decision-making; hence this paper is geared towards analyzing soft drink monthly production data in order to develop appropriate predictive models for the total production and required inventory model

Bertsimas and Thiele [7] and [8] utilized historical data in the development of useful mathematical model for forecasting. Nnabude *et al.* [9] observed that the method can also be used both for prediction, inference,

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hypothesis testing and modeling of causal relationship by allowing the forecaster to select or specify a set of independent variables that he believes may help explain why a particular dependent variable behaves in the way that it does.

The objective of this report is to model production and demand in order:

- To find the correlation coefficient between production and demand.
- To extract the seasonal index
- To measure the trend and use the trend to forecast future values of demand and production.
- To help us study the various components, which play a major role in the decision making and market strategy?
- To make recommendation to the company based on the research findings.

Above all, stated that one of the factors that determine the accuracy of a forecast is the method or methods used in the forecast. The most common and relatively easiest methods for developing a forecast from past data are simple moving averages, weighted moving averages, exponential smoothing and regression analysis. The calculations in all these methods can be done with a desk calculator or micro computer. But since our forecast is based on historical or past data there is a need to analyze these data to find out the components that influence them. It is arguable that the most important aspect in statistical analysis that has found wide application in modern companies is time series analysis.

Ranchman and Mescon [10] defined time series (or trend) as the examination of data over a sufficient long period of time so that regularities and relationships can be detected interpreted and used as the basis of forecast of future business activity such analysis are generally explained in terms of 3 factors; seasonal variation, cyclic variation and secular (or long term) trend in business growth. For Francis [11] a time series is a name given to numerical data that is defined over a uniform set of time. Time series is a series of values assumed by a variable at different points of time. Spiegel [12] has given a very useful analysis of the definition of time series. A time series is a set of observation at specified time usually at equal interval. According to [12] time series variations are as a result of four well defined influences often called components. These components include the secular trend, seasonal variation, cyclic fluctuations and random variation [6].

Time Series Characteristics: The Australian Bureau of Statistics [13] presented enough report for the understanding and analysis of a time series. A time series is a collection of observations of well-defined data items obtained through repeated measurements over time. For example, measuring the value of retail sales each month of the year would comprise a time series. This is because sales revenue is well defined and consistently measured at equally spaced intervals.

An observed time series can be decomposed into three components of the trend (long term direction), the seasonal (systematic, calendar related movements) and the irregular (unsystematic, short term fluctuations).

Time series can be classified into two different types: stock and flow. A stock series is a measure of certain attributes at a point in time and can be thought of as "stocktakes". For example, the Monthly Labour Force Survey is a stock measure because it takes stock of whether a person was employed in the reference week. Flow series are series which are a measure of activity over a given period. For example, surveys of Retail Trade activity. The main difference between a stock and a flow series is that flow series can contain effects related to the calendar (trading day effects). Both types of series can still be seasonally adjusted using the same seasonal adjustment process.

A seasonal effect is a systematic and calendar related effect. Some examples include the sharp escalation in most Retail series which occurs around December in response to the Christmas period, or an increase in water consumption in summer due to warmer weather as in figure 1. Other seasonal effects include trading day effects (the number of working or trading days in a given month differs from year to year which will impact upon the level of activity in that month) and moving holidays.

Seasonal adjustment is the process of estimating and then removing from a time series influences that are systematic and calendar related. Observed data needs to be seasonally adjusted as seasonal effects can conceal both the true underlying movement in the series, as well as certain non-seasonal characteristics which may be of interest to analysts.

When a time series is dominated by the trend or irregular components, it is nearly impossible to identify and remove what little seasonality is present. Hence seasonally adjusting a non-seasonal series is impractical and will often introduce an artificial seasonal element. The seasonal component consists of effects that are reasonably stable with respect to timing, direction and magnitude. It arises from systematic, calendar related

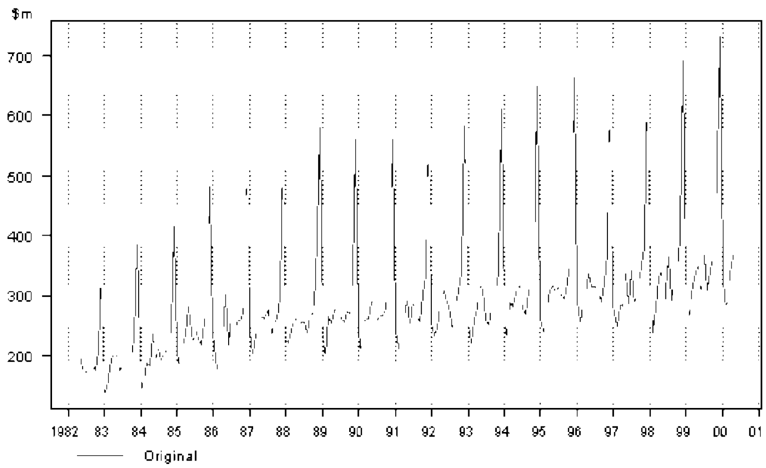

Fig. 1: Monthly Retail Sales in New South Wales (NSW) Retail Department Stores

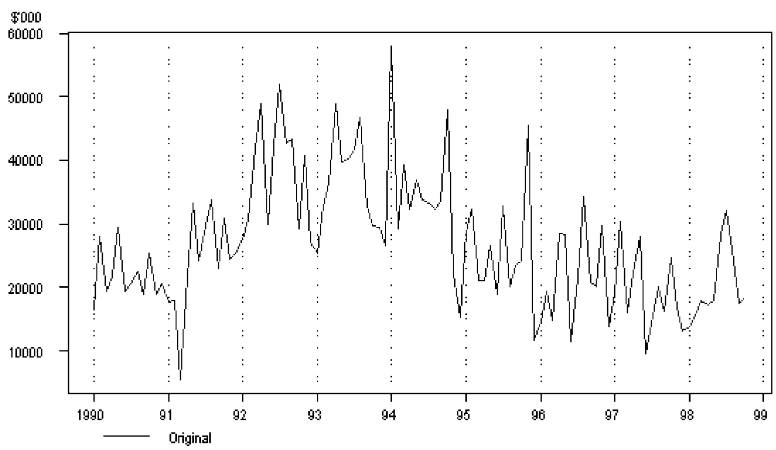

Fig. 2: Monthly Value of Building Approvals, Australian Capital Territory (ACT)

influences such like Natural Conditions such as weather whether fluctuations that that represent the season (uncharacteristic weather patterns such as snow in summer would be considered irregular, influences), Business and Administrative procedures like start and end of the school term, Social and Cultural behaviour such as Christmas.

Seasonality in a time series can be identified by regularly spaced peaks and troughs which have a consistent direction and approximately the same magnitude every year, relative to the trend. The following diagram depicts a strongly seasonal series. There is an obvious large seasonal increase in December retail sales in New South Wales due to Christmas shopping. In this example, the magnitude of the seasonal component increases over time, as does the trend.

The irregular component (sometimes also known as the residual) is what remains after the seasonal and trend components of a time series have been estimated and removed. It results from short term fluctuations in the series which are neither systematic nor predictable. In a highly irregular series, these fluctuations can dominate movements, which will mask the trend and seasonality. The following graph of figure 2 is of a highly irregular time series:

The trend is defined as the 'long term' movement in a time series without calendar related and irregular effects and is a reflection of the underlying level [13]. It is the result of influences such as population growth, price inflation and general economic changes. The following graph of figure 3 depicts a series in which there is an obvious upward trend over time.

Decomposition models are typically additive or multiplicative, but can also take other forms such as pseudo-additive. In some time series, the amplitude of both the seasonal and irregular variations do not change as the level of the trend rises or falls. In such cases, an additive model is appropriate. In the additive model,

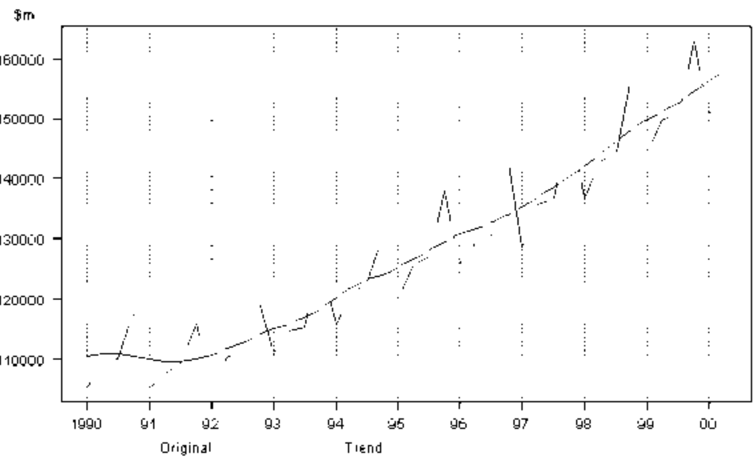

Fig. 3: Quarterly Gross Domestic Product

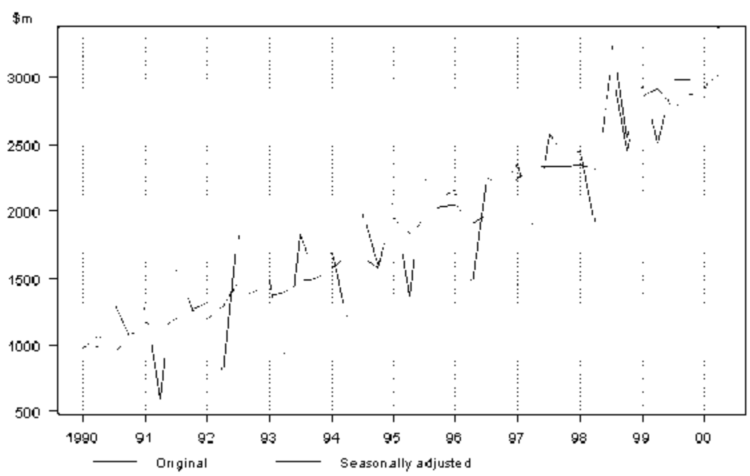

Fig. 4: General Government and Other Current Transfers to Other Sector

the observed time series O_t is considered to be the sum of three independent components: the seasonal S_t, the trend T_t and the irregular I_t.

Observed series = Trend + Seasonal + Irregular

That is

$$O_t = T_t + S_t = I_t \quad (1)$$

Each of the three components has the same units as the original series. The seasonally adjusted series is obtained by estimating and removing the seasonal effects from the original time series.

The estimated seasonal component is denoted by $\tilde{S}_t$. The seasonally adjusted estimates can be expressed as

Ssasonally Adjusted series = Observed series - Seasonal = Trend + Irregular

That is

$$SA_t = O_t - \tilde{S}_t = T_t + I_t \quad (2)$$

The following figure 4 depicts a typically additive series and the underlying level of the series fluctuates but the magnitude of the seasonal spikes remains approximately stable.

In many time series, the amplitude of both the seasonal and irregular variations increase as the level of the trend rises. In this situation, a multiplicative model is usually appropriate. In the multiplicative model, the original time series is expressed as the product of trend, seasonal and irregular components.

Observed series = Trend * Seasonal * Irregular

That is

$$O_t = T_t^* + S_t^* = I_t \quad (3)$$

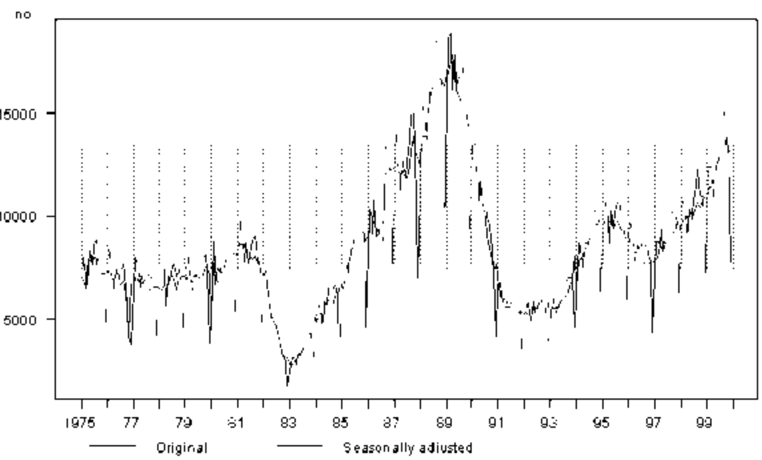

Fig. 5: Monthly NSW ANZ Job Advertisements

The seasonally adjusted data then becomes:

$$\text{Seasonally Adjusted series} = \frac{\text{Observed series}}{\text{Seasonal}} = \text{Trend} * \text{Irregular}$$

That is

$$SA_t \frac{O_t}{\tilde{S}_t} = T_t * I_t \quad (4)$$

Under this model, the trend has the same units as the original series, but the seasonal and irregular components are of no unit factors, distributed around 1. Example of multiplicative model is shown in figure 5

Selection of Decomposition Model to Use: To choose an appropriate decomposition model, the time series analyst will examine a graph of the original series and try a range of models, selecting the one which yields the most stable seasonal component. If the magnitude of the seasonal component is relatively constant regardless of changes in the trend, an additive model is suitable. If it varies with changes in the trend, a multiplicative model is the most likely candidate. However if the series contains values close or equal to zero and the magnitude of seasonal component appears to be dependent upon the trend level, then pseudo-additive model is most appropriate [13].

Methodology: This research emphasizes detailed contextual analysis of a limited number of events or conditions and their relationships. In the study, month-to month demand and production data for eight years were obtained from planning and logistics department of DANICO FOODS LTD. The demand and production data were organized in a tabular form showing the demand and production data in cartons and Minitab 15 applied for various analyses.

Company Data Presentation: The company demand and production data are presented in cartons as in tables 1 and 2.

Table 1: Demand Data for 2002-2009 Recorded for Months (raw data)

Year month	2002	2003	2004	2005	2006	2007	2008	2009
January	11200	9000	12000	21600	28500	27321	34060	57102
February	14900	14900	22900	22600	29250	29440	35610	27805
March	25102	21000	28000	17700	30500	30120	36111	35965
April	16210	25600	32600	27700	31350	32450	30109	51111
May	14592	29200	41600	32250	30230	35000	27105	34905
June	10000	25200	30200	22000	29990	25420	26850	36724
July	9920	15600	23600	15000	20500	26770	25910	55103
August	11210	15600	19600	15000	21300	25827	25103	38344
September	12401	16000	26000	24000	29300	30720	25965	45251
October	22105	21200	31200	30000	31320	32350	45700	41205
November	27820	29100	41700	40000	30200	40102	51100	52750
December	25780	27600	36400	42121	50200	52720	57102	50320
Total	201300	250000	345800	311.000	362000	388200	420700	526600

Table 2: Production from 2002-2009 Recorded for Months (raw data)

Year month	2002	2003	2004	2005	2006	2007	2008	2009
January	9011	11301	15105	17820	29009	25201	33103	55481
February	12311	13305	26102	17815	29251	30201	34702	24700
March	24102	20017	27790	18200	31520	29310	36742	33900
April	16702	11997	32701	25200	27102	16457	32710	50103
May	14502	27502	41605	31000	31177	17481	25101	37725
June	11702	29101	31710	11253	19299	15321	25481	35700
July	7102	20675	22700	17401	16102	15711	24500	54100
August	9451	20571	20271	20400	11388	19202	23344	39800
September	13321	17201	21444	23911	29402	19902	24103	44800
October	27711	17219	19210	32100	29377	33402	44102	42300
November	25211	26102	37311	39821	32105	40165	45902	51800
December	23477	25210	35372	40200	49700	47911	55205	49400
Total	100600	240200	331300	295100	335400	310200	344900	519800

Table 3: Adjusted Demand Data in Thousands of Cartons

Quarter	2002	2003	2004	2005	2006	2007	2008	2009
1	51	45	63	62	88	87	106	121
2	41	80	104	82	92	93	84	123
3	84	47	69	54	71	83	77	139
4	76	78	109	112	111	125	154	144

Table 4: Adjusted Production Data in Thousands of Cartons

Quarter	2002	2003	2004	2005	2006	2007	2008	2009
1	48	45	69	54	90	85	107	114
2	43	69	106	67	78	49	83	124
3	30	58	64	62	57	55	73	139
4	76	69	92	112	111	121	115	146

Data Analysis: The tables 3 and 4 show the adjusted data of tables 1 and 2 on quarterly demand and production in thousands of cartons per quarter for Danico Foods (Suntop), the values are in thousands of cartons. The adjustment here means that data for the first four months of the year are added up and divided by 1000 and then approximated, similar procedures were used for the other quarters to arrive at tables 3 and 4.

Tables 3 and 4 were used with excel to obtain the plots of figures 1 and 2 establishing the existence of trend in the primary data collected.

To understand the results of the forecasts one has to understand the principle of coding as used in [6, 14] in which for the quarters within 2002-2009 we have 32 codes starting with 1 for first quarter of 2002 and ending with 32 for the last quarter of 2009, so that our forecasting codes for quarters of year 2010 are 33, 34,35and 36 and for 2011are 37, 38, 39 and 40. When these codes are inserted into the trend equations the forecasts of the quarters are obtained, where t in the trend equation is the quarter code.

Trend Analysis for Demand: Minitab15 gave the fitted trend equation as

$$Y_t = 51.0323 + 2.31433t \tag{5}$$

Where t stands for the quarter code.

Accuracy measures

MAPE = 20.267, MAD = 16.251.MSD = 375.685

Forecasted Trend for Year 2010 and 2011:

Q1 = 127.405, Q2 = 129.720, Q3 = 132.034, Q4 = 134.348,Q1 = 136.663,Q2 = 138.977,Q3 = 141.291; Q4 = 143.606.

Trend Analysis for Production: Minitab 15 gave the Fitted Trend Equation as

$$Y_t = 43.0101 + 2.39333t \tag{6}$$

Accuracy measures Are Estimated as:

MAPE = 24.509, MAD = 17.753, MSD = 477.061

Forecasted Trend for the quarters 2010 and 2011 are predicted as

Q1 = 121.990, Q2 = 124.383, Q3 = 126.777, Q4 = 129.170, Q1 = 131.563, Q2 = 133.957, Q3 = 136.350, Q4 = 138.743 for the quarters.

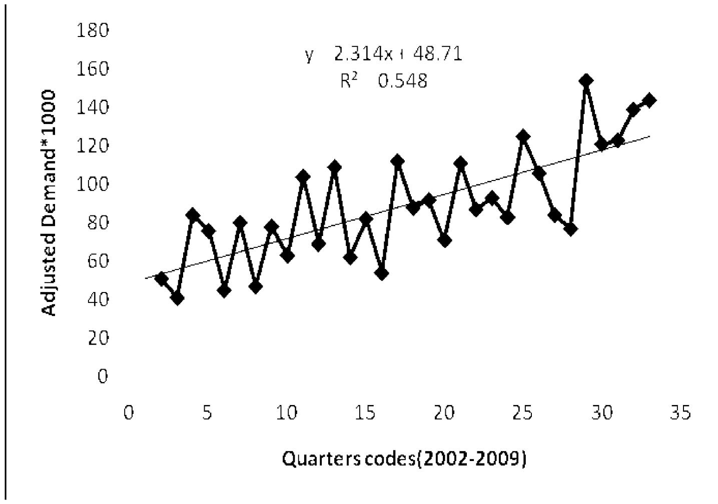

Fig. 6: Plot of Adjusted Demand Data

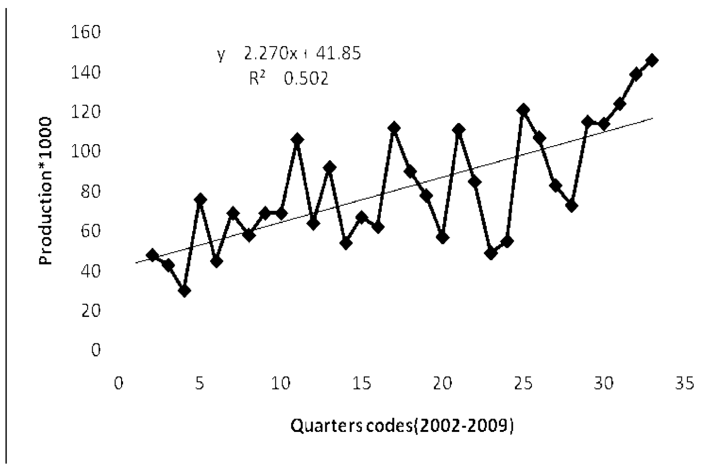

Fig. 7: Plot of Adjusted Production Data

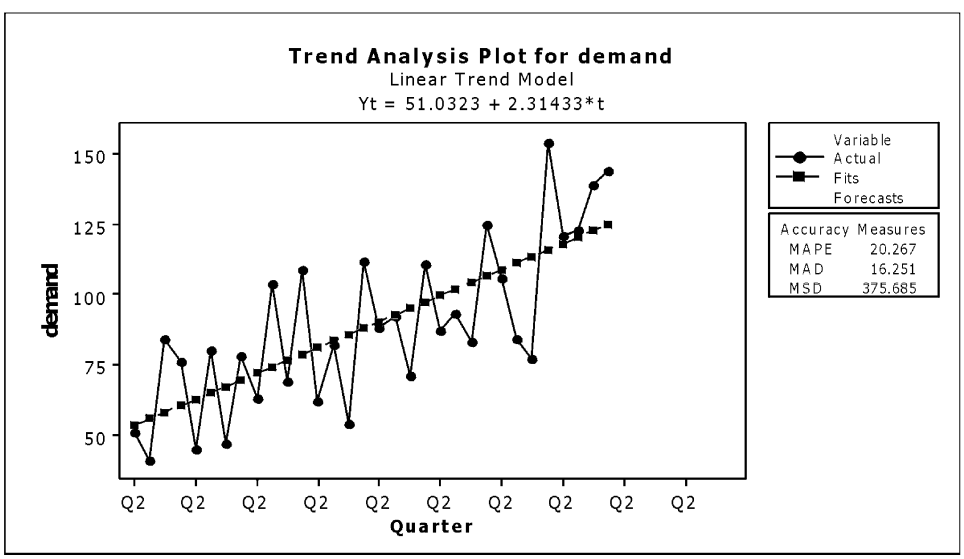

Fig. 8: Time Series Plot of Demand

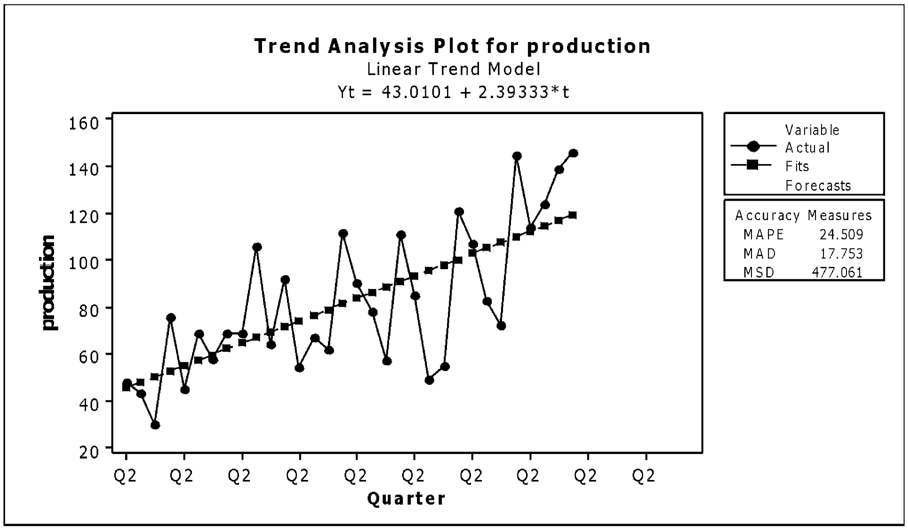

Fig. 9: Trend Analysis Plot for production

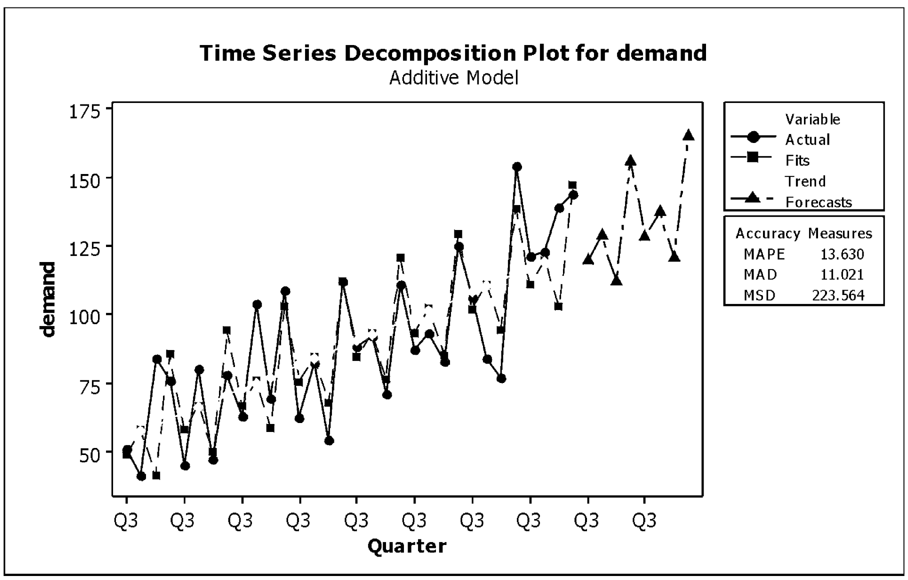

Fig. 10: Time Series Decomposition Plot for demand

Decomposition of Data: Decomposition method was employed with a view to studying hidden features of time series data such as seasonality, trend and cyclical activity.

Time Series Decomposition for Demand: Additive model: The Fitted Trend Equation is obtained as

$$Y_t = 52.7379 + 2.21096t \qquad (7)$$

while the accuracy measures are obtained as
MAPE = 13.630, MAD = 11.021, MSD = 223.564 and components of the time series are as in figure 12.

Demand Forecast: The 4 quarters forecasts of years 2010 and 2011are:
Q1 = 119.575, Q2 = 128.661, Q3 = 111.747, Q4 = 156.082,
Q1 = 128.418, Q2 = 137.504, Q3 = 120.590, Q4 = 164.926

Time Series Decomposition for Production: Additive model: Fitted Trend Equation is obtained as

$$Y_t = 45.2510 + 2.25751t \qquad (8)$$

Accuracy measures Are:
MAPE = 17.121, MAD = 12.627, MSD = 283.662 while the components of the time series are as in figure 13.

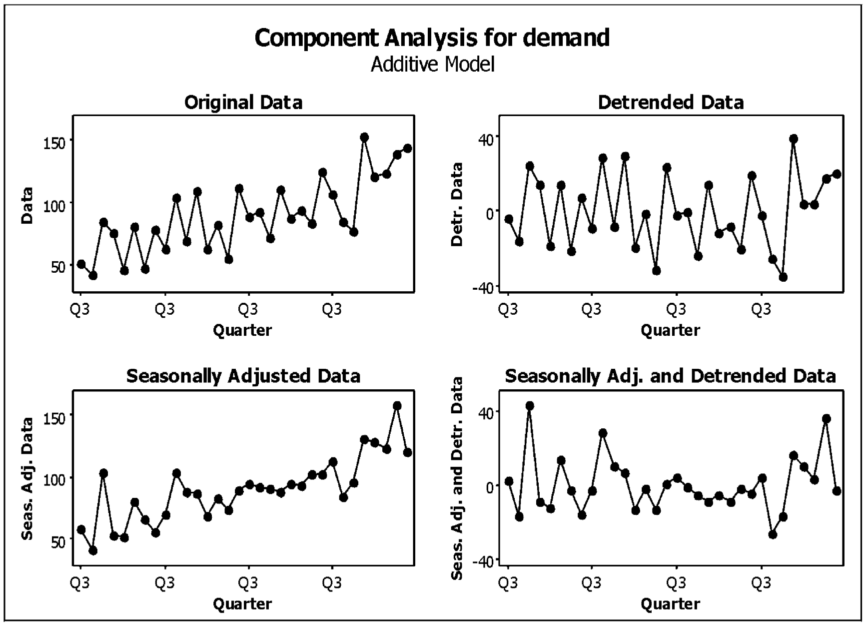

Fig. 11: Decomposition - Component Analysis for demand

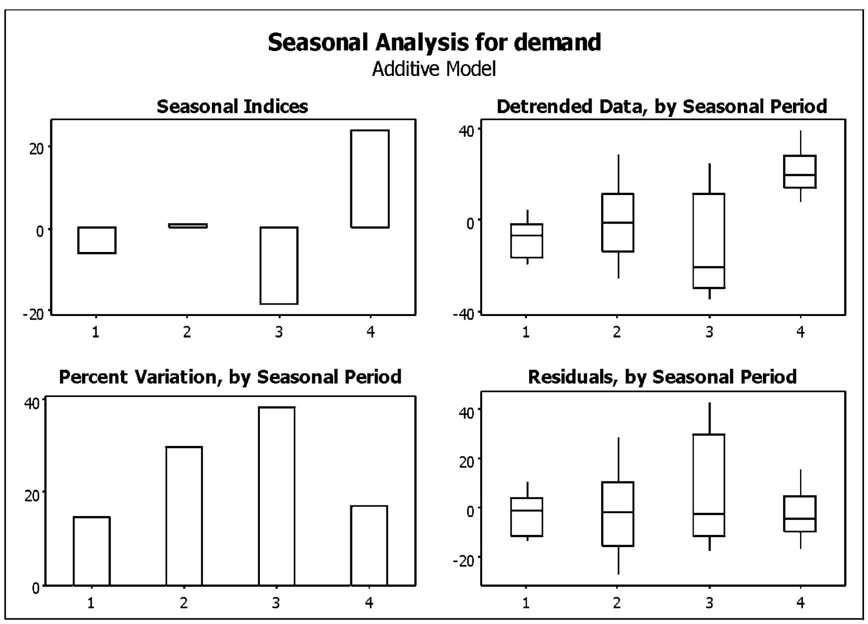

Fig. 12: Decomposition - Seasonal Analysis for demand

Production Forecast: The 4 quarters forecasts of years 2010 and 2011are:

Q1 = 113.593,Q2 = 116.975,Q3 = 106.483,Q4 = 155.490,
Q1 = 122.623,Q2 = 126.005,Q3 = 115.513,Q4 = 164.520

Production - Demand Model Validation: The results of this section were produced with Minitab 15 and through excel package.

Regression Analysis for Production and Demand Data: The regression equation obtained with Minitab 15 using demand and historical data of this study is expressed as

$$\text{Porduction} = -4.12 + 0.971\ \text{DEMAND} \quad (9)$$

The associated parameters of regression are Standard error, se = 13.8922, R2 = 81.3% R^2 (adj) = 80.6%

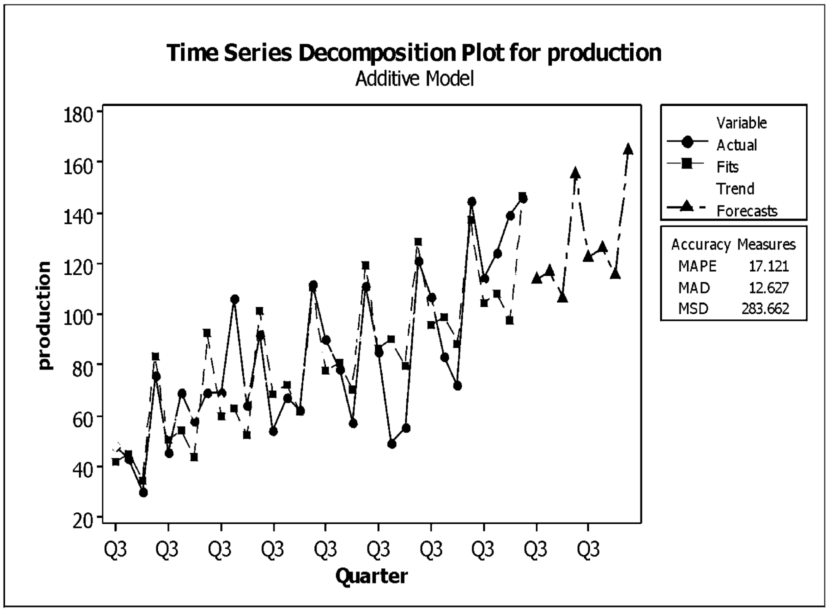

Fig. 13: Time Series Decomposition Plot for production

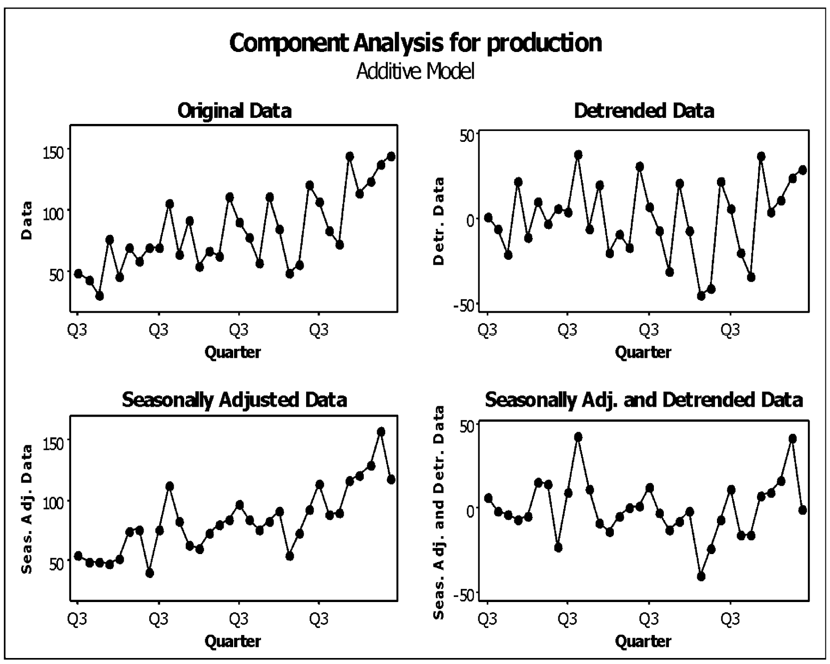

Fig. 14: Decomposition - Component Analysis for production

Correlation of Demand and Production: The Minitab 15 graphics package also was used to establish the relationship between demand and production as found in figure 16 with the coefficient of determination $R^2 = 0.8126$ giving a correlation coefficient of 0.901 so that when a demand forecast is made for a quarter the production model of this section is expressed as

$$P = 0.9708d - 4.116 \qquad (10)$$

Where D is the customer demand forecast and can be used to predict quantity to produce

Residual Analysis: To verify the adequacy of the model, coefficient of determination was used, R^2 measures the linear relationship. The correlation coefficient, R = 0.901 means that there is a strong closeness between the production data and demand data, thus the model generated is robust.

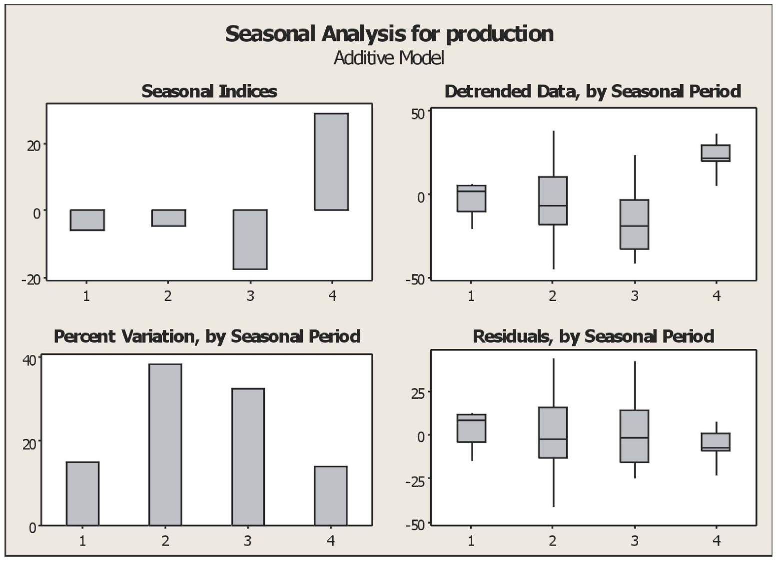

Fig. 15: Decomposition - Seasonal Analysis for production

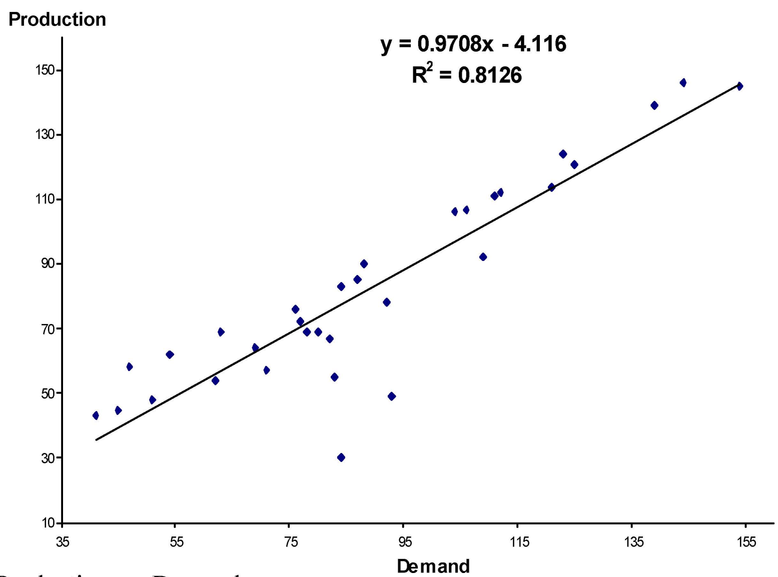

Fig. 16: Scatter Plot of Production vs. Demand

The standard error of the estimates S*e* tells us the accuracy to expect from our prediction, it can be thought of as a measure of the precision with which the regression coefficient is measured, the MINITAB 15 software outputs S*e* = 0.085, which clearly indicates that we have about 80.6% probability of being correct that the variable is having some effect, thus the model is specified correctly.

Forecasting Demand Based on Trend for Production Planning: Figure 1 gives the trend model for 2002-2009 company demand for the quarters of the years as:

$$2.3143t + 48.718 \quad (11)$$

In this model t is the quarter code so that for the first quarter of 2010, t = 33 and for the first quarter of 2011, t = 37. The forecasts of first quarters of 2010 and 2011 are then presented in table 5 using equation (11) and (10) while the Minitab predicted variables are shown in table 6.

DISCUSSION OF RESULTS

Figure 6 and 7clearly show that the time series under study may have trend, seasonal and cyclical components.

Table 5: Forecasted Values with established model

Demand and production for 2010			Demand and production for 2011		
T	D	P	T	D	P
33	125090	117321	37	134347	130447
34	127404	119568	38	136661	132694
35	129719	121815	39	138976	134942
36	132033	124061	40	141290	137189

Table 6: Actual Forecasted Values with Minitab

Demand and production for 2010			Demand and production for 2011		
T	D	P	T	D	P
33	119575	113593	37	128418	123623
34	128661	116975	38	137504	126005
35	111747	106483	39	120590	115513
36	156082	115490	40	164926	164520

The trend lines clearly describe the existence of trend and confirmation of other components of time series characterized by the existence of peaks and valleys in the data or data points falling outside the trend lines. Figures 8 and 9 also show increasing trend of demand and the subsequent increase in production over the years of this study. This may be associated with population growth or other forces driving demand.

The time series decomposition plots of Minitab 15 on figures 10 and 11 shows that the additive model fits the historical data as show with bullets of fits and actual data. Figures 11and 12 show the influence of season, trend and cyclic components on the time series in figure 11a and 12a while figure 11b and 12b show the influence of season on demand ad production data. Figure 11b and 12b also show that if the influence of season is removed then demand and production so that we find that the historical data is associated with fluctuations and trend. Similarly figures 11c and 12c showing a detrended data show that the other components of the time series did not constitute the major variability of the data. Also figures 11d and 12d show that if the factors associated with trend and season are removed the demand and production will be lowered. The decomposition of demand and production data results are further presented in tables 7 and 8 to exposed more characteristics of the time series of this study.

Figure16 for data regression also show that the relationship between production and demand is linear with coefficient of determination R^2 = 0.8126 and correlation coefficient R = 0.9010 explaining that about 90% of variation of demand and production are due to their linear relationship. This means that we can safely employ the trend equations of this study for our forecasts with minimum and allowable forecast errors.

Above all, from tables 5 and 6, the projected demand for 2010 and 2011, show that the market growth is continuous and sustained which could be due to sustained awareness and publicity, or continuous population growth within the region.

The decomposition analysis in figures 12 and 13 further shows that there is a marked seasonality in demand and production pattern for the eight years. A closer examination of graphs of seasonal index of figures 12 and 15 show that the highest peak occurred at the last quarters of the year, which happened to coincide with December Christmas celebration. Shortly after Christmas peak season, there is a sub- optimal peak, which coincides with Easter celebration. Also Immediately after Easter, the rainy season sets in and demand drops and later peaks a little before slumping as a result of wet season which causes high humidity and accompanied diminution of thirst.

The MAD (Mean Absolute Deviation) values of the forecast of both Demand and Production are 11.021 and 12.267 respectively and the MAPE (Mean Absolute Percentage Error) value of the forecast of Demand and Production are 13.630 and 17.212 respectively. This means that the Demand forecast has 83.37% accuracy level while the Production forecast has 82.88% accuracy level.

Table 7: Minitab15 Decomposition of Demand Results

Time	demand	Trend	Seasonal	Detrend	Deseason	Predict	Error
Q1	51	54.949	-6.125	-3.9489	57.125	48.824	2.1761
Q2	41	57.160	0.750	-16.1598	40.250	57.910	-16.9098
Q3	84	59.371	-18.375	24.6292	102.375	40.996	43.0042
Q4	76	61.582	23.750	14.4183	52.250	85.332	-9.3317
Q1	45	63.793	-6.125	-18.7927	51.125	57.668	-12.6677
Q2	80	66.004	0.750	13.9963	79.250	66.754	13.2463
Q3	47	68.215	-18.375	-21.2146	65.375	49.840	-2.8396
Q4	78	70.426	23.750	7.5744	54.250	94.176	-16.1756
Q1	63	72.637	-6.125	-9.6365	69.125	66.512	-3.5115
Q2	104	74.848	0.750	29.1525	103.250	75.598	28.4025
Q3	69	77.058	-18.375	-8.0585	87.375	58.683	10.3165
Q4	109	79.269	23.750	29.7306	85.250	103.019	5.9806
Q1	62	81.480	-6.125	-19.4804	68.125	75.355	-13.3554
Q2	82	83.691	0.750	-1.6913	81.250	84.441	-2.4413
Q3	54	85.902	-18.375	-31.9023	72.375	67.527	-13.5273
Q4	112	88.113	23.750	23.8867	88.250	111.863	0.1367
Q1	88	90.324	-6.125	-2.3242	94.125	84.199	3.8008
Q2	92	92.535	0.750	-0.5352	91.250	93.285	-1.2852
Q3	71	94.746	-18.375	-23.7462	89.375	76.371	-5.3712
Q4	111	96.957	23.750	14.0429	87.250	120.707	-9.7071
Q1	87	99.168	-6.125	-12.1681	93.125	93.043	-6.0431
Q2	93	101.379	0.750	-8.3790	92.250	102.129	-9.1290
Q3	83	103.590	-18.375	-20.5900	101.375	85.215	-2.2150
Q4	125	105.801	23.750	19.1990	101.250	129.551	-4.5510
Q1	106	108.012	-6.125	-2.0119	112.125	101.887	4.1131
Q2	84	110.223	0.750	-26.2229	83.250	110.973	-26.9729
Q3	77	112.434	-18.375	-35.4338	95.375	94.059	-17.0588
Q4	154	114.645	23.750	39.3552	130.250	138.395	15.6052
Q1	121	116.856	-6.125	4.1442	127.125	110.731	10.2692
Q2	123	119.067	0.750	3.9333	122.250	119.817	3.1833
Q3	139	121.278	-18.375	17.7223	157.375	102.903	36.0973
Q4	144	123.489	23.750	20.5114	120.250	147.239	-3.2386

Table 8: Minitab Decomposition of Production Results

Time	production	Trend	Seasonal	Detrend	Deseason	Predict	Error
Q1	48	47.509	-6.1563	0.4915	54.156	41.352	6.6477
Q2	43	49.766	-5.0313	-6.7660	48.031	44.735	-1.7348
Q3	30	52.024	-17.7813	-22.0236	47.781	34.242	-4.2423
Q4	76	54.281	28.9688	21.7189	47.031	83.250	-7.2498
Q1	45	56.539	-6.1563	-11.5386	51.156	50.382	-5.3823
Q2	69	58.796	-5.0313	10.2039	74.031	53.765	15.2352
Q3	58	61.054	-17.7813	-3.0536	75.781	43.272	14.7276
Q4	69	63.311	28.9688	5.6889	40.031	92.280	-23.2799
Q1	69	65.569	-6.1563	3.4314	75.156	59.412	9.5876
Q2	106	67.826	-5.0313	38.1738	111.031	62.795	43.2051
Q3	64	70.084	-17.7813	-6.0837	81.781	52.302	11.6976
Q4	92	72.341	28.9688	19.6588	63.031	101.310	-9.3099
Q1	54	74.599	-6.1563	-20.5987	60.156	68.442	-14.4424
Q2	67	76.856	-5.0313	-9.8562	72.031	71.825	-4.8250
Q3	62	79.114	-17.7813	-17.1137	79.781	61.332	0.6675
Q4	112	81.371	28.9688	30.6288	83.031	110.340	1.6600
Q1	90	83.629	-6.1563	6.3712	96.156	77.473	12.5275
Q2	78	85.886	-5.0313	-7.8863	83.031	80.855	-2.8550
Q3	57	88.144	-17.7813	-31.1438	74.781	70.363	-13.3625
Q4	111	90.401	28.9688	20.5987	82.031	119.370	-8.3701
Q1	85	92.659	-6.1563	-7.6588	91.156	86.503	-1.5026
Q2	49	94.916	-5.0313	-45.9163	54.031	89.885	-40.8851
Q3	55	97.174	-17.7813	-42.1738	72.781	79.393	-24.3926
Q4	121	99.431	28.9688	21.5686	92.031	128.400	-7.4001
Q1	107	101.689	-6.1563	5.3111	113.156	95.533	11.4674
Q2	83	103.946	-5.0313	-20.9464	88.031	98.915	-15.9151
Q3	72	106.204	-17.7813	-34.2039	89.781	88.423	-16.4227
Q4	145	108.461	28.9688	36.5386	116.031	137.430	7.5698
Q1	114	110.719	-6.1563	3.2811	120.156	104.563	9.4373
Q2	124	112.976	-5.0313	11.0236	129.031	107.945	16.0548
Q3	139	115.234	-17.7813	23.7660	156.781	97.453	41.5473
Q4	146	117.491	28.9688	28.5085	117.031	146.460	-0.4602

CONCLUSION

A close examination of the production pattern of Danico foods products based on the data analyzed, shows that the company is organizing production with a clear focus to meet the ever increasing demand and stiff competition in the beverage industry. With major competitors like Chi limited, Nigerian bottling company (5-Alive), Dansa foods. The decomposition model employed in figure 12 and 13 clearly pointed to a linear trend in Demand and Production. The company model was tested for predictive accuracy and found to be a sure fire type in the sense that the correlation coefficient proved the model to be robust.

Also demand was found to greatly influence production that production model was developed by this study as in equation (10) each having a positive correlation with each other.

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