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ANALYSIS OF AN ECONOMIC ORDER QUANTITY AND REORDER POINT INVENTORY CONTROL MODEL FOR SIBA GROUP OF COMPANIES IN UTU IKOT EKPENYONG IKOT EKPENE, AKWA IBOM STATE-NIGERIA.

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ABSTRACT

As a result of today's uncertain economy, Companies are searching for alternative ways to stay competitive. SIBA group has been faced with an ineffective forecasting method that has led to multiple product stock outs. The issue faced has caused sales loss as well as profit loss,. This research goes through the process of analyzing the company's current forecasting model and recommending an inventory control model to help her solve her current issue. As a result, an Economic Order Quantity (EOQ) and a Reorder Point was recommended along with two forecasting techniques to help her reduce her product stock outs. In addition, a cost estimate was done to compare both her current model and the recommended models. As a result, SIBA group, would be able to reduce her overall total cost from ₦1,005,335 to ₦181,155.8. This was a cost reduction of approximately 82%, which summed to a total saving of about ₦836,190 per quarter.

INTRODUCTION

With today's uncertain economy, Companies are searching for alternative methods to keep ahead of their competitors by effectively driving sales and by cost reduction. Big retail Companies do not stand a chance in today's environment if they do not have an appropriate Inventory control model inplace. The Economic Order Quantity and a Reorder Point (EOQ/ROP) model have been used for many years, but some companies have not taken advantage of it. An Economic Order quantity could assist in deciding what would be the best optimal order quantity at the Company's lowest price. Similar to EOQ, the reorder point will advice when to place an order for specific products based on their historical demand. The reorder point also allows sufficient stock at hand to satisfy demand while the order arrives due to the lead time.

Since retail can be unpredictable and competitive, the interest of seeing how forecasting can affect the economic order quantity (EOQ) and reorder point led to assist SIBA group in finding alternative methods to solve her forecasting issues.

Bill Roach explains how the origin of the Economic Order Quantity began in his article: Roach (2005). .

(Harris,1915) also contributed on the EOQ when he published his EOQ formula.

The Economic Order Quantity (EOQ) formula has been used in many disciplines like engineering, business, etc. Engineers study the EOQ formula in engineering economics and industrial engineering courses. On the other hand, business disciplines study the EOQ in both operational and financial courses. In all these, EOQ formula have practical and specific applications in illustrating concepts of cost tradeoffs; as well as specific application in inventory, (Roach ,2005).

MATERIALS AND METHODS

There are more than one model used in inventory analysis, but here we shall concern ourselves on the deterministic model: This is the best known and most fundamental inventory model, which is applicable when the demand for an item has constant or nearly constant rate i.e. when the demand is known.

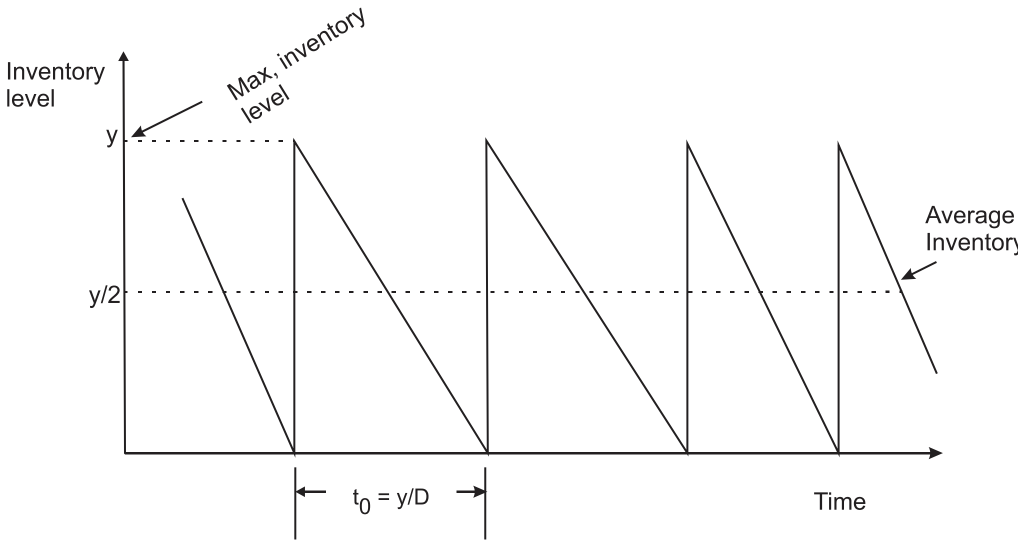

Fig 1, illustrates the inventory pattern for the EOQ inventory model.

Total inventory cost = Ordering cost + Holding cost. The setup cost equals to the product of the number of orders per unit time and the setup cost per order. That is, Ordering

$$\text{cost} = \begin{cases} 0, if \quad Q = 0 \\ K + CQ, \; if \;\; Q > 0 \end{cases} \qquad 2$$

The Holding cost can be calculated by multiplying the average inventory level to the holding cost per item per unit time and the time to exhaust an inventory

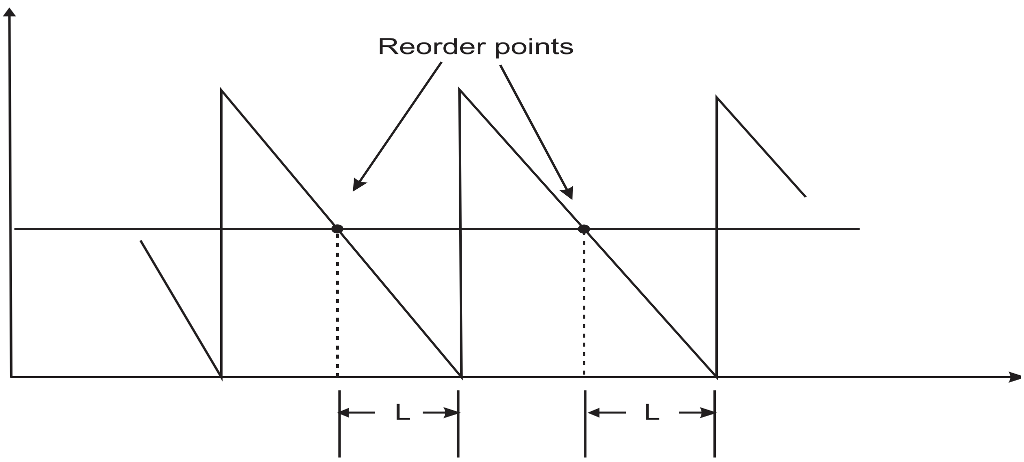

Fig (2) illustrates the situation where reordering occurs L time units before delivery is expected.

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In general, the reorder Point (R) can be calculated by the following equation:

R = L* D …………………………………….(4*)

Where D is in days. In equation (4*), L is the demand per unit time.

Note that the lead time L may be either longer or shorter than the cycle time t_0 . If L$< t_{0,}$use L directly in equation (4*); if on the other hand, L $> t_{0,}$(L -nt_0)should be used in eqtn.(4*) instead of L where n is the largest integer not exceeding L /t_0^*.

Forecasting method

A forecasting method was used to aid the company reduce stock outs as well as to help them understand alternative ways for forecasting due to products' behaviors. For this particular reason, plotting the demand in excel spreadsheet was essential to see the forecasting trends. The products were sorted into two categories, seasonal index and moving averages due to the products demand behaviors which was shown in the excel graphs. By separating each product into two categories, it would ensure we used the correct method of forecasting to get the most accurate results. This process was extremely important because it would be the use as the constant demand when calculating the economic order quantity as well as the reorder point for the recommended analysis.

Simple moving Average: There were six out of the twelve products representing half or 50 percent that were considered to be simple moving average. These products had constant demand from quarter to quarter. Moving average was used for these products since they have the least variability, which would give a more accurate forecasting results. As mentioned earlier in the design process, moving average is the average value of previous periods calculated over the period's length. The data obtained was in months, but since there was a lot of variability from month to month in each product, picking quarter demand was more useful in the calculation. As a result of choosing quarters as the time period, the variability was reduced.

The next step was to forecast for the next quarter using different time periods. So, forecasting was done using 2-8 periods and looked at how each forecasting period varied due to the amount of periods used. Ideally, using more periods would give you the best results since you have more historical data, but it's not always true. In moving average, one of the most important factors to take into consideration is calculating the mean average deviation (MAD) of the demand. So, if you do not calculate the MAD value for each period used, then the forecasting would have more variability. The MAD value provides the least variability in each period, so the lower the MAD value, the more accurate the forecasting.

$$\text{MAD} = \sum |A_i - F_t|/\text{n}$$

Where: A_i is the actual value at time t and F_t is the forecast value at time t. The difference between actual value and forecast value (Ai-Ft) is called forecast error.

Table 1: Moving average for product 4

product 4 (Rolls)										Forecast
period (Qtr)	1	2	3	4	5	6	7	8	Qtr-1(10)	MAD
Unit Sales	1444	1453	1488	1485	1616	1527	1543	1564		
Forecast (n =2)			1448.5	1470.5	1486.5	1550.5	1571.5	1535	1553.5	44.1
Forecast (n =3)				1461.7	1475.3	1529.7	1542.7	1562	1544.7	33.8
Forecast (n =4)					1467.5	1510.5	1529	1542.8	1562.5	51.5
Forecast (n =5)						1497.2	1513.8	1531.8	1547	30.4
Forecast (n =6)							1502.2	1518.7	1537.2	43.1
Forecast (n =7)								1508	1525.1	56
Forecast (n =8)									1515	

Seasonal Index:

There were six products also that fit the seasonal index category. In this method, the demand is not considered to be constant from quarter to quarter. Due to this unpredictable demand, seasonal index is used to make any seasonal adjustments throughout the year. This behavior is when the product goes through a demand cycle that imitates or is similar to a sinusoidal trend. product 1 of this project shows the behavior of a sinusoidal trend, which has gone through a seasonal cycle as it tends to peak during the spring and summer. This indicates that in order to forecast more accurately, there needs to be some form of seasonal adjustments.

For this method (seasonal index), each product went through the same process for a more accurate forecasting. Once the data was plotted for each product a linear regression line was fitted to the products demand as shown.

The trend line was then utilized to calculate the forecast for each quarter up to nine quarters.

Since there was two years' worth of data as mentioned earlier, an average seasonal index was calculated to get a more accurate result as well as to reduce variability.

RESULTS AND DISCUSSION

Table 2: Seasonal index for product 1

Product1 (meatpie)								
Year		Qtr's	Unit	Forecast	Seasonal Index		Ave. Seasonal index	
	2013	1	2256	2446.98		0.92	Qtr's 1	0.85
		2	3750	2421.96		1.55	Qtr's 2	1.41
		3	1430	2396.94		0.6	Qtr's 3	0.8
		4	2000	2371.92		0.84	Qtr's 4	0.95
	2014	5	1845	2346.9		0.77		
		6	2920	2321.88		1.26		
		7	2300	2296.86		1		
		8	2375	2271.84		1.05		
	2015	9		**1909.8**				

The forecasts for the remaining products were calculated and are shown below

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Seasonal Index Tables with Graphs (to show demand behavior)

product 1 (meat pie)								
Year		Qtr's	Unit	Forecast	Seasonal Index		Ave.Seasonal index	
	2013	1	2256	2446.98		0.92	Qtr's 1	0.85
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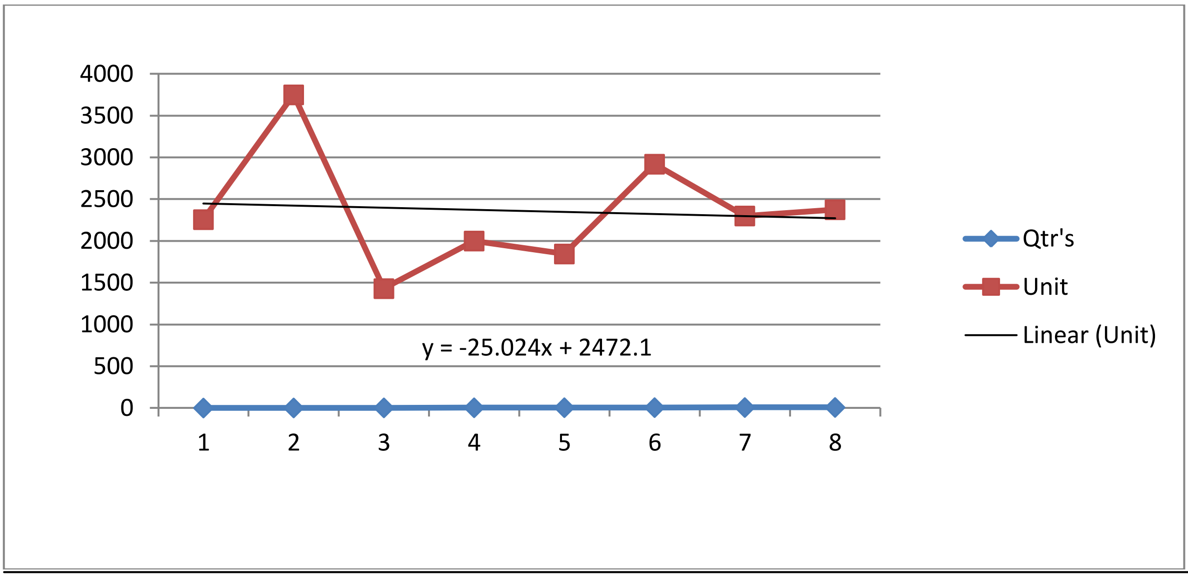
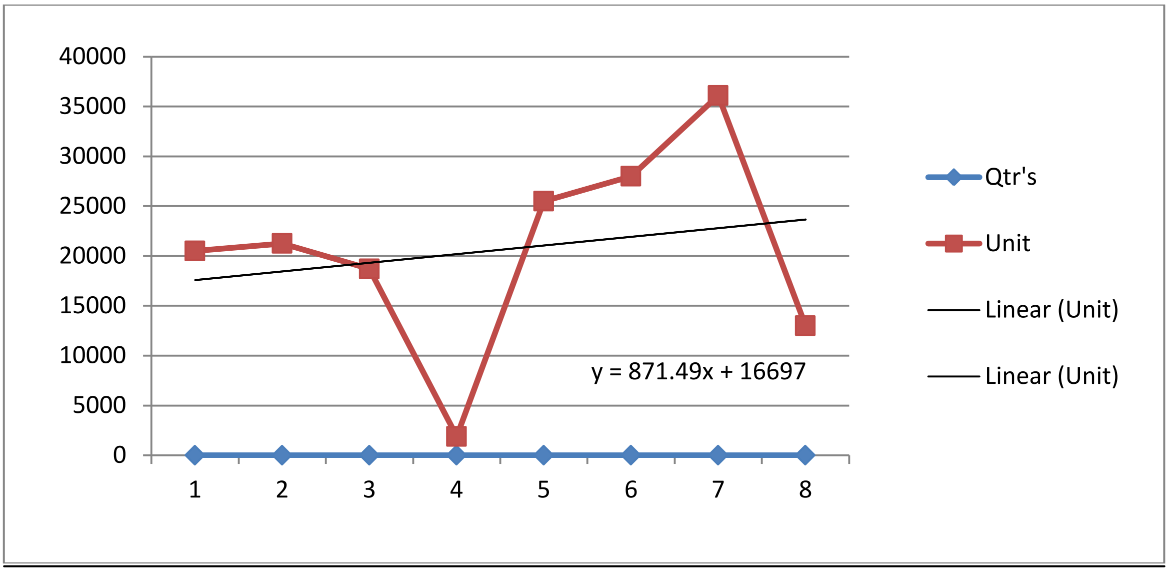
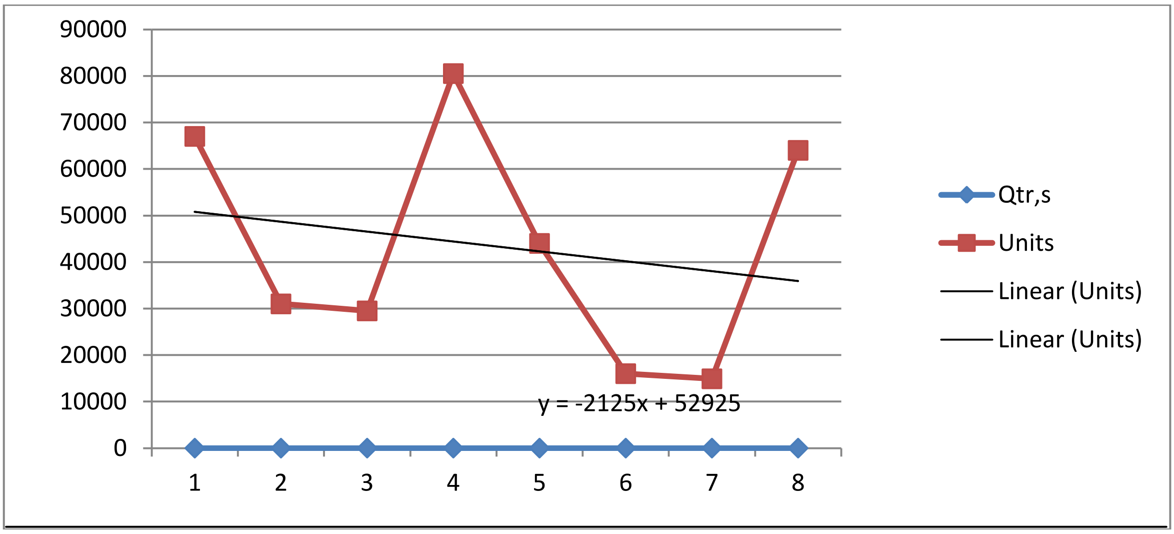
		7	2300	2296.86		1		
		8	2375	2271.84		1.05		
	2015	9		1909.8				



product 2 (Bread)								
Year		Qtr's	Unit	Forecast	Seasonal Index		Ave.Seasonal Index	
	2013	1	20500	17568.4		1.17	Qtr's 1	1.19
		2	21261	18439.8		1.15	Qtr's 2	1.22
		3	18700	19311.2		0.97	Qtr's 3	1.28
		4	1890	20182.6		0.09	Qtr's 4	0.32
	2014	5	25500	21054		1.21		
		6	28000	21925.4		1.28		
		7	36100	22796.9		1.58		
		8	13000	23668.2		0.55		
	2015	9		**29202.12**				



product 3(sachet water)								
	Year	Qtr,s	Units	Forecast	Seasonal Index		Ave.Seasonal Index	
	2013	1	67000	50800		1.32	Qtr's 1	1.18
		2	31000	48675		0.64	Qtr's 2	0.52
		3	29500	46550		0.63	Qtr's 3	0.51
		4	80500	44425		1.81	Qtr's 4	1.8
	2014	5	44000	42300		1.04		
		6	16000	40175		0.4		
		7	14900	38050		0.39		
		8	64000	35925		1.78		
	2015	9		**39884**				



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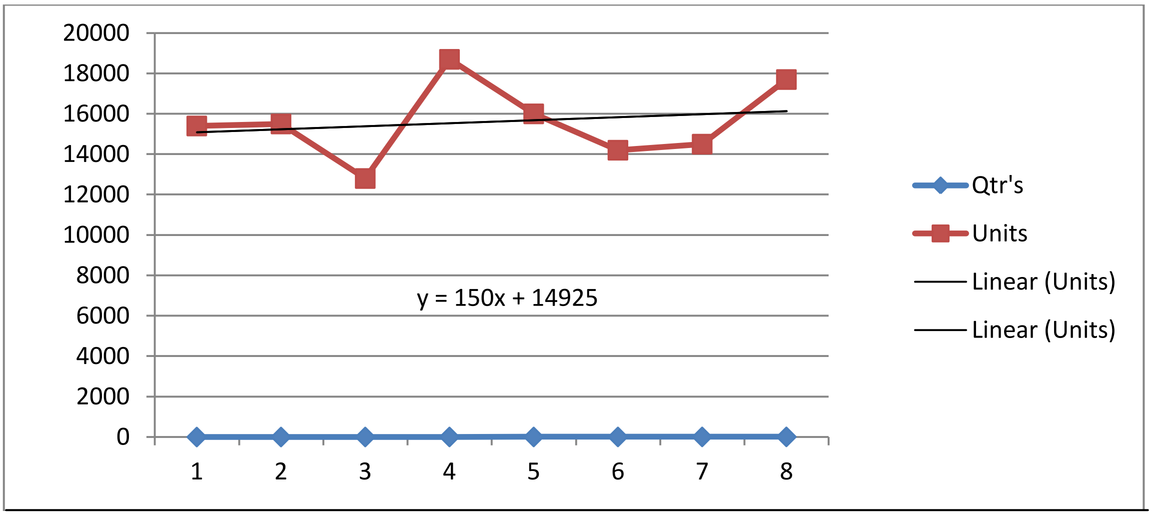
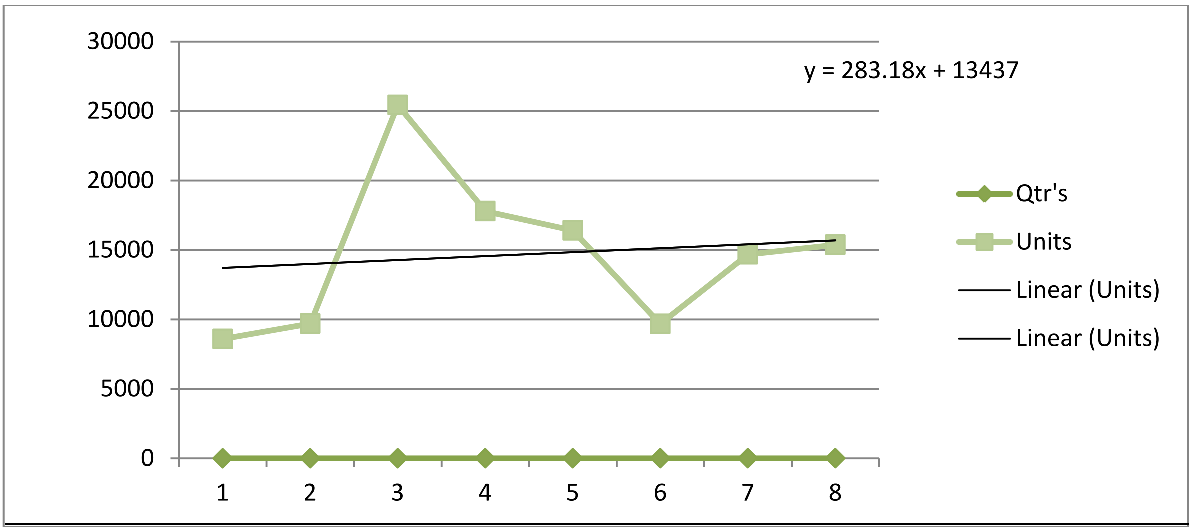
product 7 (Bottled water)							
Year	Qtr's	Units	Forecast	Seasonal Index		Ave. Seasonal Index	
2013	1	15400	15075		1.02	Qtr's 1	1.02
	2	15500	15225		1.02	Qtr's 2	0.96
	3	12800	15375		0.83	Qtr's 3	0.87
	4	18700	15525		1.2	Qtr's 4	1.15
2014	5	16000	15675		1.02		
	6	14200	15825		0.9		
	7	14500	15975		0.91		
	8	17700	16125		1.1		
2015	9		**16600.5**				



product 8 (Biscuit,Mmaida)							
Year	Qtr's	Units	Forecast	Seasonal index		Ave.Seasonal Index	
2013	1	8595	11220.3		0.77	Qtr's 1	0.98
	2	9700	11860.6		0.82	Qtr's 2	0.75
	3	25436	12500.9		1.23	Qtr's 3	1.11
	4	17800	13141.2		1.35	Qtr's 4	0.8
2014	5	16410	13781.5		1.19		
	6	9680	14421.8		0.67		
	7	14690	15062.1		0.98		
	8	15380	61804		0.25		
2015	9		**16015.85**				



product 9 (Biscuit Siba Special)							
Year	Qtr's	Units	Forecast	Seasonal Index		Ave. Seasonal Index	
2013	1	13062	15215.9		0.86	Qtr's 1	0.77
	2	14300	16207.8		0.88	Qtr's 2	0.83
	3	20750	17199.7		1.2	Qtr's 3	1.19
	4	26500	18191.6		1.46	Qtr's 4	1.22
2014	5	12800	19183.5		0.67		
	6	15600	20175.4		0.77		
	7	25000	21167.3		1.18		
	8	21487	22159.2		0.97		
2015	9		**17826.35**				

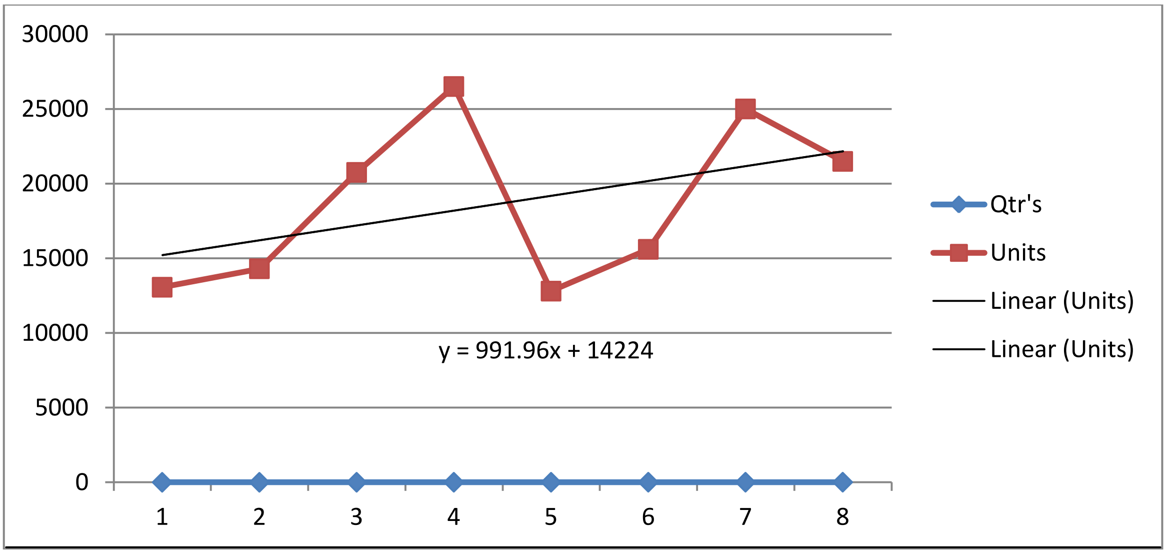


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Table 3: Total Quarter Cost.

Cost Estimate : Total Cost					
Old Method			**Recommended Method**		
Holding (₦)	**Order(₦)**	**Total cost(₦)**	**Holding (₦)**	**Order (₦)**	**Total Cost (₦)**
1005335.07	12010.33	1017345.4	90577.9	90577.9	181155.8
Overall Cost		1017345.4	Overall Cost		181155.8
		Total Savings	₦ 836,189.6		
		Percentage (%)	82.19		

With this current forecasting model, the results showed that the company's holding cost was high due to high inventory. If the company was to reduce the total inventory kept at each quarter, their holding cost would decrease.

If the company proceeds in implementing the recommended forecasting model along with the economic order quantity, it would help her save approximately 82% of her total cost which adds up to about ₦ 836,190 in saving per quarter.

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