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Executive Summary

Animal Health Pty Ltd is a pharmaceutical company that produces animal health products for farm animals such as poultry, cattle and swine. The company headquarters are situated in the USA along with the company factory where most of the company's products are produced. Animal Health Pty Ltd is a global company with affiliates in Europe, South America, North America, Africa and Asia. Currently Animal health Pty Ltd makes use of a make-to-order manufacturing policy with orders coming from the affiliates. The affiliates place the orders according to forecasted figures and always try to have ample stock on hand to meet the customer demand. The affiliates struggle with long lead times (from the time the order is placed to the delivery of the order at the affiliates' warehouse) .This is due to the length of the production run, quality assurance and shipping. With long lead times, companies have to hold large amounts of safety stock for the lead time period as well as for variation in demand for that period in order to achieve and maintain a certain customer service level. This study will determine if it is economically feasible to consolidate inventory at the manufacturing site or a postponement hub in Singapore for some of the smaller affiliates in order to reduce the lead time period and in effect the amount of stock being kept by the smaller affiliates without affecting the desired customer service level.

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1.1 Introduction & Background

Animal Health Pty Ltd is a global innovation-driven company that develops and markets products to improve animal health and food-animal production. Since 1964, Animal Health Pty Ltd products have enhanced animal health and livestock production in South Africa. For more than 45 years, Animal Health Pty Ltd has made significant contributions to the efficient production of animal protein in South Africa and will continue to provide innovative animal health solutions into the future.

Animal Health Pty Ltd is a global company with their own manufacturing sites in USA and England. The manufacturing department produces the products from the affiliate's forecasted demand. This means that when an order is placed it might take anything from 3 to 9 months before an order is received. This is due to long manufacturing time, quality control and shipping. The manufacturing sites don't have their own warehouses for finished products - the finished products are transported straight away to the country that placed an order. Each affiliate has its own warehouse to stock the ordered products. The response time when an order comes in from a client in a specific country is met from the affiliate's warehouse and not straight from manufacturing. This ensures that the order fulfilment cycle time competes with the industry standard.

The manufacturing site in the USA makes use of trucks to transport the products in containers to the port of shipping. Maritime shipping is used for all intercontinental orders from USA because of the value to weight ratios of the products. Trucks are used to transfer the products from the port to the warehouse and from the warehouse to the customers.

Stock is being kept for variance in demand from month to month, for the demand during the lead time period and in case an order is lost due to quality control or shipping errors. With long lead times, the amount of stock in the warehouses is very large. With a low turnover rate, the possibility of writing off stock or the need to adjust prices to get rid of stock is relatively high.

There is strict legislation around the import of pharmaceutical products. In the case of the animal health sector, the quality control is very tight; each product being imported has to have the correct label for the specific country. This label is put on the product at the manufacturing site. The process to transfer stock from affiliate to another is long and difficult and only happens in very extreme cases. Normally stock is written off instead of transferring it to a country that can use it because of the long and difficult regulatory process.

1.2 Project Aim

An analytic study was done to determine if it is economically feasible to consolidate inventory at the manufacturing site or at a postponement hub in Singapore for some of the smaller affiliates in order to reduce the lead time period and in effect the amount of stock being kept by the smaller affiliates without affecting the desired customer service level.

1.3 Project Scope

The proposed solutions would not reduce the order lead time to the same or lower than the lead time from the affiliates to their customers which mean both the manufacturing country or the hub and the affiliates would have to have warehouses. The structure of the company would have changed from decentralised warehousing to a combination of centralised and decentralised warehousing for the smaller affiliates. The study has shown if it is economically viable to consolidate inventory without changing the customer service level.

Not all of the countries have been taken into account, only the smaller affiliates. These affiliates included India, Malaysia, Indonesia, Philippines, Vietnam, China and South Africa. The 4 products from the USA manufacturing site with a target market in the smaller affiliates have been considered. India and South Africa have markets for all four products; China and Vietnam have markets for Products C and D; The Philippines have markets for Products B, C and D; Malaysia have markets for Products B and C; and Indonesia has a market for Product C.

The focus has been on the main supply chain areas (manufacturing, transportation and warehousing) to assess if the supply chain cost could be reduced when consolidating inventory for the smaller affiliates and reducing the amount of stock they need to keep.

2.1 Literature Review

Gunasekaran et al. (2004) identified performance measurements and metrics in supply chain management in order to determine how a company supply chain is performing in meeting certain criteria such as order lead time, efficiency of purchase order cycle time, cash flow, quality assurance, range of products, capacity utilisation and in time in full of orders. These performance measurements have been used to evaluate the success of the proposed change.

Reducing lot size will reduce the average cycle stock inventory, but at some point the increase in setup frequency will drive utilisation where it begins to increase process queue time and overall lead time. A point can be reached where further reduction of lot size will increase aggregate inventory, Vaughan (2006). It can happen that the shorter lead time will increase the order frequency which can increase setup frequency which can have a reverse effect on lead time, increasing it. There should be a balance between order quantity, order frequency, order and holding cost.

A strategic decision-making structure to determine if a product should be made-to-order or made-to-stock was developed by Zaerpour (2008) et al. A novel hybrid methodology consisting of strengths, weaknesses, opportunities and threats (SWOT) analysis and analytical hierarchy process (AHP) was developed. Hybrid models have elements of both deterministic and stochastic models, Min et al. (2002). These models include inventory-theoretic and simulation models that are capable of dealing with both certainty and uncertainty involving model parameters.

Olhager et al. (2011) found that manufacturing and supply chain improvement initiatives have a significant impact in business performance, there are significant differences between make-to-order and make-to-stock plants. Make-to-order plants benefit from external logistics integration with suppliers, while make-to-stock plants benefit from internal lean practices and supplier rationalization.

Waters (1992) indicated that if the stock turnover can be increased without affecting customer service, this will then decrease the cost to an organisation.

Fetter (1961), Waters (1992) and Kobert (1992) used the EOQ and ROP models to determine the economic order quantity and re-ordering point with uncertainties in demand, lead time, and setup cost. Despite its shortcomings, the EOQ and ROP models are widely used in the inventory consolidation research and practise, Wanke (2009). Their

shortcomings are mostly related to the following assumptions: constant and perpetual demand, normal distributed demand and lead times, and demand and lead time independence.

Wanke (2009) also showed that the share of safety stock on total inventory reduction depends on the interaction between the coefficient of variation of demand and the ratio between order processing cost and inventory holding cost. The magnitude of the consolidation effect depends on the lead time standard deviation ratio, the ratio of fixed order processing cost, and the ratio between demand means as potential locations for consolidations. Product inventories that result in larger savings from consolidation will provide clear opportunities for total cost reduction but inventories that result in lower savings from consolidation may present problems in terms of increasing total cost, especially inventories presenting low per-unit holding costs and fixed order processing cost.

Osman et al. (2011) compared in his study of several stock points facing stochastic environment, in terms of demand and lead time variability, the decentralised approach of allocating safety stock to the centralised principles of safety stock distribution. Following the decentralised approach, each stock point is required to keep sufficient safety amounts for each item at its site to face the variability of lead time demand. Following the centralised approach, the safety amounts required at all the stock points of a given stage are consolidated at the most relevant stock point at this stage. Consolidating safety stock will result in smaller amounts of safety stocks compared to the decentralised approach. This is due to pooling the lead time demand variability at each stage. It was found that 22.2 - 44.2% cost savings can be achieved annually through applying the centralised model.

Waters (1992) indicated that there are three classifications of forecasting, judgemental, casual and projective. Judgemental forecasting relies on subjective views and opinions; casual forecasting looks for relationships between variables and projective forecast are concerned with time series. The forecasting time into the future which is considered can be divided into three terms, short-term, medium-term and long-term. Short-term forecasts cover the next few months, medium-term forecasts look ahead between a few months and two or three years and long-term forecast might look ahead several years.

Inventory control systems are primarily concerned with projective short-term forecasting. This means that there are enough relevant data to allow good forecast over a short-term period. Projective forecasting has four methods, simple averages, moving averages, exponential smoothing, and models for seasonality and trend. Simple averages look at records for previous demand and take the average of them. This does not work well if the demand pattern changes. Moving averages use average demand over the latest N periods

as a forecast. The responsiveness can be changed by altering the value of N . Time series can be decentralised by setting N to the number of periods in the season. Exponential smoothing is based on the idea that as data gets older it becomes less relevant and should be given less weight. The responsiveness of forecasts can be adjusted by changing the value given to the smoothing constant, α . Data with seasonality and trend can be split up into four components of underlying value, trend, seasonal index and noise. The first three can be forecast separately and combined to give overall forecasts.

To determine the accuracy of the forecast the difference between the forecast and actual demand should be measured. This will measure the error in forecasting. This can be done measuring the mean absolute deviation (MAD) or the mean squared error (MSE). The MAD is calculated by taking the sum of the absolute difference between the forecast and actual demand at each time interval and dividing it by the number of time intervals. The MSE is calculated by taking the sum of the squares between the actual demand and the forecast for each time interval and dividing it by the number of time intervals. The forecasting method that gives the smallest error will be the most accurate and should be used for forecasting demand.

Wanke et al. (2009) found in the sensitivity analyses performed via mathematical expressions and simulation, that the inventory holding cost remarkably impacts the decision, of whether and how inventories should be pooled in the light of total cost, in terms of the degree of inventory centralisation.

From the above literature review the best approach towards the study was to create an analytical model to determine what the saving could be in terms of safety stock reduction. Sensitivity analysis has been done which indicated what products have the biggest affect on the total savings as well as which countries contributed to the most towards the savings.

2.2 Methods, Tools and Techniques

Demand figures, holding cost figures, unit base price, safety stock levels, customer service levels and product order lead times for the relevant countries were gathered. This data were analysed and assumptions made in order to create a model that reflected the real world scenario.

Two possible solutions for reducing safety stock in order to reduce supply chain cost were thought through in terms of logistics to determine if they are feasible. An analytical model was created to determine if the proposed solutions are economically feasible or not. The model took into account the current safety stock levels, the proposed safety stock levels due to the reduction in product order lead time and the holding cost of products.

The EOQ model with uncertainties was used to determine the proposed safety stock levels. The model took account customer service level, demand variability, product order lead time and demand during lead time period. The company determines the level of service they offer to their clients. The SCOR 9.0 model has five metrics to determine the customer service level. Only the reliability and responsiveness performance attributes were considered. The metrics corresponding to the performance attributes are perfect order fulfilment and order fulfilment cycle time respectively. The agility performance attribute was not considered due to the nature of the products Animal Health Pty Ltd sells and the market they currently compete in.

The demand variance was computed from past monthly demand figures or from sales figures that translates into demand. If the customer service level is high enough (close to 100%) the assumption was made that the demand is equal to the sales.

Forecasting was used to determine future demand for the affiliates. New re-order points were established with the forecasted demand and shorter lead times.

Break even analysis was conducted to see if and when a solution will have a positive return to the company. Sensitivity analysis has shown which product and which country had the biggest effect on the savings.

The AS-IS company operation were compared to the proposed solutions to determine the effectiveness of the proposed solutions.

3. Data analysis

3.1 Lead time

3.1.1 USA to Affiliates

The product lead time was broken down into five sections:

1. replenishment lead time (the time to manufacture the product),
2. picking and packaging for ocean transportation,
3. travel time from the manufacturing site to the ocean port via truck,
4. travel time on the ocean from the manufacturing country to the country that placed the order,
5. transportation time from the county's port of entry to the affiliate's warehouse.

These times make up the total lead time it takes to receive an ordered product (Appendix A – Table 1). The total lead time is fairly constant with the biggest variation in time being the last section, the travel time from the port to the affiliate's warehouse, which is due to the customs department operating the ports and seasonal demand for imports and exports. This is however a small section of the total lead time and does not have a significant effect.

There was not any changes made to the replenishment lead time (the time to manufacture the product), picking and packaging for ocean transportation, travel time from the manufacturing site to the ocean port, travel time on the ocean from the manufacturing country to the country that placed the order, and the transportation time from the county's port of entry to the affiliate's warehouse lead times because they are running at the optimal cost level and this does not form part of the study. Focus was placed on where in the chain of events it would be most beneficial to consolidate inventory for the smaller affiliates.

There were four possible places where inventory could be consolidated in the chain of events:

1. At the manufacturing site which means the lead time would decrease by the manufacturing time (Option 1).
2. After picking and packing for ocean transportation, decreasing the lead time by the manufacturing and picking and packing time (Option 2).
3. At the port of transportation, after the transportation via the truck. This should decrease the lead time by the manufacturing time, picking and packing time and the transportation time to the port (Option 3). This option has had the biggest effect on

decreasing the total lead time in the country of manufacturing. Figure 1 illustrates the 3 options.

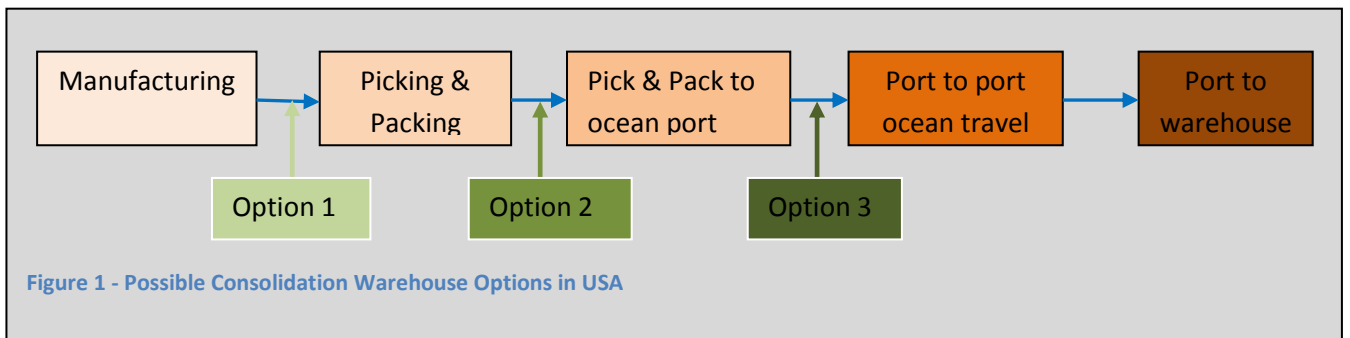


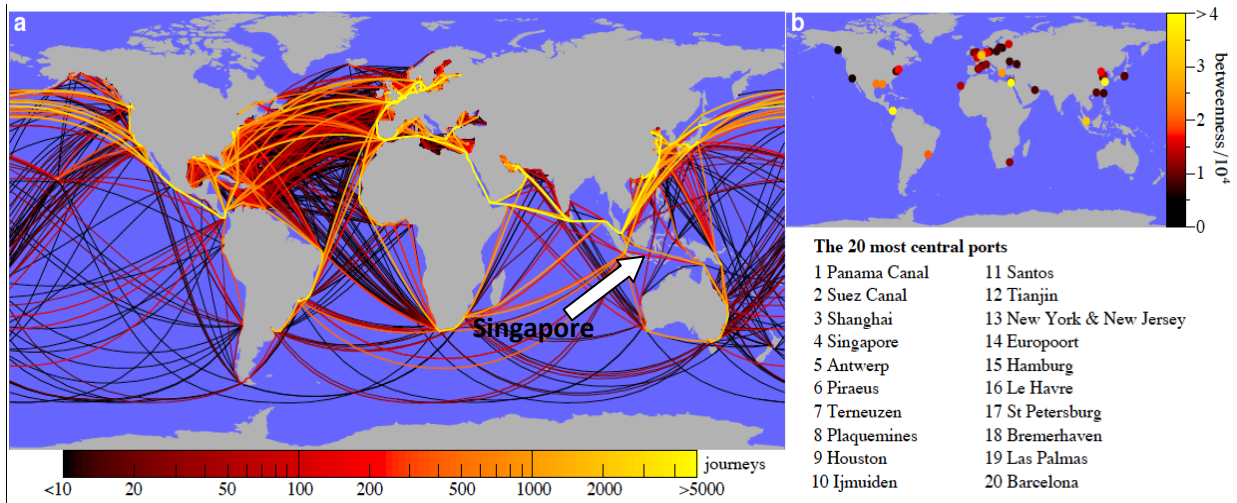
Figure 2 - USA Warehouse to Affiliates



3.1.2 Singapore hub to Affiliates

4. At a postponement hub in Singapore. Singapore being one of the world's top logistics handling countries and its location and that of the countries in the study made it an attractive option.

Figure 3 - World shipping lanes



The product lead times when consolidating inventory in Singapore were less than that of consolidating inventory in the country of manufacturing being USA. The manufacturing time, picking and packing time and transportation time to the port in the USA was cut out of the lead time. The transportation time from Singapore to the affiliates was taken to be the shipment time on the ocean from the Singapore to the affiliates and from the port of entry to the affiliate's warehouse. For the Singapore hub to be a viable option, the products must undergo relabeling before distributing to the various affiliates. The Singapore hub to affiliates lead time can be seen in Appendix A – Table 3.

Figure 4 - Singapore Hub



There was no need to study the ports of entry of the affiliates as a possible place to consolidate inventory because of current legislation stating that pharmaceutical products (bags in this case) must have the correct label for the country when entering the country and the ability for those countries to handle the logistics of products of this nature.

Each product has its own manufacturing time. Picking and packing time for ocean transportation, and picking and packing to ocean port via truck are constant for all the products. The port to port ocean travel times differ from country to country as well as the port to warehouse transportation times. This means that every country has its own lead time per product although the manufacturing, picking and packing, and transportation time to the exporting port are the same for all the countries.

3.2 Product Cost

Each product has its own product cost and all the countries pay the same unit cost per product which is set by the finance department.

Table 1 - Product Cost

Product	Cost (\$)
Product A	30
Product B	90
Product C	30
Product D	50

3.3 Safety Stock

The current safety stock levels per product per country can be seen in Table 2.

Table 2 - Current Safety Stock levels per product per country

Countries	Description	Current SS Level
China	Product A	N/A
China	Product B	N/A
China	Product C	6500
China	Product D	10000
India	Product A	150
India	Product B	1000
India	Product C	1500
India	Product D	2000
Indonesia	Product A	N/A
Indonesia	Product B	N/A
Indonesia	Product C	7500
Indonesia	Product D	N/A
Malaysia	Product A	N/A
Malaysia	Product B	600
Malaysia	Product C	250
Malaysia	Product D	N/A
Philippines	Product A	N/A
Philippines	Product B	1500
Philippines	Product C	700
Philippines	Product D	4000
S. Africa	Product A	1500
S. Africa	Product B	1500
S. Africa	Product C	1600
S. Africa	Product D	1100
Vietnam	Product A	N/A
Vietnam	Product B	N/A
Vietnam	Product C	600
Vietnam	Product D	3500

3.4 Holding Cost

Holding cost was determined per product per country. All four products are the same size and weight – 25kg bags. The bags are stored on 48x40 inch pallets. The warehouses store the pallets three shelves high.

The affiliates do not pay insurance on the stock in their warehouses and no taxes are paid for holding stock. The products do not depreciate over time but rather become obsolete. Products are seldom written off because of passing the expiry date, so no figure has been assigned for obsolescence.

The elements of holding cost that stayed the same for all the products in the country but differed from country to county are: warehouse cost and handling cost. The money tied up in stock does not grow. Money that is freed up from keeping less stock can be reinvested into the company. Interest on invested capital forms part of the holding cost because it can be seen as a penalty being paid for money being tied up in stock. These elements were combined to determine the holding cost per product per country. The holding cost per product per country can be seen in Table 3.

Table 3 - Holding cost per country

Country	Square feet	Square meter	Nr Pallets	Units/pallet	Cost per pallet/month	Land lease price per sq. ft per year (\$/sq. ft/year)	Holding cost/unit/month (\$)	Holding cost/unit/year (\$)	Interest on invested Capital [%]
China	19375	1800	700	40	7.08	8	0.18	2.12	11
India	13993	1300	450	40	5.31	6	0.13	1.59	11
Indonesia	17222	1600	600	40	6.02	6.8	0.15	1.81	11
Malaysia	10302	1050	250	40	6.64	7.5	0.17	1.99	11
Philippines	15069	1400	520	40	7.61	8.6	0.19	2.28	11
South Africa	17222	1600	600	40	6.46	7.3	0.16	1.94	11
Vietnam	13993	1300	300	40	4.87	5.5	0.12	1.46	11
Singapore				40	22.5	25.41	0.56	6.75	11
USA				40	7.7	8.7	0.19	2.31	11

3.5 Customer Service level

Animal Health Pty Ltd has very high customer service levels and makes sure that the customer demand is met. According to the SCOR 9.0 reliability and responsiveness performance attributes, Animal Health Pty Ltd has a 98% customer service level.

3.6 Demand

The assumption was made that the demand is equal to the sales because of the high customer service level. In order to find the variance in demand, sales data were analyzed. The variance per product per country was used with the customer service factor, lead time per product per country and the forecasted demand in order to determine the proposed safety stock and re-ordering point per product per country.

The sales data for the seven countries indicated with the ANOVA with two-factor without replication analysis tool that the sales/demand from month to month varied to a critical degree but the sales/demand over the years comparing the same months didn't vary to a significant degree. Appendix E shows the ANOVA analysis for Products A, B, C and D for South Africa. The rest of the countries indicated similar results.

South Africa's demand indicated a trend from year to year for Product A, and Products B, C & D showed a trend and seasonality. China's demand indicated that Product C has some seasonality and Product D have no set pattern or trend. India's demand for Product A and D has no trend or seasonality, Product B has trend, and Product C has seasonality. Indonesia shows that Product C has seasonality and trend. Malaysia's demand for Product B shows signs of a trend but is not consistent and Product C has no trend or seasonality. The Philippines has seasonality and trend for Products B, C and D. Finally, Vietnam has seasonality and trend for Products C and D.

3.7 Forecasting

Exponential Smoothing was done on all the products to find a benchmark mean absolute deviation (MAD) value. Products not having any trend or seasonality were forecasted using exponential smoothing. Products that showed signs of a trend were forecasted with the Holt's method and products having trend and seasonality were forecasted using Winter's method. Values for σ , β and γ were estimated in the methods to find the smallest mean absolute deviation (MAD) value in order to have an accurate forecast. The forecasting can be seen in Appendix C.

4. Development of conceptual design

4.1 Savings

Generic formulas were developed to determine the amount of money that could be saved per product per county and in total, if inventories were consolidated. These formulas were used to determine what the effect of the two inventory consolidation option stated earlier had on cost savings.

In order to find the savings per product and country when reducing safety stock levels, the actual safety stock levels per product and county were compared with the proposed safety stock levels per product and county. The proposed safety stock per product and county was calculated using equation 1, where the z value is the number of standard deviations from the mean corresponding to the probability specified by the customer service level, σ_{ij} the demand standard deviation per product and country, and LT_{ij} the shortened lead time per product per county. The difference between the actual and proposed safety stock levels is then multiplied by the holding cost element for the specific product and county which is a percentage value of the unit base cost. The unit base price or cost price per product was then multiplied to find the savings. Equation 2 shows the saving per product per year, equation 3 the saving per county per year and equation 4 the total saving across all the products and counties per year.

$i = \text{index set of products where } i = 1 \dots n$

$j = \text{index set of countries where } j = 1 \dots m$

$SSa_{ij} = \text{Actual safety stock for product } i \text{ in country } j$

$SSp_{ij} = \text{Proposed safety stock for product } i \text{ in country } j$

$$SSp_{ij} = z \times \sigma_{ij} \times \sqrt{LT_{ij}} \quad [1]$$

$H_{ij} = \text{Holding cost per year of product } i \text{ in county } j$

$CP_i = \text{Cost price of product } i$

$$\text{Saving per year per product} = \left[\sum_{j=1}^m [(SSa_{ij} - SSp_{ij})H_{ij}] \right] CP_i \quad \text{for } i = 1 \dots n \quad [2]$$

$$\text{Saving per year per country} = \sum_{i=1}^n [(SSa_{ij} - SSp_{ij})H_{ij}CP_i] \quad \text{for } j = 1 \dots m \quad [3]$$

$$\text{Total yearly saving} = \sum_{i=1}^n \left[\left[\sum_{j=1}^m [(SSa_{ij} - SSp_{ij})H_{ij}] \right] CP_i \right] \quad [4]$$

The 7 proposed countries and 4 products in consideration will have the index set for products from 1 to 4, thus n=4 and the index set for the countries will be from 1 to 7, thus m=7.

i = index set of products for \bar{I}

$$\text{Where } \bar{I} = \begin{bmatrix} 1 - \text{Product A} \\ 2 - \text{Product B} \\ 3 - \text{Product C} \\ 4 - \text{Product D} \end{bmatrix}$$

j = index set of countries for \bar{J}

$$\text{Where } \bar{J} = \begin{bmatrix} 1 - \text{China} \\ 2 - \text{India} \\ 3 - \text{Vietnam} \\ 4 - \text{Malaysia} \\ 5 - \text{Indonesia} \\ 6 - \text{Philipenes} \\ 7 - \text{South Africa} \end{bmatrix}$$

4.2 Costs

Consolidating inventory in the USA or Singapore cost the company extra warehousing and equipment. These costs were deducted from the savings to determine if the consolidation process would be economically feasible. To find the cost of warehousing, the maximum number of units at any point in the consolidation warehouse were calculated and multiplied by the holding costs. The generic formula is as follows:

$$\text{Total yearly cost} = \sum_{i=1}^n \sum_{j=1}^m [MU_{ij} \times H_{ij}] \quad [5]$$

Where MU_{ij} is the maximum units for product i in country j at any point in time and H_{ij} is the holding cost stated earlier.

MU_{ij} = Maximum units of product i in contry j at any point in time

The initial cost was higher due to the extra equipment cost.

4.3 Re-ordering Points

The re-ordering points for the products and countries were determined for the new safety stock levels and lead time periods. The re-ordering point was calculated as follows:

$$RoP_{ij} = SS_{p_{ij}} + D_{ij} \times LT_{ij}$$

Where RoP_{ij} is the re-ordering point for product i in county j , $SS_{p_{ij}}$ is the proposed safety stock stated earlier, D_{ij} is the forecasted demand per month for product i in county j and LT_{ij} is the lead time stated earlier.

D_{ij} is determined using the forecasting methods discussed in Section 3.7. Products that are forecasted by the Winter's method will have a year's forecasted demand but products that are forecasted using Holt's or exponential smoothing method can only be forecasted one month in advance. This is because the Holt's method and exponential smoothing uses the past two actual demand figures to forecast the upcoming month's demand.

Thus products that are forecasted by the Holt's method and exponential smoothing re-ordering point's will be determined on a month to month basis and cannot be determined a year in advance.

For the re-ordering point to be accurate when using Winter's forecasting method, the forecasted demand can be revised monthly as actual monthly demand becomes available.

5. Problem Solving and Results

5.1 Savings

Microsoft Excel was used to do the calculations. Equation 1 was used to determine the proposed safety stock which is compared with the current safety stock. The difference between the current safety stock and proposed safety stock is called the stock saving. The stock savings were multiplied by the handling and warehouse holding costs to find the savings due to the warehousing cost. The stock savings were also multiplied by the unit cost and the return on invested capital (ROIC) rate to find the savings due to money being freed up. The two savings were combined to find the total savings. This is effectively equation 4. The calculation was done for the USA consolidation warehouse and the Singapore hub, Appendix D Table 43 and Table 44 respectively.

From Table 43 it can be seen that the USA consolidation warehouse option will save a total of \$169,214.08. Table 44 show total savings of \$202,316.19 for the Singapore hub option. These savings are only due to the reduction in safety stock levels and did not take into account the cost of extra warehousing and additional equipment. The following figures show the impact of each product and county have on the total savings.

Figure 5 - Savings per product in Singapore

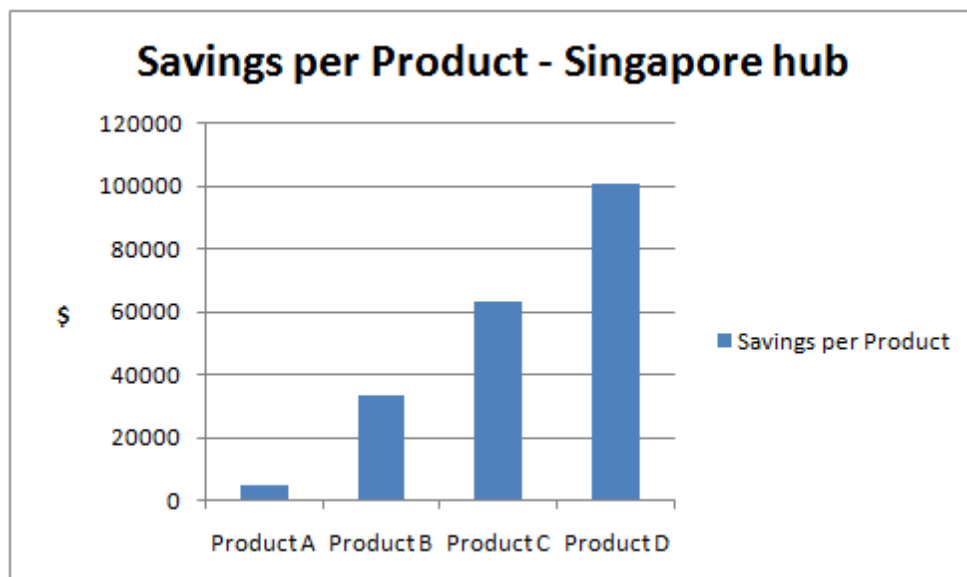


Figure 6 - Savings per Country in Singapore

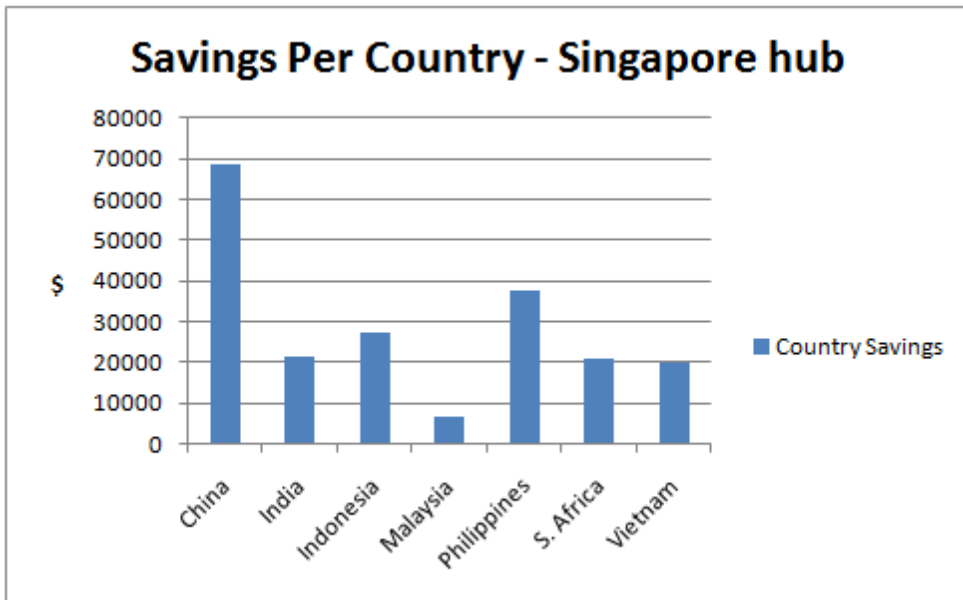


Figure 7 - Savings per product in USA

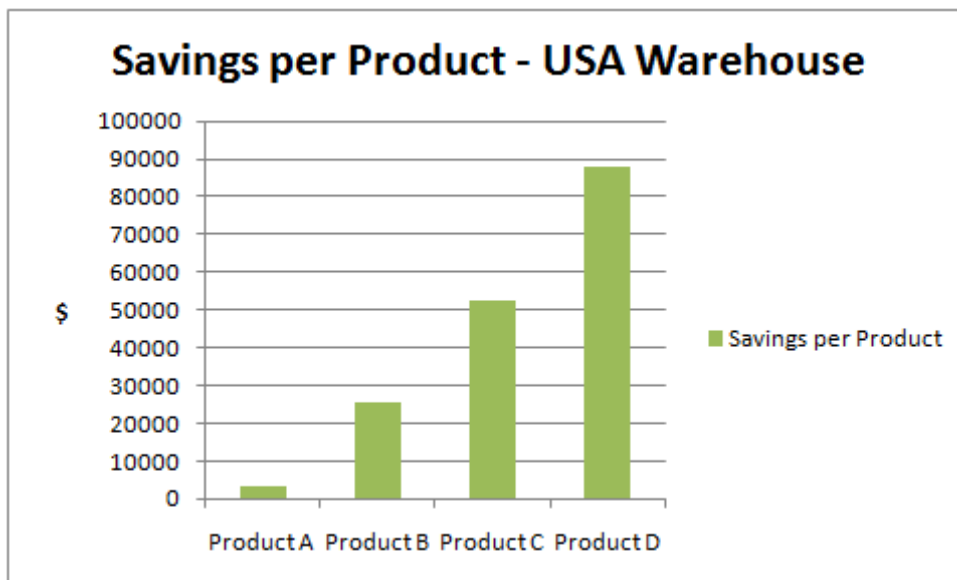
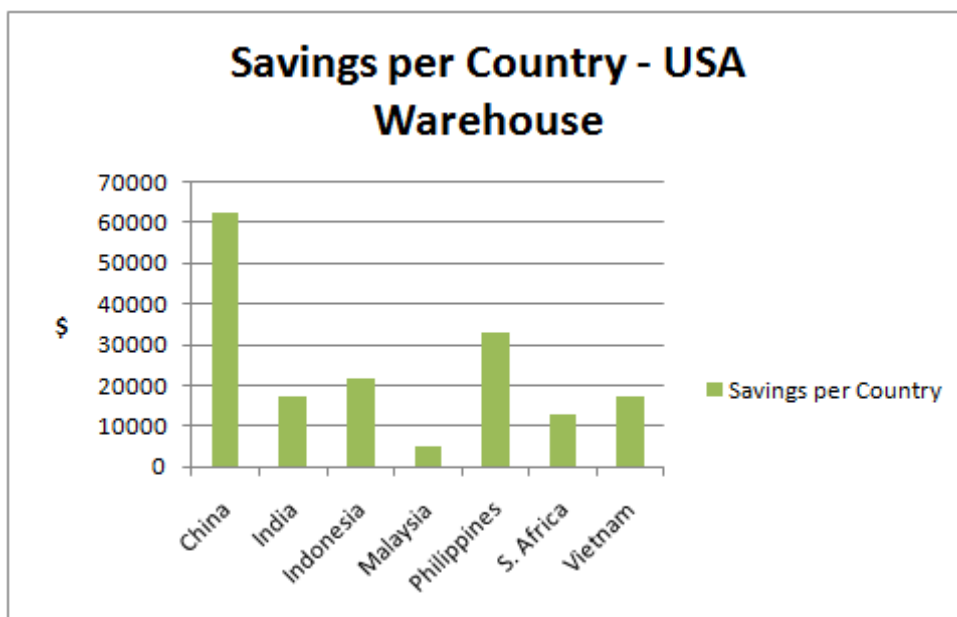


Figure 6 - Savings per country in USA



Product D had the biggest effect on savings for both consolidation options because it has the longest lead times of all the products. By reducing the lead time, it had the biggest effect on the number of safety stock units for Product D. Product A contributed the least towards the savings because of the small market it has in Asia. Only India and South Africa have markets for Product A.

China contributed the most towards the savings. This might have been because of current safety stock levels being too high. Indonesia which only sells Product C had a big contribution towards savings for only one product. This could also be because of too high current safety stock levels. India and South Africa are the only two countries that have markets for all four products. From the savings per country it could be seen that they form part of the lower contribution towards savings. This means that India and South Africa have good safety stock levels for the products.

5.2 Costs

To find the cost of leasing a warehouse for inventory, the maximum monthly demand per product and country over the past 4 years and product trends were taken to determine the maximum amount of stock that needed to be stored at the consolidation warehouse at any given point in time. Table 45 in Appendix G shows calculation. The yellow highlighted blocks indicate the month with the maximum demand. It could be seen that no more than five products reached their maximum in the same month. This meant that if demand started to rise in some months it was not going to affect the maximum number of units that needs to be stored. June was the month with the highest demand and any increase in the demand in June would have affected the total maximum demand.

The leasing cost for the USA and Singapore warehouses were calculated using two equations. Firstly, the maximum monthly demand figures, unit cost price and the ROIC rate were used to find holding cost per month for keeping stock. The yearly cost for keeping stock was determined by summing over the months, Table 46 Appendix G. Secondly the maximum demand figure which is converted to number of pallets were multiplied by the cost per pallet per year are, Table 47 Appendix D. The two totals were combined to give the total holding cost per year for the consolidation warehouses. The holding cost per year for the USA and Singapore warehouses was \$109,372.55 and \$210,499.10 respectively.

The labelling equipment in the USA had to move from the manufacturing site to the consolidation warehouse to achieve the improved lead times. No addition cost was incurred by doing so except for the moving cost of the equipment which will be once off cost.

For the Singapore hub to work, re-labelling equipment was needed. This equipment with set-up will cost \$500,000.00. The current equipment could not be moved, because there must be labelling equipment in the USA and Singapore.

5.3 Net savings and costs

From the yearly savings and yearly costs for the two consolidation options the USA consolidation warehouse would give savings of \$59,841.53 per year. It would cost the company \$8182.91 per year to operate the Singapore hub. The initial cost of \$500,000.00 for the re-labelling equipment in Singapore won't be justified or worked back through savings.

5.4 Re-ordering Points

The re-ordering points were only determined for the USA consolidation warehouse because USA's consolidation warehouse is economically feasible and the Singapore hub is not. The improved lead time period for the USA as can be seen in Table 2 Appendix A, are very close to a month (31 days) except for South Africa which is 52 days, almost 2 months. Thus for the demand during the lead time period in the RoP calculation, the lead time period will be one month and in effect, the forecasted monthly demand, and in South Africa's case two months forecasted demand. The re-ordering points for the products can be seen in Appendix C with the forecasted demand.

6. Recommendations and Conclusions

The results showed that the USA consolidation warehouse is an economically feasible solution to reduce supply chain cost by reducing safety stock levels. The company will have savings of around \$60,000.00 per year. This might not be large savings in a multimillion dollar company but with the recent financial crisis and countries still recovering from the financial meltdown, every dollar can make a difference in reducing supply chain costs.

The Singapore hub option would cost the company around \$8,000.00 per year to operate with an initial cost of \$500,000.00. This meant that the initial cost will not be worked back and thus will not justify the Singapore hub option. Comparing the two options showed that the USA consolidation warehouse is the better option with improvements in lead times and savings to the company.

The USA consolidation warehouse option will break even in a year or two depending on the movement cost of the re-labelling equipment. Once the movement cost is covered the company will start gaining the savings. The Singapore hub option will never break even because of the cost to operate the hub. The initial cost plus the cost to operate the hub will only cost the company.

The Singapore hub idea, although not economically feasible according to the study, gave valuable information. The biggest reason for the Singapore hub not being economically feasible is the high holding cost per unit in Singapore. Singapore being a very small county with high demand for land made it an expensive option to consolidate stock. Singapore's logistics ability played a massive part in choosing it for the study. There are other countries that have logistics abilities close to that of Singapore that can be considered. Countries like China with the port of Shanghai and Hong Kong, and Japan's port of Kobe are places that can handle vast amounts of shipments without any problems. These countries are close to the rest of the countries in the study and will also have lower holding costs.

Further analysis can be done to determine if a more economically feasible option in Asia can be found by looking at countries like China and Japan.

The re-ordering points for the products and countries vary from month to month which can be difficult to implement with constant changing. If data are continuously updated and orders are place one or two months in advance according to the improved lead times, the system can work.

More accurate orders will be placed with products with large variation between actual and forecasted demand if an informed decision is made when placing an order based on past experience, past demand figures, new developments and environment. It was not possible to take all of these factors into account with the forecasting used in the study.

China and Indonesia contributed the most to the savings and this can be due to high levels of safety stocks being kept. Analysis can be done to determine if the high levels of safety stock is worth carrying and if reduction in levels can be made.

If reductions are possible, the study can be done again to determine if the consolidation warehouse will be economically feasible. If not the reduction in safety stock levels for China and Indonesia will save money. This will probably not be a huge saving but could contribute to the reduction of supply chain cost.

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8. Appendix

Section A – Lead time data

Table 4 - USA to Affiliates Lead times

Countries	Description	Replen Lead Time (Cal Days)	Pick/Pack (Work Days)	Manufacturing - Port Transit (Cal Days)	Buyers Ocean Trans Dur (Cal Days)	Port to Affilate Whse (Work Days)	Total Lead Time
S. Africa	Product A	48	10	35	49	7	149
S. Africa	Product B	63	10	35	49	7	164
S. Africa	Product C	48	10	35	49	7	149
S. Africa	Product D	63	10	35	49	7	164
India	Product A	48	10	35	31	7	131
India	Product B	51	10	35	31	7	134
India	Product C	48	10	35	31	7	131
India	Product D	63	10	35	31	7	146
Malaysia	Product A	N/A	N/A	N/A	N/A	N/A	N/A
Malaysia	Product B	63	10	45	30	2	150
Malaysia	Product C	48	10	45	30	2	135
Malaysia	Product D	N/A	N/A	N/A	N/A	N/A	N/A
Vietnam	Product A	N/A	N/A	N/A	N/A	N/A	N/A
Vietnam	Product B	N/A	N/A	N/A	N/A	N/A	N/A
Vietnam	Product C	48	10	45	25	2	130
Vietnam	Product D	63	10	45	25	2	145
Indonesia	Product A	N/A	N/A	N/A	N/A	N/A	N/A
Indonesia	Product B	N/A	N/A	N/A	N/A	N/A	N/A
Indonesia	Product C	48	10	45	28	3	134
Indonesia	Product D	N/A	N/A	N/A	N/A	N/A	N/A
Philippines	Product A	N/A	N/A	N/A	N/A	N/A	N/A
Philippines	Product B	63	10	35	24	2	134
Philippines	Product C	48	10	35	24	2	119
Philippines	Product D	63	10	35	24	2	134
China	Product A	N/A	N/A	N/A	N/A	N/A	N/A
China	Product B	N/A	N/A	N/A	N/A	N/A	N/A
China	Product C	48	10	30	22	7	117
China	Product D	63	10	30	22	7	132

Table 5 - USA to Affiliates Improved lead times

USA to Affiliates Improved Lead times				
Countries	Description	Buyers Ocean Trans Dur (Cal Days)	Port to Affiliate Whse (Work Days)	Total Lead Time
S. Africa	Product A	49	7	56
S. Africa	Product B	49	7	56
S. Africa	Product C	49	7	56
S. Africa	Product D	49	7	56
India	Product A	31	7	38
India	Product B	31	7	38
India	Product C	31	7	38
India	Product D	31	7	38
Malaysia	Product A	N/A	N/A	N/A
Malaysia	Product B	30	2	32
Malaysia	Product C	30	2	32
Malaysia	Product D	N/A	N/A	N/A
Vietnam	Product A	N/A	N/A	N/A
Vietnam	Product B	N/A	N/A	N/A
Vietnam	Product C	25	2	27
Vietnam	Product D	25	2	27
Indonesia	Product A	N/A	N/A	N/A
Indonesia	Product B	N/A	N/A	N/A
Indonesia	Product C	28	3	31
Indonesia	Product D	N/A	N/A	N/A
Philippines	Product A	N/A	N/A	N/A
Philippines	Product B	24	2	26
Philippines	Product C	24	2	26
Philippines	Product D	24	2	26
China	Product A	N/A	N/A	N/A
China	Product B	N/A	N/A	N/A
China	Product C	22	7	29
China	Product D	22	7	29

Table 6 - Singapore hub to Affiliates Lead time

Singapore hub to Affiliates Lead times					
Countries	Description	Buyers Ocean Trans Dur (Cal Days)	Pick/Pack (Work Days)	Port to Affilate Whse (Work Days)	Total Lead Time (days)
S. Africa	Product A	15	8	7	30
S. Africa	Product B	15	8	7	30
S. Africa	Product C	15	8	7	30
S. Africa	Product D	15	8	7	30
India	Product A	7	8	7	22
India	Product B	7	8	7	22
India	Product C	7	8	7	22
India	Product D	7	8	7	22
Malaysia	Product A	N/A	N/A	N/A	N/A
Malaysia	Product B	1	8	2	11
Malaysia	Product C	1	8	2	11
Malaysia	Product D	N/A	N/A	N/A	N/A
Vietnam	Product A	N/A	N/A	N/A	N/A
Vietnam	Product B	N/A	N/A	N/A	N/A
Vietnam	Product C	4	8	2	14
Vietnam	Product D	4	8	2	14
Indonesia	Product A	N/A	N/A	N/A	N/A
Indonesia	Product B	N/A	N/A	N/A	N/A
Indonesia	Product C	2	8	3	13
Indonesia	Product D	N/A	N/A	N/A	N/A
Philippines	Product A	N/A	N/A	N/A	N/A
Philippines	Product B	5	8	2	15
Philippines	Product C	5	8	2	15
Philippines	Product D	5	8	2	15
China	Product A	N/A	N/A	N/A	N/A
China	Product B	N/A	N/A	N/A	N/A
China	Product C	7	8	7	22
China	Product D	7	8	7	22

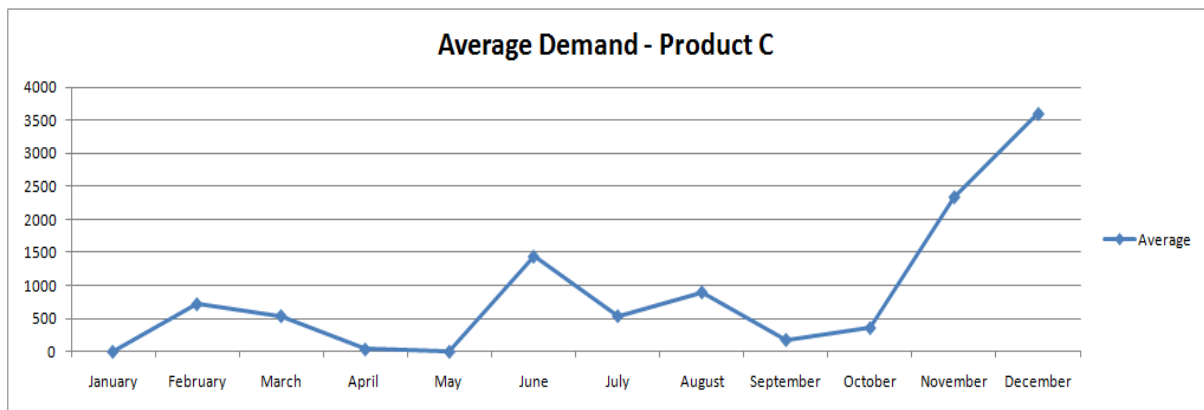
Section B – Demand data

China – Product C

Table 7 - China Product C Demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2008	0	0	0	0	0	0	0	0	0	0	1440	3600	1083.63
2009	0	720	1440	0	0	0	720	0	0	720	4320	5760	1903.91
2010	0	1440	0	0	0	5040	720	720	720	720	3600	5040	1928.504
2011	0	720	720	144	0	720	720	2880	0	0	0	0	824.8398
Average	0	720	540	36	0	1440	540	900	180	360	2340	3600	1435
Stdv	0	588	689	72	0	2424	360	1363	360	416	1983	2562	940.8812

Figure 7 - China Product C average demand

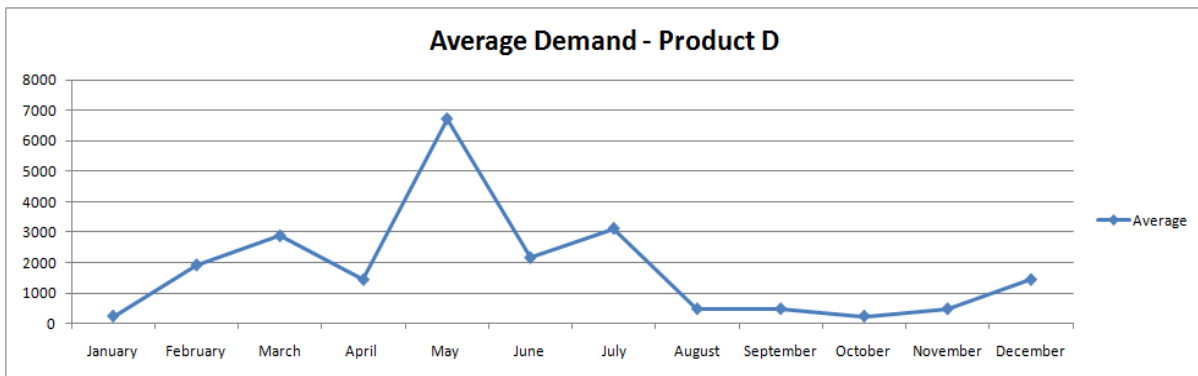


China - Product D

Table 8 - China Product D demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2009	0	2880	720	0	3600	2160	4320	1440	720	720	720	720	1406.892
2010	720	2160	2880	2880	10800	4320	1440	0	720	0	720	3600	2968.636
2011	0	720	5040	1440	5760	0	3600	0	0	0	0	0	2159.091
Average	240	1920	2880	1440	6720	2160	3120	480	480	240	480	1440	2178
Stdv	416	1100	2160	1440	3695	2160	1499	831	416	416	416	1905	998.464

Figure 8 - China Product D average demand

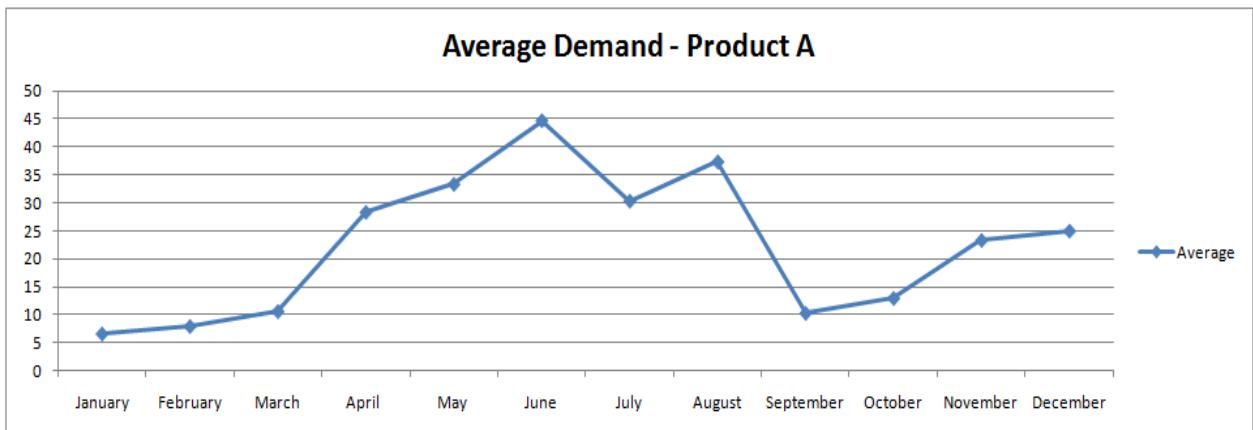


India - Product A

Table 9 - India Product A demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly	
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv	
2009	0	0	0	0	0	0	0	0	0	0	0	0	8	2.309401
2010	6	6	19	35	36	64	17	37	31	39	70	67	67	22.1255
2011	14	18	13	50	64	70	74	75	0	0	0	0	0	32.16294
Average	7	8	11	28	33	45	30	37	10	13	23	25	19	
Stdv	7	9	10	26	32	39	39	38	18	23	40	37	37	12.79612

Figure 9 - India ProductA average demand

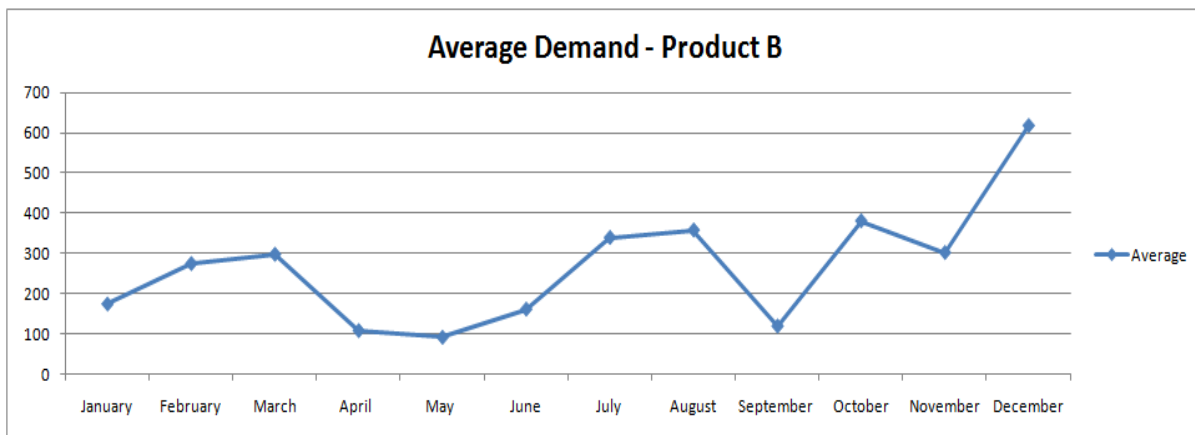


India - Product B

Table 10 - India Product B demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2006	0	1	198	159	159	0	35	1	5	50	50	0	73.87035
2007	14	14	502	12	63	29	4	59	79	229	260	177	149.3795
2008	55	48	173	77	164	18	12	410	104	108	176	406	134.7549
2009	225	439	104	259	24	59	400	368	99	625	571	956	276.2775
2010	578	873	511	36	50	704	1247	951	312	893	455	1545	453.6961
Average	174	275	298	108	92	162	339	358	120	381	302	617	218
Stdv	243	381	194	101	65	304	534	378	115	363	210	631	173.839

Figure 10 - India Product B average demand

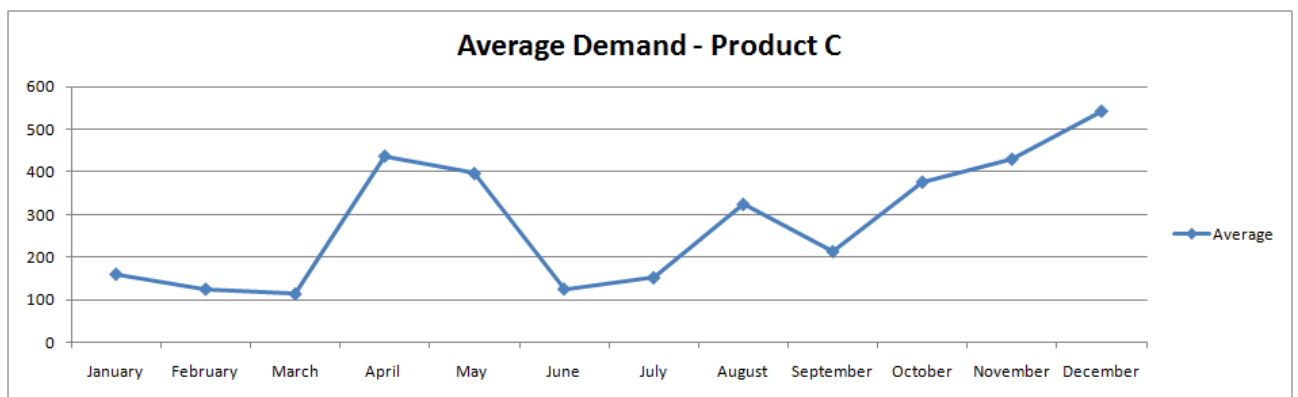


India - Product C

Table 11 - India Product C demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2006	107	131	190	1907	1774	20	242	330	2	41	46	116	676.0729
2007	94	54	40	26	6	126	90	559	279	192	421	218	170.7574
2008	89	80	243	27	61	408	204	44	161	87	299	645	182.7384
2009	170	293	26	39	28	20	83	584	104	880	626	988	355.4601
2010	343	69	72	189	115	55	142	105	523	683	760	748	283.1652
Average	161	125	114	438	397	126	152	324	214	377	430	543	334
Stdv	107	98	97	824	771	164	70	250	200	380	279	367	254.3355

Figure 11 - India Product C average demand

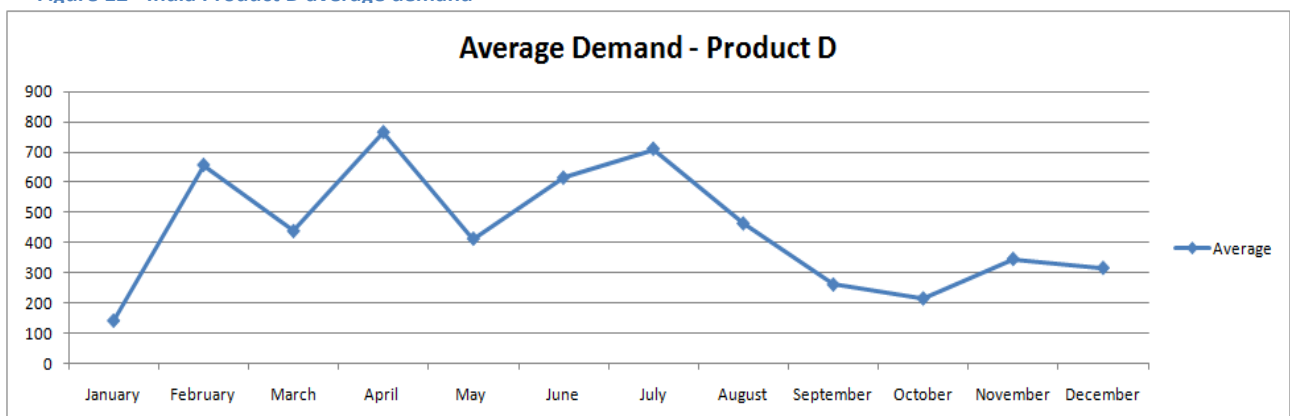


India - Product D

Table 12 - India Product D demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2006	0	787	39	1228	392	159	449	408	200	100	0	998	408.2952
2007	0	29	0	181	440	483	79	150	150	0	1005	129	294.6423
2008	254	147	107	762	644	538	365	1120	744	851	599	150	322.1351
2009	163	386	456	454	327	483	528	295	104	95	100	299	159.6049
2010	299	1932	1590	1195	263	1408	2127	345	113	36	29	9	809.5424
Average	143	656	438	764	413	614	710	464	262	216	347	317	399
Stdv	140	770	669	457	145	468	810	379	272	357	441	394	216.8353

Figure 12 - India Product D average demand

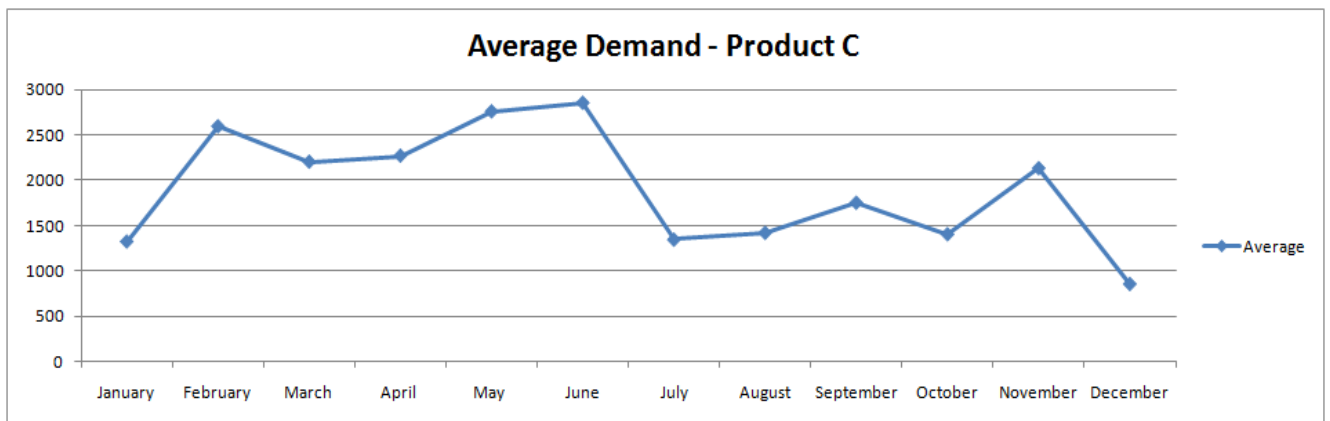


Indonesia - Product C

Table 13 - Indonesia Product C demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2006	2560	1440	0	3429	1857	1286	2429	641	1573	1286	3143	0	1113.869
2007	1929	4320	4000	2160	5440	0	0	0	2160	1440	3200	0	1882.714
2008	720	2880	0	2160	1440	5040	0	1440	720	720	0	2160	1472.364
2009	1440	0	2080	0	2880	4320	2880	5040	1440	0	2880	2160	1637.678
2010	0	4320	4940	3600	2160	3600	1440	0	2880	3600	1440	0	1753.261
Average	1330	2592	2204	2270	2755	2849	1350	1424	1755	1409	2133	864	1572
Stdv	1003	1878	2261	1440	1590	2127	1338	2106	811	1349	1392	1183	462.846

Figure 13 - Indonesia Product C average demand

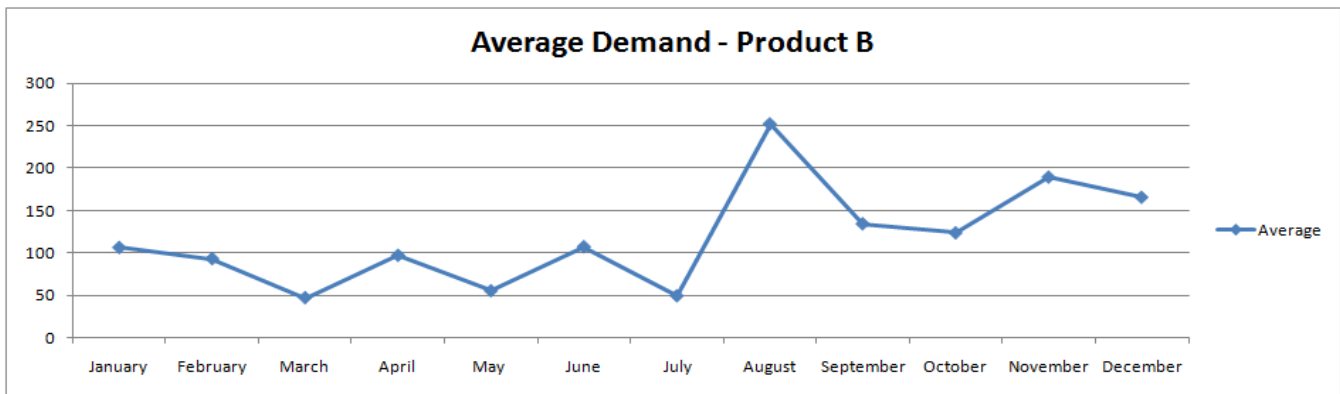


Malaysia - Product B

Table 14 - Malaysia Product B demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2006	49	0	146	16	20	55	7	288	230	40	20	20	95.12396
2007	20	45	0	20	0	20	20	20	46	80	85	140	41.41219
2008	130	32	27	20	29	176	16	180	40	200	20	305	96.99996
2009	43	355	9	192	192	72	60	160	100	100	592	187	161.5774
2010	290	34	54	238	36	213	144	612	256	198	230	176	154.4125
Average	106	93	47	97	55	107	49	252	134	124	189	166	110
Stdv	111	147	59	109	78	83	57	223	102	72	241	102	60.04998

Figure 14 - Malaysia Product B average demand

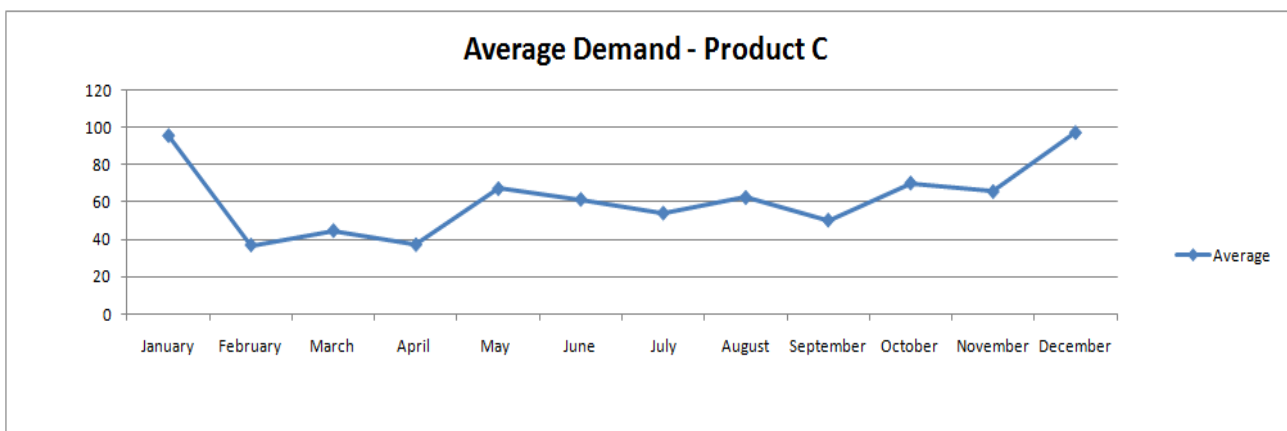


Malaysia - Product C

Table 15 - Malaysia Product C demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2006	45	20	60	8	56	47	44	72	10	67	67	8	24.36092
2007	92	40	47	25	73	77	42	37	40	57	35	120	28.05987
2008	230	46	35	57	55	20	42	45	63	45	50	87	54.53516
2009	40	25	15	70	20	95	75	98	63	77	91	167	42.45925
2010	72	53	66	25	132	68	67	60	75	105	85	105	27.87458
Average	96	37	45	37	67	61	54	62	50	70	66	97	35
Stdv	78	14	20	26	41	29	16	24	26	23	23	58	18.83343

Figure 15 - Malaysia Product C average demand

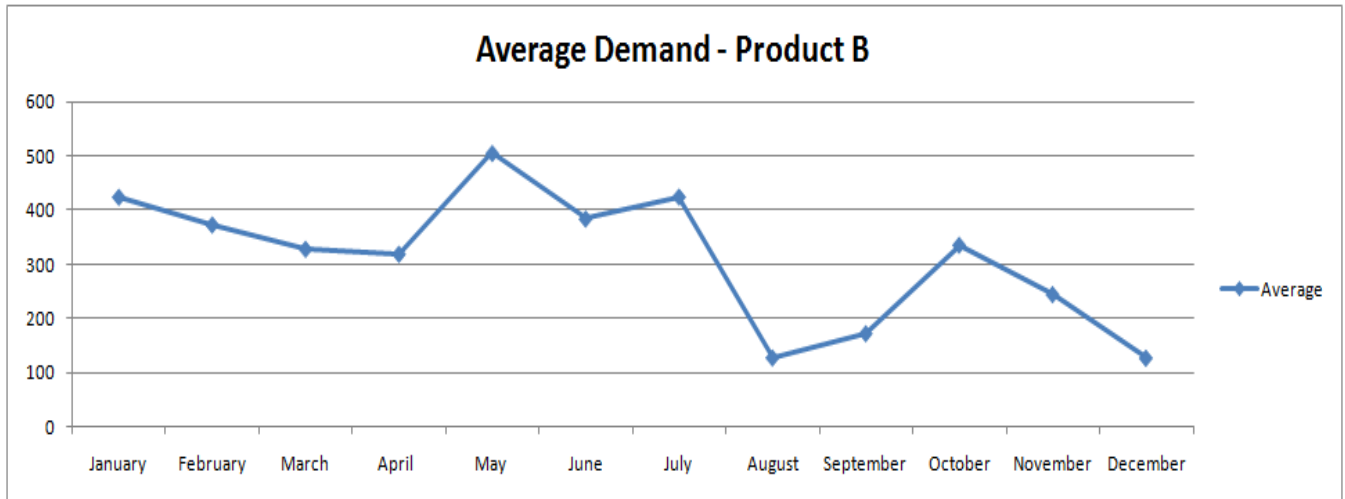


Philippines – Product B

Table 16 - Philippines Product B demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2008	0	0	0	0	0	0	0	0	476	1012	701	2	349.296
2009	522	51	64	5	7	0	8	127	77	127	142	123	142.0515
2010	206	422	607	425	868	812	669	170	136	204	135	382	264.5137
2011	970	1020	642	846	1146	725	1022	213	0	0	0	0	469.5794
Average	425	373	328	319	505	384	425	128	172	336	245	127	306
Stdv	422	470	343	404	590	445	507	92	210	459	311	180	147.1024

Figure 16 - Philippines Product B average demand

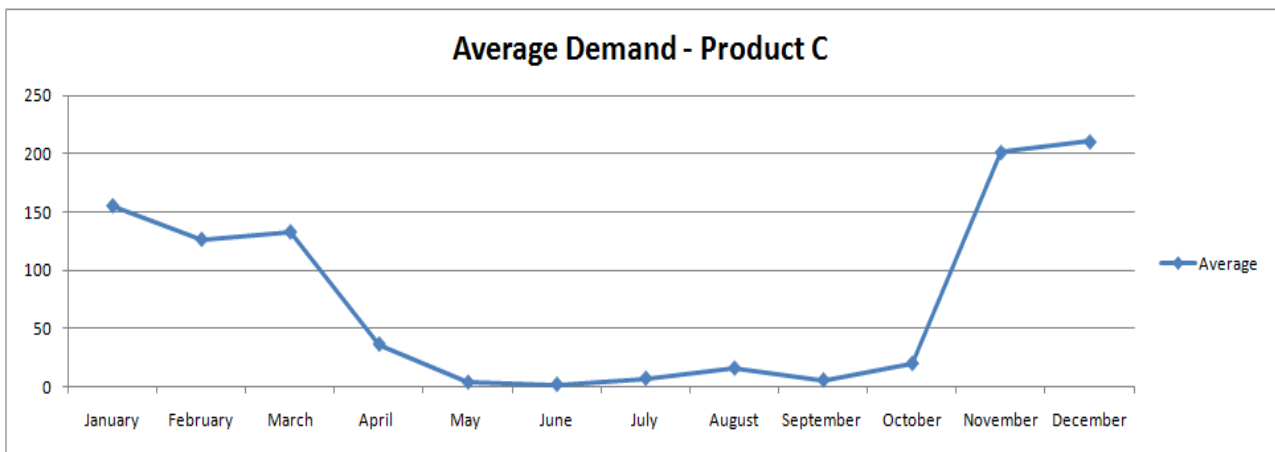


Philippines – Product C

Table 17 - Philippines Product C demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2006	19	12	47	3	0	3	5	2	12	4	609	802	273.7725
2007	744	573	510	146	2	1	2	3	7	4	1	13	274.3529
2008	1	0	23	22	12	2	22	66	0	29	266	126	77.63607
2009	2	10	9	1	0	0	1	4	8	58	126	108	44.89993
2010	13	40	77	12	6	4	6	6	1	5	6	5	22.05016
Average	156	127	133	37	4	2	7	16	6	20	202	211	139
Stdv	329	250	212	62	5	1	9	28	5	24	252	335	136.893

Figure 17 - Philippines Product C average demand

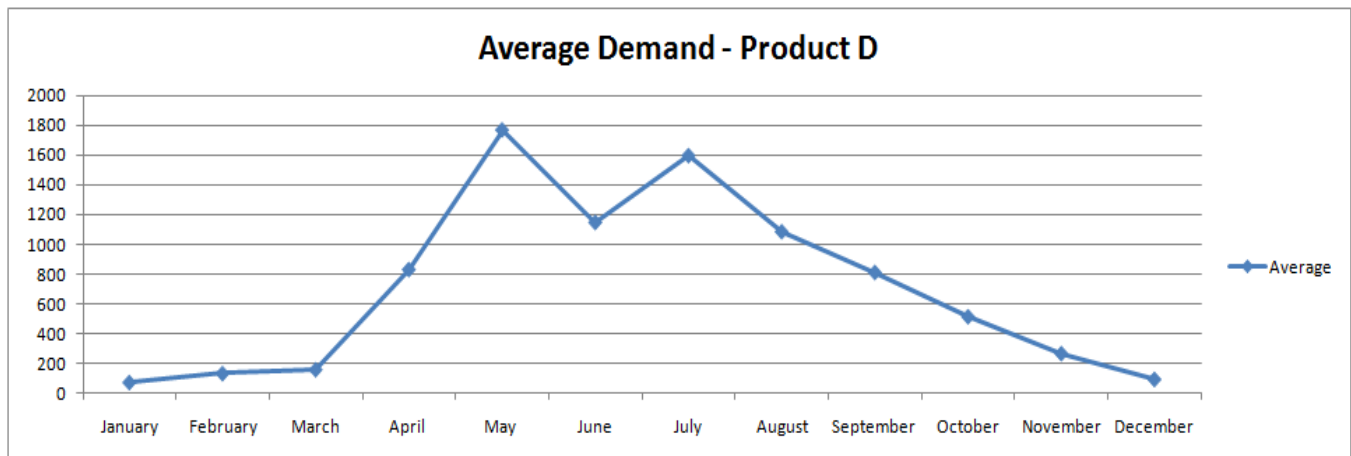


Philippines – Product D

Table 18 - Philippines Product D demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2006	0	0	60	3212	134	1708	2284	2130	2050	2100	840	314	1131.92
2007	126	354	430	228	3798	2102	2226	2476	1596	342	242	68	1233.213
2008	68	70	64	80	2360	588	1350	524	248	18	86	60	711.5759
2009	12	74	102	148	2096	1092	1826	196	34	76	50	18	755.327
2010	168	176	146	484	430	236	276	92	126	40	124	20	143.1781
Average	75	135	160	830	1764	1145	1592	1084	811	515	268	96	795
Stdv	72	138	155	1340	1503	770	826	1131	941	895	328	124	507.5184

Figure 18 - Philippines Product D average demand

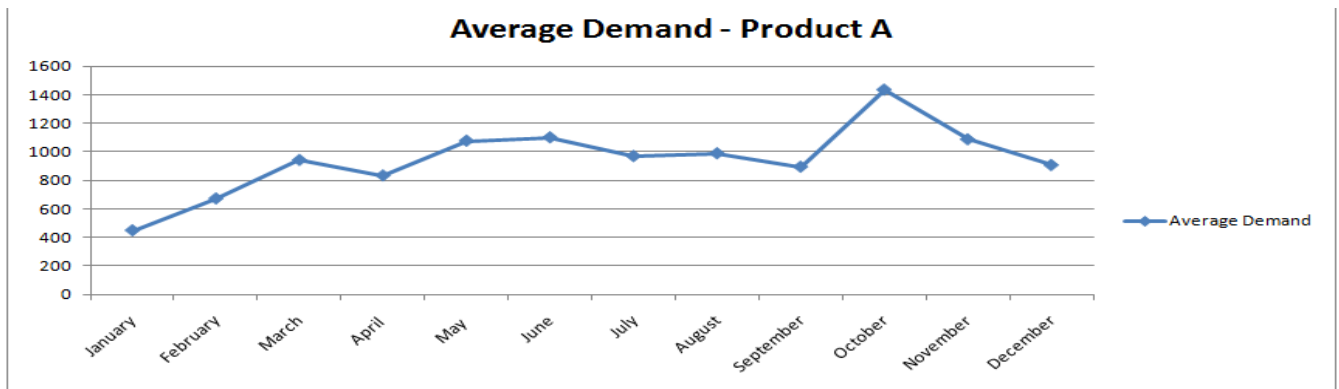


South Africa - Product A

Table 20 - South Africa Product A demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2006	371	436	651	598	951	864	791	1148	822	1139	1396	540	311.1403
2007	603	604	1074	624	1143	1853	515	733	720	1219	912	976	376.9674
2008	450	972	1032	921	1145	611	1295	873	1040	1665	441	993	345.8959
2009	552	628	873	1026	1285	829	1310	801	1025	1247	1404	1214	281.1615
2010	263	715	1074	994	855	1341	930	1383	860	1897	1275	804	409.4687
Average	448	671	941	833	1076	1100	968	988	893	1433	1086	905	345
Stdv	122	176	163	184	153	446	304	243	123	295	369	224	101.8475

Figure 19 - South Africa Product A average demand

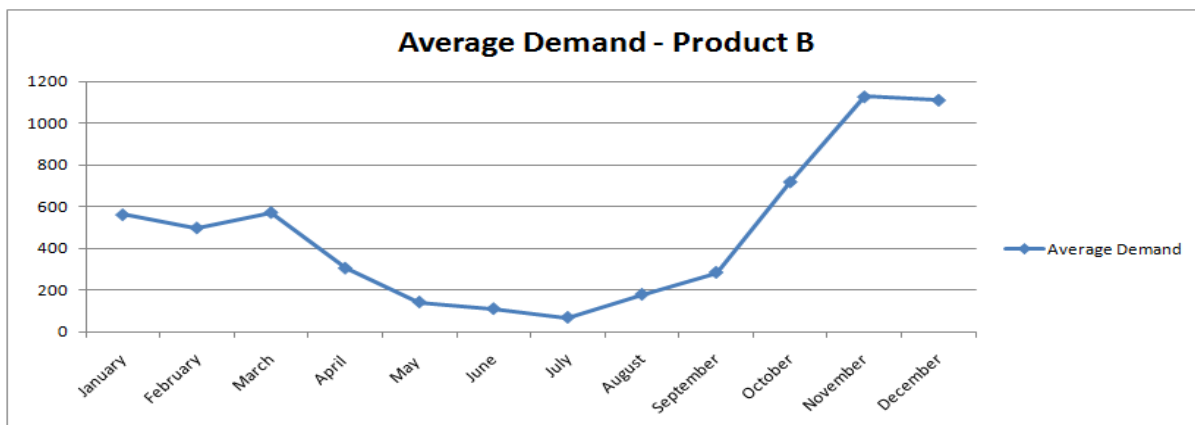


South Africa - Product B

Table 19 - South Africa Product B demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2006	678	527	603	116	20	64	25	97	376	611	1182	1021	395.9725
2007	494	591	538	288	73	19	11	241	486	480	1337	1366	449.7713
2008	346	344	242	210	108	0	132	552	280	1063	1172	1025	405.6454
2009	798	822	1117	409	406	284	125	-23	244	644	962	1100	386.7238
2010	490	205	360	499	99	179	44	25	34	798	991	1052	373.074
Average	561	498	572	304	141	109	67	178	284	719	1129	1113	402
Stdv	177	237	337	153	152	120	57	231	168	223	154	145	70.38579

Figure 20 - South Africa Product B average demand

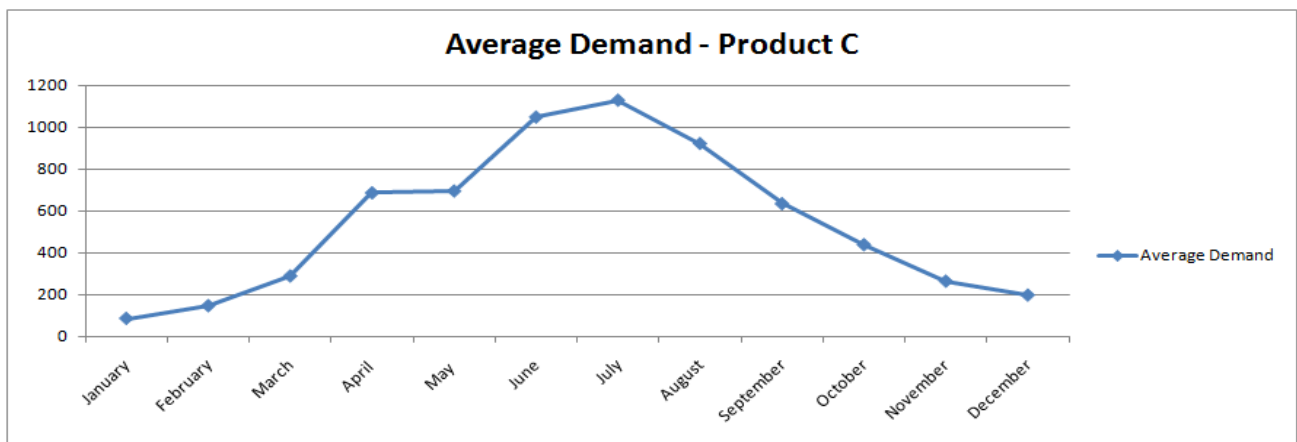


South Africa - Product C

Table 21 - South Africa Product C demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2006	183	425	135	1233	1102	1348	1167	1158	866	531	245	564	448.368
2007	76	200	165	883	747	1271	2146	1369	925	922	216	180	631.7039
2008	34	10	466	792	883	1246	1278	1078	526	447	424	120	447.0315
2009	50	33	308	195	365	683	756	649	678	260	401	71	265.0194
2010	78	57	362	323	374	693	298	354	173	26	26	44	203.402
Average	84	145	287	685	694	1048	1129	922	634	437	262	196	399
Stdv	58	173	138	425	322	331	687	411	302	333	161	212	167.3265

Figure 21 - South Africa Product C average demand

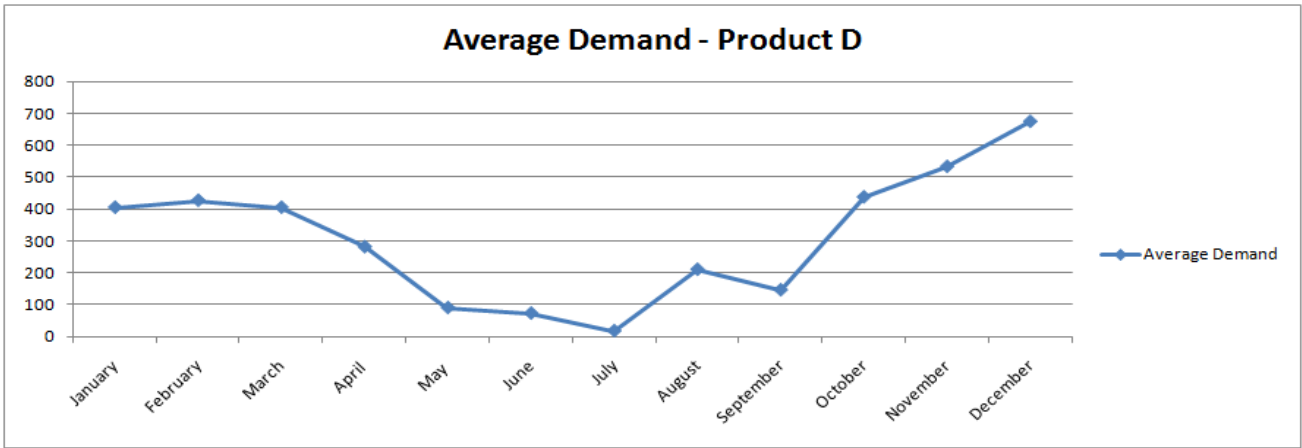


South Africa - Product D

Table 22 - South Africa Product D demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2006	583	334	539	189	48	50	25	305	285	484	722	965	291.5181
2007	562	440	410	301	112	69	0	368	132	474	804	678	250.8529
2008	295	402	157	235	122	57	0	305	240	859	401	667	247.7533
2009	307	726	639	368	101	142	36	22	48	294	635	998	320.9167
2010	274	228	275	309	64	43	23	48	21	72	99	59	110.6108
Average	404	426	404	280	89	72	17	210	145	437	532	673	244
Stdv	154	186	194	70	32	40	16	162	116	290	285	377	114.0075

Figure 22 - South Africa Product D average demand

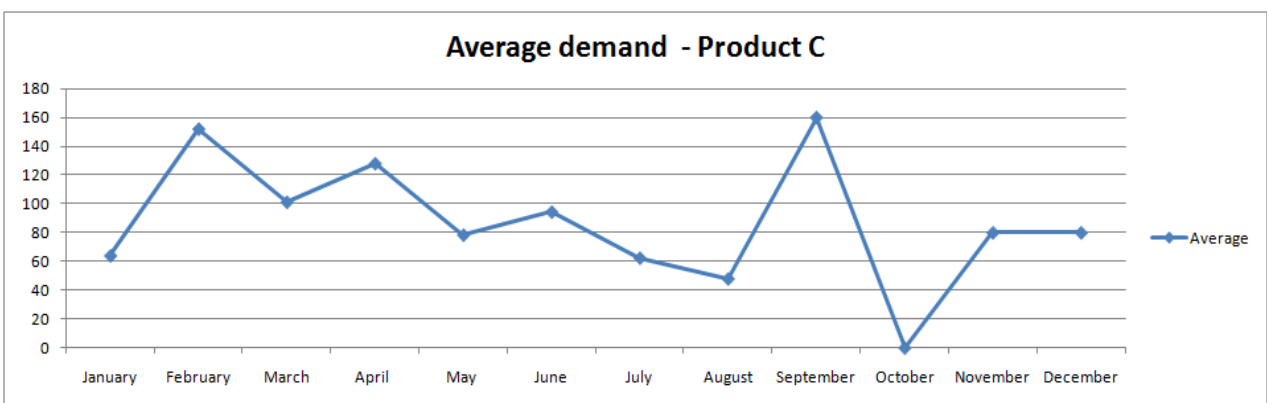


Vietnam - Product C

Table 23 - Vietnam Product C demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2006	0	0	0	0	0	72	72	0	0	0	0	0	28.02596
2007	0	0	192	0	72	80	0	0	0	0	0	80	60.20168
2008	0	120	0	640	0	0	240	240	0	0	160	0	191.0418
2009	0	320	314	0	0	320	0	0	480	0	240	320	181.5238
2010	320	320	0	0	320	0	0	0	320	0	0	0	157.5571
Average	64	152	101	128	78	94	62	48	160	0	80	80	124
Stdv	143	161	145	286	139	132	104	107	226	0	113	139	68.77684

Figure 23 - Vietnam Product C average demand

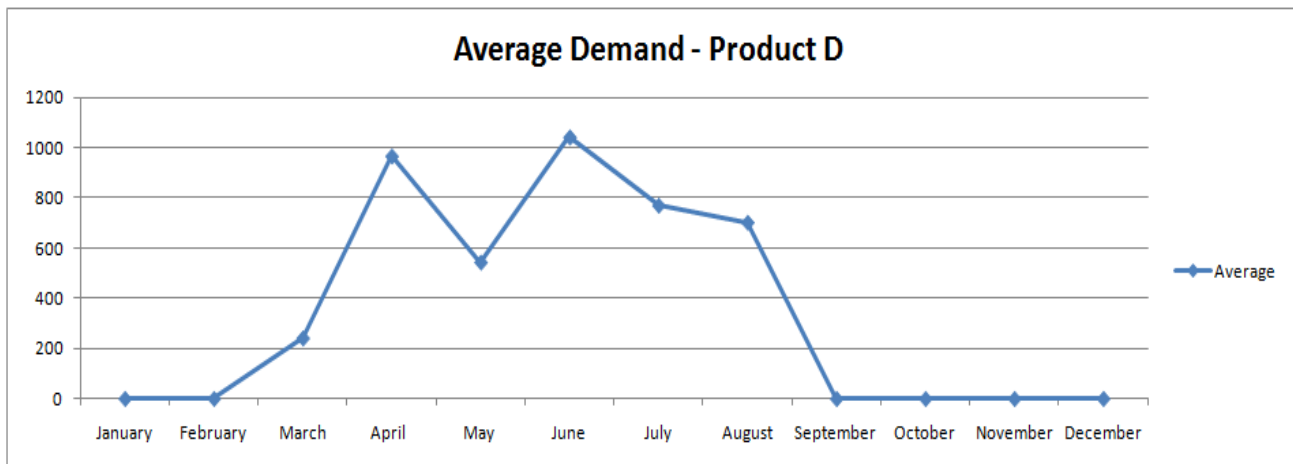


Vietnam – Product D

Table 24 - Vietnam Product D demand

Season	Summer		Autumn		Winter				Spring		Summer		monthly
Month	January	February	March	April	May	June	July	August	September	October	November	December	stdv
2008					726	726	0	726	0	0	0	0	363
2009	0	0	0	726	726	2722	0	2087	0	0	0	0	1121.218
2010	0	0	726	2177	726	726	2903	0	0	0	0	0	1092.539
2010	0	0	0	0	0	0	181	0					73.89294
Average	0	0	242	968	545	1044	771	703	0	0	0	0	663
Stdv	0	0	419	1108	363	1170	1424	984	0	0	0	0	556.6837

Figure 24 - Vietnam Product D average demand



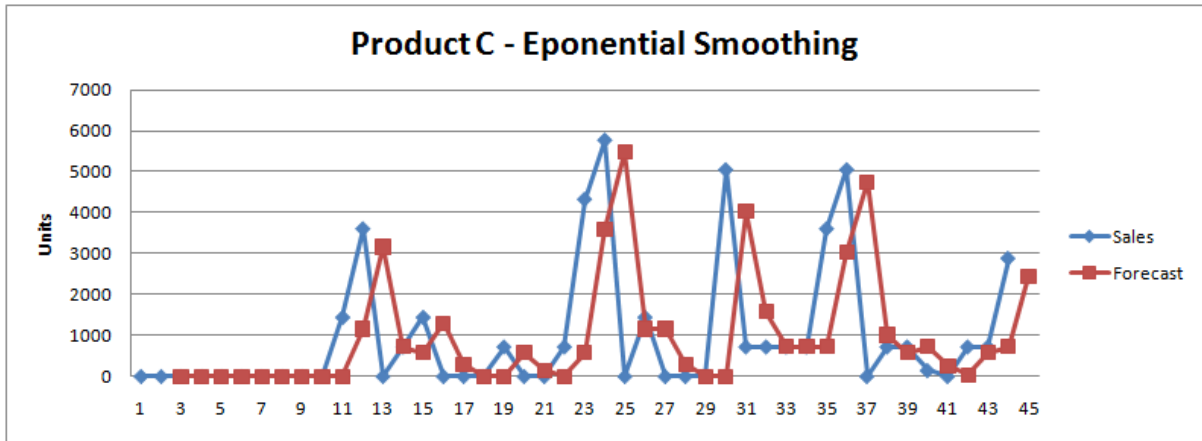
Section C – Forecast

China – Product C

Table 25 - China Product C Forecast

Product C - Exponential Smoothing Forecasting						
Alpha = 0.8		MAD = 977.8605			ROP = 2524 + forecast demand	
Month	Sales	Forecast	Diviation	SS	RoP	
1	0					
2	0					
3	0	0	0	2524	2524	
4	0	0	0	2524	2524	
5	0	0	0	2524	2524	
6	0	0	0	2524	2524	
7	0	0	0	2524	2524	
8	0	0	0	2524	2524	
9	0	0	0	2524	2524	
10	0	0	0	2524	2524	
11	1440	0	1440	2524	2524	
12	3600	1152	2448	2524	3676	
13	0	3168	3168	2524	5692	
14	720	720	1.14E-13	2524	3244	
15	1440	576	864	2524	3100	
16	0	1296	1296	2524	3820	
17	0	288	288	2524	2812	
18	0	0	0	2524	2524	
19	720	0	720	2524	2524	
20	0	576	576	2524	3100	
21	0	144	144	2524	2668	
22	720	0	720	2524	2524	
23	4320	576	3744	2524	3100	
24	5760	3600	2160	2524	6124	
25	0	5472	5472	2524	7996	
26	1440	1152	288	2524	3676	
27	0	1152	1152	2524	3676	
28	0	288	288	2524	2812	
29	0	0	0	2524	2524	
30	5040	0	5040	2524	2524	
31	720	4032	3312	2524	6556	
32	720	1584	864	2524	4108	
33	720	720	0	2524	3244	
34	720	720	0	2524	3244	
35	3600	720	2880	2524	3244	
36	5040	3024	2016	2524	5548	
37	0	4752	4752	2524	7276	
38	720	1008	288	2524	3532	
39	720	576	144	2524	3100	
40	144	720	576	2524	3244	
41	0	259.2	259.2	2524	2783	
42	720	28.8	691.2	2524	2553	
43	720	576	144	2524	3100	
44	2880	720	2160	2524	3244	
Forecast =		2448		2524	4972	
		MAD =	977.8605			

Figure 25 - China Product C Forecast

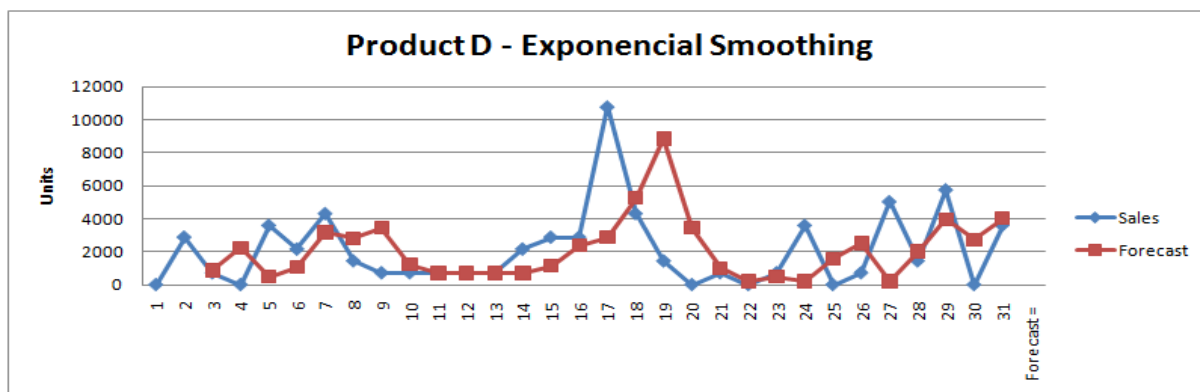


China – Product D

Table 26 - China Product D Forecast

Product D - Exponential Smoothing Forecasting					
Alpha =	0.3	MAD =	1847.172	ROP =	3831 + Forecast demand
Month	Sales	Forecast	Diviation	SS	RoP
1	0				
2	2880				
3	720	864	144	3831	4695
4	0	2232	2232	3831	6063
5	3600	504	3096	3831	4335
6	2160	1080	1080	3831	4911
7	4320	3168	1152	3831	6999
8	1440	2808	1368	3831	6639
9	720	3456	2736	3831	7287
10	720	1224	504	3831	5055
11	720	720	0	3831	4551
12	720	720	0	3831	4551
13	720	720	0	3831	4551
14	2160	720	1440	3831	4551
15	2880	1152	1728	3831	4983
16	2880	2376	504	3831	6207
17	10800	2880	7920	3831	6711
18	4320	5256	936	3831	9087
19	1440	8856	7416	3831	12687
20	0	3456	3456	3831	7287
21	720	1008	288	3831	4839
22	0	216	216	3831	4047
23	720	504	216	3831	4335
24	3600	216	3384	3831	4047
25	0	1584	1584	3831	5415
26	720	2520	1800	3831	6351
27	5040	216	4824	3831	4047
28	1440	2016	576	3831	5847
29	5760	3960	1800	3831	7791
30	0	2736	2736	3831	6567
31	3600	4032	432	3831	7863
Forecast =		1080		3831	4911
		MAD =	1847.172		

Figure 26 - China Product D Forecast

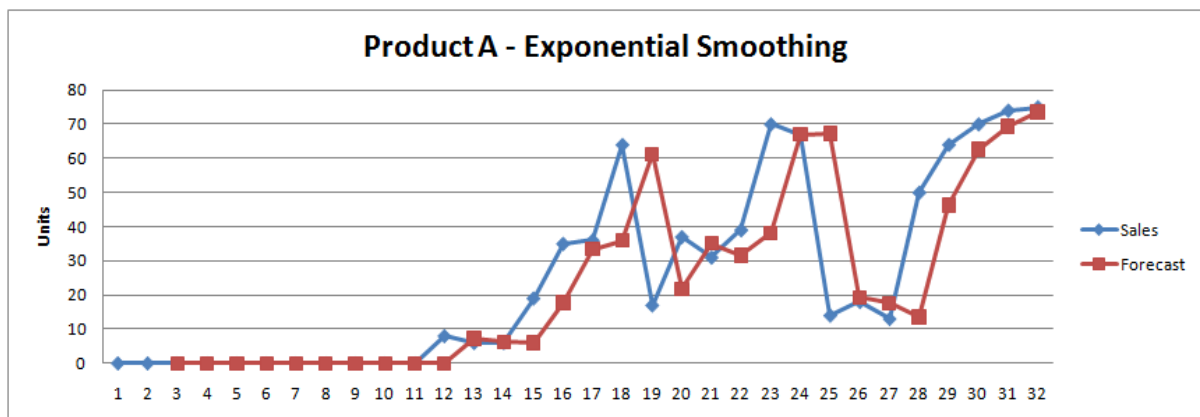


India - Product A

Table 27 - India Product A Forecast

Product A - Exponential Smoothing Forecast						
Alpha =	0.9	MAD =	10	ROP =	33 + Forecasted demand	
Month	Sales	Forecast	Diviation	SS	RoP	
1	0					
2	0					
3	0	0	0	33	33	
4	0	0	0	33	33	
5	0	0	0	33	33	
6	0	0	0	33	33	
7	0	0	0	33	33	
8	0	0	0	33	33	
9	0	0	0	33	33	
10	0	0	0	33	33	
11	0	0	0	33	33	
12	8	0	8	33	33	
13	6	7	1.2	33	40	
14	6	6	0.2	33	39	
15	19	6	13	33	39	
16	35	18	17.3	33	51	
17	36	33	2.6	33	66	
18	64	36	28.1	33	69	
19	17	61	44.2	33	94	
20	37	22	15.3	33	55	
21	31	35	4	33	68	
22	39	32	7.4	33	65	
23	70	38	31.8	33	71	
24	67	67	0.1	33	100	
25	14	67	53.3	33	100	
26	18	19	1.3	33	52	
27	13	18	4.6	33	51	
28	50	14	36.5	33	47	
29	64	46	17.7	33	79	
30	70	63	7.4	33	96	
31	74	69	4.6	33	102	
32	75	74	1.4	33	107	
Forecast =		75		33	108	
		MAD =	10			

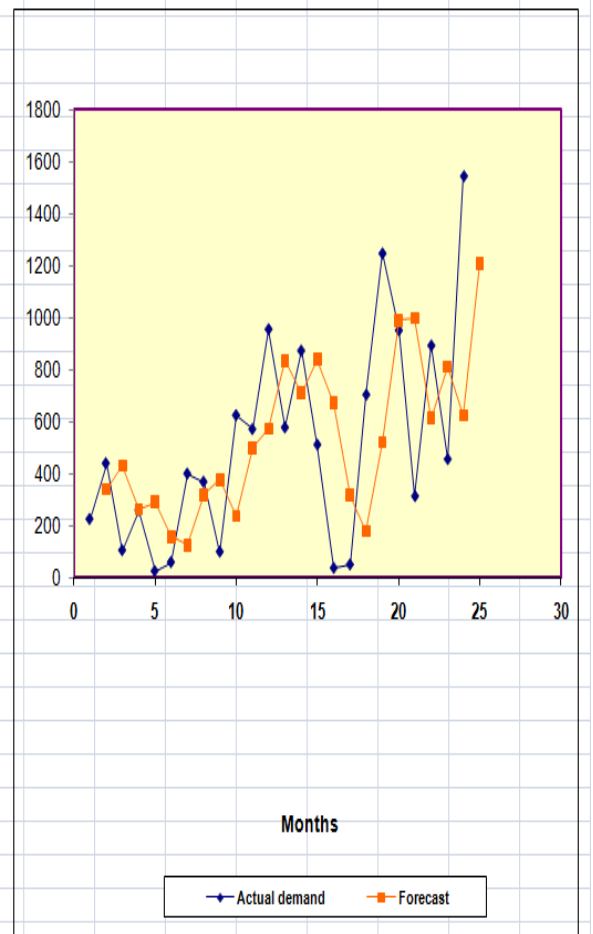
Figure 27 - India Product A Forecast



India - Product B

Table 28 - India Product B Forecast

Product B - Holt's method Forecast													
Month	1	2	3	4	5	6	7	8	9	10	11	12	
Sales	55	48	173	77	164	18	12	410	104	108	176	406	Sum
Trend		-7.2	125.1	-96.3	87.3	-145.8	-6.3	398.7	-306	3.6	67.5	230.4	351
Then :								An initial value for the Base Level, $L(0) = 405.9$ may be assumed, and					
								An initial value for the Per Period Trend, $T(0) = 31.91$ may be assumed					
Alpha =	0.6		Beta =		0.01		MAD =		359				
Month	Actual demand	L(t)	T(t)	Forecast	Abs.Error	SS	RoP						
1	225	310.12	30.63										
2	439	399.82	31.22	341	98.44	383	724						
3	104	235.06	29.26	431	326.65	383	814						
4	259	261.25	29.23	264	5.12	383	647						
5	24	130.77	27.64	290	266.18	383	673						
6	59	98.46	27.04	158	99.91	383	541						
7	400	289.96	28.68	125	274.10	383	508						
8	368	348.32	28.98	319	49.46	383	702						
9	99	210.32	27.31	377	278.29	383	760						
10	625	469.81	29.63	238	386.98	383	621						
11	571	542.14	30.06	499	71.16	383	882						
12	956	802.36	32.36	572	383.61	383	955						
13	578	680.57	30.82	835	256.91	383	1218						
14	873	808.35	31.79	711	161.62	383	1094						
15	511	642.78	29.81	840	328.94	383	1223						
16	36	290.64	25.99	673	636.59	383	1056						
17	50	156.35	24.39	317	267.13	383	700						
18	704	494.58	27.53	181	523.06	383	564						
19	1247	957.28	31.88	522	725.29	383	905						
20	951	966.44	31.65	989	37.86	383	1372						
21	312	586.62	27.54	998	685.80	383	1381						
22	893	781.34	29.21	614	278.64	383	997						
23	455	597.46	27.08	811	355.15	383	1194						
24	1545	1177.00	32.60	625	920.76	383	1008						
25		483.84	25.35	1210	1209.60	383	1593						
Forecast =				1210		383	1593						
				MAD =	359								
				MAD% =	29.72								



India - Product C

Table 29 - India Product C Forecast

Product C - Winter's method Forecast

Month	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	Sum
Year -2	94	54	40	26	6	126	90	559	279	192	421	218	2105
Year -1	89	80	243	27	61	408	204	44	161	87	299	645	2348

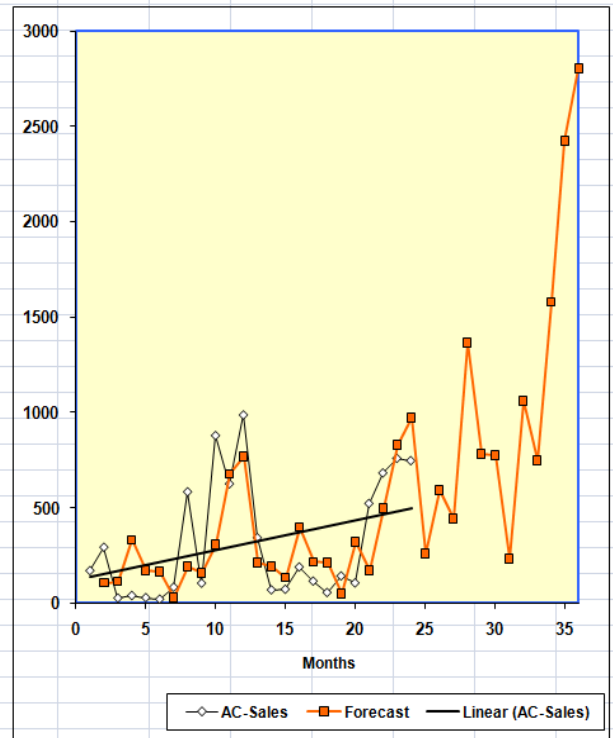
Then :

Average Sales for Year -2 =	175.42
Average Sales for Year -1 =	195.67
Initial estimate for the Base Level, L(0) =	204.95
Initial estimate for the Per Period Trend, T(0) =	1.69
Estimate for Year -2 January seasonality =	0.54
Estimate for Year -1 January seasonality =	0.45
Average January Seasonality =	0.50

and the same for all the other months

Alpha = 0.1 Beta = 0.01 Gamma = 0.1 MAD = 179.22

Months	AC-Sales	L(t)	T(t)	S(t)	Forecast	Abs.Error	SS	RoP
-11				0.65				
-10				0.50				
-9				0.45				
-8				1.41				
-7				0.80				
-6				0.82				
-5				0.16				
-4				0.88				
-3				0.60				
-2				1.20				
-1				2.20				
0				2.50				
1	170	212.13	1.74	0.67				
2	293	251.08	2.11	0.57	107	186.07		
3	26	233.65	1.92	0.42	114	87.94		
4	39	214.78	1.71	1.29	332	293.16		
5	28	198.34	1.53	0.73	173	145.19		
6	20	182.33	1.35	0.75	164	143.90		
7	83	217.19	1.69	0.18	29	53.61		
8	584	263.35	2.13	1.01	193	391.39		
9	104	256.27	2.04	0.58	159	55.29		
10	880	305.81	2.52	1.37	310	570.03		
11	626	305.95	2.49	2.18	678	52.33		
12	988	317.12	2.58	2.56	771	216.88		
13	343	339.30	2.78	0.70	213	130.35		
14	69	320.04	2.56	0.53	194	124.85		
15	72	307.64	2.41	0.40	134	62.24		
16	189	293.73	2.24	1.22	399	210.08		
17	115	282.04	2.10	0.70	217	102.28		
18	55	263.07	1.89	0.69	213	157.81		
19	142	316.40	2.41	0.21	48	93.72		
20	105	297.28	2.19	0.95	323	218.19		
21	523	359.61	2.79	0.67	174	349.13		
22	683	376.10	2.93	1.41	496	187.33		
23	760	375.91	2.90	2.17	828	68.02		
24	748	370.13	2.81	2.51	970	222.35		
25					261		587	848
26					594	MAD	587	1181
27					445	179.22	587	1032
28					1367		587	1954
29					784		587	1371
30					777		587	1364
31					234		587	821
32					1060		587	1647
33					747		587	1334
34					1579		587	2166
35					2424		587	3011
36					2804		587	3391

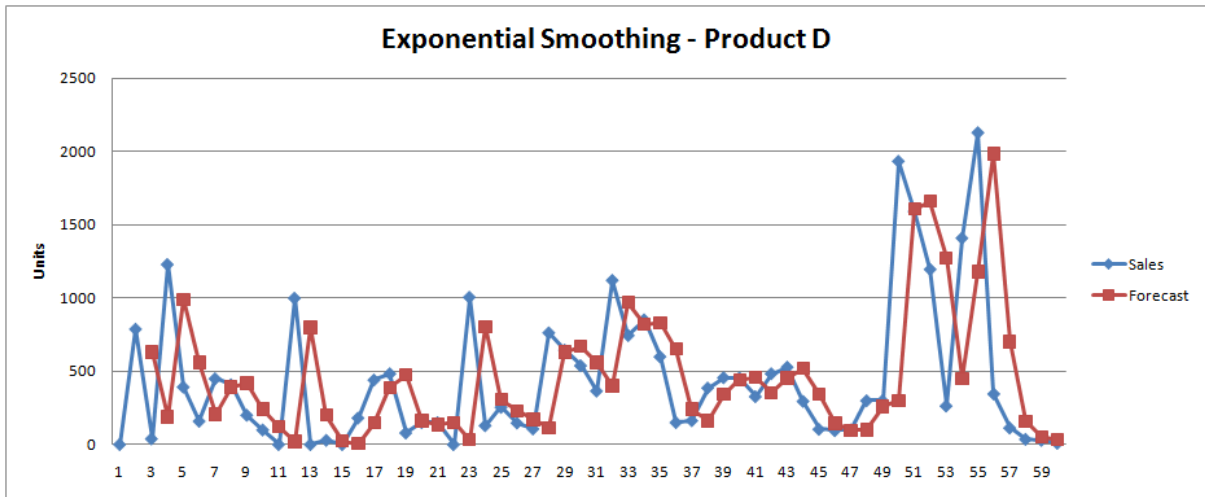


India - Product D

Table 30 - India Product D Forecast

Product D - Exponential Smoothing Forecasting						
Alpha =	0.8	MAD =	349.5228	RoP =	702 + Forecast Demand	
Month	Sales	Forecast	Diviation	SS	RoP	
1	0					
2	787					
3	39	630	590.6	702	1332	
4	1228	189	1039.4	702	891	
5	392	990	598.2	702	1692	
6	159	559	400.2	702	1261	
7	449	206	243.4	702	908	
8	408	391	17	702	1093	
9	200	416	216.2	702	1118	
10	100	242	141.6	702	944	
11	0	120	120	702	822	
12	998	20	978	702	722	
13	0	798	798.4	702	1500	
14	29	200	170.6	702	902	
15	0	23	23.2	702	725	
16	181	6	175.2	702	708	
17	440	145	295.2	702	847	
18	483	388	94.8	702	1090	
19	79	474	395.4	702	1176	
20	150	160	9.8	702	862	
21	150	136	14.2	702	838	
22	0	150	150	702	852	
23	1005	30	975	702	732	
24	129	804	675	702	1506	
25	254	304	50.2	702	1006	
26	147	229	82	702	931	
27	107	168	61.4	702	870	
28	762	115	647	702	817	
29	644	631	13	702	1333	
30	538	668	129.6	702	1370	
31	365	559	194.2	702	1261	
32	1120	400	720.4	702	1102	
33	744	969	225	702	1671	
34	851	819	31.8	702	1521	
35	599	830	230.6	702	1532	
36	150	649	499.4	702	1351	
37	163	240	76.8	702	942	
38	386	160	225.6	702	862	
39	456	341	114.6	702	1043	
40	454	442	12	702	1144	
41	327	454	127.4	702	1156	
42	483	352	130.6	702	1054	
43	528	452	76.2	702	1154	
44	295	519	224	702	1221	
45	104	342	237.6	702	1044	
46	95	142	47.2	702	844	
47	100	97	3.2	702	799	
48	299	99	200	702	801	
49	299	259	39.8	702	961	
50	1932	299	1633	702	1001	
51	1590	1605	15.4	702	2307	
52	1195	1658	463.4	702	2360	
53	263	1274	1011	702	1976	
54	1408	449	958.6	702	1151	
55	2127	1179	948	702	1881	
56	345	1983	1638.2	702	2685	
57	113	701	588.4	702	1403	
58	36	159	123.4	702	861	
59	29	51	22.4	702	753	
60	9	30	21.4	702	732	
Forecast =		13		702	715	
		MAD =	349.5228			

Figure 28 - India Product D Forecast



Indonesia - Product C

Table 31 - Indonesia Product C Forecast

Product C - Winter's method Forecast

Month	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	Sum
Year -2	1929	4320	4000	2160	5440	0	0	0	2160	1440	3200	0	24649
Year -1	720	2880	0	2160	1440	5040	0	1440	720	720	0	2160	17280

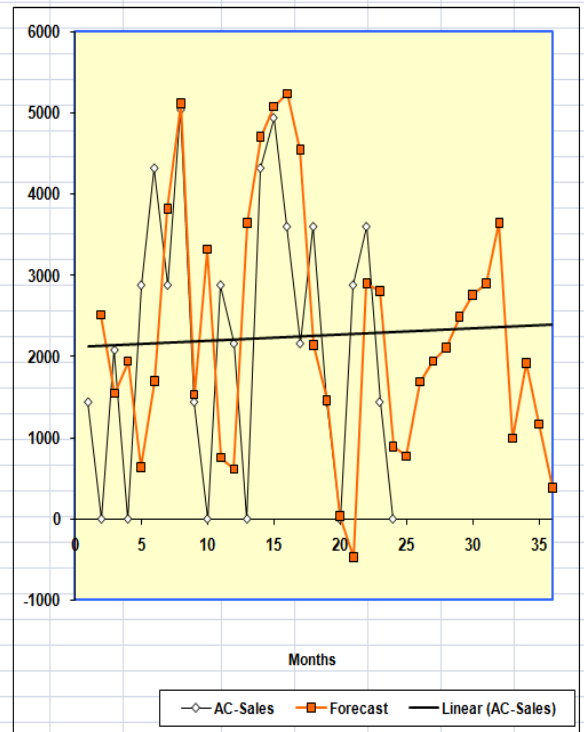
Then :

Average Sales for Year -2 =	2054.08
Average Sales for Year -1 =	1440.00
Initial estimate for the Base Level, L(0) =	1158.55
Initial estimate for the Per Period Trend, T(0) =	-51.17
Estimate for Year -2 January seasonality =	0.94
Estimate for Year -1 January seasonality =	0.50
Average January Seasonality =	0.72

and the same for all the other months

Alpha = 0.4 Beta = 0.8 Gamma = 0.01 MAD = 1475.90

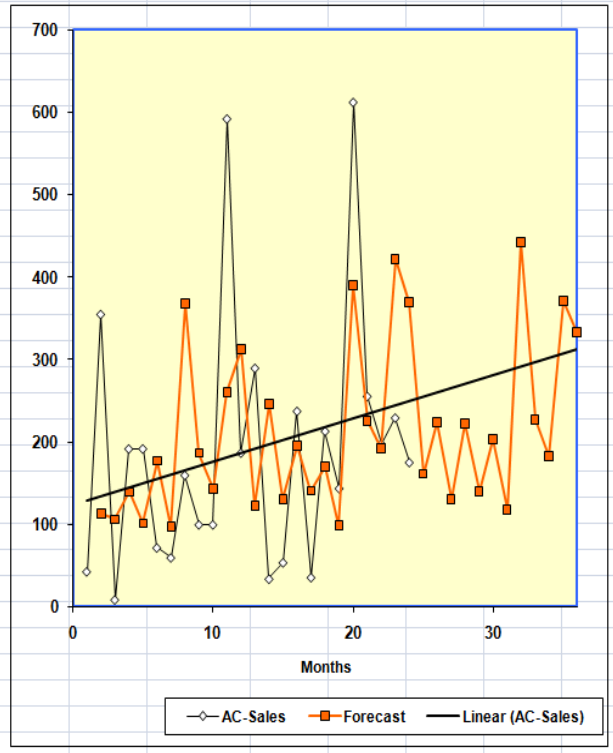
Months	AC-Sales	L(t)	T(t)	S(t)	Forecast	Abs.Error	SS	RoP
-11				0.40				
-10				0.88				
-9				1.00				
-8				1.10				
-7				1.28				
-6				1.41				
-5				1.50				
-4				1.90				
-3				0.50				
-2				1.00				
-1				0.60				
0				0.20				
1	1440	2104.42	746.47	0.40				
2	0	1710.53	-165.82	0.87	2509	2508.78		
3	2080	1758.83	5.47	1.00	1545	535.28		
4	0	1058.58	-559.10	1.09	1941	1940.73		
5	2880	1199.69	1.06	1.29	639	2240.67		
6	4320	1945.98	597.25	1.42	1693	2626.94		
7	2880	2293.94	397.81	1.50	3815	934.85		
8	5040	2676.10	385.30	1.90	5114	74.33		
9	1440	2988.84	327.25	0.50	1531	90.70		
10	0	1989.65	-733.90	0.99	3316	3316.09		
11	2880	2673.45	400.26	0.60	753	2126.55		
12	2160	6164.23	2872.67	0.20	615	1545.26		
13	0	5422.14	-19.14	0.40	3640	3640.45		
14	4320	5225.27	-161.32	0.87	4707	387.10		
15	4940	5010.77	-203.87	1.00	5073	133.20		
16	3600	4206.46	-684.22	1.09	5235	1634.72		
17	2160	2782.48	-1276.03	1.29	4548	2387.93		
18	3600	1919.32	-945.74	1.42	2136	1463.70		
19	1440	968.78	-949.58	1.50	1458	17.99		
20	0	11.52	-955.72	1.88	36	36.47		
21	2880	1738.32	1190.29	0.51	-472	3351.93		
22	3600	3211.71	1416.78	0.99	2899	700.68		
23	1440	3729.52	697.60	0.60	2799	1359.18		
24	0	2656.27	-719.08	0.20	892	892.08		
25					773		2125	2898
26					1687	MAD	2125	3812
27					1940	1475.90	2125	4065
28					2105		2125	4230
29					2491		2125	4616
30					2756		2125	4881
31					2901		2125	5026
32					3644		2125	5769
33					991		2125	3116
34					1920		2125	4045
35					1167		2125	3292
36					386		2125	2511



Malaysia - Product B

Table 32 - Malaysia Product B Forecast

Product B - Winter's method Forecast													
Month	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	Sum
Year -2	20	45	0	20	0	20	20	20	46	80	85	140	496
Year -1	130	32	27	20	29	176	16	180	40	200	20	305	1175
Then :													
Average Sales for Year -2 =												41.33	
Average Sales for Year -1 =												97.92	
Initial estimate for the Base Level, L(0) =												123.85	
Initial estimate for the Per Period Trend, T(0) =												4.72	
Estimate for Year -2 January seasonality =												0.48	
Estimate for Year -1 January seasonality =												1.33	
Average January Seasonality =												0.91	
and the same for all the other months													
Alpha =		0.1		Beta =		0.3		Gamma =		0.1		MAD = 119.78	
Months	AC-Sales	L(t)	T(t)	S(t)	Forecast	Abs.Error	SS	RoP					
-11				0.65									
-10				0.90									
-9				0.65									
-8				0.90									
-7				0.60									
-6				0.90									
-5				0.50									
-4				1.90									
-3				1.00									
-2				0.80									
-1				1.50									
0				1.55									
1	43	122.32	2.84	0.62									
2	355	152.10	10.92	1.04	113	242.35							
3	9	148.10	6.45	0.59	106	96.96							
4	192	160.42	8.21	0.93	139	52.91							
5	192	183.77	12.75	0.64	101	90.82							
6	72	184.87	9.26	0.85	177	104.87							
7	60	186.71	7.03	0.48	97	37.06							
8	160	182.79	3.75	1.80	368	208.11							
9	100	177.88	1.15	0.96	187	86.54							
10	100	173.63	-0.47	0.78	143	43.22							
11	592	195.31	6.17	1.65	260	332.27							
12	187	193.40	3.75	1.49	312	125.30							
13	289.8	224.16	11.85	0.69	122	167.54							
14	34.2	215.69	5.76	0.95	246	212.06							
15	54	208.44	1.85	0.56	131	76.89							
16	237.6	214.82	3.21	0.95	196	42.09							
17	36	201.81	-1.65	0.60	141	104.52							
18	213.3	205.27	-0.12	0.87	170	43.37							
19	144	214.50	2.69	0.50	99	45.09							
20	612	229.52	6.38	1.88	390	221.60							
21	255.6	239.04	7.33	0.97	226	30.03							
22	198	247.19	7.57	0.78	192	6.43							
23	229.5	243.17	4.10	1.58	421	191.66							
24	175.5	234.31	0.21	1.42	369	193.35							
25					161		137	298					
26					224		MAD	137	361				
27					131		119.78	137	268				
28					222		137	359					
29					140		137	277					
30					204		137	341					
31					118		137	255					
32					442		137	579					
33					227		137	364					
34					183		137	320					
35					371		137	508					
36					332		137	469					



Malaysia – Product C

Table 33 - Malaysia Product C Forecast

Product C - Holt's method Forecast													
Month	1	2	3	4	5	6	7	8	9	10	11	12	
Sales	230	46	35	57	55	20	42	45	63	45	50	87	Sum
Trend		-184	-11	22	-2	-35	22	3	18	-18	5	37	-143
Then :			An initial value for the Base Level, $L(0) = 87$ may be assumed, and										
			An initial value for the Per Period Trend, $T(0) = -13.00$ may be assumed										
Alpha =	0.4			Beta =	0.7			MAD =	30.9492				

Month	Actual demand	L(t)	T(t)	Forecast	Abs.Error	SS	RoP
1	40	60.40	-22.52				
2	25	32.73	-26.13	38	12.88	44	82
3	15	9.96	-23.77	7	8.40	44	51
4	70	19.71	-0.31	-14	83.81	44	30
5	20	19.64	-0.14	19	0.60	44	63
6	95	49.70	21.00	20	75.50	44	64
7	75	72.42	22.20	71	4.30	44	115
8	98	95.97	23.15	95	3.38	44	139
9	63	96.67	7.43	119	56.12	44	163
10	77	93.26	-0.16	104	27.11	44	148
11	91	92.27	-0.75	93	2.11	44	137
12	167	121.71	20.39	92	75.48	44	136
13	72	114.06	0.76	142	70.10	44	186
14	53	90.09	-16.55	115	61.82	44	159
15	66	70.53	-18.66	74	7.54	44	118
16	25	41.12	-26.18	52	26.86	44	96
17	132	61.76	6.59	15	117.06	44	59
18	68	68.21	6.50	68	0.36	44	112
19	67	71.63	4.34	75	7.71	44	119
20	60	69.58	-0.13	76	15.96	44	120
21	75	71.67	1.42	69	5.56	44	113
22	105	85.85	10.36	73	31.91	44	117
23	85	91.73	7.22	96	11.21	44	140
24	105	101.37	8.91	99	6.05	44	143
25			Forecast =	110		44	154
			MAD =	30.9492			
			MAD% =	28.06			

Philippines – Product B

Table 34 - Philippines Product B Forecast

Product B - Winter's method Forecast													
Month	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	Sum
Year -2	0	0	0	0	0	0	0	0	476	1012	701	2	2191
Year -1	522	51	64	5	7	0	8	127	77	127	142	123	1253

Then :	Average Sales for Year -2 =	182.58
	Average Sales for Year -1 =	104.42
	Initial estimate for the Base Level, L(0) =	68.59
	Initial estimate for the Per Period Trend, T(0) =	-6.51
	Estimate for Year -2 January seasonality =	0.00
	Estimate for Year -1 January seasonality =	5.00
	Average January Seasonality =	2.50

and the same for all the other months

Alpha =	0.1	Beta =	0.1	Gamma =	0.1	MAD =	236.86
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Months	AC-Sales	L(t)	T(t)	S(t)	Forecast	Abs.Error	SS	RoP
-11				1.70				
-10				1.60				
-9				1.40				
-8				1.30				
-7				2.00				
-6				1.90				
-5				1.95				
-4				0.60				
-3				0.55				
-2				0.70				
-1				0.50				
0				0.20				
1	206	67.99	-5.92	1.83				
2	422	82.23	-3.91	1.95	99	322.70		
3	607	113.85	-0.35	1.79	110	497.34		
4	425	134.84	1.78	1.49	148	277.45		
5	868	166.36	4.75	2.32	273	594.76		
6	812	196.74	7.32	2.12	325	486.89		
7	669	217.96	8.71	2.06	398	271.09		
8	170	232.33	9.27	0.61	136	34.00		
9	136	242.17	9.33	0.55	133	3.12		
10	204	255.50	9.73	0.71	176	27.95		
11	135	265.70	9.78	0.50	133	2.39		
12	382	438.93	26.12	0.27	55	326.90		
13	970	471.47	26.76	1.86	852	117.55		
14	1020	500.63	27.00	1.96	973	46.86		
15	642	510.68	25.31	1.74	946	304.13		
16	846	539.35	25.64	1.49	796	49.96		
17	1146	557.85	24.93	2.30	1312	165.78		
18	725	558.66	22.52	2.04	1237	512.09		
19	1022	572.62	21.66	2.03	1198	176.35		
20	213	569.59	19.19	0.59	364	151.40		
21	0	529.91	13.31	0.50	325	324.52		
22	0	488.89	7.87	0.64	386	385.60		
23	0	447.09	2.91	0.45	249	248.79		
24	0	405.00	-1.59	0.24	120	120.16		
25					748		444	1192
26					791		444	1235
27					702	236.86	444	1146
28					602		444	1046
29					926		444	1370
30					823		444	1267
31					821		444	1265
32					238		444	682
33					200		444	644
34					258		444	702
35					182		444	626
36					97		444	541

Philippines - Product C

Table 35 - Philippines Product C Forecast

Product C - Winter's method Forecast													
Month	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	Sum
Year -2	19	12	47	3	0	3	5	2	12	4	609	802	1516.4
Year -1	744	573	510	146	2	1	2	3	7	4	1	13	2006

Then :	Average Sales for Year -2 =	126.37
	Average Sales for Year -1 =	167.17
	Initial estimate for the Base Level, L(0) =	185.87
	Initial estimate for the Per Period Trend, T(0) =	3.40
	Estimate for Year -2 January seasonality =	0.15
	Estimate for Year -1 January seasonality =	4.45
	Average January Seasonality =	2.30

and the same for all the other months

Alpha =	0.8	Beta =	0.3	Gamma =	0.5	MAD =	38.02
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Months	AC-Sales	L(t)	T(t)	S(t)	Forecast	Abs.Error	SS	RoP
-11				1.50				
-10				1.30				
-9				1.40				
-8				0.60				
-7				0.35				
-6				0.10				
-5				0.15				
-4				0.40				
-3				0.10				
-2				0.95				
-1				1.92				
0				2.05				
1	1	38.28	-41.90	0.76				
2	0	-0.72	-41.03	0.65	-5	4.70		
3	23	4.68	-27.10	3.14	-58	81.25		
4	22	25.38	-12.76	0.74	-13	35.85		
5	12	29.95	-7.56	0.38	4	7.58		
6	2	20.48	-8.13	0.10	2	0.24		
7	22	121.94	24.74	0.17	2	20.55		
8	66	161.34	29.14	0.40	59	7.33		
9	0	38.10	-16.57	0.05	19	19.05		
10	29	28.89	-14.36	0.98	20	8.75		
11	266	113.57	15.35	2.13	28	237.70		
12	126	74.96	-0.84	1.87	264	138.29		
13	2	16.93	-18.00	0.44	56	54.36		
14	10	11.60	-14.20	0.74	-1	10.30		
15	9	1.83	-12.87	4.09	-8	17.34		
16	1	-1.34	-9.96	0.07	-8	8.98		
17	0	-2.26	-7.25	0.19	-4	4.24		
18	0	1.34	-3.99	0.20	-1	1.34		
19	1	5.22	-1.63	0.20	0	1.64		
20	4	8.63	-0.12	0.43	1	2.55		
21	8	136.10	38.16	0.06	0	7.97		
22	58	82.51	10.63	0.84	171	112.43		
23	126	65.82	2.44	2.02	198	72.73		
24	108	59.97	-0.05	1.83	127	19.33		
25					26		202	228
26					44	MAD	202	246
27					245	38.02	202	447
28					4		202	206
29					11		202	213
30					12		202	214
31					12		202	214
32					26		202	228
33					3		202	205
34					51		202	253
35					121		202	323
36					110		202	312

Philippines - Product D

Table 36 - Philippines Product D Forecast

Product D - Winter's method Forecast													
Month	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	Sum
Year -2	126	354	430	228	3798	2102	2226	2476	1596	342	242	68	13988
Year -1	68	70	64	80	2360	588	1350	524	248	18	86	60	5516

Then :	Average Sales for Year -2 =	1165.67
	Average Sales for Year -1 =	459.67
	Initial estimate for the Base Level, L(0) =	136.08
	Initial estimate for the Per Period Trend, T(0) =	-58.83
	Estimate for Year -2 January seasonality =	0.11
	Estimate for Year -1 January seasonality =	0.15
	Average January Seasonality =	0.13

and the same for all the other months

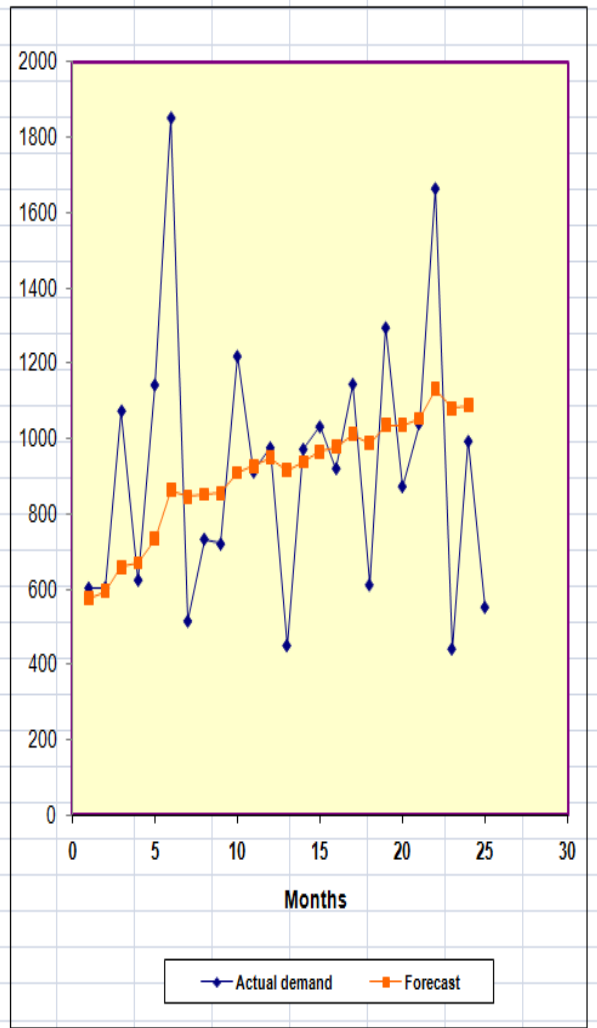
Alpha =	0.7	Beta =	0.1	Gamma =	0.6	MAD =	300.40
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Months	AC-Sales	L(t)	T(t)	S(t)	Forecast	Abs.Error	SS	RoP
-11				0.15				
-10				0.20				
-9				0.25				
-8				0.70				
-7				2.05				
-6				1.80				
-5				1.95				
-4				1.70				
-3				1.40				
-2				1.20				
-1				0.90				
0				0.20				
1	12	79.18	-58.64	0.15				
2	74	265.16	-34.18	0.25	4	69.89		
3	102	354.89	-21.79	0.27	58	44.25		
4	148	247.93	-30.30	0.64	233	85.18		
5	2096	781.00	26.03	2.43	446	1649.86		
6	1092	666.78	12.01	1.70	1453	360.65		
7	1826	859.12	30.04	2.06	1324	502.38		
8	196	347.45	-24.13	1.02	1512	1315.58		
9	34	114.00	-45.06	0.74	453	418.65		
10	76	65.01	-45.45	1.18	83	6.72		
11	50	44.76	-42.93	1.03	18	32.40		
12	18	63.55	-36.76	0.25	0	17.64		
13	168	787.16	39.28	0.19	4	163.96		
14	176	745.82	31.21	0.24	204	28.50		
15	146	608.23	14.33	0.25	212	65.70		
16	484	717.67	23.84	0.66	397	86.70		
17	430	346.31	-15.68	1.72	1802	1372.06		
18	236	196.22	-29.12	1.40	563	326.95		
19	276	144.13	-31.41	1.97	343	67.43		
20	92	97.05	-32.98	0.98	115	22.80		
21	126	138.58	-25.53	0.84	47	78.66		
22	40	57.62	-31.07	0.89	134	93.55		
23	124	92.21	-24.51	1.22	27	96.65		
24	20	76.32	-23.65	0.26	17	3.08		
25					10		1155	1165
26					13	MAD	1155	1168
27					13	300.40	1155	1168
28					35		1155	1190
29					90		1155	1245
30					74		1155	1229
31					104		1155	1259
32					51		1155	1206
33					44		1155	1199
34					47		1155	1202
35					64		1155	1219
36					14		1155	1169

South Africa – Product A

Table 37 - South Africa Product A Forecast

Product A - Holt's method Forecast													
Month	1	2	3	4	5	6	7	8	9	10	11	12	
Sales	371	436	651	598	951	864	791	1148	822	1139	1396	540	Sum
Trend		65	215	-53	353	-87	-73	357	-326	317	257	-856	169
Then :								An initial value for the Base Level, $L(0) = 540$ may be assumed, and					
								An initial value for the Per Period Trend, $T(0) = 15.36$ may be assumed					
Alpha =		0.1		Beta =		0.01							
Month	Actual demand	L(t)	T(t)	Forecast	Abs.Error	SS	RoP						
1	603	560.13	15.41										
2	604	578.38	15.44	576	28.46								
3	1074	641.84	15.92	594	480.18	709	1878						
4	624	654.39	15.89	658	33.76	709	1961						
5	1143	717.54	16.36	670	472.73	709	2037						
6	1853	845.81	17.48	734	1119.10	709	2113						
7	515	828.46	17.13	863	348.29	709	2306						
8	733	834.33	17.02	846	112.59	709	2418						
9	720	838.21	16.89	851	131.35	709	2406						
10	1219	891.49	17.25	855	363.90	709	2415						
11	912	909.07	17.25	909	3.26	709	2473						
12	976	931.29	17.30	926	49.68	709	2544						
13	450	898.73	16.80	949	498.59	709	2584						
14	972	921.18	16.86	916	56.47	709	2573						
15	1032	947.44	16.95	938	93.96	709	2563						
16	921	960.05	16.91	964	43.39	709	2611						
17	1145	993.77	17.08	977	168.04	709	2650						
18	611	970.86	16.68	1011	399.85	709	2697						
19	1295	1018.29	16.99	988	307.46	709	2707						
20	873	1019.05	16.82	1035	162.27	709	2732						
21	1040	1036.28	16.83	1036	4.13	709	2780						
22	1665	1114.30	17.44	1053	611.89	709	2798						
23	441	1062.67	16.75	1132	690.74	709	2894						
24	993	1070.78	16.66	1079	86.42	709	2920						
25	552	Forecast =		1087		709	2876						
				MAD =	272.4562								
				MAD% =	25.05								



South Africa – Product B

Table 38 - South Africa Product B Forecast

Product B - Winter's method Forecast

Month	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	Sum
Year -2	678	527	603	116	20	64	25	97	376	611	1182	1021	5320
Year -1	494	591	538	288	73	19	11	241	486	480	1337	1366	5924

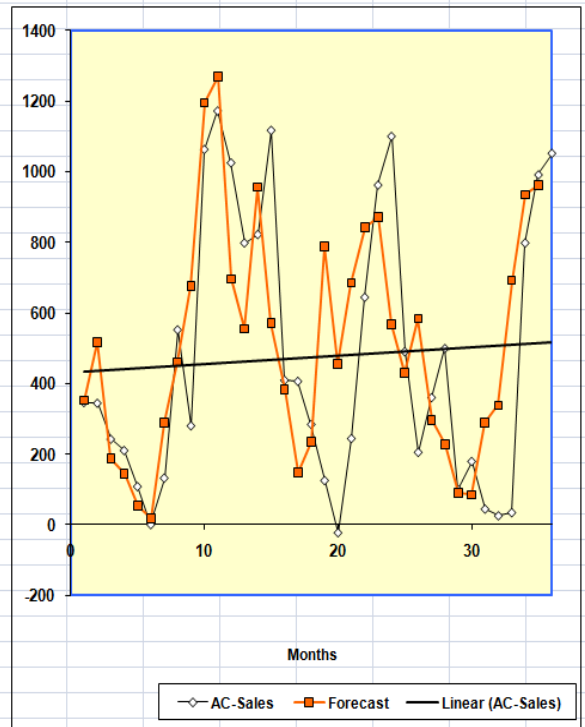
Then :

Average Sales for Year -2 =	443.33
Average Sales for Year -1 =	493.67
Initial estimate for the Base Level, L(0) =	499.17
Initial estimate for the Per Period Trend, T(0) =	1.00
Estimate for Year -2 January seasonality =	1.53
Estimate for Year -1 January seasonality =	1.00
Average January Seasonality =	1.26

and the same for all the other months

Alpha = 0.4 Beta = 0.1 Gamma = 0.2 MAD = 172.86

Months	AC-Sales	L(t)	T(t)	S(t)	Forecast	Abs.Error	SS	RoP
-11				1.28				
-10				0.88				
-9				1.33				
-8				0.65				
-7				0.50				
-6				0.22				
-5				0.16				
-4				0.72				
-3				0.82				
-2				1.41				
-1				1.97				
0				2.05				
1	346	408.23	-8.19	1.19				
2	344	396.38	-8.56	0.88	352	8.03		
3	242	305.48	-16.79	1.22	516	273.80		
4	210	302.44	-15.42	0.66	188	22.36		
5	108	258.61	-18.26	0.48	144	35.51		
6	0	144.21	-27.87	0.18	53	52.88		
7	132	399.80	0.47	0.19	19	113.39		
8	552	546.83	15.13	0.78	288	263.80		
9	280	473.76	6.31	0.77	461	180.81		
10	1063	589.60	17.26	1.49	677	386.10		
11	1172	602.09	16.78	1.97	1196	23.52		
12	1025	571.32	12.03	2.00	1269	243.69		
13	798	617.46	15.44	1.21	696	101.76		
14	822	754.41	27.59	0.92	555	266.59		
15	1117	834.70	32.86	1.25	956	161.05		
16	409	768.84	22.99	0.63	572	162.61		
17	406	810.97	24.90	0.49	383	23.13		
18	284	1146.98	56.01	0.19	147	136.89		
19	125	979.48	33.66	0.18	233	108.42		
20	-23	596.06	-8.05	0.61	788	811.12		
21	244	478.87	-18.96	0.72	455	211.24		
22	644	449.00	-20.05	1.48	685	40.62		
23	962	453.16	-17.63	2.00	843	118.98		
24	1100	481.45	-13.04	2.06	871	229.45		
25	490				568		826	2265
26	205				431	MAD	826	1825
27	360				583	172.86	826	1840
28	499				297		826	1706
29	99				228		826	1351
30	179				89		826	1143
31	44				85		826	1000
32	25				288		826	1199
33	34				338		826	1452
34	798				692		826	1856
35	991				935		826	2454
36	1052				963		826	2724



South Africa – Product C

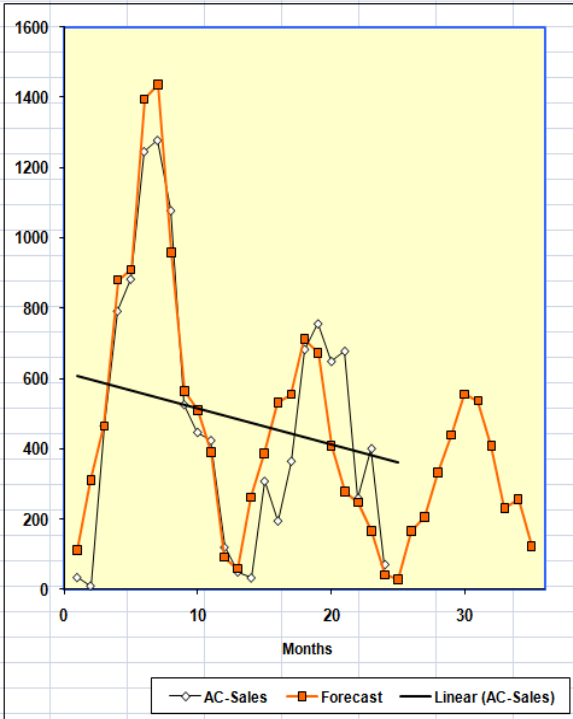
Table 39 - South Africa Product C Forecast

Product C - Winter's method Forecast													
Month	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	Sum
Year -2	183	425	135	1233	1102	1348	1167	1158	866	531	245	564	8957
Year -1	76	200	165	883	747	1271	2146	1369	925	922	216	180	9100

Then :	Average Sales for Year -2 =	746.42
	Average Sales for Year -1 =	758.33
	Initial estimate for the Base Level, L(0) =	763.80
	Initial estimate for the Per Period Trend, T(0) =	0.99
	Estimate for Year -2 January seasonality =	0.25
	Estimate for Year -1 January seasonality =	0.10
	Average January Seasonality =	0.17
and the same for all the other months		

Alpha =	0.1	Beta =	0.1	Gamma =	0.3	MAD =	152.42
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Months	AC-Sales	L(t)	T(t)	S(t)	Forecast	Abs.Error	SS	RoP
-11				0.22				
-10				0.16				
-9				0.50				
-8				0.72				
-7				1.28				
-6				1.33				
-5				1.97				
-4				2.05				
-3				1.41				
-2				0.88				
-1				0.82				
0				0.65				
1	34	703.76	-5.11	0.17				
2	10	635.04	-11.47	0.12	112	101.78		
3	466	654.41	-8.39	0.56	312	154.22		
4	792	691.42	-3.85	0.85	465	326.86		
5	883	687.80	-3.82	1.28	880	2.90		
6	1246	709.26	-1.30	1.46	910	336.31		
7	1278	702.05	-1.89	1.93	1395	116.70		
8	1078	682.73	-3.63	1.91	1435	357.32		
9	526	648.49	-6.69	1.23	958	431.53		
10	447	628.42	-8.03	0.83	565	117.78		
11	424	610.05	-9.06	0.78	509	84.72		
12	120	559.35	-13.23	0.52	391	270.64		
13	50	521.19	-15.72	0.15	92	42.02		
14	33	483.19	-17.95	0.10	59	26.00		
15	308	473.37	-17.14	0.59	262	45.78		
16	195	433.61	-19.40	0.73	387	191.72		
17	365	401.28	-20.69	1.17	531	165.67		
18	683	389.38	-19.81	1.55	555	128.09		
19	756	371.88	-19.58	1.96	711	44.54		
20	649	351.07	-19.70	1.89	672	23.43		
21	678	353.34	-17.51	1.44	408	270.31		
22	260	333.60	-17.73	0.81	279	18.54		
23	401	335.52	-15.76	0.91	247	153.83		
24	71	301.46	-17.59	0.43	166	95.07		
25					42		819	1027
26					29	MAD	819	890
27					167	152.42	819	1015
28					207		819	1193
29					332		819	1358
30					439		819	1590
31					556		819	1814
32					537		819	1911
33					408		819	1764
34					231		819	1458
35					257		819	1307
36					123		819	1200



South Africa – Product D

Table 40 - South Africa Product D Forecast

Product D - Winter's method Forecast													
Month	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	Sum
Year -2	583	334	539	189	48	50	25	305	285	484	722	965	4529
Year -1	562	440	410	301	112	69	0	368	132	474	804	678	4350

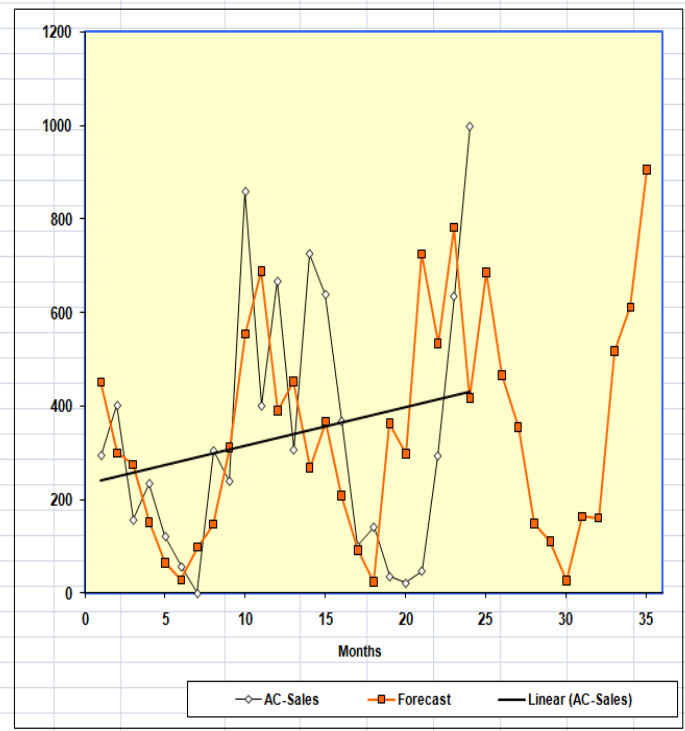
Then :

Average Sales for Year -2 =	377.42
Average Sales for Year -1 =	362.50
Initial estimate for the Base Level, L(0) =	355.66
Initial estimate for the Per Period Trend, T(0) =	-1.24
Estimate for Year -2 January seasonality =	1.54
Estimate for Year -1 January seasonality =	1.55
Average January Seasonality =	1.55

and the same for all the other months

Alpha = 0.1 Beta = 0.1 Gamma = 0.5 MAD = 154.67

Months	AC-Sales	L(t)	T(t)	S(t)	Forecast	Abs.Error	SS	RoP
-11				1.28				
-10				1.33				
-9				0.90				
-8				0.88				
-7				0.50				
-6				0.22				
-5				0.10				
-4				0.40				
-3				0.50				
-2				1.00				
-1				1.50				
0				1.90				
1	295	342.03	-2.48	1.07				
2	402	335.81	-2.86	1.26	452	49.59		
3	157	317.11	-4.44	0.70	300	142.66		
4	235	308.10	-4.90	0.82	275	40.15		
5	122	297.29	-5.49	0.46	152	29.60		
6	57	288.53	-5.82	0.21	64	7.20		
7	0	254.44	-8.64	0.05	28	28.27		
8	305	297.47	-3.48	0.71	98	206.68		
9	240	312.59	-1.62	0.63	147	93.00		
10	859	365.78	3.86	1.67	311	548.02		
11	401	359.41	2.84	1.31	554	153.46		
12	667	361.13	2.73	1.87	688	21.28		
13	307	356.13	1.96	0.97	390	82.79		
14	726	379.74	4.12	1.59	452	273.54		
15	639	437.08	9.44	1.08	268	371.24		
16	368	446.67	9.46	0.82	367	1.24		
17	101	432.71	7.12	0.34	208	106.63		
18	142	463.86	9.52	0.26	92	50.17		
19	36	498.04	11.99	0.06	24	12.33		
20	22	462.11	7.19	0.38	363	341.47		
21	48	429.94	3.26	0.37	297	249.48		
22	294	407.44	0.68	1.20	725	431.27		
23	635	415.87	1.46	1.42	534	101.23		
24	998	428.86	2.61	2.10	782	216.16		
25					417		501	1700
26					685	MAD	501	1603
27					466	154.67	501	1652
28					355		501	1322
29					149		501	1004
30					111		501	761
31					26		501	638
32					164		501	691
33					161		501	826
34					517		501	1179
35					612		501	1629
36					906		501	2019



Vietnam – Product C

Table 41 - Vietnam Product C Forecast

Product C - Winter's method Forecast													
Month	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	Sum
Year -2	0	0	192	0	72	80	0	0	0	0	0	80	424
Year -1	0	120	0	640	0	0	240	240	0	0	160	0	1400

Then :	Average Sales for Year -2 =	35.33
	Average Sales for Year -1 =	116.67
	Initial estimate for the Base Level, L(0) =	153.94
	Initial estimate for the Per Period Trend, T(0) =	6.78
	Estimate for Year -2 January seasonality =	0.00
	Estimate for Year -1 January seasonality =	0.00
	Average January Seasonality =	0.00

and the same for all the other months

Alpha =	0.1	Beta =	0.2	Gamma =	0.2	MAD =	136.05
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Months	AC-Sales	L(t)	T(t)	S(t)	Forecast	Abs.Error	SS	RoP
-11				0.90				
-10				1.10				
-9				0.80				
-8				0.30				
-7				0.30				
-6				0.70				
-5				0.60				
-4				0.30				
-3				1.20				
-2				0.10				
-1				0.70				
0				1.55				
1	0	144.65	3.56	0.72				
2	320	162.48	6.42	1.27	163	156.97		
3	314	191.26	10.89	0.97	135	178.88		
4	0	181.93	6.85	0.24	61	60.64		
5	0	169.90	3.07	0.24	57	56.63		
6	320	201.39	8.75	0.88	121	198.92		
7	0	189.13	4.55	0.48	126	126.09		
8	0	174.31	0.68	0.24	58	58.10		
9	480	197.49	5.18	1.45	210	270.01		
10	0	182.40	1.12	0.08	20	20.27		
11	240	199.46	4.31	0.80	128	111.53		
12	320	204.04	4.36	1.55	316	4.16		
13	320	232.01	9.09	0.85	150	169.95		
14	320	242.10	9.29	1.28	307	12.87		
15	0	226.25	4.26	0.77	243	243.43		
16	0	207.46	-0.35	0.19	55	55.32		
17	320	319.73	22.17	0.39	50	270.29		
18	0	307.72	15.34	0.70	300	300.12		
19	0	290.75	8.87	0.38	155	155.06		
20	0	269.66	2.88	0.19	72	71.91		
21	320	267.42	1.86	1.40	394	74.12		
22	0	242.35	-3.53	0.06	22	21.54		
23	0	214.94	-8.30	0.64	191	191.21		
24	0	185.97	-12.44	1.24	321	321.04		
25					148		174	322
26					223	MAD	174	397
27					134	136.05	174	308
28					33		174	207
29					68		174	242
30					122		174	296
31					67		174	241
32					33		174	207
33					242		174	416
34					11		174	185
35					111		174	285
36					216		174	390

Vietnam – Product D

Table 42 - Vietnam Product D Forecast

Product D - Winter's method Forecast													
Month	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	Sum
Year -2					726	726	0	726	0	0	0	0	2178
Year -1	0	0	0	726	726	2722	0	2087	0	0	0	0	6261

Then :	Average Sales for Year -2 =	181.50
	Average Sales for Year -1 =	521.75
	Initial estimate for the Base Level, L(0) =	677.70
	Initial estimate for the Per Period Trend, T(0) =	28.35
	Estimate for Year -2 January seasonality =	0.00
	Estimate for Year -1 January seasonality =	0.00
	Average January Seasonality =	0.00

and the same for all the other months

Alpha =	0.2	Beta =	0.1	Gamma =	0.9	MAD =	289.65
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Months	AC-Sales	L(t)	T(t)	S(t)	Forecast	Abs.Error	SS	RoP
-11				0.10				
-10				0.10				
-9				0.60				
-8				1.80				
-7				1.20				
-6				1.70				
-5				1.50				
-4				1.50				
-3				0.10				
-2				0.10				
-1				0.10				
0				0.10				
1	0	564.84	14.23	0.01				
2	0	463.26	2.65	0.01	58	57.91		
3	726	614.73	17.53	1.12	280	446.45		
4	2177	747.70	29.08	2.80	1138	1038.93		
5	726	742.42	25.64	1.00	932	206.13		
6	726	699.86	18.82	1.10	1306	579.71		
7	2903	962.01	43.15	2.87	1078	1824.98		
8	0	804.13	23.05	0.15	1508	1507.75		
9	0	661.75	6.51	0.01	83	82.72		
10	0	534.60	-6.86	0.01	67	66.83		
11	0	422.20	-17.41	0.01	53	52.77		
12	0	323.83	-25.51	0.01	40	40.48		
13	0	238.66	-31.47	0.00	3	2.98		
14	0	165.74	-35.62	0.00	2	2.07		
15	0	104.10	-38.22	0.11	146	146.12		
16	0	52.70	-39.54	0.28	184	184.49		
17	0	10.53	-39.80	0.10	13	13.17		
18	0	-23.42	-39.22	0.11	-32	32.30		
19	181	-37.47	-36.70	-4.06	-179	360.49		
20	0	-59.34	-35.22	0.02	-11	11.13		
21		-75.65	-33.33	0.00	-1	0.95		
22		-87.18	-31.15	0.00	-1	1.09		
23		-94.66	-28.78	0.00	-1	1.18		
24		-98.75	-26.31	0.00	-1	1.23		
25					0		174	174
26					0	MAD	174	174
27					-14	289.65	174	160
28					-35		174	139
29					-13		174	161
30					-14		174	160
31					508		174	682
32					-2		174	172
33					0		174	174
34					0		174	174
35					0		174	174
36					0		174	174

Months

◇ AC-Sales
 ■ Forecast
 — Linear (AC-Sales)

Section D – Problem solving and Results

Table 43 - USA Consolidation Warehouse Savings Calculation

USA consolidation Warehouse														
Countries	Description	Current SS Level [units]	Variation	Service Factor [%]	USA improved Lead time [days]	Proposed SS [units]	Stock Savings [units]	Product Cost [\$]	ROIC [%]	Hodling cost [\$ /year]	\$ savings - ROIC	\$ Savings - Holding Cost	Product Savings [\$]	Country Savings [\$]
China	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
China	Product B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	62213.18
China	Product C	6500	1435	98	29	2898	3602	30	11	2.12	11887.94	7637.10	19525.04	
China	Product D	10000	2178	98	29	4398	5602	50	11	2.12	30811.65	11876.49	42688.14	
India	Product A	150	19	98	38	44	106	30	11	1.59	350.07	168.67	518.75	
India	Product B	1000	218	98	38	504	496	90	11	1.59	4911.50	788.82	5700.31	17420.12
India	Product C	1500	334	98	38	772	728	30	11	1.59	2402.35	1157.50	3559.85	
India	Product D	2000	399	98	38	922	1078	50	11	1.59	5927.59	1713.61	7641.21	
Indonesia	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Indonesia	Product B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	21554.69
Indonesia	Product C	7500	1572	98	31	3282	4218	30	11	1.81	19919.86	7634.83	21554.69	
Indonesia	Product D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Malaysia	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Malaysia	Product B	600	110	98	32	233	367	90	11	1.99	3630.12	729.69	4359.81	5289.59
Malaysia	Product C	250	35	98	32	74	176	30	11	1.99	580.01	349.77	929.78	
Malaysia	Product D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Philippines	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Philippines	Product B	1500	306	98	26	585	915	90	11	2.28	9057.98	2086.08	11144.06	32861.61
Philippines	Product C	700	139	98	26	266	434	30	11	2.28	1432.99	990.07	2423.06	
Philippines	Product D	4000	795	98	26	1520	2480	50	11	2.28	13640.06	5654.42	19294.48	
S. Africa	Product A	1500	345	98	56	968	532	30	11	1.94	1755.42	1031.97	2787.39	
S. Africa	Product B	1500	402	98	56	1128	372	90	11	1.94	3682.86	721.69	4404.55	12799.55
S. Africa	Product C	1600	399	98	56	1120	480	30	11	1.94	1585.40	932.02	2517.42	
S. Africa	Product D	1100	244	98	56	685	415	50	11	1.94	2284.41	805.77	3090.18	
Vietnam	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Vietnam	Product B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Vietnam	Product C	600	124	98	27	242	358	30	11	1.46	1182.73	523.27	1706.00	17075.35
Vietnam	Product D	3500	663	98	27	1292	2208	50	11	1.46	12145.32	3224.03	15369.34	
Total Savings =											121188.27	48025.81	169214.08	

Table 44 - Singapore Hub Savings Calculation

Singapore Hub														
Countries	Description	Current SS Level [units]	Variation	Service Factor [%]	Singapore Lead time [days]	Proposed SS [units]	Stock Savings [units]	Product Cost [\$]	ROIC [%]	Hodling cost [\$ /year]	\$ savings - ROIC	\$ Savings - Holding Cost	Product Savings [\$]	Country Savings [\$]
China	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
China	Product B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	68562.72
China	Product C	6500	1435	98	22	2524	3976	30	11	2.12	13121.56	8429.61	21551.16	
China	Product D	10000	2178	98	22	3831	6169	50	11	2.12	33932.23	13079.33	47011.56	
India	Product A	150	19	98	22	33	117	30	11	1.59	384.73	185.37	570.10	
India	Product B	1000	218	98	22	383	617	90	11	1.59	6104.32	980.39	7084.71	21322.07
India	Product C	1500	334	98	22	587	913	30	11	1.59	3011.53	1451.01	4462.54	
India	Product D	2000	399	98	22	702	1298	50	11	1.59	7140.48	2064.25	9204.72	
Indonesia	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Indonesia	Product B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	27464.95
Indonesia	Product C	7500	1572	98	13	2125	5375	30	11	1.81	17736.66	9728.29	27464.95	
Indonesia	Product D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Malaysia	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Malaysia	Product B	600	110	98	11	137	463	90	11	1.99	4585.71	921.77	5507.49	6599.73
Malaysia	Product C	250	35	98	11	44	206	30	11	1.99	681.36	410.88	1092.25	
Malaysia	Product D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Philippines	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Philippines	Product B	1500	306	98	15	444	1056	90	11	2.28	10450.65	2406.82	12857.46	37774.97
Philippines	Product C	700	139	98	15	202	498	30	11	2.28	1643.87	1135.76	2779.63	
Philippines	Product D	4000	795	98	15	1155	2845	50	11	2.28	15650.17	6487.71	22137.88	
S. Africa	Product A	1500	345	98	30	709	791	30	11	1.94	2611.81	1535.43	4147.23	
S. Africa	Product B	1500	402	98	30	826	674	90	11	1.94	6676.49	1308.32	7984.81	20677.86
S. Africa	Product C	1600	399	98	30	819	781	30	11	1.94	2575.83	1514.28	4090.10	
S. Africa	Product D	1100	244	98	30	501	599	50	11	1.94	3293.87	1161.84	4455.71	
Vietnam	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Vietnam	Product B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	19913.89
Vietnam	Product C	600	124	98	14	174	426	30	11	1.46	1405.90	622.00	2027.91	
Vietnam	Product D	3500	663	98	14	930	2570	50	11	1.46	14134.04	3751.95	17885.99	
										Total Savings [\$] =	145141.19	57175.00	202316.19	

Table 45 - Maximum units Calculation

Units per month		January	February	March	April	May	June	July	August	September	October	November	December	Max units in 1 month
China	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
China	Product B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
China	Product C	0	1440	0	0	0	5040	720	720	720	720	3600	5040	5040
China	Product D	720	2160	2880	2880	10800	4320	1440	0	720	0	720	3600	10800
India	Product A	6	6	19	35	36	64	17	37	31	39	70	67	70
India	Product B	578	873	511	36	50	704	1247	951	312	893	455	1545	1545
India	Product C	343	69	72	189	115	55	142	105	523	683	760	748	760
India	Product D	299	1932	1590	1195	263	1408	2127	345	113	36	29	9	2127
Indonesia	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Indonesia	Product B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Indonesia	Product C	0	4320	4940	3600	2160	3600	1440	0	2880	3600	1440	0	4940
Indonesia	Product D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Malaysia	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Malaysia	Product B	290	34	54	238	36	213	144	612	256	198	230	176	612
Malaysia	Product C	72	53	66	25	132	68	67	60	75	105	85	105	132
Malaysia	Product D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Philippines	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Philippines	Product B	206	422	607	425	868	812	669	170	136	204	135	382	868
Philippines	Product C	2	10	9	1	0	0	1	4	8	58	126	108	126
Philippines	Product D	12	74	102	148	2096	1092	1826	196	34	76	50	18	2096
S. Africa	Product A	448	671	941	833	1076	1100	968	988	893	1433	1086	905	1433
S. Africa	Product B	561	498	572	304	141	109	67	178	284	719	1129	1113	1129
S. Africa	Product C	84	145	287	685	694	1048	1129	922	634	437	262	196	1129
S. Africa	Product D	404	426	404	280	89	72	17	210	145	437	532	673	673
Vietnam	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vietnam	Product B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vietnam	Product C	320	320	0	0	320	0	0	0	320	0	0	0	320
Vietnam	Product D	0	0	242	968	545	1044	771	703	0	0	0	0	1044
TOTAL		4345	13453	13296	11842	19421	20749	12793	6201	8085	9639	10709	14685	20749

Table 46 - ROIC Cost Calculation

ROIC - Calculation		January	February	March	April	May	June	July	August	September	October	November	December	Cost	Unit cost	ROIC									
China	Product A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A										
China	Product B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A										
China	Product C	0	1440	396	0	0	5040	1386	720	198	720	3600	5040	990	1386	30									
China	Product D	720	2160	990	2880	1320	4320	1980	720	0	330	720	3600	330	1650	50									
India	Product A	6	6	2	19	5	64	18	5	37	10	31	70	19	18,425	30									
India	Product B	578	873	720	511	422	704	581	1029	951	893	737	1545	376	1274,873	90									
India	Product C	343	69	19	72	20	55	15	39	523	144	760	748	209	205.7	30									
India	Product D	299	1932	886	1590	729	1408	645	975	113	52	29	9	13	4,125	50									
Indonesia	Product A	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
Indonesia	Product B	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
Indonesia	Product C	0	4320	1188	4940	1359	3600	990	0	2880	792	990	0	396	0	30									
Indonesia	Product D	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
Malaysia	Product A	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
Malaysia	Product B	290	34	28	54	36	213	176	612	505	211	230	176	189	144,7875	90									
Malaysia	Product C	72	53	15	66	7	68	19	60	17	21	85	105	23	28,875	30									
Malaysia	Product D	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
Philippines	Product A	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
Philippines	Product B	206	422	348	607	351	812	670	552	170	112	135	382	111	315.15	90									
Philippines	Product C	2	10	3	9	1	0	0	4	1	2	126	108	35	29.7	30									
Philippines	Product D	12	6	34	102	68	1092	501	837	90	16	50	18	23	8.25	50									
S. Africa	Product A	448	671	185	941	229	1100	968	988	272	1433	1086	905	299	248,985	30									
S. Africa	Product B	561	498	411	572	472	109	67	178	147	719	1129	1113	931	918.06	90									
S. Africa	Product C	84	145	40	287	79	1048	288	922	634	437	262	196	72	53,845	30									
S. Africa	Product D	404	426	195	404	185	72	33	210	145	67	532	673	244	306,6417	50									
Vietnam	Product A	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
Vietnam	Product B	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
Vietnam	Product C	320	88	88	0	0	0	0	0	320	88	0	0	0	0	30									
Vietnam	Product D	0	0	0	242	111	1044	478	703	322	0	0	0	0	0	50									
Total Monthly Cost (\$) =														2357	5546	5572	4811	8471	8172	5822	3023	2952	3859	4261	6955
Total Yearly cost (\$) =														61,442											

Table 47 - Holding Cost due to Warehousing

Warehousing - Holding cost				
Country	Max Units	Pallets	Cost/pallet/year [\$]	Total cost/year [\$]
Singapore	20749	519	270	140057.10
USA	20749	519	92.4	47930.65

Section E – Anova analysis

Product A – South Africa

Table 48 - Anova Analysis Product A

ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Rows	386891.6	4	96722.89	1.232194	0.311085	2.583667
Columns	3204158	11	291287.1	3.710829	0.000882	2.014046
Error	3453846	44	78496.5			
Total	7044895	59				

Product B- South Africa

Table 49 - Anova Analysis Product B

ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Rows	208998.9	4	52249.73	1.477922	0.225167	2.583667
Columns	7380583	11	670962.1	18.97866	3.09E-13	2.014046
Error	1555554	44	35353.51			
Total	9145136	59				

Product C – South Africa

Table 50 - Anova Analysis Product C

ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Rows	2606495	4	651623.9	10.10798	6.84E-06	2.583667
Columns	7190299	11	653663.5	10.13962	7.41E-09	2.014046
Error	2836516	44	64466.27			
Total	12633310	59				

Product D – South Africa

Table 51 - Anova Analysis Product D

ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Rows	522043.5	4	130510.9	4.484817	0.003984	2.583667
Columns	2289227	11	208111.5	7.151451	8.6E-07	2.014046
Error	1280427	44	29100.6			
Total	4091697	59				