The Design of a Forecasting Support Models on Demand of Durian for Domestic Markets and Export Markets by Time Series and ANNs.

Udomsri Nonthachoti, [1*] kengpol Athakorn,[2] Kazuyoshi Ishii, [3] Youishi Shimada. [4]
[1]Department of Industrial Engineering, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand.
[2]Department of Industrial Engineering, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand.
[3]Department of Industrial and social Management Systems,Kanazawa institute of Technology,Asistant instructors,Kanazawa institute of Technology, kanazawa,Japan.
[4]Department of Industrial and social Management System from the field of management and business archetecture,Kanazawa institute of technology, Kanazawa,Japan.
**Corresponding Author:* nonthachoti.u@rmutsb.ac.th, nonthachoti.u@hotmail.com

Abstract

The objective of this research is to design forecasting support models on demand of durian for domestic markets and export markets for durian gardeners, durian entrepreneurs of domestic markets and export markets and the Office of Agricultural Economics to plan durian demand conforming with domestic markets and export markets because of Production and marketing main problems (The Agricultural Information Center, The office of Agricultural Economics: 2008) such as over - much durian production, during production capital increased , farmers' durian sold price tended to be lower and lower, inefficient domestic market management and more export but cheaper price, therefore, after that, to design forecasting for the purpose in order that durian would not be over demand which is containing factors of the demand of durian fresh, durian frozen, durian paste and durian chips for domestic markets and export markets exported to Asia, America, Australia and Africa. The research involves historical collection data in the period of 2002 to 2008. The basic of forecast models are the designed and improved models using an intelligent knowledge-based approach beginning Moving average Deseasonalized Exponential smoothing Double exponential smoothing and Artificial neural network (ANNs) program within the model of new value Creation and comparative accuracy models. The evaluation result of forecasting durian demand showed that lowest MAPE of Deseasonlized models at 3 month was durian fresh durian frozen and durian paste but durian chips showed that lowest MAPE of ANNs at 4 input 10 hidden layers and 1 output was high accurate forecasting and optimal models. The analysis, recommendations and error forecast of durian demand are also presented.

Keyword: Moving Average, deseasonalized, Exponential Smoothing, double exponential smoothing, artificial neural network(ANNs).

1.Introduction

Since the plan of economic and social development of Thailand (year 2007- 2011), the Agriculture statistics of Thailand and Basic Agricultural Economy Data year 2007 have shown that the agricultural product was important to Thai economy system. The worth of domestic market was about 2,941 million dollar, especially a durian which was exported the second while the pineapple was the most. The export durian was about 88 million dollar per year (The cooperation of the office of Agricultural Economics and the customs year 2008.) The biggest area of planting durian in the East of Thailand, for example, Chanthaburi, Rayong and Trad and in the South of Thailand for example Chumphon , Suratthani , and Nakornsrithammaraj. Chanthaburi have produced 34 % of total production were the main which sources of durian production of Thailand. (Basic Agricultural Economical Data : 2006, 53) Situation of Durian Production, durian production during last 6 year from 2003 - 2008,in year 2003, the durian production was 736,651 tons, released domestic markets 628,713 tons and export markets 107,028 tons. In year 2008, the durian was production 637,790 tons, released domestic to markets 390,790 tons and export markets 247,00 tons. The durian production in year 2008 tended to increase because from year 2006 to year 2007, there was the project to promote and develop durian production in the East and the South so that durian planting increased 14,286 Acre and the area of product was 382,819 Acres. The product in the East (Chantaburi, Rayong, Trad) was gathered in March - July (more durian in April - May), in the South (Chumporn, Suratthani, Nakornsrithammaraj), it was gathered in June - October (more durian in July - August).(The office of Agricultural Economics: 2008).as shown Figure 1.

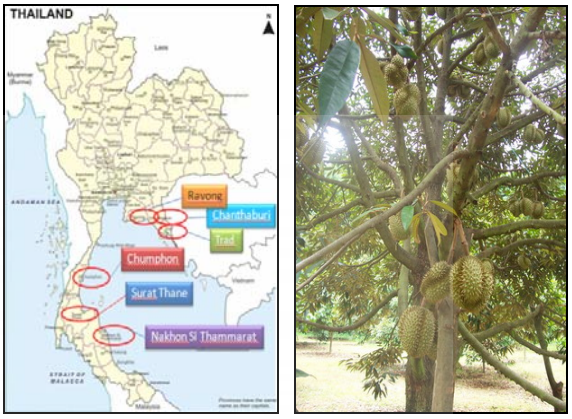

Figure 1 durian growing and the production area.(source :http ://images.google.co.th/image : 2008)

1.1 Main problems of Production and marketing (The Agricultural Information Center, The office of Agricultural Economics: 2008)

1.1.1Durian fruits were more harvested the middle of the season. More durian were harvested simultaneously because in The East consisting of Chanthaburi, Rayong and Trad, harvest period was from March to July and abundant product period was from April to May. The South consisting of Chumphon, Suratthani and Nakhon srithammaraj, harvest period was from June to October and abundant product period was from July to August

1.1.2. The old gardens had lower efficient production.

- The inversed capital was used for old durian trees.

- The export markets on demand was Mhontong durian only and guarantee for GAP but the farmer had few planting areas certified by Good Agricultural practice(GAP) of Department of Agriculture.

1.1.3. The domestic market management was inefficient because the important areas are in the East and the South had problems of over-much durian production and cheaper price durian.

1.1.4. The export durian to export markets increased but was cheaper price.

According to the situational problems of durian quantity the demand in domestic markets and export markets, there are few

researches in this field, gap of research and the problems are not solved efficiently so the research to construct the methodology for an appropriate design of a forecasting support demand of durian for domestic markets and export markets is necessary. The new methodology should be able to help marketing system efficiently for forecasting at optimal demand durian for the purpose in order that durian in domestic markets and export markets will not be over demand.

1.2 These are the research questions:

1.2.1 since previous time until present, how have the forecasting models of durian demand been in domestic markets and export markets of those forecast models?

1.2.2 What is an appropriate model for forecasting on durian demand to conform with domestic markets and export markets?

1.3This study aims to meet the following objectives:

1.3.1To design of forecasting support models on demand of durian for domestic markets and export markets.

1.3.2 To plan to sales appropriate durian fresh, durian frozen, durian paste and durian chips to conform to domestic markets and export markets.

1.3.3To finds the result of forecasting durian demand in domestic markets and export markets for the office of Agricultural Economics with stakeholder.

2. Research Methodology

2.1 Domestic and foreign market demand of durian fresh, durian frozen, Durian paste and durian chips will be studied. The information sources are Office of Agricultural Economics, Garden plants Research Institute, Department of Agricultural Extension, Office of Agricultural Economics Research, Department of Goods and Marketing Research, Department of Commercial Economy, Department of Internal Trade, Department of Export Promotion, Customs Department and etc.

2.2 The information of durian fresh, frozen durian, dehydrated durian and durian preserve demand will be studied.

2.3 Variables influencing domestic and foreign market demand will be researched.

2.4 The model of durian demand forecast will be studied and developed.

2.5 The forecast using Time series models will be studied as follows.

2.5.1 Moving Average

2.5.2 Desesonalized

2.5.3 Exponential Smoothing

2.5.4 Double Exponential Smoothing

2.6 The forecast using Artificial neural network models be determining 4 input variables will be studied as follows.

2.6.1 Input Variable1(Var1) is f durian fresh durian frozen, durian paste and durian chips export price.

2.6.2 Input Variable2(Var2)is oil price.

2.6.3Input Variable3 (Var3) is consumer price index.

2.6.4Input Variable4 (Var3) is exchange rate of Thai money.

2.7 The model of durian forecast based on the type of Back propagation of Artificial neural network will be constructed.

2.8 The model of durian forecast will be tested by using the information from year 2002 until 2009.

2.9 The forecast using artificial neural network and using Time series technique

2.10 Domestic and Export market demand will be analyzed by determining the appropriate demand quantity of durian fresh, durian frozen, durian paste and durian chips.

3. The Structure of domestic markets and export markets and Models.

The Design of a forecasting Support System on Demand of Durian for Domestic Markets and Export Markets is shown in figure 2

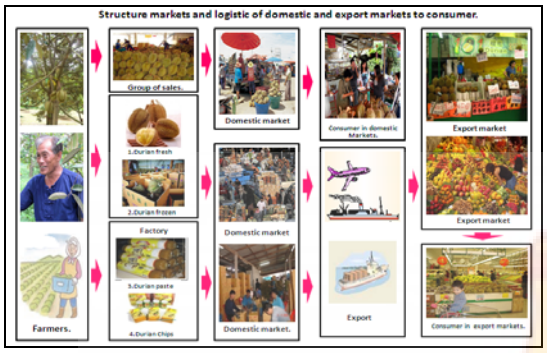

Figure 2 the structure markets and logistic of domestic markets and export markets.

The structure markets and logistics of domestic markets and export markets are shown in figure1 After harvesting durian was transported by truck to the biggest agricultural markets in Thailand which are Talaadthai and Talaad Simumueang markets of domestic markets and export markets. The both markets sells their goods in their shops Durian fruits are cut, graded and purchased by trade agencies at the orchards. The agencies purchased were kinds of durian from farmer to domestic markets for consumers in Thailand and they purchased durian fresh, durian frozen for domestic markets to export markets. The group sales purchased durian at the orchards to the factory to produce was durian paste and durian chips to export markets. Their goods for stock purchasers is smaller size/volume. The Talaadthai market is busy with a number of buyers an 24 hours and Talaad Simumueang market is busy with a number of buyers around 6 pm. The export durian marketing system durian sale consists of entrepreneurs and middlemen the kinds of durian for domestic markets and export markets as shown in figure 3

Durian fresh.

Durian frozen.

Durian paste.

Durian chips.

Figure 3 The kinds of durian for domestic markets and export markets.

3.1 Modeling Forecast of Time Series and Artificial neural network (ANNs).

Modeling forecast of time series and Artificial neural network (ANNs) has been one of the main research endeavors for decades. In the early 1920s, the decomposition model along with seasonal adjustment was the major research focus due to Persons (1919, 1923) work on decomposing a seasonal time series. Holt (1957) and winters (1960) developed method for forecasting trend and seasonal time series based on the weighted exponential smoothing. This model has performed well in much real world application sand is still one of the most widely used Time series forecasting methods. More recently, ANNs have been widely used as a powerful alternative to traditional time series modeling (Zhang et al., 1998; Nelson et al., 1999; Hansen and Nelson, 2003). While their ability to model complex functional patterns in the data has been tested, their capability for modeling time series is not systematically investigated.

3.2 Time series.

Time series are forecasting techniques by assumption that something was occurred in the pass it will continue to the future. The important factor is the only time. Forecasting methods have many types such as, moving average, deseasonalized, exponential smoothing, double exponential smoothing etc.

3.2.1Moving Average model.

The forecasting by moving average model to find the average of durian demand in the past for a month and a year in advance that the important factor is index n we can calculate by: shown in equation 1.

$$MA_{(n)}F_{t+1}^{i} = \frac{\sum_{t=m+1-n}^{m} A_t^i}{n} \quad (1)$$

Where

$MA_{(n)}F_{t+1}^{i}$ = Moving average of n forecasted demand in period $t+1$.

$t+1$ = the month of forecast.

m = the last month in that period use for calculating.

t = the first month in that period at start for calculating.

n = number of month in moving average at from 2, 3, 4,6,8,9 and 12 month

i = kind of durian if

i = 1 durian fresh

i = 2 durian frozen

i = 3 durian paste

i = 4 durian chips.

A_t^i = actual demand in period t.

3.2.2 Desesonalized model.

The forecasting by desesonalized to find the demand conforming with seasonal changes and differences each month and each year we calculate by: show in equation2.

$$D^{i}{}_{MA(n)}p = \frac{\sum_{t=m+1-n}^{m} A_t^i}{n} \quad (2)$$

Where

$D^{i}{}_{MA(n)}p$ = deseasonalized moving average of n for i in period p.

p = the period of forecast for moving average if p=1 at start for calculating from the first month to last month of number moving average if p=2 at start for calculating from the second month to last month of number moving average.

m = the last month in that period use for calculating.

t = the first month in that period at start for calculating.

n = number of month in moving average at from 3, 6,and 12 month

i = kind of durian if

i = 1 durian fresh

i = 2 durian frozen

i = 3 durian paste

i = 4 durian chips.

A_t^i = actual demand in period t.

$$RcD^{i} = \frac{A_t^i}{n} \quad (3)$$

Where

RcD^i = Ratio centered deseasonalized

$$Si^{i} = \frac{n_m \times RcD^{i}}{\sum ma} \quad (4)$$

Where

Si^{i} = Seasonal index

$\sum ma$ = Total of monthly average.

n_m = number of monthly

$$DF^{i} = \frac{A_t^i}{Si^{i}} \quad (5)$$

Where

DF^i = Deseasonalized forecasting.

3.2.3Exponential smoothing model.

The forecasting by exponential smoothing model which smoothed with the moving data and the counterbalance using the efficiency of smoothing (α) to smooth the gained average to have the accurate forecast we calculate by: show in equation.6.

$$ESF_{t+1}^{i} = \alpha A_t^i + (1-\alpha)ESF_t^i \quad (6)$$

Where

ESF_{t+1}^{i} = Exponential smoothing forecast of next month in that in period $t+1$.

ESF_t^i = Exponential smoothing forecast demand the each of i in period t

t = present time when the forecasting of i value is calculated t-1,t-2,t-3... are the past, t+1,t+2,t+3…are the future.

α_i^o = smoothing constant an optimal of kind of durian.

i = kind of durian t if

i = 1 durian fresh

i = 2 durian frozen

i = 3 durian paste

i = 4 durian chips.

α = smoothing constant when $0 \le \alpha \le 1$

A_t^i = actual demand in period t

O = an optimal of α for exponential smoothing.

3.2.4 Double Exponential smoothing model.

The forecasting by double Exponential Smoothing mode which counterbalanced the data by using the efficiency of smoothing α and β to find more accurate forecast of trend and season we calculate by: shown in equation 7.

$$DESF_{t+1}^{i} = ESF_{t+1}^{i} + T_{t+1}^{i} \quad (7)$$

where

$DESF_{t+1}^{i}$ = Double exponential smoothing for next month in that period $t+1$

$$ESF_{t+1}^{i} = \alpha A_t^i + (1-\alpha) ESF_t^i \quad (6)$$

$$T_{t+1}^{i} = \beta(F_{t+1}^{i} - F_t^i) + (1-\beta) T_t^i \quad (8)$$

Where

ESF_{t+1}^{i} = forecasting for next month in that period $t+1$ for exponential smoothing

T_{t+1}^{i} = trend factor for next month in that period $t+1$ for exponential smoothing

F_t^i = forecast demand of i in period t

i = kind of durian if

i = 1 durian fresh

i = 2 durian frozen

i = 3 durian paste

i = 4 durian chips.

A_t^i = actual demand in period t

α_i^o = smoothing constant an optimal of kind of durian.

β_i^o = smoothing constant for trend an optimal of kind of durian.

T_t^i = exponential smoothed trend factor in period t

O = optimal of α and β for double exponential smoothing.

α = smoothing constant when $0 \le \alpha \le 1$

β = smoothing constant for trend when $0 \le \beta \le 1$

3.3 Neural networks model.

The artificial neural networks have been widely used as a promising method for time series forecasting. (G.Peter andMin Qi, 2005). Neural network are a class of flexible nonlinear models that can discover patterns adaptively from the data. Theoretically, it has been show that given an appropriate number of nonlinear processing units, neural network can learn from experience and estimate any complex functional relationships with high accuracy. Empirically, neural merous successful applications have established their role for pattern recognitions and forecasting. Although many types of neural network models have been proposed, the most popular for forecasting is back propagation neural network model as shown in figure 4

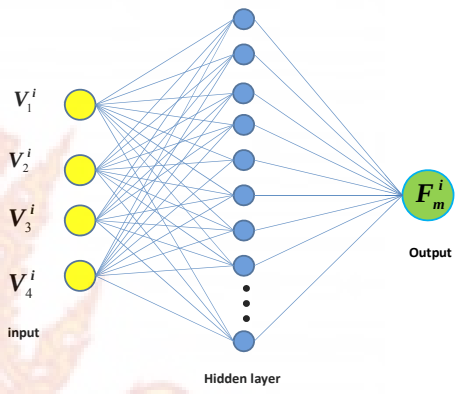

Figure 4 Network architecture for forecasting.

4. Research results

Table 1 The result of models comparing of MAPE for kinds of durian

Models.	Durian Fresh	Durian Frozen	Durian Paste	Durian chips
	MAPE	MAPE	MAPE	MAPE
1) Moving average.	106.52	52.37	74.78	86.02
an optimal for number of month at	2 month	2 month	2 month	6 month
2) Deseasonalized.	19.45	9.98	8.47	96.23
an optimal for number of month at	3 month	3 month	6 month	6 month
3) Exponential Smoothing.	82.25	42.92	66.50	121.07
an optimal of α at	$\alpha = 1.0$	$\alpha = 1.0$	$\alpha = 1.0$	$\alpha = 0.1$
4) Double Exponential Smoothing.	82.16	42.91	66.48	108.46
an optimal of α and β at	$\alpha=0.6\beta=1.0$	$\alpha=0.5\beta=1.0$	$\alpha=0.5\beta=1.0$	$\alpha=0.1\beta=0.1$
5) ANNs.				
4 input 8 hidden 1 output	23.96	56.77	174.17	80.57
4 input 10 hidden 1 output	25.97	41.85	114.05	41.50
4 input 14 hidden 1 output	26.19	58.71	158.51	80.56

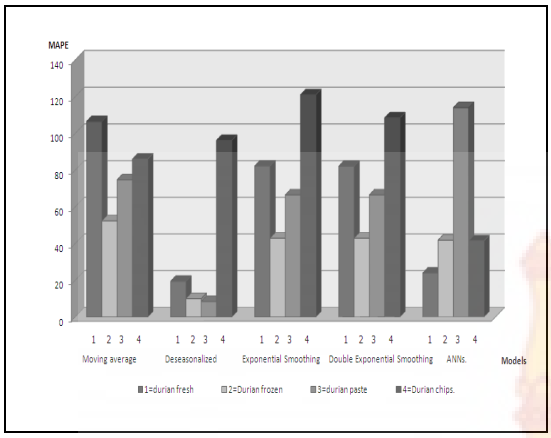

Figure 4 The result of 5 models comparing of MAPE and the kinds of durian

The research result of forecast using moving average model. The mean of forecast used were 2, 3, 4,6,8,9 and 12 month, respectively. When we compare n, the mean of 2 months was forecasted as follow. when n was 2 months at durian frozen lowest MAPE was 52.37%, durian paste was 74.78% and durian fresh was 106.52% and when n was 6 months at durian chips, the lowest MAPE was 86.02% ,respectively, the result of forecast using desesonalized model. The mean of forecast used were 3,6 and 12 month, respectively. When we compare n, the mean of 3 months was forecasted as follows. when month was 3 months at durian frozen lowest MAPE was 9.98%, durian fresh was 19.45% and when the times was 6 months at durian paste lowest MAPE was 8.47% ,durian chips was 96.76%, respectively, the result of forecast using Exponential Smoothing model. The mean of forecast used were α between 0.0 to 1.0, respectively. When we compare α, the mean of α an optimal was forecasted as follow. When α was 1.0 at durian frozen lowest MAPE was 42.92%, durian paste was 66.50% and durian fresh was 82.25% and when α was 0.1 at durian chips the lowest MAPE was 121.07% respectively, the result of forecast using by double exponential smoothing model. The mean of forecast used were α and β between 0.0 to 1.0, respectively. When we compare α and β, the mean of α and β an optimal was forecasted as follow. When $\alpha=0.6\beta=1.0$ was durian frozen the lowest MAPE was 42.91% show in table 4, when $\alpha=0.5\beta=1.0$ durian paste was 66.48% and durian fresh was 82.14% show in table 5,6 and when $\alpha=0.1\beta=0.1$ at durian chips lowest MAPE was 121.07% respectively and the result of forecast using Artificial neural network (ANNs)model. The mean of forecast used were hidden layer between 8, 10 and 14, respectively. When we compare hidden layers, the mean of hidden layer an optimal was forecasted as follows. When 8 hidden layer at durian fresh the lowest MAPE was 23.96%, when 10 hidden layers at durian chips was 41.50%,durian frozen was 41.85% and durian paste was 114.05% respectively as shown in table 1 and figure 4.

5. Conclusions

This paper describes the applied models building and analysis and result of forecasting and trial models for forecasting durian demand in monthly of durian fresh durian frozen durian paste and durian chips for domestic markets and export markets by Moving average Deseasonalized ,Exponential smoothing ,Double exponential Smoothing and Artificial neural network(ANNs) to use. The basic concept design and improved model an intelligent knowledge –based approach with a time series and artificial neural network(ANNs) program within the model of new value created and comparative accuracy models. The evaluation result of forecasting durian demand program and trial models for forecasting durian demand show that the lowest MAPE of Deseasonlized model at 3 month is durian fresh durian frozen and durian paste but durian chips show that MAPE lowest of ANNs at 4 input 10 hidden layers and 1 output was high accurate forecasting models which will give forecasting demand the best.

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