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SEASONAL TIME SERIES ANALYSIS ON EXPORT PERFORMANCE OF HAWASSA GREEN WOOD FLOWER PRODUCTION(SARIMA MODEL)

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ABSTRACT

This study focuses in determining the trend and seasonality export performance of stem rose flower at Hawassa Green Wood based on five year monthly data. The data was obtained from secondary and primary source and includes from January 2006/7 to December 2010/11. Both descriptive and inferential Statistical methods of analysis are used to analyses the data. The analysis is done by using Minitab statistical soft ware. The methods of interests are trend analysis and Box-Jenkins SARIMA models. The trend for this data shows an increasing trend however seasonal fluctuation occurs. SARIMA (0, 1, 2) (0, 1, 1) are the selected Box-Jenkins potential model for this data and by using this model forecasted two years ahead.

Contribution: This study shows the application of Stochastic Mathematical Model to Real Problems

1. INTRODUCTION

Floriculture or flower farming is a discipline of horticulture concerned with cultivation of flowering and ornamental plants for gardens and for florist, comprising the floral industry. Floriculture crops include bedding plants, flowering plants, foliage plants or house plants, cut cultivated greens, and cut flowers.

Ethiopia is now Africa's second largest flower exporter after Kenya since Ethiopia's diversified agro-climatic conditions make suitable for year round production of a broad range of fruits, vegetables and flowers; there are 70 flower farms in Ethiopia, of which 45 percent are owned by local people and the remaining 55 percent by foreign investors. Among the local owned floricultures Hawassa green wood is popular in Southern region.

Hawassa green wood private limited company (plc) is one of the leading in its industry by exporting different crops, flowers and plants to its customers around the world. The company was established by Mr.Tadesse Belay in October, 1995, with its head quarter located in Hawassa (273 kms to the south of Addis Ababa) and the current (2011) price of one stem flower in this plc export data is$ 0.17.

1.1. Statement of the Problem

The problem of this plc floriculture is that the enterprise has no longer experience in this sector. It is not in the way of increasing production and market performance. This leads the country less competent in the world flower market. Other problems are the following

- High cost of impute materials such as chemicals and fertilizers
- Less sufficiency in the transportation system
- Absence of strong domestic market and markets demand forecasters
- Don't get the special seed of rose flower

Our research project is filling the gaps when production must increase as the market demanded increases either locally or internationally and discovered other problems in open questions and to use as input in our finding.

1.2. General Objective

The main objectives of this research project are applying some time series techniques to study the change in the flower export performance; and establish time series model.

1.3. Specific Objective

- To identify in which month the average amount of rose flower is minimum exported and maximum exported for marketing purpose
- To get the appropriate trend analysis and time series models
- To predict or forecast future export performance of flowers
- To come out with policy suggestion and recommendation to the company and Governments

1.4. Significance of the Study

The study assessed the problem of this sector and determines the best way to solve those problems, to be competitive in Ethiopia flower market as well as in the world. The rational that makes as to this study is that Ethiopia is following an agricultural lead industrialization the Government also gave a great attention towards this sector so it is believed that our study will solve as a major source of inspiration for other people to would like to conduct ride research or related area. Thus our study indicate directions and stimulates of others for further were.

2. LITERATURE REVIEW

People all over the world realize that flowers enhance the quality of life and influence human feeling more than words or other gifts. Globalization ,cultural exchanges and celebration enhancing fraternity such as a new year ,valentine's day, memorial day, mother's day, father's day ,Christmases, and weddings have induced people globally to use flowers as a means of sharing their feeling.

The Netherlands the world's largest producer of cut flowers and foliage valued at $3.6 billion followed by Germany and Italy. Some countries are both producers as well as consumers. In Israel, Africa; and south and Central America countries, cut flowers have been a product produced mainly for export with no thought of a potential domestic market. If we take the case of Ethiopian it is only recently that the mere concept of flowers as gift emerged next to Kenya. Thus the domestic market is not yet matured, not withstanding Ethiopia has attracted several foreign investors in recent year, for exporting cut flowers to Ethiopian markets.

The European Market is by far the most important market for Ethiopian roses, cutting and other floriculture products. At the time of market entry by Ethiopia around the turn off millennium the European cut flower market is much more demand driven .The amount of Ethiopian exporting to the international market is low during 1996to 2000, Ethiopia export 436,196 kg of flower, amounting to about Birr 7,174, 405 [1]. Currently Ethiopia by developing 70,000hectares of land for vegetables and fruits, as well as another 4,500 for flowers, we can anticipate a major increase in production.

There is a thriving flower industry in this country ;the climate ,cheap labor and production costs have to growers from many countries (manager of Ethiopian -Indian flower firm, Holita rose plc).We grow nine type of flowers ,the country's climate offers opportunity to grow both high altitude and low altitude flowers depending on

your flavors Shinde saying. Fantaye Bifu said our export mainly comes from India and Kenya, but we are working to provide research programs at university levels so that we can have more local exports and super visors in the field [2].

Ethiopian flower export is estimated to the year 2011 is 120 million .It has taken Ethiopia 5 years to achieve half of what we have in 3 decades, going by this rate Kenya could be over taken by Ethiopia in a decade. It is now estimated that Ethiopia flower exports good generate about$300 million in just another 2-3 years.(According to the head of the Ethiopia export promotion department ,Melaku legese).The rate of growth of flower industry in Ethiopia is incredible ,and the country is bound to rand among the biggest exporters in the world .For cut flower in the next decade or so ,due to their ideal agro climatic conditions ,business friendly, environmental and government support . (Dubai flower center marketing director, Ibrahim Ali)

Ethiopia's income from horticulture exports expected to more than triple $550million in five years due to rising investment, (the head of a powers association).Ethiopia may export 186million in flowers to Europe, Asia and the middle east this year [1].Exports last year (2002) are estimated at$125 million.

3. DATA AND METHODOLOGY

The source of the data for this study is based on the information obtained from secondary and primary sources. Any reliable and suitable written documents in Hawassa Green Wood flower production enterprises (floriculture) plc. Used to get this data a number of documents were reviewed and some open questions are interviewed. The data used for this research project consisting the variables of monthly export of flowers in stems from January 2006/7 to December 2010/11.

3.1. Test of Randomness

This test is described to test the systematic oscillation of the time series data depending on the peak and trough. A peak is a value greater than its two neighboring value and a trough is a value less than its two neighboring values. A simple test (turning point test) is given by count the number of peaks and troughs. In order to carry out the test we must determine the distribution of the turning points in random series.

Let $Y_1, Y_2 \ldots Y_n$ be the observed data.

Hypothesis test

H_0: $Y_{t,t=1,2,3,\ldots n}$ are iid random variables

H_1: not H_0

Test statistic

Let p be the number of turning point define counting variable for a set of observation.

$E_t=1$, if $Y_t < Y_{t+1} > Y_{t+2}$

0 otherwise zero

Where n is total number of observation of the data and the distribution of p tends to be normal with mean E(p) and variance var (p) with test statistic:

$Z_{cal}=\{(p-E(p))/Sqrt(Var(p))\}$

Reject Ho if absolute value of $Z_{cal} > Z_{\alpha/2}$ where alpha is the level of significance [3]

3.2. Box –Jenkins Approach

Autoregressive model: a time series is said to be in autoregressive process if the current time series is a linear aggregate of a finite number of previous values plus random errors, that is

$$Y_t = \Phi_0 + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \Phi_3 Y_{t-3} + \ldots + \Phi_p Y_{t-p} + \epsilon_t$$

Where ϵ_t =the white noise error ,Φ_0= Constant term

$\Phi_1, \Phi_2 \ldots \Phi_p$ =AR parameters (coefficients) of the model which is estimated from the data.

Moving average model: a time series is said to be in moving average (MA) process if the current time series is a linear combination of current and finite number of previous errors. The p^{th} order moving average process can be expressed as

$Y_t = \epsilon_t - \Theta_1\varepsilon_{t-1} - \Theta_1\varepsilon_{t-2} - \Theta_1\varepsilon_{t-3} \ldots\ldots\ldots\ldots \Theta_1\varepsilon_{t-p}$ Where ϵ_t=the white noise error

$\Theta_1, \Theta_2, \Theta_3 \ldots\ldots\ldots\ldots \Theta_p$=MA parameters which describes the effect of the past error on Y_t

ARIMA models are the general class of models for forecasting a time series, which can be stationery by transformation, differencing and lagging.

A general ARIMA model is written as "ARIMA(p,d,q) (P,D,Q)"

Where p=number of autoregressive terms in the non seasonal model

d=number of non seasonal differencing

q=number of lagged forecast errors in the prediction equation of the seasonal model

P= number of autoregressive terms in the seasonal model

D= number of seasonal differencing

Q= number of lagged forecast errors in the prediction equation of the Seasonal model

Mathematically it can be written as:

$$Y_t = \Phi_0 + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \Phi_3 Y_{t-3} + \ldots + \Phi_p Y_{t-p} - \Theta_1\varepsilon_{t-1} - \Theta_1\varepsilon_{t-2} - \Theta_1\varepsilon_{t-3} \ldots\ldots\ldots\ldots \Theta_1\varepsilon_{t-p} + \epsilon_t$$

Table-1. Tools for Tentative model identification

Models	ACF	PACF
AR(p)	Tail off	Cut off after lag p
MA(q)	Cut off after lag p	Tail off
ARMA(p,q)	T□il off	Tail off

Box and Jenkins [4] and Vandele [5]

Stationary means there is no growth or decline in the data. To perform forecasting most of the probability theory of time series is concerned with stationary time series and for these reason time series analysis often requires one to turn a non stationary series in to stationary. To say time series data Yt stationary:

- Mean of Yt is constant for all time periods
- Variance of Yt is constant for all time periods

Forecasting the future values an observed time series is an important task in time series analysis in many areas.

Box-Jenkins forecasting

A forecasting is obtained by taking expectation at original t of the model written at time T+k [6]

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4. RESULTS AND DISCUSSIONS

Turning Point Test

Z_{cal}=-4.01 and $Z_{\alpha/2}$=1.96

From the test statistic, it shows that absolute value of $Z_{cal} > Z_{tab}$ at 5% level of significance, this indicated that the series data seems to be fluctuating more rapidly than expected for an iid sequence. This indicates that the data is time series data, implies that it is possible to apply time series analysis on this data.

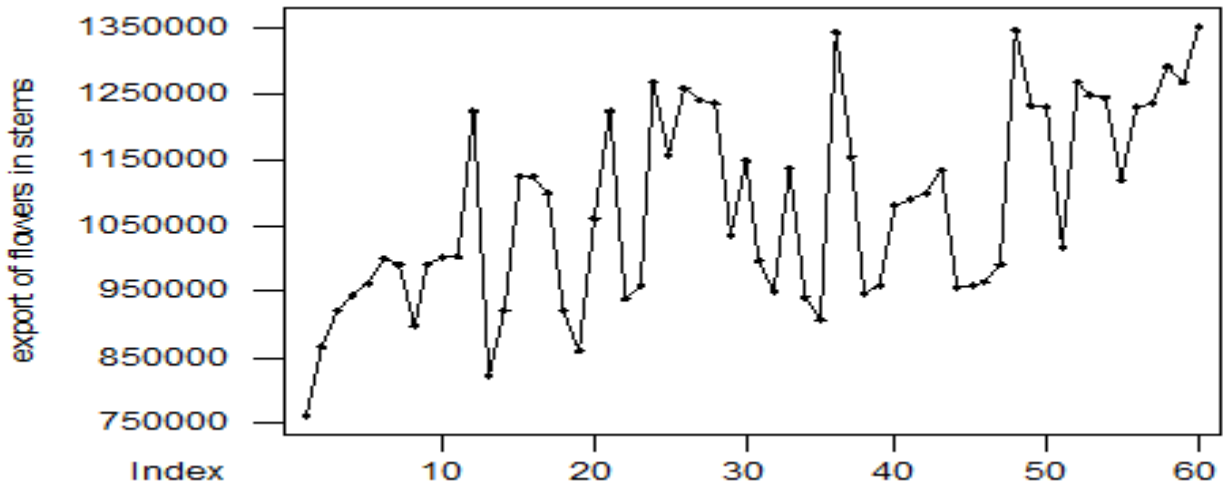

Figure-1. Plot of the original data Stems vs Months

- The plot is important to see some important features such as trend, seasonality, diseasonality, for turning point test and outliers. The plot shows a monthly fluctuation of the export performance of flowers within somewhere up and down with a general upward trend. This upward trend shows that the export performance of flowers is increasing time to time and year to year. From this as we can see the export data is a change in the mean and variance over time. This indicates that the data is not stationary.

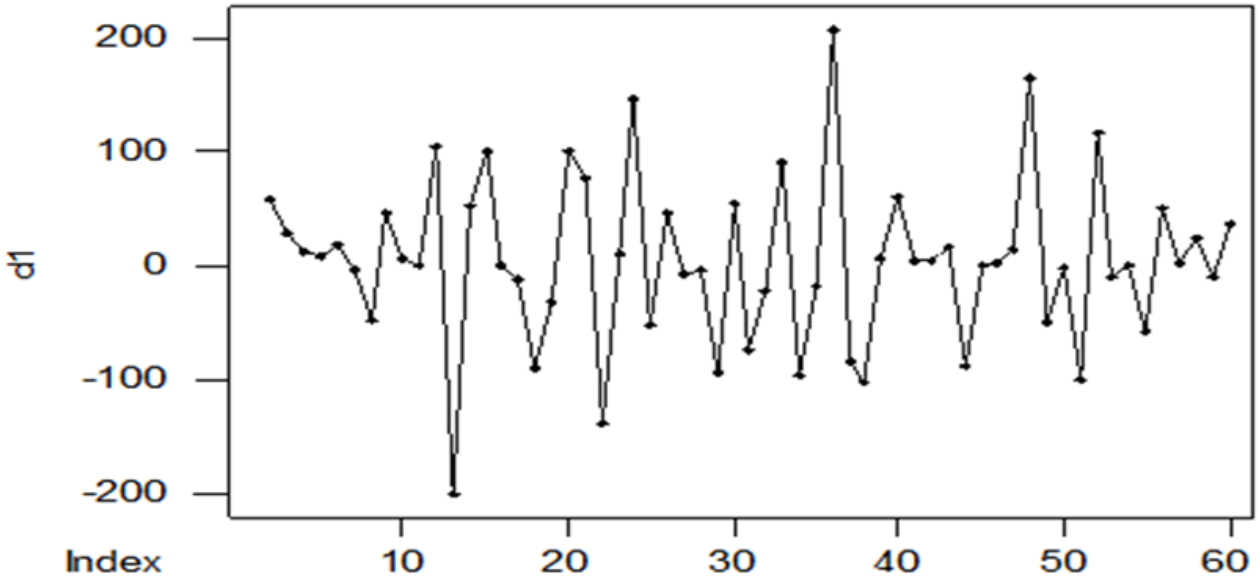

Figure-2. Plot of stationary data after making SQRT and First Regular and Seasonal differencing

- From this plot can be easily seen that the time series plot is somewhat a constant mean and variance of observation approximately. This indicates that the SQRT followed differenced data is now stationary. However if we are not sure we can apply dickey-fuller unit root test [7].

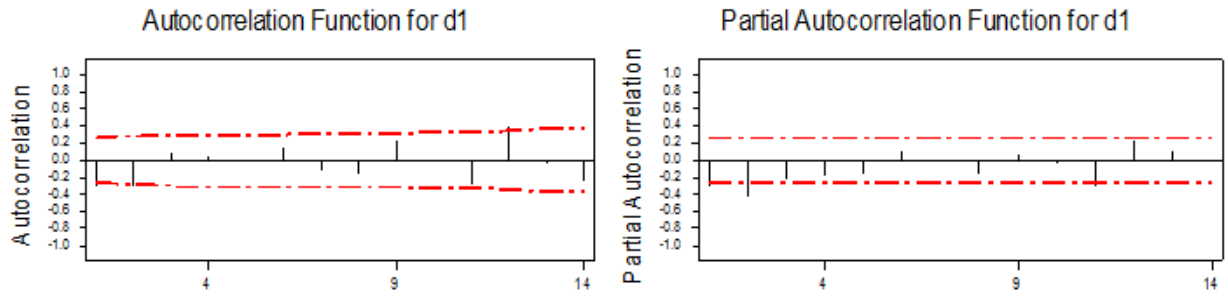

Figure-3. ACF, PACF plot for the SQRT of the original data followed by first regular &seasonal differencing

- There is one significant lags from PACF and two significance lags from ACF.
- Both ACF and PACF are the same one significance lags

Table-2. Tentative Models parameter and tests

Model Type	Stochastic Process	Coef.	SE coef.	T	P
Model 1	MA 1	0.3931	0.1332	2.95	0.005
SARIMA(0,1,2)(0,1,1)	MA 2	0.4960	0.1372	3.62	0.001
	SMA 12	0.7773	0.1840	4.22	0.000
	Constant	-0.4176	0.4319	-0.97	0.339
Model 2	AR 1	0.3088	0.1933	1.60	0.118
SARIMA(1,1,1)(1,1,1)	SAR 2	-0.0971	0.2420	-0.40	0.690
	MA 1	0.8738	0.1126	7.76	0.000
	SMA 12	0.7438	0.2482	3.00	0.005
	Constant	-0.2131	0.3929	-0.54	0.590

Residuals (MODEL 1): SS=1.27663, MS=0.02969 DF=43
Residual (MODEL 2); SS= 1.35106, MS= 0.03217 DF=42

To select the most potential model from the two, it is necessary to consider, MSE

- The MSE for model1 SARIMA(0,1,2)(0,1,1) has less MSE than that of SARIMA(1,1,1)(1,1,1),This shows that the SARIMA(0,1,2)(1,1,1) is the most potential model.

Test of significant for the SARIMA parameters

- For model 1, the MA (1), MA (2) and SMA 12 parameters have a small p-value .This shows that the associated parameters are significantly different from zero. There for we can include these parameters in the model. On the other side the constant parameters had large P-value. This shows that the associated parameters are not significantly different from zero. Therefore we cannot include these parameters in the model.

Therefore, the last potential model is has no autoregressive part and constant term and followed seasonal difference are:

$$\triangle\triangle_{12} Y_t = \epsilon_t - \Theta_1\varepsilon_{t-1} - \Theta_2\varepsilon_{t-2} - \Theta_3\varepsilon_{t-12}$$

$$\triangle(Y_t - Y_{t-12}) = \epsilon_t - \Theta_1\varepsilon_{t-1} - \Theta_2\varepsilon_{t-2} - \Theta_3\varepsilon_{t-12}$$

$$\triangle Y_t - \triangle Y_{t-12} = \epsilon_t - \Theta_1\varepsilon_{t-1} - \Theta_2\varepsilon_{t-2} - \Theta_3\varepsilon_{t-12}$$

$$Y_t - Y_{t-1} - (Y_{t-12} - Y_{t-13}) = \epsilon_t - \Theta_1\varepsilon_{t-1} - \Theta_2\varepsilon_{t-2} - \Theta_3\varepsilon_{t-12}$$

$$Y_t = Y_{t-1} + Y_{t-12} - Y_{t-13} + \Theta_1\varepsilon_{t-1} - \Theta_2\varepsilon_{t-2} - \Theta_3\varepsilon_{t-12} + \epsilon_t$$

$$Y_t = Y_{t-1} + Y_{t-12} - Y_{t-13} - 0.3931\,\varepsilon_{t-1} - 0.4960\,\varepsilon_{t-2} - 0.7773\,\varepsilon_{t-12} + \epsilon_t$$

Diagnostic Checking

Table-3. Modified Box-Piece (Lung-Box) Chi-Square Statistic

ARIMA(0,1,2)(0,1,1)				
Lag	12	24	36	48
Chi-Square	8.6	30.0	4□□3	*
DF	8	20	32	*
P-Value	0.375	0.070	0.073	*

- From the above table the box-pierce (lung-Box) statistic give non significant p-value indicating that the residuals appeared to be uncorrelated. Or the model is adequate or the model fit the data very well. (Wei [8])

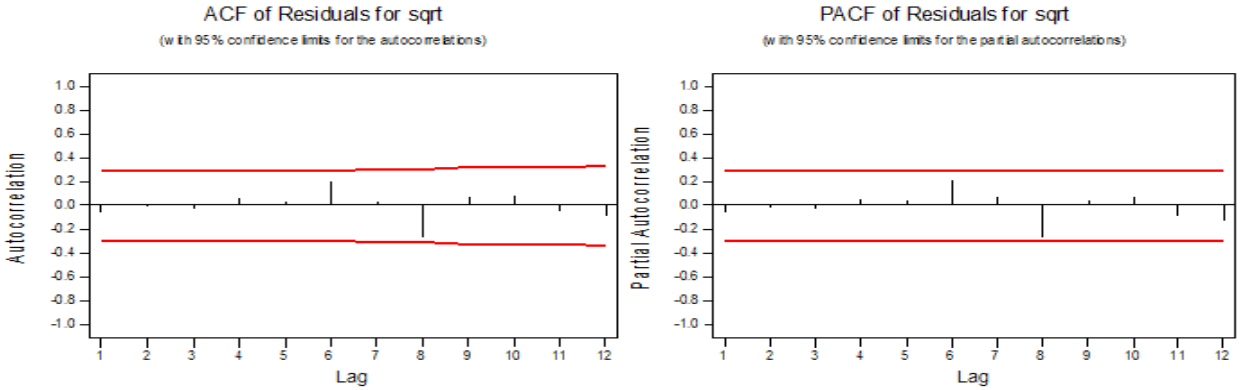

Figure-4. Graphical techniques for diagnostic checking of residuals

- From the residual plot for the ACF and PACF above, there is no significant spike. This shows that the residual of the model are white noise.

Forecasting

Table-4. Comparison of different forecasting methods

Period	Quadratic	Decomposition	ARIMA(0,1,2)(0,1,1)
61	1228567	1293680	1378276
62	1233708	1218668	1466521
63	1238859	1233553	1459264
64	1244020	1330934	1572516
65	1249191	1274964	1527696
66	1254373	1272867	1525225
67	1259564	1198220	1459264
68	1264766	1137553	1432809
69	1269978	1299486	1517824
70	1275200	1114401	1440000
71	1280432	1115841	1430416
72	1285674	1530548	1563584
73	1290926	1354831	1517824
74	1296189	1276046	1517824
75	1301461	1291406	1510441
76	1306744	1393111	1625635
77	1312037	1334295	1577536
78	1317340	1331871	1575025
79	1322653	1253550	1507984
80	1327976	1189880	1481089
81	1333309	1359034	1567564
82	1338653	1165273	1488400
83	1344007	1166587	1476225
84	1349370	1599890	1614409

As we can see from the table, the forecast values using Quadratic trend model shows strictly small value increments from the origin of forecasting up to dec, 2013.But when we apply the multiplicative decomposition model the forecast values are under estimated.

The SARIMA (0, 1, 2) (0, 1, 1) model is best forecast since it consider the seasonal expected changes, but the quadratic trend model does not consider the expected changes of the series. Therefore for this data we cannot use the quadratic trend model for forecasting rather we use the SARIMA (0, 1, 2) (0, 1, 1) which is the selected best model as we have seen before.

5. CONCLUSIONS

Depending on the outcomes the following conclusions are drawn:

- The export performance of flower in Hawassa green wood floriculture plc is increase from year to year.
- The average maximum flower export recorded in the month of the five year is in December and the minimum export of flower is in August.
- Export of flower data shows seasonal fluctuation
- The appropriate time series model for the export of flower data is SARIMA(0,1,2)(0,1,1)

6. RECOMMENDATIONS

- Based on the result of the study, it is recommended that Hawassa Green Wood plc should increase productions from year to year and its service especially in December and it is necessary to add man power in this month and uses other subsidy options in August to be more profitable. If it is possible it is necessary to answer why the export of flower is minimum in August and to take the remedial action.
- Based on the result of the study and overview open questions the Government must supported impute materials such as chemicals, fertilizers, special seeds, local and international market linkages.

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