COMPUTERIZATION OF QUARTERLY TIME SERIES ANALYSIS AND FORECASTING

"A Case Study of Coca-Cola Depot, Minna"

By

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PGD/MCS/99/2000/925

Department of Mathematics/Computer Science
Federal University of Technology, Minna

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A Project Submitted to the Department of Mathematics/Computer Science , Federal University of Technology, Minna, Niger State in Partial Fulfilment of the Requirements for the award of the Post Graduate Diploma in Computer Science.

SEPTEMBER, 2001

CERTIFICATION

This is to certify that this project work was undertaken by Emoabino Edith in the Department of Mathematics/Computer Science.

School of SSSE, Federal University of Technology, Minna, Niger State.

Project Supervisor Dr.S.A. Reju	Date
Head of Department Dr.S.A. Reju	Date
External Examiner	Date

DEDICATION

This project is dedicated to Almighty God and My parents, Mr and Mrs Izuagbe Emoabino.

ACKNOWLEDGEMENT

First and foremost, my greatest thanks go to the Almighty God to whom I own my existence and guidance and knowledge.

My profound gratitude goes to my Project Supervisor Dr. S.A. Reju for taking his time to go through the manuscript and making useful suggestion despite his tight schedule of work and my Lecturers, Dr. Aiyesimi, Prince Badmus, Mallam Isah Audu, Prof. Adeboye, Mr. Ezeako, Mr Kola, Mr. Hakimi and all that are not mentioned

At this juncture, I also wish to express my sincere thanks and appreciation to my parent Mr. Joseph Izuagbe Emoabino and Mrs Rose Joseph Izuagbe for their moral and financial support throughout my course of study.

And also to my brothers and sisters, Samuel Emoabina, Helena Emoabina, Jacob Emoabino, Alex Emoabino, Anthony Emoabino and Anthonia Emoabina.

Also special thanks go to Mr. Ismaila A. Bolarinwa who has been of remarkable assistance (Federal Polytechnic, Bida).

I also wish to express my thanks to Hadiza, Sarah, Yemi Idown Dada, Obadiah and the entire student of PGD Computer.

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ABSTRACT

This work is on time series analysis. Time series analysis involves the decomposition of time series into components. The work aimed at producing a program capable of analysizing and forecasting quarterly time series data for any number of years for that matter. Time series data used were collected from the Coca-Cola Bottling Company, Minna. The data are sales figures on quarterly basis for the period 1995 - 2000. The aimed program was successfully developed and was run with the data collected. Result of analysis revealed a downward trend in the sales of Coca-Cola at Minna Depot.

Chapter One

INTRODUCTION TO TIME SERIES

TIME SERIES ANALYSIS

1.1 TIME SERIES ANALYSIS

A time series is a set of quantitative data that are obtained at regular periods over time. Example of time series are the daily closing prices of a particular stock on the Nigerian Stock Exchange and the total annual production of crude oil in Nigeria over years.

Mathematically, a time series is defined by the values Y_1, Y_2, - - - - - - - - - - - - - - - - - of a variable Y(Annual Production of crude oil, closing price of a share etc) at times t_1, t_2- - - - - - - - - - - - - - - Thus Y is a function of t, symbolized by Y-F(t).

The basic assumption underlying time series analysis is that those factors which have influenced patterns of economic activity in the past and present will continue to do so in more or less the same manner in the future. Thus the major goals of time series analysis are to identify and isolate these influencing factors for forecasting purpose as well as for managerial planning and control.

To achieve these goals, various mathematical models have being devised for representing time series. Such models range from the (Fundamental) Classical Multiplicative/Additive model to more sophisticated Auto-Regressive - Integrated Moving Average (ARIMA) Models.

However, the focus of this work is the multiplicative model. This approach views the time series as being influenced by some characteristic movements namely the trends, cyclical, seasonal and irregular components.

This is mathematically stated as

$$Y = T * C * S * I$$

Where

Y Is the time series variable

T Is the trend Component

C Is the cyclical Component

I Is the irregular Component

TREND

This is the overall or persistent long term upward or downward pattern of movements. It could be due to changes in technology. Population, wealth, values etc. Its duration is usually several years.

SEASONAL

Fairly regular periodic fluctuations which occur with each 12 - month period year after year. It could be due to weather condition, social customs, religions custom etc. Its duration usually within 12 months.

CYCLICAL

Repeating up and down swings or movement through four phases: From peak (Prosperity) to concentration (Recession) to trouble (Depression) to expansion (Recovery or growth). Its duration usually 2-10 years with differing intensity for a complete cycle.

IRREGULAR

The erratic "residual" fluctuations in a time series which exist after taking into account the systematic effects trend seasonal and cyclical, It's due to unforeseen events such as strike, floods, fire outbreak etc.

Time series analysis consist of a mathematical description of these component.

1.2 AIM AND OBJECTIVES

AIM:- The aim is to develop a statistical software capable of carrying out time series analysis and forecasting on quarterly time series data.

OBJECTIVES:- The objectives include the following:

(a) **Trend Analysis:-** This is to analysis trend by fitting trend equation.

(b) **Seasonal Analysis:-** This is to analysis seasonal variation by computing the seasonal index.

(c) **Forecasting:-** To forecast for four quarters.

1.3 SCOPE OF STUDY

The software to be developed shall be able to carry out a time series analysis on any quarterly time series data covering any number of years ranging from five years (5) since it is meaning less to carry out time series analysis on data covering less than five years.

Chapter Two

TREND ANALYSIS CASE STUDY

2.1 REVIEW OF PAST WORKS

Example of statistical packages include:

1 - Statistical Package for Social Science (SPSS)

2 - Statistical Analysis System (SAS)

3 - MYSTAT

4 - MINITAB

5 - EXEC*U*STAT

6 - SYSTAT

7 - STATISTICA

These packages can handle the two distinct approaches to time series analysis to numerous statistical analysis, they can carry out for example, SPSS has the ability to compute the autocorrection function (ACF), the partial autocorrelation function (PACF), estimate parameter, of ARIMA model and forecast. It can also carry out the traditional time series analysis by computing the trend and the seasonal index and hence forecasting as desired. It can equally treat exponential smoothing.

Apart from these statistical packages like Lotus 1-2-3, Excel, Super-Calc can also perform the trend analysis aspect of time series analysis. If one supplies the appropriate time codes. Infact the package can handle fitting of auto regressive model (A Class of ARIMA Models) owing to their ability in Multiple Regression analysis.

In the absence of statistical packages, these spreadsheet can be used to analyse time series to some extent by creating formular and using some of the predefined functions like MAX, MIN. SUM, AVG etc.

2.2 HISTORICAL BACKGROUND OF NIGERIA BOTTLING COMPANY (NBC) COCA-COLA PLC

Coca-cola is the world leading soft drink producer, the product is sold in more than 145 countries.

A total of 250 million bottled product are consumed everyday in all part of the globe from Canada in the North to Argentina, China from Mexico to Nigeria. Coca-Cola first came to Nigeria in 1953 when Nigeria Bottling Company Plc set up its first plant in Lagos. It was to be the beginning of an exciting story of growth and development particularly during past ten years.

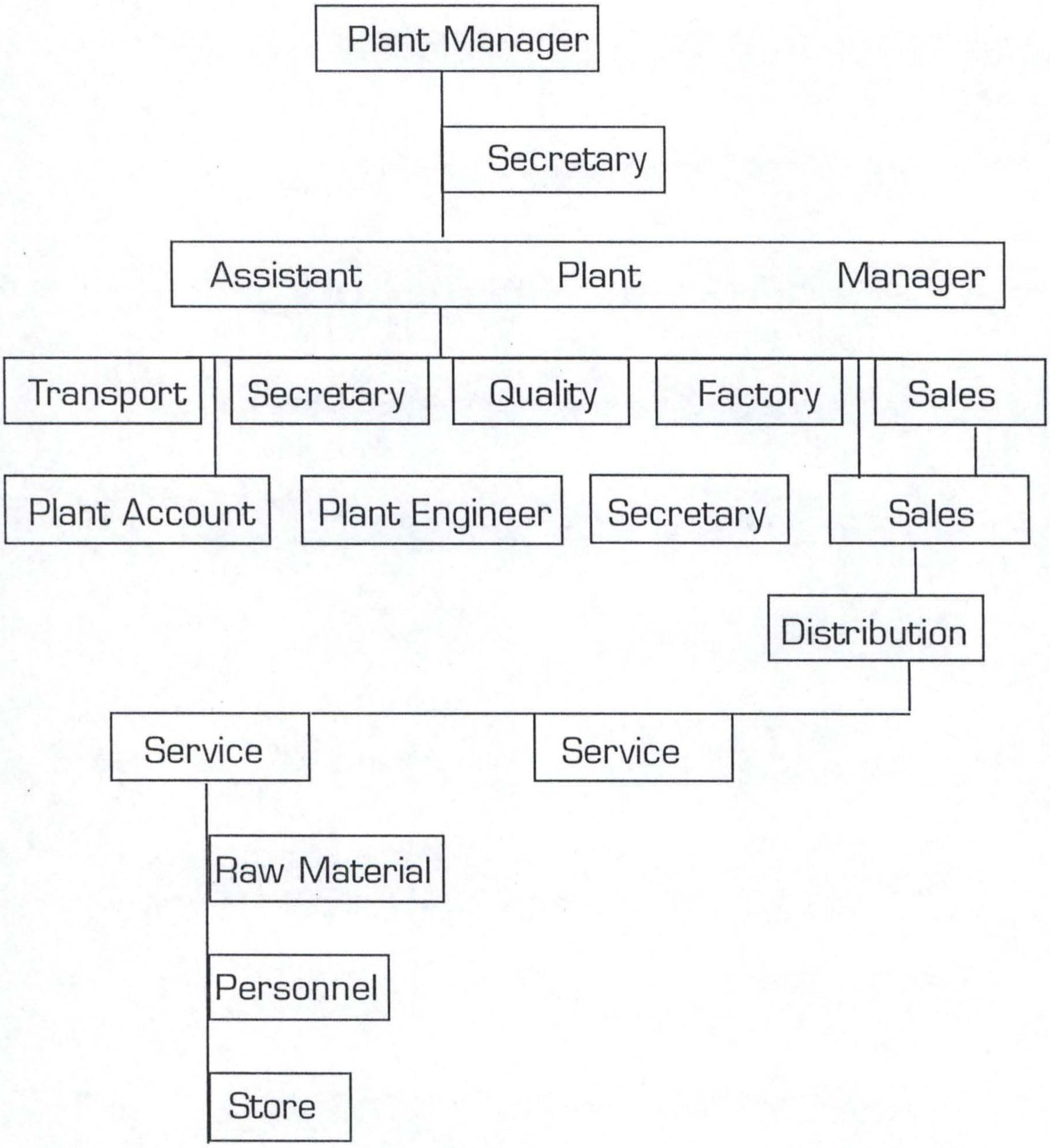
Nigerian Bottling Company is today Nigeria number one bottler of soft drink, selling more than seven (7) million per day, a figure which is still growing with the existing 18 plants. In various parts of the federation.

Fanta is by far the number one best seller in the orange seqement and sprite the most widely sold lemon drink (juice) in Nigeria. Other product bottled by Coca-Cola include Chapman, Fanta, Fanta tonic, Fanta ginger, Fanta Soda, Krest bitter lemon and Schwepps Lemon.

The success of Coca-Cola has brought with it development of a number of sister industries all contributing to the growth of the Nigerian economy. The Delta Glass Company in Ughali which supplies the million of bottles requires to keep a large bottling company in operation and the Crown Cork product factories in Ijebu Ode and Kano which manufacture the metal crown to seal the bottles, the Benin Plastic Company which makes the plastic crates for carrying the bottles. There are source of employment for many Nigerian.

Nigerian Bottling Company is also the largest manufacturer of Co_2. Carbondioxide in the country used to carbonate the favourite soft drinks. The Nigerian Bottling Company also employ over 6,000 Nigerians in all field of operation. The manufacturing process of Coca-Cola is based on a Carefully measured combination of Sugar, water and concentrate. The same standard is maintain throughout the world. The headquarters of Nigerian Bottling Company is at the Leventist building, Iddo, Lagos. The various sites all over the federation have currently been divided into four different regions.

ORGANISATION CHART OF NIGERIAN BOTTLING COMPANY PLC COCA-COLA



CASE STUDY OF MINNA DEPOT

Coca-Cola depot Minna, is situated at Chanchaga along Paiko road, It's started operating in 1994 and was formally under (controlled by) Kaduna Plant, but because of inefficiency of Kaduna plant it was taken over by Ilorin plant. Presently the depot is controlled by Ilorin Plant.

The depot has eight (8) trucks that distribute the product all over (within) the state. Area of coverage include Bida, Kontagora, Zungeru, Mokwa, Suleja and some other villages around.

According to the branch manager, records are kept in the computer system records like daily routines such as number of sales per day, week, month, name of customer and their locations (Address) number of trucks supply to the depot, staff name etc.

2.3 TREND ANALYSIS

Trend analysis can be carried out by the following method:

1. Free Hand Method
2. Moving average method
3. Semi-Average Method
4. Least Square Method

2.3.1 Freehand Method:-

In this method the line is fitted to a scatter diagram by usual judgement. Obviously, individuals can fit different lines of their choice.

2.3.2 Semi-Average Method:-

In this method, the mean (X, Y) of the set of variable X and Y are computed and the central (X, Y) is plotted on the scatter diagram then a line is drawn through the point (X, Y) keeping equal number of points above and below the line. This is also subjective because its depend on the man's choice line.

2.3.3 Least Square Method

This model lead to a unique regression line and parameter. The Least Square model is the most reliable because in the model all the errors are assumed to occur in the measurement of Y while the X are being considered "exact" it minimize errors.

The least square method is mathematically given as

$y_i = a + bx_i + e_i$ where i = 1,2,3,- - - - - - - - - - -

n and a and b are the parameters, e is the independent error.

The best fit line is assumed to be

$y_i = a + bx_i$ where y_i is an estimate of Y.

A measure of the sum of errors of estimate is given by

$\sum (y_i - \hat{y})^2 = \sum (y_i - a - bx_i)^2$

Since the model for regression equation is

$y_i = a + bx_i + e_i$

Therefore

$e_i = y_i - a - bx_i$

By minimising the sum of square of error, we will be able to determined the value of a and b i.e

$$\sum_{i=1}^{n} e_i^2 = \sum_{i=1}^{n} (y_i - a - bx_i)^2$$

Differenting $\sum e_i^2$ with respect to a and b we have

$$\frac{d}{d(a)} (\sum e^2) = 2\sum (y_i - a - bx_i) \quad \text{----------} (1)$$

$$\frac{d}{d(b)} (\sum e^2) = 2\sum (y_i - a - bx_i) xi \quad \text{----------} (2)$$

To obtain values of a and b that minimize $\sum e^2$, we differentiate $\sum e_i^2$ with respect to a and b then be equating to zero at each instant.

$\frac{d}{d(a)} (\sum e^2)$ and $\frac{d}{d(b)} (\sum e^2)$ to Zero

Thus

$$-2 \sum (y_i - a - bx_i) = 0 \quad \text{---------} (3)$$

$$-2 \sum (y_i - a - bx_i)x_i = 0 \quad \text{----------} (4)$$

Divide equation 3 and 4 by - 2 to have

$$\sum (y_i - a - bx_i) = 0 \quad \text{---------} (5$$

$$\sum (y_i - a - bx_i)x_i = 0 \quad \text{---------} (6)$$

Expanding equation 5 and 6 gives

$$\sum y_i - na - b\sum x_i = 0 \quad \text{---------} (7)$$

$$\sum x_i y_i - a\sum x_i - \sum b x_i^2 = 0 \quad \text{----------} (8)$$

Multiplying equation 7 by $\sum x_i$ and equation 8 by n

Thus

$$\sum x_i \sum y_i - na \sum x_i - b (\sum x_i)^2 = 0 \quad \text{---------} (9)$$

$$n\sum x_i y_i - na\sum x_i - nb\sum x_i^2 = 0 \quad \text{---------} (10)$$

Subtract equation 9 from equation 10

$$n\sum x_i \sum y_i - \sum x_i \sum y_i - nb\sum x_i^2 + b(\sum x_i)^2 = 0$$

Colleting like terms, we have

$$b[n\sum x_i^2 - (\sum x_i)^2] = n\sum x_i y_i - \sum x_i \sum Y_i$$

$$b = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{n\sum x_i^2 - (\sum x_i)^2}$$

"a" can be derived from equation (7)

$$\sum y_i - na - b\sum x_i = 0$$

$$na = \sum y_i - b\sum x_i$$

Divide equation 7 by n

$$a = \frac{\sum y_i}{n} - \frac{b\sum x_i}{n}$$

$$a = \overline{y} - b\,\overline{x}$$

2.4 SEASONAL ANALYSIS

METHOD OF COMPUTING SEASONAL INDEX

Before discussing the various methods of computing seasonal index, it should be mentioned that the effect of seasonal on a variable is present only when one has six monthly, quarterly, weekly or daily data.

If the data is lumped together by years or long time periods the effects of the seasons disappear automatically since the maximum duration of the seasonal effect is a year. If for instance value of a monthly series for any twelve consecutive months are added, the effects of the seasons disappear.

Owing to this argument, it therefore follow that estimate of seasonal component arises only when data is given for "parts" of years (i.e months, week etc.)

Methods for computing seasonal index are as follows:

(1) Average Percentage Method

(2) Ratio-to-Moving Average Method

(3) Ratio-to-Trend Method

(4) Link Relative Method

2.4.1 Average Percentage Method (A.P)

(i) Compute the total for each year and hence the monthly average.

(ii) Express the data for each month as percentage of the average for the year.

(iii) The percentages for the corresponding month are then averaged using either the mean or the median

(iv) Each mean in step (iii) is expressed as a percentage of their mean. The resulting percentages represent the index. These indices however do not truly represent the seasonal component since they include the trend influence.

2.4.2 Ration-to Moving Average Method (R.T.M.A.)

Step involved in it's computation are as follows

(i) Compute 12 months moving total

(ii) Compute 2 months moving total of result in (i)

(iii) Divide results in (ii) by 24. The result give 12 months centred moving average.

(vi) Expressed original data for each year months as a percentage of the results in (iii)

(v) Average percentage for corresponding month using the mean.

(vi) Express each mean in (v) as a percentage of their mean. Result gives the required index.

The logical reasoning behind this method follows from the time series model Y = T* S* C* I. A centred 12 months Average of Y series to eliminate seasonal and irregular movement S and I and is equivalent to values given by Tc. The division or the original data by Tc yield, ST i.e TCSI/TC = SI.

The subsequent average over corresponding months serve to eliminate the irregularity I and hence result in a suitable index, because this method has better theoretical basis then others. It has been recommended as the most satisfactory for computing seasonal index, as such this method would be applied in this project.

2.4.3 Ratio-to-Trend Method

The step involved are

(i) Compute monthly trend figures by the least square method.

(ii) Express each original figure as a percentage of the corresponding trend figure.

(iii) Compute the mean percentage for each month.

(iv) Express each mean in (iii) as a percentage of their own mean. The resulting percentage gives the required index. It is relevant to mention that (iii) yields $Y/T = TSCI/T = CSI$

Subsequent averaging of Y/T = i.e CSI in (iii) produces seasonal index which may include cyclical and irregular variations.

2.4.4. Link Relative Method

This method expresses data for each month as a percentage of data for previous month. These percentage are called link relatives since they link each month to the preceding one.

The steps involved are:

(i) Translate the original data into relative

(ii) Obtain the mean link relative for each month

(iii) Convert the series of mean relatives into series of chain relatives. The chain relative for any month is obtained by multiplying the link relative of that month by the chain relative of the previous month and dividing result by 100 (hundred). This process is continued until we obtain chain relatives for all the 12 months and for January seasonal time.

(iv) Although last chain relatives (for January second time) ought to be 100 (hundred). It would usually not be so due to the presence of the elements of trend. The differences between the two chain relatives for January represent the trend decrement on increment.

Adjustment of the chain relative for the effect of trend is of necessity if the last chain relatives greater than 100, the correction factor is to be deducted and is to be added when reverse is the case.

The first month is kept at 100 for subsequent months however, correction factors should be added or substracted as the case may be for monthly data, the correction factor for the month is (I - 1)/12 x D (i = 1,2,3 -------- 12) where D is the difference between the final chain relative and 100.

(v) Express the corrected relatives as percentage of the arithmetic mean. The result constitute the index.

2.5 FORECASTING

For the purpose of forecasting only the trend and seasonal effect are used if monthly or quarterly forecast are required while trend and cyclical effects are used if annual forecast are required.

Quarterly forecast shall be obtained by multiplying trend forecast for the period in question by the corresponding seasonal index for the quarter i.e forecast

= Trend x Seasonal Index (For monthly or quarterly data).

= Trend x Cyclical (For Annual Data)

Therefore

Forecast = Trend x Seasonal since it is quarterly data is required by this project.

Chapter Three

3.0 TIME SERIES ANALYSIS ALGORITHM

Programme design involves specification of the input to the program and how the input shall be captured The writing of the algorithm and coding of the algorithm in a languages of one's choice. It also specifies the type of output expected on executing of the program.

3.1 INPUT DESCRIPTION

By input to a program, we mean quantities that are processed into final result i.e by the program. The are raw materials which the program processes into finished products, output. Input may be part of the program through the use of 'DATA' and READ statement or may be required in the course of running the programme if the programme is interactive through 'INPUT' keyword. The choice of what mode of input to adopt depends on the programmer and nature of data to be inputted.

However, most times, a mixture of the two is adopted. Any area of the program that requires bulky data usually utilizes the 'DATA' and 'READ' statement and the 'INPUT' is utilized when data is scanty.

The input to this program starts in segment 0 where the user is prompted to input 'y' or 'n' in response to weather he/she is a first time user or not.

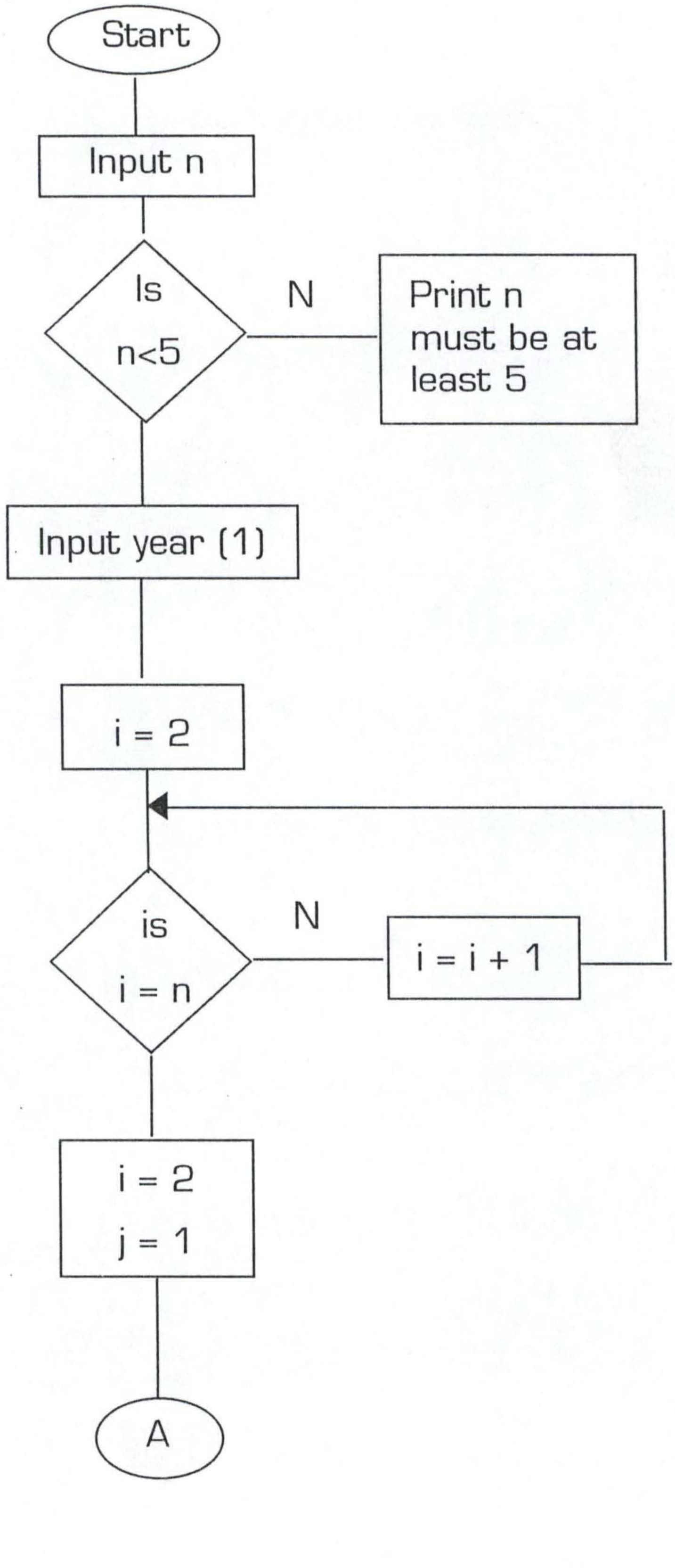
In segment I the input required is the number or years covered by data. The main input i.e the time series data are then read.

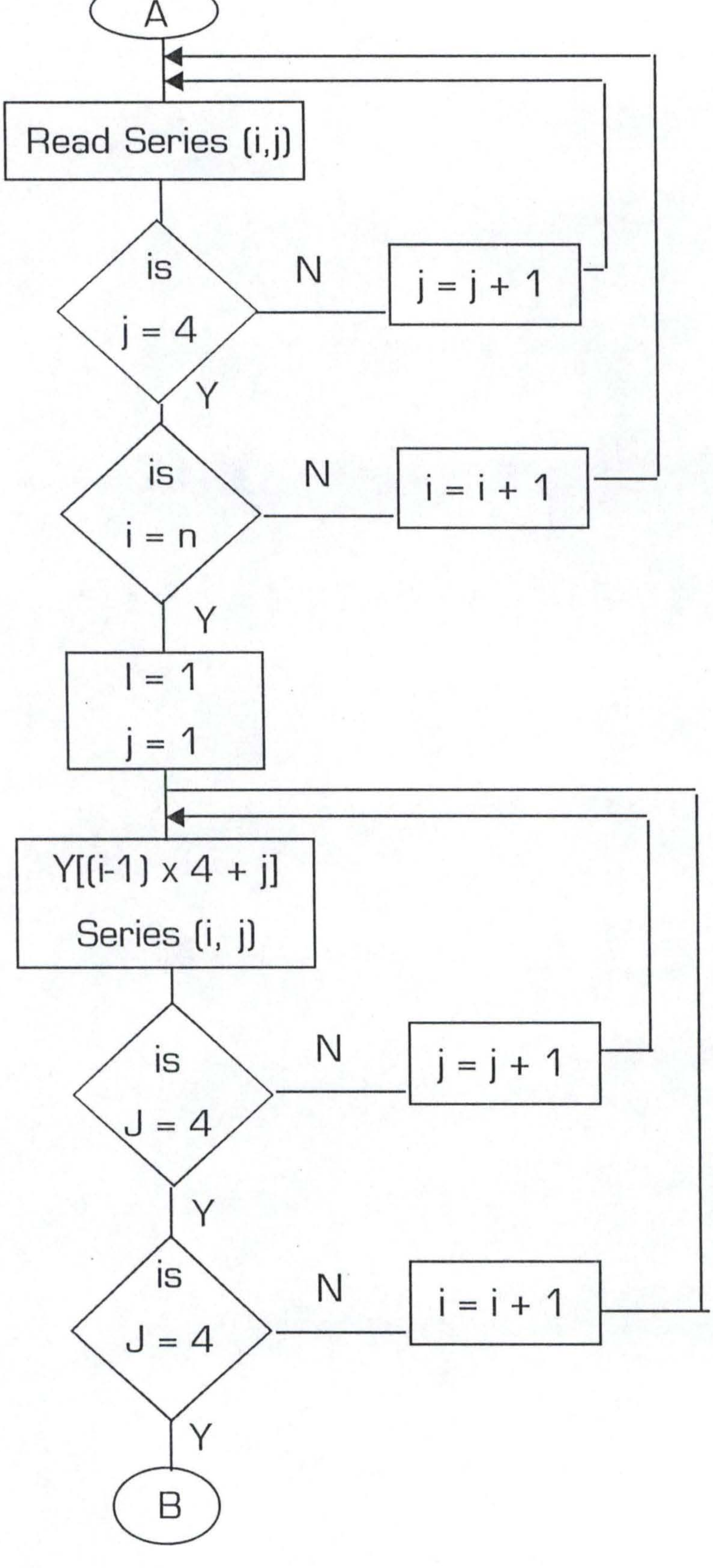
In segment 10, the input required is the year and quarter user wishes to forecast for.

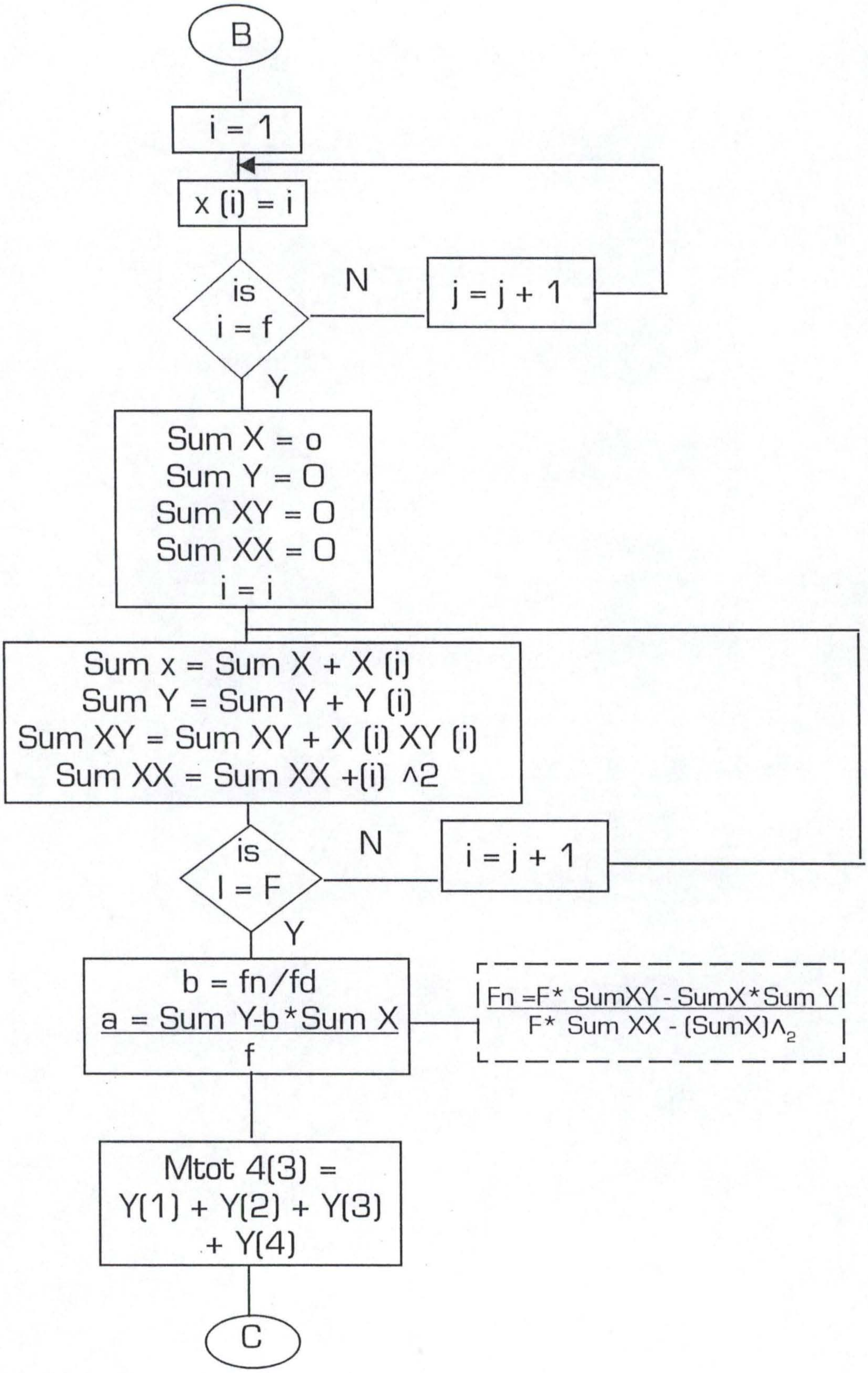
3.2 ALGORITHM REPRESENTATION/DESCRIPTION

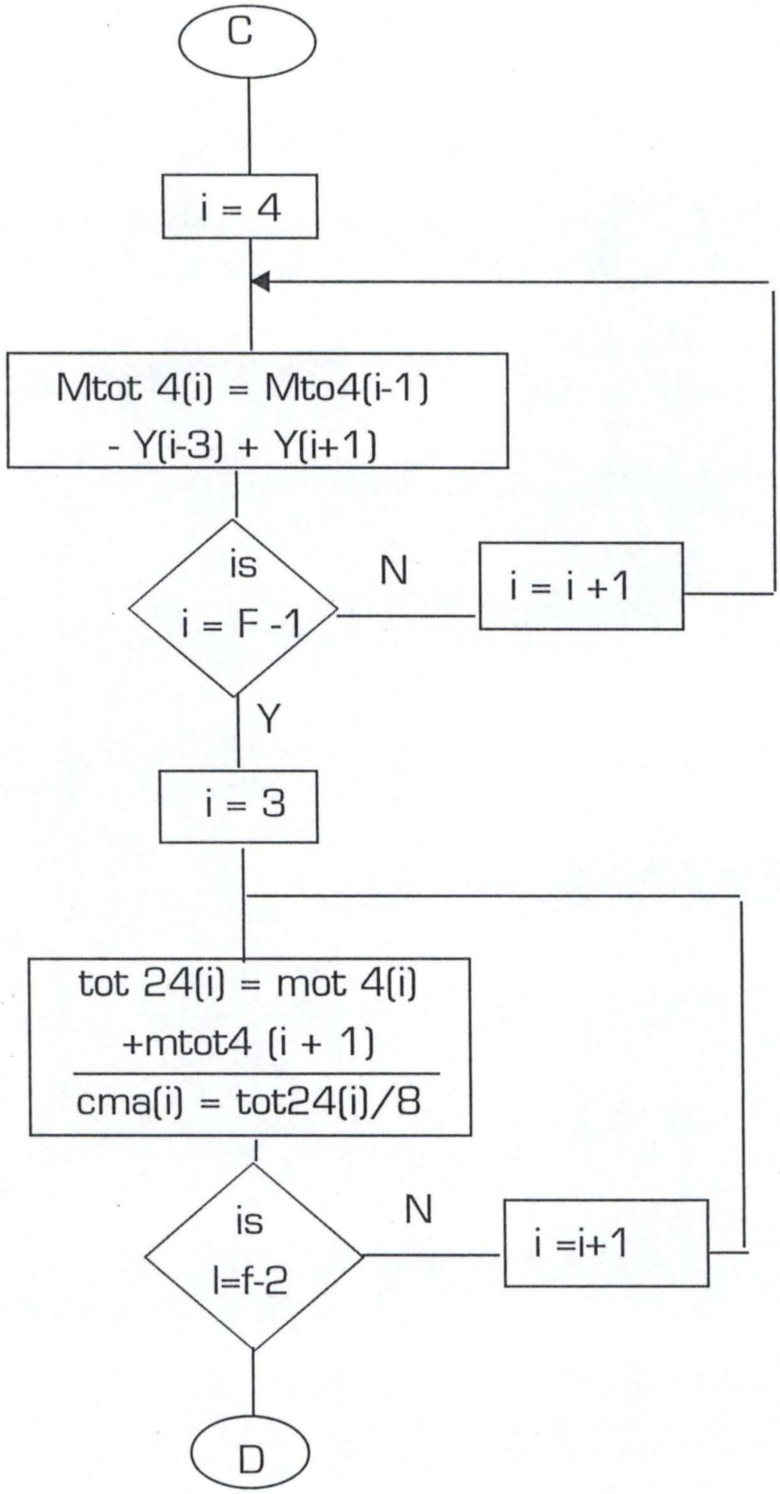
Algorithm is a description of steps required for solving a procedural problem. Such description could be descriptive or diagrammatic in nature. An algorithm could be presented in English, Pseudocode, Nassi Shnaiderman diagram or flow charts and must posses the following properties: precision, efficiently, finiteness in steps of operation, termination and production of output intermination.

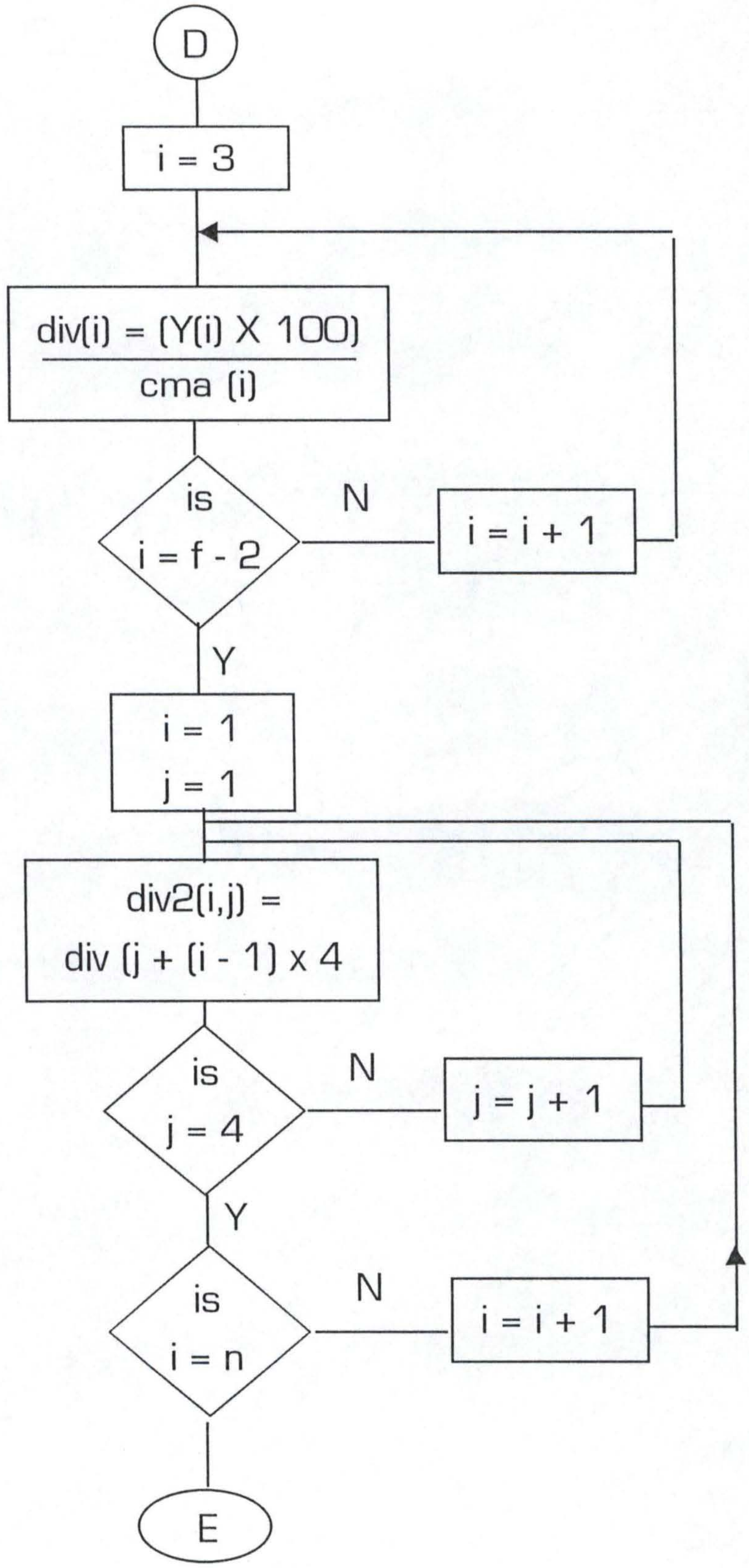
For the purpose of this work, flow chart will be used since it is most popular and familiar owing to the fact that it provides good visual representation of the logic of the algorithm it represents.

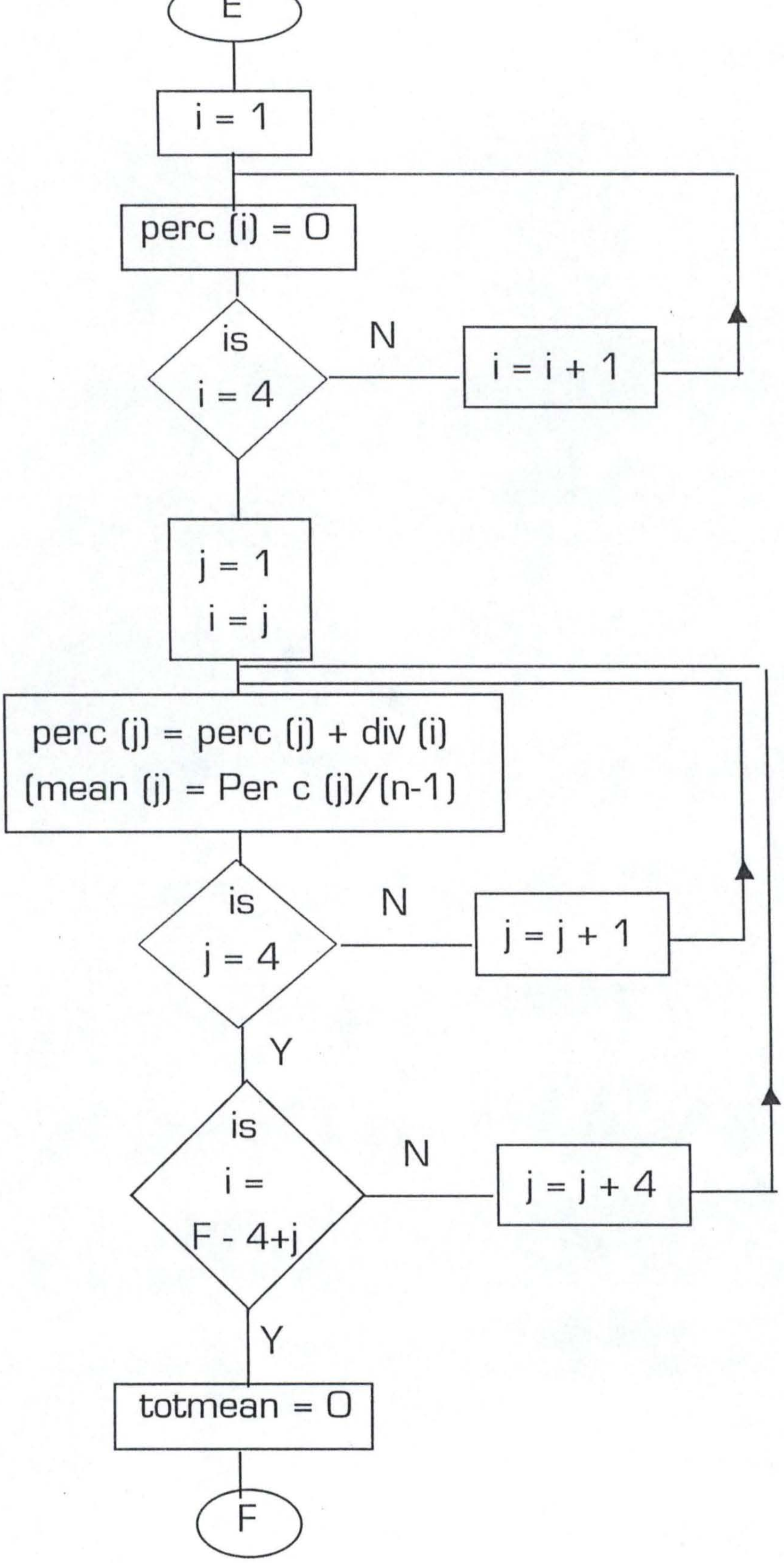

Start
Input n
Is
n<5
N
Print n
must be at
least 5
Input year (1)
i = 2
is
i = n
N
i = i + 1
i = 2
j = 1
A

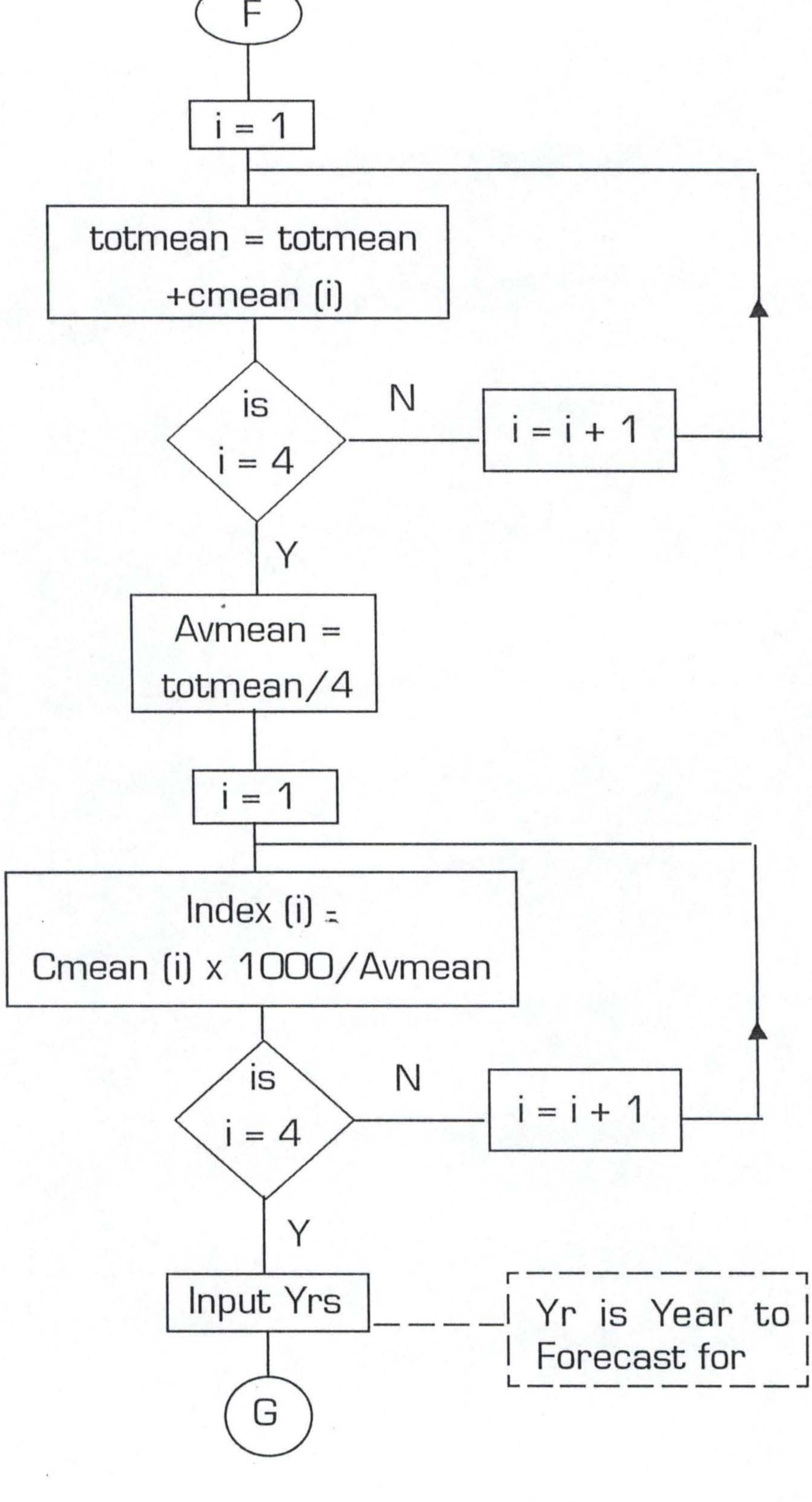

A
Read Series (i,j)
is
j = 4
N
j = j + 1
Y
is
i = n
N
i = i + 1
Y
I = 1
j = 1
Y[(i-1) x 4 + j]
Series (i, j)
is
J = 4
N
j = j + 1
Y
is
J = 4
N
i = i + 1
Y
B

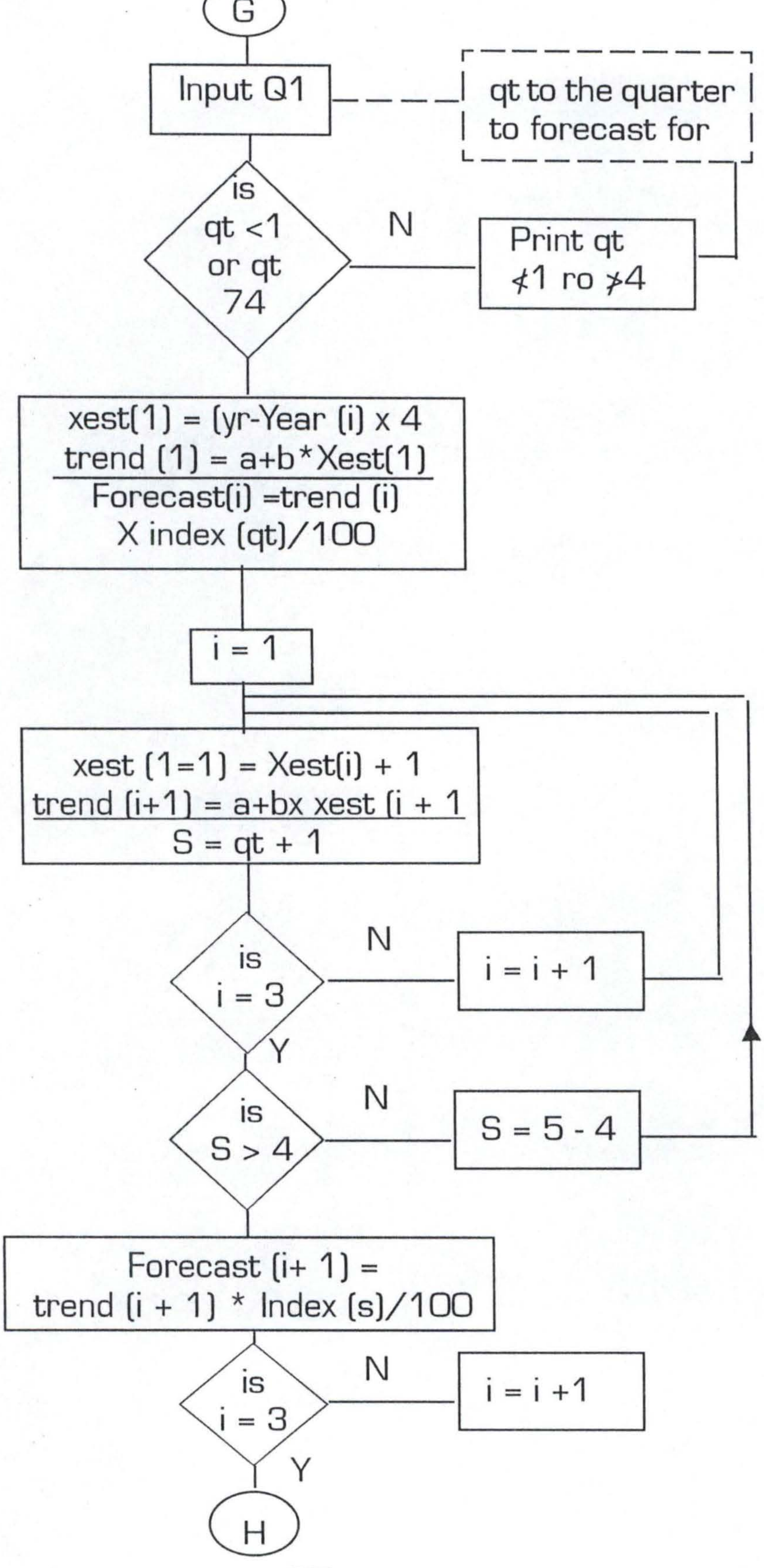

B
i = 1
x (i) = i
is
i = f
N
j = j + 1
Y
Sum X = o
Sum Y = O
Sum XY = O
Sum XX = O
i = i
Sum x = Sum X + X (i)
Sum Y = Sum Y + Y (i)
Sum XY = Sum XY + X (i) XY (i)
Sum XX = Sum XX +(i) ^2
is
I = F
N
i = j + 1
Y
b = fn/fd
a = Sum Y-b*Sum X
f
Fn =F* SumXY - SumX*Sum Y
F* Sum XX - (SumX)^2
Mtot 4(3) =
Y(1) + Y(2) + Y(3)
+ Y(4)
C

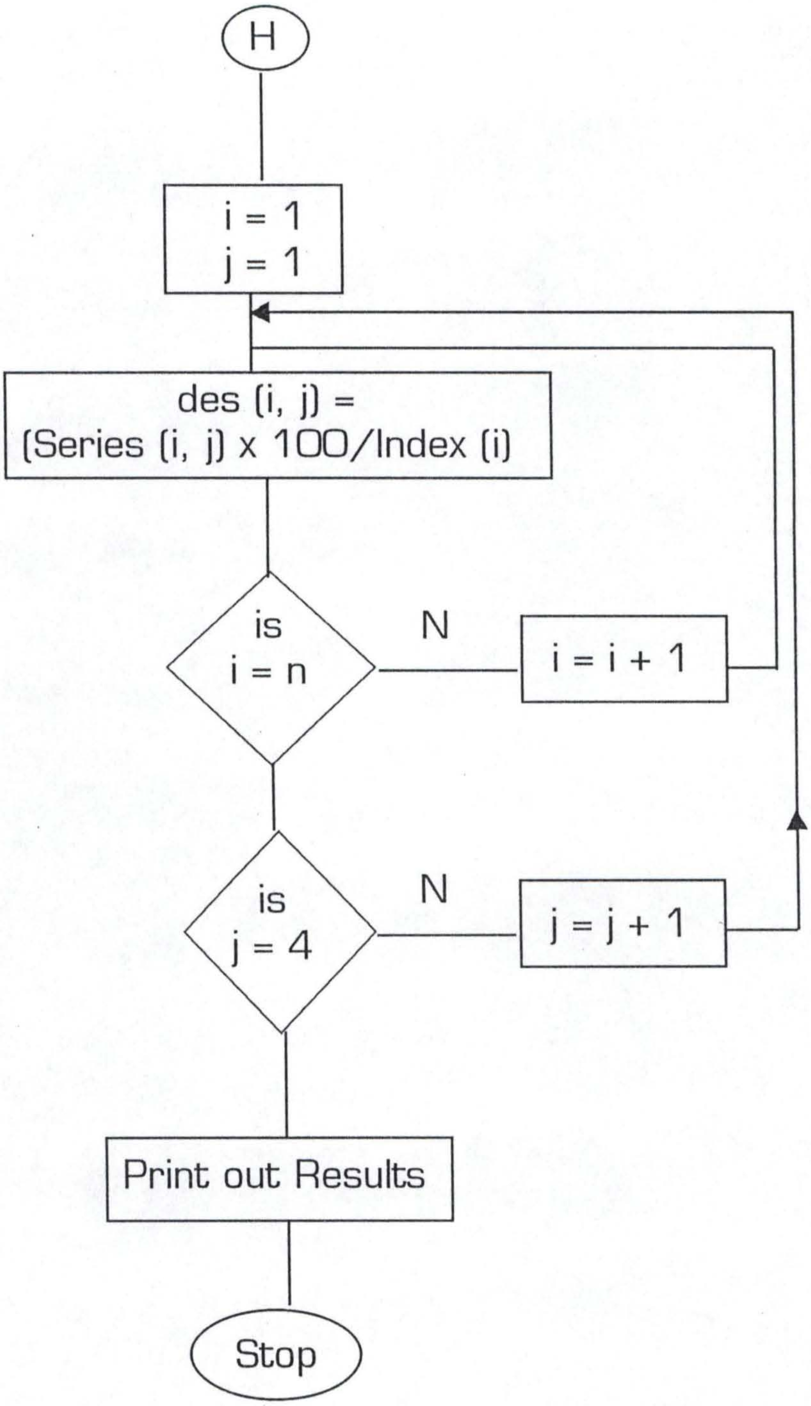

C
i = 4
Mtot 4(i) = Mto4(i-1)
- Y(i-3) + Y(i+1)
is
i = F -1
N
i = i +1
Y
i = 3
tot 24(i) = mot 4(i)
+mtot4 (i + 1)
cma(i) = tot24(i)/8
is
I=f-2
N
i =i+1
D


D
i = 3
div(i) = (Y(i) X 100) / cma (i)
is i = f - 2
N
i = i + 1
Y
i = 1
j = 1
div2(i,j) =
div (j + (i - 1) x 4
is j = 4
N
j = j + 1
Y
is i = n
N
i = i + 1
E


E
i = 1
perc (i) = 0
is
i = 4
N
i = i + 1
j = 1
i = j
perc (j) = perc (j) + div (i)
(mean (j) = Per c (j)/(n-1)
is
j = 4
N
j = j + 1
Y
is
i =
F - 4+j
N
j = j + 4
Y
totmean = 0
F


F
i = 1
totmean = totmean +cmean (i)
is i = 4
N
i = i + 1
Y
Avmean = totmean/4
i = 1
Index (i) = Cmean (i) x 1000/Avmean
is i = 4
N
i = i + 1
Y
Input Yrs
Yr is Year to Forecast for
G


G
Input Q1
qt to the quarter to forecast for
is qt <1 or qt 74
N
Print qt ≮1 ro ≯4
xest(1) = (yr-Year (i) x 4
trend (1) = a+b*Xest(1)
Forecast(i) =trend (i) X index (qt)/100
i = 1
xest (1=1) = Xest(i) + 1
trend (i+1) = a+bx xest (i + 1
S = qt + 1
is i = 3
N
i = i + 1
Y
is S > 4
N
S = 5 - 4
Forecast (i+ 1) = trend (i + 1) * Index (s)/100
is i = 3
N
i = i +1
Y
H


H
i = 1
j = 1
des (i, j) =
(Series (i, j) x 100/Index (i)
is
i = n
N
i = i + 1
is
j = 4
N
j = j + 1
Print out Results
Stop

3.3 PROGRAM DESCRIPTION

The algorithm is coded in Qbasic languages. In this section tasks accomplished by the various segments of the program will be described. To make the description readily understandable, the program is divided into 16 segments 1, 2 ..... 15, 16.

Seqment {1} gives useful information about the software to the first time user. It gives a brief description of tasks the software performs nature of inputs required and nature of output on execution. The information remains on the screen for one minute before program executive continues.

Seqment {2} prompts user to input the number of year (n) covered by data if the number of years inputted is <5, the user is prompted to re-enter the number. It also prompts user to input the first of year covered by data {years (1)}. Other years are automatically computed from the knowledge of number of years covered by data earlier inputted. The original times series data are then read.

Seqment {3} transfers original data into dimensional array Y.

Seqment {4} Assign codes to the time variable, X Quantities such as $\sum X$, $\sum Y$ $\sum XY$ and $\sum x2$ required for trend analysis are computed. The parameters a and b being the intercept and slope of the linear trend equation are computed and trend analysis is completed.

Seqment {5} begins seasons analysis by computing the 4 - quarter moving total.

Seqment {6} compute 4 - quarter centred moving average (CMA) divides original data by CMA. It adds the resulting values for corresponding values.

Seqment {7} divides original data by CMA and multiplies result by 100.

Seqment {8} transfer contents of 1 - dimensional div to 2 - dimensional div 2.

Seqment {9} manipulate div 2 by adding figures for corresponding quarter of different years. It compute the mean for each quarter.

Seqment {10] obtains the required seasonal index by expressing each of means obtained in seqment 8 (eight) as a percentage.

Seqment {11} performs forecasting. It prompts users to input the year and quarter whose forecast is desired. If user inputs any value less than 1 or > 4 for quarter, he is prompted to re-input as such value is not valid. It computes the trend figure for the year and quarter inputted by the user. The trend figure is then multiplied by the seasonal index figure of the quarter inputted, to obtain the forecast. It computes three successive additional forecasts in addition to the one required yielding four forecasts.

Segment ({12} Deseanonalizes the original data by dividing each original time series data by the corresponding seasonal index.

Seqment {13} marks the beginning of the printing of the output

Seqment {14} prints details of trend analysis. It prints out the intercept and slope of the linear trend equation fitted to the time series data.

Seqment {15} prints details of seasons analysis centred moving table, of percentages and seasonal index are printed.

Seqment {16} prints out the forecasts. It print four consecutive forecasts beginning with the other specified by the user. The computation and hence outputting of three additional forecast. Is to save the user who might be interest in more than one forecast the labour of having to run the program each time a forecast is required.

Chapter Four

4.0 PROGRAM IMPLEMENTATION

Program implementation means putting the program to use. In this section, output of the program shall be discussed. Hardware requirements would also be stated.

4.1 INTERPRETATION OF TREND ANALYSIS

From the output attached is append the intercept of the fitted linear trend equation is 293265 and the slope, - 537, the intercept implies that part of the trend effect that is independent of time is 293265 crates monthly while the slope implies that there is decrease of 537 crates in sales monthly. That is, the trend suggests a downward trend for sales.

4.2 INTERPRETATION OF SEASONS ANALYSIS

The seasonal index computed by the Ratio-to-moving average method produced 123.8%, 88.5%, 68.3% and 119.3% for quarters I, Quarter II, Quarter III and Quarter V respectively. 123.8% figure for quarter I implies that sales in Quarter I is typically 23.8% higher than quarterly average; sales in Quarter II is typically 21.5% lower than quarterly average; sales in quarter II is typical 31.7% lower than quarterly average and sale was in Quarter IV is 19.3% higher than quarterly average. In summary, Quarter I has the largest seasonal index figure of 121.5%, this implies that Quarter I typically records highest sales. This can be linked with the fact that Quarter I is peak of any dry season when consumption of cold drinks, is normally expected to be at maximum. Quarter III has the minimum index of 68.3%. This implies that sales drops to the minimum in Quarter II. This is no surprise as the period is cold and hence, consumption of cold drinks is expected to be minimum.

OUTPUT
****

Time Series Data

	Quarter1	Quarter2	Quarter3	Quarter4
1995	361678	250456	190345	320987
1996	355765	262987	186567	360765
1997	358765	255675	201130	350880
1998	359436	250860	209445	349720
1999	361234	260987	195674	330987
2000	340987	240567	190765	330572

Trend analysis table

	X	Y	XY	XX
	1	361678	361678	1
	2	250456	500912	4
	3	190345	571035	9
	4	320987	1283948	16
	5	355765	1778825	25
	6	262987	1577922	36
	7	186567	1305969	49
	8	360765	2886120	64
	9	358765	3228885	81
	10	255675	2556750	100
	11	201130	2212430	121
	12	350880	4210560	144
	13	359436	4672668	169
	14	250860	3512040	196
	15	209445	3141675	225
	16	349720	5595520	256
	17	361234	6140978	289
	18	260987	4697766	324
	19	195674	3717806	361
	20	330987	6619740	400
	21	340987	7160727	441
	22	240567	5292474	484
	23	190765	4387595	529
	24	330572	7933728	576
total	300	6877234	8.534774E+07	4900

intercept of equation = 293265.3

slope of the equation = -537.1139

Centred Moving Average table

Year	Quarter	Data	4 Qt M.T	2 P.T M.T ofCol 4	4 QT CMA
1995	Quarter1	361678	0	0	0
1995	Quarter2	250456	0	0	0
1995	Quarter3	190345	1123466	2241019	280127.4
1995	Quarter4	320987	1117553	2247637	280954.6
1996	Quarter1	355765	1130084	2256390	282048.8
1996	Quarter2	262987	1126306	2292390	286548.8
1996	Quarter3	186567	1166084	2335168	291896
1996	Quarter4	360765	1169084	2330856	291357
1997	Quarter1	358765	1161772	2338107	292263.4
1997	Quarter2	255675	1176335	2342785	292848.1
1997	Quarter3	201130	1166450	2333571	291696.4
1997	Quarter4	350880	1167121	2329427	291178.4
1998	Quarter1	359436	1162306	2332927	291615.9

1998	Quarter2	250860	1170621	2340082	292510.3
1998	Quarter3	209445	1169461	2340720	292590
1998	Quarter4	349720	1171259	2352645	294080.6
1999	Quarter1	361234	1181386	2349001	293625.1
1999	Quarter2	260987	1167615	2316497	289562.1
1999	Quarter3	195674	1148882	2277517	284689.6
1999	Quarter4	330987	1128635	2236850	279606.3
2000	Quarter1	340987	1108215	2211521	276440.1
2000	Quarter2	240567	1103306	2206197	275774.6
2000	Quarter3	190765	1102891	0	0
2000	Quarter4	330572	0	0	0

Table of percentages

	Quarter1	Quarter2	Quarter3	Quarter4
1995	0	0	67.94945	114.2487
1996	126.136	91.7774	63.91557	123.8223
1997	122.754	87.30635	68.95184	120.5035
1998	123.2567	85.7611	71.5831	118.9198
1999	123.0256	90.13161	68.7324	118.3761
2000	123.3493	87.23319	0	0

Seasonal index

Quarter	Index
Quarter1	123.8446
Quarter2	88.54224
Quarter3	68.30386
Quarter4	119.3093

Deaseasonalized data

	Quarter1	Quarter2	Quarter3	Quarter4
1995	292041.8	282866.1	278673.8	269037.8
1996	287267.2	297018.7	273142.7	302378
1997	289689.6	288760.5	294463.6	294092.8
1998	290231.4	283322.4	306637.1	293120.6
1999	291683.2	294759.9	286475.8	277419.4
2000	275334.5	271697.4	279288.8	277071.5

Forecasts for 4 Quarters

2001	Quarter1	346563.7
2001	Quarter2	247298.8
2001	Quarter3	190406.1
2001	Quarter4	331949.6

Chapter Five

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The programme has displayed its capabilities of carrying out extensively a time series analysis and forecasting of quarterly time series data. The software is user friendly and does not require more than computer literacy to use. It is flexible and there is no limit to the number of years it can handle.

Results of data analysed have suggested a downward trend in the sales of Coca-Cola. The seasonal index has revealed that highest sales is recorded in Quarter I while the lowest is in Quarter 3. The result further suggested that all things, being equal, about 346538, 2472989, 190406 and 331950 sales figure shall be recorded in Q1, QII, QIII and QIV of year 2001 respectively.

5.2 RECOMMENDATION

(1) It is recommended that the management of Coca-Cola Bottling Company should adopt all measures that could reverse the downward trend in the sales of their products.

(2) Other researchers could extend this study to other approaches to analysing time series

REFERENCES

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3. Harper, WM (1991): Statistics, M&E Hand Book Series, Pitman Publishing, 6th Edition.

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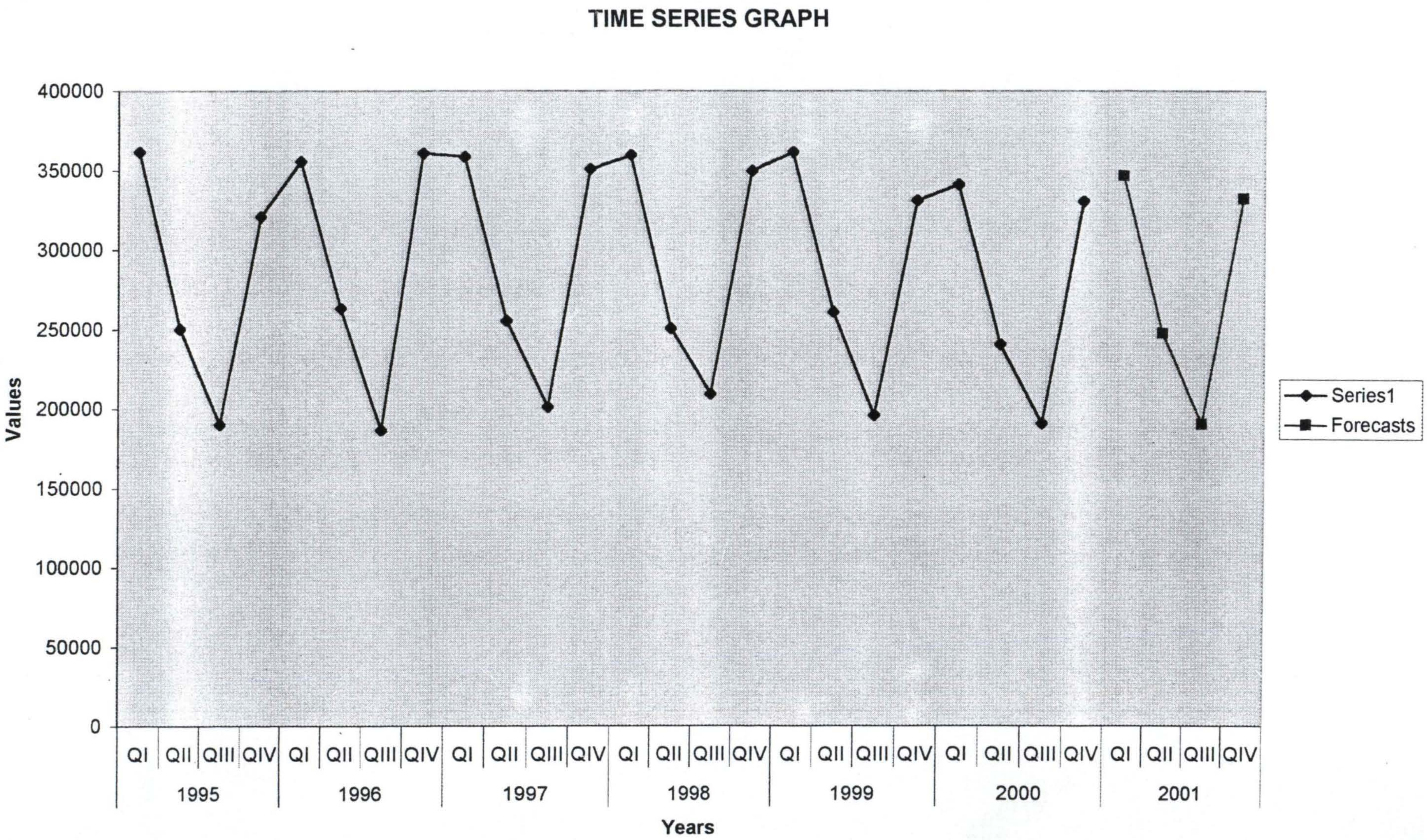
```
REM Program by Emoabino Edith PGD/MCS/99/2000/925
OPEN "a:td1.txt" FOR OUTPUT AS #1
DATA 361678,250456,190345,320987
DATA 355765,262987,186567,360765
DATA 358765,255675,201130,350880
DATA 359436,250860,209445,349720
DATA 361234,260987,195674,330987
DATA 340987,240567,190765,330572
REM Segment 1 gives information about the software to the first time user
INPUT "Are you a first time user of the software?(y/n)", ch$: CLS
PRINT #1, : PRINT #1,
     IF ch$ = "y" THEN 1 ELSE 2: CLS
1 PRINT "Information about the software"
PRINT "*****************************"
PRINT "The software carries out time series analysis & forecasting"
PRINT "on quarterly data based on the multiplicative model"
PRINT "The software prompts you for the following:"
PRINT "(i) first of years covered by data"
PRINT "(ii) year whose forecast is desired"
PRINT "(iii) quarter whose forecast is desired"
PRINT "where 1 is for quarter 1, 2 for quarter 2, etc."
PRINT "(iv) sofware automatically computes 3 consecutive"
PRINT "additional forecasts making 4 forecasts"
SLEEP 60: CLS
CLS
REM segment 2 accepts relevant data
2 INPUT "enter no of years covered by data"; n
IF n < 5 THEN
  PRINT "number of years must be at least pls"
    PRINT #1,
    GOTO 2
END IF
DIM year(n), series(n, 4), y(f), x(f), tot24(f), div2(n, 4)
DIM tot4(f), cma(f), div(f), perc(f), mtot4(f)
qs$(1) = "Quarter1": qs$(2) = "Quarter2"
qs$(3) = "Quarter3": qs$(4) = "Quarter4"
INPUT " enter first of years covered by data"; year(1)
FOR i = 2 TO n
  year(i) = year(i - 1) + 1
NEXT i
FOR i = 1 TO n
  FOR j = 1 TO 4
   READ series(i, j)
  NEXT j
NEXT i
REM segment 3 transfers original data into 1-dimensional array y
FOR i = 1 TO n
  FOR j = 1 TO 4
   y((i - 1) * 4 + j) = series(i, j)
  NEXT j
NEXT i
REM segment 4 assigns codes 1,2,3,.....,f to time variable x
FOR i = 1 TO f
 x(i) = i
NEXT i
sumx = 0: sumy = 0: sumxy = 0: sumxx = 0
FOR i = 1 TO f
 sumx = sumx + x(i)
 sumy = sumy + y(i)
 sumxy = sumxy + x(i) * y(i)
 sumxx = sumxx + x(i) ^ 2
NEXT i
b = (f * sumxy - sumx * sumy) / (f * sumxx - (sumx) ^ 2)
a = (sumy - b * sumx) / f
REM segment 5 computes 4 qt mt
mtot4(3) = y(1) + y(2) + y(3) + y(4)
FOR i = 4 TO f - 1
 mtot4(i) = mtot4(i - 1) - y(i - 3) + y(i + 1)
```

```
NEXT i
REM segment 6 computes 4-quarter cma
FOR i = 3 TO f - 2
 tot24(i) = mtot4(i) + mtot4(i + 1)
 cma(i) = tot24(i) / 8
NEXT i
REM segment 7 divides original data by cma
FOR i = 3 TO f - 2
 div(i) = (y(i) * 100) / cma(i)
NEXT i
REM segment 8 tranfers contents of 1-dim div into 2-dim div2
FOR i = 1 TO n
 FOR j = 1 TO 4
   div2(i, j) = div(j + (i - 1) * 4)
 NEXT j
NEXT i
REM segment 9 adds values for corresponding quarters of different years
FOR i = 1 TO 4
 perc(i) = 0
NEXT i
FOR j = 1 TO 4
 FOR i = j TO f - 4 + j STEP 4
  perc(j) = perc(j) + div(i)
  cmean(j) = perc(j) / (n - 1)
 NEXT i
NEXT j
REM segment 10 adjusts index
totmean = 0
FOR i = 1 TO 4
 totmean = totmean + cmean(i)
NEXT i
avmean = totmean / 4
FOR i = 1 TO 4
 index(i) = cmean(i) * 100 / avmean
NEXT i
REM segment 11 performes forecasting
INPUT "enter for year you wish to forecast for "; yr
PRINT "enter 1 for qtr1,2 for qtr2,3 for qtr3& 4 forqtr4"
20 INPUT "enter for quarter you wish to forecast for"; qt
IF qt < 1 OR qt > 4 THEN
 PRINT "value can neither be less than 1 nor greater than 4"
  GOTO 20
END IF
xest(1) = ((yr - year(1)) * 4 + qt)
trend(1) = a + b * xest(1)
FOR i = 1 TO 3
 xest(i + 1) = xest(i) + 1
 trend(i + 1) = a + b * xest(i + 1)
 s = qt + i
NEXT i
REM Segment 12 deseasonalizes
FOR i = 1 TO n
 FOR j = 1 TO 4
  des(i, j) = (series(i, j) * 100) / index(j)
 NEXT j
NEXT i
REM Segment 13 prints time series data
PRINT #1, TAB(35); "OUTPUT"
PRINT #1, TAB(35); "*******"
PRINT #1, : PRINT #1,
PRINT #1, TAB(28); "Time Series Data "
PRINT #1, TAB(28); "----------------"
 k = 11
 FOR i = 1 TO 4
  PRINT #1, TAB(k); qs$(i);
   k = k + 12
 NEXT i
FOR i = 1 TO n
```

5

```
  k = 10
  PRINT #1, TAB(2); year(i);
 FOR j = 1 TO 4
   PRINT #1, TAB(k + 2); series(i, j);
    k = k + 12
 NEXT j
NEXT i
REM segment 14 prints details of trend analysis
PRINT #1, : PRINT #1, : PRINT #1,
PRINT #1, TAB(25); " Trend analysis table"
PRINT #1, TAB(25); "--------------------"
PRINT #1, TAB(13); "X"; TAB(25); "Y"; TAB(43); "XY"; TAB(58); "XX"
FOR i = 1 TO f
 PRINT #1, TAB(12); x(i); TAB(24); y(i); TAB(42); x(i) * y(i); TAB(57); x
NEXT i
PRINT #1, TAB(5); "total"; TAB(11); sumx; TAB(24); sumy; TAB(42); sumxy;
PRINT #1, : PRINT #1,
PRINT #1, "intercept of equation ="; a
PRINT #1,
PRINT #1, "slope of the equation = "; b
PRINT #1, : PRINT #1,
REM Segment 15 prints details of seasonal analysis
PRINT #1, TAB(25); "Centred Moving Average table"
PRINT #1, TAB(25); "----------------------------"
PRINT #1, TAB(3); "Year"; TAB(11); "Quarter"; TAB(23); "Data";
PRINT #1, TAB(32); "4 Qt M.T"; TAB(47); "2 P.T M.T ofCol 4"; TAB(66); "4
PRINT #1,
FOR j = 1 TO n
 w = 1
 FOR i = 1 TO 4
  d = w + (j - 1) * 4
  PRINT #1, TAB(2); year(j); TAB(12); qs$(i); TAB(23); y(d); TAB(32); mt(
  PRINT #1, TAB(49); tot24(d); TAB(66); cma(d)
  w = w + 1
 NEXT i
NEXT j
PRINT #1, : PRINT #1,
PRINT #1, TAB(23); "Table of percentages"
PRINT #1, TAB(23); "--------------------"
k = 11
FOR i = 1 TO 4
 PRINT #1, TAB(k); qs$(i);
  k = k + 12
NEXT i
FOR i = 1 TO n
 k = 10
 PRINT #1, TAB(2); year(i);
 FOR j = 1 TO 4
  PRINT #1, TAB(k); div2(i, j);
  k = k + 12
 NEXT j
NEXT i
PRINT #1, : PRINT #1,
PRINT #1, TAB(35); "Seasonal index"
PRINT #1, TAB(35); "--------------"
PRINT #1, TAB(32); "Quarter"; TAB(44); "Index"
PRINT #1, TAB(32); "--------"; TAB(44); "------"
FOR i = 1 TO 4
 PRINT #1, TAB(32); qs$(i); TAB(42); index(i)
NEXT i: PRINT #1, : PRINT #1,
PRINT #1, TAB(23); "Deaseasonalized data"
PRINT #1, TAB(23); "---------------------"
k = 11
FOR i = 1 TO 4
 PRINT #1, TAB(k); qs$(i);
  k = k + 12
NEXT i
FOR i = 1 TO n
```

```
  k = 10
  PRINT #1, TAB(2); year(i);
  FOR j = 1 TO 4
   PRINT #1, TAB(k); des(i, j);
   k = k + 12
  NEXT j
 NEXT i
 PRINT #1, : PRINT #1,
 PRINT #1, : PRINT #1,
 REM Segment 16 prints forecasts
 PRINT #1, TAB(16); "Forecasts for 4 Quarters"
 PRINT #1, TAB(16); "-----------------------"
 FOR i = 1 TO 4
  PRINT #1, yr, qs$(qt), forecast(i)
     qt = qt + 1
     IF qt > 4 THEN
   qt = qt - 4
   yr = yr + 1
  END IF
 NEXT i
```


TIME SERIES GRAPH
400000
350000
300000
250000
200000
150000
100000
50000
0
Values
QI
QII
QIII
QIV
1995
1996
1997
1998
1999
2000
2001
Years
Series1
Forecasts