UNIVERSITY OF CAPE COAST

ANALYSIS OF KWESIMINTSIM POLYCLINIC HEALTH DATA

BY

EMMANUEL MENSAH BAAH

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DECLARATION

CANDITATE

I hereby declare that this dissertation is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: ....[signature]..

Candidate's Name: ....Emmanuel Mensah Baah....................

Date: ..June 2, 2004..

SUPERVISOR

I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by the University of Cape Coast.

Supervisor's Signature: ....[signature]..

Supervisor's Name: ..Prof. B.K. Gordor..

Date: ..June 2, 2004..

DEDICATION

In memory of Thearch Daniel Arthur

Your departure is a pain

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ABSTRACT

This dissertation is a report on efforts directed at finding the leading diseases, patterns and other characteristics of four kinds of data: Monthly Outpatient Morbidity Data, Statement Of Outpatients, Statement Of Inpatients and the Monthly Bed State Data of Kwesimintsim Polyclinic. The data spans the six-year period of 1997 to 2002.

The analysis of the data relied on descriptive statistics and time series analysis. Projected values of the number of cases of the diseases to be reported to the Polyclinic, particularly that of malaria in the immediate future were also explored. Analysis of the data showed that Malaria is the leading of the 13 most common diseases in the catchment area with an upward trend in the number of cases reported at the Polyclinic. It was also found that the number of cases of Pneumonia and Hypertension are on the ascendancy while tuberculosis is the most prevalent of the 'Six Child killer Diseases' – Diphtheria, Poliomyelitis, Tetanus, Measles, Whooping Cough, and Tuberculosis – in the catchment area. Further, Females and the age group 0 – 4 years are the subgroups in the population of the catchment area that require the most medical attention.

CONTENTS

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The health of a person is the level of the person's physical, mental and social well-being. "It involves more than just the absence of disease or infirmity" (World Book, 1994, p94). The better the health of a people, the more likely they are to enjoy life and achieve their goals; and the higher will be the quality of their achievements. Thus the central role good health plays in the development of a person, a community and the nation cannot be overemphasized. Governments, Local Authorities and Communities, therefore, strive to ensure good health through the provision of health care facilities, maintenance of hygiene and disease control through periodic immunization among other things.

The Kwesimintsim Polyclinic, situated at Sawmill, a suburb of Takoradi on the right hand side of the road when driving from Takoradi to Agona Nkwanta and close to Kwesimintsim town (see appendix D for map of Shama-Ahanta East district showing the location of the polyclinic and its catchment area), started operations on 21st February 1977 as community clinic to serve the health needs of the people of Kwesimintsim and its immediate environs. It was later upgraded along with other community clinics in the metropolis of Sekondi-Takoradi to the status of polyclinic to cater for the health needs of the people not only from the Kwesimintsim area, but also people out side the area to ease the growing burden on the two major hospitals in the metropolis: the Effia Nkwanta Regional Hospital and Takoradi Hospital, which were under pressure because of the increasing number of medical cases resulting from the increasing population of the metropolis ("Brief history,"1982).

Notably, the Polyclinic serves people from communities including Apremdo, Kwesimintsim central, Tanokrom, Assakae, Lagos Town, Whindo, Effia, Effiakuma, Anaji, Mpatado, Adenteim, Adakope and their immediate environs ("Half Year Report", 2003). All of these communities are within the Effia-Kwesimintsim area. The study therefore sees the Effia-Kwesimintsim area as the catchment area of the polyclinic.

1.2 STATEMENT OF THE PROBLEM

Health services could be broadly categorized as curative or preventive. Curative services involves the treatment of diseases and the preventive embraces Public Health, which among other things, involves provision of proper sanitation, conducting immunization programmes, enforcing quarantine regulations and provision of health education (World Book, 1994). Analysis of health data may show, for instance, that tuberculosis is endemic in locality A and may lead to measures being taken to control and eradicate it.

A health delivery system restricted to the services rendered at the health centres alone cannot be effective. An integrated health delivery system where all aspects of health are taken care of is therefore key to ensuring effective health delivery. There is, therefore, the need to appraise the various aspect of health delivery from time to time with the view to ensuring total health delivery, hence the need to analyse the health data of the Kwesimintsim Polyclinic.

1.3 OBJECTIVES OF THE STUDY

The objectives of the study are to:

i. Identify the leading diseases brought to the Polyclinic.

ii. Identify the patterns, if any, in the diseases brought to the Polyclinic.

iii. Explore the health data with the view to unearthing any unsuspected characteristics.

1.4 LITERATURE REVIEW

The extent to which a group of people have individually or otherwise been economically empowered, their level of education; their environment, including access to clean water, food and shelter; what they know about what can aid or destroy their health and how they apply this knowledge in their life; and the availability and quality of health services including Public health services are all factors that determine their health.

Population growth has the tendency of deepening environmental problems. This is especially true of the situation where infrastructure development does not keep pace with population growth. Hence the population density of an area is a factor that impinges on the health situation of that area. Furthermore, there might be adverse implications for a population for which the dependency ratio is high, because the resources of the few who provide might not be able to meet the needs.

The foregoing, therefore, suggest some of the factors that must be examined with regard to what determines health in general and the health situation in the catchment area in particular.

1.4.1 Population Situation

The catchment area, as indicated in the background, is made up of about 12 communities, holding between them an estimated population of 116,000 people (estimated from the report on the 2000 population and housing census by Ghana Statistical Service). It is one of the four major areas within the Shama Ahanta East District, which has an approximate population density of 1104 people per square kilometer and an estimated annual population growth rate of 2.5% (determined from the 1984 and 2000 population and housing censuses by Ghana Statistical Service using the Geometric Mean formula of Section 2.1). Table 1.1 gives the breakdown of the percentage age distribution.

Table 1.1 Percentage age distribution.

Age	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44
%	12.3	13.3	12.2	10.8	9.6	8.5	6.9	5.8	5.0

Age	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	≥ 85	N
%	4.0	3.1	2.1	1.8	1.3	1.0	0.7	0.6	1.2	369,166

Source: 2000 Population And Census, Ghana Statistical Service.

From the table, it could be deduced that the ratio of the school-going age (0-14 years) and retiring age (65+ years) to the active population (15-64 years) is 0.742 (42.6/57.4). Thus for every 100 people in the district who are productive there are about 74 dependants.

1.4.2 Education And Economic Situation

The catchment area is populated by, judging from their life style, a motley collection of people of all the economic classes; from people who eke out a living on what they earn daily to the well-to-do; from people with little or no education to people who have had university education. However, majority of the people are in the lower to average economic class (2000 population and housing census puts the number of employed people in the metropolis at 158,304 (42.9%) out of a total of a population of 369,166).

Table 1.2 gives the breakdown of the educational attainment of people in the Shama Ahanta East District.

Table 1.2 Percentage educational attainment.

Pop'n	Pre-Sch	Primary	Middle/JSS	Sec/SSS	Voc./Tech / Com	Post-Sec	Tertiary
243,026	7.1	26.4	38.3	12.9	5.7	2.7	6.9

Source: 2000 Population And Census, Ghana Statistical Service.

It follows from Table 1.2 that 126,140 people constituting 34.2% of the population of the district of which the catchment area is a part have had no formal education.

1.4.3 Water And Sanitation

Availability of Water

All the communities in the catchment area have access to treated water, but the supply is inadequate and irregular for some of the communities, parts of Tanokrom and Kwesimintsim, for instance. This has often led to the use of water from sources other than pipe borne, especially during long dry seasons and years with inadequate rainfall.

Waste Management

For some of the areas there are designated sites for dumping of refuse from the various homes, market and other work places, from where the metropolitan authorities collect them to the major dumpsites. Other areas are served by door-to- door refuse collection by private contractors. The problem with both mode of collection is that at times the refuse are not collected on time, thus the refuse serve as a breeding ground for diseases from where they may be spread by rodents and domestic animals which scavenge for food remnants amongst the refuse. There is indiscriminate disposal of waste, which finds their way into drains, blocking the flow of water and serving as breeding grounds for mosquitoes and other water borne diseases. In new residential localities the drainage systems are not well developed leading to pools of water in several places and producing the same result as mentioned above.

A good proportion of the houses in the catchment area do not have toilet facilities. The catchment area typifies the general situation in the Shama Ahanta East District in this regard. Shama Ahanta East Metropolitan Authority (SAEMA) reported in 1996 that 40% of the population of the Metropolis rely on public toilet facilities or the free range ("Development Strategy", 1996). There is widespread and indiscriminate defecation and urination, and human faecal matter in polythene bags lying in open spaces is a common sight in areas where the toilet situation is acute. "SAEMA can handle only 50% of total volume of waste generated per month" ("Development Strategy", 1996, p28) leading to continuing backlog of sludge and causing the underground sludge holdings to overflow into the public drains and creating environmental pollution – a recipe for the proliferation of water borne diseases ("Development Strategy", 1996)

"A survey conducted by the Ghana Water And Sewerage Company (GWSC) in 1992 which sampled 29 First Cycle Institutions, revealed that 51.7% had no toilet facilities and 52.2% had no access to potable water" ("Development Strategy", 1996, p28). It must be pointed out that the sanitation management now is comparatively better than it was a few years ago.

1.4.4 Health

The Lifestyle Factor

To a large extent we determine the state of our health. Wallis (2000) drives this point home better in "How To Stay Healthy". The issues raised are such that it is more convenient to give a detailed quotation rather than a summary.

> The role of lifestyle in determining our actual health status is now seen as being of increasing importance. Current research shows that in all causes of death four factors are outstanding. Lifestyle is the leading factor, accounting for fifty-three per cent of deaths. A further twenty-one per cent are attributed to environmental factors. If we consider that we are largely able to control lifestyle and environmental factors, we can conclude that seventy-four per cent, or nearly three- quarters, of factors contributing to death lie pretty much within our ability to change for the better. Sixteen per cent of the factors contributing to early death rest with our heredity. However, medical scientist tell us that even if we carry a genetic fault it is not inevitable that it will be manifested in our generation if we have minimized its appearance by adopting a healthy lifestyle. The remaining ten per cent of factors lie in the realm of health-care itself. That may seem odd on the surface but is easily explainable.
>
> Accidents and turns for the worst occur even in hospitals. Science, even medical science, does not have all the answers to our problems. We may know what tablet A does, and even tablet B, when taken as prescribed. What we are not so sure about is what tablet A and B do when taken at the same time. Many of these insights come with more experimentation and passing of time.

So the good news is that when we consider these factors together we see that our measure of control in all these areas is already very great and has the potential of getting better all the time.

We ought to know our bodies and how to keep them in good health, not only by ensuring that we have a positive lifestyle but also what to do when things go wrong, and there is no guarantee that they will not, as we do not live in an ideal world. (p. 10)

The foregoing points to the extent and measure of control we have in determining our health situation. The benefit of knowing our bodies and how it functions, as can be gleaned above, is that we are then better placed to contribute to maintaining and even improving our health.

Poverty And Health

The cost of health care might provide the motivation for the poor to self-medicate which is very dangerous. This is because apart from the risk of discomfort and injury the person run by not taking the right dose and combinations of drugs, it might be too late for any remedial action when it is realized that self-medication is not yielding the desired results and medical assistance must be sought at a health centre. Beyond this, lack of money may prevent a person from doing what can aid the person's health such as eating the right combination of food items.

Public Health

Periodic immunization of the people especially children and animals in the catchment area is undertaken to control such diseases as Poliomyelitis, Diphtheria and Rabies. Children are also given vitamin supplements, notably vitamin A during the immunizations.

People who sell cooked food to the public are by law required to undergo medical screening, though adherence to this requirement is debatable. The premises and operations of cooked food sellers are also inspected from time to time by the authorities concerned to ensure that practices of good hygiene are being adhered to.

The proliferation of the electronic media is helping in the dissemination of information on health issues. 'Mbaa Mpontu' and 'Fanyogo Social Agenda' are two of a number of programs on local radio stations directly or indirectly concerned with health. Some of the health issues that have come up for discussion in recent times include Pest Control, Adolescent sexuality, HIV/AIDS and Hepatitis.

1.4.5 Kwesimintsim Polyclinic

The Polyclinic has 3 Doctors, 1 Dental Surgeon, 57 Nurses (General, Reproductive And Child Health, Psychiatry, and Community health) and 61 Paramedicals. It offers twenty-four-hour service and has facilities to provide the following services:

- Internal Medicine
- General Surgery
- Dental Services
- Psychiatry

- Obstetrics and Gynaecology
- Ante-Natal Care
- Reproductive And Child Health Care, And
- Casualty and Emergency Services

Other supporting services include:

- X-Ray
- Pharmaceutical
- Laboratory
- Ultrasound services, And
- Nutritional and Rehabilitation Services ("Annual Report", 2001).

The problems faced by the Polyclinic are as follows:

- No Blood Bank, the Polyclinic relies on the Effia Nkwanta Regional Hospital for its supplies.
- Perennial water shortage.
- No incubator for nursery.
- No accommodation for staff.
- No ambulance.
- No resident Anaesthetist, this affects the twenty-four-hour service to some extent.
- Laboratory cannot perform certain investigations such as electrophoresis – determining whether or not a patient has sickle cell ("Half Year Report", 2003).

1.5 DATA (ITS NATURE AND COLLECTION)

The data that was the subject of the analysis in chapters three and four were obtained from the Records Unit of the Polyclinic. It covers the six-year period from 1997 to 2002 and is made up of four kinds: Monthly Outpatient Morbidity Data, Statement Of Outpatients, Statement Of Inpatients and The Monthly Bed State Data. Refer to Appendix A for a description of these data or to Appendix C for an appreciation of the actual data. The Monthly Outpatient Morbidity Data acknowledges 38 diseases individually. The rest, which include such diseases as Asthma, Sickle Cell, and Urethral Discharge, has been lumped together as 'Other Diseases' by the Polyclinic in extracting the data from individual records of the patients. There were entries for Asthma and Sickle Cell among others in 2002, but because there are no entries for these diseases for the preceding years they were added to 'Other Diseases' for the sake of uniformity.

Most of the diseases lumped together, it appears, are individually relatively less frequent in their occurrence, talking about the diseases that are reported to the Polyclinic and has therefore not provided the motivation for looking at them individually, as far as what the health authorities use the data for is concerned or are lumped together for reasons of sensitivity, especially when the data is being passed on to people who are under normal circumstances supposed not to handle it. For others it appears attempt has just not been made to look at them individually.

One would expect that the annual totals on the Statement Of Outpatients for the various years to be equal to the corresponding annual totals on the Monthly Outpatient Morbidity Data, but that is not the case. Those who are in charge of compiling the data could not explain these discrepancies and others that are in the data. However in line with the statistical principle of not tempering with data, they were used as they were obtained.

The number of patients discharged (discharges) plus the number of patients who died (deaths) should not necessarily equal the number of patients admitted (admissions), because patients who have not been discharged by the midnight of 31st December of any given year are counted as part of the number of admissions for the succeeding year. The Polyclinic has wards for only Labour and Gynaecology. It explains why the Statement Of Inpatients has data for only females and the age range 15-44.

Obviously, the data referred to above is coming from a secondary source as such we can not have as thorough understanding of the data as those who compiled it. Any inferences made in this dissertation must therefore be seen in this light.

1.6 LIMITATION/DELIMITATION

While it would have been preferable to complement the study with a survey, the constraint of time dictated that recourse was made to analysis of secondary data. By the same token, other health facilities within the catchment area, especially private clinics, were not covered in the study; other dimensions of health besides those that border on the operations of the polyclinic are also given very little attention.

The study acknowledges the possibility of some patients coming from communities outside the catchment area of the Polyclinic, and some people within the catchment area preferring the health centres outside the catchment area.

Additionally, this study might be limited by the fact that the one who carried it out has no training in medicine. The above limiting factors notwithstanding, no effort was spared in ensuring that the inferences made in this report are a true reflection of what is on the ground.

1.7 OUTLINE OF DISSERTATION

There are five chapters in this report. As seen already chapter one which is the introductory chapter deals with the background of the study, statement of the problem, objectives of the study, literature review, data and the limitation and delimitation of the study. Chapter two reviews the statistical methods employed in the study while the third and fourth chapters presents the preliminary analysis and further analysis respectively.

The discussion and conclusion arrived at by the study is the subject matter of the last chapter, chapter five.

CHAPTER TWO

REVIEW OF METHODS

This dissertation employs essentially two methods: Descriptive Statistics and Time Series Analysis. The descriptive statistics include measures used by people involved with health management though the interpretation of these statistics is done from the perspective of someone who has no background in health management.

2.1 DESCRIPTIVE STATISTICS

The descriptive statistical tools used include ratios (some in the form of proportions and percentages), arithmetic mean and the geometric mean.

Geometric Mean

The geometric mean (GM) is useful in dealing with quantities that change over time, such as in finding the average growth rate of a quantity over a period of time. The geometric mean is preferred in such circumstances because it paints the true picture on the ground by giving a more conservative estimate than the arithmetic mean, which is unduly affected by extreme values.

Suppose the production of a company in 1997 and 2003 are respectively 10,000 and 18,000 tons, then the growth factor over the last six-year period is 18,000/10,000 = 1.8. This figure tells us that over the six-year period production grew by 80%. Most probably production might not have grown at the same rate from year to year over the six-year period, some years might have had higher or lower growth rates than others. How do we at least estimate the average growth rate from year to year if production levels of the intervening years are not known? Indeed the growth factor of 1.8 for the six-year period is the product of the various growth factors from year to year up to the year 2003. It follows that the average growth factor per year is $(1.8)^{1/5} \approx 1.1247$. It follows that production grew by an average of 12.47 % per year for the six-year period. Thus the geometric mean is given by

$$GM = \sqrt[n]{(v_2/v_1)} \qquad \ldots\ldots\ 2.1$$

Where V_2 is the value at the end of period, V_1 is the value at the beginning of the period and n is the length of period.

The Population in the Shama Ahanta district in 1984 was 249371 and that for 2000 was 369166.

$\Rightarrow \quad n = 2000 - 1984 = 16, \quad V_1 = 249371 \quad$ and $\quad V_2 = 369166$

from equation 2.1, $\quad GM = \sqrt[16]{(369166)/(249371)} \approx 1.0248$

Thus the average annual population growth rate of the Shama Ahanta district was approximately 2.5%. This was what was referred to in Section 1.4.1.

Health Descriptive Measures

The Polyclinic like any other health centre under the Ghana Health Service calculates some Inpatient Statistics. Among other things they are used as Performance Indicators. They include the following:

a. Available Bed Days (ABD)

It is described as the Staffed Bed minus Temporary unavailable beds due to:

i. Shortage of staff.

ii. Minor redecorations.

iii. Outbreak of epidemics.

$$ABD = (\text{Bed Compliment}) \times (\text{Number Of Days})$$

b. Patient Days (PD)

It is the total number of beds in use or occupied in each ward per day for the period. It is also called the bed state. It is obtained by taking the cumulative totals of the beds state for each ward per day for the month, quarter or year.

c. Vacant Available Bed Days (VABD)

It is obtained by subtracting the total patient days from available bed days.

$$VABD = ABD - PD$$

d. Average Length Of Stay (ALS)

It is obtained by dividing the patient days by the total death and discharges for the period.

$$ALS = \frac{PD}{\text{Discharges} + \text{Death}}$$

e. Average Daily Occupancy (ADO)

It is obtained by dividing the total Bed Days by the number of days in the period.

$$ADO = \frac{\text{Total Patient Days}}{\text{Number Of Days}}$$

f. Percentage Occupancy (PO)

It is the total bed days divided by the product of the bed state and the number of days multiplied by 100.

$$PO = \frac{(\text{Patient Days}) \times 100}{(\text{Bed Compliment}) \times (\text{Number Of Days})}$$

g. Turn Over Interval (TOI)

It is the time that elapses between the discharge of a patient and the admission of another patient to occupy the same bed.

$$TOI = \frac{ABD - PD}{Discharges + Death}$$

h. Turn Over Per Bed (TOPB)

It is the total number of patients per bed per year.

$$TOPB = \frac{Discharges + Death}{Bed\ Allocation}$$

i. Death Rate (DR)

It is the ratio of deaths in the hospital during any given period of time to the total number of discharges and deaths during the period.

$$DR = \frac{(Total\ Deaths) \times 100}{Discharges + Death}$$

Kpedekpo and Arya (1981) had this to say on the importance of health statistics in general and the above statistics in particular:

> The average length of stay is usually regarded as a measure of the hospital's management efficiency. High occupancy rates are used as an argument for building extra capacity for the hospital. Information on out-patient attendances gives an estimate of illness and an index on the demand being made on the health services or indicates the workload of the staff. Rate of utilization of health facilities can be estimated from the population of a catchment area and the number of attendances. Naturally if there are great variations in this index within a country, this suggest inequalities in the distribution of health care resources.(p. 59)

The values of the above statistics could be found in Appendix C.

2.2 TIME SERIES

A time series is a collection of observations on a variable (quantitative) of interest over a period of time, usually taken at equal intervals of time. Quarterly sales at a retail store over the last four years and monthly electricity consumption of a home over the last two years are examples of time series data.

2.2.1 Components of Time Series

A time series is made up of some or all of the following four components:

i. Secular Trend

ii. Cyclical Variation

iii. Seasonal Variation

iv. Irregular fluctuations

Secular Trend is the overall long-term direction of the values in the series. It is about whether the values in the series are increasing or decreasing over time or the values are neither increasing nor increasing or the values are declining after a time of increase. "A linear trend equation is used to represent a time series data that are increasing (or decreasing) by equal amounts from one period to another; whilst data that increase by increasing (or decreasing) amounts are usually fitted by non-linear curves" (Gordor and Howard, 2000, p.191). Usually the trend is fairly obvious once a graph of the series against time has been plotted. Employing one of several smoothing techniques may also isolate the trend.

Cyclical Variation refers to the up and down movement in the values of the series about the trend line that repeat themselves after a period of more than one year; the whether situation of experiencing severe drought every 10 or so years (Elniño) is an example of cyclical variation.

Seasonal Variations are fluctuations in the values of the data that usually occur within a short period of time and repeat themselves at the same point in the consecutive time period. The period is usually a year or less as opposed to the long-term nature of cyclical variations. The high volume of sales around Christmas and Easter and the fall in sales immediately after Christmas and Easter are examples of seasonal phenomena.

Irregular Fluctuations are sharp fluctuations in the values of the series that are unexplained or unpredictable; they present themselves as sporadic fluctuations in the values of the variable in a very short time. For instance, supply of tents may fall sharply due to a strike at the plant making the tent or sales of tents may rise sharply due to high demand for tents after an earthquake.

We note that the cyclical variation is often associated with economic or business data. For this reason, it is sometimes ignored in the analysis of time series that are not clearly economic.

2.2.2 Decomposition of Time Series

The justification for looking at a time series in terms of its components is found in a couple of reasons:

i. It gives a better understanding of the series; decomposing a series gives us the opportunity to know the components that are present and the extent to which they influence the series. This knowledge is in turn helpful when it comes to forecasting;

by breaking the series into its component parts and forecasting each separately, the resulting composite forecast could be produced with a very high degree of accuracy.

ii. Analysis of the series helps to detect the entry into the series of a component (which was not present in the series initially) at an early stage. This is important especially when the new component might alter the direction of 'growth' of the series so that projected values might not agree with actual values. Measures could then be taken to factor into the forecasting process the effect of the component. (Harper, 1991).

2.2.3 Choice of Model

A time series Y is said to follow the Additive Model if it is thought to be the sum of some or all of the component parts: Secular Trend (*T*), Cyclical Variation (*C*), Seasonal Variation (*S*), Irregular fluctuations (*I*). That is $Y = T + C + S + I$, assuming all the components are present.

The series is said to follow the Multiplicative Model if it is thought to be the product of some or all of the component parts. That is $Y = T \cdot C \cdot S \cdot I$.

It is recommended that the additive model should be used when the plot of the series reveals that the trend is relatively flat (Harper, 1991) or the seasonal effect at any point in time is a certain fixed value above or below the combined trend-cycle, but where the seasonal effect is a percentage of the combined trend-cycle then the multiplicative model is appropriate (DeLurgio, 1998). Given that the seasonal effect being a percentage of the combined trend-cycle could result in the seasonal effect at any point in time being a certain fixed value above or below the combined trend-cycle "the multiplicative method is equally able to handle both flat and steep trends, it is clearly the better general purpose method, and if a choice is available the multiplicative method should normally be selected" (Harper, 1991, p.195). Additionally, the additive model assumes that the components are independent which is not realistic.

2.2.4 Estimation of Components

Fitting The Trend By The Method Of Least Squares

The trend in a time series could be linear or curvilinear. A linear (straight line) trend is described by equation $y_t = \beta_0 + \beta_1 t$ and a curvilinear trend by $y_t = \beta_0 + \beta_1 t + \beta_2 t^2$ (parabolic) or $y_t = \beta_0 \beta_1^t$ (logarithmic) among others, where y_t is the value of the series at a point t in time and the $\beta_i s$, i = 1, 2, 3., are constant parameters – their true values are never known. For any meaningful analysis and forecasting to be done we need to obtain unbiased estimates of the $\beta_i s$, i = 1, 2, ... n. . The convention is to use the Method Of Least Squares to estimate the $\beta_i s$. The procedure has been illustrated by Freund in Mathematical Statistics (pages 501–505), however we give a brief introduction here:

Suppose the relationship between a dependent variable y and independent variable x is that of a straight line, then $y = \beta_0 + \beta_1 x$ where, as observed above, β_0 and β_1 are population parameters and are the respective values of the y intercept and slope of the line . We are seeking estimates $\hat{\beta}_0$ and $\hat{\beta}_1$ of β_0 and β_1 respectively so that equation

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x \qquad \text{........ 2.2}$$

2.2 best describes the relationship between x and y. Suffice it to state the formulas for

$\hat{\beta}_0$ and $\hat{\beta}_1$ here, they are

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x} \qquad \text{......... 2.3}$$

$$\hat{\beta}_1 = \frac{n\sum_{i=1}^{n} xy - \sum_{i=1}^{n} x \sum_{i=1}^{n} y}{n\sum_{i=1}^{n} x^2 - \left(\sum_{i=1}^{n} x\right)^2} \qquad \text{......... 2.4}$$

Estimating Seasonal And Trend Component

Moving Averages (MA)

Given the series $y_1, y_2, \ldots, y_i, \ldots, y_n$ a moving average of order k is defined by the sequence of averages:

$(y_1 + y_2 + \ldots + y_k)/k, (y_2 + y_3 + \ldots + y_{k+1})/k, (y_3 + y_4 + \ldots + y_{k+2})/k, \ldots$

The numerators are referred to as moving totals of order k. For example given the numbers 3, 2, 6, 4, 5, 7, 10, 9, 3, a moving average of order 4 is given by :

$(3+2+6+4)/4, (2+6+4+5)/4, (6+4+5+7)/4, \ldots, (7+10+9+3)/4$

$= 3.75, 4.25, 5.5, 6.5, 7.75, 7.25.$

Moving averages of appropriate orders are one of several smoothing techniques employed in time series analysis. They are particularly employed to isolate the seasonal effect in a time series. They remove the short-term seasonal variation and irregular fluctuation so that what is left of the series is a combination of the trend and cycle.

From the perspective of the multiplicative model:

$$MA = TC$$

It follows that $Y/(M \cdot A) = Y/(T \cdot C) = S \cdot I$

The seasonal effect in the form of an index is then found by averaging the $S\,I$ values corresponding to the same time period. For instance if we are dealing with monthly data, then the average of all $S\,I$ values for January gives us the seasonal index for January, the average of all $S\,I$ values for February gives us the seasonal index for February, and so on. If the sum of all the averages (which is usually expressed as a percentage) is not exactly 1200 then they must be adjusted to give a sum of 1200 by multiplying the averages by the adjustment factor, 1200/(Total Of Averages).

The procedure is illustrated below using the hypothetical quarterly data (with a clear quarterly pattern) presented in Table 2.1. The columns in Table 2.2 containing estimates for SI, S, TCI and T respectively were headed $s\,i$, s, $\tau\,c\,i$ and τ to emphasize the fact that the values in these columns are estimates. The column headed CMA is necessary because the MA values do not correspond to any of the values of the actual series, we therefore find the Centred Moving Average (CMA) by calculating moving averages of order two of the MA values. However the s values were not expressed in percentages in line with the way MINITAB (Release 11.21(1996)), the statistical package used in chapter four presents s values.

Table 2.1 Quarterly data.

Quarter	Year			
	1	2	3	4
1	3	5	8	12
2	2	4	7	11
3	6	8	11	15
4	4	6	9	13

Table 2.2 Results of decomposition of time series data of table 2.1.

Year	Quarter	Period t	Actual Series y	MA	CMA	$si = y/(CMA)$	s	$\tau ci = y/s$
1	I	1	3				1.0206	2.9494
	II	2	2				0.8062	2.4808
				3.75				
	III	3	6		4.000	1.5000	1.3087	4.5847
				4.25				
	IV	4	4		4.500	0.8889	0.8646	4.6262
				4.75				
2	I	5	5		5.000	1.0000	1.0206	4.8991
				5.25				
	II	6	4		5.500	0.7273	0.8062	4.9615
				5.75				
	III	7	8		6.125	1.3061	1.3087	6.1129
				6.50				
	IV	8	6		6.875	0.8727	0.8646	6.9396
				7.25				
3	I	9	8		7.625	1.0492	1.0206	7.8385
				8.00				
	II	10	7		8.375	0.8358	0.8062	8.6827
				8.75				
	III	11	11		9.250	1.1892	1.3087	8.4053
				9.75				
	IV	12	9		10.250	0.8780	0.8646	10.4094
				10.75				
4	I	13	12		11.250	1.0667	1.0206	11.7578
				11.75				
	II	14	11		12.250	0.8980	0.8062	13.6443
				12.75				
	III	15	15				1.3087	11.4618
	IV						0.8646	15.0359

The average for the:

First quarter	(1.0000 + 1.0492 + 1.0667)/3	= 1.0386
Second quarter	(0.7273 + 0.8358 + 0.8980)/3	= 0.8204
Third quarter	(1.5000 + 1.3061 + 1.1892)/3	= 1.3318
Fourth quarter	(0.8727 + .08889 + 0.8780)/3	= 0.8799
		4.0707

Since the sum of the averages was not 4.0000 (we have four quarters per year) the averages were adjusted by multiplying the averages by the adjustment factor $\frac{4.0000}{4.0707}$. The results is as shown under the column headed s in Table 2.2

To estimate the trend component, the actual series was deseasonalized (seasonal effect was removed from the actual series) by dividing the seasonal indices into the corresponding values of the actual series, that is $Y/S = T\,C\,I$. We note that the upward trend in the deseasonalized data ($\tau\ c\ i$) is more apparent (see Table 2.3) than in the original data. This is so because the presence of the seasonal effect tended to hide the trend in the data and explains why estimating the seasonal effect and deseasonalising the actual series is often the first step towards estimating the trend. The estimated trend was obtained by fitting the least squares regression equation, dealt with above, to the values of $\tau\ c\ i$. The results is presented in Table 2.3 along with the residuals – the differences between the actual series and the fitted values ϖ. The model $\hat{y} = \varpi$ was assumed because the irregular and the cyclical components, if they exist, were thought to be insignificant.

$\sum c\tau i = 124.7801$ $\quad\sum c\tau i\,t = 1323.8499$ $\quad\sum t = 136$ $\quad\sum t^2 = 1496$

from Equation 2.4,

$$\hat{\beta}_1 = \frac{16(1323.8499) - (136)(124.7801)}{16(1496) - (136)^2} \approx 0.7742$$

from Equation 2.3,

$$\hat{\beta}_0 = \frac{124.7801}{16} - (0.7742)\frac{136}{16} \approx 1.2181$$

from Equation 2.2.

$$\tau = 1.2181 + 0.7742t \qquad \ldots\ldots\ldots 2.5$$

The values under the column headed τ were generated by substituting the value of the corresponding time period in Equation 2.5.

Table 2.3 Trend, fitted values and residuals.

τ	$\hat{y} = \tau s$	$e = y - \hat{y}$
1.9923	2.0333	0.9667
2.7665	2.2304	– 0.2304
3.5407	4.6337	1.3663
4.3149	3.7306	0.2694
5.0891	5.1939	– 0.1939
5.8633	4.7270	– 0.7270
6.6375	8.6865	– 0.6865
7.4117	6.4082	– 0.4082
8.1859	8.3545	– 0.3545
8.9601	7.0000	0.0000
9.7343	12.7393	– 1.7393
10.5085	9.0856	– 0.0856
11.2827	11.5151	0.4849
12.0569	9.7203	1.2797
12.8311	16.7921	– 1.7921
13.6053	11.7631	1.2369

It must be pointed out that different books and statistical software packages have somewhat different approaches to decomposing time series. This is because $Y = T\,C\,S\,I$ has several identical forms which serve as the basis of the decomposition, but the basic principles are almost the same. The bottom line is developing a valid model that fits the data and yields forecasts with minimal error.

As pointed out above there is more than one approach to decomposing a time series to obtain estimates of the components and thereby be able to obtain forecasts. One way of decomposing a time series is as outlined above. Let us designate the model resulting from this approach as Model 1. Minitab uses a somewhat different approach. "Minitab first fits a trend line to the data, using least squares regression, then detrends the data by either dividing or subtracting out the trend component. Then it smooths the detrended data by using a centred moving average of length equal to the length of the seasonal cycle. If the seasonal cycle length is an even number, this actually requires a two-step moving average in order to synchronize the moving average correctly. Once the moving average is obtained, it is either divided into or subtracted from the detrended data to obtain what are often referred to as raw seasonals. Within each seasonal period, the median value of the raw seasonals is found. These medians make up the seasonal indices. The seasonal indices are in turn used to seasonally adjust the data" ("How Minitab Does," 1996). We designate the model resulting from this approach as Model 2. We will explore these two models further in chapter four.

2.2.5 Assessing Model Accuracy

Dispersion

The dispersion of a set of numerical data refers to how close or apart the values are from one another, it is more meaningful when looked at from the point of view of the distance of the individual values from their mean. Dispersion is high when the values are scattered and low otherwise.

Standard Deviation

There are a number of measures of dispersion. Notable among them and perhaps the most used is the standard deviation – the root of the mean squared deviations from the mean. "Thus, it is a measure of the potential error distribution when using the mean to predict future values" (DeLurgio, 1998, p. 43).

The sample standard deviation S is given by

$$S = \sqrt{\frac{\sum_{i=1}^{n} (y_i - \bar{y})^2}{n - 1}} \qquad \text{......... 2.6}$$

where $y_1, y_2, \ldots, y_i, \ldots, y_n$ are the observations in the sample. The standard deviation of $3, 2, 6,$ and 5 whose mean is 4 is

$$S = \sqrt{\frac{(3-4)^2 + (2-4)^2 + (6-4)^2 + (5-4)^2}{4-1}}$$

$$\approx 1.83$$

The square of the standard deviation is referred to as variance, which plays almost the same role as the standard deviation.

Measures of Model Accuracy

$e_t = y_t - \hat{y}_t$ represents the deviation (or error) of the fitted (or forecasted) value $\hat{y}_t$ from the actual value y_t of the series. Several measures of model accuracy based on the difference e_t are presented below, namely Mean Absolute Deviation (MAD), Mean Square Deviation (MSD), Mean Absolute Percentage Error (MAPE), Standard Error Of The Estimate S_{xy} and Adjusted Coefficient Of Determination $\bar{R}^2$.

MAD, MSD And MAPE

$$\text{MAD} = \frac{\sum_{t=1}^{n} |(y_t - \hat{y}_t)|}{n} \qquad \text{......... 2.7}$$

$$\text{MSD} = \frac{\sum_{t=1}^{n} (y_t - \hat{y}_t)^2}{n} \qquad \text{......... 2.8}$$

$$\text{MAPE} = \frac{\sum_{t=1}^{n} |(y_t - \hat{y}_t)/y_t|}{n} \qquad \text{......... 2.9}$$

where n is the number of data points.

The values *MAD, MSD* and *MAPE* for the model of Section 2.2.4 using Equations 2.7 – 2.9 are respectively 0.7388, 0.8690 and 10.5636.

The closer the values of the actual series to the model values the smaller will be the deviation or error values $(e_t s)$ and the better will be the model as a fit or forecasting tool. Thus smaller values of *MAD, MSD* and *MAPE* are an indication that the model is a good fit or is good for forecasting. However these statistics are not that meaningful on their own; they are meaningful when comparing one model with another. That is, given a number of models one would choose the one with relatively smaller values of *MAD, MSD* and *MAPE*.

Standard Error of The Estimate S_{xy}

The standard error of the estimate S_{xy} is given by

$$S_{xy} = \sqrt{\frac{SSE}{n-k}} \qquad \text{......... 2.10}$$

Where n is the number of observations and k is the number of estimated parameters.

S_{xy}, like *MAD, MSD* and *MAPE* measures the scatter of the actual values y_t about the model $\hat{y}_t$. Thus a model with comparatively smaller value of S_{xy} is a better fit. S_{xy}^{2} measures the variability in the original data that is not accounted for by adopting the model $\hat{y}_t$.

Adjusted Coefficient of Determination $\bar{R}^2$

The adjusted coefficient of determination $\bar{R}^2$ is given by

$$\bar{R}^2 = 1 - \frac{S_{xy}^{\ 2}}{S_y^{\ 2}} \qquad \text{......... 2.11}$$

The quotient $S_{xy}^{\ 2}/S_y^{\ 2}$ measures the proportion of the variability in the actual data that is unexplained by adopting the model $\hat{y}_t$. It follows that $\bar{R}^2$ measures the proportion of the variability in the original data that is accounted for by the model $\hat{y}_t$.

DeLurgio (1998) made the following observation on $\bar{R}^2$:

> $\bar{R}^2$ is a general statistic that can be used to judge the relative accuracy of any model. For example, in using any model on a time series *Y*, assume that the [standard error of the estimate S_{xy}] is 10 and the standard deviation of $Y(S_y)$ is 40. Then $\bar{R}^2$ for this model is: $\bar{R}^2 = 1 - 10^2/40^2 = 1 - 100/1600 = 0.9375$ or 93.75%. Thus, the model has explained 93.75 percent of the original variance of *Y*. $\bar{R}^2$ is a general statistic that is useful when making inter- and intramodel accuracy estimates.(p. 106)

From Section 2.2.4, we have $SSE = \sum e^2 = 13.9034$ (Table 2.3), $k = 2$ and $n = 16$, it follows from Equation 2.10 that $S_{xy}^{\ 2} = 0.9931$. Also $\sum y = 124$, it follows that

$\bar{y} = 7.75$ and $S_y^{\ 2} = 14.6$, from Equations 2.6. Thus from Equation 2.11, $\bar{R}^2 = 0.9320$.

It goes without saying that 93.2 percent of the variability in the original data was accounted for by assuming the model $\hat{y} = \tau$ s.

2.3 ESTABLISHING WHETHER OR NOT THERE IS BIAS

A good forecasting model should underforecast just as much as it overforecast, hence an ideal model should have mean error of zero. To establish whether or not a model is consistently underforecasting or overforecasting, we test the hypothesis (alternative, H_1) $\mu_{e_t} \neq 0$ against the hypothesis (null, H_o) $\mu_{e_t} = 0$, where μ_{e_t} is the population mean error.

That is H_o: $\mu_{e_t} = 0$, H_1: $\mu_{e_t} \neq 0$

It could be shown that $\frac{\bar{e} - \mu_{e_t}}{S_{e_t}/\sqrt{n}} \sim t(n-1)$, for small sample size n. Under H_o, $\mu_{e_t} = 0$

$$\Rightarrow \qquad P\left\{- t_{\alpha/2}(n-1) \leq \frac{\bar{e} - 0}{S_{e_t}/\sqrt{n}} \leq t_{\alpha/2}(n-1)\right\} = 1 - \alpha ,$$

$$\Leftrightarrow \qquad P\left\{- t_{\alpha/2}(n-1)S_{e_t}/\sqrt{n} \leq \bar{e} \leq t_{\alpha/2}(n-1)S_{e_t}/\sqrt{n}\right\} = 1 - \alpha ,$$

Where α is the level of significance, that is, the unlikely event of an error value lying outside the interval $\left(-t_{\alpha/2}(n-1)S_{e_t}/\sqrt{n},\ t_{\alpha/2}(n-1)S_{e_t}/\sqrt{n}\right)$ when the errors are not biased and are approximately normally distributed with mean zero is α ("Errors from good forecast are typically normally distributed" (DeLurgio, 1998, p 45)). It follows that H_o will be rejected if $\bar{e}$ does not lie in the interval $\left(-t_{\alpha/2}(n-1)S_{e_t}/\sqrt{n},\ t_{\alpha/2}(n-1)S_{e_t}/\sqrt{n}\right)$.

We would want α to be as small as possible. Suppose a forecasting model yields a mean error of − 99.3 with standard deviation of 154.6, then on the average the model is overforecasting by 99.3 units. We would want to know whether or not this value is significantly different from zero at 5% level of significance. Hence we test

H_o: $\mu_{e_t} = 0$ against H_1: $\mu_{e_t} \neq 0$

Given that there are 9 forecast values, the mean error of − 99.3 is expected to lie within $(- t_{0.05/2}(9-1)\ 154.6/\sqrt{9}$, $t_{0.05/2}(9-1)\ 154.6/\sqrt{9})$, where $t_{0.05/2}(8) = 2.31$. Which gives the interval (− 119.04, 119.04). Clearly − 99.3 is lying inside the interval , hence we fail to reject H_o: $\mu_{e_t} = 0$ and conclude that − 99.3 is not significantly different from zero.

CHAPTER THREE

PRELIMINARY ANALYSIS

3.1 MONTHLY OUTPATIENT MORBIDITY DATA (1997-2002)

An examination of the data shows that Malaria, Diseases Of The Oral Cavity, Upper Respiratory Tract Infection (URTI), Skin Diseases and Ulcers, Accidents, Diarrhoeal Diseases, Intestinal Worms Infestation, Gynaecological Disorders, Pregnancy And Related Complications, Chicken Pox, Hypertension, Mental Disorders and Pneumonia have featured in the list of top ten causes of outpatient attendance at least once in the six years under consideration. Table 3.1 presents their ranks for the various years in the period under consideration. Refer to Appendix C for the top ten causes of attendance and corresponding percentage attendance due these diseases relative to the total attendance (new cases) for the years under consideration.

Table 3.1: The most reported medical problems and their ranks.

Disease	Rank					
	1997	1998	1999	2000	2001	2002
Malaria	1	1	1	1	1	1
Upper Respiratory Tract Infection	3	2	2	2	2	2
Skin Diseases And Ulcers	4	3	3	3	6	4
Accidents	5	6	4	4	7	10
Diarrhoeal Diseases	6	5	7	5	5	7
Intestinal Worms Infestation	7	7	8	9	3	5
Gynaecological Disorders	8	8	6	6	8	9
Diseases Of The Oral Cavity	2	4	5	-	4	3
Hypertension	-	9	10	7	9	6
Pregnancy And Related Complications	9	10	-	8	10	-
Mental Disorders	-	-	9	10	-	-
Pneumonia	-	-	-	-	-	8
Chicken Pox	10	-	-	-	-	-

The first seven of the diseases on the table were among the top ten diseases in all the six years under consideration.

It is clear that Malaria is the leading cause of attendance at the Polyclinic. It featured in all the six years under consideration, taking the first position in each year and accounting for 37.65% of the total outpatient attendance (new cases) in 1997; the least for Malaria for all the years under consideration. The number of cases of Malaria rose steadily from 9,598 cases in 1997 to 13,513 cases in 2000, from where it shot up dramatically by 44.47 % to 19,523 cases in 2001 and then dropped in a similar fashion to 14,026 cases in 2002. This is captured in Figure 3.1.

Infection of the upper respiratory tract (URTI) is the next leading cause of attendance at the Polyclinic. It took the second position in the five of the six years under consideration, taking the third position in 1997.The pattern in number of cases for the various years is also shown in Figure 3.1.

The fact that the number of cases of URTI (being the second leading cause of attendance) could account for at most only 24.1% of the corresponding number of Malaria cases comparing the annual number of cases of the two diseases (excluding 1997) underscores the relative seriousness of Malaria. Figure 3.1 shows a comparison of the number of cases of Malaria and URTI.

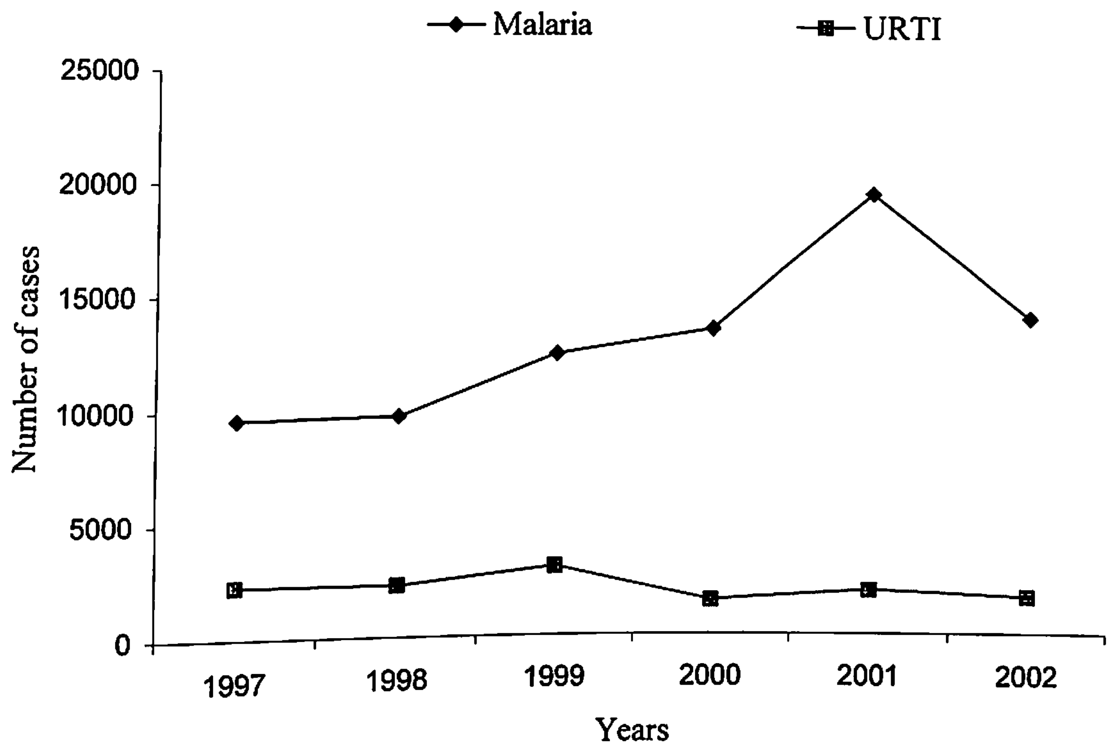

Fig. 3.1: Line chart showing the number of cases of Malaria and URTI, 1997-2002

A close study of data shows that the number of Pneumonia cases started to rise in the last quarter of 2001 and attained its highest value of 83 cases in December of 2002 in the period under consideration; it is not surprising then that it featured among the top ten diseases for the first in 2002. In fact, the number of cases in 2002 was more than two times the number of cases in all the preceding five years put together. Figure 3.2 shows the line chart of the number of Pneumonia cases for the six years under consideration. The steepness of the lines joining the values of the year 2000 and 2001, and 2001 and 2002 underscores the dramatic rise in the number of pneumonia cases in the last two years of the period.

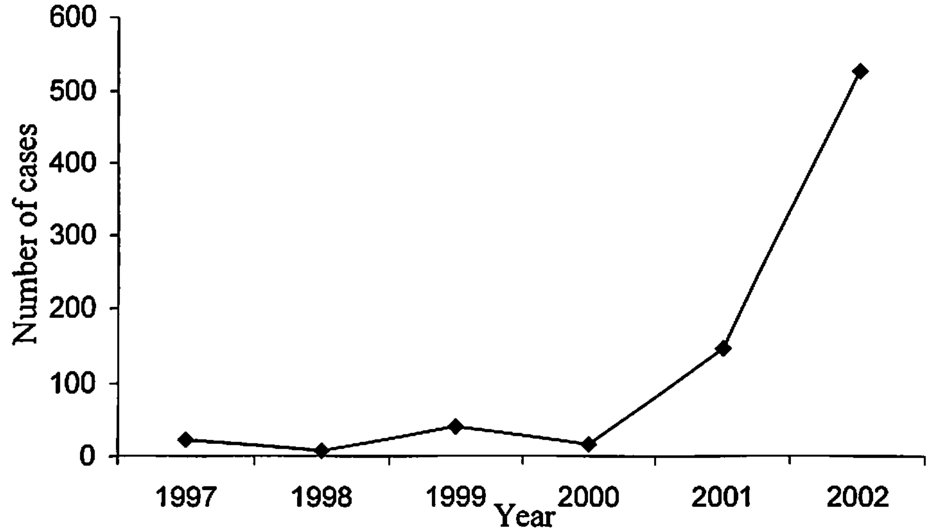

Fig. 3.2: Line chart showing the number of Pneumonia cases, 1997-2002

Chicken Pox was the tenth leading cause of attendance (194 cases) in 1997 and has since not appeared in the top ten causes of attendance, though the number of cases rose considerably in 1999 (244 cases), even higher than the 1997 value.

Hypertension, is on the increase in the catchment area. This is captured in Figure 3.3.

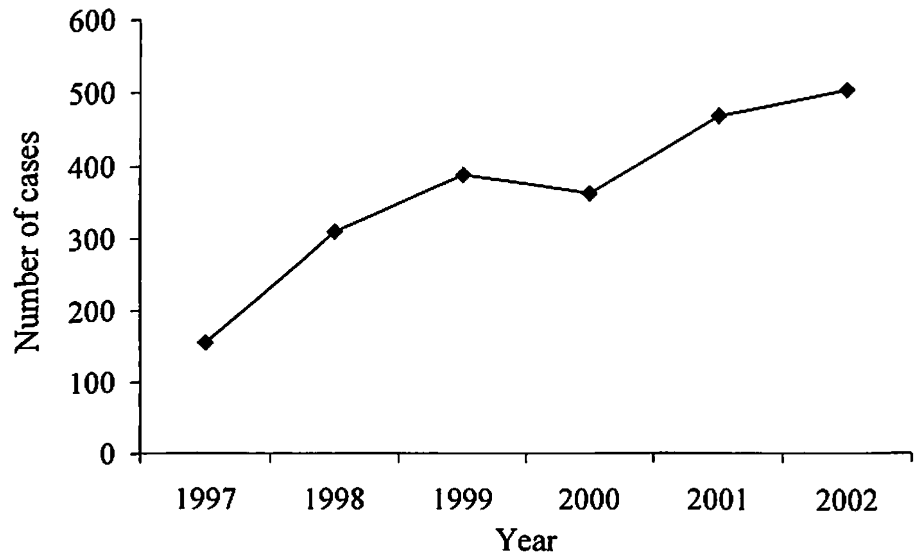

Fig 3.3: Line chart showing the number of cases of Hypertension, 1997-2001

The diseases accounting for little or no attendance in the six years under consideration are, in order of increasing numbers, Acute Poliomyelitis 0, Leprosy 0, Tetanus 4, Onchocerciasis 4, Cataract 5, Whooping Cough 6, Gonorrhoea 14, Meningitis 15, Yaws 20, Malnutrition 21, and Tuberculosis 46. Clearly Tuberculosis is the most prevalent of what has been branded as the 'Six Child killer Diseases' – Diphtheria, Poliomyelitis, Tetanus, Measles, Whooping Cough, and Tuberculosis – in the catchment area.

Using the ratio (expressed as percentage) of the total outpatient attendance as obtained from the Monthly Outpatient Morbidity Data to the estimated annual population for the catchment area, the rate of utilization of the Polyclinic for 1997, 1998, ..., 2002 are respectively 27.57, 25.80, 28.18, 22.37, 30.00 and 26.11, giving an average rate of utilization of 26.6. This means that on the average about 26.6% of the people of the catchment area has been using the Polyclinic over the last six years.

3.2 STATEMENT OF INPATIENTS (1997-2002)

Figure 3.4 is a pie chart drawn from the statement of in-patients presented in Appendix C. Barring any other (medical) interpretation of the data (on discharges and deaths) either solely or in conjunction with other parameters or medical benchmarks, one is tempted to infer from the pie chart that the proportion of deaths at the Polyclinic is 'low'. Indeed it accounts for less than one percent (0.52 %) of the number of discharges and deaths put together.

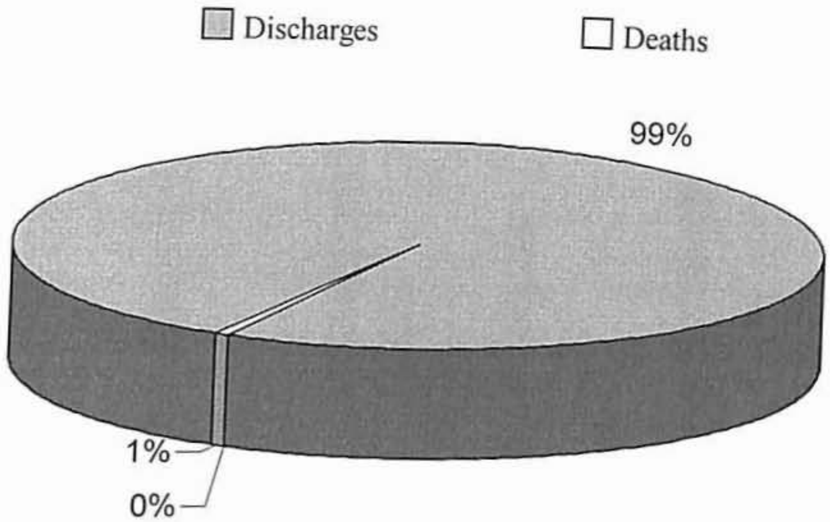

Fig. 3.4: Pie chart showing percentage of discharges and deaths for the cumulative data from 1997 to 2002

3.3 STATEMENT OF OUTPATIENTS (1997-2002)

Figure 3.5 presents a comparison of the proportion of each of the age groups reporting at the Polyclinic in the form of a compound bar chart. The proportion was found by dividing the number of people in the given age group as captured in the statement of the outpatients by its corresponding number in the population of the catchments area. While this approach might not be the best, it provides a comparatively better basis for comparing the various age groups than the raw data; more so when the range of the various age groups are unequal. It is clear from the chart that though the proportions of the various age groups who reported at the Polyclinic kept fluctuating from year to year, they occurred in decreasing order of magnitude as 0-4, 15-44, 45-59, ≥ 60, 5-14 in all the years except in 1997 when groups 0-4 and 5-14 swapped positions with groups 15-44 and ≥ 60 respectively.

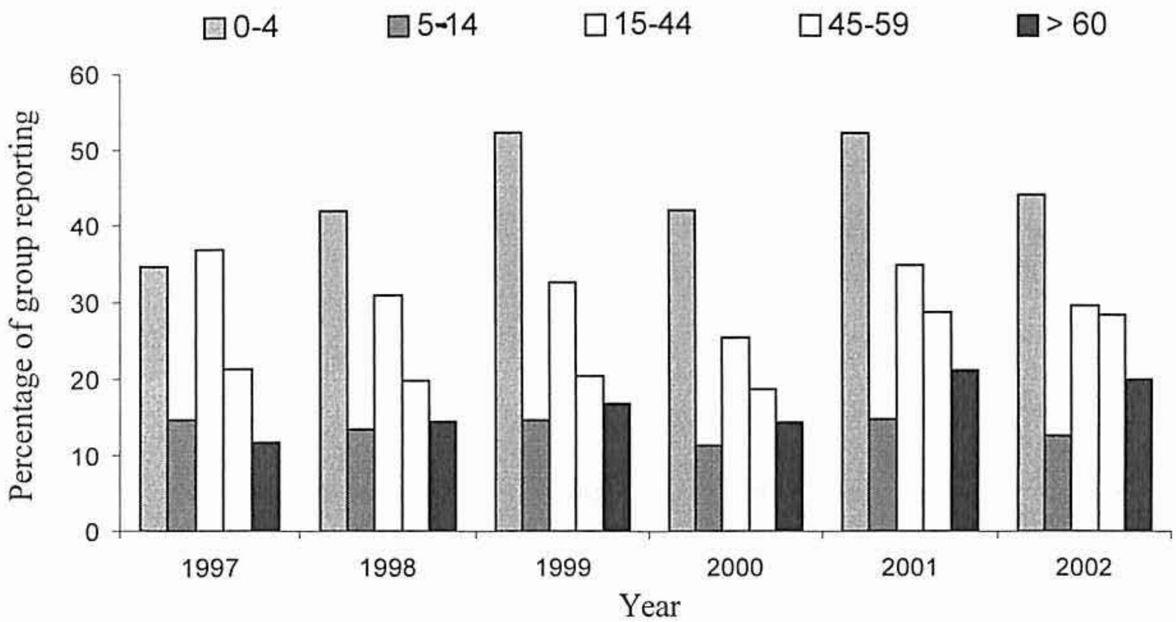

Fig. 3.5: Multiple bar chart showing percentage of each age group reporting at the Polyclinic, 1997-2002

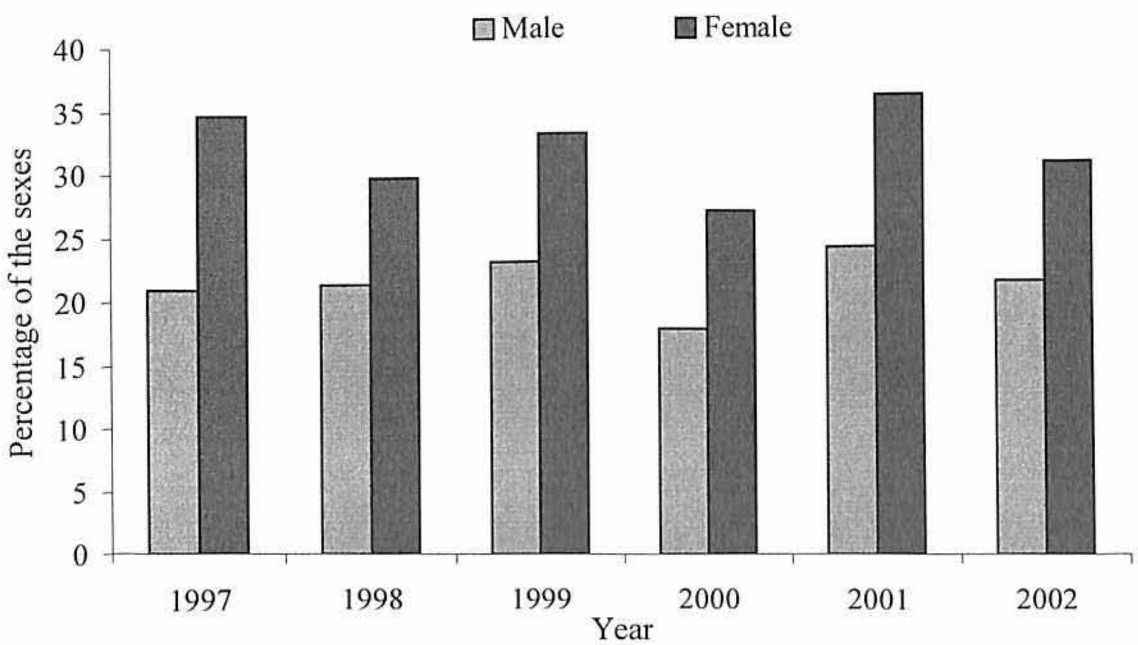

Fig. 3.6: Multiple bar chart showing percentage of the sexes reporting at the Polyclinic, 1997-2002

Examining the same data from the perspective of gender, we see from Figure 3.6 that the proportion of the females in the catchment area that reported for medical attention at the Polyclinic was higher than that of the males for all the years under consideration. Again the proportions for the two sexes kept fluctuating in the period under consideration.

3.4 MONTHLY BED STATE DATA (1997-2002)

Table 3.2 presents the composite figures of the inpatient statistics presented in Section 2.1 for the labour and gynaecology wards from 1997 to 2002. See Appendix C for the full data.

Table 3.2: Composite figures of inpatient statistics.

Inpatient statistic		Year					
		1997	1998	1999	2000	2001	2002
Death Rate	(DR)	0.8	1.0	0.6	0.1	0.1	0.4
Patient Days	(PD)	6925	5480	4662	3992	3755	3582
Average Daily Bed Occupancy	(ADO)	19.0	15.0	12.8	10.9	10.3	9.8
Occupancy %	(PO)	75.9	57.7	49.1	42.0	39.6	37.7
Average Length Of Stay	(ALS)	2.8	2.8	2.8	2.2	2.2	2.1
Turnover Per Bed	(TOPB)	100.1	76.4	64.1	70.1	66.3	65.5
Turnover Interval	(TOI)	.09	2.0	2.9	3.0	3.3	3.5

There is a general decreasing pattern in the values of PD, ADO, PO, ALS and TOPB while the values of DR appear to fluctuate. Also there is an increasing trend in the values of TOI.

CHAPTER FOUR

FURTHER ANALYSIS

4.1 PLANNING AND FORECASTING

Planning is central to all activities of an organisation and may necessitate obtaining future values of the variables needed in the planning. One would wish that there would be no diseases in the future, but that is utopian and therefore there is the need to project into the future to know how the disease conditions will be in the future, as this will place us in a good stead to manage diseases. To this end, time series may be used to obtain future estimates of the number of cases of the diseases and other variables.

4.2 SELECTING AND ASSESSING A MODEL

We compare the two models discussed in chapter two on the basis of forecast of the number of cases of malaria for 2003 using these models, the actual number of cases recorded and the measures of model adequacy discussed in Subsection 2.2.5. The values of statistics needed to do the comparison are given in Table 4.1. The computer printouts for models one and two are shown in Appendix B (including the actual and forecasted values of the number of malaria cases for 2003).

Table 4.1 Comparing Model 1 and Model 2 based on the accuracy measures.

		Model 1	Model 2
Fit	*MAPE*	16.48	16.20
	MAD	179.42	177.30
	MSD	50809.78	52220.60
	$\bar{R}^2$ %	52.47	51.15
Forecast	*MAPE*	36.57	36.11
	MAD	386.11	386.95
	MSD	206009.08	190999.83

Considering the fits, it could be seen from Table 4.1 that the respective *MAPE* and *MAD* values of 16.20 and 177.30 for Model 2 are less than the corresponding values of 16.48 and 179.42 for Model 1, hence it appears Model 2 is the better of the two models; but the respective *MSD* and $\overline{R}^2$ values of 50809.78 and 52.47 for Model 1 are respectively less than and higher than the corresponding values of 52220.60 and 51.15 for Model 2, indicating that in terms of these two statistics Model 1 is the better of the two. However the differences in these statistics are not dramatic and since the values of the aforementioned four statistics are not all decisively in favour of any one of the models, one is inclined to conclude that in terms of the fits the two models are comparable.

Examining the forecast values of *MAPE, MAD* and *MSD* for the two models, the respective *MAPE* and *MSD* values of 36.11 and 190999.83 for Model 2 are slightly lower than the corresponding values of 36.57 and 206009.08 for Model 1; but *MAD* value of 386.11 for Model 1 is lower than the corresponding value of 386.95 for model 2. Again the differences in the values of the statistics are small. However the fact that the values of *MAPE* and *MSD* for Model 2 is slightly lower than that of Model 1 makes it the favourable choice as a forecasting model.

We note that the forecasting accuracy of both models are inferior to the fitted accuracy, as the *MAPE, MAD* and *MSD* values of the fits are considerably lower than the corresponding values of the forecasts.

Turning to Model 2 as the model of choice, the mean error of − 338.89 indicates that there is some bias in the forecasted values, that is on the average a forecast value is 338.89 higher than the actual.

We would want to establish whether or not this bias is statistically significant. Hence we test the hypothesis (alternative, H_1) $\mu_{e_t} \neq 0$ against the hypothesis (null, H_o) $\mu_{e_t} = 0$.

That is

$$H_o\text{: } \mu_{e_t} = 0$$

$$H_1\text{: } \mu_{e_t} \neq 0$$

Taking a cue from Section 2.3, the mean error of -338.89 should lie out side the interval (−183.05, 183.05) if H_o: $\mu_{e_t} = 0$ is to be rejected. Since −338.89 lies outside the interval (−183.05, 183.05) we reject H_o, and conclude that there is consistent bias, namely Model 2 is overforecasting by an average of 338.89.

CHAPTER FIVE

DISCUSSION AND CONCLUSIONS

This chapter is the concluding chapter of this dissertation. The findings of chapters three and four are discussed and conclusions drawn from these discussions. It also raises a few issues, which may be the subject of further research.

In Section 3.1, we saw that 13 diseases, namely Malaria, Upper Respiratory Tract Infection (URTI), Skin Diseases and Ulcers, Accidents, Diarrhoeal Diseases, Intestinal Worms Infestation, Gynaecological Disorders, Diseases Of The Oral Cavity, Hypertension, Pregnancy And Related Complications, Mental Disorders, Pneumonia and Chicken Pox have been among the top ten causes of outpatient attendance at least once in the six years under consideration. The first seven of the aforementioned diseases appeared in the list of top ten causes of outpatient attendance in all the six years under consideration with malaria leading the pack, and accounting for 37.65% of the total outpatient attendance (new cases) in 1997; the least for malaria for all the years under consideration.

The seriousness of Malaria is underscored by the fact that the number of cases of URTI (being the second leading cause of outpatient attendance) could account for at most only 24.1.% of the corresponding number of Malaria cases comparing the annual number of cases of the two diseases (excluding 1997). However the dramatic rise in the number of cases of malaria in 2001 is believed to be unusual, possibly an agency might have provided the conducive environment for mosquitoes (the vector of malaria) to proliferate, leading to the dramatic rise in the number of cases of malaria. This line of thinking is all the more plausible when one considers the fact that a lot of pools of water – perfect condition for breeding of mosquitoes – resulted from the construction of the Takoradi – Agona Nkwanta section of the Trans-West Africa highway which runs through the catchment area between 2000 and 2002. Indeed much of the construction was undertaken in 2001. No wonder then, perhaps, that the number of cases of malaria dropped in a similar fashion when the road project was completed in 2002. The general trend in the data suggests that malaria cases will continue to rise in the years ahead.

The number of cases of Pneumonia in 2002 was more than two times the number of cases in all the preceding five years put together. The steepness of the plot of the number of cases for the last two years as captured in Figure 3.2 suggests the number of cases will continue to rise after 2002.

There is an upward trend in the number of cases of Hypertension, one of the 'Diseases Of Affluence'. Is it an indication that stress is on the increase in the catchment area or rather a change in the eating habits of the people of the catchment area? This is an issue that call for further investigation.

Among the 'Six Child Killer Diseases' tuberculosis is the most prevalent. Though the number of cases of 46 is small compared to the leading diseases such as malaria, its debilitating and opportunistic nature – its one of the diseases that capitalise on the weakened immune system of HIV/AIDS patients to kill them – makes the need to control and eradicate it urgent.

We also conclude from the analysis of the Monthly Outpatient Morbidity Data for the six years under consideration that the Polyclinic has an average annual utilization of 26.6%.

We saw from Figure 3.5 that apart from 1997 the proportion of patients from the age groups 0 – 4 years and 5 – 14 years were respectively the highest and the smallest in any given year within the six-year period under consideration. Also Figure 3.6 shows that the proportion of female patients was higher than that of the males in all the years under consideration. It follows that the age group 0 – 4 years and females are the subgroups in the catchment area that require the most medical attention while the age group 5 – 14 years require the least attention.

The patterns in the values of the inpatient statistics as captured in Table 3.2 appear to raise a number of questions. The increasing trend in the values of TOI means that the interval between when a patient is discharged and when another is admitted to occupy the same bed is increasing. Could this mean that the general health situation of women in the catchment area is improving or the people in the catchment area are turning to other health facilities, for which reason there is a let up in the demand rate (in terms of TOI)? Are programmes on the local electronic media that focus on women impacting positively on female health in the catchment area? This also calls for further investigation.

Granted that patients who are discharged have really been cured of the medical problems they brought to the Polyclinic the decreasing trend in the values of ALS appear to be an indication of the improving management efficiency at the Polyclinic. The increasing trend in the values of TOI and the decreasing trend in the values of ALS seem to be in line with the decreasing trend in the values of TOPB. Obviously if the length of stay is becoming shorter and it is taking longer to admit a patient to occupy the same bed a previous one has left, then the demand on the beds is expected to decrease.

The decreasing trend in the values of PO and ADO seem to be consistent with the decrease in ALS and appear to suggest that the need for extra capacity is not as pressing as it used to be or the need for extra capacity is decreasing.

The fluctuating values of DR suggest that the death rate is not stable. The interpretation of the significance of the number of deaths relative to the number of discharges for the period under consideration, as presented in Section 3.2 is a matter that is best left to people involved with health management.

The model of choice, Model 2, was found to be overforecasting by an average of 338.89. It is believed that the trend might have been unduly influenced by the unusually high number cases of malaria in 2001 leading to the forecasts for 2003 being higher than the actual values, and that it is only a matter of time that the differences between the forecasted values and the actual values will take on values which will render the mean error not significantly different from zero, all things being equal, and the model will prove useful. However overforecasting, in the context of the data used is not as serious as underforecasting which would have meant that the Polyclinic could run out of resources.

In picking a time series model to be used to get projected values of the number of cases of the diseases in the immediate future, the Polyclinic could employ the analysis carried out in chapter four to select any one of two models, whether both models are based on the same kind of trend, like linear-linear, quadratic-quadratic et cetera but differ in the approach used in the decomposition; or the two models are based on different kinds of trends, like linear-quadratic, linear-exponential et cetera but are based on the same approach of decomposition; or both are based on different trends and different procedures of decomposition.

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APPENDIX A

DEFINITION OF (SELECTED) DISEASES / TERMS AND THEIR CODE

Term/Disease	Code
Inpatients A term used in reference to patients who stay at the polyclinic while receiving medical attention.	
Outpatients A term used in reference to patients who stay at home but come to the polyclinic for medical attention.	
Morbidity In the context of this report it means disease or illness.	
Monthly Outpatient Morbidity Data It is a record of the number of cases of each of the diseases under discussion for every month of the year.	
Statement Of Outpatients It is a record of the number of outpatients grouped according to age, sex and whether or not the patient is new.	
Statement Of Inpatients It is a record of the number of admissions, deaths and discharges grouped according to age and sex.	
Monthly Bed State Data This is a record of the values of health descriptive measures presented in chapter two.	

Fever A medical condition in which a person has a temperature that is higher than usual.	
Infection The act or process of causing or getting a disease.	
Infestation Present in the body or organ of large numbers of foreign matter or organisms that cause damage to the body or organ.	
Diarrhoeal Diseases Diseases that results in waste matter being passed from the bowels more frequently than usual.	1
Typhoid Fever Serious infectious disease that causes fever, red spots on the chest and severe pain in the bowels, and sometimes death.	2
Tuberculosis An infectious disease that usually attacks and wastes the lungs. It can also attack virtually all parts of the body – brain, kidney, urinary organs, skin, breast, spinal chord and the bones. Severe coughing and swellings on the lungs and other parts of the body may accompany it.	3
Whooping Cough An infectious disease, especially of children, that makes them cough and have difficulty breathing.	4
Meningitis Serious disease that causes tissues enclosing the brain and the spinal chord to swell, causing severe headache, fever and sometimes death.	5

Tetanus A disease that causes the muscles, especially that of the jaws, to become stiff. It results in death in few days when not treated.	6
Acute Poliomyelitis An infectious disease that affects the central nervous system and can cause temporary or permanent paralysis.	7
Chicken Pox A disease, especially of children, that causes a slight fever and many spots on the skin.	8
Measles An infectious diseases, especially of children, that causes fever and small red spots that cover the whole body.	9
Infant Hepatitis A serious disease of the liver that affects children.	10
Mumps A disease, especially of children, that causes painful swellings in the neck and cheek.	11
Malaria	12
Gonorrhoea A sexually transmitted disease which causes a thick discharge from the sex organs.	13
Yaws A infectious skin disease which causes large red swellings.	14
Bilharzias (Shistosomiasis) A serious disease caused by some small worms that get into the blood which results in rash, abdominal pains, coughing, discomfort, fever and nausea. It may	15

also cause diarrhoea, weight loss, and may damage the liver, the spleen and the intestines.	
Intestinal Worms Infestation	16
Guinea Worm Disease in which a parasitic worm live under the skin and cause discomfort. It is contracted through contact with infected water bodies.	17
Malnutrition A poor health condition caused by a lack of food or a lack of right kind of food.	18
Anaemia A medical condition in which a person has too few red cells in the blood making the person look pale and feel weak.	19
Mental Disorders	20
Acute Eye Infection	21
Cataract A medial condition of the eye that causes a gradual loss of sight.	22
Ear Infection	23
Hypertension The condition of a person's blood pressure being higher that usual.	24
Other Heart Diseases	25
Upper Respiratory Tract Infections (URTI)	26
Pneumonia A serious illness affecting one or both lungs that makes breathing difficult.	27
Diseases Of The Oral Cavity	28
Gynaecological Disorders Disorders relating to female health especially of their reproductive system.	29
Pregnancy And Related Complications	30
Skin Diseases	31
Rheumatism A disease that makes the muscles and joints painful, stiff and swollen.	32

P.U.O. (Pyrexia of unknown nature) A term used in reference to diseases of unknown nature.	33
Accidents	34
Diabetes mellitus A medical condition caused by a lack of insulin (the chemical in the body that controls the level of sugar in the blood), which makes the patient produce a lot of urine, and feels thirsty. It may result in other secondary diseases such as ulcer.	35
Leprosy An infectious disease that causes painful white areas in the skin and can destroy nerves and flesh leading to the deformation of some body parts.	36
Enteric Fever A disease similar to typhoid fever.	37
Onchocerciasis Otherwise known as 'river blindness', this disease affects people when bitten by the Black Fly. It may lead to total blindness when not treated early.	38
Other Diseases This term is used in reference to diseases other than those mentioned in these definitions.	39
Total New Cases	40
Re-attendance	41
Grand Total	42
Referrals	43

Source: Oxford Advanced Learner's Dictionary.

APPENDIX B

COMPUTER PRINTOUTS

Trend Analysis Of y/s For Malaria, Model 1

Data	Malaria
Length	72.0000
NMissing	0

Fitted Trend Equation

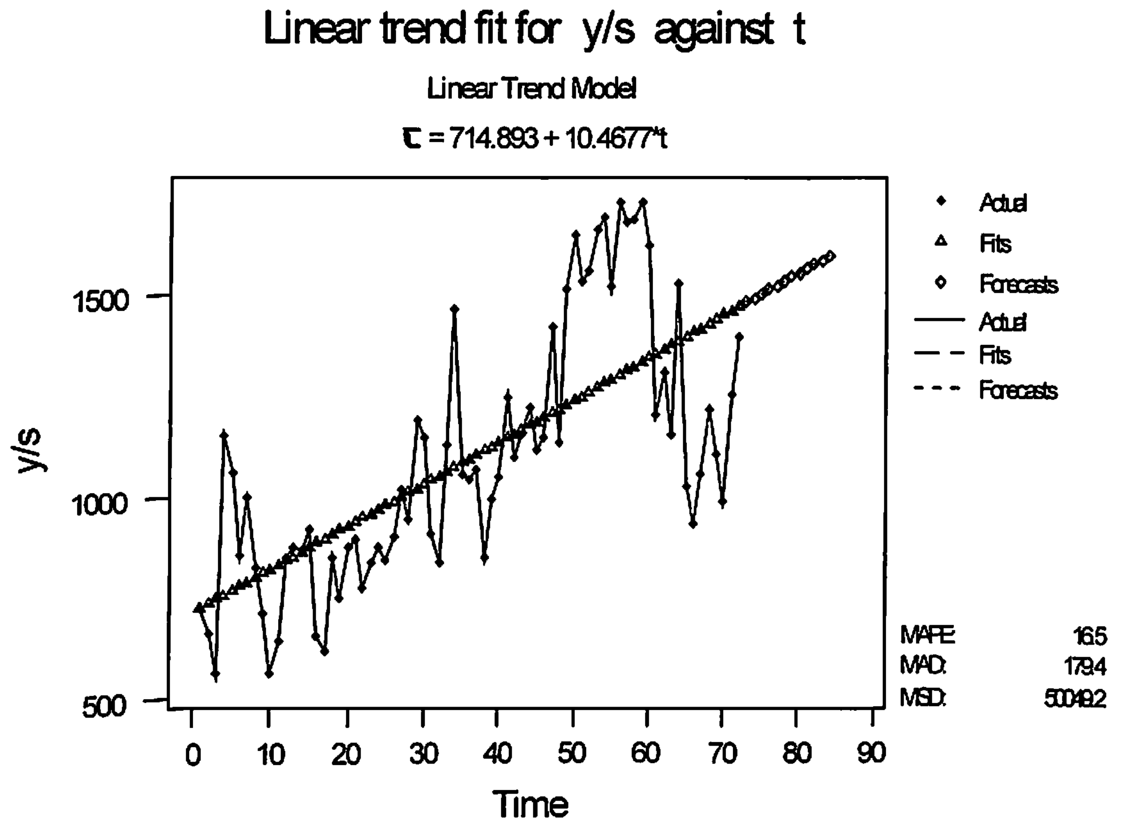
$\tau_t = 714.893 + 10.4677*t$

Accuracy Measures

MAPE:	16.4801
MAD:	179.378
MSD:	50049.2

Row	Period	Forecast
1	73	1479.03
2	74	1489.50
3	75	1499.97
4	76	1510.44
5	77	1520.90
6	78	1531.37
7	79	1541.84
8	80	1552.31
9	81	1562.77
10	82	1573.24
11	83	1583.71
12	84	1594.18

Graphical Display
Model 1



Fit (Model 1)

t	y	CMA	$s{\cdot}i$	s	i	y/s	τ	$\tau{\cdot}s$	$y-\tau{\cdot}s$
1	793	*	*	1.10004	*	720.88	725.36	797.93	-4.927
2	652	*	*	0.98317	*	663.16	735.83	723.44	-71.444
3	494	*	*	0.88295	*	559.49	746.3	658.94	-164.942
4	939	*	*	0.81498	*	1152.17	756.76	616.75	322.251
5	1042	*	*	0.98166	*	1061.46	767.23	753.16	288.837
6	822	*	*	0.95938	*	856.8	777.7	746.11	75.889
7	1248	806.83	1.54679	1.25142	1.23603	997.27	788.17	986.32	261.676
8	930	822.25	1.13104	1.13349	0.99784	820.47	798.63	905.25	24.755
9	699	843.75	0.82844	0.97885	0.84634	714.1	809.1	791.99	-92.994
10	596	839.96	0.70956	1.05873	0.6702	562.94	819.57	867.7	-271.703
11	594	805.04	0.73785	0.92447	0.79813	642.53	830.04	767.35	-173.347
12	789	786.58	1.00307	0.931	1.07741	847.47	840.51	782.51	6.488
13	961	773.17	1.24294	1.10004	1.1299	873.6	850.97	936.11	24.894
14	854	762.58	1.11988	0.98317	1.13905	868.62	861.44	846.94	7.058
15	808	772.17	1.04641	0.88295	1.18513	915.11	871.91	769.85	38.149
16	534	788.71	0.67706	0.81498	0.83076	655.23	882.38	719.12	-185.121
17	609	805.42	0.75613	0.98166	0.77025	620.38	892.84	876.47	-267.472
18	812	813.71	0.9979	0.95938	1.04015	846.38	903.31	866.62	-54.621
19	936	813.33	1.15082	1.25142	0.91961	747.95	913.78	1143.52	-207.517
20	988	813.13	1.21507	1.13349	1.07197	871.64	924.25	1047.63	-59.626
21	871	818.04	1.06474	0.97885	1.08774	889.82	934.71	914.95	-43.95
22	821	831.5	0.98737	1.05873	0.9326	775.46	945.18	1000.69	-179.692
23	770	864.54	0.89065	0.92447	0.96341	832.91	955.65	883.47	-113.472
24	812	899.88	0.90235	0.931	0.96922	872.18	966.12	899.46	-87.457
25	929	920.04	1.00974	1.10004	0.91791	844.51	976.59	1074.28	-145.284
26	881	926.58	0.9508	0.98317	0.96708	896.08	987.05	970.44	-89.44
27	899	934.5	0.96201	0.88295	1.08954	1018.18	997.52	880.76	18.24
28	766	974.46	0.78608	0.81498	0.96453	939.9	1007.99	821.49	-55.493
29	1170	1013.42	1.15451	0.98166	1.17608	1191.86	1018.46	999.78	170.22
30	1099	1028.54	1.0685	0.95938	1.11374	1145.53	1028.92	987.13	111.869
31	1133	1045.17	1.08404	1.25142	0.86625	905.37	1039.39	1300.71	-167.71
32	948	1053.21	0.90011	1.13349	0.7941	836.35	1049.86	1190.01	-242.006
33	1101	1050.25	1.04832	0.97885	1.07097	1124.78	1060.33	1037.91	63.094
34	1550	1053.04	1.47193	1.05873	1.39028	1464.02	1070.79	1133.68	416.319
35	976	1058.83	0.92177	0.92447	0.99708	1055.74	1081.26	999.6	-23.597
36	969	1059.04	0.91498	0.931	0.98279	1040.81	1091.73	1016.4	-47.402
37	1171	1070.21	1.09418	1.10004	0.99467	1064.51	1102.2	1212.46	-41.463
38	832	1101.5	0.75533	0.98317	0.76826	846.24	1112.67	1093.94	-261.938
39	877	1119.38	0.78347	0.88295	0.88734	993.26	1123.13	991.67	-114.669
40	855	1104.92	0.77381	0.81498	0.94949	1049.1	1133.6	923.86	-68.864
41	1220	1104.88	1.1042	0.98166	1.12482	1242.79	1144.07	1123.09	96.911
42	1054	1122.5	0.93898	0.95938	0.97873	1098.62	1154.54	1107.64	-53.641

t	y	CMA	s.i	s	i	y/s	τ	τ·s	y−τ·s
43	1446	1146.54	1.26118	1.25142	1.00781	1155.49	1165	1457.9	-11.903
44	1386	1199.67	1.15532	1.13349	1.01926	1222.77	1175.47	1332.39	53.614
45	1092	1252.08	0.87215	0.97885	0.89099	1115.59	1185.94	1160.86	-68.862
46	1212	1289	0.94026	1.05873	0.88811	1144.77	1196.41	1266.67	-54.671
47	1313	1323.17	0.99232	0.92447	1.07339	1420.27	1206.87	1115.72	197.278
48	1055	1363.71	0.77363	0.931	0.83096	1133.19	1217.34	1133.35	-78.347
49	1662	1406.21	1.1819	1.10004	1.07442	1510.85	1227.81	1350.64	311.359
50	1616	1448.88	1.11535	0.98317	1.13444	1643.66	1238.28	1217.44	398.564
51	1351	1495.38	0.90345	0.88295	1.02322	1530.1	1248.74	1102.58	248.422
52	1267	1541.83	0.82175	0.81498	1.0083	1554.64	1259.21	1026.24	240.764
53	1628	1577.29	1.03215	0.98166	1.05143	1658.41	1269.68	1246.4	381.602
54	1619	1608	1.00684	0.95938	1.04947	1687.54	1280.15	1228.15	390.849
55	1901	1612.67	1.17879	1.25142	0.94197	1519.08	1290.62	1615.1	285.904
56	1955	1584.54	1.2338	1.13349	1.08849	1724.76	1301.08	1474.77	480.234
57	1639	1556.67	1.05289	0.97885	1.07564	1674.41	1311.55	1283.82	355.182
58	1780	1541.75	1.15453	1.05873	1.09049	1681.26	1322.02	1399.66	380.34
59	1596	1514.83	1.05358	0.92447	1.13966	1726.39	1332.49	1231.85	364.153
60	1509	1458.54	1.0346	0.931	1.11127	1620.83	1342.95	1250.29	258.708
61	1320	1403.83	0.94028	1.10004	0.85477	1199.95	1353.42	1488.82	-168.82
62	1283	1355.33	0.94663	0.98317	0.96284	1304.96	1363.89	1340.93	-57.934
63	1015	1307.83	0.77609	0.88295	0.87898	1149.56	1374.36	1213.49	-198.488
64	1245	1253.63	0.99312	0.81498	1.21858	1527.64	1384.82	1128.61	116.393
65	1004	1204.54	0.83351	0.98166	0.84908	1022.75	1395.29	1369.71	-365.706
66	892	1177.54	0.75751	0.95938	0.78958	929.76	1405.76	1348.66	-456.661
67	1315	*	*	1.25142	*	1050.81	1416.23	1772.29	-457.289
68	1377	*	*	1.13349	*	1214.83	1426.7	1617.15	-240.146
69	1077	*	*	0.97885	*	1100.27	1437.16	1406.77	-329.774
70	1041	*	*	1.05873	*	983.25	1447.63	1532.65	-491.649
71	1157	*	*	0.92447	*	1251.52	1458.1	1347.97	-190.972
72	1300	*	*	0.931	*	1396.35	1468.57	1367.24	-67.237
Forecasts									
73	988	*	*	1.10004	*	*	1479.03	1627	-638.998
74	868	*	*	0.98317	*	*	1489.5	1464.43	-596.432
75	993	*	*	0.88295	*	*	1499.97	1324.4	-331.397
76	807	*	*	0.81498	*	*	1510.44	1230.98	-423.979
77	1277	*	*	0.98166	*	*	1520.9	1493.02	-216.015
78	1415	*	*	0.95938	*	*	1531.37	1469.17	-54.172
79	1019	*	*	1.25142	*	*	1541.84	1929.48	-910.482
80	1282	*	*	1.13349	*	*	1552.31	1759.53	-477.527
81	1264	*	*	0.97885	*	*	1562.78	1529.73	-265.73
82	1250	*	*	1.05873	*	*	1573.24	1665.64	-415.638
83	1419	*	*	0.92447	*	*	1583.71	1464.1	-45.097
84	1742	*	*	0.931	*	*	1594.18	1484.18	257.818

Time Series Decomposition For Malaria, Model 2

Data	Malaria
Length	72.0000
NMissing	0

Trend Line Equation

$\tau_t = 715.238 + 10.4109*t$

Seasonal Indices

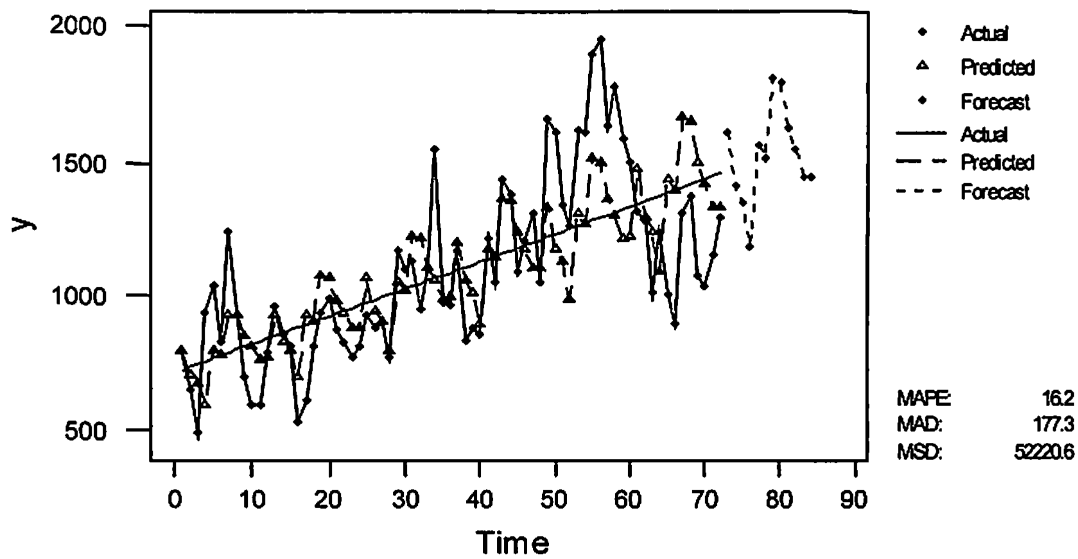
Period	Index
1	1.09469
2	0.954386
3	0.908253
4	0.790561
5	1.03643
6	0.998676
7	1.18087
8	1.16174
9	1.04940
10	0.990074
11	0.920538
12	0.914385

Accuracy of Model

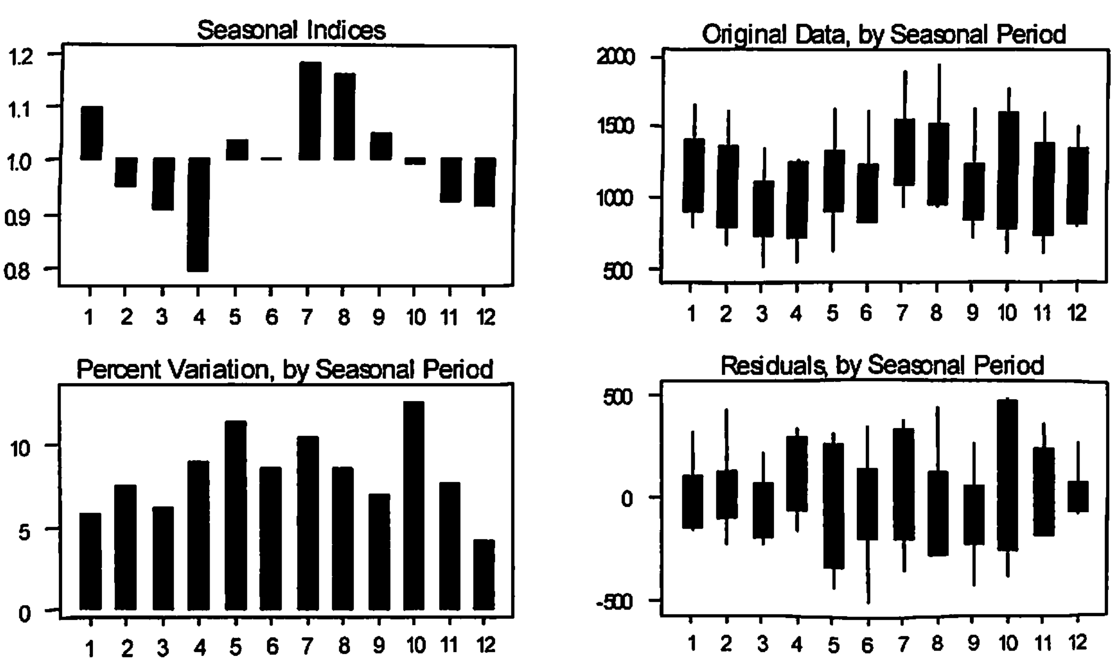
MAPE:	16.2
MAD:	177.3
MSD:	52220.6

Graphical Displays
Model 2

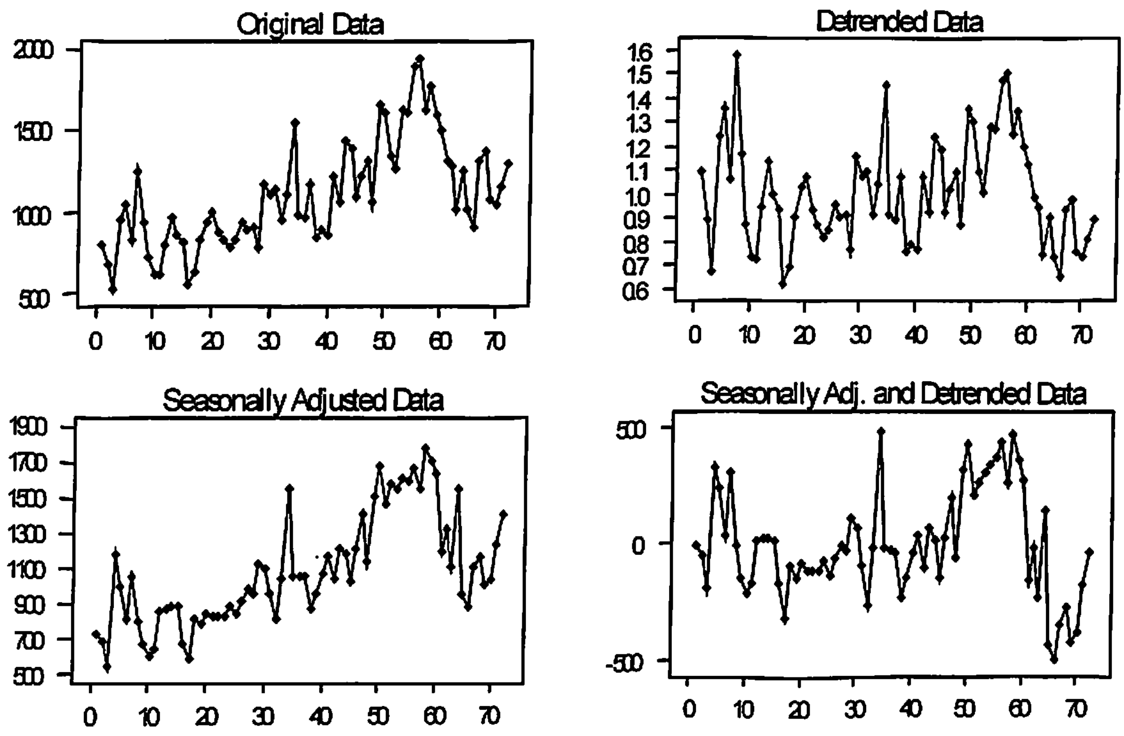
Linear trend fit for y (the number of Malaria cases) against time



Seasonal analysis for y, the number of Malaria cases



Component analysis for y, the number of Malaria cases



Fit (Model 2)

t	*y*	*τ*	*s*	*τ·s*	*y-τs*
1	793	725.65	1.09469	794.36	-1.361
2	652	736.06	0.95439	702.48	-50.485
3	494	746.47	0.90825	677.98	-183.984
4	939	756.88	0.79056	598.36	340.639
5	1042	767.29	1.03643	795.25	246.753
6	822	777.7	0.99868	776.67	45.326
7	1248	788.11	1.18087	930.66	317.343
8	930	798.53	1.16174	927.68	2.319
9	699	808.94	1.0494	848.89	-149.894
10	596	819.35	0.99007	811.21	-215.214
11	594	829.76	0.92054	763.82	-169.824
12	789	840.17	0.91438	768.24	20.763
13	961	850.58	1.09469	931.12	29.879
14	854	860.99	0.95439	821.72	32.283
15	808	871.4	0.90825	791.45	16.547
16	534	881.81	0.79056	697.13	-163.126
17	609	892.22	1.03643	924.73	-315.729
18	812	902.63	0.99868	901.44	-89.439
19	936	913.05	1.18087	1078.18	-142.184
20	988	923.46	1.16174	1072.82	-84.819
21	871	933.87	1.0494	980	-108.996
22	821	944.28	0.99007	934.91	-113.905
23	770	954.69	0.92054	878.83	-108.828
24	812	965.1	0.91438	882.47	-70.472
25	929	975.51	1.09469	1067.88	-138.882
26	881	985.92	0.95439	940.95	-59.949
27	899	996.33	0.90825	904.92	-5.922
28	766	1006.74	0.79056	795.89	-29.892
29	1170	1017.15	1.03643	1054.21	115.788
30	1099	1027.57	0.99868	1026.2	72.795
31	1133	1037.98	1.18087	1225.71	-92.71
32	948	1048.39	1.16174	1217.96	-269.956
33	1101	1058.8	1.0494	1111.1	-10.098
34	1550	1069.21	0.99007	1058.6	491.404
35	976	1079.62	0.92054	993.83	-17.831
36	969	1090.03	0.91438	996.71	-27.707
37	1171	1100.44	1.09469	1204.64	-33.643
38	832	1110.85	0.95439	1060.18	-228.182
39	877	1121.26	0.90825	1018.39	-141.391
40	855	1131.67	0.79056	894.66	-39.657
41	1220	1142.09	1.03643	1183.69	36.306
42	1054	1152.5	0.99868	1150.97	-96.971

t	y	τ	s	$\tau \cdot s$	$y-\tau \cdot s$
43	1446	1162.91	1.18087	1373.24	72.763
44	1386	1173.32	1.16174	1363.09	22.906
45	1092	1183.73	1.0494	1242.2	-150.2
46	1212	1194.14	0.99007	1182.29	29.713
47	1313	1204.55	0.92054	1108.84	204.165
48	1055	1214.96	0.91438	1110.94	-55.942
49	1662	1225.37	1.09469	1341.4	320.597
50	1616	1235.78	0.95439	1179.41	436.586
51	1351	1246.19	0.90825	1131.86	219.14
52	1267	1256.61	0.79056	993.42	273.577
53	1628	1267.02	1.03643	1313.18	314.823
54	1619	1277.43	0.99868	1275.74	343.264
55	1901	1287.84	1.18087	1520.76	380.237
56	1955	1298.25	1.16174	1508.23	446.769
57	1639	1308.66	1.0494	1373.3	265.698
58	1780	1319.07	0.99007	1305.98	474.022
59	1596	1329.48	0.92054	1223.84	372.161
60	1509	1339.89	0.91438	1225.18	283.823
61	1320	1350.3	1.09469	1478.16	-158.164
62	1283	1360.71	0.95439	1298.65	-15.646
63	1015	1371.13	0.90825	1245.33	-230.328
64	1245	1381.54	0.79056	1092.19	152.812
65	1004	1391.95	1.03643	1442.66	-438.659
66	892	1402.36	0.99868	1400.5	-508.502
67	1315	1412.77	1.18087	1668.29	-353.29
68	1377	1423.18	1.16174	1653.37	-276.369
69	1077	1433.59	1.0494	1504.4	-427.404
70	1041	1444	0.99007	1429.67	-388.669
71	1157	1454.41	0.92054	1338.84	-181.842
72	1300	1464.82	0.91438	1339.41	-39.412
Forecasts					
73	988	1475.23	1.09469	1614.92	-626.925
74	868	1485.64	0.95439	1417.88	-549.879
75	993	1496.05	0.90825	1358.8	-365.797
76	807	1506.47	0.79056	1190.95	-383.954
77	1277	1516.88	1.03643	1572.14	-295.142
78	1415	1527.29	0.99868	1525.27	-110.267
79	1019	1537.7	1.18087	1815.82	-796.817
80	1282	1548.11	1.16174	1798.51	-516.507
81	1264	1558.52	1.0494	1635.51	-371.506
82	1250	1568.93	0.99007	1553.36	-303.36
83	1419	1579.34	0.92054	1453.85	-34.846
84	1742	1589.75	0.91438	1453.65	288.353

APPENDIX C

TOP TEN CAUSES OF OUTPATIENT ATTENDACE (NEW CASES) 1997 – 2002

1997

Rank	Disease	Number Of Cases	Percentage
1	Malaria	9598	37.65
2	Diseases Of The Oral Cavity	2378	9.33
3	Upper Respiratory Tract Infection	2295	9.00
4	Skin Diseases And Ulcers	2041	8.01
5	Accidents (all kinds)	1102	4.32
6	Diarrhoeal Diseases	893	3.50
7	Intestinal Worms Infestation	806	3.16
8	Gynaecological Disorders	667	2.62
9	Pregnancy And Related Complications	446	1.75
10	Chicken Pox	194	0.76

1998

Rank	Disease	Number Of Cases	Percentage
1	Malaria	9776	41.81
2	Upper Respiratory Tract Infection	2275	9.73
3	Skin Diseases And Ulcers	1928	8.25
4	Diseases Of The Oral Cavity	1800	7.70
5	Diarrhoeal Diseases	1310	5.60
6	Accidents (all kinds)	1086	4.64
7	Intestinal Worms Infestation	718	3.07
8	Gynaecological Disorders	469	2.01
9	Hypertension	306	1.31
10	Pregnancy And Related Complications	267	1.14

1999

Rank	Disease	Number Of Cases	Percentage
1	Malaria	12421	43.88
2	Upper Respiratory Tract Infection	2999	10.60
3	Skin Diseases And Ulcers	1857	5.08
4	Accidents (all kinds)	1439	6.56
5	Diseases Of The Oral Cavity	1117	3.95
6	Gynaecological Disorders	893	3.15
7	Diarrhoeal Diseases	829	2.93
8	Intestinal Worms Infestation	578	2.04
9	Mental Disorders	402	1.42
10	Hypertension	381	1.35

2000

Rank	Disease	Number Of Cases	Percentage
1	Malaria	13513	59.10
2	Upper Respiratory Tract Infection	1518	6.64
3	Skin Diseases And Ulcers	1228	5.37
4	Accidents (all kinds)	656	2.87
5	Diarrhoeal Diseases	582	2.55
6	Gynaecological Disorders	488	2.13
7	Hypertension	354	1.55
8	Pregnancy And Related Complications	330	1.44
9	Intestinal Worms Infestation	306	1.34
10	Mental Disorders	155	0.68

2001

Rank	Disease	Number Of Cases	Percentage
1	Malaria	19523	61.20
2	Upper Respiratory Tract Infection	1942	6.09
3	Intestinal Worms Infestation	1426	4.47
4	Diseases Of The Oral Cavity	1261	3.95
5	Diarrhoeal Diseases	971	3.04
6	Skin Diseases And Ulcers	717	2.25
7	Accidents (all kinds)	661	2.07
8	Gynaecological Disorders	630	1.97
9	Hypertension	464	1.45
10	Pregnancy And Related Complications	284	0.89

2002

Rank	Disease	Number Of Cases	Percentage
1	Malaria	14026	52.54
2	Upper Respiratory Tract Infection	1667	6.24
3	Diseases Of The Oral Cavity	1553	5.82
4	Skin Diseases And Ulcers	1359	5.09
5	Intestinal Worms Infestation	1261	4.72
6	Hypertension	597	2.24
7	Diarrhoeal Diseases	553	2.07
8	Pneumonia	529	1.98
9	Gynaecological Disorders	497	1.86
10	Accidents (all kinds)	461	1.73

PROPORTION OF THE AGE GROUPS IN THE STATEMENT OF OUTPATIENTS RELATIVE TO THAT IN THE POPULATION OF CATCHMENT AREA
1997 – 2002

1997

Age Group	Number Of Patients	Population In 1997	Proportion (%)
0 – 4	4584	13256.15726	34.58
5 – 14	4069	27482.27726	14.81
15 – 44	18408	50222.51452	36.65
45 – 59	2117	9915.17454	21.35
≥ 60	833	7112.059996	11.71

1998

Age Group	Number Of Patients	Population In 1998	Proportion (%)
0 – 4	5670	13585.20299	41.74
5 – 14	3777	28164.44522	13.41
15 – 44	15788	51469.14304	30.67
45 – 59	2013	10161.29004	19.81
≥ 60	1059	7289.621117	14.53

1999

Age Group	Number Of Patients	Population In 1999	Proportion (%)
0 – 4	7245	13922.41632	52.04
5 – 14	4222	28863.54603	14.63
15 – 44	16996	52746.7155	32.22
45 – 59	2113	10413.51465	20.29
≥ 60	1250	7470.564856	16.73

2000

Age Group	Number Of Patients	Population In 2000	Proportion (%)
0 – 4	5948	14268.0000	41.69
5 – 14	3362	29580.0000	11.37
15 – 44	13605	54056.0000	25.17
45 – 59	1984	10672.0000	18.59
≥ 60	1091	7656.0000	14.25

2001

Age Group	Number Of Patients	Population In 2001	Proportion (%)
0 - 4	7602	14622.1618	51.99
5 - 14	4473	30314.23787	14.76
15 - 44	19136	55397.78372	34.52
45 - 59	3112	10936.90151	28.45
≥ 60	1647	7846.038037	20.99

2002

Age Group	Number Of Patients	Population In 2002	Proportion (%)
0 - 4	6559	14985.11462	43.77
5 - 14	3919	31066.70105	12.61
15 - 44	16647	56772.87329	29.32
45 - 59	3159	11208.37842	28.18
≥ 60	1597	8040.793213	19.86

PROPORTION OF THE SEXES IN THE STATEMENT OF OUTPATIENTS RELATIVE TO THAT IN THE POPULATION OF CATCHMENT AREA 1997 – 2002

1997

Gender	Number Of Patients	Population In 1997	Proportion (%)
Male	11260	53671.27088	20.99
Female	18751	54102.36542	34.66

1998

Gender	Number Of Patients	Population In 1997	Proportion (%)
Male	11774	55003.50479	21.41
Female	16533	55445.30001	29.82

1999

Gender	Number Of Patients	Population In 1997	Proportion (%)
Male	12970	56368.80755	23.01
Female	18856	56821.56905	33.18

2000

Gender	Number Of Patients	Population In 1997	Proportion (%)
Male	10259	57768.00000	17.76
Female	15731	58232.00000	27.01

2001

Gender	Number Of Patients	Population In 1997	Proportion (%)
Male	14319	59201.92337	24.19
Female	21651	59677.44083	36.28

2002

Gender	Number Of Patients	Population In 1997	Proportion (%)
Male	12973	60671.43970	21.38
Female	18906	61158.76050	30.91

STATEMENT OF INPATIENTS
1997 – 2002

1997

Age Groups	Admissions		Discharges		Death	
	Male	Female	Male	Female	Male	Female
Under 1 year						
1 - 4						
5-14						
15-44		2516		2463		20
45-49						
≥ 60						
Total (All Ages)		2516		2463		20

1998

Age Groups	Admissions		Discharges		Death	
	Male	Female	Male	Female	Male	Female
Under 1 year						
1 - 4						
5-14						
15-44		1975		1967		20
45-49						
≥ 60						
Total (All Ages)		1975		1967		20

1999

Age Groups	Admissions		Discharges		Death	
	Male	Female	Male	Female	Male	Female
Under 1 year						
1 - 4						
5-14						
15-44		1670		1657		10
45-49						
≥ 60						
Total (All Ages)		1670		1657		10

2000

Age Groups	Admissions		Discharges		Death	
	Male	Female	Male	Female	Male	Female
Under 1 year						
1 - 4						
5-14						
15-44		1842		1838		1
45-49						
≥ 60						
Total (All Ages)		1842		1838		1

2001

Age Groups	Admissions		Discharges		Death	
	Male	Female	Male	Female	Male	Female
Under 1 year						
1 - 4						
5-14						
15-44		1711		1723		2
45-49						
≥ 60						
Total (All Ages)		1711		1723		2

2002

Age Groups	Admissions		Discharges		Death	
	Male	Female	Male	Female	Male	Female
Under 1 year						
1 - 4						
5-14						
15-44		1702		1695		6
45-49						
≥ 60						
Total (All Ages)		1702		1695		6

STATEMENT OF OUTPATIENTS
1997 – 2002

1997

Age Groups	New		Old		Total	
	Male	Female	Male	Female	Male	Female
Under 1 year	765	764	23	16	788	780
1 - 4	1445	1438	63	70	1508	1508
5-14	1884	1804	192	189	2076	1993
15-44	4964	9826	807	2811	5771	12637
45-49	680	1108	122	207	802	1315
≥ 60	280	437	35	81	315	518
Total (All Ages)	10018	15377	1242	3374	11260	18751

1998

Age Groups	New		Old		Total	
	Male	Female	Male	Female	Male	Female
Under 1 year	1022	865	173	133	1195	998
1 - 4	1539	1430	272	236	1811	1666
5-14	1508	1616	353	300	1861	1916
15-44	4406	8108	1193	2081	5599	10189
45-49	698	783	210	322	908	1105
≥ 60	314	480	86	179	400	659
Total (All Ages)	9487	13282	2287	3251	11774	16533

1999

Age Groups	New		Old		Total	
	Male	Female	Male	Female	Male	Female
Under 1 year	1242	1238	61	55	1303	1293
1 - 4	2306	2093	142	108	2448	2201
5-14	1979	1939	181	123	2160	2062
15-44	4949	9778	818	1451	5767	11229
45-49	697	1015	138	263	835	1278
≥ 60	375	623	82	170	457	793
Total (All Ages)	11548	16686	1422	2170	12970	18856

2000

Age Groups	New		Old		Total	
	Male	Female	Male	Female	Male	Female
Under 1 year	1238	1066	17	22	1255	1088
1 - 4	1816	1639	78	72	1894	1711
5-14	1540	1530	187	105	1727	1635
15-44	3579	7880	782	1364	4361	9244
45-49	601	1092	62	223	663	1321
≥ 60	328	595	31	137	359	732
Total (All Ages)	9102	13808	1157	1923	10259	15731

2001

Age Groups	New		Old		Total	
	Male	Female	Male	Female	Male	Female
Under 1 year	1306	1220	37	20	1343	1240
1 - 4	2567	2296	87	69	2654	2365
5-14	2103	2069	187	114	2290	2183
15-44	5444	10761	929	2002	6373	12763
45-49	970	1626	130	386	1100	2012
≥ 60	509	883	50	205	559	1088
Total (All Ages)	12899	18855	1420	2796	14319	21651

2002

Age Groups	New		Old		Total	
	Male	Female	Male	Female	Male	Female
Under 1 year	1160	1019	31	25	1171	1044
1 - 4	2096	1903	204	121	2300	2024
5-14	1682	1751	294	192	1976	1943
15-44	4762	8730	1138	2017	5900	10747
45-49	883	1577	215	482	1098	2059
≥ 60	386	829	122	260	508	1089
Total (All Ages)	10969	15809	2004	3097	12973	18906

MONTHLY BED STATE DATA
1997 – 2002

1997

Inpatient Statistic	Ward		Composite
	Labour	Gynaecology	
Bed Complement	10	15	25
Admissions	1754	762	2516
Discharges	1748	749	2497
Deaths	8	13	21
Death Rate	0.5	1.7	0.08
Patient Days	2562	4363	6925
Average Daily Bed Occupancy	7.0	11.9	19.0
Occupancy (%)	70.2	79.5	7509
Average Length Of Stay	1.5	5.7	2.8
Turnover Per Bed	175.6	50.8	100.7
Turnover Interval	0.6	1.5	0.9

1998

Inpatient Statistic	Ward		Composite
	Labour	Gynaecology	
Bed Complement	16	10	26
Admissions	1586	389	1975
Discharges	1574	392	1966
Deaths	17	3	20
Death Rate	1.1	0.8	1.0
Patient Days	4302	1178	5480
Average Daily Bed Occupancy	11.8	3.2	15.0
Occupancy (%)	73.7	32.3	57.7
Average Length Of Stay	2.7	3.0	2.8
Turnover Per Bed	99.4	39.5	76.3
Turnover Interval	1.0	6. 3	2.0

1999

Inpatient Statistic	Ward		Composite
	Labour	Gynaecology	
Bed Complement	-	-	26
Admissions	-	-	1670
Discharges	-	-	1657
Deaths	-	-	10
Death Rate	-	-	0.6
Patient Days	-	-	4662
Average Daily Bed Occupancy	-	-	12.8
Occupancy	-	-	49.1
Average Length Of Stay	-	-	2.8
Turnover Per Bed	-	-	64.1
Turnover Interval	-	-	2.9

2000

Inpatient Statistic	Ward		Composite
	Labour	Gynaecology	
Bed Complement	10	16	26
Admissions	1353	489	1842
Discharges	1353	485	1838
Deaths	0	1	1
Death Rate	0	0.2	0.1
Patient Days	1492	2500	3992
Average Daily Bed Occupancy	4.1	6.8	10.9
Occupancy	40.8	42.7	42.0
Average Length Of Stay	1.1	5.1	2.2
Turnover Per Bed	135.3	30.4	70.7
Turnover Interval	1.6	6.9	3.0

2001

Inpatient Statistic	Ward		Composite
	Labour	Gynaecology	
Bed Complement	10	16	26
Admissions	1201	510	1711
Discharges	1190	533	1723
Deaths	0	2	2
Death Rate	0	0.4	0.1
Patient Days	1251	2504	3755
Average Daily Bed Occupancy	3.4	6.9	10.3
Occupancy	34.3	42.9	39.6
Average Length Of Stay	1.1	4.7	2.2
Turnover Per Bed	119.0	38.4	66.6
Turnover Interval	2.0	6.2	3.3

2002

Inpatient statistic	Ward		Composite
	Labour	Gynaecology	
Bed Complement	10	16	26
Admissions	1248	454	1702
Discharges	1246	450	1696
Deaths	1	5	6
Death Rate	0.08	1.10	0.4
Patient Days	1234	2348	3582
Average Daily Bed Occupancy	3.4	6.4	9.8
Occupancy	33.8	40.2	37.7
Average Length Of Stay	1.0	5.2	2.1
Turnover Per Bed	124.7	28.4	65.5
Turnover Interval	1.9	7.7	3.5

MONTHLY OUTPATIENT MORBIDITY DATA

DISEASES(CODE)

YEAR MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
1997 JAN	59	0	0	1	0	0	0	14	7	2	0	793	0	0	3	79	0	0	6	14	11	0	0	0	0	159	4	193	49	29	214	11	0	114	0	0	3	0	200	1965	342	2307	0
FEB	65	0	0	1	0	0	0	15	5	5	0	652	0	1	0	75	0	0	4	12	7	0	3	10	0	194	1	135	47	28	156	13	1	70	0	0	1	0	190	1691	300	1991	0
MAR	69	0	1	0	1	0	0	10	10	0	3	494	0	1	6	49	0	1	4	12	3	1	1	4	1	150	3	42	61	51	177	4	0	72	0	0	4	0	225	1460	346	1806	0
APR	114	2	1	0	1	0	0	15	8	2	0	939	2	0	7	37	0	2	8	17	9	0	3	14	0	150	2	112	54	42	199	18	0	91	0	0	2	0	306	2157	380	2537	0
MAY	62	6	0	0	0	0	0	9	5	2	0	1042	1	0	5	60	0	0	6	7	4	0	3	11	0	204	4	201	85	37	74	3	0	97	0	0	0	0	406	2334	332	2666	0
JUN	62	1	0	0	0	2	0	4	3	0	0	822	0	1	6	47	0	1	10	6	8	0	3	5	0	190	1	144	75	46	163	6	0	52	0	0	0	0	318	1976	377	2353	0
JUL	76	5	2	0	0	0	0	22	6	1	0	1248	1	0	4	63	1	0	10	17	3	2	3	17	0	255	3	178	94	35	76	11	0	95	0	0	0	0	311	2539	501	3040	0
AUG	63	6	0	0	0	0	0	32	6	2	0	930	0	1	7	41	0	0	5	14	4	0	2	17	5	198	4	259	66	28	203	11	0	99	0	0	0	1	353	2357	435	2792	0
SEP	71	9	1	0	0	0	0	38	9	1	0	699	2	0	4	50	0	0	5	0	4	0	0	16	0	132	0	239	42	46	249	10	0	100	0	0	0	0	418	2145	410	2555	0
OCT	85	0	1	0	0	0	0	19	6	1	0	596	0	1	2	71	0	0	3	20	7	0	1	23	2	171	0	357	33	43	161	1	0	131	0	0	5	0	601	2341	278	2619	0
NOV	67	3	0	0	1	0	0	6	5	5	2	594	0	2	0	103	0	0	1	13	2	0	0	17	0	196	1	234	35	38	171	2	0	83	0	0	0	0	440	2021	222	2243	0
DEC	100	0	1	0	0	0	0	10	5	2	0	789	0	0	1	131	0	1	2	16	2	0	0	21	1	296	0	284	26	23	198	6	0	98	0	0	0	0	496	2509	301	2810	0
TOTAL	893	32	7	2	3	2	0	194	75	23	5	9598	6	7	45	806	1	5	64	148	64	3	19	155	9	2295	23	2378	667	446	2041	96	1	1102	0	0	15	1	4264	25495	4224	29719	0
1998 JAN	127	1	1	0	0	0	0	19	7	1	0	961	1	0	1	96	0	0	6	21	3	0	2	32	0	239	0	175	49	38	189	2	4	110	0	0	0	0	404	2489	291	2780	3
FEB	161	0	0	0	0	0	0	10	6	0	0	854	0	0	1	117	0	0	1	12	4	0	2	33	1	202	0	175	35	4	162	5	0	97	0	0	1	0	180	2063	289	2352	0
MAR	146	0	0	0	0	0	0	10	14	0	0	808	0	0	0	68	0	1	0	7	5	0	0	46	12	140	0	178	42	8	238	5	0	118	0	0	0	0	158	2004	287	2291	7
APR	118	0	0	0	0	0	0	3	10	1	0	534	0	0	1	62	0	0	1	13	1	0	1	31	4	118	0	125	27	5	178	0	0	69	0	0	0	0	225	1527	301	1828	5
MAY	79	0	0	0	0	0	0	1	7	2	0	609	0	0	2	43	0	0	0	11	0	0	0	16	0	92	1	114	38	5	189	0	0	88	0	0	0	0	224	1521	823	2344	8
JUN	91	0	0	0	0	0	0	5	6	0	0	812	0	1	0	54	0	1	0	21	0	0	0	15	2	112	1	144	29	5	140	0	0	78	0	0	0	0	237	1754	900	2654	2
JUL	100	4	0	0	0	0	0	11	4	2	0	936	0	0	1	43	0	0	1	91	2	0	1	18	3	168	1	150	56	28	121	3	3	72	0	0	4	0	251	2074	561	2635	6
AUG	81	0	4	0	1	0	0	14	5	3	0	988	0	1	1	49	0	0	4	10	0	0	1	42	6	245	2	121	40	38	161	3	0	93	0	0	0	0	234	2147	383	2530	4
SEP	78	3	0	0	0	0	0	15	2	0	0	871	0	1	1	43	0	0	0	17	1	0	0	36	1	159	0	142	59	50	171	1	2	74	0	0	0	0	223	1950	272	2222	3
OCT	154	4	0	0	0	0	0	31	1	2	0	821	0	0	2	51	0	0	2	19	1	0	0	17	3	195	0	156	42	38	138	0	0	83	0	0	0	0	217	1977	345	2322	1
NOV	153	1	2	0	0	0	0	15	0	0	0	770	0	0	1	47	0	0	0	15	11	0	5	8	0	313	2	177	23	29	127	1	0	82	0	0	0	0	229	2011	183	2194	7
DEC	22	0	1	0	0	0	0	24	4	0	0	812	0	0	0	45	0	0	3	17	4	0	3	12	3	292	0	143	29	19	114	2	0	122	0	0	2	0	193	1866	479	2345	5
TOTAL	1310	13	8	0	1	0	0	158	66	11	0	9776	1	3	11	718	0	2	18	254	32	0	15	306	35	2275	7	1800	469	267	1928	22	9	1086	0	0	7	0	2775	23383	5114	28497	51
1999 JAN	32	5	1	0	0	0	0	10	4	5	0	929	0	0	5	52	0	0	8	60	9	0	2	21	1	314	6	163	36	34	143	5	0	83	0	0	0	0	332	2260	191	2451	1
FEB	1	1	1	0	1	0	0	14	8	1	1	881	0	1	1	53	0	0	7	150	6	0	3	24	0	243	0	184	46	29	137	3	1	52	0	0	0	0	244	2093	112	2205	1
MAR	58	0	0	0	0	0	0	14	11	0	0	899	0	0	0	61	0	0	6	56	3	0	0	37	0	208	0	147	81	14	200	8	0	116	1	0	0	0	349	2269	238	2507	1
APR	65	0	1	0	0	1	0	17	21	0	1	766	0	0	3	47	0	1	4	5	3	0	1	34	1	140	0	141	73	5	153	10	1	112	1	0	2	0	345	1954	276	2230	0
MAY	4	0	0	0	0	0	0	14	7	0	2	1170	0	0	0	63	0	0	5	16	4	0	1	48	1	215	2	145	53	31	182	2	0	88	0	0	0	0	385	2438	342	2780	0
JUN	25	0	0	0	0	0	0	16	4	1	5	1099	0	1	1	43	0	0	7	10	8	0	2	28	0	244	1	162	51	16	44	5	0	76	0	0	0	0	325	2174	345	2519	0
JUL	28	0	0	0	0	0	0	8	2	1	3	1133	1	0	3	43	1	0	1	2	6	0	6	22	3	458	1	109	57	16	179	6	1	57	2	0	0	0	354	2503	97	2600	1
AUG	68	0	1	1	1	0	0	18	3	1	3	948	0	1	3	42	0	0	12	10	2	0	2	28	4	160	0	61	119	46	118	3	6	96	0	0	3	0	208	1968	366	2334	2
SEP	143	0	1	0	0	0	0	45	8	1	6	1101	0	1	9	42	0	1	12	15	9	1	12	31	6	176	3	2	147	59	273	1	4	167	1	0	4	0	308	2589	488	3077	9
OCT	202	0	0	0	0	0	0	40	13	7	9	1550	0	0	1	63	0	1	23	24	27	1	17	57	15	356	9	1	62	63	79	24	3	236	0	0	0	0	468	3351	535	3886	12
NOV	156	0	0	0	1	0	0	32	24	5	8	976	1	0	7	65	0	0	5	46	9	0	5	28	15	260	9	2	147	53	204	5	6	184	0	0	1	1	466	2721	313	3034	0
DEC	47	0	0	1	0	0	0	16	17	9	10	969	0	0	3	4	0	0	3	8	18	0	7	23	0	225	9	0	21	14	145	0	0	172	0	0	1	0	263	1985	289	2274	0
TOTAL	829	6	5	2	3	1	0	244	122	31	48	12421	2	4	36	578	1	3	93	402	104	2	58	381	46	2999	40	1117	893	380	1857	72	22	1439	5	0	11	1	4047	28305	3592	31897	27
2000 JAN	42	0	0	0	0	0	0	12	13	4	7	1171	0	0	0	23	0	1	13	22	18	0	4	37	0	262	2	2	129	62	155	5	0	75	0	0	0	0	335	2394	247	2641	8
FEB	52	0	1	0	0	0	0	12	8	1	2	832	0	0	1	30	0	1	11	6	8	0	7	35	0	204	0	0	30	63	143	0	1	73	0	0	0	0	319	1840	285	2125	7
MAR	46	0	0	0	0	0	0	5	5	1	2	877	0	0	3	17	0	0	9	15	0	0	6	27	0	138	1	0	29	19	98	0	0	59	0	0	0	0	330	1687	401	2088	10
APR	35	0	0	0	1	0	0	9	2	2	0	855	0	0	2	15	0	0	0	7	0	0	6	12	0	90	0	0	39	19	106	1	0	51	0	0	0	0	268	1520	288	1808	0
MAY	50	1	0	0	0	0	0	7	2	4	0	1220	0	0	0	23	0	0	12	13	5	0	0	24	0	112	0	0	4	11	109	0	1	49	0	0	0	0	282	1929	228	2157	5
JUN	37	1	1	0	0	0	0	0	4	8	0	1054	1	0	2	22	0	0	17	18	1	0	11	19	0	95	0	0	0	10	96	1	0	42	0	0	0	1	194	1635	195	1830	3
JUL	58	0	0	0	0	0	0	7	5	3	0	1446	1	0	2	18	0	2	17	15	0	0	1	25	0	105	1	0	18	11	101	1	0	39	0	0	0	0	186	2062	194	2256	3
AUG	50	1	0	0	0	0	0	8	4	0	2	1386	0	0	0	17	0	0	12	9	0	0	1	36	0	82	0	0	59	16	105	0	0	52	0	0	1	1	232	2074	190	2264	3
SEP	55	0	0	0	0	0	0	10	8	3	2	1092	0	1	2	22	0	0	4	10	2	0	3	24	0	70	3	0	44	14	103	1	0	34	0	0	0	0	227	1734	273	2007	3
OCT	68	0	2	0	0	0	0	11	3	4	1	1212	2	0	4	38	0	1	13	18	1	0	3	42	0	117	3	0	55	40	77	0	0	70	0	0	0	0	312	2097	249	2346	1
NOV	33	4	1	0	1	0	0	7	2	3	0	1313	0	0	3	30	0	0	14	13	1	0	2	37	0	127	2	0	45	35	68	0	0	61	4	0	0	0	268	2074	283	2357	3
DEC	56	2	2	2	0	0	0	11	5	2	0	1055	0	0	1	51	0	0	17	9	0	0	5	36	0	116	4	0	36	30	67	0	0	51	1	0	0	0	260	1819	247	2066	4
TOTAL	582	9	7	2	2	0	0	99	61	35	16	13513	4	1	20	306	0	5	139	155	36	0	49	354	0	1518	16	2	488	330	1228	9	2	656	5	0	1	2	3213	22865	3080	25945	50
2001 JAN	86	0	2	0	0	0	0	9	4	0	0	1662	0	2	5	46	0	0	10	17	3	0	0	21	0	82	3	16	58	21	47	0	0	51	1	0	0	0	229	2375	252	2627	0
FEB	57	1	0	0	0	0	0	10	1	1	0	1616	0	0	7	72	0	0	11	19	1	0	3	26	0	208	1	104	70	19	36	1	0	45	1	0	0	0	261	2571	298	2869	9
MAR	54	5	0	0	0	0	0	6	2	4	0	1351	0	0	1	89	0	1	6	34	4	0	1	39	0	167	0	167	59	14	81	0	0	59	5	0	0	0	241	2390	374	2764	0
APR	52	0	2	0	0	0	0	4	2	0	0	1267	0	0	0	129	0	1	6	14	4	0	0	26	0	126	0	90	51	4	86	0	0	36	1	0	0	0	177	2078	349	2427	0
MAY	45	2	0	0	0	0	0	8	1	3	0	1628	0	0	1	133	0	0	10	27	7	0	3	33	0	148	5	124	71	22	84	0	0	70	1	0	0	0	262	2688	428	3116	3
JUN	78	4	0	0	0	1	0	4	2	2	1	1619	0	1	1	141	0	3	12	19	5	0	7	35	0	149	0	137	58	18	113	0	0	56	4	0	0	0	309	2779	330	3109	5
JUL	139	7	1	0	1	0	0	6	0	3	0	1901	0	1	0	150	0	0	22	12	6	0	5	39	0	172	2	121	55	27	102	0	0	45	1	0	0	0	292	3110	372	3482	3
AUG	122	1	4	0	0	0	0	5	2	3	0	1955	0	0	0	136	0	0	11	16	4	0	3	52	0	157	6	106	53	32	61	2	0	61	2	0	0	0	342	3136	379	3515	6
SEP	81	2	1	0	0	0	0	5	0	1	0	1639	0	0	0	138	0	0	11	8	0	0	2	50	0	117	26	110	44	16	24	0	2	59	4	0	0	0	233	2573	0	2573	0
OCT	101	0	0	0	0	0	0	6	2	3	0	1780	0	0	0	135	0	0	15	8	3	0	5	38	0	232	38	87	37	22	30	3	0	46	2	0	0	0	342	2935	415	3350	0
NOV	84	1	1	0	0	0	0	3	2	4	1	1596	0	0	0	110	0	0	7	15	6	0	1	49	4	192	50	84	36	50	17	0	0	68	0	0	0	0	273	2654	299	2953	0
DEC	72	3	1	0	0	0	0	6	2	5	1	1509	0	0	1	147	0	0	5	8	3	0	1	56	0	192	16	115	38	39	36	0	1	65	4	0	0	0	286	2612	267	2879	0
TOTAL	971	26	12	0	1	1	0	72	20	29	3	19523	0	4	16	1426	0	5	126	197	46	0	31	464	4	1942	147	1261	630	284	717	6	3	661	26	0	0	0	3247	31901	3763	35664	26
2002 JAN	77	5	0	0	0	0	0	9	1	5	2	1320	0	0	1	204	0	0	5	25	5	0	4	40	0	216	12	136	40	34	79	1	0	60	1	0	0	0	306	2648	414	3062	0
FEB	77	3	1	0	0	0	0	6	1	1	0	1283	0	0	0	230	0	0	4	20	12	0	3	39	0	222	31	125	43	27	121	0	0	70	1	0	1	0	369	2690	368	3058	6
MAR	69	0	1	0	0	0	0	1	1	1	2	1015	0	0	0	146	0	0	6	18	9	0	2	25	0	158	23	91	27	19	131	0	1	49	1	0	0	0	371	2167	294	2461	0
APR	31	3	1	0	0	0	0	1	0	8	0	1245	1	0	0	135	0	0	4	18	4	0	4	42	0	127	21	104	46	21	96	0	0	124	4	0	0	0	400	2440	385	2825	0
MAY	5	0	0	0	0	0	0	0	0	3	0	1004	0	1	3	69	0	0	5	55	3	0	2	106	0	104	43	159	42	4	158	0	1	9	0	0	0	0	554	2330	362	2692	0
JUN	11	0	1	0	0	0	0	1	2	2	0	892	0	0	4	60	1	1	3	11	0	0	0	64	0	72	38	59	37	13	134	0	0	23	1	0	0	0	331	1761	378	2139	8
JUL	6	0	1	0	1	0	0	3	1	5	0	1315	0	0	0	37	0	0	4	16	0	0	0	43	1	112	57	105	38	15	112	0	1	30	2	0	0	0	173	2078	527	2605	12
AUG	73	3	0	0	0	0	0	8	5	6	1	1377	0	0	2	37	0	0	2	17	0	0	1	33	0	178	65	162	67	14	91	0	0	11	1	0	0	0	140	2294	414	2708	11
SEP	79	1	1	0	1	0	0	7	2	1	2	1077	0	0	1	43	0	0	4	17	0	0	0	54	0	118	47	125	57	14	133	1	0	9	0	0	0	0	161	1955	505	2460	7
OCT	55	0	0	0	0	0	0	13	2	3	0	1041	0	0	3	52	0	0	4	30	0	0	0	45	0	124	48	186	22	19	114	0	0	36	0	0	0	0	180	1977	536	2513	3
NOV	51	2	0	0	2	0	0	7	12	4	2	1157	0	0	2	87	0	0	1	23	0	0	0	29	3	109	61	176	51	28	102	0	0	23	0	0	0	0	158	2090	454	2544	11
DEC	19	1	1	0	1	0	0	5	6	8	2	1300	0	0	0	161	0	0	3	10	0	0	0	77	0	127	83	125	27	26	88	0	2	17	0	0	0	0	179	2368	472	2740	7
TOTAL	553	18	7	0	5	0	0	61	33	47	11	14026	1	1	16	1261	1	1	45	260	33	0	16	597	4	1667	529	1553	497	234	1359	2	5	461	11	0	1	0	3382	26698	5109	31807	65

APPENDIX D

MAP OF SHAMA - AHANTA DISTRICT SHOWING CATCHMENT AREA OF KWESIMINTSIM POLYCLINIC