KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

FORECASTING OF NATIONAL HEALTH INSURANCE SCHEME CLAIM

A CASE STUDY OF AOWIN-SUAMAN DISTRICT HEALTH INSURANCE SCHEME

By

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DECLARATION

I hereby declare that this submission is my own work towards the award of the M.Sc degree and that, to the best of my knowledge, it contains no material previously published by another person nor material which had been accepted for the award of any other degree of the university, except where due acknowledgment had been made in the text.

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DEDICATION

I dedicate this work to my parents and Hilda Assaw whose prayers and words of encouragement enabled me to go through my education up to this level.

ABSTRACT

Health insurance is a form of insurance in which people pool their resources together to pay for medical expenses that are incurred by the insured. Claims payment by the National Health Insurance Scheme remained challenging, the monthly health care of claims payment by National Health Insurance Scheme seems to be rising. This study presents an Auto Regressive Integrated Moving Average (ARIMA) model to see the pattern of growth. Time series claims payment data for the Aowin-Suaman District Mutual Health Insurance Scheme (DMHIS) for the period January 2010 to November 2014 were analyze using time series methods. Appropriate Box-Jenkins model was fitted. From the result, it was clear that ARIMA(1,1,0) model was the best for forecasting claims payment.

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To all, I say may the good Lord grant all your wishes and richly bless you.

CONTENTS

LIST OF ABBREVIATION

ACF ....Autcorrelation Function AIC

.... Akaike Information Criteron

AR ....Autoregressive ARIMA

...........................Autoregressive Integrated Moving Average ARMA

.....................................Autoregressive Moving Average

BIC .... Schwarz-Bayesian Information Criteron DMHIS

...........................District Mutual Health Insurance Schemes

MA ....Moving Average

MHIS .... Mutual Health Insurance Scheme

NDC ....National Democratic Congress NHIA

.... National Health Insunrace Authority

NHIF .... National Health Insurance Fund NPP

.... New Patriotic Party PACF ....

Partial Autocorrelation Function

PCHIS ....Private Commercial Health Insurance Schemes

PMHIS ....Private Mutual Health Insurance Schemes SARIMA ....

Seasonal Autoregressive Integrated Moving Average SSNIT ....Social

Security and National Insurance Trust

UN ....United Nations VAT
....Value Added Tax

WB ....World Bank

WHO ....World Health Organisation

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The cost of health is high to the extent that, wages alone may not be enough to pay instant health bills and hence it is necessary to have various forms of health insurance Andam et al. (2011)

Health insurance is a form of insurance in which people pool their resources together to pay for medical expenses that are incurred by the insured. Ntem and Nwolley (2012)

1.2 Background

In developing countries like Ghana and other countries in Africa, inadequate funds together with increase in population, the rising incidence of new and deadly diseases like Ebola, HIV/ AIDS, cholera, hepatitis B, malaria, typhoid fever, diabetes and other diseases like hypertension make funding health more difficult. This made way for the popular "cash and carry system" introduced in 1992. In spite of the cash and carry system, government still subsides hospital fees. The policy of cost recovery has however led to increasing concern about equity and access for the poor health care. Waddington and Enyimayew (1989).

To solve the issue of financing health care , the government brought about National Health Insurance Scheme in 2001 as a way to financing health care. It is believed health insurance is capable of improving funding quality, efficiency and equity of health care. Health insurance has the ability to bring about equity and protection to the poor and the vulnerable through risk pooling where rich and healthy will subsidize the poor and the sick (Griffin and Shaw 1995). The World Health Organization(W.H.O); World Bank (W.B); United Nation(U.N) and other western donors have also proposed health insurance and health care with the hope of bringing about quality, effective, equity and efficiency in health services in the developing countries. They also recommended the introduction of market economics into health care to generate additional cover for the country so that more resources would be devoted to health services.

The Government of Ghana enacted, in August 2003, legislation to establish a national health insurance system ("the Act"). The Act was designed to meet the Government's commitment to replace the existing "cash and carry" public health system with a national system of district mutual health insurance scheme, in order to increase and improve access to health care for all Ghanaian citizens. Funding NHIS comes from a combination of premiums paid by the individual, money from the SSNIT fund and a levy on selected goods and services.

1.2.1 Method of Funding Health Care

There are many techniques to funding health care. Some countries such as Japan, France etc adopt multi-payer system in which health care is funded by private and public contributions (http://en.wikipedia.or/wiki/Health Care Economics). The UK is the only country that adopt single spine tax paying system through which the government reimbursed the medical centers for services, allocates resources for medical facilities and ensures a reduction in administrative cost (http://en.wikipedia.org/wiki/ Health care in United Kingdom).
Singapore's system uses a contribution of compulsory savings from payroll deductions funded by both employers and workers and government subsidies as well as "activity regulating the supply and prices of health care services in the country" to keep cost in check (http://en.wikipedia.org/wiki/Health care systems).

Contrast to the giant strides made by the developed countries for health care provision, the least developed countries are yet to come to terms due to their slow economic growth, constraint on the public sector and low institutional development (Carin, 2001).

Health systems in most countries are nearly collapsing particularly the less develop countries like Ghana and, thereby, the need for emergency measures to reverse the situation. Some measures adopted by developing countries are direct payments by end users of health care services and few exemptions enforced by central government. Exemption system include exempting the aged persons, exemption from certain communicable diseases and in some countries, emergency cases are not required to pay charges. The direct payment for health care as a measure to reduce constraints on government budget in most part of developing world has led to increase in social cost in terms of health service utilization and effects on such societies. However, a more basic and responsible means of financing health systems by avoiding utilization from directs payment and protecting the vulnerable groups from adopting various coping mechanisms is by a health insurance system.

A major characteristic of a social health Insurance is by risk pooling which enabled registered members access health care without an instant out- of- pocket payments

1.2.2 Funds Allocation For National Health Insurance Scheme

About 85 percent of funds allocation to the National Health Insurance is through taxation by Government through

- 4.2 percent NHIS levy on the sale of goods through VAT
- 2.5 percent of 17.5 percent payroll of each government worker's SSNIT contribution is subtracted and pay as premium for each worker.

- Interest on funds from investment made by the council.
- Other income such as donations, gifts made to the funds.

Andam et al. (2011)

All these funds have been giving concerned by Parliament of Ghana.

All these funds are paid into the National Health Insurance Fund (NHIF) which is manage by the NHIA. They also in returned gives subsides and reinsurance to the DMHIS for the payment of claims and day to day running of the schemes. However, all Teaching Hospitals are paid directly by the National Health Insurance Authority irrespective of the region they belong.

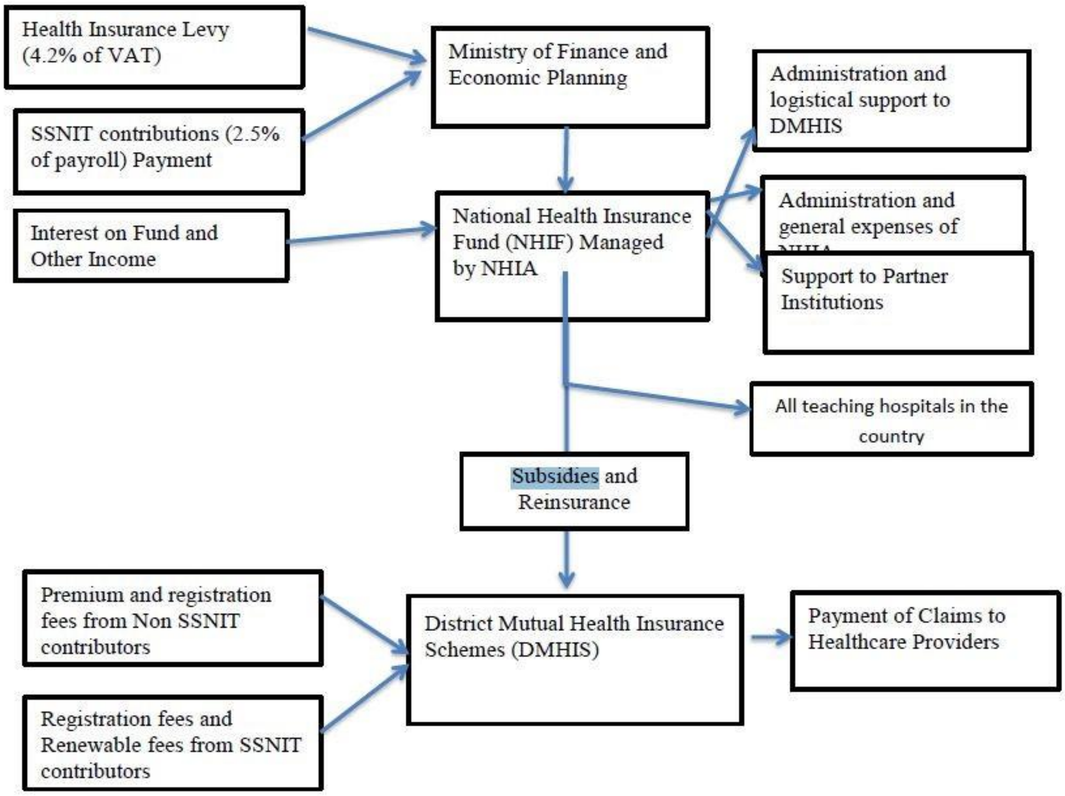
Below is the cash flow diagram of the NHIS.

Source: Aowin-Suaman District Mutual Health Insurance Scheme

1.2.3 Fee for Service and Diagnosis Related Groupings

Ghana started its NHIS with paying all service by fee for service. Here, after the provider had finished servicing the insurance client, a bill is send to NHIS for onward payment for whatever has been done for the patient.However, this caused a rapid rise in cost and had a significant threat to the sustainability of the NHIS. There lack of standardization of the fees charged was also a source of confusion and controversy.

In 2008, the NHIA introduced the Diagnosis Related Grouping(DRG) which means payment rates to providers are fixed for a given group of diagnosis. That is, the medicines remained under the fee for service system, but their prices were Figure 1.1: Cash Flow of NHIS



an agreed uniform across the the country.

The Ghana-DRG payment method is useful at all levels from the primary care to the teaching hospitals.

Capitation Payment System

The NHIS Law(LI 1809) particularly stated capitation as one of the provider payment system to be decided for use under the NHIS.

This proposer reform did not replace the existing provider payment system but rather introduced Capitation for a particular level of care, that is the primary level of walk in Out patient Department (OPD) Care, which is the fundamental base of health care system and reserves the DRG for services and itemized fee for medicines system to a higher levels of care.

The benefit of bringing on board Capitation payment are

- It helps the NHIA to forecast their budget.
- It reduced delayed in claims payment
- It enforces the implementation of gatekeeper system as part of the policy of the Ministry of Health.
- It has a good potential to ensure the financial sustainability and preservation of the NHIS.
- Improve efficiency and effectiveness of health service through more rational resource use.
- Simplify claims processing.
- share financial risk among schemes,providers and subscribers.
- Improve cost containment.
- Improve provider-patient relationship.
- Correct imbalance created by DRG.

However it is believe capitation may tempted provider to provide less needed service to client. Therefore a close monitoring is required for quality of care under capitation payment system.

A test to the cost to NHIS and providers in terms of skills and time consuming in claims processing suggest the need to revisit the way of implementing the capitation payment system which was proposed for use in Ghana at the time Act 650 was drawn but still unimplemented.

1.2.4 Non Payment of Claims

Delayed claims processing protracts reimbursement to health care providers which has the potential of inhabit the scheme function slowly. An article published in the (Daily Graphic,12th May,2009) indicated that the Akyem Oda government hospital in the Eastern Region was in debt to the amount of GH619000 because of the inability of NHIS to pay for service rendered to insured persons. The Birm North and Kwaebibirem districts NHIS owned hospital to the tuned of GH482000 and GH619000 respectively. The hospital authorities revealed that if the amount not paid sooner than later was going to close down. Suppliers had stopped supplying the hospital with drugs since the health facility could not settle their dept.

A study conducted by (Witter,et al,2007) on exemption for deliveries in the Central and Volta Region indicated that managers were used to unpredictable erratic funding and that the failure to reimburse correctly had adverse effect on the scheme. Analysis of financial flow by (Witter,et al,2007) found out that the exemption policy was under funded by 35 percent in 2004 to 76 percent in 2007. It is based on this assumption that (Witter,et al,2007) concluded that the policy is possible in theory but not always in practice if the provider is not reimbursed for lost income.

1.3 Membership of National Health Insurance

All residents of Ghana and Ghanaian outside the country are eligible to be members of the NHIS. Currently, anyone who registers with the NHIS normally wait for a period of about one month to get the permanent NHIS card but for pregnant women they are sometimes given a temporary card to get access to hospital.

The membership of the NHIS are

- SSNIT Contributors
- Children below 18 years

- Those from 70 years and above
- Pensioners covered by SSNIT
- Indigents
- Pregnant women
- Informal sector members
- Differently Able Persons

Source (National Health Insurance Act,2003)

For the informal sector, members that do not contribute to SSNIT are group into social classes as very poor, poor, middle income and the rich. The very poor pays nothing whilst the rest pay not less than GH7.20 to GH48.00 depending the social classes you fall. Andam et al. (2011). Also pregnant women do not pay and their premium is covered by the National Health Insurance Authority through subsides from the NHIF. Any one whose card expired is expected for renewal at the end of the year till five years of which he/she is to register for another card. Also children under 18 years up to four are covered once their parents or guidance have register as a member of the NHIS.

1.3.1 Aowin-Suaman District Mutual Health Insurance Scheme

The Aowin-Suaman District Mutual Health Insurance Scheme started operations in the year November 2004 with the registration of their members. Members had their benefit in the year 2005 with a total of 300 claims made by various contracted providers of the scheme amounting to GH¢ 700.00. This was in 2005 when their total membership of the scheme stood at 2,452. Information gathering from Mr. Joseph Annor, the claim officer of the Aowin-Suaman District Health Insurance Scheme said the total active membership of the Aowin-Suaman DMHIS stands at 91572 accounting for 71.5 percent of the total population of the district in which about 46 percent of them are children below 18 years of age.

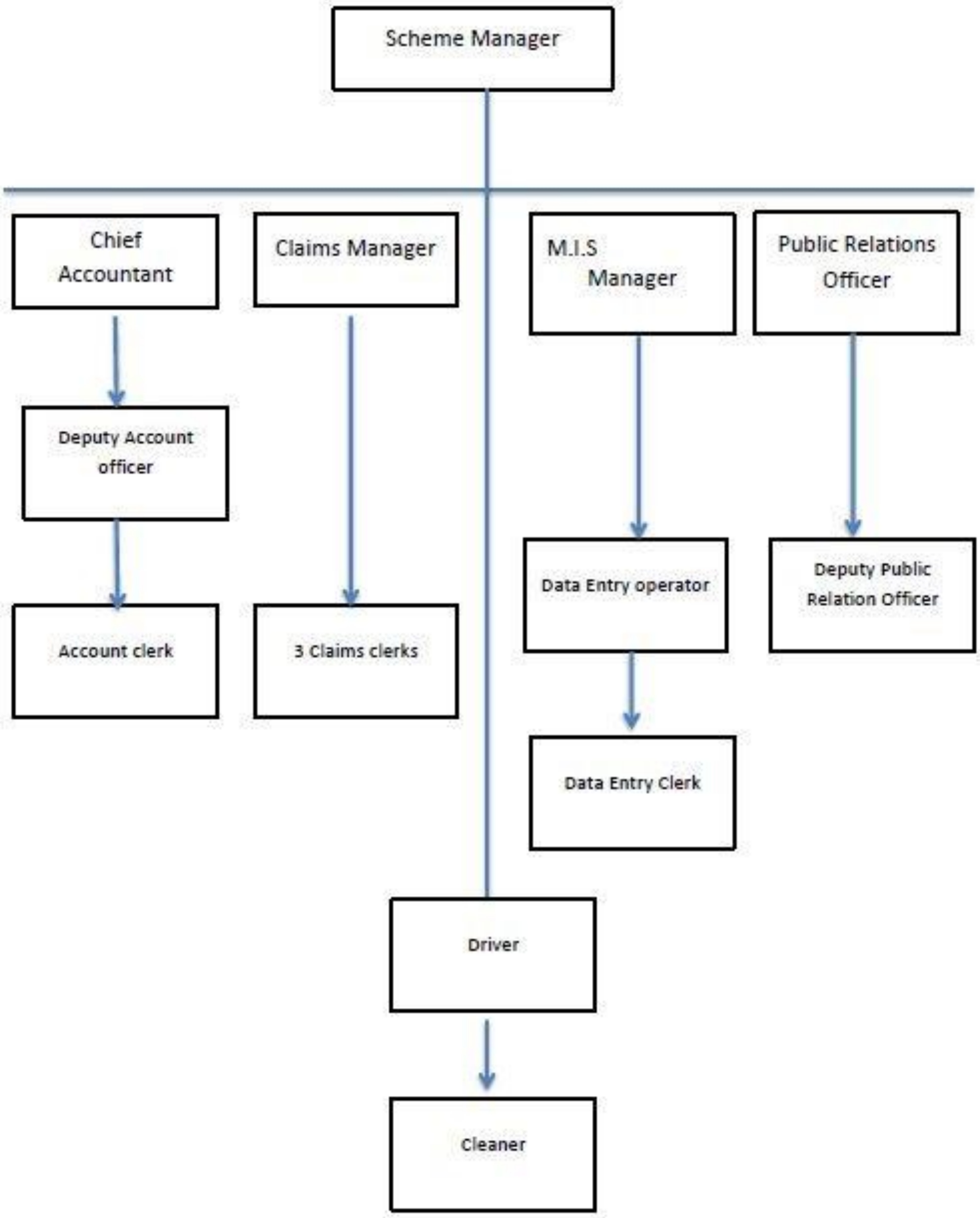
The scheme has no board of directors and it was initially governed by a four member caretaker committee. Comprising the District Coordinator Director, the District Finance Officer, a representative from the NHIA regional office and the Scheme Manager who doubles as the secretary to the committee. Management of the scheme is in the hands of fifteen(15) core staff of the scheme; Scheme Manager, Chief Accountant, Public Relations Manager, Management Information Manager, Claims Manager, Deputy Account Officer, Assistant Public Relations Officer, Data Entry Clerk, Account Clerk, three(3) Claims Clerk, Driver and Cleaner. Apart from these, the scheme contract a lot of casual staff to run its operations. Currently, there are some casual and temporary staffs with the scheme.

The salaries of the core staff are paid from the National Health Insurance Authority. The scheme raises money from processing fees and reactivation fees from which the other staff are paid from. Most of the funding of the scheme comes from the NHIA in the form of subsidies, reinsurance and administrative support. The Aowin-Suaman DMHIS operates with the Tariff list and the Medicines list developed by the NHIA. It contracts providers accredited by the NHIA to provide health services.

The diagram below is the organogram of a typical District Mutual Health Insurance Scheme (DMHIS).

Source: Aowin-Suaman DMHIS

Figure 1.2: Diagram of Aowin-Suaman District Health Insurance Scheme



1.3.2 Claims Management Steps

Claims management steps are in two categories. These are at Health Provider Level and at the Health Insurance Scheme Level.

Claims Management at the Provider Level

Patients are first given a folder and claim form. Patients personal details are entered on the claims register such as name, age, sex and health insurance number at the Out

Patients Department(OPD) for proper documentations about their history and examinations.

After medication have been received by the patients. Patients information is entered in consulting room register. Treatments and patients information is transfer to a different claims form that is, the diagnosis written by the medical officer at the consulting room and treatment or medicine given in the internal pharmacy are recorded on the claims sheet form with their respective charges. Where the medicine needed is not available, the patient is referred to any accredited pharmacy where the patients will send the authorized medicine prescription form given by the medical officer. A different claims form is issued in the name of heath insurance client after receiving medication.

The OPD claims forms from the internal pharmacy and inpatients claims forms from the various wards and if possible that from the laboratory and dental clinics are collected and separated into outpatients and in-patients then vetted by checking their diagnosis with prescriptions and their related charges.

All processed claims forms are arrange into their various groupings. These grouping include

- Out Patient Department Patients
- In-Patient Department Patients
- Medicals (General Patients) Adults and Pediatrics
- Surgery, Adults and Pediatrics

Source: (Aowin-Suaman District Mutual Health Insurance Scheme) All claims forms are then collated normally a period of one month and forwarded to the District Health Insurance Scheme.

Challenges Confronting Claims Compilation and Claims Management at the Service Provider

- Per the last day of the month you may not be able to complete all the claims.
- Calculation of bills per prescribing prices.
- Insufficient staff to work on the claims.
- Delay in submitting of patients folders to the claims compilation leading to delay in claims submission to the health insurance office.
- Process of handling claims
- Vetting of claims (Investigation)
- Process of paying is long since it passed through so many ministries having negative impact on the private hospitals on how to pay their staff and purchasing of logistics and drugs thereby forcing patients to pay their drugs.
- Rejection of claims by the insurance office
- Reduction of claims amount submitted
- Disparity in the price list
- Improper vetting of claims
- Adverse selection
- Wrong quoting of Ghana Diagnostics Related Grouping (G-DRG).
- Delay in tariff review.
- Non acceptance of resubmitted claims.
- Delay in reimbursement.
- Weak technical and managerial capacity of scheme management.

- Illegal collection of money from clients
- Non-compliance of NHIS protocols and drug list.

Source: (Aowin-Suaman District Mutual Health Insurance Scheme)

Claims Management at the Health Insurance Level

Firstly, a contract is sign as the initial step at scheme level. The NHIA then give accreditation to the health facility which qualified them to submit claims to the insurance scheme on monthly bases.

Procedure of Claim Process

- Provider submits claims
- Check Provider eligibility,receive and register claims if provider is an accredited provider
- Check for client eligibility
- Check for G-DRG code
- Check for diagnosis and ICD-10 code
- Verify whether condition is covered under NHIS.
- Link medicines to diagnosis through standard treatment guidelines.
- Determine whether the medicines prescribed are related to diagnosis.
- Compare diagnosis and medicines charges with tariff and medicines list.
- Make recommendation for payment.
- Provide provider notification.

Source: (Aowin-Suaman District Mutual Health Insurance Scheme)

Challenges with Claims Compilation

- Wrong price of drugs(Coating wrong price of drugs)
- Diagnosis treatment mix-match (Diagnosis does not relate to the drugs given)
- Anti-biotic drugs used in management of malaria
- Prescription above level of care
- Misapplication of service
- No-diagnosis stated on claims forms
- Used of medicine outside NHIS medicine list
- Claims without NHIS identification number stated
- General OPD visit of pregnant women built as ANC service.
- Lack of logistics
- Irregular flow of funds
- Delay in claims submission by accredited health service providers.
- Non compliance with recommendation in vetting reports
- Double billing(duplication of claims forms)

Source: (Aowin-Suaman District Mutual Health Insurance Scheme)

1.4 Profile of the Study Area

The Aowin-Suaman District Mutual Health Insurance serve both Aowin District and Suaman District. Both Aowin District and Suaman District which are one of the twenty-two political/administration districts in the Western region of Ghana, are located in the western-north of the Region. The Aowin District is rectangular in shape. It is bordered on the North by Suaman District, on the North-East by Sefwi-Akotombra

District, on the East by Wassa-Amenfi District, on the West by the Ghana-Cote D' Ivoire border and on the South by Jomoro District. It's capital is Enchi. The Suaman District is also triangular in shape. It is bordered on the North by Sefwi-Juaboso, on the East by Sefwi-Akotombra

District, on the West by Ghana-Cote D'Ivoire border and on the South by Aowin District. It's district capital is Suaman-Dadieso. The Health Insurance Office is located in Enchi (The District capital of Aowin.

1.4.1 Local government

The Aowin District Assembly and Suaman District are headed by a Chief Executive. It has thirty nine(39)electoral areas in all. Each electoral area is represented by an elected Assembly member and five elected unit committee members and six(6) zonal councils.

1.4.2 Rivers

Both districts are mainly drained by River Tannoe, River Bion and River Bia.

1.4.3 Vegetation and topography

The northern zone of the District are mountainous and covered with forest likewise the southern zone.

1.4.4 Climate

There are two main rainy seasons in the District mainly the major and the minor seasons. The major season begins from March to July and the minor season begins from August to November.

Temperatures are generally low throughout the year which is good for plants and food crop farming. During the dry season, temperatures are so high that except for irrigation in river valley, food crop cultivation is not encourage.

1.4.5 Economic Activities

The major economic activities carried out in the districts are farming and trading and the minor include fishing, cattle rearing,wood carving and poultry among others.

1.4.6 Ethnic Groups

There are two main ethnic groups; the Aowin and Anyi but Twi is the predominant language they speak. There is also a large presence of Malians, Nigeriens and Ivorians.

1.4.7 Religion

The predominant religion is Christianity. There are however a number of Traditional religious practitioners and a few Muslims.

1.4.8 Traditional Administration

The Tradition council are the Aowin Tradition council and the Suaman Tradition council.

1.4.9 Transport and Communication

The main transportation system within the Districts which also links with other District Capitals is road transport. Most of the roads within the District are not motorable during the raining season except the road from Enchi (District Capital of Aowin) to Asankragwa (Wassa-Amenfi District Capital). The district has no railway facilities. Telecommunication facilities are available in most parts of the District. These include landlines provided by Ghana Telecommunication and mobile communication services provided by Scancom, Mobitel and Ghana Telecommunication. Local inhabitants

receive television transmission from GTV from Ghana. The District has four FM Radio stations; Tricky FM, Radio Max,
Burosaman FM and Radio AS operated by the Ghana Broadcasting Corporation.

1.4.10 Education

The only tertiary educational institution in Aowin-Suaman District is Enchi Teachers Training Collage. There is only one second cycle institution in the Aowin District likewise Suaman District.

1.4.11 Energy

Majority of the communities in the districts are connected to the National electricity grid. There are eleven Liquefied Petroleum Gas(LPG) filling points. Clean/hygienic water(pipe-borne, mechanized pumps) is available in most communities across the district.

1.4.12 Financial Services

Many Banking/Financial institutions operate within the Aowin District namelyGhana Commercial Bank, ADB, Access Bank, Amenfiman Rural Bank and Adom micro finance. Those who operate in Suaman district are Ghana Commercial Bank, Bia-Torya Rural Bank, Adom micro finance, Boin micro finance and Mejiland micro finance.

1.4.13 Security

A District Police and Ghana National Fire Service are located in the Aowin District. Suaman District has a District police and Ghana National Fire Service which is under the Aowin District command.

1.4.14 Health Facilities

The Aowin District has a district hospital likewise Suaman District and a total of 14 health institutions in all where most of them are managed by Ghana Health Services. There rest are for Christian Health Association of Ghana (C.H.A.G) and other Organization and individuals.

1.5 Problem Statements

Every body needs health care. It is generally accepted that investing in the health care of the people of any country is one of the best way in alleviating poverty. Health Insurance is one of such collective actions which advance the social welfare of any nation if properly managed and well resourced. There have been a tremendous increase in the claims payment to the health services as a result of the high number of people who have registered to get treated free of charge for sickness and conditions that would have cost them more. The claims payment to health care services through the NHIS has increase and is therefore very important to always forecast and have a fair ideal how the next claims payment would be like in other to know your budget so as to sustain the NHIS.

1.6 Objectives of the study

The main objective is to project National Health Insurance Claim and to access the advantages associated with the scheme in Aowin-Suaman District. The specific objectives to be determined are as follows;

1. Model health care service claims payment by Aowin-Suaman District Mutual Health Insurance Scheme(DMHIS) using ARIMA.

2. To forecast claims payment based on the ARIMA and interpret the results.

1.7 Methodology

The assessment, measurement and evaluation of the above objectives involved various methods of analysis. These included qualitative and quantitative tools, some of which were statistical analysis, random sampling, analysis of routine data generated by the Aowin-Suaman District Health Insurance Scheme, the NHIS reports and annual health sector reports. The main comparison is between membership registration, premium mobilization and claims payment over four years six months(2010-2014). Key informants were chosen purposively with regards to their roles, knowledge and experience. They included some members of the management team of the Aowin-Suaman District health insurance scheme, Dadieso S.D.A clinic, Dadieso Government hospital, Enchi Government hospital, Enchi Presbyterian clinic and Boinso Government clinic.

Time Series Analysis will be done using R-soft ware to choose the best ARIMA model to project claims payment for the scheme. Books from the main library at KNUST and the Mathematics Department library will be used on the course of the thesis. Research on the Internet to provide additional information to obtain the related literature.

1.8 Justification of the study

1.8.1 Stakeholders improvement

This study when completed will be a resourceful material to both the management of the Aowin-Suaman District Mutual Health Insurance Scheme management and the National Health Insurance Authority at large, especially the claims management department as the research is intended to collate the claim payment figures of the Aowin-Suaman DMHIS.

It will help management of the Aowin-Suaman DMHIS to objectively plan ahead of schedule in making decisions that concern claim payments at the various accredited health care centers for their health care needs and the expected claims to be paid. It will also guide the Aowin-Suaman District Health Scheme in particular to develop strategies that would enhance claims management and sustainability of NHIS.

1.8.2 Economical improvement

When claims management problems are identified very well and solved, the quality of claims data management will be enhance and hence enhancing the payment systems to health providers. This could be achieved when claims payment is done timely to the health providers.

1.8.3 Enhancing quality of care

Health services delivery and quality os care will be improved. These will automatically limit or reduce the rate of mortality and encourage more clients tot have faith in the National Health Insurance Scheme.

1.8.4 Academic/ Research

The result will provide useful and elaborate information and an in-dept knowledge of National Health Insurance Scheme that would guide the design of further studies.

1.9 Research Limitation

1. Lack of access to quality and reliable information particularly from health practitioners because of their code of ethics on clients chatter and confidentiality.

2. Time constraints in terms of revisit and thorough scientific analysis, since this study was combined with academic work.

1.10 Thesis Organization

This study is organized into five chapters. Chapter one is the introduction of the study. It provides the background to the study and intensively states the focus of the work. It also provide the problem of the statement, objectives, methodology, justification of the study, research limitation and thesis organization. The second Chapter talks about the literature review of the National Health Insurance Scheme. The third chapter deals with the entire process of the empirical investigation by discussing the data collection methods, formulation and variants and methods of solution. The fourth Chapter talks about the analysis and discussion of the major findings. Tables and graphs will be used in grouping, tabulating and presentation of quantitative data will also be provided. Simple percentages will be calculated in the spread sheet to enhance data presentation. Summary of result and their significance and how the results relate to the literature will be provided. Finally, the last chapter deals with the conclusion and recommendation which is related to the objectives and findings. Better recommendations will be provided for stakeholder to address issues identified in the problem statement.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter gives primary concepts and review of the works of other scholar in this field. There are many forms and procedures of forecasting. These include Regression and Time Series Analysis. In this chapter, I would review some works of scholar on Time Series Analysis using other news papers, journals, books, thesis and internet as resources for research.

2.2 Application of Time Series

Anko and Adetunde (2011) used time series model as comparison of Registration and Claims Figures of Health Insurance Schemes:A Case Study of the Builsa Health Insurance Scheme.

They employed a reliability linear and Quadratic regression models to check the trends of registration and claims. The result showed that linear model is the better for registration as compared to curvilinear whilst curvilinear time series model is the better for claims.

Tindogo (2013) conducted a study to forecast utilization by subscribers of the National Health Insurance Scheme:A Case Study of Nadowli District Health Insurance Scheme using Time Series Analysis Technique.

His study aimed at Model health care services utilization by subscribers of Nadowli DMHIS using ARIMA . He used ARIMA models to collect data from

March 2006 to June 2012. The result showed that the most suitable model was the ARIMA(0,1,0)(1,0,0). This is because it has the least BIC value, the highest degree of freedom and the least number of parameters (parsimony).

Todoko (2013) conducted a study on Time Series Analysis of Water Consumption in the Hohoe Municipality of the Volta Region of Ghana.
His studied seek to develop a time series model and prediction fortnight of water consumption by residents and business for the 4 years (2013-2016) in the Hohoe municipality. He used many time series models which include AR, MA,
ARMA, ARIMA and SARIMA to fit into the data. He collected data from 2009-2012 on fortnight bases collated from Ghana Water Company Limited at Hohoe. The result showed that the most suitable model was the ARIMA(2,1,2).

According to Bostner et al. (2014), Insurance companies mainly use linear regression to forecast models by drawing a line of best fit through the data. But they implemented the strategies of time series analysis' to create a more correct way to model trend analysis for quarterly insurance. Within the data, features such as trend and seasonality were utilized to improve upon basic linear regression. After comparing several models, the ARIMA model proves to be better at forecasting the data as compare to linear regression.

According to Lenten and Rulli (2006), they carefully used the time-series characteristics of life insurance demand using a novel statistical strategies that used multiples un-observable component to be extracted. Their technique allowed the data to be modeled in new and creative ways. They found univariate series decomposition which allowed them to easily comment the character of life insurance demand over the sample period (1981– 2003)..

Olszowy (2013) investigated the development of the insurance industry in Poland over the last twelve years (2001-2012) and predicted the development of all quarters of the year 2013. They commented that G.W.P was the best indicator giving the size of the insurance industry. Their main objective is to find out the relationship between GWP and other time series specifically the Polish economy: profitability ratio of technical activity for the whole insurance industry, Gross Domestic Product, inflation and consumer confidence indicators. First and foremost, they investigated about univariate analysis of all the six time series, found trends and seasonal effects, model the residuals, as well as apply SARIMA models. In each situation, the corresponding prediction were presented. In the next part they investigated multivariate time series analysis, in specifically they modeled their data with VAR and searched for Granger causalities.

Ntem and Nwolley (2012) used time series to model and forecast claims payment from 2006 to 2010 in Ho municipality. They used time series method to choose the quality and correct model among various ARIMA models which posses high power of projecting for predicting payment of claims from the year 2006 t0 2010. The result showed that ARIMA(0,1,1) model was the best model for forecasting of claims payment.

Ashuri and Lu (2010) used time series to predict various ways in forecasting the Construction Cost Index (CCI) . They particularly focused on examination of univariate time series strategies for in-sample and out of sample predicting of CCI. They found out that the SARIMA model was the best time series method for in-sample forecasting of CCI, whilst the Holt-Winters Exponential Smoothing (Holt-Winters ES) model was the best time series method for out-of-sample forecasting of CCI. Again, they found out that several of the time series models gives more accurate out-of-sample prediction than those produced by ENR's own CCI predictors.

They found out that the development of a more informed predicting model using time series analysis can help reduce uncertainty about future construction cost.

CHAPTER 3

METHODOLOGY

3.1 Theory of Time Series

3.2 Definition

Time series is a set of observation measured sequentially through the period. That is ,time series is simply given an observed sequence to build a model that can predict what comes next. That is, what happens at time t_0 contains information about what will happen at time t_1. Observation are treated as both outcome and then forecast variables as we go forward in time. If a time series can be projected exactly then it is known as deterministic time series. However, when the future is partially determined by previous values such that correct prediction are not possible and must be changed with the reason that future values have a probability distribution with knowledge of past values is called stochastic time
series

3.3 Application of Time Series

The application of time series forecasting are

- Sales forecasting
- Stock control
- Economic planning
- Budgeting
- Model evaluation

- Financial risk management
- Production and capacity planning
- Evaluation of alternative economic strategies

3.4 Objectives of Time Series

The objectives of time series are;

Description of Data

Giving a time series data, the first thing is to plot the data to get the major characteristics of the series such as seasonal effect, trend etc. The description of the data can be done using summary statistics and / or graphical methods.

Interpretation of Data

When two or more variables are observe, one can use the variation in one time series variable to interpret the other time series variable. This help to get the meaning of the mechanism which generate a given time series.

Forecasting of Data

Taken a time series that has been observe, one can forecast the would be values of the data. This is a essential task in sales prediction.

Control of Data

A good prediction aid the analyst to have a better control in a given process whether an economy or industrial process or whatever. Nagpaul (2005)

3.5 Components of Time Series

Time series are made up of four components.

Trend Component

Is a long term pattern within a time series.

Seasonal Component

A seasonal component is a pattern that occurs throughout a calender time and has a recurrence period which could be monthly, quarterly or a year

Cyclic Component

It is a data within the time series which keep on recurring itself throughout the time series and is usually has a repeated period of more than a year and is related to the seasonal component.

Irregular Component

These refer to changes that occurs in the data of time series and is not associated with trend, seasonal and cyclic components.

3.6 Estimation and Elimination of Trend and Seasonal Components

Plotting of data is the first thing to do in analyzing any time series. When there is a presence of any outlying observations in the series then vigilant should be taken before they are being discarded. Graph should be inspected to suggest the possible representation of data to realize the process (Classical decomposition model).

$$X_t = m_t + s_t + Y_t \quad (3.1)$$

where m_t is trend component, s_t is seasonal component and Y_t is irregular component. There are two methods to trend and seasonal component removal;

- By differencing the series X_t
- By estimation of m_t and s_t

3.7 Estimation and Elimination of Trend when Seasonality is not Present

When seasonal component is not present the model becomes

$$X_t = m_t + s_t + Y_t \tag{3.2}$$

$t = 1,2,3.....n$ where

$E(Y_t)$ 6= 0

Since $E(Y_t)$ 6= 0, hence we can replace m_t and Y_t with $m_t + E(Y_t)$ and $Y_t - E(X_t)$ respectively.

Method 1: Trend Estimation

Moving average and special smoothing are significantly nonparametric techniques for trend estimation. The type of smoothing filter enquirers analytical thinking, hence very necessary to try varieties of filters in order to get a good ideal of the underlying trend.

Method 2 : Trend Elimination by Differencing

Another method is that, elimination of the trend can be done by differencing.

3.8 Differencing

Differencing is a process of finding the difference between every two successive values within time series. Often differencing is used to account for nonstationarity that occurs in the form of trend or seasonality or both. Differencing is said to be non-seasonal differencing when it deals with trend and when it deals with seasonality it is known as seasonal differencing. Thus if $Y_t(t = 1,2,3,....,n)$ denotes the previous series, the first order non seasonal difference is

$$\delta X_t = X_t - X_{t-1} \tag{3.3}$$

The difference $X_t - X_{t-1}$ can be expressed as $(1-B)X_t$, where B is the backward shift operator. Using B before either a value of the series Y_t or an error term Wt means to move that element back one time. Example $BX_t = X_{t-1}$. An exponent of B means to constantly apply the backward shift in order to move back a number of time periods that equal the "exponent". Hence $B^j(X_t) = X_{t-j}$. It must be noticed that the backward shift operator is not operated on coefficients because they are constant quantities that do not move in time.

3.9 Stationary Time Series

The basic ideal is that the laws of probability that governs the features of the process do not change over time. That is, a stationary time series has the same mean for all time, same variance over time and autocorrelation remain the same through time that is seasonal dependencies have been removed through Differencing.

If there is a trend in the mean then differencing the time series data will remove the trend so that stationary would be achieved. First order differencing is enough for non seasonal data, so that stationary would be achieved.

If there is a trend in variance, the series is made stationary by transforming the data as follows; $X_t = U_t$ where $U_t = logY_t$

3.10 Moving Average (M.A)

3.10.1 Single Moving Average

The Moving Averages (MA) technique are the best technique for forecasting. The most commonly used method is the simple moving average and is calculate by summing the set of numbers of specific periods and divide these by the time periods. The Simple moving averages technique is the most popular and is considered highly useful because of its smoothing effect.

Moving average is used because as new sample observation becomes available, new mean is calculated by ignoring the initial sample observation and including the newest sample observation. As new mean is calculated, it becomes the forecast for the next period.

Single Moving Average is given by

$$M_t^1 = \frac{y_t + y_{t-1} + y_{t-2} + ... + y_{t-n-1}}{n} \quad (3.4)$$

Where y_t is the sample observed.

3.10.2 Double Moving Average

According to Tindogo (2013), double moving averages is simply treating the moving averages over time as individual series and obtaining a moving average of moving averages. The double moving averages is suitable for data with a linear or quadratic trend. The double moving average is an improvement of the simple moving average to correct for the biases and develop a better forecasting equation.

Double Moving Average is given by $M_t^{ii} = \frac{m_t + m_{t-1} + m_{t-2} + ... + m_{t-n-1}}{n}$

3.10.3 Exponential Moving Average

Another aspect of moving average which is closely related to the single moving average, only that, in exponential moving average, more weight is given to the latest data. It is also known as Weighted Moving Average.

3.11 Exponential Smoothing

Exponential Smoothing assign exponential decrease weight as the observation get older. That is, current observation are given more weight when projecting as compare to the initial observations.

3.11.1 Single Exponential Smoothing

This starts by putting S_2 to y_1 where s_i stand for smoothed observation and $x_1, x_2, x_3, ...x_n$ are the time series data. For the next period, which is the third period, is given by $S_3 = \alpha x_2 + S_2 - \alpha S_2$. There is no s_1.

Hence for any period t, the smoothed value is found by given by ;

$S_t = \alpha x_{t-1} + S_{t-1} - \alpha S_{t-1}$

The constant α is called the smoothing constant and it lies within 0 and 1.

3.11.2 Double Exponential Smoothing

Double Exponential Smoothing is when an exponential smoothing is done over an already smoothened time series.

The double Exponential Smoothing is giving by;

$$S_t = \alpha y_t + (S_{t-1} + b_{t-1}) - \alpha(S_{t-1} + b_{t-1}) \quad (3.5)$$

$$b_t = \theta(S_t - S_{t-1}) + (1 - \theta)b_{t-1} \quad (3.6)$$

Where s_i stand for smoothed observation and b_t stand for trend factor.

The smoothing weights α and θ are selected from the interval 0 and 1 each.

3.11.3 Triple Exponential Smoothing

When data show both trend and seasonality, double smoothing does not work. Hence, it is necessary to add a third parameter. Therefore, in triple exponential smoothing, smoothing is done three times. That is, one for level, the second for trend and the last for seasonality.

3.12 Autoregressive Model of Order P [AR(p)]

A better method is to see if the next value in the time series can be predicted as some function of its past values is known as autoregressive. An autoregressive model of order p is denoted by AR(p) is determined by the partial autocorrelation function (PACF). An autoregressive model of order p is given by $X_t = \sum_{t=1}^{p} \alpha_k X_{t-k} + \mu + w_t$, where X_t is the time series μ is the mean of the time series, w_t is a white noise and α is constant

An Autoregressive Model of Order One [AR(1)]

The AR(1)process is given by ;

$$X_t = \alpha_1 X_{t-1} + \mu + w_t \quad (3.7)$$

Putting $\mu = o$ we get

$$X_t = \alpha_1 X_{t-1} + w_t \quad (3.8)$$

Multiplying through by X_{t-k}, we get

$$X_{t-k}X_t = \alpha_1 X_{t-k}X_{t-1} + w_t X_{t-k} \quad (3.9)$$

$$cov(X_{t-k}, X_t) = \alpha cov(X_{t-k}, X_{t-1}) + cov(X_{t-k}, w_t) \quad (3.10)$$

but

$$cov(X_{t-k}, w_t) = 0 \quad (3.11)$$

Hence,

$$X_t = \alpha_1 X_{k-1} \quad (3.12)$$

Dividing both sides by cov d_0; we get

$$\frac{X_k}{d_0} = \alpha_1 \frac{X_{k-1}}{d_0}(p_k - \alpha_1 p_{k-1}) \quad (3.13)$$

where $p_0 = 1$ For

$k = 1$

$$p_1 = \alpha_1 p_0 \quad (3.14)$$

$$p_1 = \alpha_1 \quad (3.15)$$

When $k = 2$

$$p_2 = \alpha_1 p_1 = \alpha_1(\alpha_1) = \alpha_1^2 \quad (3.16)$$

Generally,

$$p_k = \alpha_1^k \quad (3.17)$$

Yule-Walker Equations

The important aspect of autoregressive models is that it give chance to get a simple linear equations that give the constants of the model in terms of autocorrelations and variance of the data. These linear equations are called the Yule-Walker equations. Also it can be used to determine the constants of AR(p) model.

3.13 Introduction to Moving Average Models

As another approach to autoregressive representation in which the X_t on the lefthand side of the equation are imagined to be combined linearly, the MA(q) is taken as the white noise w_t on the right-hand side of the defining equations are combined linearly to form the observed data. Thus, it gives predictions of X on the idea of linear combination of previous forecast error.

3.13.1 Moving Average Model of Order q MA(q)

MA(q) model is given mathematically by;

$$X_t = \sum_{t=1}^{q} \theta_k w_{t-k} + \mu + w_t \quad (3.18)$$

Where X_t is time series, w_t is white noise, μ is the mean of time series, θ_k are parameters and q are the lags in moving average. MA(q) process can also be in the form of backward-shift operator(B) as follows

$$X_t = \theta(B)w_t \quad (3.19)$$

Where

$$\theta(B) = 1 + \theta_1 B + \theta_2 B^2 + ... + \theta_q B^q \quad (3.20)$$

The difference in Moving Average Model is that these random shocks are generated to future values of time series and fitting this model is more difficult than Autoregressive model since the errors terms are not seen.

The order of the MA(q)process is given by the autocorrelation function(ACF). The ACF cuts off after lag q and the partial autocorrelation function decay to zero. Thus an MA(1) process cuts off after one.

3.14 Autoregressive Moving Average Models (ARMA)

Another important model is the combination of AR(p) and MA(q)models named as Autoregressive Moving Average Model (ARMA) of order (p,q). It is given by;

$$X_t = \sum_{t=1}^{p} \alpha_1 X_{t-1} + \sum_{t=1}^{q} \theta_1 w_{t-1} + \mu + w_t \tag{3.21}$$

The parameters p and q are called the autoregressive and the moving average orders respectively. If X_t has a non- zero mean then the ARMA model becomes;

$$X_t = \sum_{t=1}^{p} \alpha_1 X_{t-1} + \sum_{t=1}^{q} \theta_1 w_{t-1} + w_t \tag{3.22}$$

The AR(p) model is the same as ARMA(p,0) and MA(q) is the same as ARMA(0,q). An essential features of ARMA models is that both the ACF and PACF do not cut off as can be seen in AR and MA models. An example of an ARMA(p,q) model is the ARMA(1,1) model given by

$$X_t = \alpha_1 X_{t-1} + \theta_1 w_{t-1} + \mu + w_t \tag{3.23}$$

In an ARMA(1,1) model both ACF and PACF trail off to zero. The steps for estimating the parameters of the ARMA model is like the one for the MA model, it is an iterative method. .

3.15 Autoregressive Integrated Moving Average Model(ARIMA)

Once a time series model has been differenced to do away the trend, the time series has been integrated. Basically, all AR(p) and MA(q) models can be represented as ARIMA models. For example an AR(1) can be represented as ARIMA(1,0,0); that is no differencing and no MA part. The general model is ARIMA (p,d,q) where p is the order of the AR part, d is the degree of differencing and q is the order of the MA part.

In practice, most time series are non-stationary and the series is differenced until the series becomes stationary. An AR,MA or ARMA model is fitted to the differenced series and estimation procedures are as described for the AR, MA and ARMA.

3.16 Seasonal Autoregressive Integrated Moving Average(SARIMA)

According to Pennstate (2015) seasonality in a time series is a pattern that occurs throughout a calender time and has a recurrence period which could be monthly, quarterly or a year . For instance, there is seasonality in monthly data for which the pattern of dry season in a specific district changes in some particular months and the rain season also changes in other specific months. Let S defines the number of time period until the pattern repeats again, then in this case, S = 12 . For quarterly data, S = 4 time periods per year.

In a seasonal ARIMA model, AR and MA terms forecast y_t using data values and errors at times with lags that are multiples of S . For instance, with monthly data, S= 12, a first order autoregressive model with seasonality might use y_{t-12} to project y_t. For example, if we were selling television set and fridge, we might predict this year November's sales using last year November's sales.

Also, a seasonal second order AR(2) model would use y_{t-12} and y_{t-24} to predict y_t. Here we may predict this year November's values from the last two November.

Similarly, a seasonal first order MA(1) model, with S = 12 would use w_{t-12} as a predictor. Again, a seasonal second order MA(2) model might use w_{t-12} and w_{t-24}.

It is very prudent to know the differenced data when seasonality is present or not. Seasonality normally make the series to be unstationary since the mean values at some specific times may differ from the mean values at another times.

Seasonal differencing is defined as a difference between a value and a value with lag that is a multiple of S. For instance, monthly data, S = 12, a seasonal difference is $(1 - B^{12})y_t = y_t - y_{t-12}$. Pennstate (2015)

If there is a presence of trend in the data, we may need non-seasonal differencing to remove the trend. Normally, a first difference (non-seasonal) will “detrend” the data. That is, we use $(1 - B)y_t = y_t - y_{t-1}$ in the presence of trend. Again, if there is presence of trend and seasonality, we would use a non-seasonal first difference and a seasonal difference. Basically, we may need to examine the ACF and PACF of $(1-B^{12})(1-B)y_t = (y_t - y_{t-1}) - (y_{t-12}t - y_{t-13})$. Removing trend does not necessary mean, we have removed the dependency. Even though, we may have removed the mean, μt, which may include a periodic component. But, in some ways we are breaking the dependency down into recent things that have happened and long-range things that have happened.

3.16.1 Seasonal ARIMA Model

In order to identify a seasonal ARIMA process, it is divided into parts. To identify the seasonal pattern, we do away the non-seasonal process and check whether the seasonality is determined by an AR or MA process by focusing our attention on the variables of the seasonal patterns. Assuming the non-season part is an ARIMA(1, 0, 1) and the series show a monthly seasonal pattern, then the model is written as;

$$(1 - \alpha_1 B)(1 - \alpha_{12} B^{12})y_t = (1 - \theta_1 B)e_t \qquad (3.24)$$

If seasonality is on the AR part then the equation is;

$$(1-\alpha_1 B)y_t = (1-\theta_1 B)(1-\theta_{12}B^{12})e_t \tag{3.25}$$

However, if it is on the MA part, then;

$$(1-\theta_{12}B_{12})y_t = y_t - \theta_{12}B_{12}y_t \tag{3.26}$$

Identifying a Seasonal Model

First and foremost, plot a time series of the data and check for characteristics such as trend and seasonality. See that you have gathered seasonal data which may be months, quarters, etc, and look at the pattern across those time units to see if there is indeed a seasonal pattern. The following guidelines should be considered in identifying seasonal ARIMA model parameters.

- If there is seasonality and no trend take a difference of lag S. For example, take a 4th difference for quarterly data with seasonality.
- If it is a linear trend and no seasonality, take a first difference.
- If there is both trend and seasonality, apply both a non-seasonal and seasonal difference to the data.
- If there is neither obvious trend nor seasonality, don't take any differences.

3.17 The Box-Jenkins Method of Modeling Time Series

The Box-Jenkins modeling technique is also known as Autoregressive integrated moving average (ARIMA) modeling, inquire importantly large data set and the development of ARIMA model for any variable requires many procedures These include

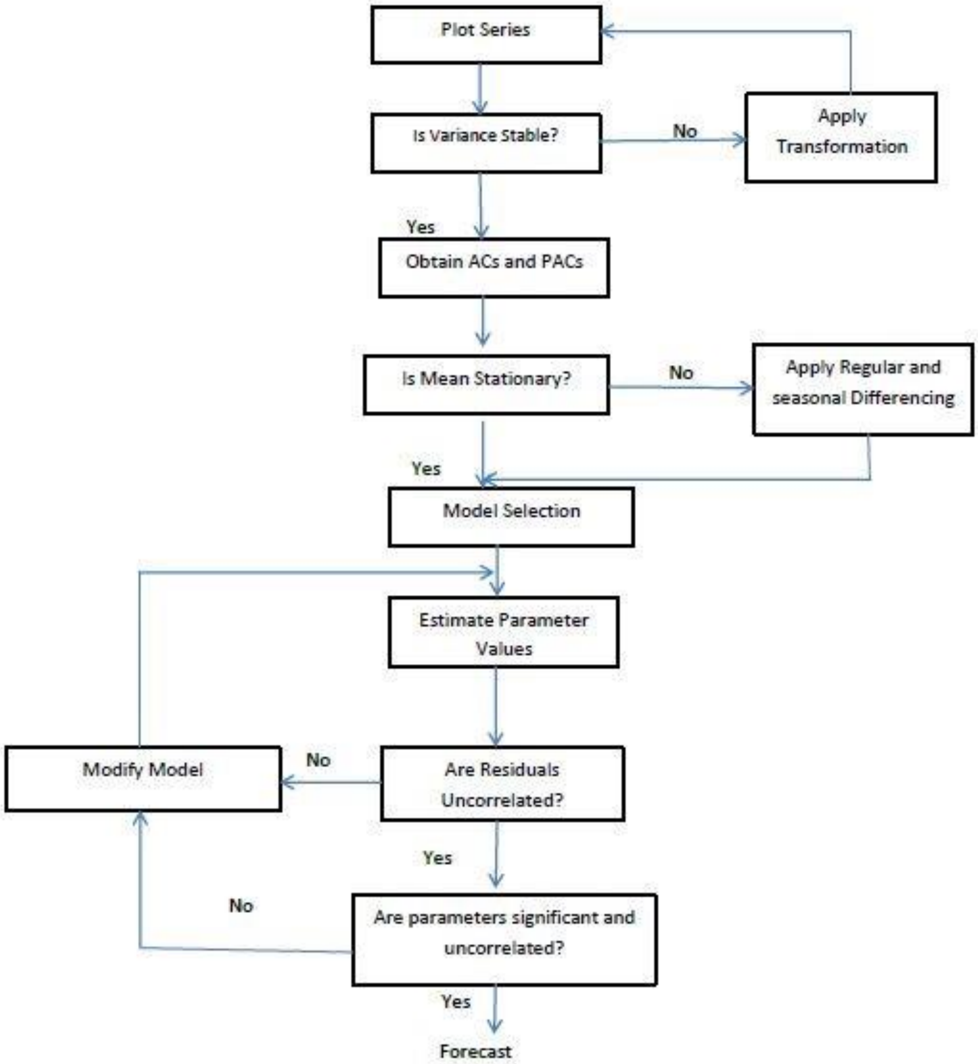
1. Identification of the correct ARIMA model
2. Estimation of the parameters of the ARIMA

3. Checking the verifiability of the model

4. Predicting or Forecasting

The figure below shows the schematic representation of Box-Jenkins process.

Figure 3.1: The Box-Jenkins Process



3.18 The Box-Jenkins Process

3.18.1 Identification Techniques

. The only way to estimate ARIMA model is when the variable for predicting into a stationary series has been transform. From our previous submission, a stationary time series is the one who has the same mean for all time, same variance over time and autocorrelation remain the same through time. A carefully going through the graph of the data give an idea to know whether stationarity is presence or not.

3.18.2 Estimation of the Parameters of the model

Identified

According to Box and Jenkins, the estimation of the parameters of the models are obtained using least squares . This can be done using SPSS, SAS, R etc to find the estimation of the necessary parameters using iterative techniques.

3.18.3 Checking the verifiability of the model

The best way of checking the verifiability of the model by using either of the following procedures

1. The Akaike's Information Criteria(AIC) which was proposed by Akaike used the maximum likelihood technique.
2. Another method is the Schwarz's Bayesian Information Criterion(BIC)

Each of these statistics technique used the lowest values to decide which model is best and has the highest reliability.

The test statistic is the Q-statistic given by;

$$Q = n(n+2)\sum_{i=1}^{k}\frac{r_i^2}{n-1} \tag{3.27}$$

which is approximately distributed as a x^2 with $k-p-q$ degree of freedom, where n is the length of the time series, k is the first autocorrelation being check, p is the order of the AR process and q is the order of MA process and r is the estimated autocorrelation coefficient of the i^{th} residual term.

If the calculated value of Q is greater than x^2 for $k-p-q$ degrees of freedom, then the model is considered inadequate and adequate if Q is less than x^2 for $k-p-q$ degrees of freedom. If the model is tested inadequate then the forecaster should select an alternative model and test for the adequacy of the model.

3.18.4 Forecasting

The last stage is to forecast the model selected. Basically, we have two types of forecast

1. In-sample Prediction
2. Post-sample Prediction

The first one help to generate the confidence in the model and the second one give rise in forecasting the behaviour to help planners to take better decisions.

3.19 Conclusion

Just as any predicting method, the ARIMA technique do not necessary give perfect prediction but can be used perfectly for predicting long time series data. The ARIMA method is good for any time series with any pattern of change and it is a suitable method for forecasting the length of any variable. It does not inquire the predictor to pick a priori the value of any parameter. Tindogo (2013)

CHAPTER 4

ANALYSIS OF RESULTS

4.1 Introduction

Chapter four offers detail analysis of the claim payment and forecasted for the following year and the steps involved in health insurance claims management.
The software employed is R.

4.2 Data Collection

Both primary and secondary data were collected. The primary data was based on interviewed collated from twenty health accredited facilities. This include health insurance offices in Aowin-Suaman District and Sefwi Ankotombra District. The brain behind the primary data is to know the challenges of claims compilation at the providers level and scheme levels and also to find how health insurance claims were managed.

4.3 Stages in Data Analysis

4.3.1 Primary Data Analysis

The primary data was analyzed manually and only key personnel who were directly involved in the claims management were interviewed.

4.3.2 Result of Primary Data Analysis

Sex Distribution

Fourteen(14) of the interviewers were males and the rest were females.

Age Distribution

Ten of the interviewers representing 50 percent were the age group of 20-29 and five of them were the age group of 30-39 representing 25 percent and the rest of the interviewers were in the age group above 40 representing 25 percent.

4.4 Secondary Data Analysis

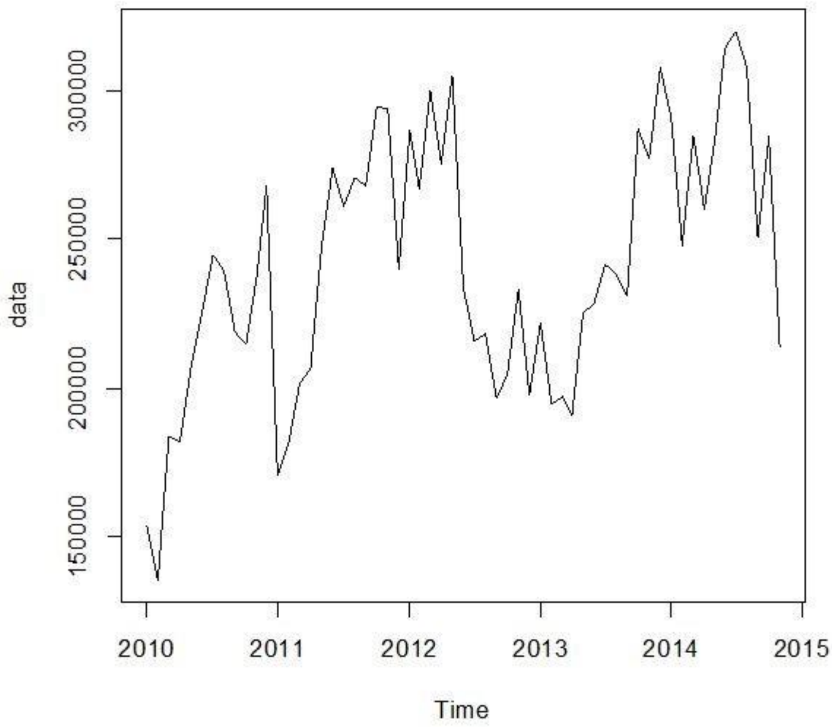
The analysis of the secondary data include the following

- Formulation of model instances
- Algorithms
- Computational steps

This offers a descriptive analysis of the character of payment of claims over a period of 59 months taking into accounts time series method and models to analyze data from January 2010 t0 November 2014 and to forecast for the next year.

4.5 Descriptive Analysis

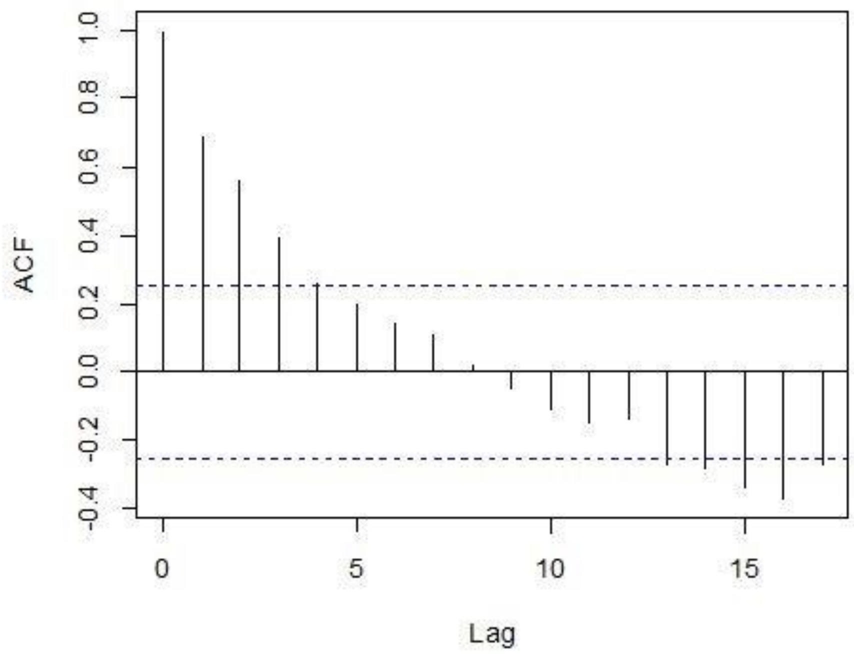
Figure 4.1: Plot of the Series



The chart above shows unusual features as results of random fluctuations in the claim data payment within the period. It could be noted that it fluctuates between increasing and decreasing hence giving it a zigzag shape. The lowest claim payment was recorded in 2010 and the highest was recorded in 2014.

The annual time plot of claims payment shown in the diagram above does not show any seasonal variation and it is not stationary due to the presence of trend component.

Figure 4.2: ACF of the Claim Data



The ACF diagram above shows a trend in data, Therefore a regular differencing is to be applied to do away the trend component in the series. Thereby to achieve stationarity of the mean, the Augmented Dicker Fuller Test(ADF) will be taken to test whether the mean is stationary or not.

Test for Stationary Augmented

Dickey-Fuller Test

H_0 : The data is a stationary series

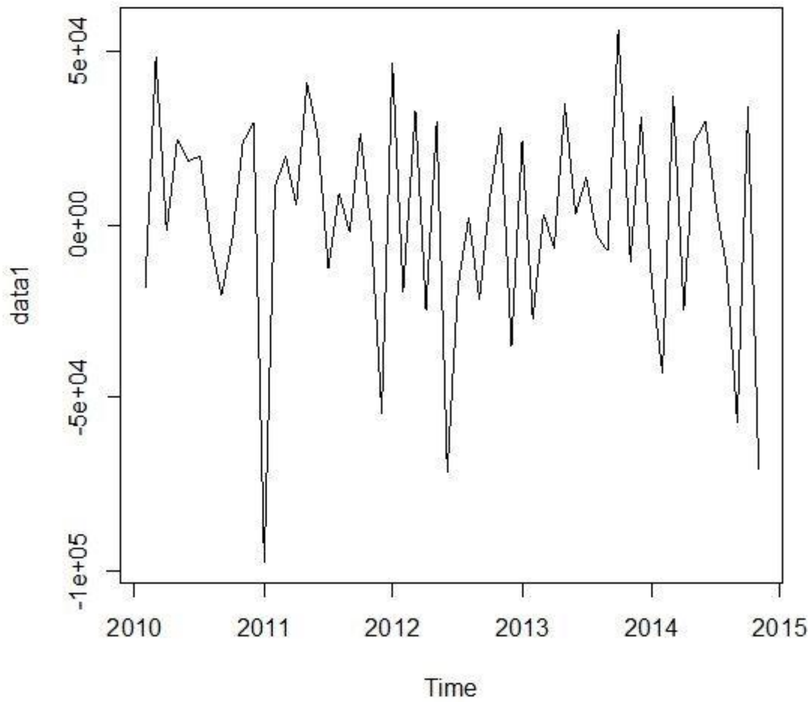
H_1 : The data is not stationary series

Dickey-Fuller	Lag order	p-value
-2.737	3	0.277

The test statistics above gave a p-value of 0.277 which is greater than the alpha value of 0.05, hence we fail to reject H_0, concluding that the data is not stationary.

The Diagram Below is Trend Differencing

Figure 4.3: Diagram of the First Differencing



A transformation of the payments of claims using first differencing technique is done to do away the presence of trend component from the initial data. The variability is almost constant. Payments of claim data is approximately stable.

Augmented Dickey-Fuller Test

H_0 : The data is a stationary series

H_1 : The data is not stationary series

Dickey-Fuller	Lag order	p-value
-4.2481	3	0.01

From the test statistics above, the p-value is 0.01 which is less than the alpha value of 0.05, concluding that there is no unit root(Mean is stationary).

Figure 4.4: Plot of PACF of the Differenced Claim Data

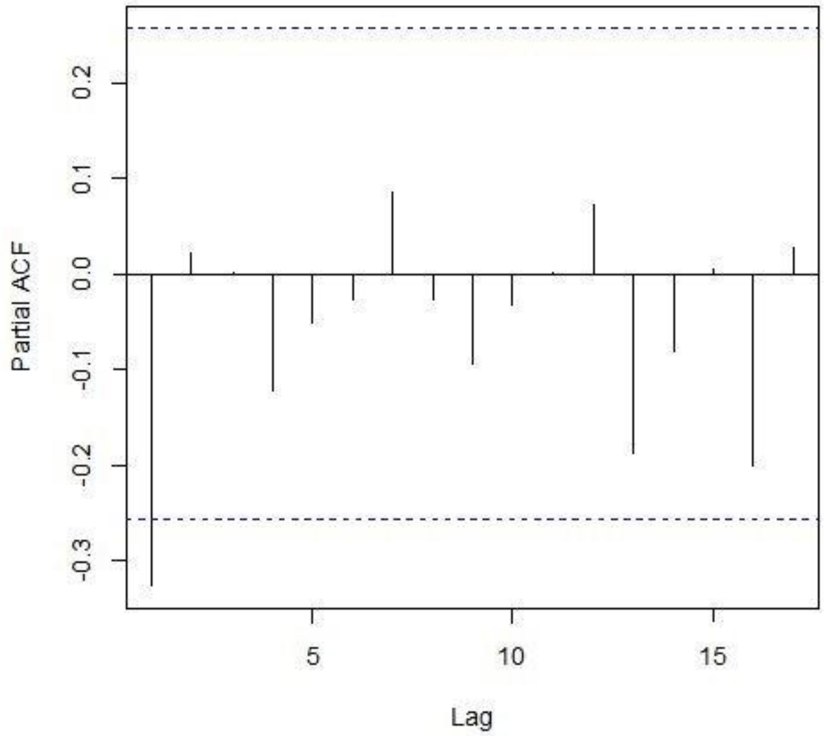
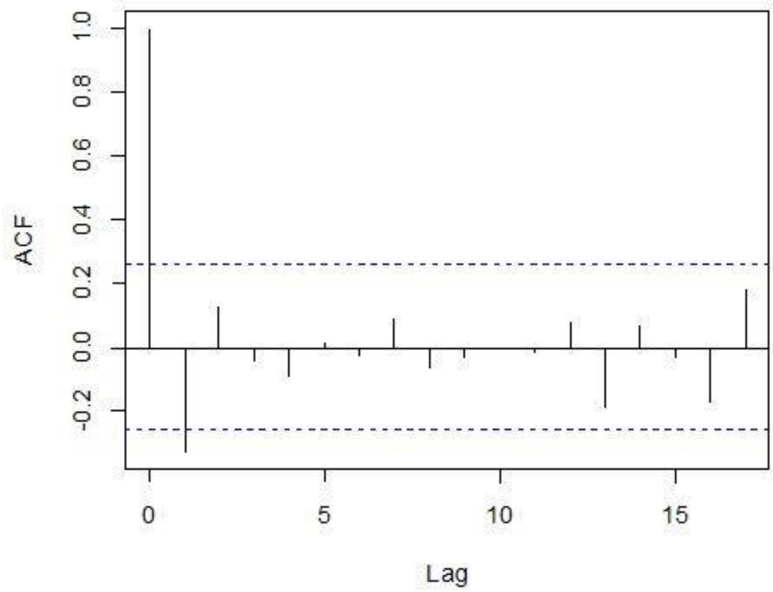


Figure 4.5: Plot ACF of the Differenced Claim Data



The plot of the ACF suggests an MA (1) because the only significant spike is one even though there are two spikes out of the confident interval and that of the PACF suggests an AR(1) because there is only one spikes out the confidence interval.

The following models are suggested;

1. ARIMA (1,1,0).
2. ARIMA (0,1,1).
3. ARIMA (1,1,1).

4.6 Best Model Selection

COEFFICIENT OF ARIMA

Table 4.1: ARIMA(1,1,0) with drift

Coefficients:	AR(1)	drift
	-0.3556	1451.736
s.e.	0.1294	2904.127

Table 4.2: ARIMA(0,1,1)

Coefficients:	AR(1)	MA(1)
	-	-1.0000
s.e.	-	0.0596

Table 4.3: ARIMA(1,1,1)

Coefficients:	AR(1)	MA(1)
	-0.3432	-1.0000
s.e.	0.1301	0.1061

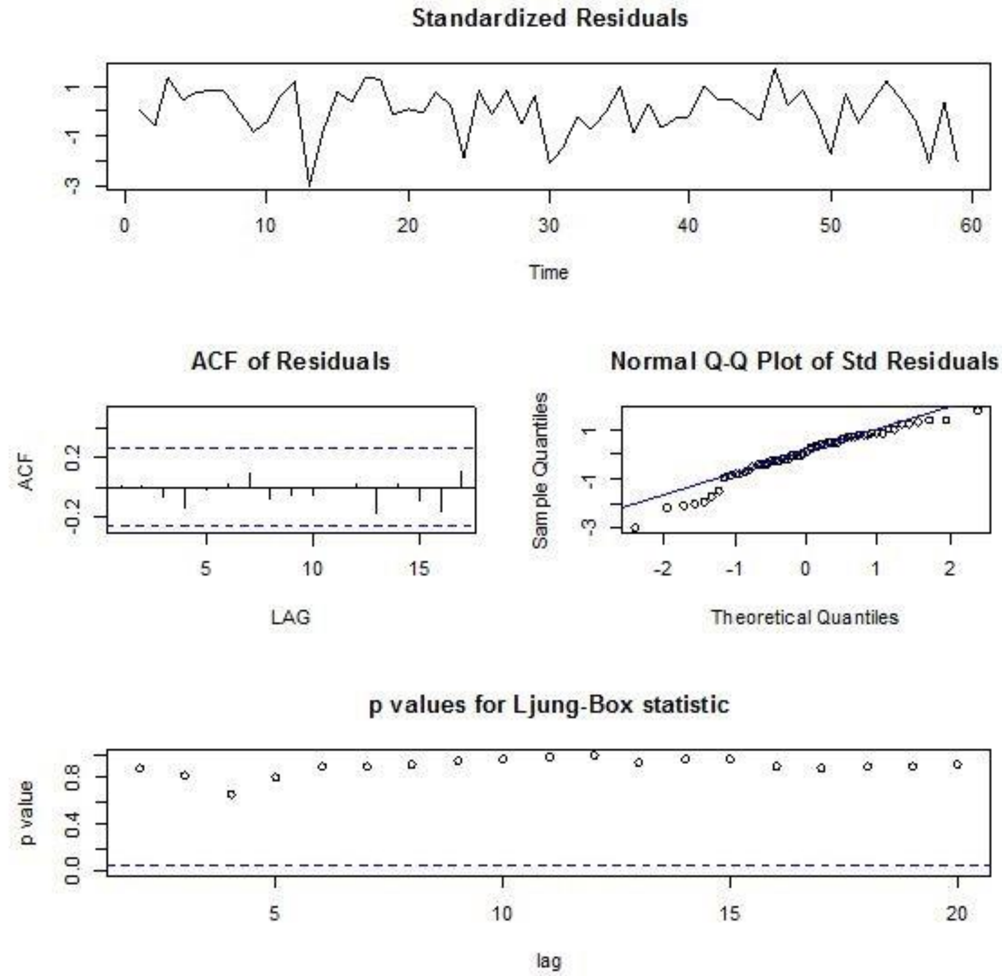
Parameter Estimates and Diagnostic of Various ARIMA Model.

Model	$\sigma 2$	log-likelihood	AIC	AICc	BIC
ARIMA(1,1,0)	889514771	-667.73	1341.45	1341.9	1347.63
ARIMA(0,1,1)	$1.009e+09$	-673.78	1351.56		
ARIMA(1,1,1)	889810227	-670.55	1347.1		

From the table 4.6, the best model is ARIMA(1,1,0) because it has the least AIC(Akaike Information Criterion).

4.7 Diagnostics Checking

Figure 4.6: Diagnostic of ARMA(1,1,0)



i The standardized residuals shows an ARIMA(1,1,0) model fitted to the payment of claims. The plot supports the model due to the absence of trend and it shows no obvious pattern.

ii The plot of ACF against the lag show displays of the sample of the residuals from ARIMA(1,1,0) model of payments of claims. We conclude that the plot does not show a major statistically important witness of non-zero autocorrelation in the residuals

iii The next diagnostics is the plot of the normal q-q plot of the standard residual,few of the standardized deviate from the line of best fit whilst most residuals follow normality.

iv The last part is the plot of the Ljung-Box statistics. It is observed that all residuals lie above the 0.05 significance line(blue line) and it can also observed that all Ljung –Box statistics plot is not significant at any positive lag.

4.8 Forecasting with Model

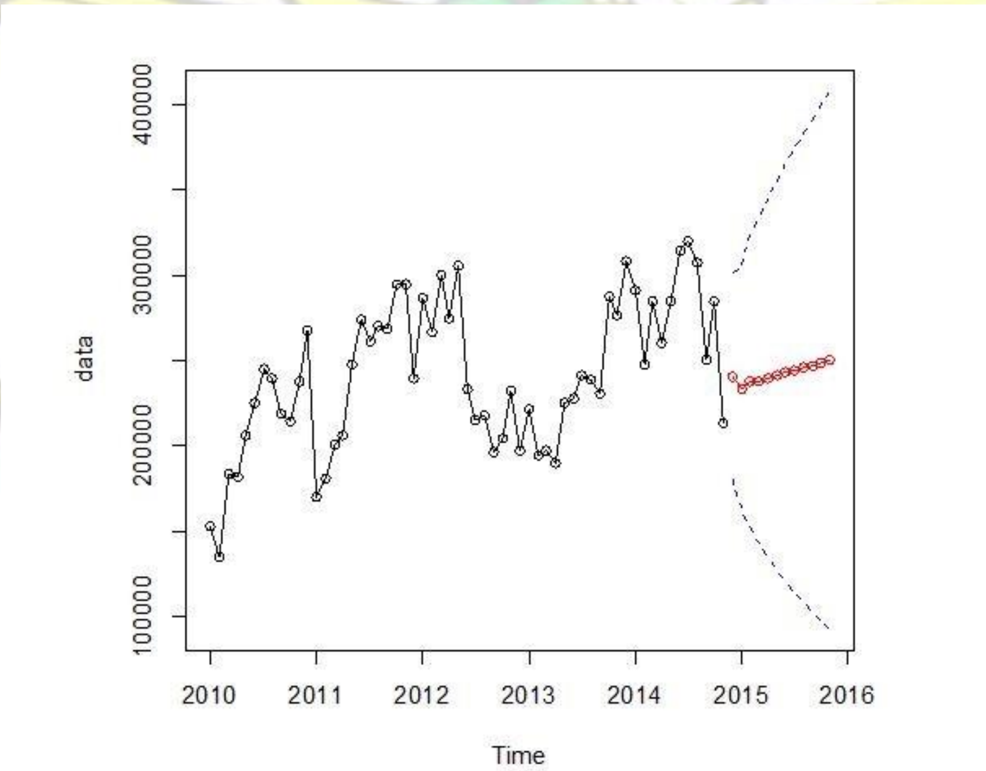
In this situation, it is clear that ARIMA (1,1,0) model is the best model for predicting the next 6 months ahead of initial data for the period from January 2015 to June 2015 in this study

Table 4.4: Forcast Claims for the next 6 months

Month	January	February	March	April	May	June
Forcast Claim	241467.7	231243.2	237897.9	237026.6	239511.0	240499.2

Below is the the graph of the payments of claim and its forecast.

Figure 4.7: Forcast Graph



CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents conclusions drawn from the study and some recommendations made to inform policy at the Aowin-Suaman District Health Insurance Scheme in the Western Region of Ghana.

5.2 Findings

The following findings were gather from the research:

- The best ARIMA model for the monthly health care claims payment in the district is ARIMA(1,1,0). From the model above it can be seen that it has a linear trend with a difference of one.
- Claims payment by the Aowin-Suaman would continue to swell up in the short to medium term as more people continue to attend to health care as population increases and emergencies of new diseases.
- From the forecast values, the pattern of claims payment by Aowin-Suaman to health providers will sharply decline from January to February and then increases slowly from March to December and the cycle continues.

5.3 Conclusion

The core aim of the thesis were to model health care claims payment by the NHIS to the health services providers in the Aowin-Suaman District. It also used the Box-Jenkins methodology to model and predict for the future based on the time series model developed.

The validated model is used to forecast or predict time series values. The unstationary claims payment time series data from January, 2010 to November, 2014 was differenced once to achieve stationarity. ACFs and PACFs were used to help select the best ARIMA.

5.4 Recommendation

- Claims payment should always be modeled and forecast in other to enhance advance payment of claims to service providers.
- The management of Aowin-Suaman NHIS should also look at how claims are being managed apart from forecasting.
- Since claims payment is a financial data and the data was not stationary, student who would like to do research on this study can use G.A.R.C.H (General Auto Regressive Continuous Heteroskedasticity)

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APPENDIX A

Table 5.1: Claims Payment Data In Ghana Cedis From January 2010 To November 2014 By Aowin-Suaman District NHIS

	2010	2011	2012	2013	2014
January	153,671.83	170,672.79	286,848.26	221,898.62	291,008.05
February	135,538.24	181,555.43	267,083.36	194,471.55	248,074.30
March	184,031.19	201,196.72	300,032.01	197,429.51	284,911.59
April	182,019.25	206,855.45	275,242.93	190,654.70	260,384.51
May	206,805.31	247,930.23	304,999.53	225,292.00	284,415.83
June	225,314.67	273,938.91	233,467.07	228,228.36	314,303.20
July	244,980.39	261,335.02	215,858.75	241,800.92	319,821.95
August	239,482.78	270,540.79	218,161.59	238,474.82	307,533.51
September	218,976.04	268,199.17	196,442.09	231,085.95	250,489.72
October	214,823.84	294,531.56	204,670.46	287,379.17	284,646.42
November	238,389.48	294,210.42	232,943.65	276,882.29	213,835.78
December	267,982.29	239,943.86	197,542.98	307,975.13	-
Grand total	2,512,015.31	2,910,910.27	2,933,292.68	2,841,573.02	3,059,424.86

Table 5.2: R-Software Codes

Codes	Function
bline( )	Graphics command
acf( )	Estimation of the autocorrelation function
arima( )	Fitting ARIMA–models p.
arima.sim( )	Simulation of ARIMA–models .
Box.test( )	Box–Pierce and Ljung–Box test .
c( )	Vector command .
cos( )	Cosine .
density( )	Density estimation .
diff( )	Takes differences .
dnorm( )	Normal distribution .
filter( )	Filtering of time series .
hist( )	Draws a histogram.
HoltWinters( )	Holt–Winters procedure .

ks.test( )	Kolmogorov–Smirnov test .
length( )	Vector command .
lines( )	Graphics command .
lm( )	Linear models .
log( )	Calculates logs .
lsfit( )	Least squares estimation .
mean( )	Calculates means
pacf( )	Estimation of the partial autocorrelation function
plot( )	Graphics command
predict( )	Generic function for prediction
read.csv( )	Data import from CSV–files
rep( )	Vector command
sd( )	Standard deviation
seq( )	Vector command
shapiro.test( )	Shapiro–Wilk test
sin( )	Sine
stl( )	Seasonal decomposition of time series
summary( )	Generic function for summaries
ts( )	Creating time–series objects
tsdiag( )	Time series diagnostic
qqnorm( )	Quantile–quantile plot
sarima	summary of fitted model
sarima.for	recasting code