THE STUDY OF ARIMA MODEL TO FORCAST THE EXCHANGE RATE OF NIGERIA NAIRA TO EUROPEAN EURO

BY

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CERTIFICATION

This is to certify that this study was carried out by SAKARIYAU ABUBAKAR AJAO with Matric number HND/23/STA/FT/0004 in the Department of Statistics, Kwara State Polytechnic, Ilorin.

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DEDICATION

This project work is dedicated to Almighty Allah, the most beneficent, the merciful for the successful complete of this research work and also to my loving and caring parent Late. MR. AND MRS SAKARIYAH whose endless effort enable me to be what I am today I pray to Almighty Allah to grant both of you Al-jannat Firdaos (Amina Yah Allah).

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All praise to Allah to beneficent and merciful for his uncountable blessing he had shown to me from the beginning of my programme to the end.

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My profound gratitude goes to all Lecturers in my noble Department. As I have been saying and will always say, you are my parents, without mining words that who you are and your impact in my life can't be rewarded by me, may God Almighty reward you all bountifully.

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ABSTRACT

This project work was aimed at analyzing the Naira /Euro exchange rate using time series on the given data. The time plot was as introduced, so as to depict the embedded pattern (components) of the exchange rate series for the year 2012-2023. Attempts were made to study the component of time series which exist in the data set. Like trend, seasonal component, cyclical component and the irregular component. The trend line was fitted using least squares method. It was discovered that the series has trend and no seasonal variation which showed that its non-stationarity nature. A differencing was done to make the series a stationary one so that a prediction into the future periods could be made easy, and done, a model was fitted for the data. Some model selection criteria like Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC) and Log likelihood were also used on models that were subsequently developed which led to selecting ARIMA(l,1,2) as the most parsimonious model for the forecast or prediction into the future periods.

***Keyword**: Exchange Rate, Time Series, Naira/Euro, Trend, Stationarity, Differencing, Forecasting, ARIMA,*

TABLE OF CONTENTS

Title Page	i
Certification	ii
Dedication	iii
Acknowledgement	iv
Abstract	v
Table of Content	vi
CHAPTER ONE	
1.1 INTRODUCTION	1
1.2 PROBLEM STATEMENT	4
1.3 AIM AND OBJECTIVES	7
1.4 SCOPE OF THE STUDY	8
1.5 ORGANISATION OF PROJECT	8
CHAPTER TWO	
2. LITERATURE REVIEW	9
2.1 INTRODUCTION	10
2.2 INTRODUCTION	10

2.3 USES OF TIME SERIES 13

2.4 COMPONENTS OF TIME SERIES 14

2.5 TREND 15

2.6 SEASONAL VARIATION 21

2.7 CYCLICAL VARIATION 22

2.8 IRREGULAR VARIATION DECOMPOSITION OF TIME SERIES 23

2.9 USES OF TIME PLOT 23

CHAPTER THREE

3.0 METHODOLOGY 25

3.1 INTRODUCTION 25

3.2 SOURCES AND NATURE OF DATA TO BE USED 25

3.3 TECHNIQUES OF DATA COLLECTION 25

3.4 ANALYSIS PROCESSING AND ANALYSIS 26

3.6 TIME PLOT 29

3.8 THE NON-STATIONARITY AND DIFFERENCING 33

3.9 CONCEPT OF STATIONARITY	33
3.10 UNIT ROOT TESTS	33
3.11 AUGUMENTED DICKEY FULLER TEST	36
3.10 LAG	35
3.12 TESTING PROCEDURE	36
3, 13 AUTOCORRELATION FUNCTION	37
3.14 PARTIAL AUTOCORRELATION FUNCTION	37
3.15 AIC	37
3.16 SBIC	38
3.17 MODELLING APPROACH	38
3.18 MODEL IDENTIFICATION	40
3.19 MODEL ESTIMATION	41
3.20 MODEL DIAGNOSIS	41

3.21 BOX-JENKINS METHODOLOGY 42

3.22 FORCASTING 43

CHAPTER FOUR

4.0 PRESENTATION AND ANALYSIS OF DATA 44

4.1 DATA 44

4.2 DATA ANALYSIS 44

4.3 INTRODUCTION 44

4.4 TIME PLOT FOR THE DATA 45

4.5 TEST FOR TREND AND AUTOCORRELATION 45

4.6 SEASONALITY TEST FOR THE RAW DATA 45

4.7 STATIONARY TEST FOR THE RAW DATA 48

4.8 SUMMARY OF THE DESCRIPTIVE ANALYSIS 51

4.13 AUGUMENTED DICKEY FULLER TEST WITH INTERCEPT 51

4.10 TIME PLOT FOR THE DIFFERENCED DATA 52

4.12 AUGUMENTED DICKEY FULLER TEST WITH INTERCEPT 51

4.13 MODELS IDENTIFICATION 52

4.14 ESTIMATION OF PARAMETERS 52

4.15 MODEL EVALUATION 53

4.16 MODEL CHECKING 54

4.17 ARIMA MODEL DIAGNOSTIC RESULT 54

4.18 FORECASTING 55

CHAPTER FIVE

5.0 SUMMARY AND CONCLUSION 57

5.1 INTRODUCTION 57

5.2 SUMMARY AND CONCLUSION 57

REFERENCES 58

CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND OF THE STUDY

Foreign exchange is the means of payment for international transactions. It is made up of convertible currencies that are generally accepted for the settlement of international trade and other external obligation. Just like every other commodity, a market is established which works more like any other market having a supply curve, a demand curve and an equilibrium price and quantity. There are also conditions which are held constant (creteris paribus). When these conditions change, the curve shifts and there is a change in the equilibrium price quantity. This market for currencies is known as the foreign exchange market.

The foreign exchange market according to the central bank of Nigeria is the medium of interaction between the sellers and buyers of foreign exchange a bid to negotiate a mutually acceptable price for the settlement of international transactions. The sellers of foreign exchange constitute the supply while the buyers of foreign exchange constitute its demand. The supply of foreign exchange is derived from oil exports, non-oil export, expenditure of foreign tourist in Nigeria, capital repatriation by Nigerians resident abroad etc.

The demand for foreign exchange on the other hand consist of payments for imports, financial commitments to international organizations, external debt service obligations etc,

Before 1958, when the central bank was established and the enactment of the exchange control act of 1962, foreign exchange was earned by the private sectors and held in balances abroad by commercial banks which acted as agents for local exporters. Another feature of this period was that agriculture exports contributed the bulk of foreign exchange receipts. The fact that the British pound sterling was at par with the Nigerian pound sterling with easy convertibility delayed the establishment of an active foreign exchange market.

However by 1958, when the central bank was established and subsequent centralization Of foreign exchange authority. In bank, the need for a local foreign exchange market became paramount. Other factors that led to the evolution of the foreign exchange market in Nigeria include:

The changing pattern of international trade institutional changes in the economy. Structural shift in production, etc.

By the early 1970's, the official exchange receipt was enhanced following the sharp rise in prices and demand for crude oil exports which had by now displaced agricultural exports. The foreign exchange market experienced a boom during this period and there became a need for the management of foreign exchange resources. However, it was not until 1982 that comprehensive exchange controls were applied.

The exchange control system failed to evolve an appropriate mechanism for foreign exchange allocation. This led to the development of a dual exchange rate system, comprising of the first and second tier foreign exchange market which was adopted in September 1986. The first tier was managed while the second tier was subjected to market forces. Not only has there been a metamorphosis of the institutional frame work from second tier foreign exchange market (SFEM) to foreign exchange market (FEM) to inter -bank foreign exchange market (IFEM) to Autonomous Foreign Exchange market (AFEM) e.t. c, there have been frequent changes in operational guidelines and procedures. Various pricing methods, marginal and weighted average exchange rates determinations and the Dutch Auction System (DAS) among other have also been adopted .

All those aimed at ensuring more efficient allocation and utilization of scarce foreign exchange resources, to enhance the flow of capital into the country, stimulates domestic industrial production, promote export, increase revenue to the government, help reschedule our foreign debt at more profitable terms etc.

When there are fluctuations in foreign exchange rates, various economic activities are usually affected such as the purchasing power, balance of payment, prices of goods and services, import structure, export earning, government revenue, external reserves among others.

1.2. STATEMENT OF THE PROBLEM

Since September 1986, when the market determined exchange rate system was introduced via the second tier foreign exchange market, the naira exchange rate has exhibited the features of continuous depreciation and instability.

This instability and continued depreciation of the naira in the foreign exchange market has resulted in declines in the standard of living of the populace, increased cost of production which also leads to cost push inflation. It has also tended to undermine the international competitiveness of non-oil exports and make planning and projections difficult at both micro and macro levels of the economy. A good number of small and medium scale enterprises have been strangled out as a result of low dollar/ naira exchange rate and so many other problems resulting from fluctuations in exchange rates can also be identified.

This movement of the exchange rate along the path of depreciation since 1986 has raised a lot of questions on the impact of exchange rate policies on the Nigerian economy.

Being the main force driving the global economic market, currency is no doubt an essential element for a country. However, in order for all the countries with

different currencies to trade with one another, a system of exchange rate between their currencies is needed; this system, is
formally known as foreign exchange or currency exchange. In the early days, the system of currency exchange is supported solely by the gold amount held in the vault of a country. However, this system is no longer appropriate now due to inflation and hence, the value of one's currency nowadays is determined through the market forces alone. In order to determine the value of a currency's exchange rate, two main types of system is used which is floating currency or pegged currency..

For floating exchange rate, its value is determined by the supply and demand of the global market where the supply and demand is bound by all these factors such as foreign investment, inflation and ratios of import and export. Normally, this system is adopted by most of the advance countries like for example UK, US and Canada. All of these countries have a similarity where their market is well developed and stable in economic terms. These countries choose to practice this system due to the reason where floating exchange rate is proven to be much more efficient compared to the pegged exchange rate. The reason behind this is because for floating exchange rate, the market itself will re-adjust the exchange rate real-time in order to portray the actual inflation and other economic forces. However, every system has its own flaw and so does the floating exchange rate system. For instance, if a country suffers from economic instability due to various reasons such as political issues, a floating exchange rate system will certainly discourage investment due to the high risk of suffering from inflationary disaster or sudden slum in exchange rate.

Another form of exchange rate is known as pegged exchange rate. This is a system where the value of the exchange rate is fixed by the government of a country and not the supply and demand of the market. This system is called pegged exchange rate because the value of a country's currency is fixed to another country's currency. As a result, the value of the pegged currency will not fluctuate unlike the floating currency. The working principle behind this system is slightly complicated where the government of a country will fixed the exchange rate of their currency and when there is a demand for a certain currency resulting a rise in the exchange rate, the government will have to release enough of that currency into the market in order to meet that demand. However, there is a fatal flaw in this system where if the pegged exchange rate is not controlled properly, panics may arise within the country and as a result of that, people will be rushing to exchange their money into a more stable currency. When that happens, the sudden overflow of that country's currency into the market will decrease the value of their exchange rate and in the end, their currency will be worthless. Due to this reason, only those under-developed or developing countries will practice this method as a form to control the inflation rate. However, the truth is, most of the countries do not fully practice the floating exchange rate or the pegged exchange rate method in reality. Instead, they use a hybrid system known as floating peg. Floating peg is the combination of the two main systems where one country will normally fixed their exchange rate to the US Dollars and after that, they will constantly review their peg rate in order to stay in line with the actual market value.

The Foreign exchange market, or commonly known as FOREX, is the largest and most prolific financial market because each day, more than I trillion worth of currency exchange takes place between investors, speculators and countries. From this, we can deduce that the actual mechanism behind the world of foreign exchange is far more complicated than what we may already know, and that, the information mentioned earlier is just the tip of an iceberg.

1.3 AIM AND OBJECTIVES OF THIS STUDY

- The main aim of this work is to fit an appropriate model to the exchange rate series (naira/euro) for the period of 12 years from January 2012 - December 2023 and the objectives are to :
- Identify the suitable ARIMA model for the exchange rate series.

- Estimate the identified model.
- Diagnose or check the adequacy of the model.
- Forecast for future values of exchange rate using the fitted model.

1.4 SCOPE OF THE STUDY

The data extracted from the records of the Milly Forex Academy will be used for the study. The data set will consider the monthly Naira /Euro exchange rate only for the duration of 12 years from January 2012 - December 2023.

1.5 ORGANIZATION OF CHAPTERS

The organization of the project in chapters which are describe as:

- Chapter Two: in this aspect of the project a review on exchange rate and time series will be discussed.
- Chapter Three: A methodology for analysis was done based on time series, which is well explained in this chapter
- Chapter Four: The analysis for this project is carried out in this aspect of the project to clearly explain the affore- mentioned Aim and Objectives.
- Chapter Five: Summary and Conclusion on the analysis are being made to look at the depreciation of Naira against Euro

CHAPTER TWO

LITERATURE REVIEW

2.1 EXCHANGE RATE

In finance, an exchange rate (also known as a foreign-exchange rate, forex rate, FX rate or Agio) between two currencies is the rate at which one currency will be exchanged for another. It is also regarded as the value of one country's currency in terms of another currency. For example, an interbank exchange rate of 119 Japanese Yen (JPY, ¥) to the United States dollar (USS) means that ¥l 19 will be exchanged for each US$I or that US$I will be exchanged for each VI 19. In this case it is said that the price of a dollar in terms of yen is ¥l 1 9, or equivalently that the price Of a yen in terms of dollars is $ 1/119.

Exchange rates are determined in the foreign exchange market, which is open to a wide range of different types of buyers and sellers where currency trading is continuous: 24 hours a day except weekends, i.e. trading from 20:15 GMT on Sunday until 22:00 GMT Friday. "_ the spot exchange rate refers to the current exchange rate. The forward exchange rate refers to an exchange rate that is quoted and traded today but for delivery and payment on a specific future date. Most trades are to or from the local currency. The buying rate is the rate at which money dealers YGII buy foreign currency, and the selling rate is the rate at which they will sell In the retail currency exchange market, a different buying rate and selling rate will be quoted by the currency. The quoted rates will incorporate an allowance for a dealer's margin (or profit) in trading, or else the margin may be recovered in the form of a commission or in some other way. Different rates may also be quoted for cash (usually notes only), a documentary form (such as traveler's cheques) or electronically (such as a credit card purchase). The higher rate on

documentary transactions have been justified to compensate for the additional time and cost of clearing the document, while the cash is available for resale immediately. Some dealers on the other hand prefer documentary transactions because of the security concerns with cash.

2.2 THE RETAIL EXCHANGE MARKET

Currency for international travel and cross-border payments is predominantly purchased from banks, foreign exchange brokerages and various forms of Bureau de change. These retail outlets source currency off the inter-bank markets which are valued by the Bank for International Settlements at $5.3 trillion-dollar-per-day. The purchase price is conducted at the spot contract rate. The process of selling currency on to retail clients will involve the charge of commission to cover processing costs while also deriving profit. Additional gains are realized by the quotation of an exchange rate that differs to the original spot rate. This difference is referred to as the bidask spread. In determining their own bid and ask price the retail provider is therefore the Market maker of the retail currency market which confirms this market as being determined on discretion.

A currency pair is the quotation of the relative value of a currency unit against the unit of another currency in the foreign exchange market. The quotation EUR/IJSD 1.11 means that I Euro is able to buy 1.11 US dollar. In other words, this is the price of a unit of Euro in US dollar. Here, EUR is called the "Fixed currency", while USD is called the "Variable currency".

There is a market convention that determines which is the fixed currency and which is the variable currency. In most parts of the world, the order is: EUR GBP - AUI) NZD USD others. Accordingly, a conversion from EUR to AUD, EUR is the fixed currency, AUD is the variable currency and the exchange rate indicates how many Australian dollars would be paid or received for 1 Euro. Cyprus and Malta which were quoted as the base to the USD and others were recently removed from this list when they joined the Eurozone.

In some areas of Europe and in the non-professional market in the UK, EUR and GBP are reversed so that GBP is quoted as the base currency to the euro. In order to determine which is the base currency where both currencies are not listed (i.e. both are "other"), market convention is to use the base currency which gives an exchange rate greater than 1.000. This avoids rounding issues and exchange rates being quoted to more than four decimal places. There are some exceptions to this rule, for example, the Japanese often quote their currency as the base to other currencies.

Quotes using a country's home currency as the price currency (for example, EUR 0.9009 USD 1.00 in the Eurozone) are known as direct quotation or price quotation (from that country's perspective) and are used by most countries.

Quotes using a country's home currency as the unit currency (for example, USD 1.11 EUR I .00 in the Eurozone) are known as indirect quotation or quantity quotation and are used in British newspapers and are also common in Australia, New Zealand and the Eurozone.

Using direct quotation, if the home currency is strengthening (that is, appreciating, or becoming more valuable) then the exchange rate number decreases. Conversely, if the foreign currency is strengthening, the exchange rate number increases and the home currency is depreciating.

2.3 EXCHANGE RATE REGIME

Each country, through varying mechanisms, manages the value of its currency. As part of this junction, it determines the exchange rate regime that will apply to its currency. For example, the currency may be free-floating, pegged or fixed, or a hybrid.

If a currency is free-floating, its exchange rate is allowed to vary against that of other currencies and is determined by the market forces of supply and demand. Exchange rates for such currencies are likely to change almost constantly as quoted on financial markets, mainly by banks, around the world.

A movable or adjustable peg system is a system of fixed exchange rates, but with a provision for the revaluation (usually devaluation) of a currency. For example, between 1994 and 2005, the Chinese yuanrenminbi (RMB) was pegged to the United States dollar at RMB 8.2768 to $1. China was not the only country to do this; from the end of World War Il until 1967, Western
European countries all maintained fixed exchange rates with the US dollar based on the Bretton Woods system. But that system had to be abandoned in favor of floating, market-based regimes due to market pressures and speculations according to President Richard M. Nixon in a speech that he delivered on August 15, 1971 in what is known as Nixon Shock.

Still, some governments strive to keep their currency within a narrow range. As a result, currencies become over-valued or under-valued, leading to excessive trade deficits or surpluses.

2.4 FLUCTUATIONS IN EXCHANGE RATES

A market-based exchange rate will change whenever the values of either of the two component currencies change. A currency will tend to become more valuable whenever demand for it is greater than the available supply. It will become less valuable whenever demand is less than available supply (this does not mean people no longer want money, it just means they prefer holding their wealth in some other form, possibly another currency).

Increased demand for a currency can be due to either an increased transaction demand for money or an increased speculative demand for money. The transaction demand is highly correlated to a country's level of business activity, gross domestic product (GDP), and employment levels. The more people that are unemployed, the less the public as a whole will spend on goods and services. Central banks typically have little difficulty adjusting the available money supply to accommodate changes in the demand for money due to business transactions.

Speculative demand is much harder for central banks to accommodate, which they influence by adjusting interest rates. A speculator may buy a currency if the return (that is the interest rate) is high enough. In general, the higher a country's interest rates, the greater will be the demand for that currency. It has been argued that such speculation can undermine real economic growth, in particular since large currency speculators may deliberately create downward pressure on a currency by shorting in order to force that central bank to buy their own currency to keep it stable. (When that happens, the speculator can buy the currency back after it depreciates, close out their position, and thereby take a profit). For carrier companies shipping goods from one nation to another, exchange rates can often impact them severely. Therefore, most carriers have a CAF charge to account for these fluctuations.

2.5 PURCHASING POWER OF CURRENCY

The real exchange rate (RER) is the purchasing power of a currency relative to another at current exchange rates and prices. It is the ratio of the number of units of a given country's currency necessary to buy a market basket of goods in the other country, after acquiring the other country's currency in the foreign exchange market, to the number of units of the given country's currency that would be necessary to buy that market basket directly in the given country. There are different kinds of measurement for RER. Thus the real exchange rate is the exchange rate times the relative prices of a market basket of goods in the two countries. For example, the purchasing power of the US dollar relative to that of the euro is the dollar price of a euro (dollars per euro) times the euro price of one unit of the market basket (euros/goods unit) divided by the dollar price of the market basket (dollars per goods unit), and hence is dimensionless. This is the exchange rate (expressed as dollars per euro) times the relative price of the two currencies in terms of their ability to purchase units of the market basket (euros per goods unit divided by dollars per goods unit), If all goods were freely tradable, and foreign and domestic residents purchased identical baskets of goods, purchasing power parity (PPP) would hold for the exchange rate and GDP deflators (price levels) of the two countries, and the real exchange rate would always equal 1.

the rate of change of the real exchange rate over time for the euro versus the dollar equals the rate of appreciation of the euro (the positive or negative percentage rate of change of the dollarsper-euro exchange rate) plus the inflation rate of the euro minus the inflation rate of the dollar.

2.6 BALANCE OF PAYMENTS MODEL

The balance of payments model holds that foreign exchange rates are at an equilibrium level if they produce a stable current account balance. A nation with a trade deficit will experience a reduction in its foreign exchange reserves, which ultimately lowers (depreciates) the value of its currency. A cheaper (undervalued) currency renders the nation's goods (exports) more affordable in the global market while making imports more expensive. After an intermediate period, imports will be forced down and exports to rise, thus stabilizing the trade balance and bring the currency towards equilibrium.

Like purchasing power parity, the balance of payments model focuses largely on trade-able goods and services, ignoring the increasing role of global capital flows. In other words, money is not only chasing goods and services, but to a larger extent, financial assets such as stocks and bonds. Their flows go into the capital account item of the balance of payments, thus balancing the deficit in the current account. The increase in capital flows has given rise to the asset market model effectively.

2.7 ASSET MARKET MODEL

Manipulation of exchange ratcs

A country may gain an advantage in international trade if it controls the market for its currency to keep its value low, typically by the national central bank engaging in open market operations. In the early twenty-first century it was widely asserted that the People's Republic of China had been doing this over a long period of time.[12]

Other nations, including Iceland, Japan, Brazil, and so on also devalue their currencies in the hopes of reducing the cost of exports and thus bolstering their economies. A lower exchange rate lowers the price of a country's goods for consumers in other countries, but raises the price of imported goods and services, for consumers in the low value currency country.

In general, a country that exports goods and services will prefer a lower value on their currencies, while a country that imports goods and services will prefer a higher value on their currencies.

2.8 EURO (€)ISO CODE: EUR

The euro (sign:€;code: EUR)is the official currency of the eurozone, which consists of 19 of the 28 member states of European union :Austria, Belgium, Cyprus ,Estonia, Finland, Germany, Greece, Ireland, Italy, Lativa, Lithuania, Luxemborg, Malta, the Netherlands, Portugal, Slovakia, Slovenia and Spain.

The euro came into existence on 1 January 1999, although it had been a goal of the European

Union (EU) and its predecessors since the 1960s.After tough negotiations, particularly due to opposition from the united kingdom the Maastricht Treaty entered into force in 1993 with the goal of creating an economic and monetary union by 1999 for all EU states except the UK and Denmark (even though Denmark has a fixed exchange rate policy with euro)

In 1999 the currency was born virtually and in 2002 notes and coins began to circulate. It rapidly took over from the former national currencies and slowly expanded the rest of the EU.In 2009 the Lisbon treaty finalized its political authority, the Eurogroup, alongside the European Central Bank.

The currency was introduced in non-physical form (traveler's . cheques, electronic transfers, banking, etc.) at midnight on I January 1999, when the national currencies of participating countries (the eurozone) ceased to exist independently in that their exchange rates were locked at fixed rates against each other, effectively making them mere non-decimal subdivisions of the euro. The euro thus became the successor to the European Currency Unit(ECU).The notes and coins for the old currencies, however, continued to be use as legal tender until new notes and coins were introduced on I January 2002 and dealers were surprised by the speed at which it replaced the national currencies. By the speed at which it replaced the national currencies 2002(having been distributed in small amounts in the previous December).Beginning on I Januaryl 999,11 bonds and other forms of government debt by eurozone nations were denominated in Euros.

The value of the euro which started at the USD 1.1686 on 31 December 1998, rose during its first day of trading, Monday,4 January 1999, closing at approximately USD 1.18.It was rapidly taken up and dealers were supposed by the speed at which it replaced the national currencies by the speed at which it replaced national currencies.

2.9 TIME SERIES

A time series is a sequence of observations that are arranged according to the time of their outcomes. The order of taking the observations is considered at equal time intervals. In other words, time series is a collection of observations taken sequentially in time. This can be used to model, stimulate and forecast behavior of a system. Time series models are frequently used in fields such as economic, finance, biology, and engineering. Mostly, these observations are collected at equally spaced, discrete intervals. When there is only one variable upon which observations are made we call them single time series or more specifically a univariate time series.

Examples of time series include:

- The annual crop yield of sugar-beets and their price per ton for example is recorded in agricultures
- The newspapers' business sections report daily stock prices, weekly interest rates, monthly rates of unemployment and annual turnovers
- Meteorology records hourly wind speed, daily maximum and minimum temperature and annual rainfall.

2.10 COMPONENTS OF TIMES SERIES

It is customary to consider time series variations as being the result of four well defined influences; the trend, the seasonal variation, the cyclical fluctuation and the random or irregular variation.

i. TREND OR SECULAR VARIATION

This is that characteristic of time series which extends consistently through the entire period of time under consideration. The secular trend is the basic long term tendency of a particular activity to grow or decline. Trends, whether deterministic or stochastic. have to be considered for extracting, fitting, and forecasting. A deterministic trend may derive from a definition that prescribes a well-defined formula for increment or decrement as a function of time, such as contractual interest. A stochastic trend is due to random shift of level, perhaps the cumulative effect of some force that endows the series with a long-run change in level. Trends may stem from changes in society, social movements, technology, and social custom.

ii. SEASONAL VARIATION

These are variation that occurs in regular sequence at specific interval of time.

When the series is characterized by a substantial regular annual variation, one must control for the seasonality as well as trend in order to forecast. The periodic annual changes in the series may follow from yearly changes in weather such as temperature,

Reasons for studying seasonal variation;

- The description of the seasonal effect provides a better understanding of the impact this component has upon a particular series.

- Eliminating the seasonal pattern from the time series to study the effect of other components.

O To project the past pattern into the future, knowledge of the seasonal variations is a must in the prediction of the future trend.

CYCLICAL VARIATION

This refers to the long term movement that represent consistent recurring rises and decline in activity. The cyclical component is the fluctuation above and below the long-term trend line. Cyclical fluctuations in times of a business activity are usually called business cycle. A typical business cycle consists of a period of prosperity followed by periods of recession, depression, and then recovery with no fixed duration of the cycle. They are sizable fluctuations unfolding over more than one year in time above and below the secular trend. In a recession, for example, employment, production and many other business and economic series are below the long-term trend lines. Conversely, in periods of prosperity they are above their long-term trend lines. These oscillations or cycles may be periodic and may not. That is, they may follow exactly similar pattern after equal intervals of time. Where trend and cycle are not separated from one another, the series component is called the trend-cycle.

RANDOM IRREGULAR VARIATION

These are variations that occur in a completely unpredictable fashion. Random variations are due to unforeseeable forces and may be the result of wars, strikes, floods, fire, earthquakes, or some political events.

It occurs if the variation from one observation to the other in time is due to random movement.

That is, it is a form or a type of variation that is due to sporadic movements.

2.11 THE TIME PLOT: This is the graph of observation Ytagainst time t. it is the first Stepto take in time series analysis. It depicts some characteristics of interest that are present in the series like the trend and the seasonal variation.

2.12 USES OF TIME PLOT

1. Time plot shows the features of the series as trend, seasonality and discontinuities
2. It makes the visual display easier to read
3. The plot helps to describe the given data and formulate a sensible model
4. It shows that a continuous time scale exist between the plotted line.

CHAPTER THREE
METHODOLOGY

3.0 TIME SERIES

A Research is best explained as a process of coming about an independent solution to a problem through the systematic collection, analysis and interpretation of data. This chapter entails the data collection methods, sources of data, and methods of data analysis.

3.1 SOURCES AND NATURE OF DATA USED

The data used is secondary data that was obtained from the records of **Milly-Forex Academy** on Naira/Euro monthly exchange rate for the period of 12years (2012-2023).

3.2 ANALYSIS SOFTWARE

Data entry was by the use of the computer package, Microsoft Excel, and then exported to statistical package SPSS for analysis.

3.3 DATA ANALYSIS

A time series is a sequence of observations that are arranged according to the time of their outcomes, The order of taking the observations is considered at equal time intervals. In other words, time series is a collection of observations taken sequentially in time. This can be used to model, stimulate and forecast behavior of a system. Time series models are frequently used in fields such as economic, finance, biology, and engineering. Mostly, these observations are collected at equally spaced, discrete intervals. When there is only one variable upon which observations are made we call them single time series or more specifically a univariate time series.

Examples of time series include:

- The annual crop yield of sugar-beets and their price per ton for example is recorded in agricultures
- The newspapers' business sections report daily stock prices, weekly interest rates, monthly rates of unemployment and annual turnovers
- Meteorology records hourly wind speed, daily maximum and minimum temperature and annual rainfall. (Gujarati 2004)

3.4 COMPONENTS OF TIMES SERIES

It is customary to consider time series variations as being the result of four well defined influences; the trend, the seasonal variation, the cyclical fluctuation and the random or irregular variation.

TREND OR SECULAR VARIATION

This is that characteristic of time series which extends consistently through the entire period of time under consideration. The secular trend is the basic long term tendency of a particular activity to grow or decline. Trends, whether deterministic or stochastic, have to be considered for extracting, fitting, and forecasting. A deterministic trend may derive from a definition that prescribes a well-defined formula for increment or decrement as a function of time, such as contractual interest. A stochastic trend is due to random shift of level, perhaps the cumulative effect of some force that endows the series with a long-run change in level. Trends may stem from changes in society, social movements, technology, and social custom.

SEASONAL VARIATION

These are variation that occurs in regular sequence at specific interval of time.

When the series is characterized by a substantial regular annual variation, one must control for the seasonality as well as trend in order to forecast. The periodic annual changes in the series may follow from yearly changes in weather such as temperature,

Reasons for studying seasonal variation;

- The description of the seasonal effect provides a better understanding of the impact this component has upon a particular series.
- Eliminating the seasonal pattern from the time series to study the effect of other components.
- To project the past pattern into the future, knowledge of the seasonal variations is a must in the prediction of the future trend.

CYCLICAL VARIATION

This refers to the long term movement that represent consistent recurring rises and decline in activity. The cyclical component is the fluctuation above and below the long-term trend line. Cyclical fluctuations in times of a business activity are usually called business cycle. A typical business cycle consists of a period of prosperity followed by periods of recession, depression, and then recovery with no fixed duration of the cycle. They are sizable fluctuations unfolding over more than one year in time above and below the secular trend. In a recession, for example, employment, production and many other business and economic series are below the long-term trend lines. Conversely, in periods of prosperity they are above their long-term trend lines. These oscillations or cycles may be periodic and may not. That is, they may follow exactly similar pattern after equal intervals of time. Where trend and cycle are not separated from one another, the series component is called the trend-cycle.

RANDOM [IRREGULAR VARIATION

These are variations that occur in a completely unpredictable fashion. Random variations are due to unforeseeable forces and may be the result of wars, strikes, floods, fire, earthquakes, or some political events.

[t occurs if the variation from one observation to the other in time is due to random movement.

That is, it is a form or a type of variation that is due to sporadic movements.

3.5 TIME SERIES MODELS

A model is used to estimate the influence of each of the components mentioned above and also to know their relationships. The time series model is of two forms. These are;

The Additive Model for a Time Series

I*he additive model for a given time series . . ., yn is the assumption that these data are realizations of random variables Yt that are themselves sums of the four components

$Y_t = {}^{rT}rt + St + Ct + It$

$t = 1, \ldots, n$

Where,

T_t s a (monotone) function of t, called trend or secular trend omponent.

C_t denotes some non-random long term cyclic influence.

S_t denotes the seasonal component.

I_t is a random or erratic component.

Here, the components C, S, .1 will have positive or negative values individually according to whether the values are below or above the trend line. The yt should be sum up to zero.

The Multiplicative model of a Time Series

The four components contribute to the model, and are related in the following manner.

Y_t=% x S_t X C_tX I_t

= 1, . . . ,n

Where,

Yt is the product of the variables T S C I which produce the trend, seasonal, cyclical and irregular variations respectively.

rt is a (monotone) function of t, called trend or secular trend component.

Ct denotes some non-random long term cyclic influence.

St denoteS the seasonal component.

$I_t$is a random or erratic component.

Isolating those parts of the overall variation of a time series that are traceable to each of those four components independently are major aims of a Time Series analysis.

3.6 ESTIMATION AND ELIMINATION OF TREND

The following methods are used in the estimation of Trend of a Time Series.

i. The Least Square Method; The least squares method is used to find the best linear relationship between two variables. The long-term trend of many business series, such as sales, exports, and production, often approximates a straight line. If so, the equation to describe this growth is:

LINEAR TREND EQUATION:

$$Y = \alpha + \beta t$$

Where:

Y-is the projected value of the Y variable for a selected value of t.
a -is the Y-intercept. It is the estimated value of ' Y' when 1=0.
β-Is the slope of the line, or the average change in 'Y for each change of one

Unit in t.

t-is any value of time that is selected.

$$\hat{\beta} = \frac{n\sum tYt - \sum t\sum Yt}{n\sum t^2 - (\sum t)^2} \quad \text{and}$$

$$\hat{\alpha} = \sum(Y/n) - \beta\sum(t/n)$$

So that when $\sum(Y - \bar{y})^2$ is minimized, the trend value T will be obtained.

ii. The Semi average Method: it involves dividing the data into two equal parts and finding the mean of each part. The two points are plotted on the graph and a straight line is drawn to join the points. Its major advantage is that it is straight forward and

easy to apply. It is however not appropriate when the trend is non-linear. It also gives poor estimates of the trend because it is crude

iii. Free hand Method: here a trend line is drawn through the series. It consists of drawing a trend line or curve simply by looking at the time plot. This method has the disadvantage of depending too much on individual judgement.

iv. The Moving Average Method: By using moving average of appropriate orders, cyclical, seasonal, and irregular patterns may be eliminated. This is accomplished by "moving" the arithmetic mean values through the time series. One disadvantage of this method is that data at the beginning and the end of the series are lost, Moving average may generate cycles or other movements not originally present in the data.

3.7 ESTIMATION OF SEASONAL VARIATION

The seasonal variation can •be determined by estimating how the time series data vary from month to month throughout the year and the average of each month is called the seasonal index. A typical set of monthly indexes consists of 12 indexes that are representative of the data for a 12-month period. Logically, there are four typical seasonal indexes for data reported quarterly. Each index is a percent, with the average for the year equal to 100; that is, each monthly index indicates the level of sales, production, or another variable in relation to the annual average of 100. Note that, the sum of the 12-month index number should be 1 a monthly series) and the sum of four quarters should be 400% (for quarterly series).

Methods of computing seasonal index:

i. THE AVERAGE PERCENTAGE METHOD: the data for each month are expressed as percentages of the average for the year.

ii. THE PERCENTAGE TREND OR RATIO TO TREND METHOD: the data for each month are expressed as percentages for monthly trend values and appropriate average of this percentage for corresponding months gives the required index numbers.

iii. THE LINK RELATIVE METHOD: the data for each month are expressed as percentages of the previous month. These percentages are called 'link relatives' since they link each month to the preceding month and then an appropriate average for the link relatives for corresponding months is then taken.

iv. **P**ERCENTAGE MOVING AVERAGE OR RATIO TO MOVING AVERAGE METHOD;

The three-step procedure yields a seasonal index for each period;

Step 1: find the centred 12 monthly (or 4 quarterly) moving averages of the original data values in the time series

Step 2: express each original data value of the time series as a percentage of the corresponding centred moving average values obtained in step (1).

i.e. $\frac{T*S*C*I}{T*C}$ X 100 = S*I X 100. This implies that ratio to moving average represents

the seasonal and irregular components.

Step 3: arrange these percentages according to months or quarters of the given years. Find the average over all months or quarters of the given years. (Gupta)

3.8 DESEASONALIZATION OF DATA

The reason for Deseasonalizing the exchange rate series is to remove the seasonal fluctuations so that the trend and cycle can be studied. Using the multiplicative model, to remove the effect ()f seasonal variation, the observation for each month (which contains trend, cyclical, irregular,

and seasonal effects) is divided by the seasonal index for that month. That is,

$$\frac{TSCI}{S} = \text{TCI}$$

3.9 ESTIMATION OF CYCLICAL VARIATION

After the data has been deseasonalized, they can be adjusted for trend by simply dividing the data by corresponding trend values. Adjusting for seasonal variation and trend corresponds to division by *'ST'* which gives *'CT.* An appropriate moving average of a few months duration (3, 5

or 7) months can be used to obtain the cyclical variation.

3.10 ESTIMATION OF IRREGULAR VARIATION.

his can be achieved by adjusting data for trend, seasonal or cyclical variations. This amounts to division of original data 'Y' by 'T, S & C'. In practice it is found that irregular movements tend to be of small magnitude and that they often tend to follow the pattern of a normal distribution. That is, small deviations occur with small frequency.

3.11 AUTOCORRELATION FUNCTION (ACF) AND CORRELOGRAM

One simple test of stationarity is based on the so-called autocorrelation function (ACF). The ACF at lag k, denoted by Pk , is defined as

$$\rho_k = \frac{\gamma_k}{\gamma_0} = \frac{covariance\ at\ lag\ k}{variance\ at\ lag\ k}$$

Since both covariance and variance are measured in the same units of measurement, Plc is a unitless, or pure, number. It lies between —l and +1, as any correlation coefficient does. If we plot against k, the graph we obtain is known as the population correlogram. Since in practice we only have a realization (i.e., sample) of a stochastic process, we can only compute the sample autocorrelation function (SAFC), . To compute this, we must first compute the sample covariance at lag k, 1k , and the sample variance, , which are defined as

$$\hat{\gamma}_k = \sum_{t=k+1}^{n} (Y_t - \bar{Y})(Y_{t-k} - \bar{Y})$$

$$\hat{\gamma}_0 = \sum_{t=1}^{n} (Y_t - \bar{Y})^2$$

3.12 THE TIME PLOT: This is the graph of observation Ytagainst time t. it is the first Step to take in time series analysis. It depicts some characteristics of interest that are present in the series like the trend and the seasonal variation.

3.13 USES OF TIME PLOT

Time plot shows the features of the series as trend, seasonality and discontinuities It makes the visual display easier to read The plot helps to describe the given data and formulate a sensible model It shows that a continuous time scale exist between the plotted line

3.14 TREND TERMS *d*

The terms needed to make a non-stationary time series stationary. A model with two trend terms *(d=2)* has to be differenced twice to make it stationary. The first difference removes linear trend; the second difference removes quadratic trend. In other words, the series tend to be stationary if there exists no trend, seasonality, and cyclic variation

3.15 STATIONARITY AND NON-STATIONARITY

Data points are said to be stationary if there is a constant mean and variance over time i.e they are time invariant. In other words, the series tend to be stationary if there exists no trend, seasonality, and cyclic variation, otherwise it is non stationary .

3.16 LAG:

The time periods between two observations. For example, lag 1 is between Y_t and Y_{t-1}.Lag 2 is between Y_t and Y_{t-2}. Time series can also be lagged forward, Y_t and Y_{t+1}

3.17 DIFFERENCING: This simply means calculating differences among pairs of observations at some lag to make a non-stationary series stationary.

3.18 UNIT ROOT TEST

For a univariate time series, the Unit Root test is frequently employed for testing stationarity. The test first poses the null hypothesis that the given time series has a unit root, which means that the time series is non-stationary, and tests if the null hypothesis is to be

statistically rejected in favor of the alternative hypothesis that the given time series is stationary. To detect whether a given series has non stationarity, let's assume that the relationship between current value (in time t) and last value (in time t - 1) in the time series is as follows (Enders, 1995):

$$Y_t = \rho Y_t + \mathcal{E}_t$$

Where Yt an observation value at time t, Et is a white noise process. This model is a first order autoregressive process. The time series Yt converges, as t* co, to a stationary time series if p < l . If p = lor > 1, the series Yt is not stationary and the variance of Yt is time dependent (Diebold et al., 2006). In other words, the series has a unit root. The Unit Root test subsequently tests the following one-sided hypothesis

Ho : p =1 (has a unit root)

HI : p< 1 (has root outside the unit circle)

A well-known test that is valid in large samples is the Augmented Dickey-Fuller test. The optimal finite sample tests for a unit root in autoregressive models were developed by John Denis Sargan and AlokBhargava. Other tests are the Phillips-Perron (PP) and KwiatkowskiPhillips-Schmidt-Shin (KPSS) tests. These tests use the existence of a unit root as the null hypothesis.

3.19 Augmented Dickey-Fuller Test

An. Augmented Dickey-Fuller test (ADF) is a test for a unit root in a time series sample. it is an augmented version of the Dickey-Fuller test for larger and more complicated set of time series models. The Augmented Dickey-Fuller (ADF) statistic, used in the test, is a negative number. The more negative it is, the stronger the rejection of the hypothesis that there is a unit roots at some level of confidence.

3.20 Testing Procedure:

. The testing procedure for the ADF test is the same as for the [Dickey-Fuller test] but it is applied to the model.

$$\Delta y_t = \alpha + \beta t + \gamma\, y_{t-1} + \delta_1 y_{t-1} + \ldots + \delta_{p-1} \Delta_{y t-p-1} + \varepsilon_t$$

Where u is a constant, [3 the coefficient on a time trend and p the lag order of the autoregressive process. Imposing the constraints u 0 and 0 corresponds to modeling a random walk and using the constraint ß — 0 corresponds to modeling a random walk with a drift. Consequently, there are three main versions of the test to test for the presence of unit root, the first is pure random walk, the second a ran dom walk with an intercept or a drift term and the third model includes a drift and linear time trend. By including lags of the order "p" the ADF formulation allows for higher-order autoregressive processes. This means that the lag length "p" has to be determined when applying the test. One possible approach is to test down from high orders and examine the [t-valuel on coefficients. An alternative approach is to examine information criteria such as the [Akaike information criterion] and [Bayesian information criterion] . The unit root test is then carried out under the null hypothesis y 0 against the alternative hypothesis of 0, Once a value for the test statisticis computed, it can be compared to the relevant critical value for the Dickey-Fuller Test. If the test statistic is less (this test is non-symmetrical so we do not consider an absolute value) than (a larger negative) the critical value, then the null hypothesis of y 0 is rejected and no unit root is present.

3.21 AUTOCORELLATION

Correlations among sequential scores at different lags. The lag 1 autocorrelation coefficient is similar to correlation between the pairs of scores at adjacent points in time,

$r_{y_t, y_{t-1}}$ (e.g., the pair at time 1 and time 2, the pair at time 2 and time 3, and so on). The lag 2 autocorrelation coefficient is similar to correlation between the pairs of scores two time periods apart, ryt,yt-2 (e.g., the pair at time 1 and time 3, the pair at time 2 and time 4, and so on).

3.22 THE PROBABILISTIC TIME SERIES MODELS

AUTOREGRESSIVE MODELS: Autoregressive models are based on the idea that the current value of the series,Yt, can be explained as a function of p past values, Y_{t-1}, Yt_2, ... , Y_{t-p}, where p determines the number of steps into the past needed to forecast the current value.

An autoregressive model of order p, abbreviated AR (p), can be written as:

$$Y_t = C + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \ldots + \phi_p Y_{t-p} + \varepsilon_t$$

Where Y_t stationary series is $\phi_1, \phi_2, \ldots, \phi_p$ are the parameters of AR ($\phi_p \neq 0$) and C is a constant term. Unless otherwise stated, we assume that ε_t is a Gaussian white noise series with mean zero and variance $\sigma^2{}_w$. The highest order p is referred to as the order of the model. The model inlag operators takes the following form:

$$(1 - \phi_1 B - \phi_2 B^2 - \ldots - \phi_P B^P) Y_t = \varepsilon_t$$

Where the lag (back shift) operator B is defined as:

$$B^P Y_t = Y_{t-p},\ p = 0, 1, 2, \ldots$$

More concisely we can express the model as:

$$\Phi(B)\, Y_t = \varepsilon_t$$

The autoregressive operator Φ(B) is defined to be

$$\Phi(B) = 1 - \Phi_1(B) - \Phi_2(B)^2 - \ldots - \Phi_p(B)^p$$

$$\Phi(B) = 1 - \sum_{i=1}^{p} \phi_i B^i$$

The values of (I) which make the process stationary are such that the roots of lie outside the unit circle in the complex plane (Chatfield, 1991). If all roots of (D(B) are larger than one in absolute value, then the process is a stationary process satisfying the autoregressive equation and can be represented as:

$$Y_t = \sum_{j=0}^{\infty} \psi_j \varepsilon_{t-j}$$

The coefficients zpj converge to zero, such that

$$\sum_{j=0}^{\infty} |\psi_j| < \mathbf{00.}$$

if some roots are "exactly" one in modulus, no stationary solution exists. A plot of the ACF of a stationary AR (p) model show a mixture of damping sine and cosine patterns and exponential decays depending on the nature of its characteristic roots. Another characteristics feature of AR (p) models is that the partial autocorrelation function defined as PACF $(j) = (Y_t, Y_{t-j} | Y_{t-1}, Y_{t-2}, \ldots, Y_{t-j+1})$ becomes "exactly" zero for values larger than p (Tsay, 2005).

MOVING AVERAGE MODEL As an alternative to the autoregressive representation in which the Yton the left-hand side of the equation are assumed to be combined linearly, the moving average model of order q, abbreviated as MA (q), assumes the white noise (ED on the right-hand side of the defining equation are combined linearly to form the observed data. A series Yt is said to follow a moving average process of order q, or simply MA (q) process if

$$Y_t = \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \ldots + \theta_q \varepsilon_{t-q}$$

Where *θ1, θ2, . . , θq* are the MA parameters. MA (q) models immediately define stationary, every MA process of finite order is stationary (Diebold et al., 2006). In order to preserve a unique representation, usually the requirement is imposed that all roots of θ (B) 1+ θ_1B + 92B^2
- . . . –OqB^q = 0 are greater than one in absolute value. If all roots of 9(B) 0 lie outside the unit circle, the MA process has an autoregressive representation of generally infinite order

$$\sum_{j=0}^{\infty} \psi x_{t-j} = \varepsilon$$

With $\sum_{j=0}^{\infty} |\psi_j| < \infty$. MA process as with an infinite order autoregressive representation are said to be invertible. A characteristics feature of MA (q) is that their ACF, becomes statistically insignificant after j q. The property of the ACF should be reflected in the correlogram, which should cut off after q. The PACF converges to zero geometrically.

AUTOREGRESSIVE MOVING AVERAGE (ARMA)

We now proceed with the general development of autoregressive, moving average, and mixed autoregressive moving average (ARMA), models for stationary time series. In most cases, it is best to develop a mixed autoregressive moving average model when building a stochastic model to represent a stationary time series. The order of an ARMA model is expressed in terms of both p and q. The model parameters relate to what happens in period t to both the past values and the random errors that occurred in past time periods. A general ARMA model can be written as follows:

$$Y_t = \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \ldots + \phi_p Y_{t-p} + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \ldots + \theta_q \varepsilon_{t-q}$$

Equation above of the time series model will be simplified by a backward shift operator B to obtain

$\Phi(B)Y_t = (B)\varepsilon_t$

The ARMA model is stable i.e., it has a stationary 'solution' if all roots of (I) (B) = 0 are larger than one in absolute value. The representation is unique if all roots of = 0 lie outside the unit circle. Stable ARMA models always have an infinite order MA representation. If all roots of $\Phi(B)$ are larger than one in absolute value, it has an infinite order AR representation. The process is invertible only when the roots of O(B) lie outside the unit circle. Furthermore, a process is said to be causal when the roots of lie outside the unit circle. To have ARMA (p; q) model, both ACF and PACF should show a pattern of decaying to zero. The autocorrelation of an ARMA (p; q) process is determined at greater lags by the AR (p) part of the process as the effect of the MA part dies out. Thus, eventually the ACF consists of mixed damped exponentials and sine terms. Similarly, the partial autocorrelation of an ARMA (p; q) process is determined at greater lags by the MA (q) part of the process. Thus, eventually the partial autocorrelation function will also

consist of a mixture of damped exponentials and sine waves.

Behavior of the ACF and PACF for ARMA Models

	AR(P)	MA(Q)	ARMA(P,Q)
ACF	**Tails off**	**Cuts off after lags Q**	**Tails off**
PACE	**Cuts off after lags P**	**Tails off**	**Tails off**

AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA)

ARIMA means autoregressive integrated moving average models. Univariate (single vector) is a forecasting technique that projects the future values of a series based entirely on its own inertia. Its main application is in the area of short-term forecasting requiring at least 50 data points. It works best when data exhibits a stable or consistent pattern over time with minimum amount of outlier, sometimes called Box-Jenkins (after the original authors). In statistics and econometrics, and in particular in time series analysis, an autoregressive integrated moving average (ARIMA) model is a generalization of an autoregressive moving average (ARMA) model. These models are fitted to time series data either to better understand the data or to predict future point in the series (forecasting). They are applied in some cases where data show the evidence of non-stationary, where an initial differencing step (corresponding to the integrated part of the model) can be applied to remove the non-stationary. The model is generally referred to as an ARIMA (p, d, q) model where parameter p ,d and q are non-negative integers that refer to the order of the autoregressive, integrated, and moving average parts of the model respectively. ARIMA models form an important part of the Box-Jenkins approach to time series modeling. When one of the three terms is zero, it is usual to drop AR, I, MA.

IV. ARIMA Model: let d be the differenced times, the process is an ARIMA process call the Differenced process Wt. Then Wt is an ARMA process and Wt = $(1 - B)^d$Yt

Here, the model for Yt is non, stationary because the AR operator on the left hand side has d root on the unit circle, if d is 1 and random walk is ARIMA (0, I ,0).

3.23 BOX-JENKINS MODEL IDENTIFICATION

Stationarity and seasonality

The first step in developing a Box-Jenkins model is to determine if the time series is stationary and if there is any significant seasonality that needs to be modeled.

3.24 DETECTING STATIONARITY

Stationarity can be accessed from a run plot sequence plot. The run sequence plot should show constant location and scale. It can also be detected from an autocorrelation plot.

Specifically, non-stationarity is often indicated by an autocorrelation plot with slow decay.

Detecting seasonality

Seasonality (or periodicity) can usually be assessed from an autocorrelation plot, a seasonal subseries plot or a spectral plot.

3.25 Differencing to achieve stationarity

Box-Jenkins recommends the differencing approach to achieve stationarity. However, fitting a curve and subtracting the fitted values from the original data can also be used in the context of Box-Jenkins models.

3.26 NORMALITY OF RESIDUALS.

A model is developed and then normality of residuals is evaluated in time-series analysis Examine the normalized plot of residuals for the model before evaluating an intervention. Transform the data if residuals are not normal. The normalized plot of residuals is examined as part of the diagnostic phase of modeling. The usual square root, logarithmic, or inverse transformations are appropriate in the event of non-normally distributed residuals.

3.27 FORECASTING

Forecasting is the prediction of future value using the present information (data) which are obtained using fitted model ,that is, the model obtained have been identified and estimated.

In order words, it is all about making projection into the future from its past values on the basis of a model that effectively describe the evolution of a series.

However, most forecasting results are derived from the general theory of linear prediction developed by Kolmogorov in 1939 and 1941.

Method of Forecasting includes:

(I) Least square predictor.

(ii) Probability method of forecasting.

(iii)Exponential smoothing method.

CHAPTER FOUR

4.0 PRESENTATION AND ANALYSIS OF DATA

4.1 DATA

YERAS	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
JAN	194.8	212.1	206.97	202.5	200.5	211.7	189.3	171.8	164.8	156.4	174.1	171.6
FEB	204.7	212.7	208.1	206.7	205.5	203.6	186.4	172.3	166.0	153.3	173.0	171.0
MAR	213.7	215.3	201.9	206.0	211.1	201.3	191.3	181.1	168.0	153.1	176.2	164.8
APR	212.1	215.1	202.8	205.0	220.0	186.5	192.2	183.7	171.4	156.2	171.8	159.8
MAY	219.8	213.9	202.3	199.4	219.6	186.5	199.6	181.5	162.3	162.3	168.5	159.7
JUN	220.8	211.6	205.4	193.9	220.2	181.6	205.6	181.4	169.3	160.9	161.6	161.5
JUL	216.8	211.2	203.1	191.5	216.0	189.8	207.3	183.9	172.9	161.2	160.0	162.8
AUG	219.3	207.4	207.2	193.2	216.7	191.9	214.4	174.6	170.7	162.9	162.8	161.6
SEPT	221.2	201	210.2	200.2	211.7	195.9	219.0	169.1	170.6	161.5	158.6	162.0
OCT	221.	197.6	212.7	202.2	208.2	208.3	219.3	154.8	175.3	161.5	155.7	165.9
NOV	211.5	197.6	210.1	199.9	208.7	203.6	223.0	148.5	173.4	155.1	144.9	172.6
DEC	214	207.1	213.4	204.3	206.5	197.2	216.8	174.7	170.6	167.8	153.0	177.9

Table 4. I : Showing the exchange of euro to naira

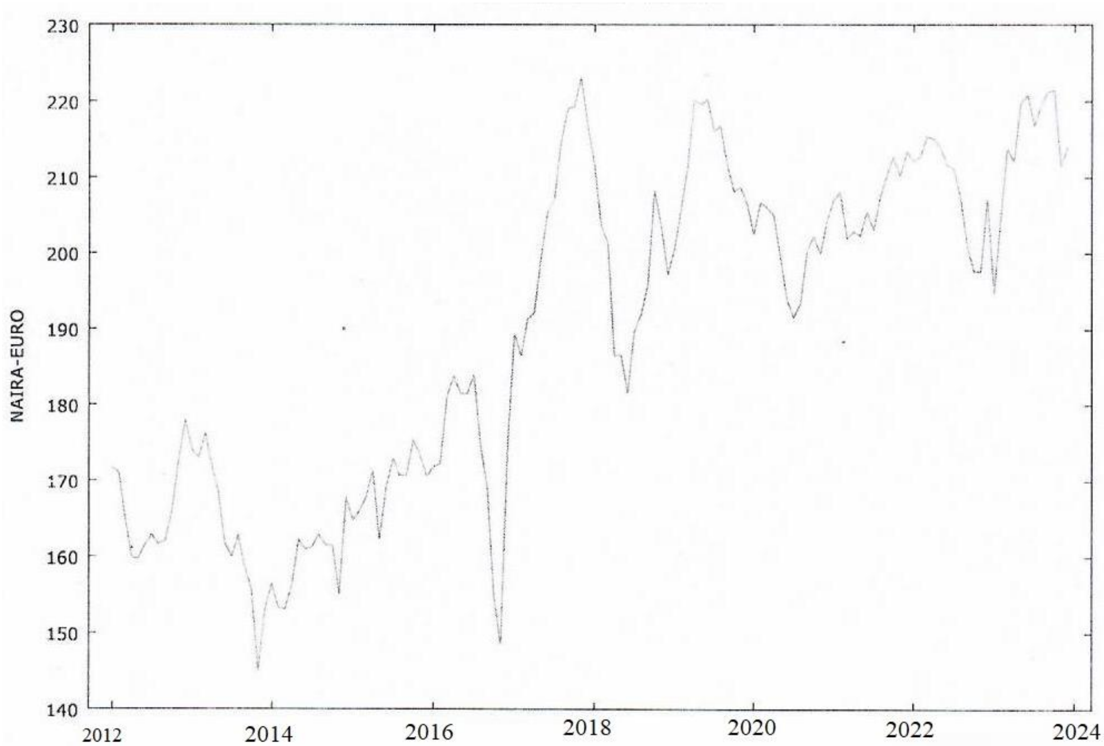
4.2 DATA ANALYSIS

4.3 INTRODUCTION

This chapter presents key findings on the trend and seasonal variation. 11 presents both descriptive analysis and model for the observed data. The choice of the different test statistic used depended on the hypothesis to be tested. The data was obtained from the records of the **Milly-Fx Academy Limited** and directly entered into Microsoft Excel from which it was exported to SPSS, for analysis.

4.4 TIME PLOT FOR THE DATA

TIME PLOT FOR NAIRA-EURO



YEARS

Fig 4. I : Time plot for exchange from euro to naira

Studying the above time plot for the period of 12years, (fig I. seem to be an upward trend in the exchange rate series. To statistically prove the presence of the trend, a least squares regression and testing the significance of the slope was done.

4.6 TEST FOR AUTOCORRELATION HYPOTHESIS

Null hypothesis, Ho: *p*=0 (no autocorrelation)

Vs

Alternative hypothesis, H1: *p*=/O (there exists autocorrelation)

TEST STATISTIC:

The test statistic is Durbin-Watson test

$$DW = \frac{\sum(\varepsilon_t - \varepsilon_{t-1})^2}{\sum \varepsilon_t^2} = 2(1-\rho)$$

α=0.05

DECISION RULE: If DW#2 (i.e. ρ≠0), then reject *Ho* and conclude that there exist autocorrelation.

Model Estimation	
Std. Error of the Estimate	Durbin-Watson
1 1.75529	0.352

"Fable 4.2 Durbin-Watson test statistics

TEST STATISTIC:

The test statistic is Durbin-Watson test

$$DW = \frac{\sum(\varepsilon_t - \varepsilon_{t-1})^2}{\sum \varepsilon_t^2} = 2(1-\rho)$$

a=0.05

DECISION RULE: If DW≠2 (i.e. ρ≠0), then reject H_0 and conclude that there exist autocorrelation.

Using SPSS (Statistical Package for Social Science) the value of

$DW = 0.352$

$$\rho = 1 - \left(\frac{0.352}{2}\right) = 0.176$$

CONCLUSION: Since the Durbin-Watson test of significance shows a positive autocorrelation, we
conclude that autocorrelation between the error term is significant and the fitted model is inadequate.

4.7 ADJUSTING FOR THE AUTOCORRELATION

One of the methods of adjusting for the autocorrelation is by Cochran Orchutte differencing method. The original regression model is replaced by

$$Y_t - \rho Y_{t-1} = \alpha(1-\rho) + \beta\left(T_t - \rho T_{t-1}\right) + \varepsilon_t - \rho\varepsilon_{t-1}, T = 2,3,\cdots,144$$

Where, p is initial autocorrelation coefficient.

T	$T^* = T_t - \rho T_{t-1}$	Yt	$Y_t^* = Y_t - \rho T_{t-1}$
1		194.85	
2	1.176	204.78	44.2236
3	1.352	213.74	45.00128
4	1.528	212.11	35.98824
5	.704	219.85	45.07136
.	.	.	.
.	.	.	.
.	.	.	.
142	25.816	165.91	32.37256
143	5.992	172.67	35.96016
144	26.168	177.95	35.66992

Table 4.3: Showing the adjustment for autocorrelation

4.8 ESTIMATION OF NEW TREND EQUATION

The original model, $\hat{Y}_t = \hat{\alpha} + \hat{\beta} t$ for t = 1,2…,144 is replaced with the new model $Y_t^* = \alpha^* + \beta^* t + \varepsilon_t^*$, for t*=2,3,…,143 n* = n-1=143

Model Summary	
Std. Error of the Estimate	Durbin-Watson
6.63939	1.712

Table 4.4: Showing the new durbin Watson value

Model		Coefficients			P-value
			Std. Error		
	Constant	39.559	1.183	33.434	<O.OOOI
	TIME	460	.076	-6.013	<0.0001

Table 4.5: Coeffients for regression equation for trend

The new trend equation is given as:

$$Y_t^* = 39.559 + 0.460t^*$$

4.9 TESTING FOR AUTOCORRELATION OF THE TRANSFORMED DATA

$$DW = 1.712\ (d \approx 2)$$

$$\rho = 1 - (2/2) = 0$$

CONCLUSION: Since DW 2 and p = 0, we do not reject Ho and therefore conclude that the autocorrelation has been adjusted.

4.10 TESTING FOR THE TREND

$$Y_t^* = 39.559 + 0.460t^* \quad t^* = 2, 3, \ldots, 144$$

HYPOTHESIS

H_0: β=0,

H_1: β≠0

STATISTIC

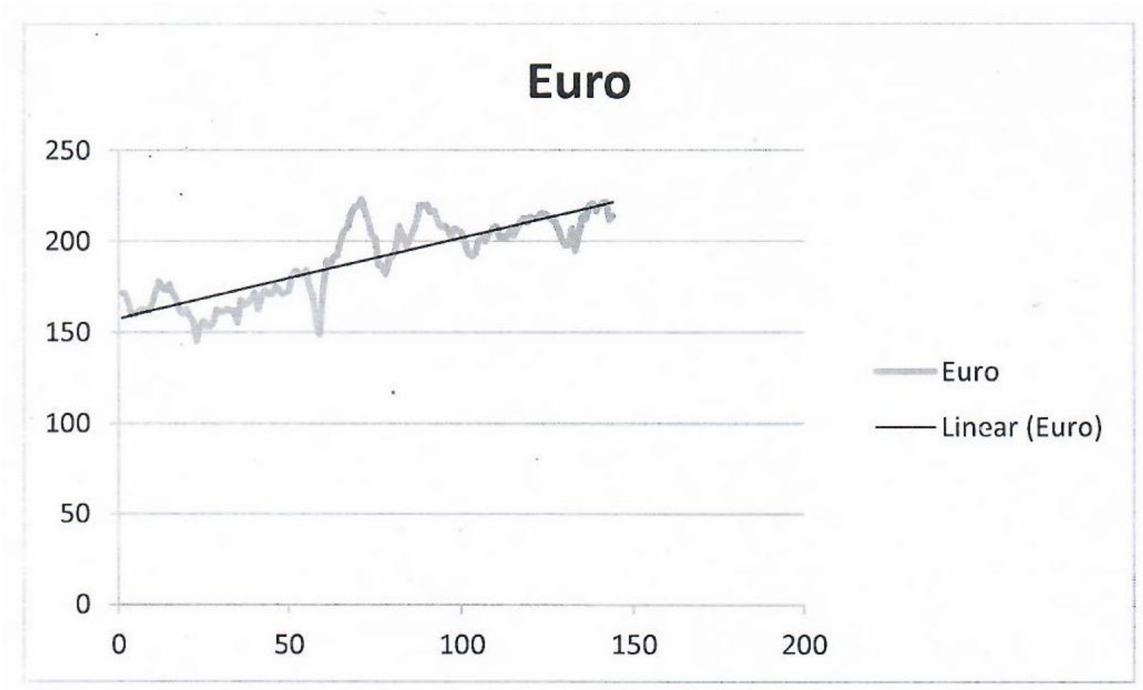
$$t = \frac{\beta}{S.E} \sim t_{(n-2)}$$

DECISION RULE: If the p-value is greater than the absolute value of the level of

Significance, we do not reject the null hypothesis at 5%.

From the table, the p-value (0.0001) is less than the level of significance [5%(0.05)] for the test, we reject the null hypothesis and conclude that there is trend.

Fig 4.2 Time plot showing trend on exchange from naira to euro



4.11 ESTIMATION OF SEASONAL COMPONENT

The seasonal variation of the data is examined using the One Way Analysis of Variance by comparing the means of the data.

$$Ho: \mu_i = 0$$

$$H1: \mu_i \neq 0 \quad \text{for } i=1,2,3,\ldots 144$$

DECISION RULE: Reject the null hypothesis if (1 value is greater than the p value, otherwise do not reject the null hypothesis. Table 4.6: Test for seasonal component

ANOVA					
	Sum of Squares	df	Mean S uare		Sig.
Between Groups	552.012	11	50.1829	.105	1 .ooo
Within Grou s	63131.55	132	478.269		
Total	63684.567	143			

CONCLUSION: Since the u —value is less than the p-value , we therefore do not reject the null hypothesis. That is it is not significant.

It can now be seen that there is no point in time where there is a significant increase or decrease in the price of pound in naira.

4.12 SUMMARY OF THE DESCRIPTIVE ANALYSIS

From the description of the time series component on Trend, Seasonality and Cyclic variation. It was statistically obtained that there was no trend since the data are not serially correlated after computing a least square regression on the significance of the slope, and the one way ANOVA test showed no seasonal component. Also there was no cyclic variation in the data. Now, a model can be fitted to best describe the exchange rate series and forecast for the next 12months.

4.13 STATIONARITY TEST FOR THE RAW DATA

4.14 AUGMENTED DICKEY FULLER TEST WITH INTERCEPT

AUGMENTED DICKEY FULLER TEST

HYPOTHESIS:

$H_o: |\rho| = 1$ (There is unit root)

$H_1: |\rho| \neq 1$ (There is no unit root)

DECISION RULE: reject Ho if P - value is less than $a = 0.05$, otherwise do not reject Ho

Test critical values	Test Statistic	P value	Conclusion
ADF TEST	-1.431735	0.5652	
5% level	-2.881685		NON STATIONARY

Table 4.7: Test for stationarity of the data

From table (1.6), the p-value (0.6673) is greater than the levelof significance [5%(0.05),] for the unit root test, we do not reject the null hypothesis and conclude that there is unit root in the data series, hence the data is not stationary.

Since it has been shown that the data is not a stationary one, then a differencing has to be done so that stationarity can be attained.

4.10 TIME PLOT FOR THE DIFFERENCED DATA

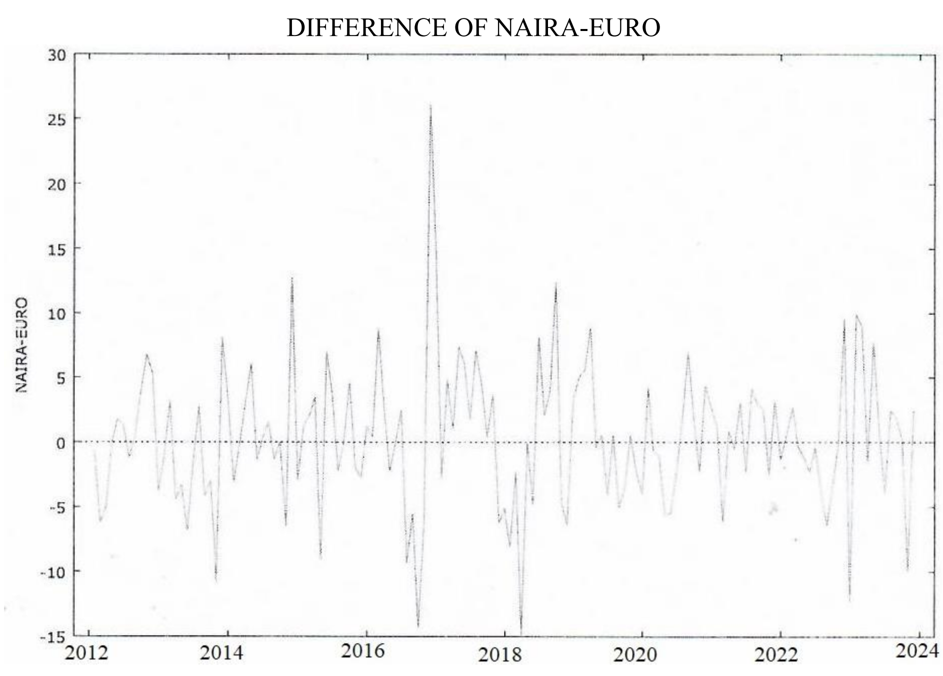


Fig 4.3: plot for differenced data

4.9 HYPOTHESIS TESTING

H_o: |ρ|=1 (There is unit root)

H_1: |ρ| ≠1 (There is no unit root)

DECISION RULE: reject Ho if P - value is less than u = 0.05, otherwise do not reject 1-10

Test critical values	**Test Statistic**	***P* value**	**Conclusion**
ADF TEST	-10.74818	0.0000	
5% level	-2.881530		STATIONARY

Table 4.8: Showing the test on differenced data for stationarity

From table(l .6), the p-value (0.0000) is less than the level of significance [5%(0.05),] for the unit

root test, we reject the null hypothesis and conclude that there is no unit root in the data series,

hence the data is stationary.

4.15 ESTIMATION OF PARAMETERS

The parameter of the autoregressive model identified above is then estimated. The AIC values

are generated and out of the AIC values generated, the order of p, q that gives the least AIC and

BIC value gives the best ARIMA (p, d, q) model.

ARIMA MODEL RESULTS

S/N	Model	AIC	BIC	Log-Likelihood

1.	ARIMA(0,1,1)	900.8771	909.76571	-447.3838
2.	ARIMA(1,1,0)	900.8771	909.6561	-447.4386
3.	ARIMA(1,1,1)	902.5699	914.4679	—447.2849
4.	ARIMA(2,1,1)	904.5625	914.4272	-447.2812
5	ARIMA(1,1,2)	897.3413	916.3352	—443.6707
6	ARIMA(2, 1,0)	902.6165	9914.4679	-447.3082

Table 4.9:Table on the ARIMA model estimation

Table 4.10: Table on the ARIMA model estimates

The model for ARIMA (1,1,2) is given below

$$Y_t=0.412093+0.862036_{t-1}-0.833672_{\varepsilon_{t-1}}-0.166328_{\varepsilon_{t-2}}\varepsilon_t$$

ARIMA (1,1,2) Model diagnostic Result

From Table 4.10 above, the LB statistics is 18.356 and its P- value is 0.244. This implies that the null hypothesis cannot be rejected and we therefore conclude that the residuals from the fitted ARIMA (1, 1 ,2) model are not serially correlated.

4.16 MODEL CHECKING

Hypothesis Testing

$H_o: \rho\neq0$ (There is no serial correlation)

$H_1: \rho=0$ (There is serial correlation)

Test statistic:LB = n(n + 2) $\sum_{k=1}^{m}(\frac{\hat{\rho}^2_k}{n-k}) \sim \chi^2_m$

4.17 ARIMA (1,1,2) Model diagnostic Result

Fable 4.1 1 Model diagnosis estimate

Modei	Ljung-Box Q(18)		
	Statistics		Sig.
EXCHANGE	18.356	15	O. 244

4.18 FORECASTING

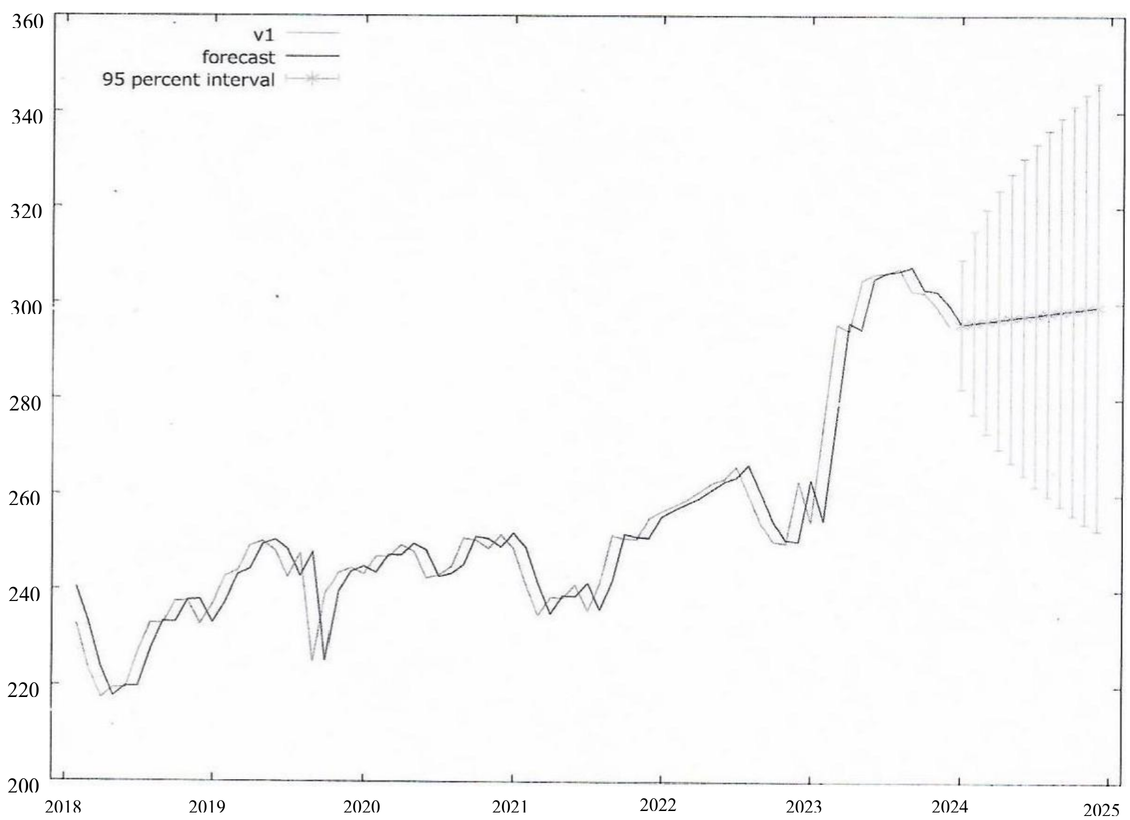


Fig 4.4: Time plot for forecasted values

Based on the principal aim of identifying simple and accurate model for the Naira-EURO exchange rate, it was observed that the best model is ARIMA(I,1,2) and this agrees with Gujarati (2004) claim that asset prices such as stock prices and exchange rates do exhibit random walk.

The estimated model result shows that Naira-euro exchange rate will be increasing by the model given above. Finally, the forecasting result shows that the naira will continue to depreciate

against the euro for the period (2012-2023) forecasted.

CHAPTER FIVE

SUMMARY AND CONCLUSION

5.0 INTRODUCTION

This chapter summarizes the findings, conclusions in line with the objectives of the study. This research work aims to identify a time series model forecast for the price of Euro in Naira for the period of January 2012 to December 2023.

5.1 SUMMARY AND CONCLUSION

This research work aims to identify a time series model forecast for Nara /Euro exchange rate for the period of January 2012 to December 2023 through the use of Box Jenkins fundamental approach. From the description of time series components, Trend, Seasonality and Cyclic variation. It was statistically proven that there was no trend, seasonal variation as well as the cyclic variation. As regard modeling aspect, the modeling cycle was in three stages, the first stage was model identification stage where the series were tested for stationary at level form based on the result provided ADF test, correlogram and time plot .Based on the selection criteria, AIC and SBIC, reports showed that ARIMA (1,1,2) is selected to be the best model to fit the data. The second stage was the Model Estimation stage where the parameters conform to the stationary •conditions (less than one) and finally the third stage was model diagnosis where the errors derived from the model ARIMA(l,l,2) was normally distributed, random (no time dependence) and no presence of serial correlation. An out-sample forecast for period of 12 months term was made, and this showed that naira will keep depreciating and the price will continue to increase per pound for the period forecasted.

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