

**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND
TECHNOLOGY, KUMASI**

**A MULTI-STATE MODEL OF A MORTGAGE INSTITUTION
IN GHANA.**



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Declaration

I hereby declare that this submission is my own work towards the award of the Master of Science (MSc.) degree in Actuarial Science 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 acknowledgement had been made in the text.

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Dedication



To

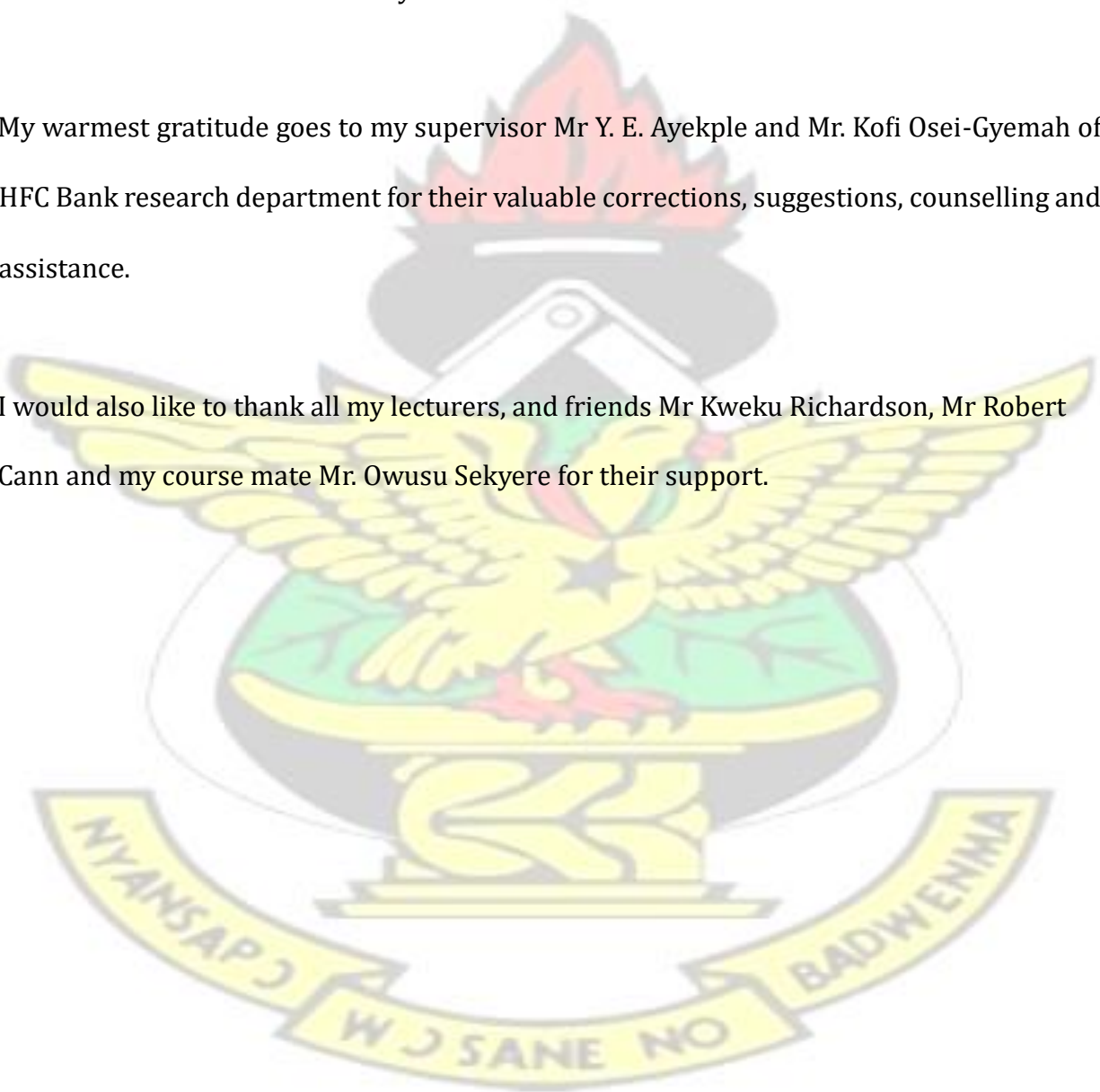
my children and wife Juliet Garbrah

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Abstract

The abnormal high rate of mortgage lending in the mortgage industry in Ghana which was under rated in the financial sector led to the foreclosure and sale of mortgaged properties.

This thesis develops a transition probability Markov chain analysis to mortgage loans classification and performance. The transition matrix obtained shows that classified loans switch from one status to another is possible and recommended the means by which foreclosure of properties could be reduced to the barest minimum or avoided altogether.



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Chapter 1

Introduction

1.1 Background of Study

The mortgage industry in Ghana traces its backgrounds to the First Ghana Building Society (FGBS) in 1956 under the Building Society Ordinance, 1955 (Act 30) and the Mortgages Decree, 1972 (NRCD 96). This overlaps with the liberalized financial era (1957-1987) and the 1959-1964 housing policy, during which era mortgage advancing largely by the FGBS was heavily financed by short-term deposits and direct government soft loans and grants. In harmony with the state's new role as a architect and regulator or watchdog under the 1970-1971 housing policy, the defunct Bank for Housing and Construction (BHC) was incorporated to provide concessionary construction finance and credit to home-purchasers (Donkor-Hyiaman, 2013).

After granting housing loans amounted to GHS 223,895,588 (US\$ 994,075) to only 363 mortgagors between 1974 and 1988, the BHC failed to make the required effect like the SSB (now SG-SSB), Ghana Commercial Bank, Barclays and Standard Chartered Banks; whose mortgage advancing undertakings were also brief due to inadequate capital to operate. The

global economic and financial decline in the 1970's, characterized by high inflation levels, high default and interest rates control economy or policy of the state in the 1970s to 1980s and the poor savings culture of Ghanaians inhibited the ability of the FGBS now First Ghana Savings & Loans Ltd (FGSL) and banks to raise funds for mortgage advancing on a continual basis. It is only FGBS which has provided 1,250 mortgages to its customers since its inception in 1956.

The post-financial liberalization era from the 1987s and the World Bank Urban II project saw the first failed effort to establish a two-tier integrated housing finance system. The World Bank and Social Security and National Investment Trust's (SSNIT) contributed US\$ 8.2 million and US\$ 16.2 million respectively as an initial capital. The Home Finance Company, now HFC Bank was formed to function as secondary lender but ended up as a primary lender; obviously dominating the market over a decade.

As time went by both the pre-liberalization and early post-liberalization periods, macroeconomic instability as measured by large and irregular movements in inflation and real exchange rates has distorted price signals and has astronomically increased the perceived market risk of default and credit loss and risk premiums. This is shown by the wide variance between the Bank of Ghana policy rate (16%) and average mortgage interest rate (30%) as at 2013 (Donkor-Hyiaman, 2013).

This is interwoven with the weak legal and regulatory environment, low income levels, the lack of refinancing opportunities and reliable credit rating events. This makes mortgage lending unappealing and expensive; only to benefit the few rich in today's market as well. Hedging against these risks however, the mortgage market is unofficially dollarized; altogether serving as a disincentive to long term investments. The mortgage market as a result is normally long-term capital scarce leading to most banks resorting to short-term cheaper deposits in funding long term projects.

Managing the risk of mortgage portfolios needs diagnostic tools that are able to consider a variety of factors that affect the cash flows of the banks. Mortgage Insurance (MI) specifies a significant tool to manage the risk related with the Portfolio of mortgages and allows the bank to spread the inherent risk. In Ghana, the amount of the mortgage loan is repayable by a series of monthly instalments over a period of fifteen to twenty years.

If a mortgagor fails to meet one or more of these repayments, these arrears will be examined in detail and if it happens that the mortgagor is facing financial difficulties which threatens his or her ability to pay the scheduled installments, the mortgagee's initial response is usually the attempt to reschedule the debt repayment. After this if the mortgagor is still not able to repay the debt, the mortgagee will then foreclose the property and sell it to redeem its investment.

In this present thesis, a theoretical and empirical analysis to estimate the transition probabilities of switching from one classified loan to the other using a Multi-State (Markov Jump) Process with a set of mortgage lending data from HFC Bank Ltd.

1.2 Statement of the problem

Mortgage loan portfolio is the one of the largest asset and major income for HFC bank. Even though it is a fact that a higher proportion of the income is derived from the mortgage lending, existing records show that portions of the loan go bad and the bank has to foreclose mortgaged properties used as collaterals and sell them to redeem the bank's investments. The proportion of loans that transit from one state to another is not known. How this proportion affects the bank for a foreclosure of collaterals and also the customer that defaults has to be determined.

1.3 Research Objectives

The main objective of the study is;

1. To estimate the transition probabilities from one state to another
 2. To estimate the transition matrix using Markov Chain Process on mortgage Loans
- Classification or categorization

3. To find out the proportion of loans those are in default.

1.4 Methodology

The research is aimed at applying a multi-state (Markov jump) time-inhomogeneous process in the estimation of transition probabilities on the Mortgage Loan Classification and its performance.

1.5 Justification.

1. To help mortgage firms to reduce their default rates to improve on their profitability.
2. To encourage mortgagors to take life insurance policy to redeem their mortgage loans in times of ill-health or death to avoid foreclosure of their properties.
3. Serves as reference for future literature review.

1.6 Research Questions

It would be of interest to consider the Mortgage loan management in Ghana where between 12% to 15% of mainly top civil servants and staff of financial institutions have access to mortgage loans.

Mr. Asare Akuffo of HFC Bank in a housing seminar emphatically stated that only 5% 8% of Ghanaians can manage to put up their own houses, about 60% would need financial support and 35% are not capable of owning or putting up a house in their life time.

As a result there is likelihood that the default rate in the mortgage loan repayments will be high because the loan repayments would be generated from low income earners. Hence the following are the research questions of study (Asare- Akuffo, -2012).

To what extent do these explanatory variables (covariates), example age, income level as part of the modeling process will have a significant effect on the mortgage loan repayment?

1.7 Significant of the study

Even though mortgage loans have the properties of the borrowers used as collateral securities for the loans, some of the loans go bad which to some extent affect the financial performance of the bank.

It could be concluded therefore that a healthy mortgage loan portfolio has a direct positive impact on the financial performance of the bank. In view of the critical role the mortgage industry play in the economy it is essential to identify problems associated with the performance of this institution. This is because the non-performing assets can affect the bank's ability to play a major role in providing finance for potential borrowers. In the light of the foregoing, the significance of the study includes the following:

- The findings would enable the bank to put in place pragmatic policies to improve the quality of the mortgage loan portfolio to the recommended percentage of less than ninety (90) as required by bank of Ghana.
- It could also be seen as a contribution to existing works on performing and nonperforming loans.

1.8 Limitations and Delimitation

The work is looking at the actuarial approach of assessing the classification and performance of mortgage loans in Ghana. Due to non-availability of data from Ghana Home Loans and these were limited to only HFC Bank.

1.9 Organization of the study

The thesis is categorized into five chapters.

Chapter one emphasized on the background to the study, problem statement, objectives, significant of study, research methodology, (limitations and delimitations).

Chapter two deals with the systematic review of existing literature with emphasis on the history of mortgage market and mortgage insurance in Ghana.

The third chapter deals with the research methodology in addition to the population, sampling techniques, data collection methods and the research instruments used. Chapter four consists of detailed analysis of data collected and information presentation with the aid of quantitative statistical and actuarial models.

The fifth chapter deals with the summary, conclusion and recommendations.

Key Words

1. Multi-state process: A mortgage loan will require the borrower or the mortgagor to meet certain repayments obligations as stated in the mortgage deed or agreement. If the borrower is paying according the schedule the loan is regarded as CURRENT.
2. If the borrower fails to pay at any time or meet his repayment obligations as they fall due, the loan is said to be in DEFAULT (ARREARS) (repayments more than 30 days).
3. If the borrower fails to make any repayments within 360 days, the loan is regarded as a LOSS, the lender will take possession (foreclose) of the property. This is designated as FORECLOSURE or PROPERTY-IN-POSSESSION (Default more than 360 days).
4. Once the property has been foreclosed, the lender will proceed to SALE. If the proceeds of the sale, less associated expenses (advertisement, cost of auction, etc),

exceed the outstanding loan balance, the loan will be discharged and there will be no mortgage insurance claim.

5. If however the Mortgage loan balance exceeds the net proceeds of the sale, a claim of insurance of the balance will be demanded.

Chapter 2

Literature Review

2.1 Introduction

Chapter two deals with the conceptual framework on the role of Mortgage Insurance (MI) on the Mortgage Loan portfolio of banks in Ghana. Existing number of literature have been reviewed to reflect on the theories on this thesis. This will assist to explain some key terms which are pertinent to the study.

2.2 Conceptual Frame Work

Mortgage insurance started in the United States of America in the 1880s, and the first law on it was promulgated in New York in 1904. The industry grew in reaction to the 1920s real estate revolution and became insolvent after the great depression. By 1933 no private

mortgage insurance existed. The federal government then began insuring mortgages in 1934 through the Federal Housing Administration and Veteran's Association. After the great depression, a private mortgage insurer, Mortgage Guaranty Insurance Corporation was chartered.

It was invented and formed by Mr. Max H Karl, a lawyer by profession and helped to put home ownership within the reach of millions of families. He was able to raise \$ 250,000 from friends and other investors to form the Mortgage Guaranty Insurance after being upset with the frustration to obtain a home backed by Federal Government Insurance.

Unlike many mortgage insurers which collapsed during the depression era, MGI only insured the first 20% of loss on a defaulted mortgage, thus restricting its exposure and fashioning more inducements for mortgage firms to issue loans only to home purchasers who could afford them. In Ghana, it was Gold Coast Insurance Company which became the State Insurance Corporation and the Enterprise Insurance Company were the Insurance Companies which were insuring the mortgages of the first Mortgage firm, First Ghana Building Society.

The gap left in the mortgage insurance administration in most countries included the insurance of the property against fire and other natural disasters (earth quakes, floods and storms) in the mortgage deed or agreement. Now there are many insurance companies in Ghana which are playing important roles of insuring mortgages today (Quint, 1998).

2.3 Definition of Mortgage Insurance

It is insurance policy allotted to safeguard the mortgagee from any default by the mortgagor.

2.3.1 Purpose of Mortgage Insurance.

The reason of mortgage insurance carried out by Mortgage institutions is to spread credit risk on their portfolios by surrendering part of the credit risk to a third party.

2.3.2 Advantages of Mortgage Insurance.

In case the insured mortgaged property is damaged by fire, the insurance company will pay the estimated cost of damage. When the insured mortgage property is destroyed by any natural disaster such as earth quake, floods and storms, the insurance company will bear the estimated cost of damage. In case of default and the mortgaged property is foreclosed or repossessed and sold, the insurance company will pay the difference if there is any shortfall.

This applicable only in the developed countries and not in Ghana.

2.3.3 A model Mortgage Market

According to Bank of Ghana research department, the mortgage market has two main principal actors; the mortgagee (the lender on the supply side and the mortgagor (the borrower on the demand side). The secondary players in the market, mostly on the supply side include:

- Mortgage Bankers (generally assumed to initiate and fund their advances and loans, which are then sold on the secondary market.
- Mortgage Brokers (initiate advances, then place those advances with other lending institutions with which they usually have pre-established affiliation).
- Mortgage Insurance Companies which provide insurance to shield the lender against some losses incurred as a result of defaults, fire and other natural disasters.
- Mortgage Regulatory Institution, a legal body providing the legal framework for the implementation of contract and normal or standard practices including foreclosures procedures.

It must be emphasized that, a fruitful development of a vivacious mortgage market depends on the existence of certain macro-economic environment which makes delivery of long term finance attractive, an efficient regulatory frame work that ensures a harmless and crystal clear land title and capacity to ensure repayment and foreclosures (Bank of Ghana, 2007).

2.4 Mortgage Financing in Ghana

Ghana has an inconsistent history of mortgage financing with several but un-sustained methods of finance. Financial institutions such as Social Security and National Insurance Trust (SSNIT), State Insurance Corporation (SIC), Social Security Bank (now SG-SSB Bank),

mortgage institutions particularly First Ghana Building Society (now First Ghana Savings & Loans Ltd), and Home Finance Company have one point or the other offered mortgage facilities to the working class of the population.

The mortgage products of these institutions were however hampered by high costs of borrowing and therefore their combined positive effect on the housing industry was limited, benefiting only middle and higher income groups. With the exception of the Home Finance Company (currently HFC Bank), FGBS and Ghana Home Loans, the other institutions are no more participants in the mortgage financing industry in the country.

Apart from high costs of borrowing, the mortgage financing industry has further been heightened by the introduction of indexation which was necessitated by concerns about risk, high inflation and currency instability. As a result, the housing market appears to be positively skewed to non-resident Ghanaians and foreigners whose incomes are dominated or indexed in foreign currencies (Donkor-Hyiaman, 2013).

According to BOG research department publishing about the Housing Market in Ghana (November 2007), there are other factors that affect the potential mortgagors for accessing mortgage advances in the country. Amongst these are low income earners which have resulted in high mortgage payment-to-income ratio for many loan applicants thus pricing them out of the market. Additionally estate developers quote prices in foreign exchange, primarily as a hedge against currency depreciation which also served as impediment to

demand for mortgage. Since it is obligatory for mortgagors to make payments in local currencies, this often results in very high costs of repayment (BOG, 2007).

2.5 Types of mortgage loans in Ghana.

Basically there are five kinds of mortgage loans and advances delivered by HFC Bank.

These are:

1. Home purchase Mortgage (HPM)/ First Time Buyer.
2. Home Equity Loan (HEM)/Equity Release
3. Home Completion Mortgage (HCM)/Refinance.
4. Home improvement Mortgage (HIM)/Home completion.
5. Construction Finance/Home Construction.

2.5.1 Home purchase Mortgage (HPM)/ First Time Buyer

Home Purchase Mortgage is loan product created to assist the citizens and organizations to buy residential properties for their own use or for rental and leasing purposes. This product is for both first time buyers and existing home owners. The mortgagor is usually required to make a minimum of 15% down-payment and the mortgagee provides a loan corresponding to a maximum of 85% of the selling price. The redemption period is 15 years subject to variable interest rates.

2.5.2 Home Equity Loan (HEM)/Equity Release

This product is intended to enable borrowers who currently own a home to use the property as a collateral to access the facility to improve their liquidity position. Individuals or companies who have properties that are either fully paid for or are currently funded, but have title to it, may apply for this loan. The loan proceeds could be used to improve their homes, expand their businesses, paying for school fees or buy a car. The maximum loan allowed under this facility is subject to variable rate of interest and redemption period of 15 years.

2.6 Home Completion Mortgage (HCM)/Refinance.

This product is created to assist mortgagors with funding to complete the construction of their homes. These houses could have been started with the mortgagors own resources or through funding from their employers, bankers or mortgage companies. The idea is to assist the borrower to complete his or her project by achieving his or her aim of home ownership. Here again the maximum redemption period for the loan is 15 years subject to a variable interest rate. The maximum loan-to- value ratio is usually 50%.

2.6.1 Home improvement Mortgage (HIM)/Home completion

This product or facility is planned to assist mortgagors with funding to undertake facelift or extension work on their existing homes. The group targeted for this product is the existing

home owners and companies who have properties that need facelift or improvement. This facility is similar to the Home Equity Mortgage described and mentioned above, but proceeds from this facility must be strictly used on the existing home as mentioned in the mortgage deed or agreement.

2.6.2 Construction Finance/Home Construction

This facility or product is currently offered in three different ways ;

1. Construction funding to real estate developer
2. Construction funding to the borrower and
3. Construction funding to customer of real estate developer. In all these cases, this facility will be for homes constructions.

In all these cases, this facility will be for homes constructions. The target market is principally real estate developers (HFC Bank, 2006). All these facilities are insured through the private mortgage insurance to cover fire, hurricanes and other natural disasters.

2.7 A long term outlook for the mortgage sector

Mortgages remain underdeveloped in Ghana, with the segment facing problems such as a lack of new housing supply, complications surrounding land ownership and high interest

rates of banks as a result of variance between long - term nature of mortgage investments and Ghana's mostly short-term banking deposit structure. According to Bank of Ghana figures released in 2013, a relatively marginal element of lending in Ghana ,mortgage in 2011 showed just 1.6% of total credit to the private sector(around GHS 137m)=US \$81.2). It also indicated that 2.5% of Ghanaians had a loan outstanding for the purchase of a home in 2011 as against to 5.4% and 5.3% of middle income countries and sub-Sahara African countries respectively (Adu, 2015).

2.8 Challenges to Development.

Apart from a few banks such as HFC, Fidelity, Stanbic and non-banking financial institutions such as Ghana Home Loans (GHL), many lenders pay this segment of advances limited attention. "Apart from a few such as HFC and GHL, most banks are not interested in the mortgage sector and do not market mortgages aggressively, as mortgages are long term investments and they don't want their money to be tied up for long periods (Mohammed, 2014).

Banks themselves lack the long-term funding to make mortgages feasible, while high borrowing costs frighten customers. The biggest challenges are the current bank deposit structure, which is mostly short-term, and historically high interest rates, which put monthly payments on long term loans out of reach for most people(Alhassan Andani,

Interview OBG 2013). Formerly it was the only HFC which did not operate under the Mortgages decree

SMC (55) and was allowed to foreclose on properties, with recourse to lengthy court cases; this discouraged other institutions from participating in the mortgage industry.

This attitude of banks changed with the passage of the Home Mortgage Finance Act (HMFA), drafted with help of International Finance Corporation (IFC), a private sector funding arm of the World Bank. In 2007 the IFC also launched a project to provide credit collaterals and advice concerning mortgages of banks in order to spur the sectors development. Kojo Addo-Kuffour of GHL described IFC efforts as unsuccessful (Addo-Kuffour, 2013).

Another challenge is a shortage of new housing policy, limiting the size of the market. Official statistics assessment of the government revealed that 1.5 million people need housing. The effective demand of eligible people for mortgage loan to purchase houses is nearly 750,000, Addo-Kuffour told the Oxford Business Group (OBG). However housing supply is limited and nowhere close to the level of demand, with nearly 20,000 new units being built a year, partly as a result of a lack of construction funding for developers. According to "Ghana Housing profile, the country needs Two million (2,000,000) new units by 2020. The study was issued by the Ministry of Water Resources, Works and Housing, in conjunction with the UN Human Settlement Programme, in June 2012 (OBG, 2013).

2.9 Land Ownership Issues

Issues surrounding land tenure has proved to be problematic, especially in Accra. Many people buy land with the intention to build a house on it and then find that they cannot register it as there are several claims of ownership on the same plot. Such cases end up in court system and can last for decades. The situation is made more complicated by the fact that current land litigations is not revealed in the search results provided by the land commission. This was disclosed by Addo-Kufuor to OBG. (OBG, 2013)

2.10 Mortgage Growth in Ghana

However, interest in the mortgage advancing segment is growing. In 2006, HFC was the only mortgage provider in the country, while now there are at least five. Bankers are becoming increasingly willing to recognize the long-term possibilities of the market due to the passage of the Home Mortgage Finance Act (HMFA) which has made the mortgage market attractive. According Alhassan Andani of Stanbic Bank he told OBG that, the potential for mortgage business in Ghana is huge. “While many banks are wary of the segment, Addo Kufour said it is natural to expect that more specialized non-bank financial institutions are likely to follow GHL into the housing finance market in coming years”. Ghanaian banks he echoed, have not shown much commitment to the mortgage product given its complexity and the tendency for title related fraud. Increased competition is more likely to come in the form of stand-alone companies that focus on home funding.

Ghana Home Loans (GHL) itself has expanded to become one of the largest mortgage players in the country. The firm may have had a market share of as much as 60% in 2010, while French Development institution Proparco, which lent US\$ 7 million in April 2012, describes the firm as the “market leader” in mortgages, attributing it a market share of “over 50%”. GHL had already disbursed \$80 million of \$100 million it has mobilized in long term funding-mostly from development funding institutions.

2.11 Finance for Real Estate Development

Finance for real estate development in Ghana are derived from varied sources. Some are obtained through debt finance with some banks in the country giving financial support to real estate developers provided all requiring conditions are met. Investigations conducted by Debrah et al,2002 and Erguden (2002) all over the country also indicate the persistence of informal financing methods such as the use of homeowners’ own sweat equity, barter arrangements and remittances from abroad. Loans are given on long, medium and short terms repayment period with interest rates charged on them. Different kinds of loans that can be considered by real estate firms in Ghana include mortgage facilities, and appropriations from institutions such as building societies, investment trusts, merchant and commercial banks, mortgage companies, pension funds, insurance companies, credit union property bonds, etc.

2.12 Difficulties in Raising Finance

Most medium and small sized companies in Ghana felt constrained in their access to credit (Ofei et al, 2001). Access to finance for real estate development is influenced by the characteristics of the corporate real estate institutions such as age, size (turnover, profitability, number of employees, net worth, etc) and legal status. Corporate real estate developers in developing countries like Ghana are small in size. As short term advances are the most available forms of finance in Ghana, real estate developers who acquire loans to pay back within the agreed period due to their inability to sell their products in the short term normally suffer penalties. Real estate investment periods take a longer time for recovery, particularly when viewed from the land acquisition and development stage, through the construction to leasing or eventual sale of the property. The World Bank estimates that registering formal ownership/lease over a piece of unencumbered land in Ghana is the third longest registration process in the world (World Bank, 2004). Land disputes and corruption, especially involving public lands in urbanizing areas have been experienced by significant majorities (CDD report, 2000). Disruption in development process, are frequent from corruption and land disputes.

In Ghana, the stock of mortgageable properties is small, while in South Africa it is large and tied to a well-developed secondary property market supported by an widespread realestate broker network, which makes it easier for home loan providers to achieve scale rapidly. The

South African non-bank sector has developed swiftly and has been enhanced by its mortgage switching facility. In Ghana, real-estate brokers are still informal, although professional establishments such as Broll and JHI of South Africa have begun to enter the market. Ghana Home Loans predominately writes loans on new properties and took over five years to disburse US\$ 100 million. By contrast, SAH reached US\$ 1 billion within three years mainly due to borrowers moving to them from banks to avail themselves of better interest rates. The development of a secondary property market in Ghana, currently obstructed by the fact that home owners see their properties as purely for accommodation rather than as an investment, will be required to fuel the growth of the home loans market and to enable home loan providers to achieve scale (Gyamfi-Yeboah, 2015).

The restrictions of the capital market in Ghana proved another test to Home loans lenders. So far, the only access to long-term funds at competitive rates has come from Developed Financial Institutions (DFIs). In South Africa, Non-Banking Financial Institutions have assisted by increasingly deep and sophisticated capital market that have given them access to securitization since 1989, enabling them to acquire funds at costs similar to banks and to fund their loans using capital markets and in local currency. This is a luxury not available to Ghanaian Home Loans Lenders, whose funding model includes negotiating long-term facilities with DFIs and reimbursing these using repayments from the pool of home loans. Each of the long-term lenders can follow its own pool of home loans and related collaterals registered titles and securities. At this stage, Mortgage loans providers are not

able to spread its funding sources to include private capital markets because the capital market in Ghana is small and illiquid and a securitization structure has still not been built.

In Ghana, as in many developing countries, home loan providers or the banks face many other challenges, such as insufficient property supply, unsophisticated underwriting techniques due to a lack of well-developed and resourced crediting reporting systems, and delays in title registration. They also suffer from difficulties in collateral execution, which are aggravated by lack of government enticements such as mortgage tax relief or first-time home purchase subsidies (subventions), and by a lack of long-term capital in the capital market (Adu, 2015).

2.13 Creating a Secondary Mortgage Market in Ghana

In the developed economies particularly the United States, the secondary mortgage market offers the level of liquidity required for a energetic mortgage market. The achievements chalked in the US and some parts of Europe in this field corroborate to this fact. Ghana in its need in creating a secondary mortgage market wanted to implement a two-tier housing financing system in 1993. The system was created by the Home Mortgage Finance Law (PNDCL 329) 1993, which charged the HFC to provide mortgage funding to individuals and to provide liquidity to participating financial institutions under the law. It initiated the

Secondary Mortgage Market (SMM) as means of fashioning a continuous housing finance in the country.

SMM depend on capital market investors to offer a long term sustainable funding for housing. There are numerous types, including purchases by Mortgage Credit Institutions (MCI), loans by MCIs and the mortgage securitization. An example is the Federal National Mortgage Association (FNMA) and the Federal Home Loan Mortgage Corporation, in the US and Stadshypothek in Sweden.

Securitization, pooling loans as collateral to issue bonds:

Securitization is a method by which a mortgagee creates a similar pool of home loans and uses the cash flows from this as collateral to issue securities (Bonds) to local or international investors. The value of the pool used as security is often higher, normally by 10%, than the amount raised by issuance (Towards a sustainable mortgage market in Ghana by Addai-Boamah, 2015).

Lawyers, accountants and crediting- rating agencies, are engaged to value the pool in order to assure buyers of the securities that they are not being sold non-performing loans. The mortgagee can use securitization to gain further liquidity to write new loans and may benefit from a lower regulatory capital condition. The home loan lender also looks after the loans on behalf of the investors for a fee. Investors get a better match of their liabilities, often long-term periodic pension payments, to their assets, the proceeds from the securities.

There are three major pre-requisites for the development of a secondary market: a sufficient primary market infrastructure, a satisfactory legal and regulatory framework and an adequate capital market infrastructure. A strong favourable legal framework is a precondition for both primary and secondary market developments. The primary concern for investors is the enforceability of their claim on the collateral in the event of default which in most cases has been insured. This depends on the efficiency of the land title system and ability to foreclose and repossess within a reasonable period of time. Similarly Mortgages must be attractive investments; interest rates must be determined market forces and provide investors with a positive, real, risk-adjusted rate of return. The mortgage instrument and certification should be standardized, underwriting must be comprehensive and consistent, and servicing must be efficient.

A properly structured secondary market can lead to an increased funding for housing, lower mortgage credit cost for both participants and lenders-through an efficient allocation of risk and better-quality competition, reduce transaction costs through standardization, and provide liquidity for primary market mortgagees. Liquidity reduces liquidity risk, facilitates participation in the mortgage market and increases lending activities, by providing lenders access to the capital market and expanded funding prospects. SMM reduces interest rate risk by matching long-term mortgages with long-term sources of funds. It can provide institutional investors with attractive trade-offs between profitability, liquidity, simplicity and security. A well-functioning mortgage market provides huge external benefits to the

economy, including capital market development, increased labour market movement, construction sector employment, and the efficient allocation of real estate asset. By expanding the pool of funding options available, there is less pressure on governments to provide direct (and often subsidized) credit to home buyers (Adu, 2015).

However, SMM cannot solve basic problems such as household income and credit risk, which limit the flow of funds and/or increase the relative cost of mortgages, and a poor legal framework. SMM are not suitable vehicles for subsidizing mortgage credit. Their primary mission should be to mobilize private capital, broaden the financial markets and expand risk allocation. The decision to operate the two-tier system was a suitable means of realizing a long-term sustainable housing finance in Ghana. Secondary Mortgage market with efficient foreclosure procedures addresses the major risks; interest rate, liquidity and default risk that lenders face (Adu, 2015).

2.14 Prospects for the Home loans sector in Ghana

The home loans or mortgage market in Ghana has lately seen signs of significant improvement. These include the introduction of credit agencies that give lenders right to use the credit history of borrowers within seconds or minutes, foreclosure process legislation to be acted upon swiftly, reducing it from 18 months to just 90 days; and a new collateral management regime that allows for instant online registration of collateral at the BOG, prior to 2010 the process took up to 18 months. There has been a steady extension of

local currency bond tenors from five to seven years, while government and regulatory institutions have prioritized the expansion of a viable bond market to include corporate bonds (BOG, 2007).

Additionally, pension transformation has allowed the private sector access to pension fund management, formerly a state monopoly- thereby created a new pool of long-term commercially investible funds. It is in this context that mortgage loans providers are striving to build and sufficient securitization structure with all appropriate stakeholders to issue its first mortgaged backed security in Ghana by the second quarter of 2015. Though substantial progress has been made, the government needs to also consider subsidizing developers so that construction costs will be reduced and not to pass on to homebuyers, or subsidize buyers, via measures such as mortgage tax relief, to increase affordability. Crucial areas for reform include introducing the legal and regulatory agency for securitization, faster title transfer, building authorization and foreclosure processes. Ultimately, as in many emerging economies, it is only with a deep, liquid, long-term local currency bond market with the adequate regulation, fiscal and legal frame works and enabling institutions, such as credit rating organizations, that Ghana will be able to craft a viable home loans market.

The HFC Bank and Ghana Home Loans expertise have been that, despite the difficult operating topography, the demand for home advances is very strong and that most mortgagors are firmly committed to meeting their loan commitments. This underscores the need for further efforts to create an enabling environment. This will be a key condition for

lowering interest rates, which will in turn help improve access to home loans and advances for all income brackets. (Ghana Home Loans Report, 2015)

2.15 How does Private Mortgage Insurance Works in Ghana

As stated in the introduction, mortgage insurance guarantees the mortgagee to recoup his/her investment if the mortgagor defaults or fail to pay the loan advanced to him or her. Typically the potential mortgagor has to make a down payment of 15% to 20% of the value of the home (HFC Bank). Usually in the developed countries, if the mortgagor pays less than the 20% of the value of the home, mortgagees will require mortgagors to carry mortgage insurance. The mortgage insurance premiums are paid by the mortgagor until his or her loan-to-value ratio (LTV)-this is simply the amount of money one borrowed divided by the value of the property bought hits 80%. For example lets assume the borrower bought a GHS 100, 000 house and put down 10% or GHS 10, 000 and got a GHS 90, 000 loan to pay the rest. The loan-to-value ratio (LTV) in this case would be GHS 90, 000 divided by GHS 100, 000 or 90%. The longer the mortgagor pays down his or her mortgage, the lower his or her LTV will become. If the LTV is less or equal to 80% the mortgagor can opt not to pay the mortgage insurance (HFC bank, mortgage dept). In Ghana, Mortgage insurance is required regardless of the LTV (HFC Bank Ltd, 2002).

2.16 What is the cost of Mortgage insurance in Ghana?

A conventional Mortgage Insurance premium is between 1% and 1.5% of the value of the amount borrowed.

If the cost of the property is GHS150,000 and borrower makes 20% (GHS30,000) down payment, then premium to be paid monthly

$$= \frac{(150,000 - 30,000) \times 0.015}{12} = GHS150.00$$

2.17 Why does the potential mortgagor need mortgage insurance?

The mortgagee requires the mortgagor to have mortgage insurance so that in case the mortgagor can no longer make payments on his or her home the mortgagee will get paid. In Ghana the mortgagee will foreclose on the property or repossess it and sell to redeem its investment. The insurer will pay the cost of the house when it is gutted by fire, destroyed by floods or earth quake.

Chapter 3

Methodology

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3.1 Introduction

This chapter deals with the profile of the bank, the sources of data collected, the research population, sampling techniques applied and the sample size. Besides, the research instrument used with the data collection, the collection procedure and tools for data analysis were also discussed.

3.2 Profile of the Bank

HFC bank was founded in May 1990 as non-banking financial institution providing mortgage lending facilities to non-customers and its customers. It metamorphosed into a fully fledged universal bank in 2001 and operates two segments:

1. Consumer and mortgage banking, and
 2. Corporate and micro-finance banking
- Mission Statement: To create wealth and better life for our customers.
 - Vision statement: To be the Ghanaian financial institution of choice for our staff, customers and shareholders.
 - Core Values: Customer Focus, Integrity, Professionalism, Respect and Results Ori-

entation.

The mortgage loan classifications for the period of ten years beginning from year 31st December 2005 to 31st December 2014 are used as a basis for the estimation of the transition probability matrix. The transition probability of a classified loan moving from one type to another type.

3.2.1 Markov Chain Model

Markov chain is a random process that undergoes transitions from one state to another on a State Space. It must possess a property that is usually characterized as “memorylessness” the probability distribution of the next state depends on the current state and not on the sequence of events that preceded it.

The specific kind of “memorylessness” is called the Markov property. A sequence of a random variables $X_1, X_2, X_3, \dots$ with the Markov property namely that, the probability of moving to the next state depends only on the present state and not the previous states, That is

$$P(X_{n+1} = x / X_1 = x_1, X_2 = x_2, \dots, X_n = x_n) = P(X_{n+1} = x / X_n = x_n) \quad (3.1)$$

If $P(X_1 = x_1, X_2 = x_2, \dots, X_n = x_n) > 0$ The possible values of X_i form a countable set S called the STATE SPACE of the chain. Markov chains are often described by a directed graph, where the edges are labeled by the probabilities of going from one state to the other

states.

3.2.2 State Space

Suppose we have a set of states $S = S_1, S_2, \dots, S_N$. The process begins in one of these states and moves successively from one state to another. Each move is called a step.

3.2.3 Markov Property

It is a sequence of random variables X_1, X_2, X_3 with a Markov property. Namely that, given the present state, the past and future states are independent. Then

$$P(X_{n+1} = x / X_1 = x_1, X_2 = x_2, \dots, X_n = x_n) = P(X_{n+1} = x / X_n = x_n) \quad (3.2)$$

3.2.4 Absorbing State

A state i is called Absorbing state if it is impossible to leave this state. Therefore the State i is an Absorbing State if and only if $P_{ii} = 1$ and $P_{ij} = 0$ for all $i \neq j$. If every state can reach an Absorbing State, then the Markov Chain is an Absorbing Markov chain. In an Absorbing Markov Chain, a state which is not absorbing is called a transient.

The diagram below shows a five state Markov chain transition diagram of single, married, widowed, divorced and dead. Here the dead state is an absorbing state while the others are transient.

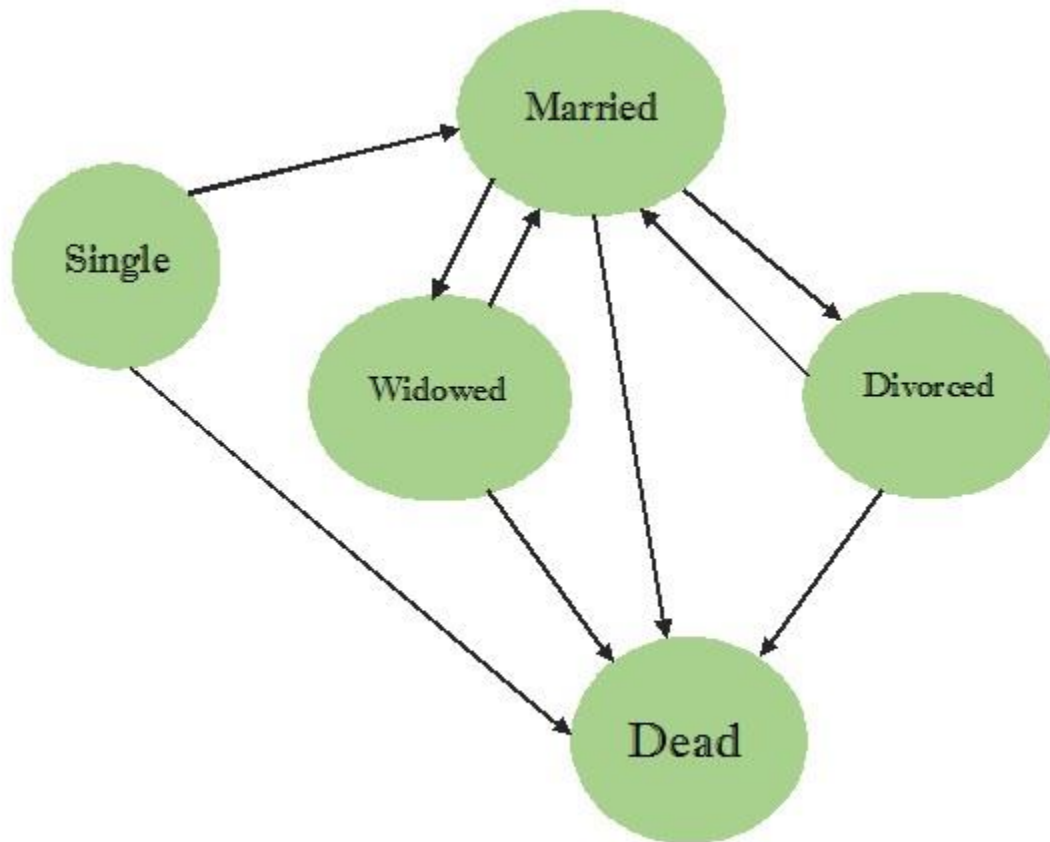


Figure 3.1: five state Markov chain transition diagram of single, married, widowed, divorced and dead

3.2.5 Ergodicity

Markov Chain is said to be Ergodic if and only if it is possible to go from every state to every state (not necessarily) in a single move.

3.2.6 Periodicity

A State i has a period k if any return to the state i must occur in multiples of k time steps.

Formerly the period of a state is defined as $K = \gcd \{n > 0 : P(X = i / X = i) > 0\}$ where “gcd” is greatest common divisor, provided the set is not empty. ie $K > 1$. If $K = 1$, then the state is said to APERIODIC.

3.2.7 Irreducibility

A Markov Chain is said to be irreducible if it is possible to get to any state from any state.

3.2.8 Time-Homogeneous Markov Jump Process

A Markov jump process is said to be time-homogeneous if the transition probabilities $P(X_t = j / X_s = i)$ depend on only the time interval $(t-s)$. Thus $P_{ij}(t) = P(X_t = j / X = i)$.

3.2.9 Time-Inhomogeneous Markov Jump Process

The transition probabilities $P(X_t = j / X_s = i)$ depends on the time interval $t - s$ and also on the times s and t when it starts and ends. This is because the transition rates for a time-inhomogeneous process vary over time.

3.2.10 Stationarity of the Markov Chain

If $W_j, j \in S$ is a stationary probability distribution for a Markov chain with transition matrix P , then the following conditions hold for all j in S :

$$W_j = \sum_{i \in S} W_i P_{ij} \quad (3.3)$$

$$W_j \geq 0 \quad (3.4)$$

$$\sum_{j \in S} W_j = 1 \quad (3.5)$$

Equation (3.3) can be stated in a compact form $w = wP$, where w is viewed as a row vector. The interpretation of equation (3.3) is that, if we take w as our initial probability distribution, that is to say $P(X = i) = W_i$, then the distribution at time $n \geq 1$ is again given by w :

$$P(X_i) = \sum_{j \in S} P(X_1 = j / X_0 = i) P(X_0 = i) = \sum_{j \in S} P_{ij} W_i = W_i. \quad (3.6)$$

So if the chain reaches the distribution w at some time n , ie $P(X_n = i) = W_i$ for all values of i , then because the transition matrix sends w back to itself, $w = wP$, the distribution X_t , will be w for all subsequent times $t \geq n$. The statistical properties of the process do not change over time, so the chain is a stationary process.

3.2.11 Markov Probability Model

The probability of switching a loan classification type i to loan classification j is a conditional probability and can be represented by the transition matrix $P = [P_{ij}]$ such that

$\sum_{i=1}^k P_{ij} = 1$ where the indices i refer to the loan classification type. P_{12} represents the probability of a borrower moving from the current state to Olem state, where P_{ii} represents the probabilities of no change in state.

The stochastic model used to explain the loans classifications is a Markov chain with a finite number of states E , Markov process X_t with discrete time t such that P_{ij} in general represents the probability of the process moving from one state i at time $(t-1)$ to the state j at time t . In this study, we assume that loan classification type i in the next period t (days) is only determined by the preceding period $(t-1)$. In other words, the history of loan classified at $(t-1)$ does not influence the future loans classifications. This is known as a first order time dependency. In statistical notation it is represented as ;

$$P(X_t = j / X_0, X_1, X_2, \dots, X_{t-1}) = P(X_t = j / X_{t-1} = i) \quad \text{for } i, j \in S \quad (3.7)$$

Also the probability relations must be satisfied at all times.

$$\sum_{j \in E} P_{ij} = 1, \text{ and } 0 \leq P_{ij} \leq 1 \quad \forall i, j \in E \quad (3.8)$$

In this study computer packages MATLAB AND QM windows were used for generating the probability transition matrix.

3.3 Research Design

Both descriptive and quantitative survey method was used in this research work. This implies that a descriptive and quantitative survey includes the act of collecting; organizing, summarizing and presenting data in a manner that quickly and easily describe the given data.

Quantitative survey was also used in the analysis of questions and the interpretation of data with a view of generalizing the results of the sample for the corresponding population parameter in this study. They basically consist of data that are numerical and non-numerical.

3.4 Sources of Data

Data was collected from primary sources and these were the HFC Bank Ltd. The data consist of classification of mortgage loans and advances covering a decade of HFC Bank.

These loans cover all the five types discussed in the literature review.

3.5 Research Population

Population is the whole aggregation of mortgages from which samples can be drawn. The population is the all the Universal Banks including all Non-banking mortgage institutions in Ghana.

The sample size represents the subset of the identified population.

The sample size consists of HFC Bank Ltd which is the leading mortgage institution in the country.

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3.6 Sampling Method

The researcher used the simple random sampling method. The Head of Planning and Research department was randomly selected to assist and provide certain information to the researcher. This method was to ensure that every possible element of the population has an equal or fair chance of being selected.

3.7 Data Collection Tools

The data collection tool was a self-development questionnaire which was descriptive and quantitative in nature. This method was used to provide a systematic description of the data collected. This consists of transition graphs or diagrams, transition matrices and tables. This method was used in an interview responses received to generalize the opinions and attitudes of the staffs of the respondent companies. The type of interview was however both structured and unstructured.

Chapter 4

Results and Discussion

4.1 Introduction

The focus on this chapter is based on the analysis of the data collected from the field of study according to the response given by the respondent. Mortgage loans advanced to customers and repayments being received have been categorized or classified into Current, OLEM, Sub-Standard, Doubtful and Loss LOAN (ASSET) CLASSIFICATIONS (BOG).

Here are their meanings:

4.2 Loans Classification

According to the New Financial Institutions Act of 1999, Loans and Advances should be classified in the following five categories, which will determine the level of provisions, required against the professed or expected diminution in asset quality;

1. Current or Performing
2. Other Loans especially mentioned (OLEM) or Critisable)

- 3. Substandard
- 4. Doubtful

- 5. Loss

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4.3 Current or Performing

Loans and Advances are judged to be performing if the payments of both interest and principal are up-to-date in the contractual agreement with the agreed terms. An overdraft would be regarded as current if the account is being continuously operated with no sign of debt developing (BOG).

4.4 OLEM Loans and Advances

Loans and Advances in this group are currently secured by adequate security, both as to principal and interest, but they are actually weak and susceptible to credit risk, although not to the point of the grouping it as “Sub-Standard”. The credit risk may be relatively small yet constitute an unwanted risk in the light of circumstances with a specific case. The feebleness, may, if not checked or corrected, weaken the asset or inadequate to safeguard the banks credit position at some foreseeable future. This class would include loans and advances that are unusual due to their kind, the customer or project; loans in respect of which on the financial agreement is not available; the officer in charge may not be able to supervise the loan properly over the collateral; or any other nonconformities from prudent

advancing practices of the bank because of lack of capacity; an insufficient loan contractual agreement; the condition and control are required to keep such loans and advances in the Watch List so as to properly and closely screen them (BoG).

4.5 Sub-Standard Loans and advances

Non- performing loans and advances are loans and advances which principal remains outstanding for more than 90 days but less than 180 days shall be grouped as substandard. and Credits and overdraft lacking pre-established repayment program are deemed substandard when advances exceeds the customers borrowing line of ninety (90) successive days but less than one hundred and eighty days.

Substandard loans and advances show clear expressions of credit feebleness that endanger the liquidation of the debt. Substandard loans and advances are loans to borrowers whose cash flows are not sufficient to meet currently maturing debts, loans to borrowers, which are significantly undercapitalized, and loans to borrowers lacking sufficient working capital to meet their operational needs. Substandard loans and advances are not secured by the current sound worth and paying ability of the customer. In this respect, the bank will need to depend on the secondary sources of repayment such as collateral, or fresh capital to service the debt (BOG).

4.6 Doubtful Loans and Advances

Non-performing loans and advances for which the principal and /or the interest remaining for one hundred and eighty (180) days but less than three hundred and sixty (360) days shall be categorized doubtful. Doubtful loans and advances which show all the weakness inbuilt in loans and advances categorized as sub-standard but with the added characteristics that they are not well protected and the weaknesses make pool or liquidation in full, on the basis of currently available information, highly dubious and doubtful. The possibility of loss is very high, but because of certain alleviating conditions, which may work to the advantage and strengthening of the facility, its classification as an estimated loss is deferred until its more defined status is established (BOG).

4.7 Loss Loans and Advances

Non-performing loans and advances for which the principal and or the interest remaining for three hundred and sixty (360) days or more shall be grouped as loss. Loans and advances shall be categorized as loss where they are considered uncollectible and of such a small value that their continuation as recoverable facilities is indefensible. This categorization does not mean that the facility has totally no recoverable value, but rather it is not practical or necessary to defer making full provisions for the facility even though partial recovery in future may not be completely ruled out. Loans and advances grouped as loss take account of those bankrupt companies and insolvent firms with adverse working

capital and cash flow or those to judgement debtors with no means or fore-closable collateral to settle the debts. Licensed banks should not keep such facilities on their books while pursuing long-term recoveries. Losses should be booked in the period in which they surface as not collectible (FIA, 1999).

Table 4.1: loan classifications,provisions and the number of days for it to be delinquent

Classifications	Provision in Percentage	Number of Days to be delinquent
Current	1	0 less than 30
OLEM	10	30 less than 90
Sub-Standard	25	90 less than 180
Doubtful	50	180 less than 360
Loss	100	Over 360

Table 4.1 shows the provisions that should be made in the financial statement of Financial Institutions against loans delinquent in the days assigned to them above according to Financial Institution Act 1999.

The transition diagram below shows the Markov Chain loan classification (C,O,R,L,T,S,P,O) model. It is time-inhomogeneous model with constant transition rates of $\alpha, \eta, \gamma, \kappa, \mu, \varphi, \omega, \theta, \eta, \lambda$ and ω .

Let C=Current; O=Olem; R=Sub-Standard; T=Doubtful; L=Loss (Foreclosure) (PIP); S=Sale and PO=Paid Off=Loan Discharge.

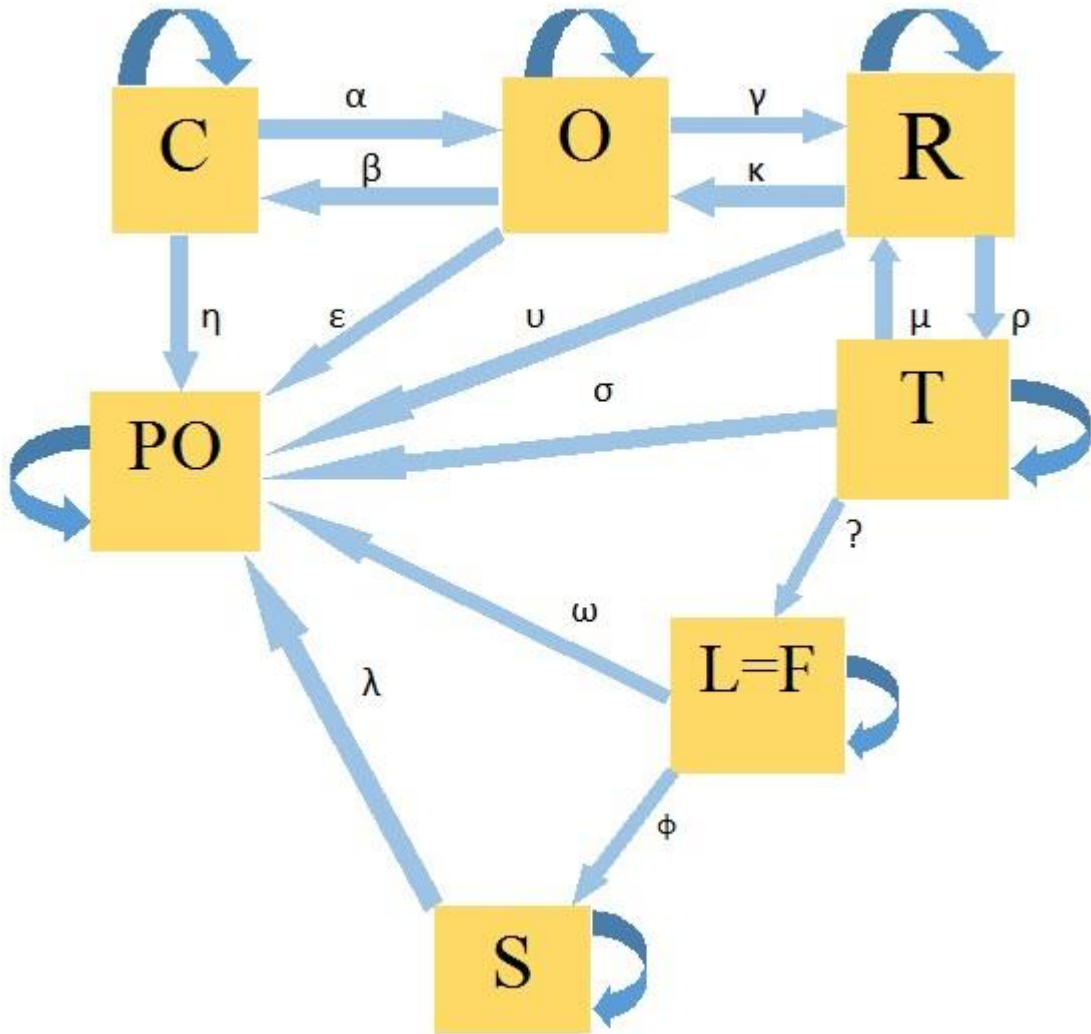


Figure 4.1: Pictorial transition paths of classified mortgage loans

Figure 4.1 shows the transition diagram of the seven states of classified mortgage loans with C, O, R, T, L, S, and PO representing Current, OLEM, Substandard, Doubtful, Sale and Paid Off or loan discharged, It is time-inhomogeneous model with constant transition rates of $\alpha, \beta, \eta, \kappa, \mu, \phi, \xi, \sigma, \lambda, \delta$ and ω

The table below illustrate the transition rates from state to state of the transition diagram shown in the Figure 4.1

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Table 4.2: Table showing transition Probabilities from state i to state j

	C	O	R	T	L	S	PO
C	$1 - \alpha - \eta$	α	0	0	0	0	η
O	β	$1 - \beta - \gamma - \varepsilon$	γ	0	0	0	ε
R	0	κ	$1 - \kappa - \rho - \nu$	ρ	0	0	ν
T	0	0	μ	$1 - \mu - \theta - \delta$	θ	0	δ
L	0	0	0	0	$1 - \nu - \omega$	θ	ω
S	0	0	0	0	0	$1 - \lambda$	λ
PO	0	0	0	0	0	0	1

Table 4.2 illustrate the transition rates from state to state of the transition diagram shown in the in figure 4.1. The transition rate 0 implies it will be impossible for example for loan in current state to move to substandard state.

The Monthly payment for a borrower who has accessed loan with principal value of P is given by;

$$M = P \left(\frac{c}{1} - (1 + c)^{-n} \right) \quad (4.1)$$

Where M = monthly payment, P = Principal value of the loan, $c = i/12$ monthly interest rate, and n = number of payments.

Table 4.3: Classification of mortgage loans from 2005 to 2014

YEAR	CURRENT	OLEM	SUB-STANDARD	DOUBTFUL	LOSS	SALE	PAID OFF	TOTAL
	GHS'000'	GHS'000'	GHS'000'	GHS'000'	GHS'000'	GHS'000'	GHS'000'	GHS'000'
2014	173,270.00	15,852.00	1,961.00	1,826.00	546.00	546.00	546.00	194,547.00
2013	117,467.00	10,711.00	1,325.00	1,234.00	761.00	761.00	761.00	133,020.00
2012	89,474.00	8,310.00	2,040.00	1,953.00				101,777.00
2011	62,437.00				1,541.00	1,541.00	1,541.00	67,060.00
2010	47,777.00	9,775.00						57,552.00
2009	42,621.00	5,712.00	994.00	520.00	280.00	280.00	280.00	50,687.00
2008	32,520.00	4,520.00	634.00	191.00	17.00	17.00	17.00	37,916.00
2007	27,222.00		1,100.00					28,322.00
2006	26,022.00			300	96.00	96.00	96.00	26,610.00
2005	22,420.00	1,250.00			1,550.00	1,550.00	1,550.00	28,320.00
TOTAL	641,230.00	56,130.00	8,054.00	6,024.00	4,791.00	4,791.00	4,791.00	725,811.00

Table 4.3 shows the data collected from HFC bank showing the mortgage loans classifications for ten years spanning the period 2005 to 2014.

Table 4.4:

The current loans on the loan classification table constitute the Performing Loans and those from OLEM to loss constitute the Nonperforming Loans

Date	Performing Loans	% of Performing Loans	Non-Performing	% of Non-Performing Loans
	GHS '000'		GHS '000'	
2005	22,420	88.90	2,800	11.10
2006	26,022	98.50	396	1.50
2007	27,222	96.12	1,100	3.88
2008	35,520	86.88	5,362	13.12
2009	42,621	85.03	7,506	14.97

2010	47,777	83.02	9,775	16.98
2011	62,437	97.59	1,541	2.41
2012	89,474	87.91	12,303	12.09
2013	117,467	89.33	14,031	10.67
2014	173,270	89.57	20,185	10.43

According to Financial Institution Act 1999, loans should be categorized as performing and non-performing. The loans which are current constitute the performing loans and those from OLEM to loss form the non-performing loans. The best performance year was 2006 followed by 2011 and the worse performance was 2010. The bench mark is 90 %.

From the Table 4.4, the best performance year was 2006 followed by 2011 and the worse performance was 2010. Bank of Ghana, the regulating body for Financial Sector bench mark is 90%.

4.8 Markov Chain Analysis

This method is developed from Markov Chain analysis and calculates the probability of a mortgagor or a borrower making a transition from one status to another.

Transitions are modelled for individual loans within each loan status. To show this method, consider a mortgagor in a particular loan status which is Current (i. e. no payments overdue). A transition matrix contains the complete set of mathematical probabilities of this mortgagor rolling from his Current state to any of the other possible states:

1. (1) 0 30 days remaining Current,
2. 31-90 days in arrears, Olem state.

3. A mortgagor who is more than 90 days but less than 180 days in arrears transits to a Sub-standard state.
4. A mortgagor or a borrower who is more than 180 days but less or equal to 360 days delinquent will automatically move to a doubtful state.
5. From doubtful state, the borrower transits to the loss state where his or her property will be foreclosed and sold to discharge or pay off the outstanding balance of the loan. If the proceeds from the sale of the foreclosed property is less than the outstanding balance then the difference will be paid by the insurance firm. In certain instances a borrower who is in arrears sells the property to offset the outstanding loan. In Ghana this research also wants to address the situation where the mortgagor or the borrower has defaulted due to death or incapacity (disability).

In order to describe the transition probabilities mathematically, a discrete time Markov chain analysis is employed. Markov chains have been extensively used in credit modelling (Lando, 2004).

Table 4.5 shows the total waiting time spent at each state before a number of transitions move from one state to another.

Table 4.5:

Table showing total time (days) spent in each state (Total time spent in state i) and total number of transitions from one state to another. (Total number of ij transactions)

STATE	TOTAL DAYS SPENT
CURRENT (C)	30
OLEM (O)	60
SUB-STANDARD (R)	90
DOUBTFUL (T)	180
LOSS (L)	180
SALE (S)	90
TOTAL	630

Table 4.6: Table showing number of transitions from one state to another.

NO OF TRANSITIONS	STATE
$\alpha=11$	FROM C TO O
$\beta=21$	FROM O TO C FROM O
$\gamma=16$	TO R
$\kappa=25$	FROM R TO O
$\mu=23$	FROM R TO T
$\rho=36$	FROM T TO R
$\omega=32$	FROM T TO L
$\theta=31$	FROM L TO S
$\eta=9$	FROM C TO PO
$\epsilon=10$	FROM O TO PO
$\zeta=9$	FROM R TO PO
$\phi=22$	FROM T TO PO
$\omega=20$	FROM L TO PO
$\lambda=15$	FROM S TO PO
$\delta=18$	FROM C TO C

Table 4.6 shows the number of transitions from one state to another. The transitions are assumed to be constant.

1. A mortgagor or a borrower who is more than 180 days but less or equal to 360 days delinquent will automatically move to a doubtful state.
2. From doubtful state, the borrower transits to the loss state where his or her property will be foreclosed and sold to discharge or pay off the outstanding balance of the loan.

If the proceeds from the sale of the foreclosed property is less than the outstanding balance then the difference will be paid by the insurance firm.

In certain instances a borrower who is in arrears sells the property to offset the outstanding loan. In Ghana this research also wants to address the situation where the mortgagor or the borrower has defaulted due to death or incapacity (disability).

In order to describe the transition probabilities mathematically, a discrete time Markov chain analysis is employed. Markov chains have been extensively used in credit modeling (Lando, 2004).

The mathematical framework is now briefly described as follows:

The Markov chain is said to be time inhomogeneous if $P(\mu = j/\mu_t = i)$ depends on t , hence the following one-period transition probability from status i , is defined as ;

$$P = P(\mu = j/\mu = i) \quad (4.2)$$

a specific time t . The transition probabilities at a time t are conveniently expressed in a transition matrix;

$$\begin{matrix} & \begin{matrix} 1 & 2 & \dots & k \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \\ \vdots \\ k \end{matrix} & \begin{pmatrix} P_{11} & P_{12} & \dots & P_{1k} \\ P_{21} & P_{22} & \dots & P_{2k} \\ P_{31} & P_{32} & \dots & P_{3k} \\ \vdots & \vdots & \ddots & \vdots \\ P_{k1} & P_{k2} & \dots & P_{kk} \end{pmatrix} \end{matrix} \quad (4.3)$$

$$P_t = \begin{bmatrix} P_{11} & P_{12} & P_{13} & P_{14} & P_{15} & P_{16} & P_{17} & P_{18} \\ P_{21} & P_{22} & P_{23} & P_{24} & P_{25} & P_{26} & P_{27} & P_{28} \\ P_{31} & P_{32} & P_{33} & P_{34} & P_{35} & P_{36} & P_{37} & P_{38} \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ P_{k1} & P_{k2} & P_{k3} & P_{k4} & P_{k5} & P_{k6} & P_{k7} & P_{k8} \end{bmatrix}$$

Where $\sum_{j=1}^k P_{ij} = 1$ for all i (I.e. rows sum to 1).

The probability of a transition from one status to another in the Markov Chain analysis from Mortgage loan classification is estimated by using maximum likelihood method for the fourteen parameters $\alpha, \beta, \dots, \theta$.

The transition probabilities across states from one month to the other. For example, the first row C implies that any current account this month may next month either become thirty days delinquent, pay the outstanding balance in full (PO), or remain at current, zeros imply that it is impossible for a mortgage loan which is current to move to one of the states within 30 days, and ones denote liquidated accounts.

Table 4.7: Table showing transition Probabilities from state i to state j

	C	O	R	T	L	S	PO
C	0.333	0.3667	0	0	0	0	0.3000
O	0.3500	0.2166	0.2667	0	0	0	0.1667
R	0	0.2778	0.3666	0.2556	0	0	0.1000
T	0	0	0.2000	0.8611	0.1778	0	0.1222
L	0	0	0	0	0.7167	0.1722	0.1111

S	0	0	0	0	0	0.8333	0.1667
PO	0	0	0	0	0	0	1

Now the maximum likelihood L is given by:

$$L(\alpha, \beta, \eta, \gamma, \epsilon, \mu, \zeta, \varphi, \theta, \omega, \lambda) = Ke^{-30(\alpha+\eta)}e^{-60(\gamma+\beta+\epsilon)}e^{-90(\kappa+\mu+\zeta)}e^{-180(\phi+\zeta+\omega)} \\ + e^{-180(\theta+\omega)}e^{-90} \times \alpha^{11}\beta^{21}\eta^9\gamma^{16}\epsilon^{10}\mu^{23}\zeta^9\varphi^{36}\theta^{31}\omega^{22}\lambda^{15} \quad (4.4)$$

Table 4.6 represents the transition probabilities derived from the transition probability matrix.

The transition probabilities in the table form above is given in a matrix form as:

$$P_T = \begin{matrix} & \begin{matrix} C & R & T & L & S & PO \end{matrix} \\ \begin{matrix} C \\ R \\ T \\ L \\ S \\ PO \end{matrix} & \begin{bmatrix} 0.3333 & 0 & 0 & 0 & 0 & 0.3000 \\ 0.3500 & 0.3667 & 0.2667 & 0 & 0 & 0.1667 \\ 0 & 0.2166 & 0.3666 & 0.2556 & 0 & 0.1000 \\ 0.2778 & 0.2000 & 0.8611 & 0.1778 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.7167 & 0.1722 \\ 0 & 0 & 0 & 0 & 0.8333 & 0 \end{bmatrix} \end{matrix} \quad (4.6)$$



4.8.0.1 Calculation of Confidence Intervals

Now the asymptotic sampling distribution of the estimated parameters are assumed to be normal.

For example the asymptotic sampling distribution of the parameter α is $(\alpha, \alpha/E(V))$, where $E(V)$ is expected time in days spent at a loan classification status. The variance of is given by the Cramer-Rao lower bound:

$$-1/E(d^2 \ln L/d\alpha^2) \quad (4.7)$$

We find an approximate 95% confidence intervals for all the estimated parameters:

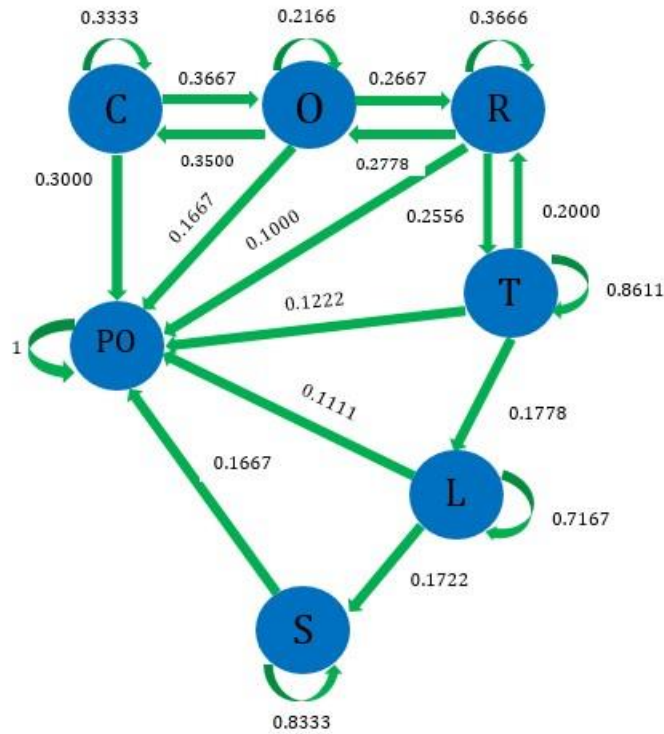


Figure 4.2: Pictorial Transition Probabilities of Mortgage Loan Classifications. Figure 4.2 shows the pictorial representation indicating the switching of classified mortgage loan derived from the probability transition matrix.

95% interval for p_{11} is:

$$\begin{aligned}
 \alpha \pm 1.96\sqrt{\text{var}(\alpha)} &= 0.3667 \pm 1.96\sqrt{p_{11}/30} \\
 &= 0.3667 \pm 0.2167 \\
 &= (0.1500, 0.5834)
 \end{aligned}$$

Similarly 95% confidence interval for the rest of the probabilities are:

$$\begin{aligned}
 p_{21} &= 0.3500 \pm 1.96 \sqrt{p_{21}/60^2} \\
 &= 0.3500 \pm 0.1497 \\
 &= (0.2003, 0.4997)
 \end{aligned}$$

Calculating the rest of the confidence intervals similarly we have

$$p_{17} = (0.1040, 0.4960); p_{23} = (0.1360, 0.3974); p_{32} = (0.1145, 0.4411); p_{34} = (0.1512, 0.3600)$$

$$p_{43} = (0.1347, 0.2653); p_{45} = (0.1162, 0.2394); p_{56} = (0.1116, 0.2328); p_{67} = (0.1245, 0.2089)$$

$$p_{27} = (0.0634, 0.2700); p_{37} = (0.0347, 0.1653); p_{47} = (0.0711, 0.1733); p_{57} = (0.0624, 0.1598)$$

We then go ahead and test

$$H_0: p_{11} = 0.3333$$

$$H_1: p_{11} \neq 0.3333$$

Under $H_0: \sqrt{n}(\hat{p}_{11} - p_{11})/\sqrt{p_{11}(1-p_{11})} \approx N(0,1)$ approximately. Since we are carrying out two-sided test, the value of the test statistic should lie between -1.96 and 1.96 .

$$\sqrt{0.3333(1-0.3333)} \sqrt{18/30^2} = 1.6650$$

The value of the test statistic is less than 1.96 and greater than -1.96. So we have sufficient evidence not to reject H_0 at 5% level of significance and conclude that the value of p_{11} is the true transition probability from current to current.

The transition probability matrix for the mortgage loan classification is given the table 5 while figure 18 shows the pictorial representation.

The transition probability matrix shows that the probability of a classified loan moving from sun-standard to Paid Off is the lowest (0.1000) while a classified loan moving from Doubtful to Doubtful is the highest (0.8611).

The probability value gives the indication of a classified mortgage loan moving from one to another. The probability 0 for example means, it is impossible to move from current to sub-standard.

Chapter 5

Conclusion And Recommendations

5.1 Introduction

Shelter is a basic human need and good policies must be formulated and operated to promote a housing sector capable of supplying adequate shelter to the Ghanaian

population. Thus a well-designed policies will not only lead to expansion of the construction industry, but will increase the welfare of the population, particularly the poor who are vulnerable in the society by improving the living conditions and expanding their physical assets. Empirical evidence on housing sector suggests that government that pursue housing policies base on the “enabling markets approach” (mortgage financing) have better results than those that pursue traditional policies based on direct public sector supply and financing of houses for lowincome families. This “enabling markets approach” relies on the private sector as the main supplier of houses and issuer of long-term financing for households of all income levels, with government playing a role as a regulator and facilitator of housing markets.

The approach minimizes the direct influence of government in direct construction and financing of houses, and rather promotes government interventions on the development of private housing financing, the facilitation of land subdivision for residential uses, the improvement of the construction industry and the support of affordable housing solutions for low-income households. Ghana’s housing sector and mortgage industry remain underdeveloped and faces myriads of problems such as land acquisition where estate developers sometimes have to pay three to five times the normal price making houses more expensive for resident Ghanaians.

5.2 Research Findings

The major findings and observations of this research are as follows: It was observed that clients discuss with the banks mortgage department about the time within which to service their mortgage loans obligations. However, even when the mortgagors are not able service their mortgage repayments, the bank is flexible with them by restructuring their loan repayments. However, even when the mortgagors are able service their mortgage repayments, the bank deals with them gently. However mortgage transactions are characterized by the banks dictation of interest rate terms and the bank can vary the interest rates as it deems fit as stated in the mortgage deed or agreement without ceiling.

Another finding is that turnaround time for approval and disbursement of mortgage loans to clients are quite irregular varying between one month to six months or even more. The disposal of foreclosed properties were also done on the quite in order not to affect the corporate image of the bank. The banks mortgage department does not also advise its clients to take mortgage insurance coverage of their mortgaged properties so that in times of invalidity or death the properties would not be foreclosed and disposed off, The transition matrix obtained shows that classified loan switching from one state to another is possible. The thesis proposes the approach to estimating transition matrix for Markov Chain model for mortgage loan classification. The estimated transition probabilities lie within the 95% confidence as calculated.

5.3 Conclusion

This thesis proposes ground-breaking method for estimating transition matrix for Markov chain model for mortgage loans classification and performance. We applied the maximum likelihood method to generate the transition probabilities. Modeling mortgage loans performance and classifications under extreme economic conditions requires sophisticated techniques based on the loans level data.

In most research conducted into multistate process such as modeling mortgage insurance as a multistate process (Taylor and Mulquincy,1997) the states of Olem, sub-standard, doubtful and loss which constitute the non-performing loans are merged into one state called 'default' to reduce the number of states for easy estimation of transition probabilities. This research separated the default state into four states making a total eight states for estimation of transition probabilities.

Variables such as interest rates, currency instability, hedging or indexation, inflation, level of income and the age of the customers should be considered. Another approach such as multinomial or polytomous logistic regression model is therefore recommended.

5.4 Recommendations

C= Current, O= Olem, R= Sub-Standard, T=Doubtful L = Loss, S=Sale, I= Invalidity, M= Insurance Claim, PO = Loan Paid Off.

1. It is recommended that the Mortgage department of HFC bank must advise potential mortgagors to take a life endowment insurance policy or personal mortgage (property) insurance policy to PAY OFF or DISCHARGE the outstanding mortgage loan balance in case of death or when the mortgagor is incapacitated or invalid to avoid foreclosure of his or her property as illustrated in the transition diagram in Figure 5.1
2. HFC bank must also initiate a programme where low income earners can also access the mortgage loan facility. The government should also create alternative strategies to mortgage financing that benefit low to middle income earners and increase their access to affordable housing, also needs to be considered.
3. The Government should design a loan guarantee scheme that reduces that risk premiums because interest rate charged on guaranteed loans would be lower than the prevailing market rate.
4. A strong legal and regulatory framework which comprises consistent and holistic set of laws is needed (areas such as property rights, collateral, foreclosure etc) for the housing sector. This calls for amendment of the Mortgages Decree (1972) and the Home Mortgage Act, 1993. The efforts of enhancing land administration must also be intensified.
5. Since HFC bank and Ghana Home Loans alone cannot offer credit facilities to cater for the Ghanaian population, the government should create a favourable macro-economic environment and policies to encourage the establishment of more diverse mortgage

(lending) financial institutions, publicly or privately which would eventually encourage healthy competitions to make the scheme more accessible.

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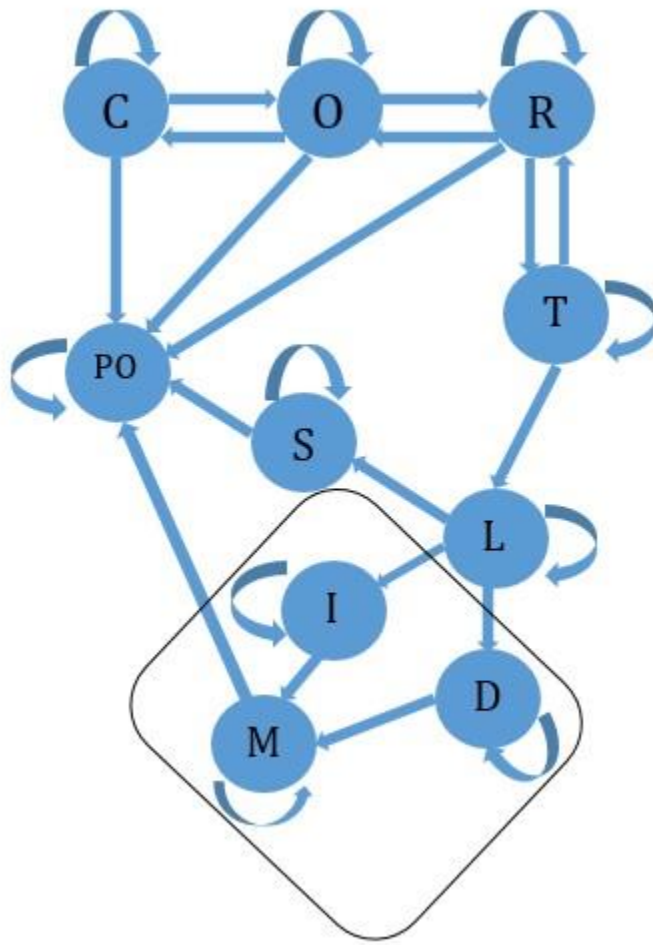


Figure 5.1:
Transition graph showing the insurance claim when the mortgagor is dead or incapacitated

The figure 5.1 is proposed instead of the one shown in the figure 4.1. It is suggested that borrowers should take up a mortgage insurance policy of their properties or buy life insurance endowment policy so that in case of death or invalidity, insurance would be claimed to pay off the outstanding balance of the loan to avoid foreclosure of their properties. The states I, D, M represent the states of invalidity, death and insurance claim respectively. It represent the safety net for mortgagors or borrowers who undertake life

insurance or mortgage insurance.

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Appendix

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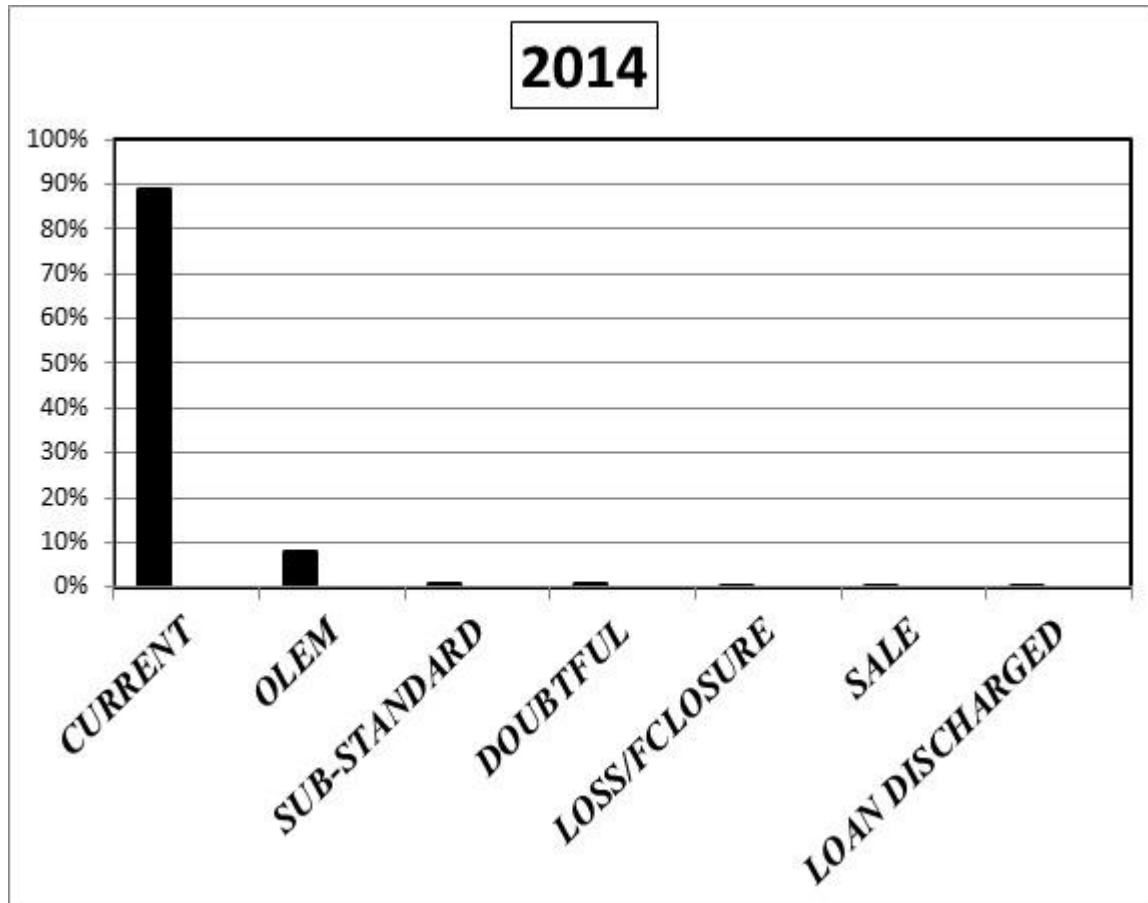


Figure 5.2: Graph showing mortgage loan classification for 2014



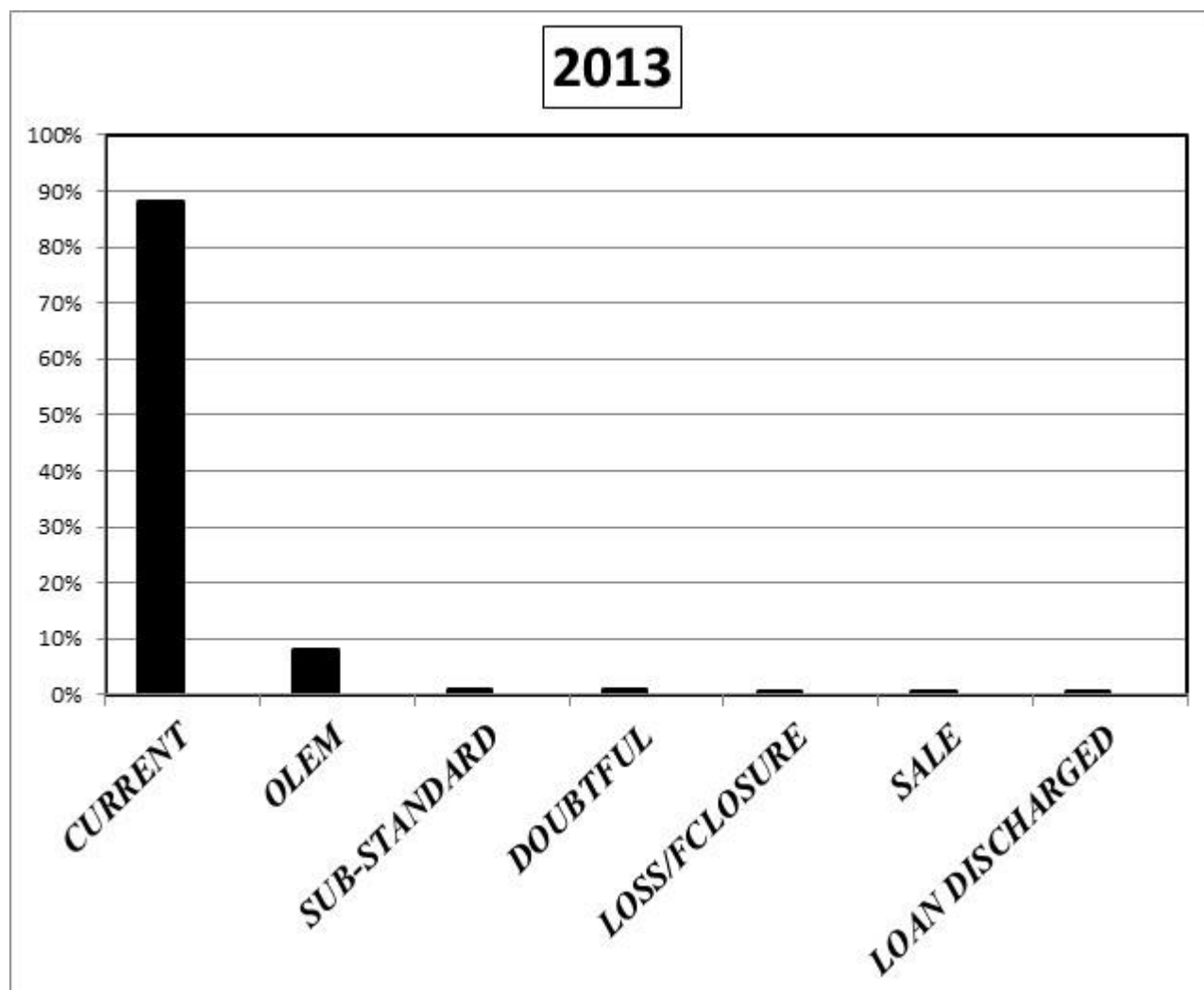


Figure 5.3: Graph showing mortgage loan classification for 2013



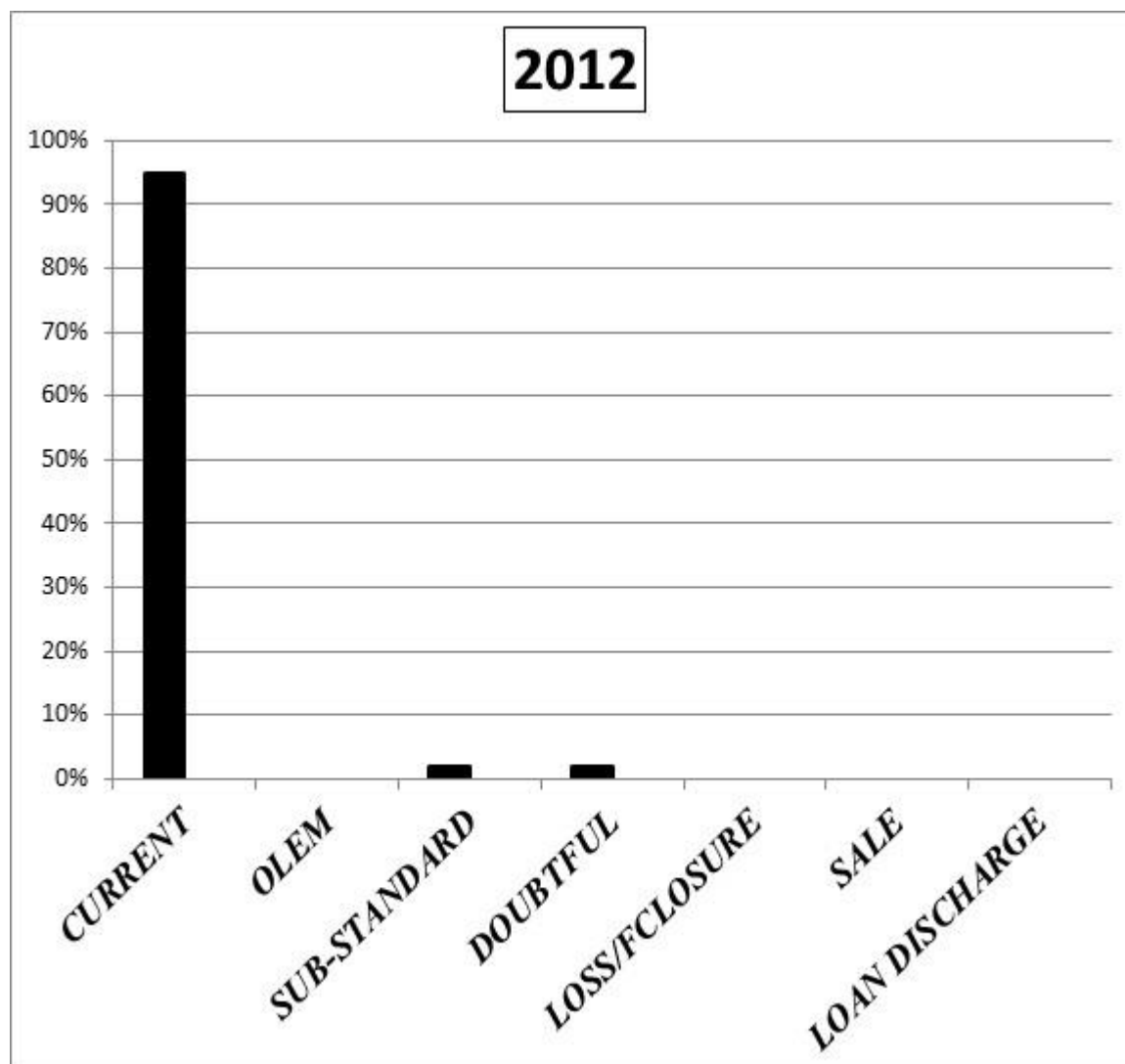


Figure 5.4: Graph showing mortgage loan classification for 2012

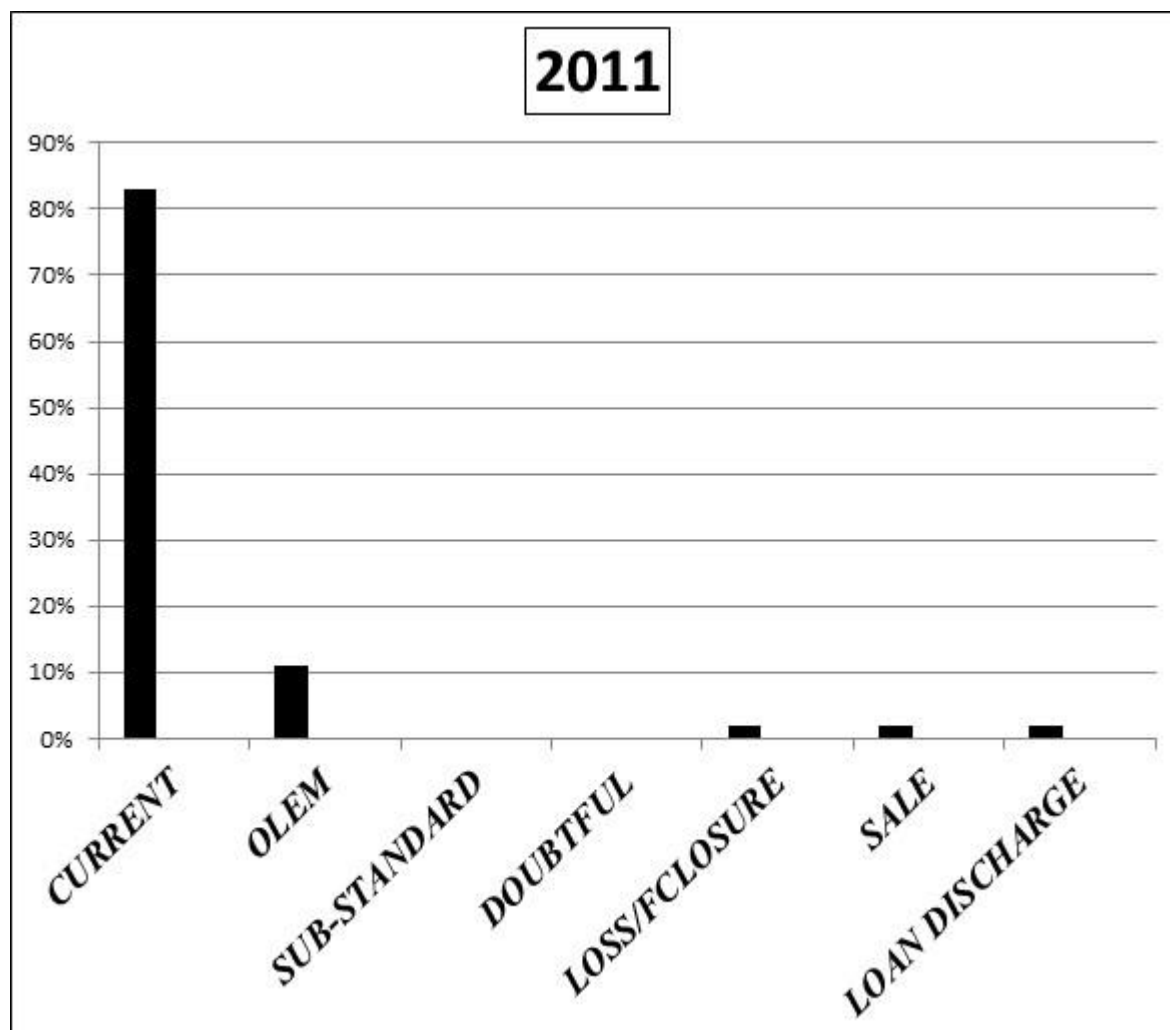


Figure 5.5: Graph showing mortgage loan classification for 2011



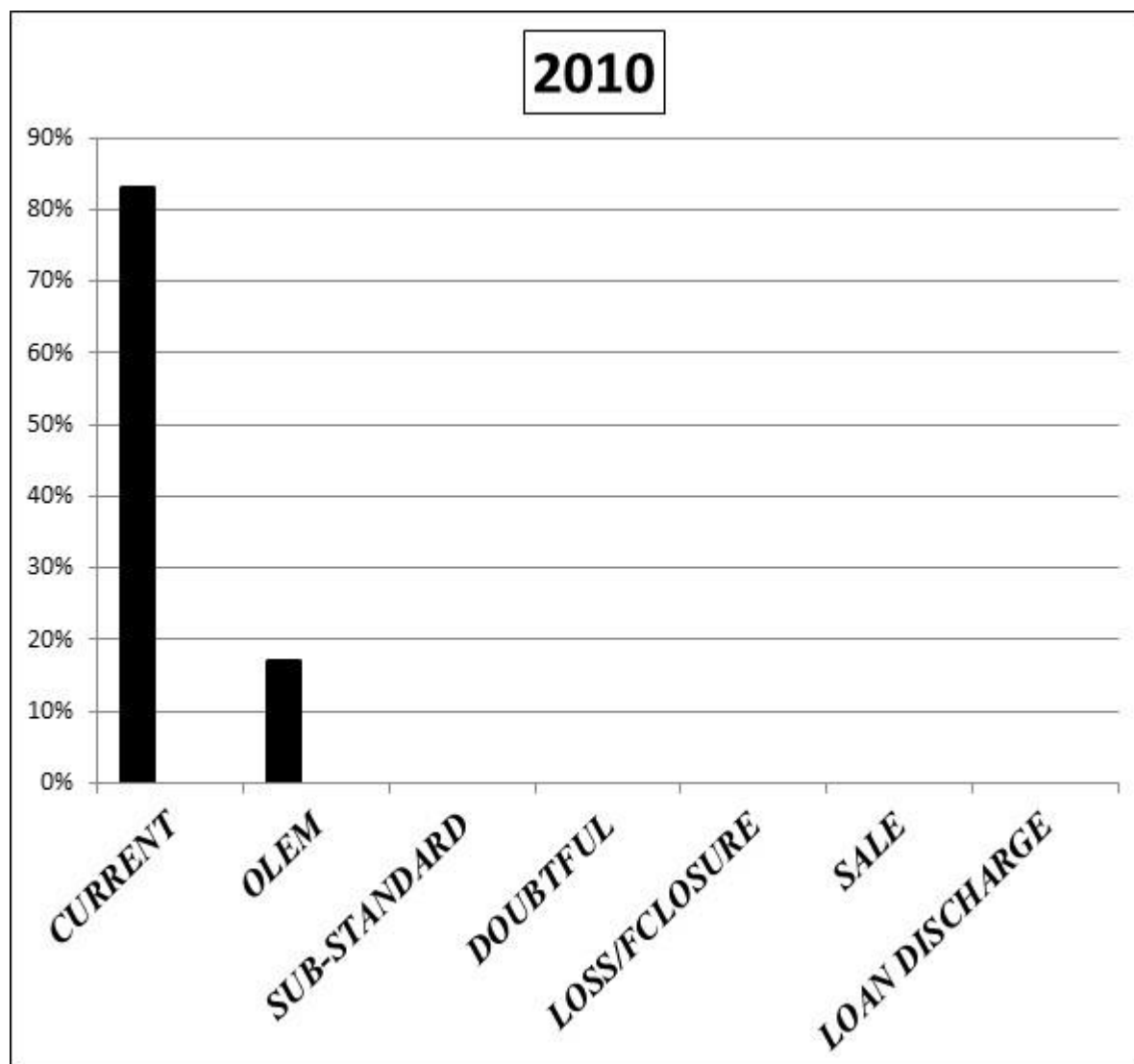


Figure 5.6: Graph showing mortgage loan classification for 2010

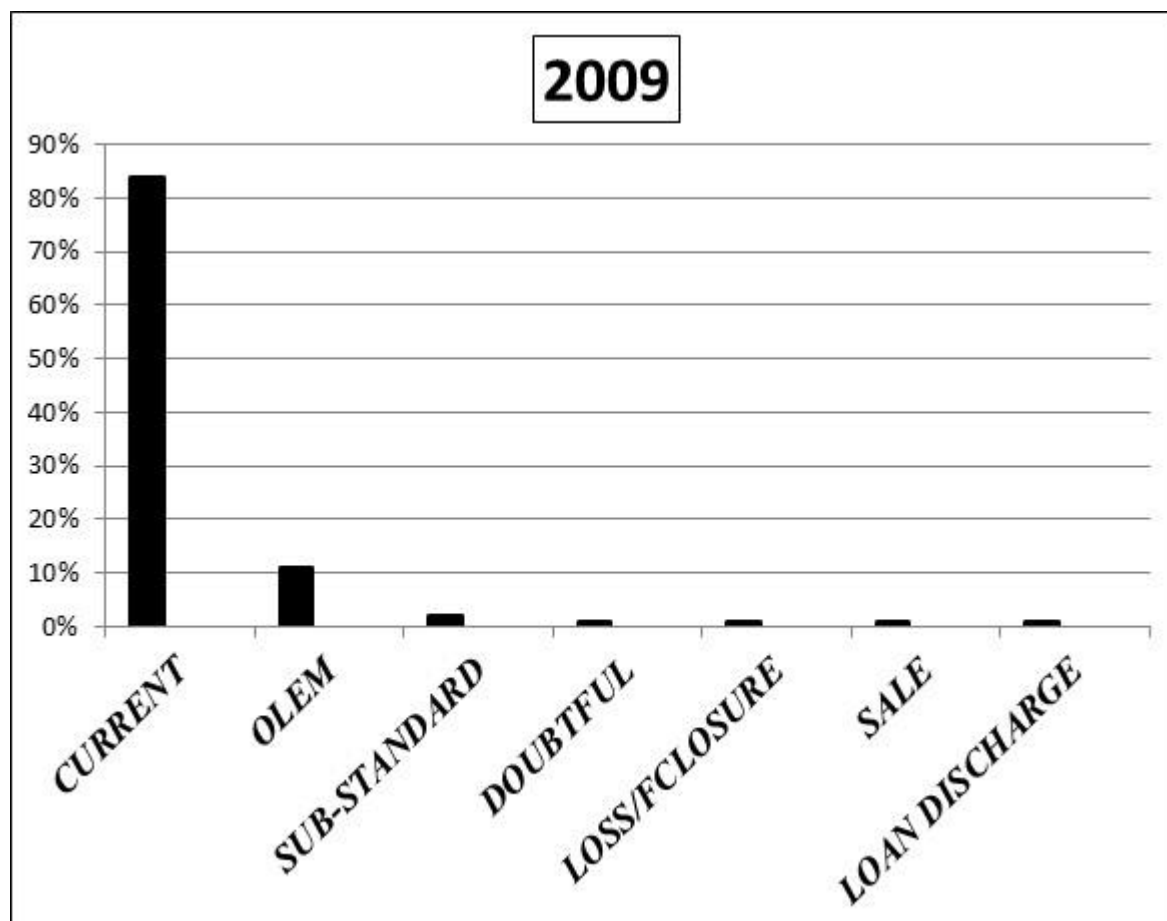
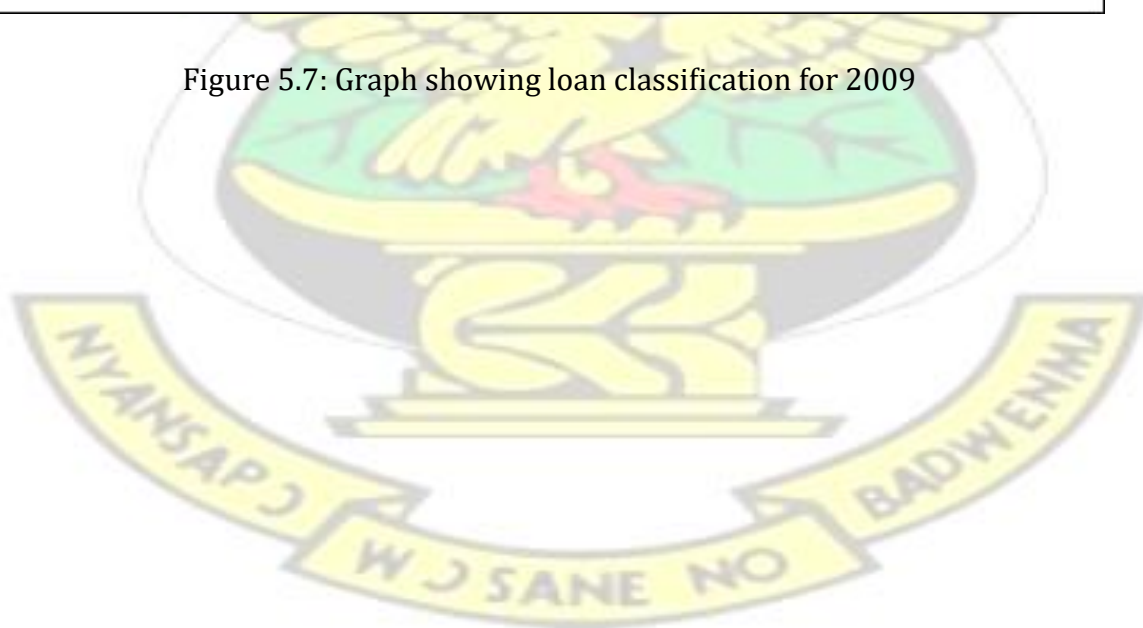


Figure 5.7: Graph showing loan classification for 2009



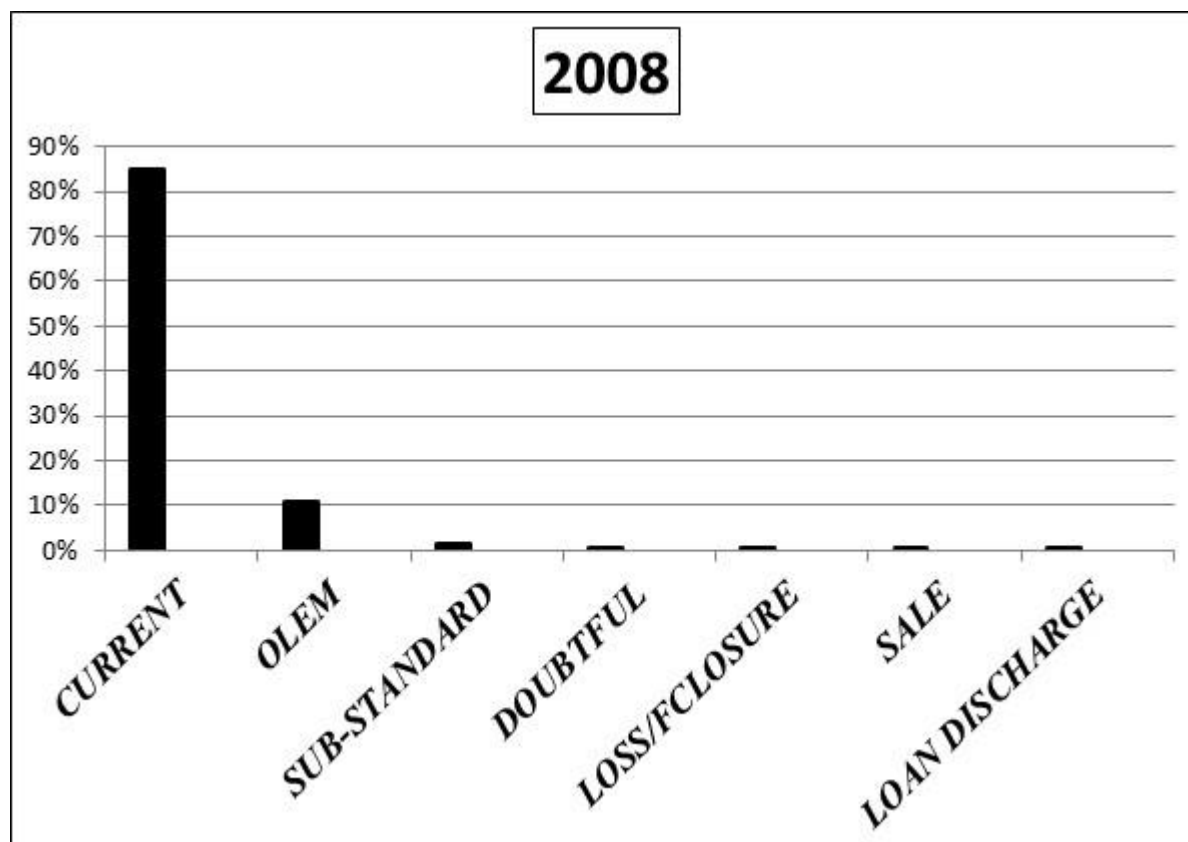


Figure 5.8: Graph showing mortgage loan classification for 2008



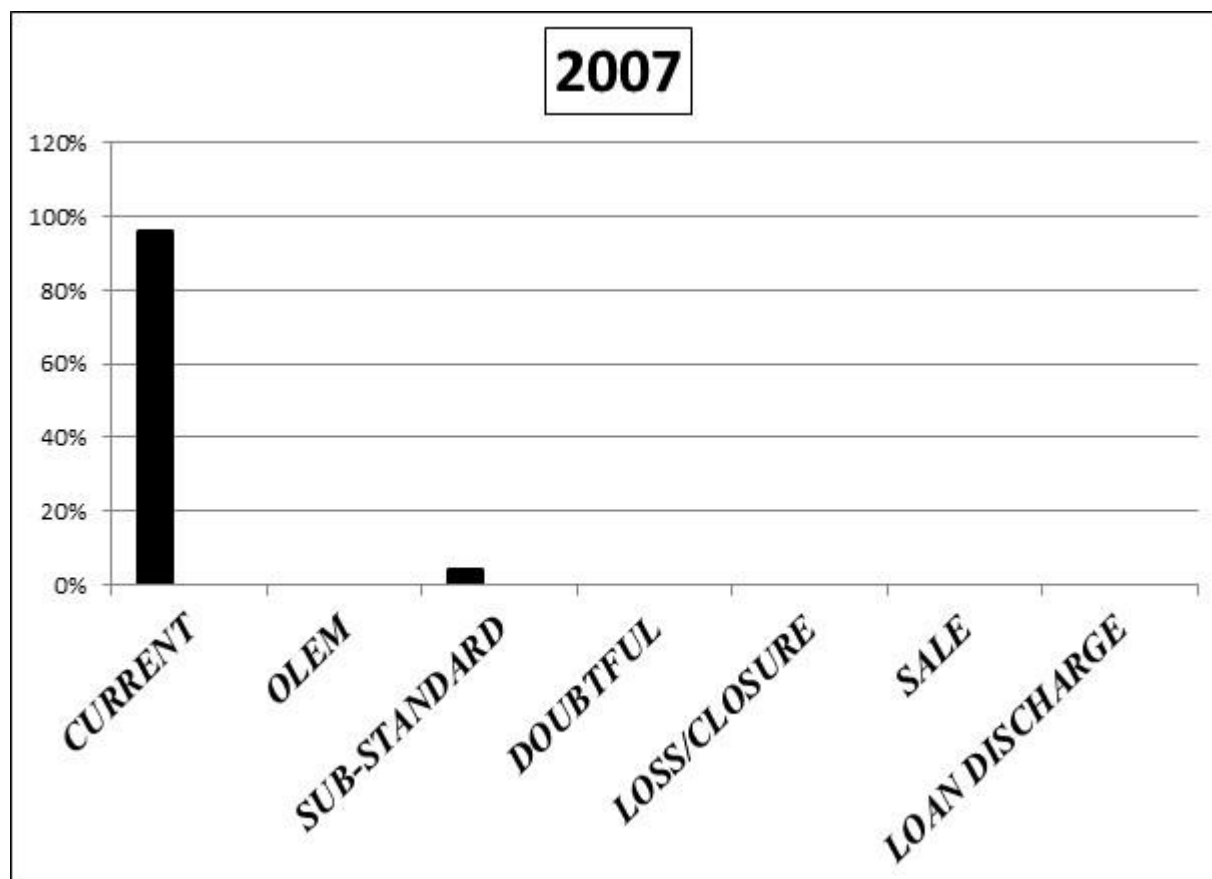


Figure 5.9: Graph showing mortgage loan classification for 2007



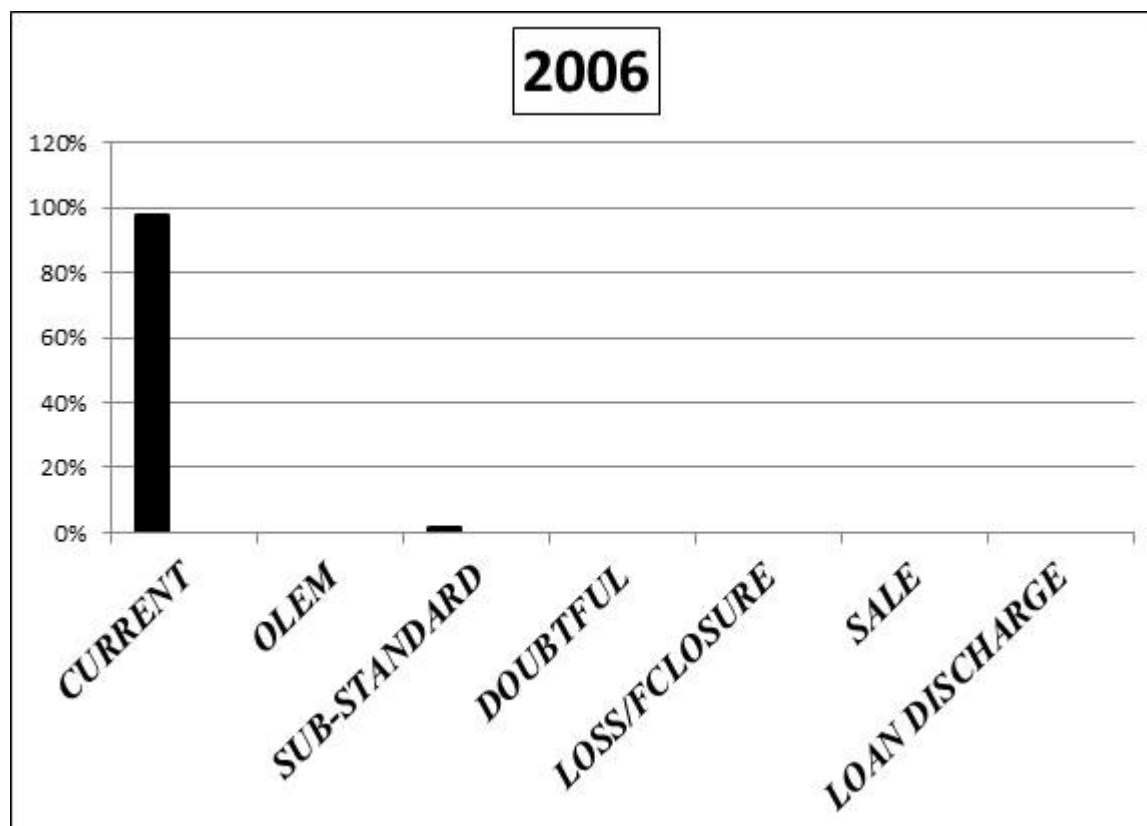
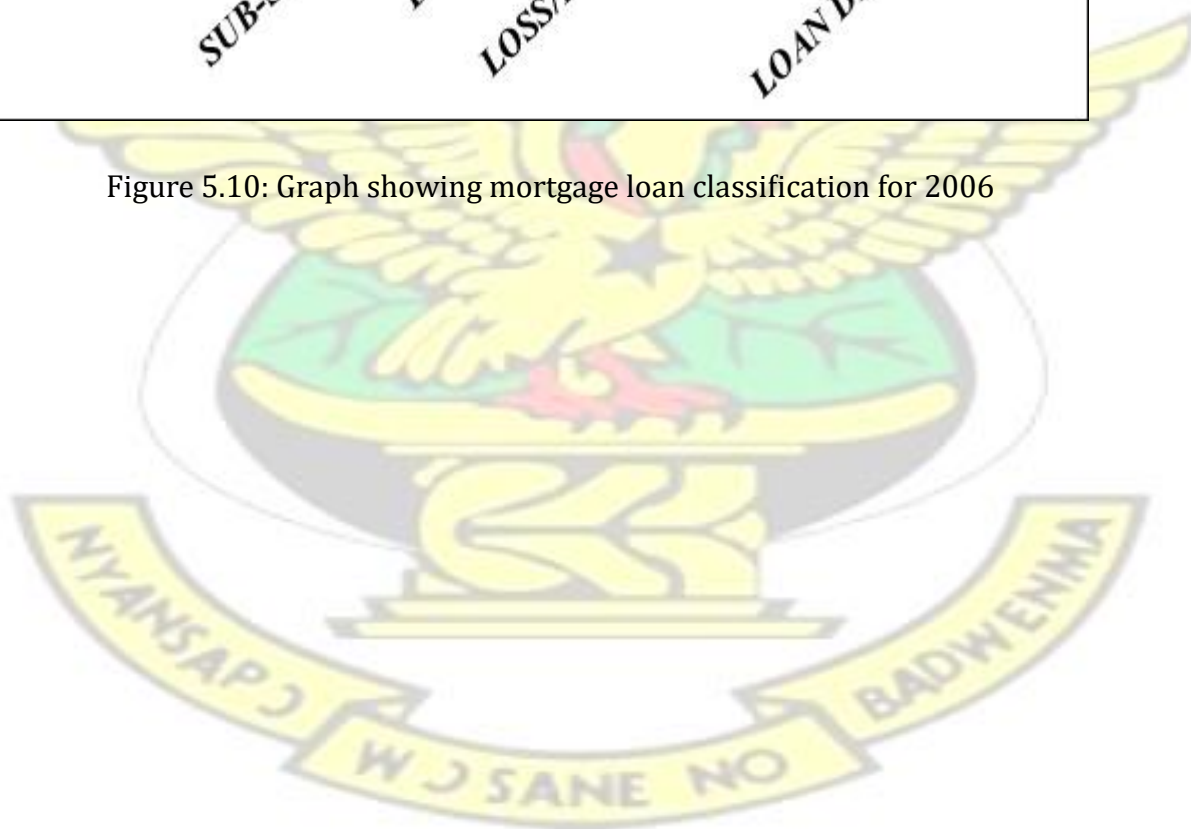


Figure 5.10: Graph showing mortgage loan classification for 2006



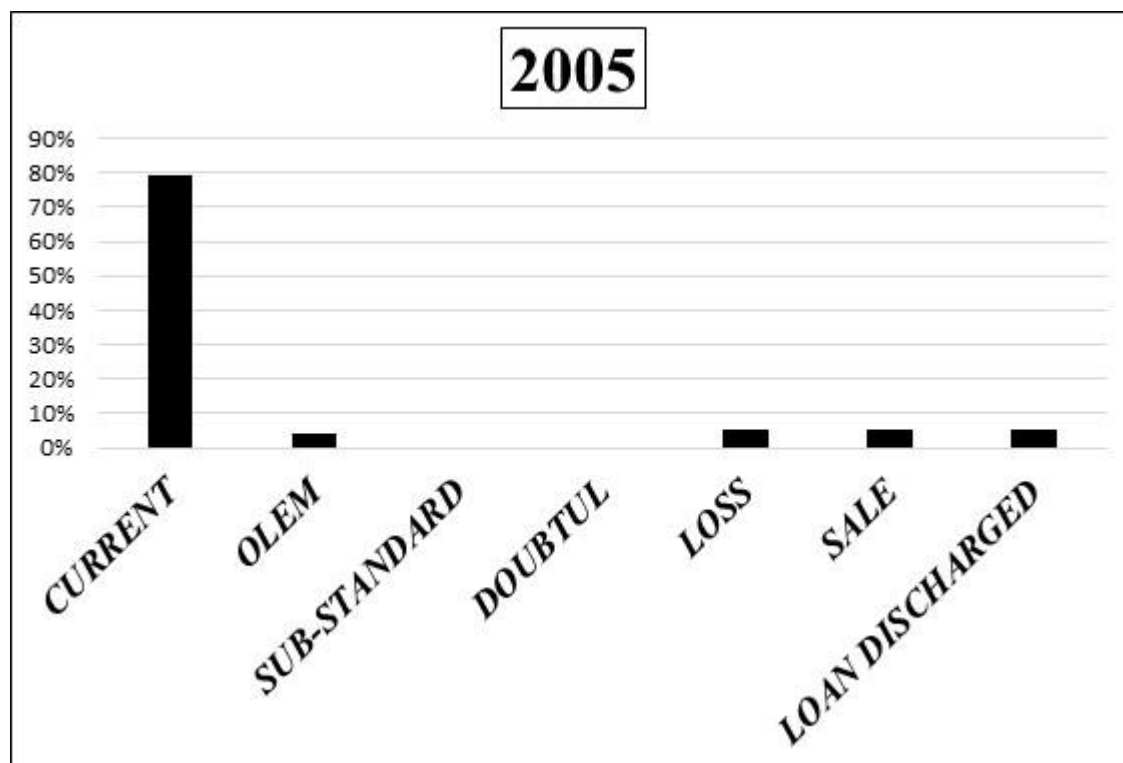
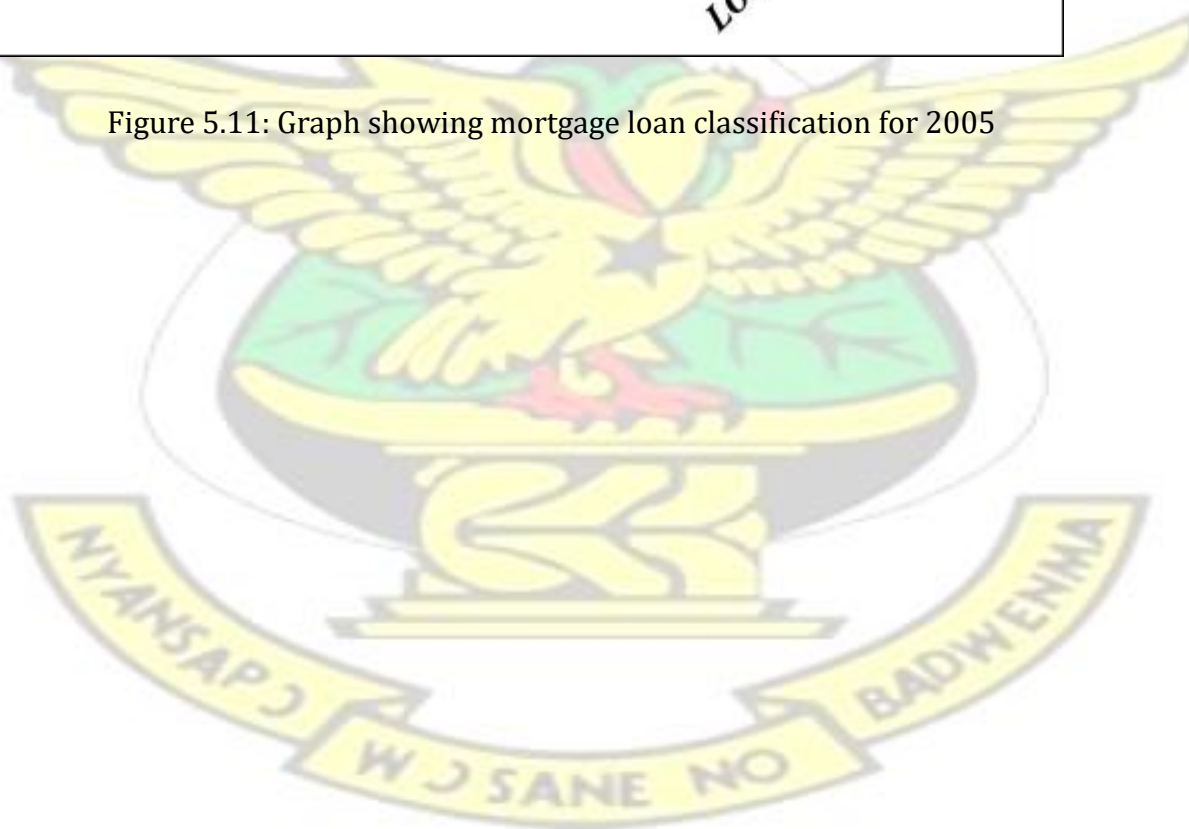


Figure 5.11: Graph showing mortgage loan classification for 2005



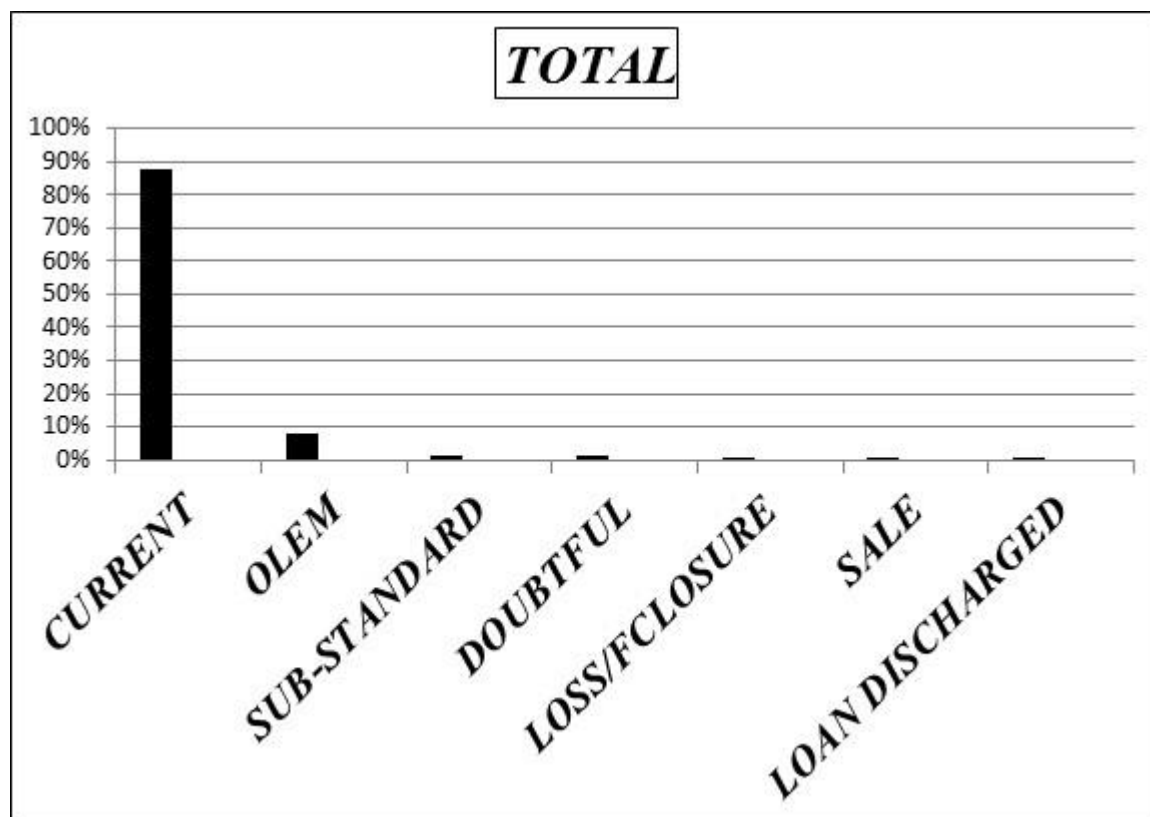
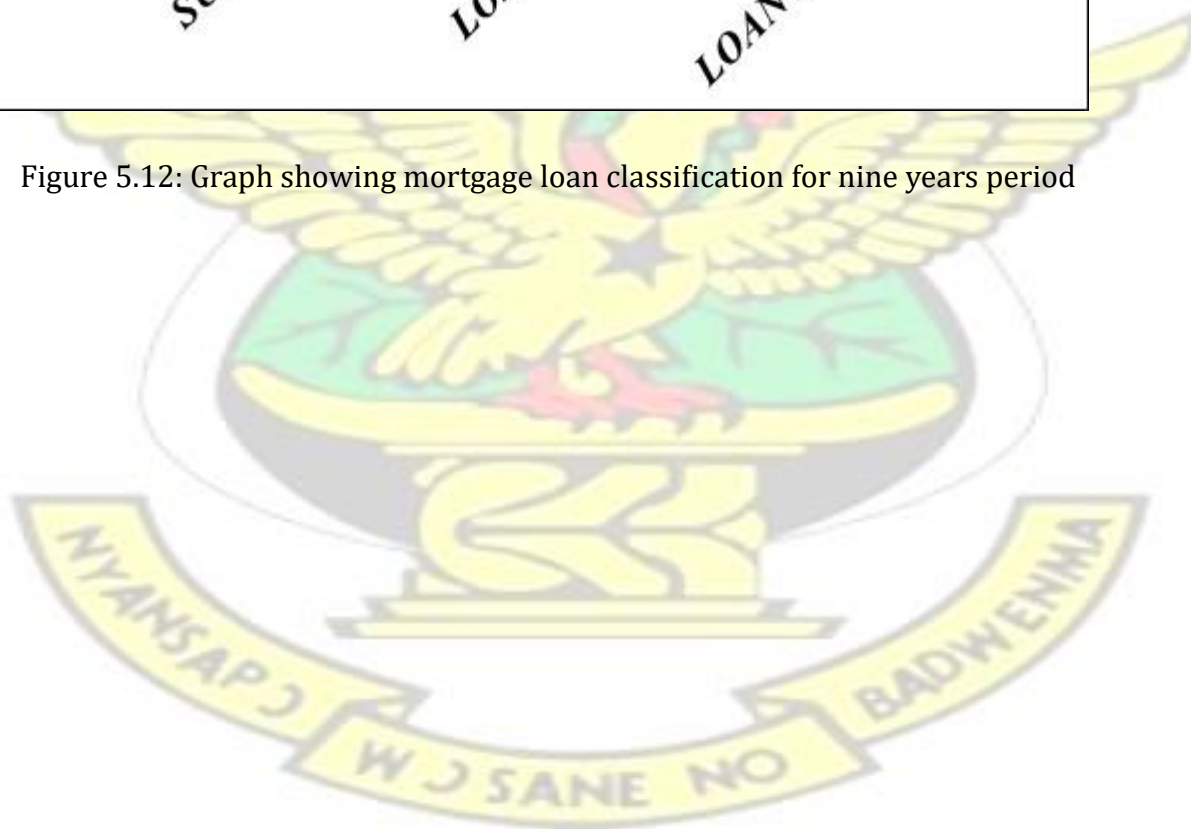


Figure 5.12: Graph showing mortgage loan classification for nine years period



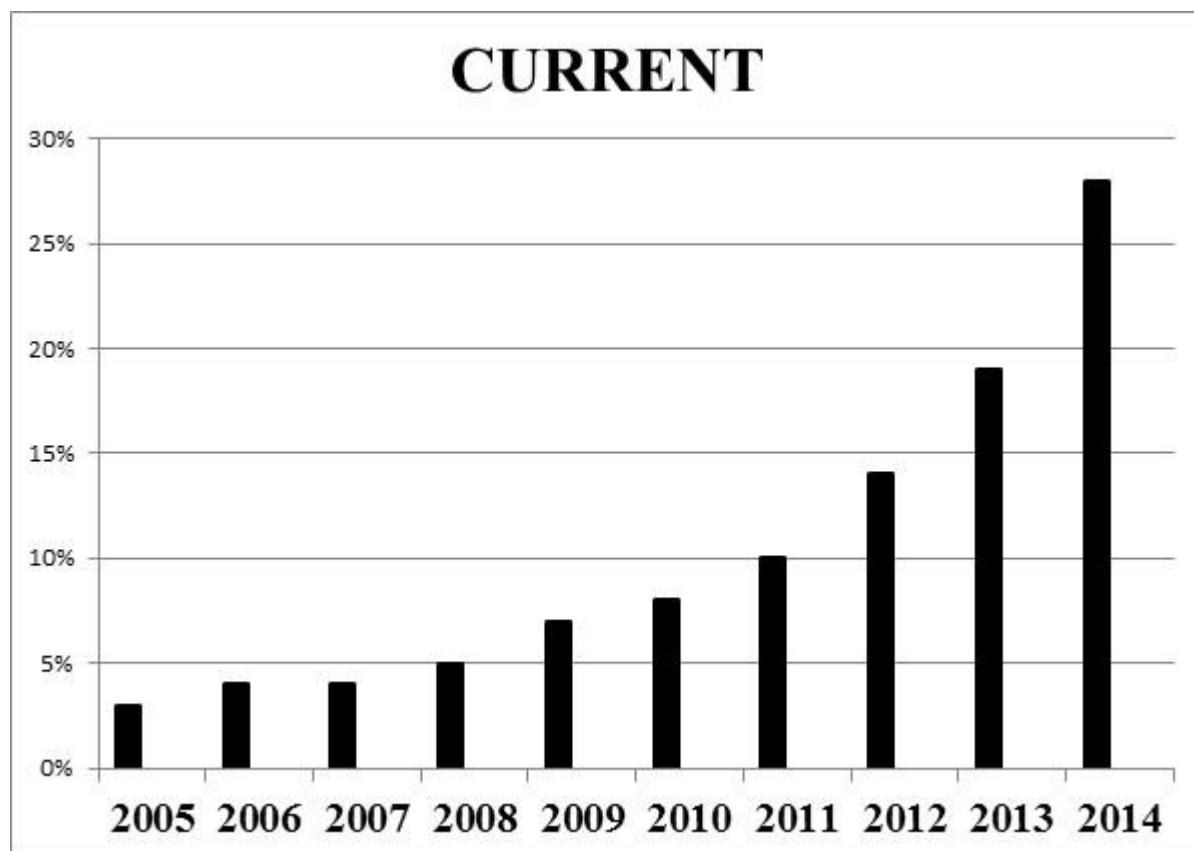


Figure 5.13: Graph showing mortgage loan classification showing current from 2005-2014



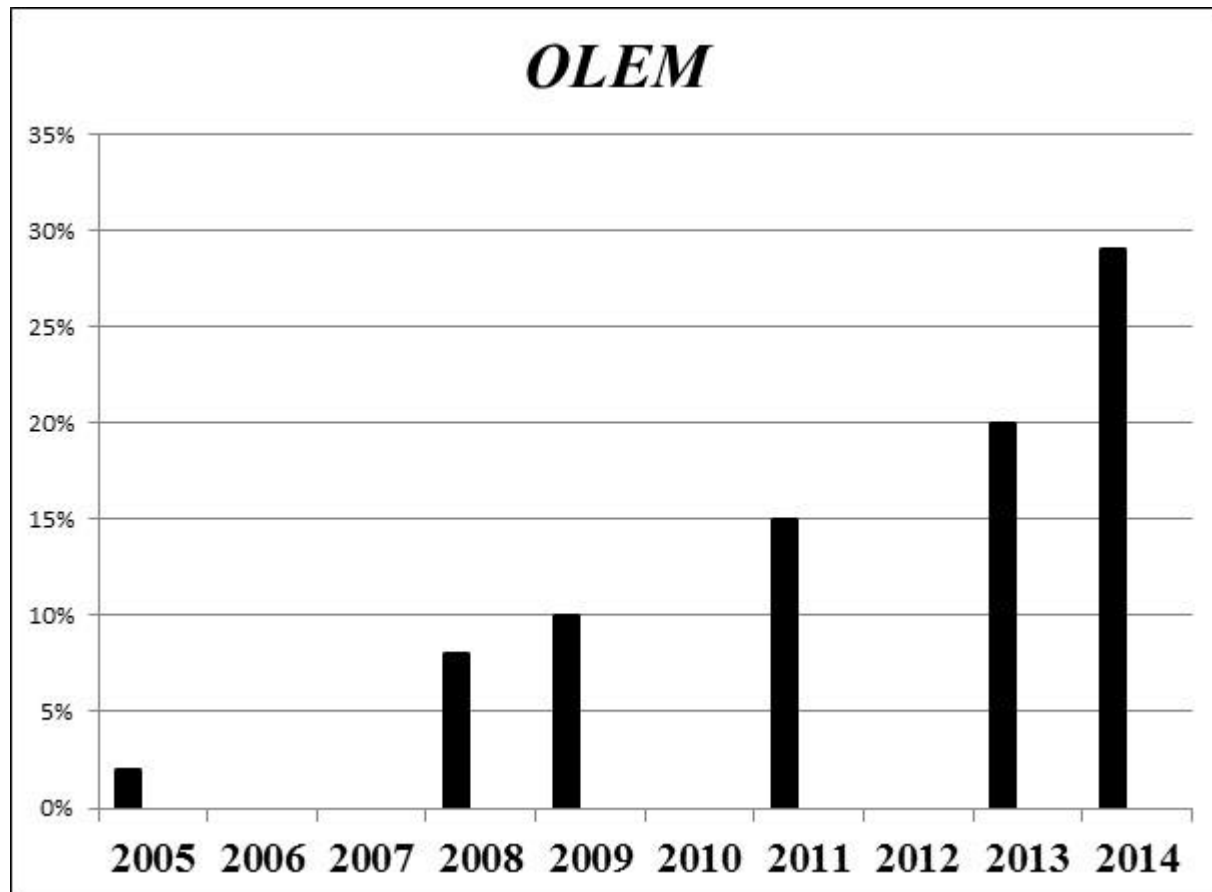


Figure 5.14: Graph showing mortgage loan classification showing Olem from 2005-2014



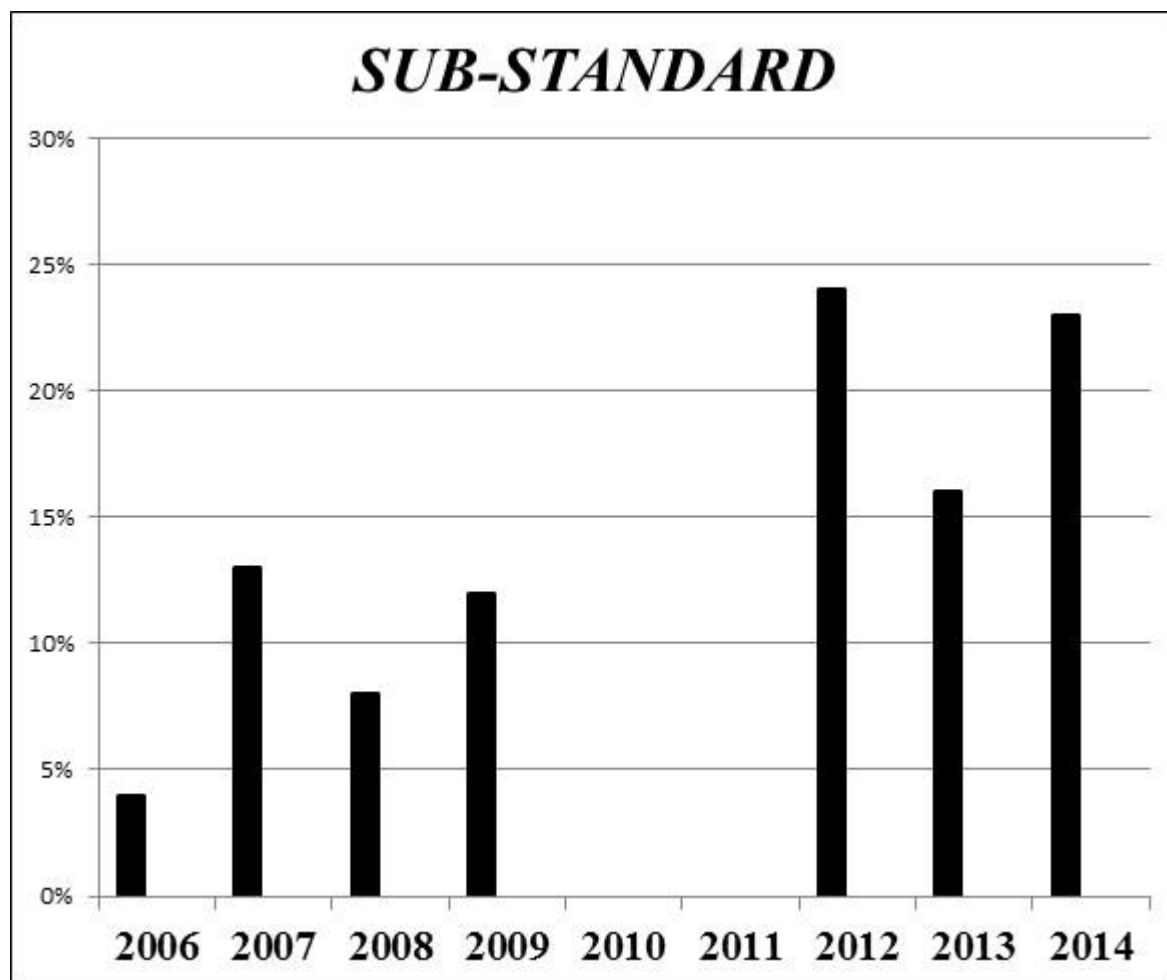


Figure 5.15: Graph showing mortgage loan classification for sub-standard for 2005-2014



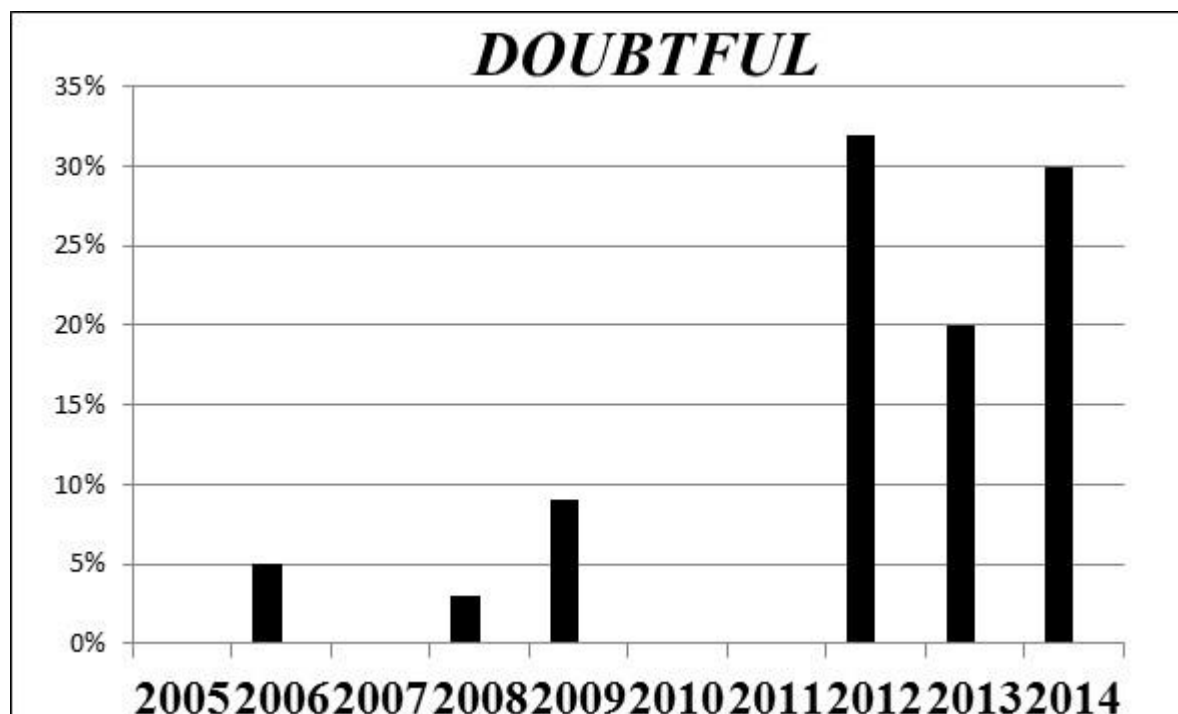


Figure 5.16:

Graph showing mortgage loan classification for Doubtful loans from 2005-2014



Figure 5.17:

Graph showing mortgage loan classification for Loss and properties foreclosed 2005-2014

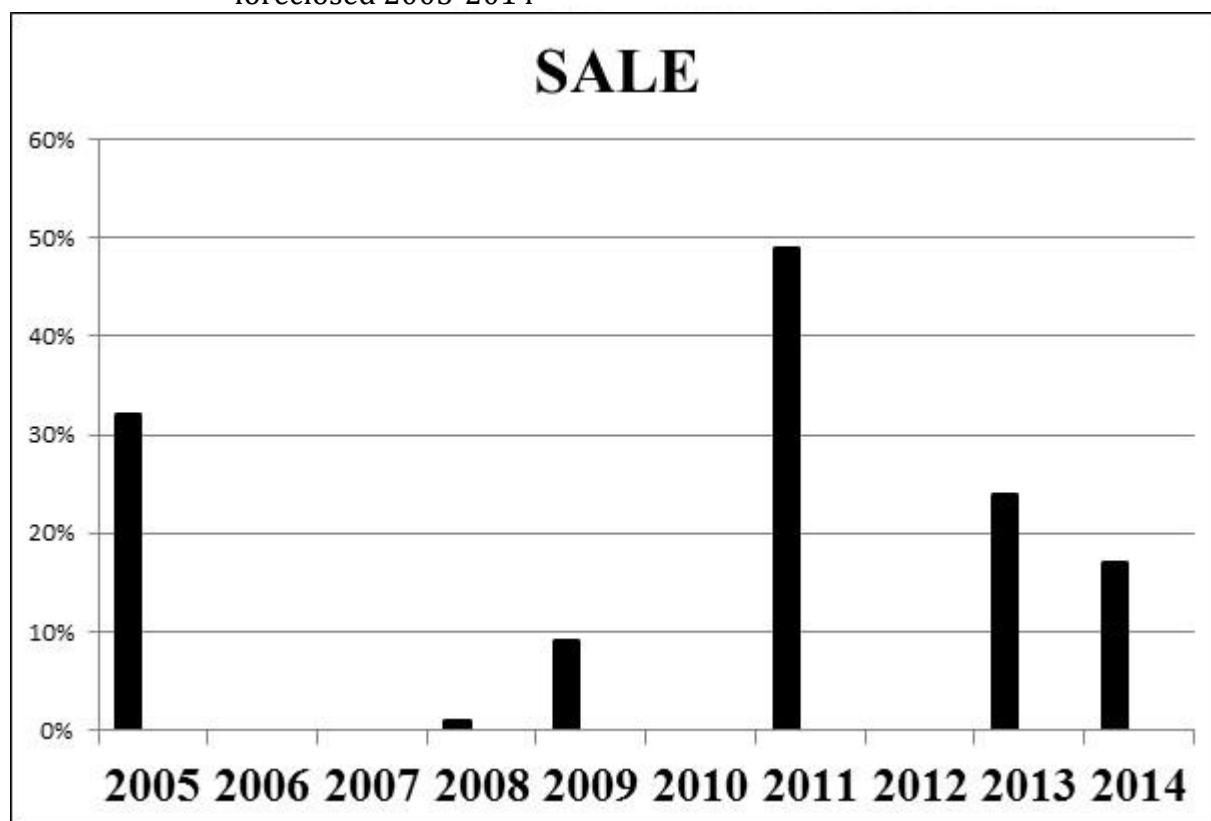
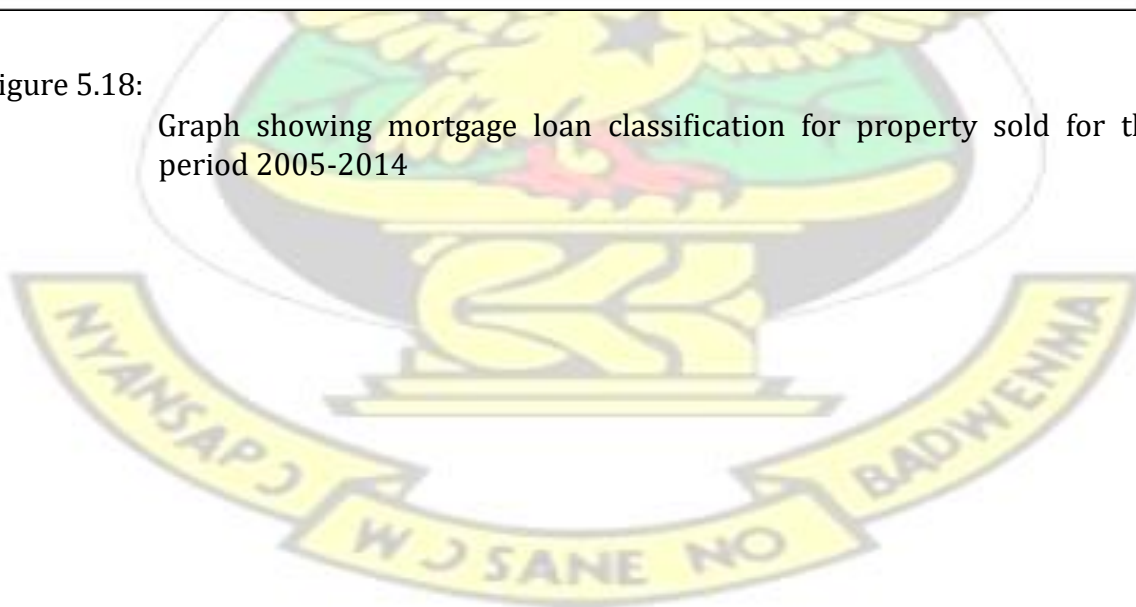


Figure 5.18:

Graph showing mortgage loan classification for property sold for the period 2005-2014



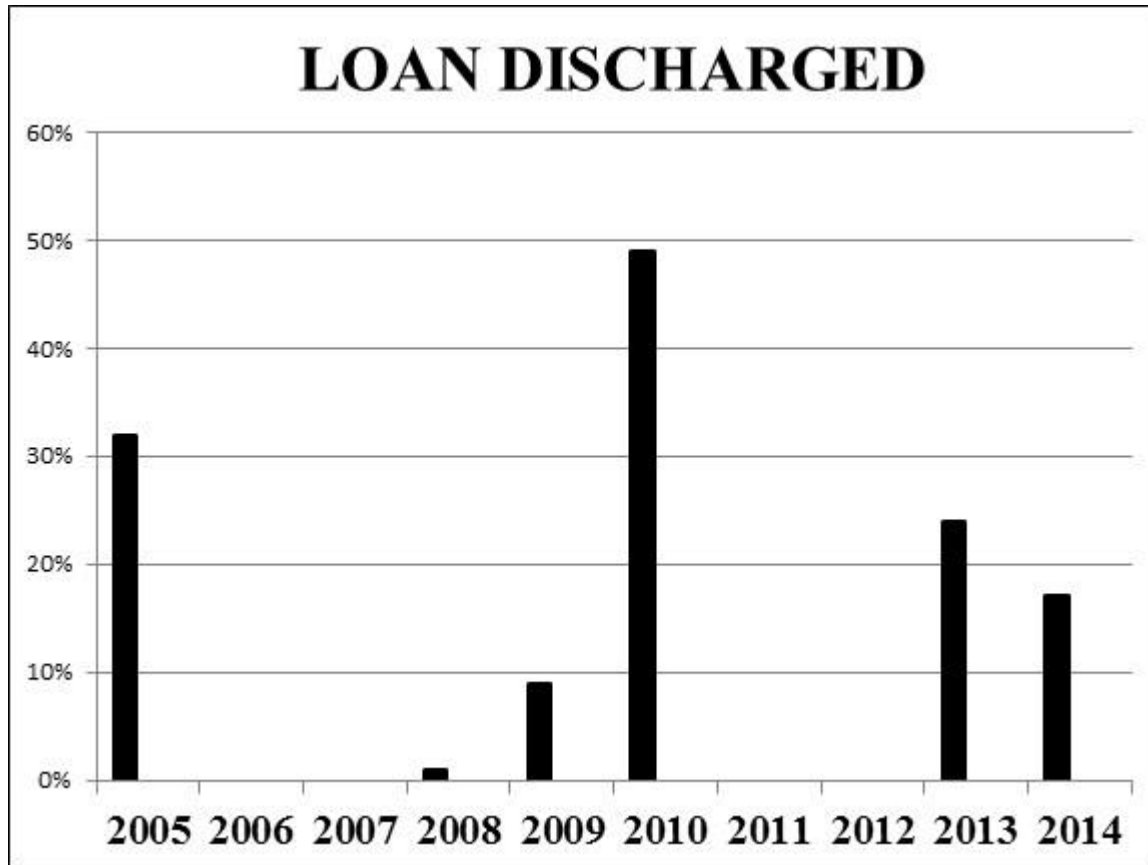


Figure 5.19:

Graph showing mortgage loan classification for properties sold to discharge loans from 2005 -2014