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**THE IMPACT OF GOVERNMENT AFFORDABLE HOUSING PROGRAM ON
HOUSING PRICES: CASE STUDY OF NAIROBI, KENYA**

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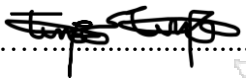
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ABSTRACT

This study examines the impact of the Kenyan government's affordable housing program, Boma Yangu, on housing prices in Nairobi. The research seeks to understand how the introduction and implementation of affordable housing initiatives influence the dynamics of the local housing market, with a particular focus on property values in surrounding areas. As housing affordability remains a significant challenge in rapidly urbanizing cities like Nairobi, this study employs a Hedonic Pricing Model (HPM) to analyze the relationship between the affordable housing program (independent variable) and the housing index (dependent variable), while controlling macroeconomic factors such as inflation, GDP, mortgage rates, and money supply.

The analysis is based on descriptive statistics and regression modeling, which revealed that the affordable housing program significantly reduces housing prices, with the housing index decreasing by 7.95 units ($p = 0.021$). This reduction is attributed to increased housing supply, which fosters competition and aligns with the fundamental principles of supply-demand dynamics. Other significant factors influencing housing prices include inflation and money supply, while GDP growth and mortgage rates were found to have negligible effects in this context. Model diagnostics, including tests for multicollinearity and heteroscedasticity, confirmed the reliability of the findings, with the model explaining 89.44% of the variance in housing prices ($R\text{-squared} = 0.8944$).

The study concludes that the Boma Yangu program is effective in reducing housing prices, making homes more accessible to Nairobi's low- and middle-income residents. However, it also emphasizes that affordability is not solely about price reductions. The program should expand its reach to accommodate diverse income groups and address broader housing equity concerns. Policy recommendations include continued government investment, policy adjustments to enhance program efficiency, and consistent monitoring of its long-term impacts.

This research provides critical insights for policymakers and urban development stakeholders, highlighting the potential of government-led housing programs to reshape urban housing markets and address affordability challenges. It also underscores the need for further studies to evaluate the program's impact across different regions, offering a scalable model for similar urban centers facing housing crises.

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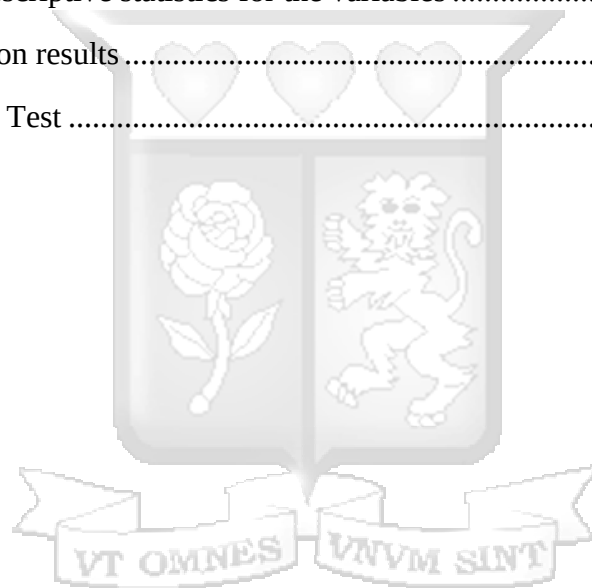
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DEDICATION

This research project is dedicated to my family, whose unwavering support, encouragement, and belief in my abilities have been a constant source of strength throughout my academic journey.

To my mentors and educators, thank you for inspiring me to pursue knowledge with curiosity and determination. Your guidance has been invaluable in shaping my understanding and approach to this work.

Lastly, I dedicate this project to individuals and communities whose stories and experiences continue to inspire meaningful research in pursuit of positive change. May this work contribute to a better understanding of the challenges they face and the solutions that can help address them.



CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The primary goal of housing sector policy interventions worldwide is to encourage the supply of affordable housing. According to studies by Ko & Kim (2022), China has made significant investments in the region's affordable housing market with its Cheap Rental Housing Guarantee Plan, which aimed to build 7.5 million public housing units with the help of the country's central government. Additionally, their analysis reveals that between 1995 and 2018, the Low-Income Housing Tax Credit program in the United States produced an average of nearly 1,400 projects and 106,400 units annually. Approximately 5 million homes, or roughly 6% of all homes in the United Kingdom, were in the social housing sector as of April 2018.

According to studies by Omagwa (2021), knowledge of how the supply of new housing reacts to prices is important because this is a critical component of wealth creation and a nation's economic growth. The previous government's housing program, which was introduced in 2017, was aimed at middle-class and upper-class individuals, with a specific focus on reducing the housing gap for the low-income individuals by 60%, generating 350,000 jobs in the construction industry, and boosting GDP. Kenya's revised National Housing Policy, Sessional Paper No. 3 of 2004, aimed to address the issue of safer neighborhoods, as also discovered by Omagwa (2021), as well as the nation's declining housing conditions and housing shortage, particularly in urban areas. To guarantee that its citizens would have the chance to purchase homes at reasonable costs and in better housing conditions, the Kenyan government established affordable housing as one of its top priorities under the Big Four Agenda. Everybody has the right to reasonable standards of sanitation and to accessible, adequate housing, according to Article 43 of Chapter 4 of the 2010 Kenyan Constitution. The Affordable Housing Program in Kenya was administered by the State Department of Housing and Urban Development. By 2022, the Kenyan government aimed to provide 500,000 reasonably priced housing units. However, the growing population of Kenya has made it more difficult to provide affordable housing. Omagwa (2021) underlined that creating

excellent infrastructure also entails creating networks for efficient transportation, sanitary facilities, clean water, and communication. The government intended to build affordable housing units in five lots over the course of a five-year project pipeline. Lot number one targeted 35,940 units in communities like Ngara, Parkroad, Makongeni, Shauri Moyo, Starehe, and Mavoko. The Kenyan government's affordable housing program included both the social housing and slum upgrading initiatives. Unfortunately, the program did not fully come into fruition.

Affordable housing is a significant policy issue in Kenya, where a large proportion of the population struggles to access decent and affordable housing. In response, the current Kenyan government has implemented the 'Boma Yangu' affordable housing program aimed at increasing the availability of housing for low and middle-income earners. Kenya's housing policies have evolved significantly over the years, particularly with the introduction of Vision 2030, which prioritizes affordable housing as a key component of national development. Before this, housing policies were largely fragmented and ineffective in addressing the growing urbanization and housing needs. The housing market in Kenya is characterized by a high demand for affordable housing, particularly in urban areas like Nairobi, Mombasa, and Kisumu. However, the supply has lagged demand, leading to high housing prices and the proliferation of informal settlements.

1.2 Problem Statement

Affordable housing remains a critical issue in Kenya, where a significant portion of the population struggles to secure adequate living conditions. In response, the government has launched an affordable housing program aimed at increasing the availability of low-cost housing. However, the impact of this initiative on overall housing prices in Kenya remains unclear.

Despite the potential benefits, there are concerns that government intervention in the housing market may lead to unintended consequences. For instance, the introduction of affordable housing units could influence the prices of existing homes, either by increasing competition and driving down prices or by creating demand pressures that inflate prices. Understanding these dynamics is essential for policymakers to ensure that the affordable housing program effectively meets its goals without destabilizing the broader housing market.

In contrast to other Kenyan towns and cities, Nairobi has high rates of housing congestion, with over 9% of the country's population residing there, as shown by Omagwa (2021). Nairobi's population is predicted to increase by 4.06% in 2024 after growing by 4.02% in 2023. Nairobi, however, makes up only 8% of Kenya's total land area. Studies by Kim, Kwon and Choi (2020) show that the vulnerable population is disproportionately affected by the growing cost of housing and renting in urban areas, which prevents low-income families from having access to adequate housing, healthcare, education, and other urban services. As a result, Kenya's slum population is increasing. Since public rental housing policies of various kinds are promoted globally, affordable rental housing policies represent a promising way to lessen the burden of housing costs.

The United Nations' Sustainable Development Goals (SDGs) aim to address global challenges and improve the well-being of all. Specifically, SDG 11 focuses on making cities inclusive, safe, resilient, and sustainable, which includes ensuring access to adequate, safe, and affordable housing. SDG 11 helps reduce poverty globally and improves living standards, ensuring that everyone has access to basic human rights. Affordable housing can stimulate world-wide economic growth by creating jobs in construction and related industries. Incorporating sustainable practices in housing projects can also reduce environmental impact and promote green living. However, implementing global affordable housing requires significant resources and international cooperation, which can be challenging to manage. Large-scale housing projects also have the potential of displacing existing communities if not managed carefully. Africa, as a continent, faces unique challenges in providing affordable housing due to rapid urbanization, population growth, and economic constraints. Firstly, many African countries lack the necessary infrastructure to support large-scale housing projects, which can limit the effectiveness of such programs. They also have limited financial resources and high poverty levels which make funding and sustaining affordable housing projects challenging. However, SDG 11 offers immense opportunities to African nations as affordable housing can support orderly urban development, reducing the growth of informal settlements and slums which is the norm in many parts of Africa. Reducing slums and informal settlements leads to better housing conditions which in turn lead to improved health outcomes by reducing exposure to disease and improving sanitation. Through the Kenyan lens, affordable housing initiatives create jobs and stimulate economic activities in construction and related sectors. It also provides better living conditions for many Kenyans, particularly those in urban areas like Nairobi. Moreover, it encourages the development of essential services and

infrastructure in new housing areas. Therefore, although affordable housing initiatives in Kenya may face challenges such as high costs of land and construction materials, they ultimately enhance the living conditions of the citizens.

The Human Development Index (HDI) measures a country's average achievements in health, education, and income. As of the latest data, Kenya's Human Development Index (HDI) for 2022 is 0.575, which categorizes it under "medium human development". SDG 11, which entails affordable housing, significantly impacts HDI. Improved living conditions reduce health risks, leading to better overall health outcomes. Stable housing provides a conducive environment for education, helping improve educational attainment and affordable housing reduces the financial burden on households, allowing more income to be spent on other essential needs. However, focusing too heavily on housing can divert resources from other critical areas like healthcare and education and if not managed well, the costs associated with large-scale housing projects can strain national budgets and economic stability.

Affordable housing initiatives, as aligned with the SDGs, have the potential to significantly enhance living conditions globally, in Africa, and specifically in Kenya. While there are challenges in terms of resource allocation, policy implementation, and market impacts, the overall benefits to health, education, and economic stability make these programs crucial for sustainable development. Therefore, this study aims to investigate the impact of the 'Boma Yangu' housing program on housing prices in Kenya. Specifically, it will examine whether this program will lead to a measurable change in housing prices and explore the mechanisms through which these effects occur. This analysis will provide valuable insights for designing more effective housing policies that balance affordability with market stability.

1.3 Research Objective

The primary objective of this study is to evaluate the impact of the Kenyan government's affordable housing program on housing prices in the country. Specifically, the study aims to:

1. Assess the possible changes in housing prices after the implementation of Kenyan affordable housing initiative.

1.4 Research Question

1. What is the impact of the Kenyan government's affordable housing program on housing prices in the country?

1.5 Significance of the Study

Analyzing the impact of our government's affordable housing program on housing prices is vital for multiple reasons. This research aims to provide empirical data to aid policymakers in understanding how affordable housing initiatives affect the overall dynamics of the housing market in Kenya, thus facilitating informed decision-making regarding future housing policies. By assessing the effectiveness of this program, the study will inform resource allocation towards the most impactful housing strategies. Additionally, the research will examine whether the affordable housing project stabilizes or destabilizes housing prices, thereby influencing the broader economy. Insights from this study can enhance investor confidence in the housing market, potentially attracting increased investment in the sector. Evaluating the impact of this program on housing prices will illuminate its effectiveness in improving housing accessibility for low and middle-income families, addressing housing inequality, and assisting in planning community development projects that complement housing initiatives. This research will contribute to the existing body of knowledge on housing economics and public policy, particularly within the context of developing countries like Kenya.

Because housing has an impact on social and economic factors, it is important to analyse the factors that determine housing prices. One good that is closely related to other markets and the nation's overall economic situation is housing. Price changes for housing eventually have an impact on the building industry as well as other economic factors like inflation and unemployment. As a result, developed nations have conducted a great deal of research on the economic and financial factors that influence housing prices, such as GDP, unemployment, interest rates, and credit conditions. But Kenyan housing prices are not always determined by the same factors as those in developing nations. There are limited studies on how the affordable housing program in Kenya will influence its housing prices, a topic which this study aims to investigate. The findings will provide a

framework for future studies on the relationship between government interventions and market responses in the housing sector.



CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This literature review examines the major components relevant to the research topic. The review is structured into three key sections. The theoretical framework discusses the economic theories and models that explain the relationship between government interventions in housing and market prices, providing a conceptual basis for the study. The empirical review summarizes existing studies and data on the effects of affordable housing programs on housing markets in various contexts, highlighting methodologies, findings, and implications. Finally, the research gap identifies the specific areas where current knowledge is lacking, underscoring the need for this study to provide insights into the unique economic and social conditions in Kenya, and to contribute to a more nuanced understanding of the impact of affordable housing programs in developing countries.

2.2 Theoretical Literature Review

2.2.1 Classical Economic Theory

Classical economic theory, originating from economists like Adam Smith and David Ricardo, provides a fundamental understanding of supply, demand, and price mechanisms in a market economy. Often considered the father of modern economics, Adam Smith's seminal work laid the groundwork for classical economics. Smith described the "invisible hand" of the market, where individual self-interest drives supply and demand to allocate resources efficiently. Smith discussed how market prices adjust to balance supply and demand. He introduced the concept of a "natural price," where market prices tend to settle based on production costs and competition. It is important to note though that the theory assumes that the markets are perfect with many buyers and sellers but none of them can influence the prices of goods and services significantly. In the context of affordable housing, classical economic theory can be used to explain how government interventions might impact the housing market. Key concepts include, firstly, supply and demand.

According to classical economic theory, the price of goods, including housing, is determined by supply and demand. An increase in the supply of housing, driven by a government affordable housing program, would theoretically lead to a decrease in housing prices if demand remains constant. Secondly, classical economic theory posits that markets tend toward equilibrium, where supply equals demand. Government interventions, such as affordable housing programs, can shift this equilibrium by altering either the supply side (building more houses) or the demand side (subsidizing housing costs). Another key concept is price elasticity. The responsiveness of the quantity demanded or supplied to changes in price is critical. If the demand for housing is inelastic, a substantial increase in supply may not significantly lower prices. Conversely, if demand is elastic, small increases in supply could lead to notable price reductions.

2.2.2 Housing Market Theory

Housing market theory is an interdisciplinary field that combines elements from economics, urban planning, and real estate to understand how the housing market functions. It explores the dynamics of supply and demand, pricing mechanisms, and the impact of various factors such as government policies, economic conditions, and demographic trends on housing markets. Housing market theory has evolved from early classical economic concepts to a sophisticated field that integrates insights from urban economics, behavioral economics, and spatial analysis. Key aspects include the Filtering model which suggests that new housing units typically cater to higher-income households, and as these households move into new housing, their previous units become available to lower-income households, effectively filtering down through the market. Affordable housing programs can influence this process by directly providing lower cost housing options, thereby affecting the entire housing market. Another key aspect is Hedonic Pricing Models. These models explain how housing prices are determined by various attributes, such as location, size, and amenities. Government affordable housing programs can alter the perceived value of these attributes, potentially stabilizing or even lowering prices in the affected areas. Thirdly, the impacts of policy interventions also play a key role. Housing market theory examines the effects of government policies on housing prices and availability. Policies such as subsidies, tax incentives, and zoning regulations directly impact housing supply and demand. The implementation of these policies, particularly affordable housing programs, can lead to changes in market dynamics and price adjustments.

This literature review integrates classical economic theory and housing market theory to provide a comprehensive understanding of how affordable housing initiatives affect the housing market. Studies reviewed often employ classical economic theory to analyze the effects of increased housing supply. For example, the study by Sirmans and Macpherson (2009) discusses the influence of government-subsidized housing on local market prices, highlighting the balance between supply and demand. Research examining price trends before and after the implementation of affordable housing programs often references market equilibrium concepts. Studies like that of Mnisi and Karam (2020) utilize these principles to explain initial price fluctuations followed by stabilization in the long run. Literature frequently incorporates housing market theory, particularly the filtering model, to explain how affordable housing impacts different market segments as seen in studies by Jin (2015) who uses hedonic pricing models to evaluate how new housing developments affect the pricing of existing housing stock. Studies also analyze the specific policies and strategies employed in affordable housing programs. Ganiyu, Fapohunda, and Haldenwang (2017) discuss various financing models and their effectiveness in addressing housing deficits, applying both classical and housing market theories to evaluate policy outcomes.

By integrating classical economic theory and housing market theory, the literature review provides a robust framework for understanding the potential impacts of the Government Affordable Housing Program on housing prices in Kenya. These theories offer valuable insights into the mechanisms through which supply, demand, and policy interventions influence the housing market, helping to predict and analyze the outcomes of affordable housing initiatives. This theoretical foundation supports a comprehensive analysis of existing studies and highlights the need for further research to address specific gaps in understanding the long-term impacts of affordable housing programs in Kenya and similar contexts.

2.3 Empirical Literature Review

Empirical studies provide insights into the impact of affordable housing programs on housing prices. Houses are durable goods with long lifespans and can undergo lengthy construction due to complex building regulations and slow administrative processes, making their short-term supply relatively inflexible. Even in the long run, houses are restricted to particular sites and a finite

amount of land. Moreover, the housing market and the mortgage financing market are closely related because of the high acquisition value of homes compared to average household income. Thus, the supply and demand for housing are strongly impacted by changes in mortgage lending as well as other factors such as interest rates and inflation. When estimating the factors that determine house prices, most empirical studies concentrate on demand factors because of the rigidity of the housing supply caused by land shortages and long construction times. Put another way, supply limitations and flaws in the market mean that demand, particularly in the short run, drives home prices.

In the Dutch data, Vermeulen and Rouwendal (2007) discovered evidence that the housing supply and prices do not cointegrate, while Glaeser et al. (2008) hypothesized that areas with higher responsiveness to housing supply would see fewer, shorter, and less pronounced increases in house prices. A handful of studies have also examined the impact of affordable housing on house prices in the USA. A study on the effects of LIHTC (Low-Income Housing Tax Credit) financed developments on property values in low-income neighbourhoods was done by Baum-Snow and Marion (2009) using a regression discontinuity approach. It was found that low-income areas had more appreciation in housing prices. Grimes and Aitken (2010) were persuaded that areas with less noticeable price spikes in response to demand shocks were those with more price elastic housing supplies. Despite eschewing traditional cointegration tests, Caldera Sanchez and Johansson (2013) discovered evidence supporting cointegration between housing supply and prices in several countries. The significance of housing supply conditions for determining house prices was highlighted by Igan et al. (2014). Policymakers and the public have been deeply concerned about housing price issues because prices not only impact affordability and accessibility to housing but also have a ripple effect on wealth and the economy. However, one important but little-studied topic in the literature is how price affects the supply of newly constructed homes.

In the African context, affordable housing programs in Africa have been implemented with the goal of providing adequate housing to low-income households while potentially stabilizing housing prices. Several studies have investigated how government affordable housing programs affect housing prices. These studies indicate mixed results, with some showing stabilization in targeted areas, while others highlight continued upward pressure on prices due to high demand. For instance, a study by Mnisi & Karam (2020) on the Integrated Residential Development

Programme (IRDP) in Fleurhof, Johannesburg, revealed that affordable housing developments initially negatively affected nearby property values. However, in the long run, the impact on property values was neutral. Another study by Gupta, Jurgilas & Kabundi (2010) using the Factor-Augmented Vector Autoregression (FAVAR) approach in South Africa found that house price inflation responded negatively to monetary policy shocks, but the responses varied across different segments of the housing market. Affordable housing programs also provide broader socio-economic benefits, including improved living conditions and reduced prevalence of informal settlements. A study in South Africa by Ganiyu, Fapohunda & Haldenwang (2017) highlighted the significant socio-economic benefits of such programs, emphasizing the improvement in living standards and reduced informal settlements. Furthermore, Franklin (2020) found that households receiving government housing in South Africa experienced increased incomes driven by higher employment rates among female household members. Despite the benefits, challenges such as financing constraints, land acquisition issues, and governance problems persist, limiting the effectiveness of affordable housing programs. A study by Goebel (2007) examining low-cost housing challenges in South Africa identified major impediments, including macroeconomic conditions, historical legacies of race and class, and rapid urban growth. Similarly, another study by Okoro, Olaleye & Owojori (2023) emphasized the risks associated with private sector investment in affordable housing, citing market dynamics, land supply constraints, and unsupportive policies as significant barriers.

2.4 Research Gap

Kim, Kwon, and Choi (2020) discovered that some of the earliest affordable housing studies had limitations, such as properly delineating neighbourhood boundaries, obtaining adequate sample sizes, and accounting for various affordable housing programs. The previous research tends to show that affordable housing programs have an impact on housing prices. However, the overall impact on housing prices was mixed. While there was some evidence of price stabilization in targeted areas, high demand continued to exert upward pressure on prices as seen by Sirmans & Macpherson (2009). Studies by Jin (2015) showed that affordable housing programs had broader socio-economic benefits, including improved living conditions and reduced prevalence of informal

settlements. However, challenges such as financing constraints and land acquisition issues persisted, limiting the effectiveness of these programs (Nguyen, 2005). There was a lack of longitudinal studies that assessed the long-term impacts of previous affordable housing programs in Kenya. Additionally, more comprehensive data was needed on the informal housing sector, which remains a significant part of the housing market. The findings by Nguyen (2005) suggest that while affordable housing programs are beneficial, they must be part of a broader strategy that includes infrastructure development, land reform, and financial innovation to address both supply-side and demand-side challenges effectively.

There is a noticeable gap in longitudinal studies that assess the long-term impacts of previous affordable housing programs in Kenya. Comprehensive data on the informal housing sector, which remains a significant part of the housing market, is also lacking. Studies such as those by Tita and Opperman (2021) have highlighted the need for both supply and demand-side policies to support affordable housing development and address the economic and social implications of housing affordability. Previous studies are beneficial to the present study in showing that there is a correlation between housing supply or housing programs and house prices. However, this present study deviates from the previous studies in focus and setting. The present study focuses on predicting the impact of the recent Kenyan affordable housing program 'Boma Yangu' on housing prices while previous studies focused on longitudinal impact of already existing housing programs on housing prices. Further, while previous studies have concentrated on other countries and long-term impacts, this study will offer insights specific to Kenya.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presented the methodology used to analyze the impact of the public residential program on housing prices in Kenya. It included data sources, variables used in the study and their measurement, model specification, limitations to the study and lastly ethical consideration in relation to the study.

3.2 Research Design

This research paper employed an exploratory research design. This approach was chosen due to the complex and multifaceted nature of housing markets and the relatively novel introduction of the affordable housing program in the Kenyan context. Exploratory research is particularly suited for studies where the variables and their relationships are not well-defined, allowing for a flexible and open-ended investigation. The primary reason for using an exploratory design was to gain a comprehensive understanding of the potential impacts of the affordable housing program on housing prices, which had not been extensively studied in Kenya. This design enabled us to investigate various dimensions of the housing market, including supply and demand dynamics, market perceptions, and potential unintended consequences of the program.

3.3 Population and sampling

In research, population is the subject of a study. The population for this study consisted of individuals and families residing in both urban and rural areas across Kenya, particularly those affected by or potentially benefiting from the government affordable housing program, residential properties ranging from single-family homes to apartment complexes, both those constructed under the affordable housing program and existing properties in the market and policymakers, real estate developers, housing market analysts, and other professionals involved in the housing sector.

By defining the population broadly, the study aimed to capture the diverse impacts of the affordable housing program on different segments of the housing market and various geographic regions.

A sample is a subset of the population selected for the actual study. The sample was chosen to represent the population, allowing the researcher to make inferences about the population without examining every member. The process of selecting a sample involves using specific sampling techniques to ensure that it accurately reflects the population's characteristics. For this research topic, a stratified random sampling technique was used. This technique ensured that different segments of the population were adequately represented, providing a comprehensive analysis of the housing market.

3.4 Data collection

The research relied on secondary data, which involved using data collected by other researchers, institutions, or organizations. Secondary data is advantageous due to its cost-effectiveness, time efficiency, and the breadth of information it offers. This data provided a comprehensive foundation for analyzing the impact of housing initiatives on house prices. The study focused on discrete quantitative data which consisted of countable, distinct values, such as the number of housing units built, housing prices, and demographic statistics. Discrete quantitative data was crucial for statistical analysis and for making precise estimations regarding future housing prices.

The secondary data was sourced from a variety of reputable sources to ensure comprehensiveness and reliability. These sources included government publications such as the Central Bank of Kenya and Kenya National Bureau of Statistics, academic journals and articles, real estate market reports from Kenya Bankers' Association and Hass Consult, documents and records. The methods used to collect data included case studies, document analysis, and records review. Each method was chosen for its ability to provide detailed and relevant information for the study. Case studies involved detailed examinations of specific instances of government housing projects in not just Kenya but the world. By analyzing successful and unsuccessful housing projects, the research could identify key factors that affect housing prices. Document analysis involved systematically

reviewing various documents to extract relevant information. The documents reviewed included policy papers, strategic plans, and official reports on housing programs. Records review involved analyzing historical data and databases to identify trends and patterns in housing prices and market dynamics.

The instruments used for data collection, such as case study protocols, document review checklists and data extraction forms, were designed to ensure the systematic and accurate extraction of relevant information. The data collection instruments were adequate and appropriate for the research due to their comprehensive data coverage. By using multiple sources and methods, the research ensured a comprehensive collection of all relevant information. This diversity in data sources enhanced the robustness of the findings. Secondly, the data collected from reputable sources such as government reports and peer-reviewed journals was reliable and valid, which enhanced the credibility of the research findings. Using standardized protocols and checklists further ensured the consistency and reliability of the data. The use of case studies also provided detailed contextual insights into the specific impacts of housing programs. This method helped in understanding the nuanced effects of government initiatives on housing prices. Lastly, structured instruments such as document review checklists and data extraction forms ensured systematic and thorough data collection. This systematic approach minimized the risk of bias and incomplete data, leading to more accurate and reliable results. The selected data collection instruments ensured reliability and validity.

3.5 Variable Specification and measurement

The Housing Index, sourced from the Kenya Bankers' Association, served as the dependent variable in this study. It represented a composite measure of housing price trends across various sub-regions in Nairobi and other urban centers. The index captured price variations in three defined regions, each reflecting distinct socio-economic and infrastructural characteristics. Region 1 primarily included peri-urban and emerging residential areas with relatively affordable housing. Region 2 encompassed mid-tier residential zones characterized by moderate housing prices and proximity to key urban infrastructure. Region 3 comprised high-end neighborhoods with premium property values, often hosting affluent populations. This categorization provided a nuanced view

of housing price dynamics across diverse residential markets, enabling a comprehensive analysis of the impact of the affordable housing program.

Table 3.1: The Definition of the Sub-Regions

Region 1	Region 2	Region 3
<i>Athi River, Mlolongo, Mavoko, Nakuru, Ngong, Ruaka, Syokimau, Embakasi, Kahawa Wendani, Thika, Mtwapa, Utange, Kitengela, Kiembeni, Nyeri, Likoni, Eldoret, Ruiru, Kilifi, Thika road (Kasarani, Roysambu, Ruaraka), Meru, Bungoma.</i>	<i>Thindigua (Kiambu Road), Kiambu, South B, South C, Kabete, Komarock, Imara Daima, Membley, Buruburu, Rongai, Waiyaki Way (Uthiru, Regen, Kinoo, Kikuyu), Mbagathi road, Ngong Road, Langata.</i>	<i>Kileleshwa, Kilimani, Lavington, Westlands, Spring Valley, Riverside, Milimani (Kisumu), Milimani (Nakuru), Runda, Karen, Garden Estate, Parklands, Ridgeways, Muthaiga, Loresho, Kitisuru, Adams Arcade, Nyali, Mountain View, Nyari.</i>

The independent variables were categorized into two. The government housing program acted as a dummy variable where 1 indicates the presence of the affordable housing program in the area and 0 indicates its absence. The other independent variable was a control variable which consisted of a set of attributes that influence housing prices which are gross domestic product, level of money supply, mortgage rate and inflation.

3.6 Model Specification

The methodology for the study followed that adopted by Mnisi and Karam (2020) in investigating the impact of housing prices in Johannesburg. In contrast, this study had a focus on Nairobi, Kenya and the housing program, Boma Yangu, being implemented by the Kenyan government. To determine the effect of the housing program on housing prices, the hedonic pricing model (HPM), developed by Andrew Court (1939), was used.

3.6.1 Justification for use of Hedonic Pricing Model for analysis

The Hedonic Pricing Model (HPM) is widely used in real estate economics to determine the influence of various attributes on housing prices. This model was particularly suitable for assessing the impact of a housing program in Kenya due to its ability to allow for the breakdown of housing prices into various attributes. The model could also be tailored to include variables relevant to the Kenyan housing market, making it adaptable to the local context as highlighted by Palmquist (2005).

3.6.2 Hedonic Pricing Model (HPM)

The equation is expressed as:

$$P = \alpha + \beta_1 G + \sum \beta_i X_i + \epsilon$$

Where:

α is the intercept and β are the coefficients on independent variables. The dependent variable, P , is the housing index. G represents a dummy variable where 1 indicates the presence of the affordable housing program in the area and 0 indicates its absence; X_i represents the control variables which are a set of attributes that influence housing prices i.e gross domestic product, mortgage rates, inflation rate and level of money supply; ϵ is the error term.

3.7 Specification tests

3.7.1 Ordinary Least Squares (OLS) Regression

The multivariable OLS model was chosen for this study because it allowed for the inclusion of multiple independent variables, making it possible to identify statistically significant factors among them. Incorporating multiple independent variables strengthened the regression model, making it appropriate for this analysis. Statistically significant variables were identified by calculating adjusted R-squared statistics and p-values. This study emphasized the use of adjusted R-squared to identify significant variables because it provided a percentage measure of the

response variable's variation explained by the model, ranging from 0% (indicating no model explanation) to 100% (indicating the model fully explains the variability). A higher adjusted R-squared indicates a better fit, but it does not determine model adequacy. As a result, p-values are also used to ensure the significance of the model's independent variables, with the p-value indicating the statistical significance of each variable. A lower p-value implies that the independent variable under analysis fits well with the model, whereas a high p-value suggests more randomness, corresponding to a lower t-statistic. The coefficient β_1 on the dummy variable G captures the impact of the affordable housing program on housing prices, controlling for other factors. Positive β_1 indicates that the program increases housing prices, while a negative β_1 suggests a decrease.

Hypothesis Test

3.7.2: t-Test

The t-test assesses whether the individual coefficients β differ significantly from zero. A null hypothesis signifies that β equals zero and there is no effect while an alternative hypothesis means β is not equal to zero and therefore there is a significant effect. Compare the t-statistic to the critical value from the t-distribution to determine significance.

Diagnostic Tests

3.7.3: Multicollinearity

When independent variables in a regression model have a high degree of correlation with one another, this phenomenon is known as multicollinearity, and it can lead to unstable and inflated coefficient estimates. By calculating the amount that the variance of an estimated coefficient rises because of collinearity, Variance Inflation Factor (VIF) assesses the degree of multicollinearity. For each independent variable X_i the VIF is calculated as:

$$VIF = \frac{1}{1 - R^2}$$

Where R^2 is the coefficient of determination from regressing X_i on all other independent variables. A VIF > 10 typically indicates high multicollinearity. If high VIFs are detected, we should consider dropping or combining variables.

3.7.4: Heteroscedasticity

When the variance of the error terms, ϵ , varies between observations, it is referred to as heteroscedasticity. This can lead to inefficient estimates and potentially violate the assumptions of OLS. The Breusch-Pagan Test, which regresses the squared residuals from the OLS model on the independent variables, is one of several tests used to check for heteroscedasticity. The homoscedasticity of the null hypothesis denotes a constant variance. The null hypothesis should be rejected if the test statistic shows heteroscedasticity and is significant. White's Test is an additional test for heteroscedasticity that is more universal in nature. It investigates the relationship between the squared residuals and the independent variables alone or in combination. As with Breusch-Pagan, heteroscedasticity is suggested by a significant test result. We think about employing robust standard errors to account for heteroscedasticity if it is found, enabling trustworthy inference even in its presence.

By thoroughly conducting OLS regression, hypothesis testing, and diagnostic tests, researchers could ensure that the hedonic regression model used was both statistically sound and reliable, providing valuable insights for policymakers and stakeholders.

3.8: Limitations of the study

The fact that the housing program was still in its infancy was a limiting factor. Therefore, the study might have focused on the short-term impacts of the affordable housing program, overlooking longer-term effects on housing prices that could have emerged over time. The data collected may not have captured the full impact of the program on housing prices.

3.9: Ethical Considerations

Secondary data was sourced from government publications and real estate market reports. The study avoided reinforcing stereotypes or biases related to certain neighborhoods or demographic groups. Care was taken to present findings in a way that does not unfairly disadvantage any group.



CHAPTER 4

RESULTS AND ANALYSIS

4.1 Introduction

This chapter presents the analysis and interpretation of data gathered for this study. The objective of this section is to assess the relationship between the government affordable housing program (independent variable) and the average housing index (dependent variable) through the Hedonic Pricing Model (HPM). Descriptive statistics are used to summarize the data, followed by a regression analysis to establish whether a significant impact exists between the variables. Additionally, the results of the hedonic pricing model are interpreted to explain how independent variables affect housing prices.

4.2 Descriptive Analysis of the Study Variables

The table below shows the summary of descriptive statistics for the variables used in the study, including the minimum, maximum, mean, and standard deviation for each variable. This provides an understanding of the range and variability of the data collected.

Table 4.1: Summary of descriptive statistics for the variables

Variable	No. of Observations	Mean	Minimum	Maximum	Standard Deviation
House Index (Y)	29	112.02	92.25	127.00	10.1989
Mortgage Rate	29	12.58%	10.90%	14.75%	0.01287429
Money Supply ('000 000')	29	3,928	2,847	5,499	749.5202
Inflation Rate	29	6.441%	4%	10.8%	0.01704724
GDP	29	4.903%	-4.1%	10.3%	0.02961236

On average, the housing index is 112.02, with a variation of 10.2 units. It ranges from 92.25 to 127.00, indicating relatively volatile house prices within this range. The average mortgage rate is 12.58%, varying slightly ($SD = 1.29\%$). Rates range from 10.9% to 14.75%, suggesting controlled fluctuations in borrowing costs. The mean money supply is KES 3.928 billion, with a wide range (KES 2.847 billion to KES 5.499 billion) and relatively high variability ($SD = 749.52$). This indicates that the level of money supply is consistently increasing with time but with a very high level of variability. On average, inflation is moderate at 6.441%, with values ranging from 4% to 10.8% and moderate variability ($SD = 1.7\%$). Lastly, the GDP growth averages 4.903%, but it shows significant variability ($SD = 2.96\%$) and ranges from negative growth (-4.1%) to high growth (10.3%), reflecting periods of economic contraction and expansion. These descriptive statistics help provide a concise overview of the data distribution and trends, which is useful for further statistical analysis.

Interpretation of Regression Model Results

The hedonic pricing model used in this study had four control variables (mortgage rate, money supply, inflation rate and GDP) which could potentially influence Kenyan housing prices. Previous studies done by Lei & Wu (2014) used macroeconomic factors like money supply, mortgage interest rates, GDP, and inflation to analyze housing prices because these factors are foundational in understanding housing market dynamics. These factors were selected because they capture the interaction between macroeconomic policy, financial markets, and the housing sector. The coefficients below represent the estimated effects of each variable on the Housing Index, holding the other variables constant. Below are the linear regression results, which show the coefficients, standard errors, t-values, and p-values.

Table 4.2: Linear regression results

Variable	Coefficient	Standard error	T-value	P-value
Intercept	156.9	12.31	12.743	0
Housing Program	-7.949	3.208	-2.478	0.020986
Money Supply	-0.006908	0.001732	-3.989	0.000579
GDP	-15.17	24.13	-0.629	0.535783
Mortgage Rate	-61.46	74.86	-0.821	0.420023
Inflation Rate	-105.8	48.93	-2.161	0.041311

Technical Interpretation

The analysis reveals several significant relationships between the housing index and key economic variables, each of which is explained below in terms of both technical interpretation and broader economic implications.

Firstly, the housing program's activation correlates with a 7.95-unit decrease in the housing index, supported by a p-value of 0.021. This finding suggests that increased housing supply in Nairobi introduces greater market competition, leading to lower prices through supply-and-demand dynamics. When affordable housing projects are launched, the influx of new housing units reduces demand pressure, particularly for low- and middle-income housing segments. This is consistent with economic theories linking increased supply to price reductions.

Secondly, an increase in money supply by KES 1 million results in a small but significant decline in the housing index, supported by a p-value of 0.000579 and a t-value of -3.989. This relationship likely stems from the increased availability of funds for real estate development. With more liquidity in the financial system, banks and other institutions can offer more loans to developers, facilitating housing construction and thus reducing housing shortages.

The analysis finds that GDP growth and mortgage rate increases are not statistically significant predictors of the housing index (p-values of 0.536 and 0.420, respectively). While GDP growth theoretically correlates with higher housing demand and prices, the lack of significance may reflect the uneven distribution of economic growth benefits in Kenya. Similarly, while rising mortgage rates are expected to suppress demand, the Kenyan housing market's high reliance on cash transactions and low mortgage penetration likely diminishes their effect.

Inflation significantly decreases the housing index by 105.8 units, with a p-value of 0.041. This large magnitude suggests that inflation erodes affordability and suppresses demand, particularly in the lower-income housing market. However, the effect size appears excessively large compared to the average index, warranting further investigation into potential overestimation or contextual factors amplifying the effect.

Lastly, the residual values of the model indicate how much the actual housing index values deviate from the predicted values by the model. Ideally, residuals should be normally distributed around zero. The model's residual analysis shows a range of -7.6928 to 7.1821, with a median close to zero, suggesting a balanced distribution of errors. The residual standard error (RSE) of 3.656 indicates moderate precision, though the deviation is substantial. The high R-squared (0.8944) and adjusted R-squared (0.8715) values indicate that the model explains a significant portion of variance in the housing index, confirming its reliability. The R-squared of 0.8944 indicates that about 89.44% of the variance in the housing index is explained by the model. The adjusted R-squared of 0.8715 is slightly lower but still high, meaning the model fits the data well while adjusting for the number of predictors. Additionally, the model's F-statistic (38.98) and p-value (<0.001) demonstrate overall statistical significance. Therefore, the overall model is statistically significant, meaning at least one of the predictors is significantly related to the housing index.

4.3 Multicollinearity Test

The Variance Inflation Factor (VIF) is a measure used to detect multicollinearity in a regression model, which occurs when independent variables are highly correlated with each other. Multicollinearity can inflate the variance of the coefficient estimates, making them unstable and

harder to interpret. A VIF of 1 indicates no multicollinearity while a VIF of between 1 and 5 shows moderate correlation which is generally acceptable. A VIF of greater than 5 indicates strong multicollinearity, requiring corrective actions like removing or combining variables.

The Variance Inflation Factor (VIF) analysis indicates the following about the independent variables:

The Mortgage Rate has a VIF of 1.945, suggesting a low correlation with other variables and no evidence of multicollinearity. For GDP, the VIF is 1.069, indicating almost no correlation and ruling out multicollinearity concerns. The Inflation Rate has a VIF of 1.457, also showing no significant multicollinearity. However, the Money Supply, with a VIF of 3.530, shows moderate correlation but remains below the threshold of 5. Finally, the Housing Program has the highest VIF of 4.778, nearing the threshold, suggesting potential correlation with other variables, particularly the Money Supply, though not yet at critical levels.

There is no strong evidence of multicollinearity in the model since all VIF values are below 5. However, the housing program (4.778) and money supply (3.530) variables are on the higher end and might need to be monitored if adjustments are made to the model or if further testing reveals concerns.

4.4 Heteroscedasticity

Heteroscedasticity, or non-constant variance of residuals, can compromise the reliability of statistical inferences in linear regression. To investigate this, we applied the Studentized Breusch-Pagan test, a common test for heteroscedasticity in regression analysis. The null hypothesis of the Breusch-Pagan test is that there is no heteroscedasticity, meaning that the variance of the residuals is constant across all levels of the predictor variables.

Results

Table 4.3: Breusch-Pagan Test

Breusch-Pagan statistic (BP)	5.0119
Degree of Freedom	5
P-value	0.4144

With a p-value of 0.4144, which is significantly above the typical significance threshold of 0.05, we do not have sufficient evidence to reject the null hypothesis.

The findings indicate that there is no statistically significant heteroscedasticity in the model's residuals. Given this result, the model is likely to produce reliable estimates, and no adjustments for heteroscedasticity, such as the use of robust standard errors, are necessary at this stage. This strengthens the reliability of the model's estimates, suggesting that housing prices are not unduly influenced by non-constant variance across predictor levels. As such, this model can be used with confidence for further analysis and policy interpretation related to the effects of affordable housing programs on housing markets.

4.5 Summary of the findings

The analysis reveals that the government's affordable housing program has a significant effect on housing prices in Nairobi, with the development of new housing units contributing to negative impacts in the housing market. The inflation rate and level of money supply were also found to lower housing prices, while the mortgage rate and GDP did not show significant effects in this model. Therefore, the affordable housing program 'Boma Yangu' can indeed make housing in Nairobi more affordable for its citizens in the future. These findings suggest that the model has a high explanatory power, and the overall significance is strong, indicating that the variables included explain a substantial portion of the variation in housing prices.

CHAPTER 5

DISCUSSIONS AND CONCLUSION

5.1 Introduction

This chapter evaluates the effects of the Kenyan affordable housing program ‘Boma Yangu’ on housing prices in Nairobi, Kenya, specifically examining how the program's implementation affects housing prices and exploring the study's alignment with existing research. The analysis reveals that the program effectively reduces housing prices, confirming that affordable housing initiatives can impact market dynamics in urban settings. This section entails a summary of the findings, conclusions, recommendations, suggestions for further research and limitations of the research conducted.

5.2 Summary of the findings

The study accurately concludes that Nairobi's affordable housing program is projected to contribute to lower house prices, consistent with the supply-demand model. By examining metrics such as housing price changes before and after the program's introduction, the study substantiates its claim of price reduction effects. This conclusion is similar to research carried out by Yeganeh, McCoy and Hankey (2019), showing a sustained housing price decline correlated with the green affordable housing project carried out in the USA. Therefore, the study's conclusions appear methodologically sound and reflect a logical interpretation of the quantitative findings.

5.3 Conclusions

Overall, the study effectively estimates that the affordable housing program in Nairobi will have a negative effect on house prices, aligning with similar findings in the field and drawing well-supported conclusions. Its recommendations are appropriately aimed at sustaining affordability while addressing the diverse needs of Nairobi's population. Recognizing valid limitations, the study underscores the need for further research to generalize findings across varied urban contexts.

This chapter reaffirms the significance of government interventions in shaping housing market dynamics and offers a valuable model for similar urban centers.

5.4 Recommendations

The Kenyan government should prioritize efforts to enhance affordable housing initiatives, with a focus on meeting its target of constructing 200,000 houses annually. These homes should cater to low- and middle-income households, emphasizing the delivery of decent and affordable living conditions. To achieve this, there is a need for streamlined implementation processes, increased budget allocations, and adherence to project timelines.

Expanding the scope of the affordable housing program is essential to include additional income brackets. By doing so, the benefits of these initiatives can extend to broader segments of the population, promoting inclusivity and addressing the diverse housing needs of Kenyan citizens. Public-private partnerships (PPPs) should be actively encouraged to mobilize resources, reduce project costs, and improve the quality of housing. Such collaborations can also introduce innovative construction designs and techniques, contributing to the overall success of affordable housing projects.

Policy adjustments are necessary to create an enabling environment for affordable housing development. This includes offering tax incentives to developers focusing on such projects, simplifying regulatory processes, and introducing measures to curb land speculation, which significantly drives up housing costs. To ensure sustainable impact, a robust monitoring and evaluation framework should be established. This will help assess project performance, ensure transparency and accountability, and identify areas for improvement. Regular evaluations will also guide strategic adjustments to housing programs as needed.

Incorporating green building practices is another vital recommendation. Environmentally friendly construction techniques and materials can reduce energy consumption and operational costs for homeowners, enhancing the overall affordability and sustainability of the housing units.

5.5 Suggestions for further research

Further research should explore the socio-economic impacts of affordable housing on beneficiaries. This includes examining how access to such housing influences employment opportunities, educational attainment, and health outcomes for individuals and families. It is also important to study regional disparities in housing affordability across Kenya. Understanding these variations can help tailor interventions to the specific challenges faced by different regions, ensuring more equitable access to affordable housing.

Research into the role of technology in reducing housing costs is equally crucial. Emerging technologies, such as 3D printing and modular construction, have the potential to lower construction costs and accelerate the delivery of housing projects, making them more accessible to the target population.

Finally, the long-term environmental impacts of affordable housing projects should be assessed. This research could provide insights into how these initiatives align with sustainable development goals and inform policies to ensure environmentally responsible housing solutions in the future.

5.6 Limitations of the research

This research identifies several limitations that must be considered when interpreting its findings. One significant limitation is related to data generalizability. The observed price reduction in Nairobi may not fully capture the complex factors influencing housing prices in other regions or markets across Kenya. This geographic specificity limits the extent to which the findings can be applied to broader contexts. Another limitation is the influence of external factors, such as economic fluctuations and market cycles, which can independently affect housing prices. These factors are beyond the scope of this study and may impact the affordability outcomes of housing programs.

These limitations underscore the need for future research to incorporate cross-regional data and a broader scope of analysis. Such studies could provide a more comprehensive understanding of the impacts of affordable housing programs across diverse socio-economic and geographic contexts.

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APPENDICES

APPENDIX 1: Data Table for Study

Housing Index	Mortgage Rate	Money Supply	Inflation Rate	GDP	Program Status	Housing Program	Timeframe
100.11	0.143	5204.4	0.063	0.05	Yes	1	2024 Q1
98.22	0.1415	5498.6	0.068	0.051	Yes	1	2023 Q4
99.75	0.14	5295.9	0.069	0.06	Yes	1	2023 Q3
92.25	0.1385	5037.4	0.079	0.056	Yes	1	2023 Q2
96.15	0.137	4668.7	0.091	0.055	Yes	1	2023 Q1
100.35	0.13425	4534.5	0.094	0.041	Yes	1	2022 Q4
102.64	0.1315	4430.4	0.087	0.046	Yes	1	2022 Q3
99.58	0.12875	4443	0.072	0.049	Yes	1	2022 Q2
98.69	0.126	4221.2	0.053	0.059	Yes	1	2022 Q1
104.77	0.12275	4235.2	0.06	0.086	No	0	2021 Q4
109.13	0.1195	4177.7	0.067	0.094	No	0	2021 Q3
113.32	0.11625	4137.8	0.06	0.103	No	0	2021 Q2
115.23	0.113	4030	0.058	0.024	No	0	2021 Q1
117.37	0.112	3990.9	0.053	0.02	No	0	2020 Q4
117.11	0.111	3843.5	0.043	-0.036	No	0	2020 Q3
117.2	0.11	3863.6	0.053	-0.041	No	0	2020 Q2
117.44	0.109	3661	0.068	0.046	No	0	2020 Q1
118.04	0.11	3524	0.068	0.046	No	0	2019 Q4
118.76	0.111	3473.4	0.05	0.05	No	0	2019 Q3
121.47	0.112	3564.2	0.059	0.06	No	0	2019 Q2
123.56	0.113	3415.3	0.044	0.057	No	0	2019 Q1
127	0.11725	3337.8	0.056	0.06	No	0	2018 Q4
125.1	0.1215	3261.1	0.047	0.063	No	0	2018 Q3
123.42	0.12575	3262.6	0.04	0.064	No	0	2018 Q2
121.29	0.13	3015.7	0.045	0.065	No	0	2018 Q1
118.81	0.1475	3010.9	0.05	0.053	No	0	2017 Q4

118.01	0.145	2986.4	0.075	0.045	No	0	2017 Q3
117.52	0.1425	2936.1	0.108	0.044	No	0	2017 Q2
116.37	0.14	2846.6	0.088	0.052	No	0	2017 Q1



APPENDIX 2: Hedonic Pricing Model Coding Through R Programming

Research Project code 145445

145445_Timothy Ndungu

2025-01-08

Load necessary libraries

```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.3.3
```

```
## Warning: package 'tidyr' was built under R version 4.3.1
```

```
## Warning: package 'readr' was built under R version 4.3.1
```

```
## Warning: package 'purrr' was built under R version 4.3.1
```

```
## Warning: package 'dplyr' was built under R version 4.3.1
```

```
## Warning: package 'forcats' was built under R version 4.3.3
```

```
## Warning: package 'lubridate' was built under R version 4.3.1
```

```
## -- Attaching core tidyverse packages ----- tidyverse 2.0.0 --
```

```
## v dplyr      1.1.3      v readr      2.1.4
```

```
## v forcats   1.0.0      v stringr    1.5.0
```

```
## v ggplot2   3.4.2      v tibble     3.2.1
```

```
## v lubridate 1.9.3      v tidyr      1.3.0
```

```
## v purrr     1.0.2
```

```
## -- Conflicts ----- tidyverse_conflicts() --
```

```
## x dplyr::filter() masks stats::filter()
```

```
## x dplyr::lag()      masks stats::lag()
```

```
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(readr) library(ggplot2) ##
```

Step 1: Load the data

Data in a CSV file with columns:

```
# 'housing_index', 'mortgage_rate', 'gdp', 'inflation_rate', 'money_supply', 'housing_program' data <-  
read.csv("C:/Users/Ndungu/Documents/Research Data.csv")
```

Step 2: Check data structure head(data)

	HousingIndex	MortgageRate	MoneySupply	InflationRate	GDP	ProgramStatus
## 1	100.11	0.14300	5204.4	0.063	0.050	Yes
## 2	98.22	0.14150	5498.6	0.068	0.051	Yes
## 3	99.75	0.14000	5295.9	0.069	0.060	Yes
## 4	92.25	0.13850	5037.4	0.079	0.056	Yes
## 5	96.15	0.13700	4668.7	0.091	0.055	Yes
## 6	100.35	0.13425	4534.5	0.094	0.041	Yes

HousingProgram Timeframe

## 1	1	2024 Q1
## 2	1	2023 Q4
## 3	1	2023 Q3
## 4	1	2023 Q2
## 5	1	2023 Q1
## 6	1	2022 Q4

str(data)

'data.frame': 29 obs. of 8 variables:

\$ HousingIndex : num 100.1 98.2 99.8 92.2 96.2 ...

\$ MortgageRate : num 0.143 0.141 0.14 0.139 0.137 ...

\$ MoneySupply : num 5204 5499 5296 5037 4669 ...

\$ InflationRate : num 0.063 0.068 0.069 0.079 0.091 0.094 0.087 0.072 0.053 0.06 ...

\$ GDP : num 0.05 0.051 0.06 0.056 0.055 0.041 0.046 0.049 0.059 0.086 ...

\$ ProgramStatus : chr "Yes" "Yes" "Yes" "Yes" ...

\$ HousingProgram: int 1 1 1 1 1 1 1 1 1 0 ...

\$ Timeframe : chr "2024 Q1" "2023 Q4" "2023 Q3" "2023 Q2" ...

```

# Step 3: Convert 'housing_program' into a factor (dummy variable) data$HousingProgram <-
as.factor(data$HousingProgram)

# Step 4: Build the linear regression model
# Dependent variable: housing_index
# Independent variables: mortgage_rate, gdp, inflation_rate, money_supply (in billions), housing_program model <-
lm(MortgageRate ~ GDP + InflationRate + MoneySupply + HousingProgram, data = data)

# Step 5: Summary of the model to view coefficients, R-squared, etc.
summary(model)

```

```

InflationRate +
##      MoneySupply + HousingProgram, data = data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -7.6928 -2.1476  0.0426  2.2613  7.1821
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    1.569e+02  1.231e+01  12.743 6.61e-12 ***
## MortgageRate   -6.146e+01  7.486e+01  -0.821 0.420023
## GDP            -1.517e+01  2.413e+01  -0.629 0.535783
## InflationRate  -1.058e+02  4.893e+01  -2.161 0.041311 *
## MoneySupply    -6.908e-03  1.732e-03  -3.989 0.000579 ***
## HousingProgram1 -7.949e+00  3.208e+00  -2.478 0.020986 *
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.656 on 23 degrees of freedom
## Multiple R-squared:  0.8944, Adjusted R-squared:  0.8715
## F-statistic: 38.98 on 5 and 23 DF, p-value: 1.731e-10

```

```

# Step 6: Check for multicollinearity (VIF - Variance Inflation Factor) library(car)

```

```

## Warning: package 'car' was built under R version 4.3.3

## Loading required package: carData

## Warning: package 'carData' was built under R version 4.3.3

##
## Attaching package: 'car'
##
## The following object is masked from 'package:dplyr':
##

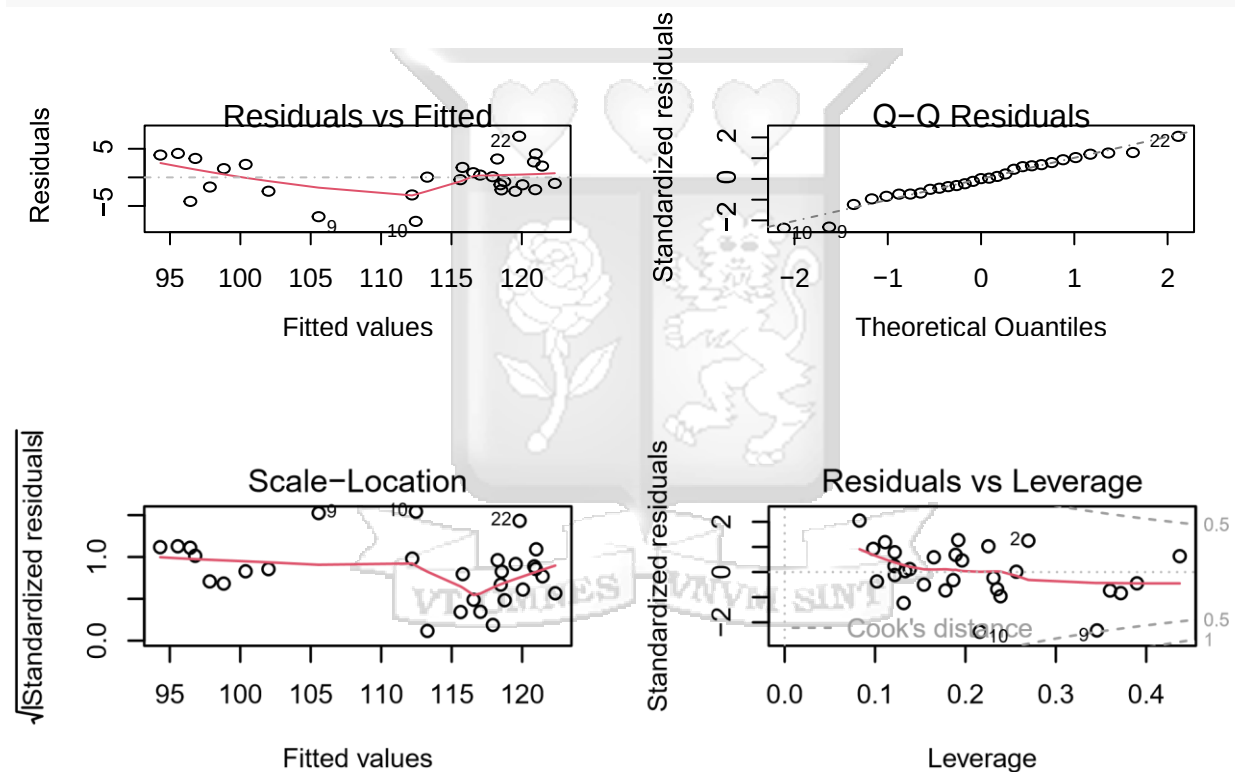
```

```
##      recode
##
## The following object is masked from 'package:purrr':
##
##      some
vif(model)
```

```
##      MortgageRate      GDP InflationRate      MoneySupply HousingProgram
##      1.945461      1.069110      1.457392      3.530237      4.777784
```

```
# Step 7: Plot residuals to check for homoscedasticity
```

```
par(mfrow = c(2, 2))
plot(model)
```



```
# Perform the Breusch-Pagan test
```

```
library(lmtest)
```

```
## Warning: package 'lmtest' was built under R version 4.3.3
```

```
## Loading required package: zoo
```

```
##
```

```
## Attaching package: 'zoo'
```

```
##
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
##      as.Date, as.Date.numeric
```

```
bp_test <-
```

```
bptest(model)
```

```
# Display the
```

```
test results
```

```
print(bp_test)
```

```
##
```

```
## studentized Breusch-Pagan test
```

```
##
```

```
## data: model
```

```
## BP = 5.0119, df = 5, p-value = 0.4144 sd(data$MortgageRate)
```

```
## [1] 0.01287429
```

```
sd(data$HousingIndex)
```

```
## [1] 10.1989
```

```
sd(data$MoneySupply)
```

```
## [1] 749.5202
```

```
sd(data$InflationRate)
```

```
## [1] 0.01704724
```

```
sd(data$GDP)
```

```
## [1] 0.02961236
```