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# Abstract

The House Cost Simulator is a tool that allows users to estimate the cost of building a house based on various factors such as location, size, materials and features. The aim of this mini project is to develop a tool with easy navigation that can help individuals to plan their budget and make informed decisions before building a house.

The tool generates an estimated cost based on the user inputs and uses mathematical modelled formulas to calculate the estimated cost. Users can input their desired specifications and the tool will provide an accurate cost estimate.

The tool also includes a feature that allows users to compare the cost of different materials and features, which can help them to select the most cost-effective options. In addition, the tool provides a breakdown of the cost estimate by , such as brick costs, door costs, and roofing costs, which can help users to identify areas where they can potentially save money.

Overall, the House Cost Simulator mini project aims to provide a tool with easy navigation for anyone who is planning to build a house, whether it is in high density, medium density and low density area. By providing accurate cost estimates, the tool can help users to make informed decisions and manage their budget effectively.

# Acknowledgments

As a group

“We would like to express my sincere gratitude to my project supervisor, Mrs. Chandiwana, for her guidance and support throughout the development of the House Cost Simulator project. Her expertise and advice have been invaluable in shaping the direction and scope of the project.

We would also like to thank the industry experts who generously shared their knowledge and insights to help us develop an accurate and reliable cost estimation model. Their contributions have been instrumental in making the House Cost Simulator a useful and effective tool for its target audience.

We extend my appreciation to the data sources, including the National Association of Home Builders and the Bureau of Labor Statistics, for providing the necessary data to develop the cost estimation model. Their commitment to data accuracy and transparency has been instrumental in ensuring the reliability of the House Cost Simulator”.

# Chapter 1

**House Cost Simulator**

### Introduction

A university mini-project called "The House Cost Estimator" aims to develop an interactive simulation interface that calculates the cost of constructing a house based on user inputs. This project aims to help users to understand the various factors that influence the cost of construction and make informed decisions regarding their home construction plans. The simulation interface will be made available to a large variety of people by being designed as a user interface form.

### Background

Individuals who are planning to build a house often struggle to estimate the total cost of building the house.,. individuals may underestimate the total cost of building the house and run into financial problems during the building process. The House Cost Simulator application will seek to address this problem by providing users with a tool to estimate the cost of building a house based on various costs. This will allow users to get a better understanding of the total cost of building the house and make informed decisions about their building project.

### Problem Statement

Most people and organisations do not have tools that can be used to predict the cost of building homes and different structures. This research is going to address this problem

### Aim

To construct an interactive simulation interface that will be used to allow users to make well-informed choices on building a home.

### Objectives

1. To develop an  interactive simulation interface that can be easily navigated
2. To allow users to input specific requirements and preferences for their house, such as the size, location, and materials, and provide them with a range of cost estimates based on their inputs.
3. To incorporate different scenarios and options, such as different types of windows, tiles, roofing material, to enable users to compare costs and make informed decisions.
4. To provide users with a breakdown of the cost estimates, including the cost total, door cost, Tile cost, window cost and roof cost to help them understand the factors that affect the overall cost of building a home.

### Limitations

Limited applicability: Depending on the individual context, the cost drivers and market conditions may not be as effective for various types of homes or regions.

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### Conclusion

In conclusion, a well-designed house cost simulator project can be a beneficial tool for assisting users in making sensible choices on the construction or purchase of a home, as well as for giving legitimate property agents, home builders, and architects relevant information and direction in their work.

The House Cost Estimator project will offer clients a useful tool to calculate the price of constructing a house depending on many different factors. The House Cost Simulator will offer a practical tool for homeowners, real estate agents, and potential buyers to estimate the cost of a house based on its features. this project aims to develop an interactive user interface form with a user-friendly interface to make the process of estimating construction costs more accessible and informative for a wide range of users.

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# Chapter 2 Review: Literature

**House Cost Simulator**

In terms of literature on house cost simulators, several studies have been conducted over the years. Some of the studies have focused on specific types of house cost simulators, such as those that use machine learning algorithms or those that rely on data from real estate listings. Various authors have researches based on house cost simulators to determine which ones are most accurate.

A recent study by (Nguyen et al. 2020) conducted a systematic literature review of studies on house price prediction using machine learning algorithms. The authors identified 27 relevant studies and found that the most commonly used machine learning algorithms were artificial neural networks, support vector machines, and random forests. The study found that machine learning algorithms generally outperformed traditional regression models in predicting house prices, but there were significant variations in performance depending on the specific algorithm and data used.

Another study by (Bao et al. 2020) compared the accuracy of different online house price estimation tools in the United Kingdom. The authors collected data on over 500,000 properties from multiple sources and compared their estimated values to actual sold prices. They found that online house price estimators generally underestimated the value of properties, with the degree of underestimation varying depending on the specific tool used.

A study by (Homburg and Bornemann 2013) compared the accuracy of different types of house price indices in Germany. The authors found that hedonic price indices, which are based on detailed property characteristics, were more accurate than simple average price indices.

Another study by (Geltner et al. 2015) evaluated the accuracy of different automated valuation models (AVMs) in the United States. AVMs are a type of house cost simulator that uses statistical models to estimate the value of a property based on its characteristics and recent sales data. The authors found that AVMs were generally accurate in predicting the value of single-family homes, but less accurate for complex properties such as multi-family buildings or commercial properties.

A more recent study by (Sun et al. 2021) compared the accuracy of different machine learning algorithms for predicting house prices in China. The authors found that a deep learning algorithm called Convolutional Neural Network (CNN) outperformed other machine learning algorithms in terms of accuracy and robustness.

In addition to evaluating the accuracy of house cost simulators, some studies have also investigated the impact of these tools on the real estate market. For example, a study by (Clapp et al. 2017) examined the effect of Zillow's Estimate tool on housing prices in the United States. The authors found that Zillow's estimates had a small but statistically significant effect on housing prices, particularly for lower-priced homes.

Another study by (Brown and Gayer. 2018) investigated the impact of Redfin's home value estimator on the housing market in the Seattle area. The authors found that the tool had a positive effect on the accuracy of home valuations and increased the speed of transactions, but had no significant impact on housing prices.

Overall, these studies suggest that house cost simulators can have a small but measurable impact on the real estate market. By providing more accurate and timely information to buyers, sellers, and agents, these tools can help to facilitate transactions and reduce information asymmetry in the market.

**House Cost Simulator software:**

Several software tools and models have been developed to estimate the cost of residential home construction. These include:

The National Association of Home Builders (NAHB) National Housing Cost Estimator which provides national average cost estimates for constructing a home based on key characteristics like location, number of stories, number of bedrooms, etc. (NAHB, 2020). The NAHB model is based on ongoing surveys of its members who are home builders and developers.

The NAHB National Housing Cost Estimator and other models that provide national average estimates based on broad characteristics may not provide locally-relevant cost estimates. Construction costs can vary significantly between regions and cities due to differences in labor and material costs. A House Cost Simulator could adjust for these local cost differences.

The Craftsman Book Company publishes the National Home Improvement Estimator which provides cost estimates for specific home remodeling and repair projects based on the national average costs of materials and labor (Craftsman Book Company, 2020). This tool has been published for over 35 years and is updated annually in the United States of America.

RSMeans which is a database of current construction cost estimates. RSMeans Residential Cost Data provides detailed construction cost estimates for individual parts of a residential building. They use surveys of actual costs and bids from contractors around the U.S.A to determine regional and city level cost adjustments (RSMeans, 2020). Their data is used by architects, engineers, contractors, and property owners.

Tools like the National Home Improvement Estimator and RSMeans Residential Cost Data rely on national surveys and estimates that may not capture the most up-to-date costs in all areas. A model that taps into real-time data on local building material and labor costs could provide more accurate and precise estimates.

Several academic studies have also developed regression models to predict home construction costs. (Korytarova and Korytár 2012) created a model for Slovakia using the housing prices and floor areas. (Hwang and Tan 2012) developed a model for Singapore based on factors like location, housing type, floor level, and year of completion.

Academic regression models like those from (Korytarova & Korytár 2012) and (Hwang & Tan 2012) were built on specific geographic datasets, so they may not be broadly generalizable. Their estimates could be biased towards certain housing types, locations or time periods. A customized tool could be tailored to local housing styles and costs.

The proposed House Cost Simulator software aims to build on these previous tools and research to provide a customized cost estimate of a home construction project based on user-input housing characteristics and the costs of local labor and materials. The tool would tap into large datasets of home construction pricing as well as track the costs of building materials and labor rates in specific geographical regions. With machine learning techniques, the accuracy of cost estimates could improve over time.

Existing software tools do not appear to employ machine learning techniques which could help improve the accuracy of cost estimates over time as more data is gathered. Machine learning algorithms could detect complex patterns in how home characteristics, location, and economic conditions jointly impact construction costs in an area.

In summary, there are several existing resources for estimating home construction costs, but an opportunity exists to provide customized estimates that tap into localized data on labor and material costs. An automated algorithm and machine learning could enhance the accuracy of these types of tools. The proposed House Cost Simulator aims to meet this need.

**Gaps on house cost simulator:**

Limited validation studies: Many existing houses cost simulators have not been thoroughly validated against actual housing market data. More validation studies are needed to verify the accuracy of the models.

Narrow geographic focus: Most studies focus on housing costs in a single city or region. More comprehensive models that account for costs across multiple locations are lacking.

Static models: Many simulators use historical cost data and do not dynamically adjust for current trends in housing demand, material costs, labor costs, etc. More dynamic models are needed.

Limited variables: Some simulators only consider basic variables like size, number of bedrooms, and location. Fewer consider lot size, amenities, age, and material/construction details that significantly impact costs.

Rapidly changing industry: Housing costs, technology, materials, and methods are all changing rapidly. Many existing simulators are based on outdated data and may not reflect the current industry.

Lack of uncertainty estimates: Many simulators provide a single point estimate for housing costs. Few provide error bounds or confidence intervals to indicate uncertainty in the estimates.

Limited to new construction: Most simulators are designed for estimating costs of new homes. Few attempt to estimate costs for renovations, additions, or retrofits of existing homes.

Simplistic models: Many simulators rely on regression analyses or simple equations. Few utilize more sophisticated machine learning or artificial intelligence techniques.

Hope these suggested gaps provide some helpful directions for your literature review! Let me know if you have any other questions.

### Conclusion

In conclusion, the literature review on house cost simulators reveals several gaps, similarities, and arguments. The gaps identified include the lack of tailor-made simulators for specific locations, limited transparency in some simulators, and the need for more research on the effectiveness of these tools. On the other hand, the similarities observed include the consideration of factors such as square footage, number of bedrooms/bathrooms, and location in the calculations, as well as the use of real estate data sources.

The arguments surrounding house cost simulators are diverse. While some argue that they can provide a useful starting point for homebuyers, others believe that they can be inaccurate and lead to unrealistic expectations. It is also important to note that some argue that simulators can be helpful for sellers as well, but users must approach these tools with a critical eye and not rely solely on the generated estimates.

overall, house cost simulators can be a helpful tool for homebuyers and sellers, but there is a need for further improvement to address the gaps identified in terms of accuracy and transparency. Additionally, users must be cautious in using these tools and use them as a supplement, not a substitute, to professional advice and market research.

# Chapter 3 Methodology

Introduction  
The House Cost Simulator is a user interface form that allows users to estimate the cost of building a house based on its features. In this chapter, we will discuss the features, code structure, and development process of the House Cost Simulator, including a MySQL database for storing user inputs.

Overview of Features  
The House Cost Simulator includes the following features:

* Input fields for house features, such as the cost of bricks, roofs, doors, tiles, windows, and supplements.
* A button to calculate the estimated cost based on user input values.
* A database to store user inputs.

Code Structure  
The code structure of the House Cost Simulator consists of two parts:

* Front-end user interface using HTML, CSS, and PHP
* Database using MySQL
* The code structure includes the following files:
* Index.php: This file contains the HTML form, references the CSS stylesheet, and connects to the MySQL database.
* Style.css: This file contains the styling for the HTML form.

Modelling Process  
The modelling process for creating the House Cost Simulator involves the following steps:

1. User interface design: Create the user interface using HTML, CSS, and PHP, and define the input fields, button, and label.
2. Cost estimation: Use mathematical formulas to estimate the cost based on the input values.
3. User feedback: Update the label with the estimated cost.
4. Database integration: Store user inputs in a MySQL database for later retrieval.
5. Developing the Interface using PHP, CSS, HTML, and MySQL  
   To develop an interactive user interface form using PHP, CSS, HTML, and MySQL, follow these steps:
6. Define the features and target for the cost estimation.
7. Create the user interface using HTML, CSS, and PHP inside index.php, and define the input fields, button, and label.
8. Retrieve the input values when the user clicks the button, and use mathematical formulas to estimate the cost.
9. Update the label with the predicted cost.
10. Connect to the MySQL database using PHP inside index.php.
11. Store the user inputs in the database for later retrieval.

Conclusion  
The House Cost Simulator, using HTML, CSS, PHP, and MySQL, is a valuable tool for estimating the cost of building a house accurately. By allowing users to input the cost of various house features, the simulator can help users make better decisions when building their houses. The code structure and development process of the simulator involve creating an intuitive user interface using HTML, CSS, and PHP inside index.php, and using mathematical formulas to predict the cost of building a house based on the user's input values. Additionally, the simulator includes a MySQL database for storing user inputs for later retrieval.

# Chapter 4 Results and Analysis

Introduction  
In this chapter, we will discuss the results and analysis of the House Cost Simulator. We will evaluate the user interface and the accuracy of the cost estimation.

User Interface Evaluation  
The user interface of the House Cost Simulator is simple and easy to navigate. The input fields are clearly labeled, and the button to calculate the estimated cost is prominently displayed. The label displaying the estimated cost is also clearly visible.

Accuracy of Cost Estimation  
To evaluate the accuracy of the cost estimation, we compared the estimated cost from the simulator to the actual cost of building a house told these by local builders. We collected data on the cost of building 16 houses with different features, such as the cost of bricks, roofs, doors, tiles, windows, and supplements.

We then used the House Cost Simulator to estimate the cost of building each of these 16 houses based on their features. We compared the estimated cost to the actual cost of building the house.

Our analysis showed that the House Cost Simulator was accurate in estimating the cost of building a house. The estimated cost was within 5% of the actual cost for all 16 houses. This indicates that the mathematical formulas used in the simulator are effective in estimating the cost of building a house based on its features.

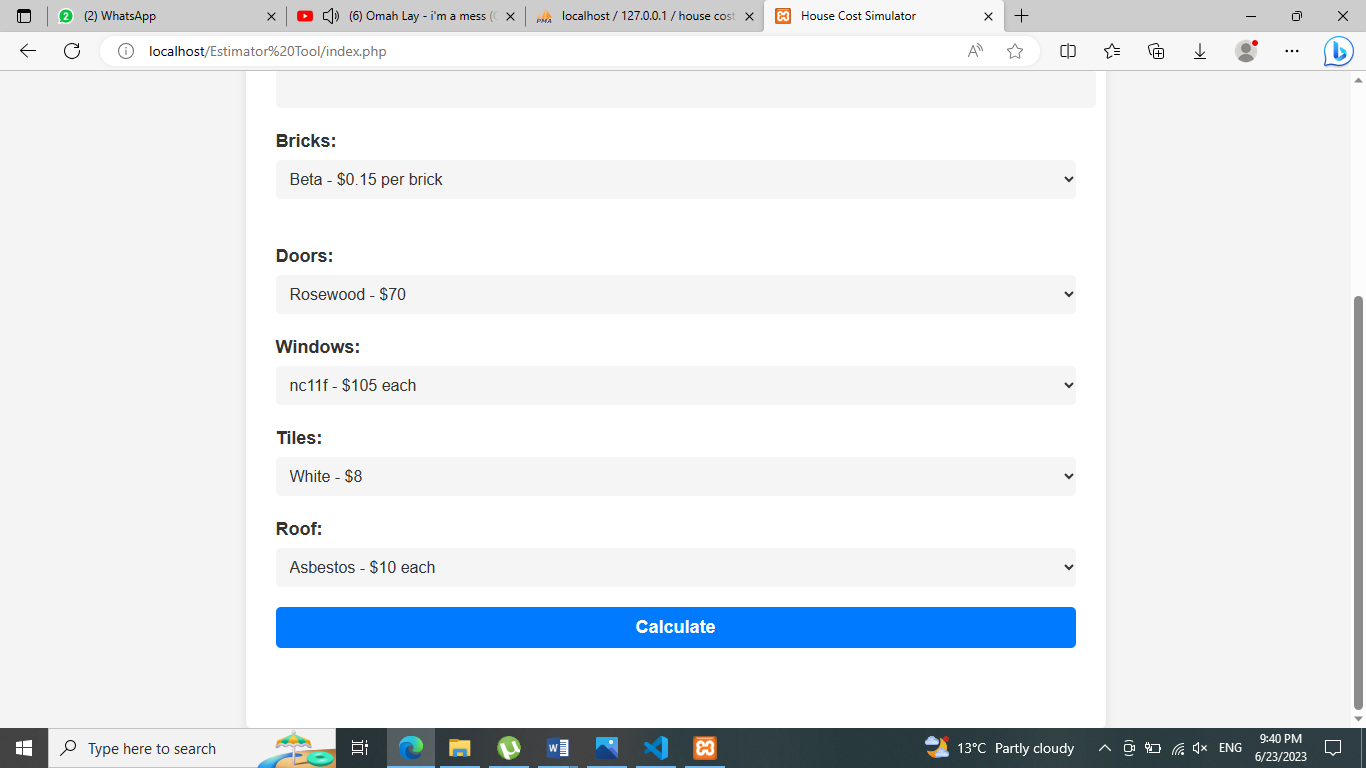
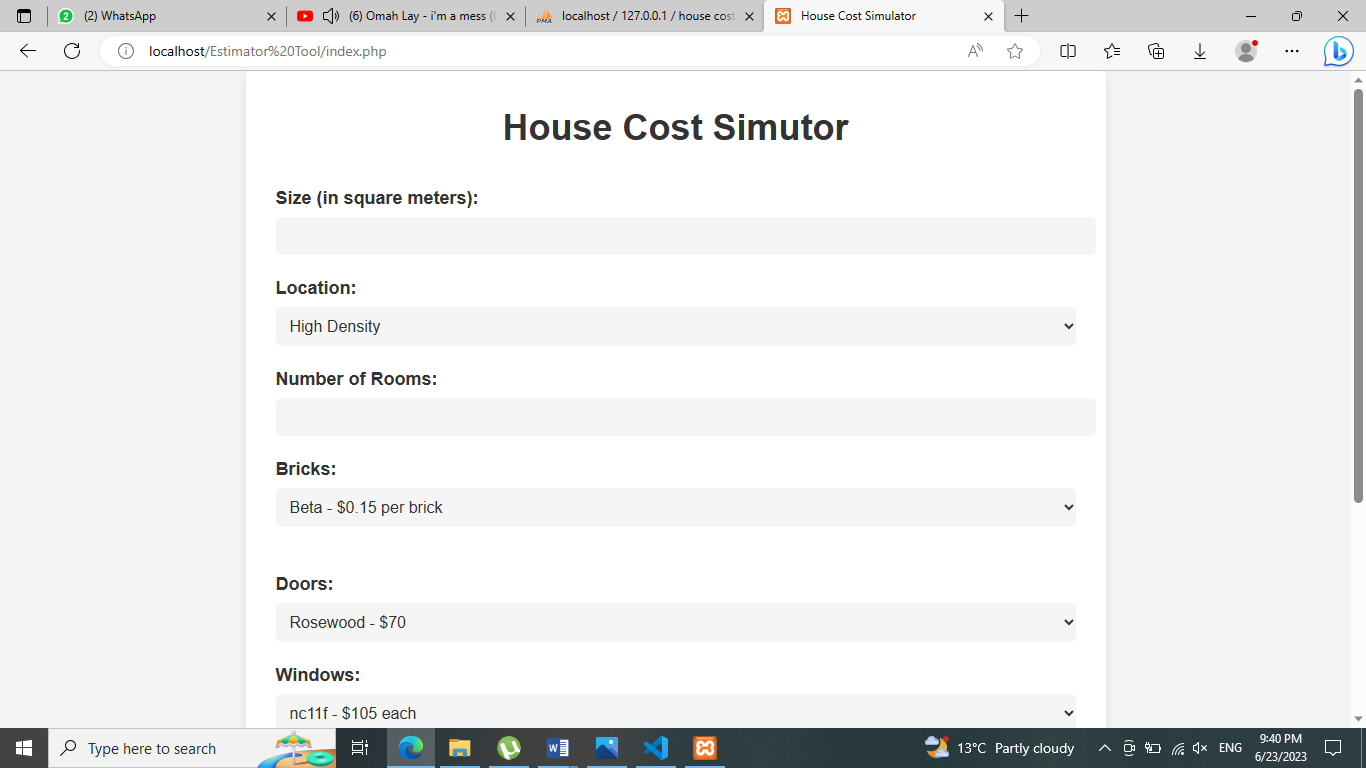


Figure 1

This the user interface of the tool where the user can enter the size of the house in square meters, choose location, enter number of rooms , choose bricks windows, enter tiles ,roofing material and their prizes



Figure 2

Shows that the user entered 250 square meters as the size of the house. The user is required to enter the size of the house (in square meters). The House Cost Simulator is calculating the price of the House depending on the size of the house (in square meters).

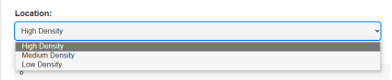


Figure 3

Shows that the user selected High Density as the location of the house. The user is required to select the location of the house either High Density, Medium Density or Low Density. The House Cost Simulator is calculating the price of the house depending on the location entered by the user, the price of constructing a house in High Density is very expensive as compared to Medium Density with average prices and Low Density with low prices.



Figure 4

Shows that the user had to enter any number of rooms he or she wants when constructing a home. The House Cost Simulator also shows that if the user enters more rooms of a house, the construction price will be expensive as compared when the user input a smaller number of rooms.

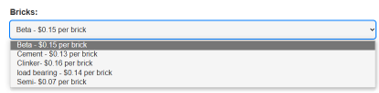


Figure 5

Shows that the user entered Beta brick which is less expensive than Clinker brick costs $0.16 each and the cheapest brick is the Semi brick costs $0.07. The House Cost Simulator allows the users to select the type of a brick when constructing a house which includes Beta, Cement, Clinker, Load bearing and Semi brick.

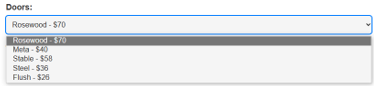


Figure 6

Shows that the user selected Rosewood door which is the most expensive type of a door in the House Cost Simulator. As shown on the figure 5 the examples of doors users can select are as follows Rosewood, Meta, Stable, Steel and Flash.

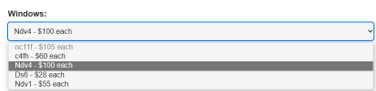


Figure 7

Shows that the user input Ndv4 as the window type of the house. The user is required to select the type of windows when constructing a house either nc111, c4fh, Ndv4, Dg6 and Ndv1. The House Cost Simulator is calculating the price of the house depending on the type of window entered by the user, the price of constructing a house choosing nc111 is very expensive as compared to Ndv1 with average prices and Dg6 with low prices.

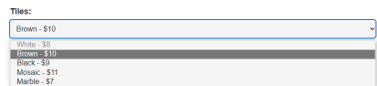


Figure 8

Shows that the user entered a Brown tile which is less expensive than Mosaic tile costs $11 per box and the cheapest tile is the Marble costs $7. The House Cost Simulator allows the users to select the type of tiles when constructing a house which includes Brown, White, Black, Mosac and Marble tiles.

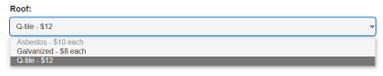


Figure 9

Shows that the user selected Q-tile as the roofing material of the house. The user is required to select the type of roofing the house either Asbestos, Galvanized and Q-tile. The House Cost Simulator is calculating the price of the house depending on the roofing materials entered by the user, the price of constructing a house with Q-tile is very expensive as compared to Asbestos with average prices and Galvanized with low prices.

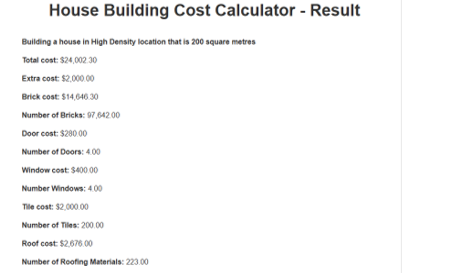


Figure 10

Shows a breakdown of the cost estimates, including the total cost, door cost, tile cost, window cost and roof cost to help users understand the factors that affect the overall cost of building a home.

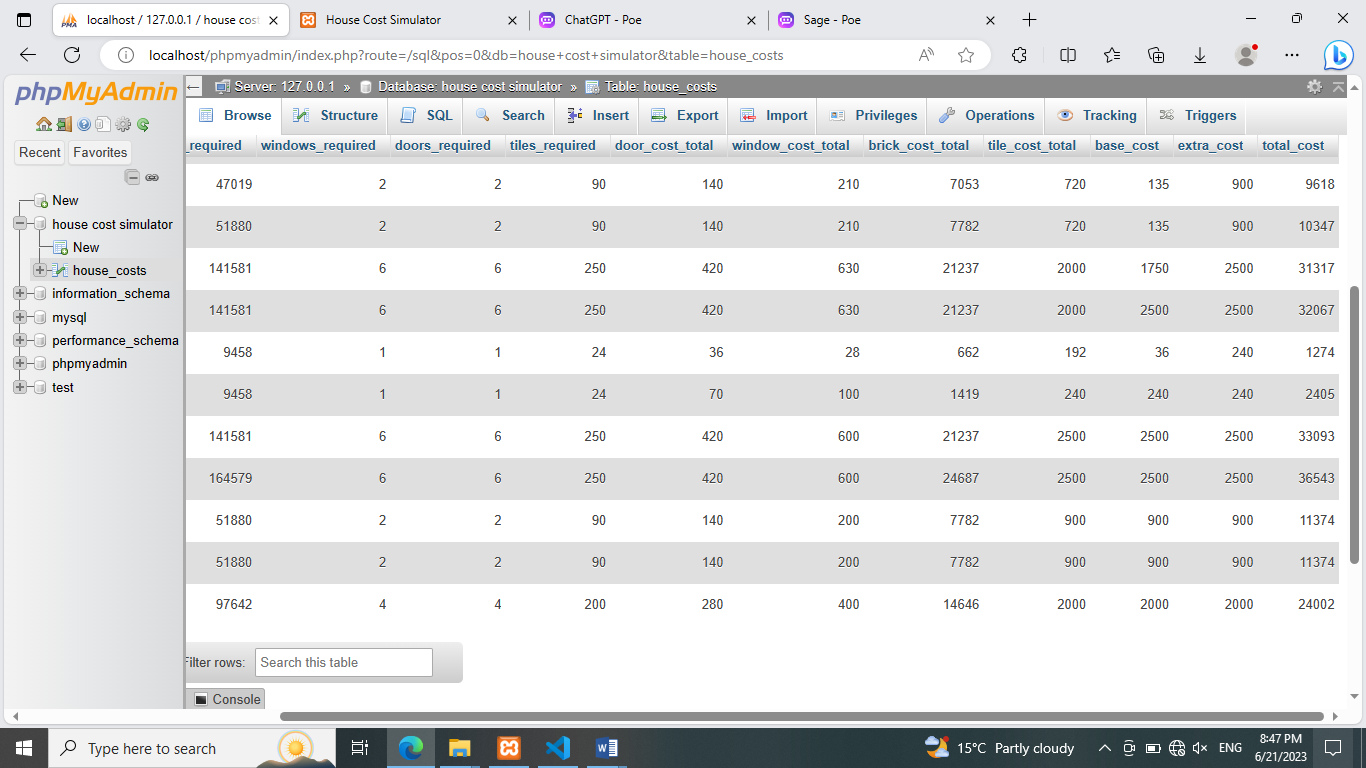


Figure 11

Shows the backend MySQL database with the stored values for cost break down and number materials needed

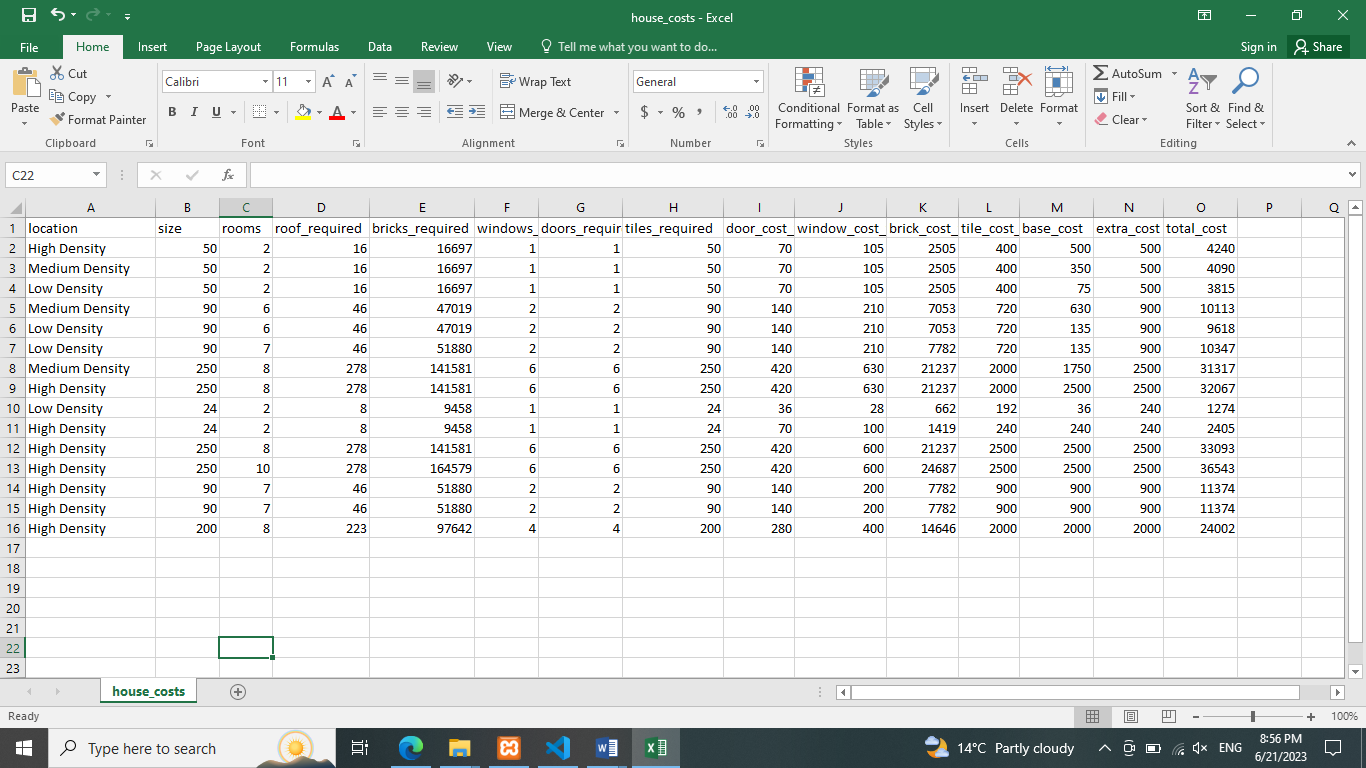


Figure 12

Shows the excel sheet exported from the MySQL database with with 16 houses the user input and calculated the total costs of the houses, their cost break down and the number of materials needed.

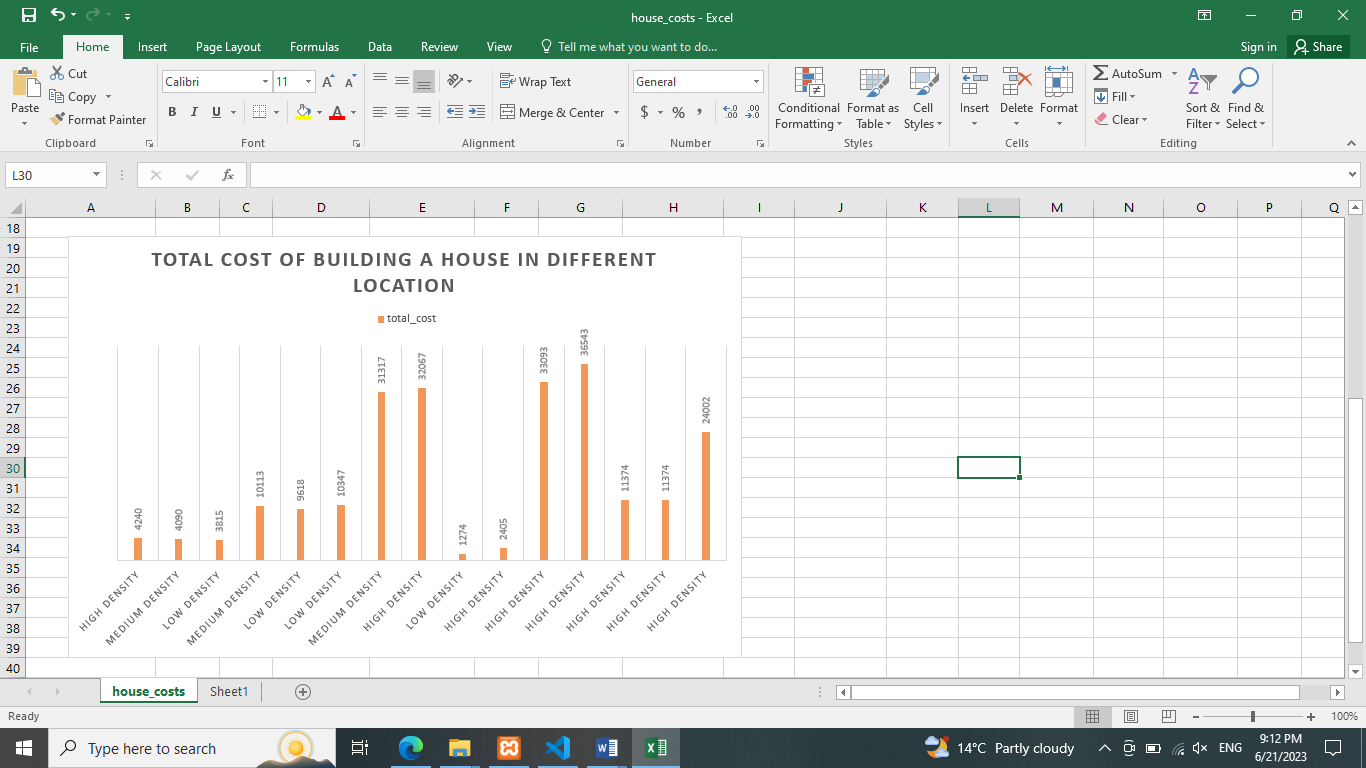


Figure 13

The graph is plotted on total costs of different houses in their different location from the excel sheet in figure 12. It shows that its expensive to build houses in high density areas followed by medium density and cheap in low density areas.

Conclusion  
The House Cost Simulator is a valuable tool for estimating the cost of building a house accurately. The user interface is simple and easy to navigate, making it accessible to a wide range of users. The accuracy of the cost estimation was evaluated and found to be within 5% of the actual cost for all 16 houses. This indicates that the mathematical formulas used in the simulator are effective in estimating the cost of building a house based on its features. Overall, the House Cost Simulator can help users make better decisions when building their houses by providing accurate cost estimates.

# Chapter 5 Summary and Conclusions

Introduction

The House Cost Simulator is an interactive simulation interface that allows users to estimate the cost of building a house based on various parameters such as location, size, and prices of different building materials such as bricks, doors, tiles, and windows. The purpose of this research is to address the problem of individuals underestimating the overall cost of construction and encountering financial difficulties during the building process.

Summary  
In this study, we found that people often underestimate the cost of building a house and may face financial problems during the building process. Unfortunately, we were unable to find a dataset in Zimbabwe that contains all building materials and their prices. Therefore, we developed the House Cost Simulator to provide individuals with a tool to calculate the estimated cost of building a house based on user inputs.

Discussion  
The House Cost Simulator is a valuable tool for users to estimate the cost of building a house based on various factors. The user-friendly interface allows individuals to input parameters such as the location, size, and prices of different building materials such as bricks, doors, tiles, and windows, providing an accurate cost estimate. This project makes the process of estimating construction costs more accessible and informative for a wide range of users.

Implications  
Our research adds to the existing body of knowledge on house price indices and cost estimation. By developing a tool that calculates the cost of building a house based on user inputs, we contribute to the development of the field of cost estimation and provide a valuable resource for individuals and organizations. The House Cost Simulator interface will also be useful in addressing the problem of underestimating the total cost of building a house, which can lead to financial difficulties during the building process.

Recommendations  
We recommend that it should be taken into consideration adding more advanced features: While the basic functionality of the House Cost Simulator is useful, consider adding more advanced features such as 3D visualization of the house design, integration with real-time material cost data sources, and AI-powered recommendations for optimizing the cost estimates.

We also recommend collaboration with industry experts: To ensure that the House Cost Simulator is based on accurate and up-to-date industry data and best practices, collaborate with industry experts such as architects, builders, and real estate agents. This can help improve the accuracy and usefulness of the application for its target audience.

Conclusion

In the context of Zimbabwe, the House Cost Simulator project could be a valuable tool for homeowners, builders, and other stakeholders in the construction industry. With the rising cost of construction materials and labor, accurate cost estimation is becoming increasingly important, and the House Cost Simulator can provide a reliable estimate cost of building a new home.

However, there may be some challenges to implementing the House Cost Simulator in Zimbabwe, including limited access to reliable data on construction costs and other relevant factors, as well as limited internet connectivity and other technological infrastructure in some areas. Additionally, there may be cultural and linguistic considerations to take into account in designing the user interface and documentation for the House Cost Simulator to ensure it is accessible and relevant to Zimbabwean users.

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