RESEARCH PROGRESS IN MECHANICAL AND MANUFACTURING ENGINEERING
e-ISSN: 2773-4765

RPMME

Vol. 5 No. 1 (2024) 192-199
https://publisher.uthm.edu.my/periodicals/index.php/rpmme

Development of Economic Analysis Program Via Matlab's App Designer

Muhammad Nur Izzat Zaini[1], Rosli Asmawi [1]*, Zamri Noranai[1]

[1] *Faculty of Mechanical and Manufacturing Engineering*
Universiti Tun Hussein Onn Malaysia (UTHM), Parit Raja, 86400, MALAYSIA

*Corresponding Author: roslias@uthm.edu.my
DOI: https://doi.org/10.30880/rpmme.2024.05.01.021

Article Info

Received: 31 January 2024
Accepted: 19 June 2024
Available online: 15 September 2024

Keywords

MATLAB, Economic analysis, App Designer

Abstract

Economic analysis is a critical part of any business's development process, and it is one of the most important tasks that engineers and scientists have to undertake. MATLAB provides engineers with a comprehensive platform for computational analysis and design, offering a combination of a powerful programming language, interactive apps, professionally built toolboxes, and scalability options, all geared towards accelerating research, innovation, and problem-solving in diverse fields. In this project, the focus is on developing an accessible and user-friendly economic analysis program using MATLAB and App Designer. The project focuses on learning the most recent version of the program, R2023, as well as economic engineering fundamentals to improve comprehension and proficiency in economic analysis. The objective of this project is to create a tool that simplifies the process of economic analysis, making it more accessible to a wider range of users, including those without in-depth knowledge in the field.

1. Introduction

This project centers on addressing the absence of user-friendly economic analysis tools by developing a comprehensive program using MATLAB and its App Designer tool. MATLAB, a powerful high-level programming language, and development environment is widely utilized in scientific and technical fields, offering versatile capabilities for numerical calculations and data analysis. The App Designer tool simplifies the creation of interactive apps without extensive coding.

The project aims to enhance proficiency in economic analysis and MATLAB by incorporating economic engineering fundamentals. The primary objective is to create an accessible economic analysis program enabling users to input data, conduct analyses, visualize results, and gain insights into economic trends. The scope encompasses developing the program in MATLAB, targeting ROI and NPV methods, and utilizing the cost-free student version of MATLAB App Designer for educational purposes.

MATLAB is an advanced programming platform tailored for engineers and scientists, providing powerful tools for analyzing and designing impactful systems and products. Its distinctive programming language, centered on matrices and arrays, allows for a natural expression of computational mathematics. [1]. MATLAB's data representation has evolved over time to meet diverse user needs. Initially supporting only 64-bit IEEE 754 double-precision floating-point data, MATLAB expanded to accommodate greater data quantities and diverse types in response to user demand [2].

App Designer, a potent MATLAB tool, enables users to create professional applications effortlessly, even without extensive software development expertise. The intuitive drag-and-drop interface allows users to build the graphical user interface (GUI) by arranging visual components as needed. The integrated editor further simplifies the programming of the GUI's behavior for efficient application development [3]. MathWorks®

discontinued GUIDE, the drag-and-drop environment for MATLAB® app development, in R2019b. Existing GUIDE apps will still function, and their program files remain editable. Migration to App Designer offers expanded UI options and auto-reflow features for responsive design, with a migration tool introduced in R2018a, improved significantly in R2020a [4].

Economic analysis is crucial for assessing the viability, impact, ranking of initiatives, investments, and events. It involves identifying, evaluating, and comparing costs and benefits to enable optimal resource allocation and informed decision-making [5][6]. Stakeholders gain insights into risks and rewards, aiding the design of strategies for economic efficiency and sustainability. The primary goal is to rank and assess economic viability, guiding effective resource allocation and informed decision-making [6].

In the "Malta House" project, Graph'it Studio utilized BIM for MEP installations, conducting ROI analysis that revealed negative returns: -507,000 PLN, -816,000 PLN, and -1,101,000 PLN after the first, second, and third years, respectively [7]. Despite the negative ROI, Skanska acknowledged the project's success, attributing the low returns to initial costs for training and technology adoption.

The use of Return on Investment (ROI) in a Hawaii case study highlights its effectiveness in allocating funds strategically for restoration, influencing management and policy decisions. The study assessed different land use types in Hawaii's North Kona and South Kona districts, including open pasture, wooded pasture, Acacia koa-dominated regeneration stand, and native forest. The focus was on identifying six potential restoration transitions to enhance native tree and understory plant cover in various parcels [8].

2. Materials and Method

This study explains the systematic approach used to conduct a study, outlining methods, steps, and strategies to address objectives and produce results. It is vital in a research report as it allows others to assess the study's validity and reliability.

2.1 Program procedure process

The initial step involves understanding the project title, which requires developing a user-friendly economic analysis app for the community. Next, gather information from various sources such as journals, theses, and the internet for the study background and literature review. Three key points must be thoroughly investigated before proceeding with the app creation and testing. After creating the official program, test the results, and if inaccuracies arise, adjust the program until correct results are obtained. Finally, conclude with a discussion to enhance the app before completion.

2.2 Method Used to calculate Economic Analysis

There were several methods used to calculate Economic Analysis. For this project required using only two methods which are Return of Investment (ROI) and Net Present.

2.3 Calculation Estimation Program

This section details the methods employed to perform economic analysis for domestic users using MATLAB App Designer. The program facilitates cost evaluation and project viability assessment, helping users determine profitability. Economic analysis calculations can be challenging, particularly for those without expertise in the field, often requiring specific knowledge and skills. Traditionally, manual calculations are time-consuming and may slow down the project process.

2.4. MATLAB App Designer

This study aims to create a user-friendly economic analysis program using MATLAB App Designer, catering to individuals without extensive technical knowledge. Unlike existing software designed for experts, App Designer simplifies application development without requiring significant programming expertise. Leveraging MATLAB's power and App Designer's intuitive interface, the goal is to make economic analysis accessible to a broader audience.

2.4.1 Code View Command

In this research, only MATLAB App Designer was utilized, focusing on the Code View function. This function provides programming features similar to the MATLAB Editor. It simplifies code exploration and modifications, offering convenience for users in analyzing and editing their MATLAB code.

2.4.1 Manage UI Components

In App Designer, UI components are assigned default names when added. Users should refer to components in their code using these default names, including the app prefix. To change a component's name, users can double-click it in the Component Browser or design view and enter a new name. App Designer promptly updates all references to the component when its name is changed by the user.

2.5 Simulation and Modelling

A precise mathematical model for economic analysis has been simulated using MATLAB software. Developed in MATLAB App Designer, the model automates the calculation of economic analysis. Currently, the program concentrates on two methods—Return on Investment (ROI) and Net Present Value (NPV)—offering simplified yet effective tools for users to evaluate the financial aspects of their projects

2.5.1 Code Development in MATLAB Apps designer

MATLAB App Designer was used to code the Economic Analysis model in this study. MATLAB, short for Matrix Laboratory, excels in handling matrix-formatted data and enables data visualizations. It's crucial for numerical operations, performing complex calculations and analyses. Common uses include algorithm creation. Before MATLAB programming, the mathematical model is converted into pseudocodes, providing an organized framework for coding.

2.5.2 Pseudocodes for Economic Analysis program

Pseudocode serves as a command for programming calculations, providing a high-level description of processes in an algorithm or program. Acting as a transitional stage between design and coding, pseudocode offers a clear example of the structure before converting to MATLAB syntax. It simplifies understanding and planning for developers by outlining program logic and flow in simple terms, aiding in creating a program's structure and breaking down complex problems into manageable steps.

2.5.3 Verification of MATLAB App Designer Code u

App Designer code verification involves manual calculations, often using an Excel spreadsheet for crosschecking. This process ensures the code functions as intended, offering a reliable and accurate outcome.

2.5.4 Run Programmer

After programming and saving the App Designer project, the critical next step is running the program. Running the program executes the code, but it's essential to review for any grammatical or logical errors beforehand. Code errors can prevent the program from running correctly. Once error-free, launching the application through App Designer ensures it performs the intended functionality, delivering the required output as per instructions.

2.5.5 Comparing Result

After running the program and inputting research data, computation results are displayed and saved in a designated folder for easy comparison with past outcomes. To verify accuracy, the program's calculations are compared with a previous research study using ROI and NPV methodologies. If the outcomes align, it validates the correctness of the program's computations, ensuring accuracy in the implemented calculations.

3. Results and Discussion

This chapter discusses research results and their progression, involving app development using data from a reference thesis. Calculations were done using the created program, and results were rigorously compared with the reference paper, ensuring accuracy and reliability.

3.1 Program Panel

The program includes panels for user-driven economic analysis. The home page introduces the program, the main menu displays types of evaluation methods, and the final panel allows users to input data and receive results based on their selected criteria.

3.1.1 Home Panel

The program opens with a friendly greeting, "WELCOME TO ECONOMIC ANALYSIS CALCULATOR," setting a welcoming tone. Two strategically placed buttons guide users to the next steps: "MAIN MENU" leads to additional features, ensuring a smooth transition. At the same time "EXIT" provides a quick way to leave the application for users who choose not to continue.

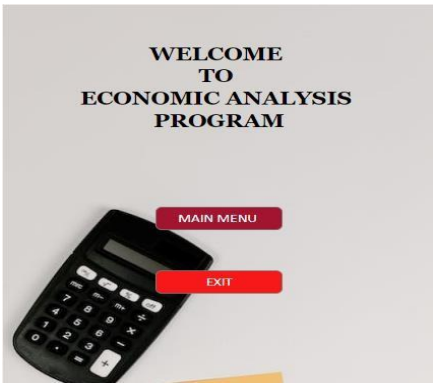

Fig 1 *Home panel for the program*

3.1.2 Main Menu Panel

Figure 2 displays the main menu panel, featuring five buttons ("RETURN OF INVESTMENT," "NET PRESENT VALUE," "EAC," "IRR," and "LCC") representing different economic analysis methods. Users can choose a button, and the program will guide them to a specific panel for that calculation.

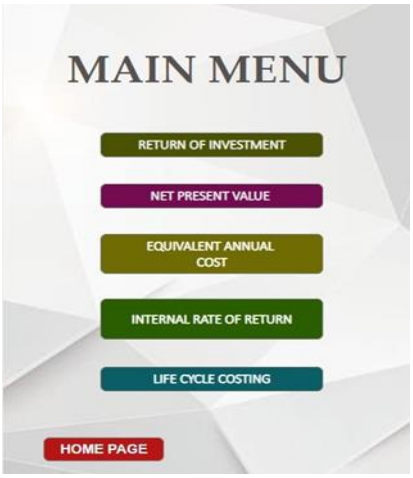

Fig 2 *Main menu for the program*

3.1.3 Return of Investment Panel

Return on Investment is a key financial performance metric used to assess an investment's efficiency and compare it to the efficiency of other investments [9]. For the easy word, it tells investors how much money they will make in the future if they invest now.

Fig 3 *ROI panel*

3.1.4 Net Present Value Panel

Net Present Value (NPV) is a financial statistic used in capital budgeting and investment analysis to determine the profitability of a project or investment. It compares the present value of predicted cash inflows against the present value of expected cash outflows over a predetermined period. It compares the present value of predicted cash inflows against the present value of expected cash outflows over a predetermined period [10].

Fig 4 *Net Present Value panel*

3.2 Result and Verification

The developed program is verified by comparing the results and the data from research papers. Data collection and compilation have been done to validate this program.

Table 1 *Result of reference data and software data using ROI*

Items	Reference data	Software data
Measure 1	1.12	1.12
Measure 2	0.00	0.00
Measure 3	0.53	0.53
Measure 4	0.25	0.25
Measure 5	5.47	5.47
Measure 6	0.70	0.70
Measure 7	4.07	4.07

Table 1 demonstrates a consistent alignment between software outputs and the reference, affirming the accuracy and reliability of the Return on Investment (ROI) panel. This strong validation, supported by the consistent results from both sources, confirms the software's capability to accurately compute and display return on investment (ROI) measurement.

Table 2 *Result of reference data and software data using NPV*

Items	Measure 1		Measure 2		Measure 3		Measure 4	
	RD	SD	RD	SD	RD	SD	RD	SD
1st year	-4015	-4015	7604	7604	14516	14516	3965	3965
2nd year	11743	11743	14516	14516	45895	45895	8934	8934
3rd year	26069	26069	20800	20800	74421	74421	13451	13451
4th year	39093	39093	26513	26513	100353	100353	17557	17557
5th year	50933	50933	31706	31706	123929	123929	21290	21290
6th year	61696	61696	36427	36427	145361	145361	24684	24684
7th year	71481	71481	40719	40719	164844	164844	27769	27769
8th year	80376	80376	44621	44621	182556	182556	30574	30574
9th year	88463	88463	48168	48168	198659	198659	33123	33123

10th year	95815	95815	51393	51393	213297	213297	35441	35441
Similarity (%)	100		100		100		100	

Table 2 *(continued)*

Items	Measure 5		Measure 6		Measure 7	
	RD	SD	RD	SD	RD	SD
1st year	-25001	-25001	1811	1811	-6211	-6211
2nd year	-20468	-20468	8912	8912	-4584	-4584
3rd year	-16348	-16348	15367	15367	-3106	-3106
4th year	-12602	-12602	21235	21235	-1762	-1762
5th year	-9197	-9197	26570	26570	-540	-540
6th year	-6102	-6102	31420	31420	571	571
7th year	-3288	-3288	35829	35829	1581	1581
8th year	-729	-729	39838	39838	2499	2499
9th year	1596	1596	43482	43482	3334	3334
10th year		3711	46794	46794	4093	4093
Similarity (%)	100		100		100	

Table 2 illustrates an exact match between the similarity of the software data and the reference data, both showing 100% similarity. This similarity ensures that the Net Present Value calculations are accurate and correct within the software. By letting the software handle the calculations, using it guarantees reliable results and speeds up the calculating process. It highlights the reliability and efficiency of the software in handling complex computations.

4. Conclusion

In conclusion, this project set out with the primary objectives of studying economic engineering principles, gaining insights into Economic Analysis methods, exploring the fundamentals of MATLAB and App Designer programming, and developing a user-friendly economic analysis program using these tools. The project successfully achieved its objective by creating an efficient economic analysis program that embodies the principles studied and enhances the understanding of Economic Analysis methods. The development of the economic analysis program using MATLAB App Designer has proven to be a valuable tool for assessing investment scenarios. Validation through matched results with reference data confirmed the accuracy of the

software's calculations, validating the program's reliability for conducting comprehensive economic analyses such as return on investment and net present value. The program serves as both an educational resource and a showcase of MATLAB App Designer's potential in facilitating practical economic assessments. Creating this economic analysis program offered valuable learning opportunities, enhancing the creator's programming skills, understanding of syntax rules, and ability to apply programming skills in various applications. Engaging in this project also facilitated the development of proficiency in designing skills for program creation, providing an opportunity to learn how to create visually appealing and user-friendly interfaces, along with utilizing complex features to enhance the overall program.

Acknowledgment

The authors would like to thank the Faculty of Mechanical and Manufacturing Engineering Universiti Tun Hussein Onn Malaysia for its support

References

[1] [1] “A Brief History of MATLAB - MATLAB & Simulink.” https://www.mathworks.com/company/newsletters/articles/a-brief-history-of-matlab.html (accessed Jun. 23, 2023).
[2] [2] “Data Types - MATLAB & Simulink.” https://www.mathworks.com/help/matlab/data-types.html (accessed Jun. 23, 2023).
[3] [3] “MATLAB App Designer - MATLAB & Simulink.” https://www.mathworks.com/products/matlab/app-designer.html (accessed Jun. 23, 2023).
[4] [4] “GUIDE Migration Strategies - MATLAB & Simulink.” https://www.mathworks.com/help/matlab/creating_guis/differences-between-app-designer-and-guide.html (accessed Jun. 23, 2023).
[5] [5] “Economic Analysis - Meaning, Tools, Examples, What is It?” https://www.wallstreetmojo.com/economic-analysis-2/ (accessed Jun. 24, 2023).
[6] [6] N. Edomah, “Economics of Energy Supply,” Ref. Modul. Earth Syst. Environ. Sci., Jan. 2018, doi: 10.1016/B978-0-12-409548-9.11713-0.
[7] [7] D. Walasek and A. Barszcz, “Analysis of the Adoption Rate of Building Information Modeling [BIM] and its Return on Investment [ROI],” Procedia Eng., vol. 172, pp. 1227–1234, Jan. 2017, doi: 10.1016/J.PROENG.2017.02.144.
[8] [8] J. H. Goldstein, L. Pejchar, and G. C. Daily, “Using return‐on‐investment to guide restoration: a case study from Hawaii,” Conserv. Lett., vol. 1, no. 5, pp. 236–243, 2008, doi: 10.1111/j.1755-263x.2008.00031.x.
[9] [9] D. Walasek and A. Barszcz, “Analysis of the Adoption Rate of Building Information Modeling [BIM] and its Return on Investment [ROI],” Procedia Eng., vol. 172, pp. 1227–1234, Jan. 2017, doi: 10.1016/J.PROENG.2017.02.144.
[10] [10] “Net Present Value (NPV): What It Means and Steps to Calculate It.” https://www.investopedia.com/terms/n/npv.asp (accessed Jun. 24, 2023).