FRESH FRUIT BUNCH (FFB) GRADING ANALYSIS FOR PALM OIL INDUSTRY BASED ON DESCRIPTIVE AND PREDICTIVE ANALYTICS

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FRESH FRUIT BUNCH (FFB) GRADING ANALYSIS FOR PALM OIL INDUSTRY BASED ON DESCRIPTIVE AND PREDICTIVE ANALYTICS

NURUL HAFIKA HAFINA BINTI MOHAMAD FADZLI

This report is submitted in partial fulfillment of the requirements for the Bachelor of Computer Science (Artificial Intelligence) with Honours.

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FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

DECLARATION

I hereby declare that this project report entitled

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is written by me and is my own effort and that no part has been plagiarized without citations.

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STUDENT : NURUL HAFIKA HAFINA BINTI MOHAMAD FADZLI Date : 18/9/2023

I hereby declare that I have read this project report and found this project report is sufficient in term of the scope and quality for the award of Bachelor of Computer Science (Artificial Intelligence) with Honours.

SUPERVISOR : PM Ts Dr Zuraida Bt Abal Abas Date : 19 September 2023

DEDICATION

This final year project is dedicated to my Final Year Project supervisor, Prof Madya Ts Dr Zuraida Bt Abal Abas for the continuous support throughout the completion of the project, for her patience to guide me until the end and to motivate and give moral support to me during this project. I appreciate all the help that was given by my supervisor. I would like to dedicate to my beloved parents and siblings who always give me the strength, support financially and emotionally during my studies in university and for the continuous encouragement to finish my project. Finally, I want to dedicate it to my friends who always supported and helped me in the past years during my study in university.

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A big thank you to PM Ts Dr Zuraida Bt Abal Abas for her guidance and help to complete the final year project (FYP). There were some problems in completing this final year project (FYP), but with her guidance and help, I was able to get through it. Without her advice and guidance, the final year project (FYP) could not have been completed successfully.

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ABSTRACT

Fresh Fruit Bunches (FFB) grading is an important step in palm oil production as it allows producers to optimize oil extraction and ensure consistent quality. The detection of the quality of FFB is done based on Malaysian Standard (MS) grade specifications. The grading process usually involves the evaluation of various FFB, including ripe bunches, “Mengkal” bunches, young bunches, empty bunches, rotten bunches, fermented bunches, and old bunches. The dataset obtained is from one of the palm oil companies. This project involves the evaluation and prediction of outcome through a numerical value. Therefore, the developer decided to test out data with a few time series models. The models that are used are autoregressive integrated moving average (ARIMA), simple exponential smoothing, Holt-Winters (HOLTS), Naïve forecasting and Trigonometric seasonality Box-Cox transformation ARIMA errors Trend Seasonal components (TBATS). To ensure that each mill delivers good quality of palm oil, meets the set percentage, and can make it easier for the staff to monitor the grading of palm oil, the developer proposed index scoring for FBB grading based on mathematical calculation. This dashboard was developed with the aim of improving quality grading and business performance. This system is produced not only to monitor the grading but can also see the prediction for the index scoring produced according to the mill in the coming week. This can improve the quality of the fruit delivered and can improve the quality of the oil produced easily.

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ABSTRAK

Penggredan Buah Tandan Segar (BTS) merupakan langkah penting dalam pengeluaran minyak sawit kerana ia membolehkan pengeluar mengoptimumkan pengekstrakan minyak dan memastikan kualiti yang konsisten. Pengesanan kualiti Buah Tandan Segar (BTS) dilakukan berdasarkan spesifikasi gred Standard Malaysia (MS). Proses penggredan biasanya melibatkan penilaian Buah Tandan Segar (BTS), termasuk tandan masak, tandan mengkal, tandan muda, tandan kosong, tandan busuk,tandan peram dan tandan lama. Dataset yang diperolehi ialah dari salah satu syarikat kelapa sawit. Projek ini melibatkan penilaian dan ramalan hasil melalui nilai berangka. Oleh itu, pembangun memutuskan untuk menguji data dengan beberapa model siri masa. Model yang digunakan ialah purata bergerak bersepadu autoregresif (ARIMA), pelicinan eksponen mudah, Holt-Winters (HOLTS), ramalan naif dan Trigonometri bermusim Transformasi Box-Cox ralat ARIMA Komponen Trend Musim (TBATS). Bagi memastikan setiap kilang menyampaikan buah sawit yang berkualiti, menepati peratusan yang ditetapkan, dan dapat memudahkan kakitangan memantau penggredan minyak sawit, pembangun mencadangkan pemarkahan indeks untuk penggredan Buah Tandan Segar (BTS) berdasarkan pengiraan matematik. Papan pemuka ini dibangunkan dengan tujuan untuk meningkatkan kualiti penggredan dan prestasi perniagaan. Sistem ini dihasilkan bukan sahaja untuk memantau penggredan tetapi juga boleh melihat ramalan bagi pemarkahan indeks yang dihasilkan mengikut kilang pada minggu akan datang. Ini dapat meningkatkan kualiti buah yang dihantar dan dapat meningkatkan kualiti minyak yang dihasilkan dengan mudah.

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LIST OF ABBREVIATIONS

FYP	-	Final Year Project
FFB	-	Fresh Fruit Bunches
OER	-	Oil Extraction Rate
KPG	-	Grade Extraction Rate
BTS	-	Fresh Fruit Bunches
MS	-	Malaysian Standard
CRISP-DM	-	Cross Industry Standard Process for Data Mining

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Malaysian palm oil accounted for approximately 13% of the world's total vegetable oil production in 2011. Palm oil is widely used in various products, including food, cosmetics, and biofuels. The quality and purity of palm oil are important factors that can affect the quantity of palm oil produced and the capital used. The quality and characteristics of palm oil are influenced by the quality of the Fresh Fruit Bunches (FFB) from which it is extracted. Each farm has different palm oil quality and needs to be graded according to the fresh fruit bunches (FFB) grading manual.

Fresh Fruit Bunches (FFB) grading is an important step in palm oil production as it allows producers to optimize oil extraction and ensure consistent quality. The detection of the quality of FFB is done based on Malaysian Standard (MS) grade specifications. If agricultural products do not have MS specifications, they must be guided by the grade standard of the country of origin, or the grade standard specified by the board from time to time. The grading process usually involves the evaluation of various FFB, including ripe bunches, "*Mengkal*" bunches, young bunches, empty bunches, rotten bunches, fermented bunches, and old bunches.

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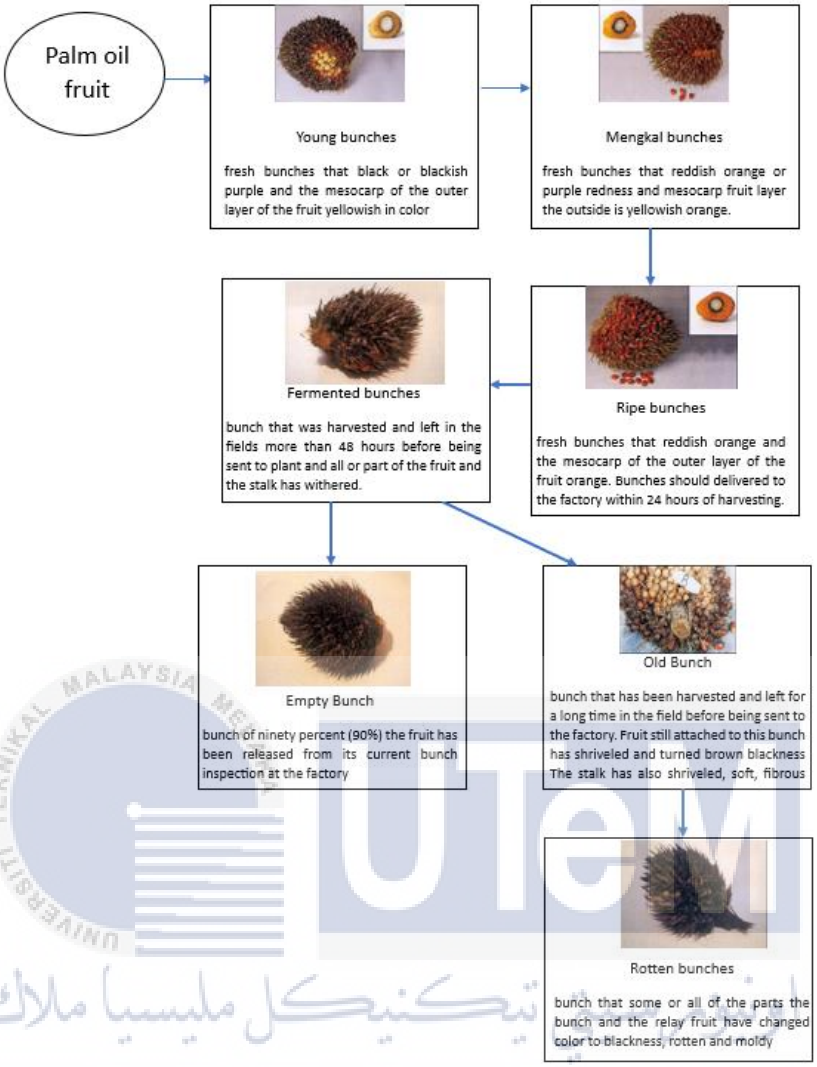

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Figure 1: Step Palm oil fruit

Figure 1 shows the process by which a palm oil fruit moves from one stage to another. Graders carefully inspect the FFB for any signs of damage or deterioration that may impact the final product's quality. By grading palm oil based on the quality attributes of FFB, producers can optimize their operations, improve efficiency, and ensure consistent oil quality. Palm oil grading based on Fresh Fruit Bunches (FFB) is crucial in palm oil production. This grading process helps producers optimize their operations, ensure consistent quality, and facilitate trade in the palm oil industry. Therefore, it is crucial to analyze palm oil quality to determine the frequency of factories producing high quality palm oil and make decisions to produce better results.

1.2 Problem statement

Table 1.1 : Problem statement

PS	Problem statement
PS1	Grading is very important in the palm oil industry. To ensure the quality of the processed palm oil is good and meet the requirements of FFB and to be able to analyze the grading. Next, use mathematical calculation to propose index scoring to make it easier for the staff to monitor the quality of the fruit delivered. Using artificial intelligence forecasting algorithms requires analysis to predict the index scoring for FBB grading based on time-series model so that the staff can observe the quality of the palm oil delivered.

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1.3 Project Question

PS	PQ	Project Question
PS1	PQ1	What the alternative can used?
PS1	PQ2	How to show the proposed solution is effective?

Table 1.2: summary of project Question

1.4 Project Objectives

PS	PQ	PO	Project Objective
PS1	PQ1	PO1	To analyze the FBB grading for palm oil industry.
		PO2	To propose index scoring for FBB grading based on mathematical calculation

		PO3	To predict the index scoring for FBB grading based on time-series model.
	PQ2	PO4	To visualize the FBB grading and analysis in a dedicated R-shiny dashboard.

Table 1.3:summary of project Objective

1.5 Project Significance

1. Software

   RStudio

   i. Version: R 4.2.3

2. Programming language

   i. R: 4.2.0

3. Device specifications

   i. Processor: Intel(R) Core (TM) i5-8265U CPU @ 1.60GHz 1.80 GHz

   ii. RAM: 8.00 GB

   iii. System type: 64-bit operating system, x64-based processor

   iv. Manufacturer: Acer

4. Windows specifications

   i. Edition: Windows 10 Pro

   ii. Version: 22H2

   iii. OS build: 19045.3086

1.6 Project Contribution

PS	PQ	PO	PC	Project Contribution
PS1	PQ1	PO1	PC1	Proposed index scoring for FBB grading based on mathematical calculation technique and to solve the

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				predction index scoring for FBB grading based on time-series model.
		PO2		
	PQ2	PO3	PC2	Proposed the FBB grading and analysis in a dedicated R-shiny dashboard.

Table 1.4: summary of project Contribution

1.7 Report Organization

Chapter 1: Introduction

This chapter serves as an introduction to the project, providing an overview of its background, context, and significance. The objectives of the project are stated, outlining the specific goals and aims to be achieved. The scope of the project is defined, specifying the boundaries and extent of the research or development. The structure of the report is briefly outlined, giving an overview of the subsequent chapters and their content.

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Chapter 2: Literature Review

In this chapter, a comprehensive review of relevant literature, research, and existing work in the field is presented. Key theories, concepts, and methodologies related to the project are critically analyzed and synthesized. Gaps or limitations in the existing body of knowledge are identified, highlighting the need for the current project. The literature review serves as a foundation for the subsequent chapters and justifies the importance of the project.

Chapter 3: Project Methodology

This chapter explains the methodology adopted for the project, describing the overall approach and research methods employed. The specific data collection

techniques, tools, and procedures used in the project are detailed. Justifications for the chosen methodology are provided, considering the project objectives and constraints. Ethical considerations or limitations associated with the methodology are discussed, ensuring the project's integrity.

Chapter 4: Design

The design chapter focuses on the conceptual and technical aspects of the project, outlining the design. Discusses the items and details that need to be taken into consideration during design, the methodology and techniques used. Detailed explanations of the design choices and considerations are provided, demonstrating how they align with the project objectives. Some experimental designs, procedures, validation procedures, and limitations of the design are also addressed in this section. The design chapter provides a comprehensive blueprint of the project's structure and functionality.

Chapter 5: Implementation

In this chapter, the actual implementation process of the project is described, including software development, hardware setup, and other technical aspects. Challenges encountered during the implementation are discussed, along with the strategies or solutions employed to overcome them. The final product or system is presented, highlighting its key features, functionalities, and specifications. The implementation chapter demonstrates the practical realization of the project and its alignment with the design phase.

Chapter 6: Result and Analysis

This chapter focuses on evaluating and validating the model's performance and reliability. The testing procedures are used to evaluate the project's performance, functionality, or other relevant aspects. The results of the tests conducted are presented and analyzed, providing insights into the project's strengths and weaknesses. Data analysis or statistical techniques may be employed to interpret the findings and draw meaningful conclusions. The testing and analysis chapter assesses

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the project's effectiveness and provides valuable information for further improvements.

Chapter 7: Project Conclusion

The final chapter of the report summarizes the main findings, contributions, and achievements of the project. Reflections on the success of the project in meeting its objectives are provided, highlighting its significance and impact. Limitations or constraints encountered during the project are acknowledged, along with recommendations for future work or research. The project conclusion chapter report, emphasizing the overall outcomes and the value of the project's results.

1.8 Conclusion

In conclusion, this chapter has introduced palm oil grading based on Fresh Fruit Bunches (FFB). The palm oil industry relies heavily on grading to ensure quality control and standardization. Grading FFB is a crucial step as it directly influences the quality and characteristics of the palm oil produced. By improving FFB grading practices, we can enhance palm oil overall quality, reach the target, and can get the highest profit by achieving greater OER than KPG.

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