CHAPTER 1

INTRODUCTION

1.0 Introduction

AirAsia, a leading low-cost carrier in Asia, operates within one of the most volatile and economically sensitive sectors: the airline industry. With fuel accounting for approximately 30% of total airline expenditures, fuel price fluctuations play a significant role in determining overall profitability (Chen et al., 2024). Despite AirAsia's aggressive digital transformation initiatives—ranging from AI-driven customer service platforms to predictive analytics for operational efficiency—its exposure to external economic shocks, particularly in fuel markets, remains substantial (Wu, 2024). Given the narrow profit margins characteristic of low-cost carriers, even a modest rise in fuel prices can cause disproportionate impacts on financial performance, with estimates showing that a 10% fuel price increase could reduce profits by up to 15% for carriers like AirAsia (Cai et al., 2025).

In light of these vulnerabilities, accurate fuel price forecasting has become essential for risk mitigation, financial planning, and long-term strategic decision-making. In Malaysia, fuel prices particularly Ron97, which is directly linked to international crude oil markets without subsidies are influenced by multiple factors such as global oil supply, foreign exchange volatility, and domestic tax policies (Sokkalingam et al., 2021). Traditional statistical methods such as ARIMA have been successfully used to model such time series due to their strength in capturing linear temporal dependencies. However, the rise of machine learning (ML) techniques like XGBoost offers complementary benefits by modelling nonlinear relationships and incorporating multiple external features, thereby improving predictive accuracy (Pin Li & Zhang, 2018).

This research project aims to forecast AirAsia's profitability by modelling historical fuel price trends as the core external cost driver. By integrating ARIMA and XGBoost into a hybrid predictive framework, the study seeks to assess the effectiveness of combining time series analysis and structured data modelling to capture both trend-based and nonlinear

impacts of fuel prices on profitability. Unlike past approaches that examined financial performance in isolation or relied solely on statistical or Machine learning models, this study bridges the gap by adopting a hybrid, data-driven methodology. Through this approach, the project not only enhances predictive capability but also provides actionable insights for AirAsia's financial resilience and operational planning in a fuel-volatile environment.

1.2 Problem Background

AirAsia, a major player in the low-cost airline sector, operates within a highly volatile and cost-sensitive industry where fuel expenses can account for up to 50% of operating costs (Cai et al., 2025). In recent years, escalating fuel price fluctuations—driven by global oil supply shocks, currency volatility, and evolving government subsidy policies—have posed significant challenges to the airline's profitability and financial planning (Sokkalingam et al., 2021). Although AirAsia has taken strategic steps to digitalize its operations and improve cost efficiency through predictive maintenance, mobile platforms, and AI-driven customer engagement (Wu, 2024), fuel volatility continues to represent a critical risk factor.

Traditional statistical forecasting models like ARIMA have proven effective for analyzing linear trends in time series data. However, these models often fall short when addressing complex, nonlinear patterns that dominate fuel price movements. As a result, hybrid models that combine ARIMA with machine learning algorithms like XGBoost are gaining traction for their ability to enhance predictive performance by capturing both temporal dependencies and multifactorial interactions (Baumann et al., 2021).

Despite their success in sectors like energy forecasting, the application of such hybrid models in aviation-specific profitability forecasting—particularly within the context of Malaysian fuel pricing structures—remains underexplored. In Malaysia, retail fuel prices such as those under the Managed Float System fluctuate weekly based on global benchmarks and domestic policies, yet limited access to proprietary data like MOPS hampers accurate prediction (Sokkalingam et al., 2021). This unpredictability has raised concerns among aviation stakeholders, particularly low-cost carriers like AirAsia, which operate on tight profit margins and have limited hedging capacities (Cai et al., 2025).

Accordingly, this project aims to fill a critical research and practical gap by leveraging a hybrid ARIMA and XGBoost framework to forecast AirAsia's profitability based on

historical fuel price trends. By integrating time series and machine learning approaches, the study seeks to deliver a more robust and adaptive forecasting model that supports informed decision-making, minimizes financial exposure, and promotes long-term business sustainability in a turbulent operating environment.

1.3 Problem Statement

At present, there is no integrated forecasting framework specifically designed to measure and anticipate the financial impact of fuel price volatility on the profitability of low-cost airlines such as AirAsia. While traditional statistical models have been used in isolation for financial forecasting, they often fall short in capturing the nonlinear patterns and complex external influences that affect aviation fuel pricing and operational costs. This limitation becomes especially critical in an industry where fuel expenses represent a significant portion of total operating costs and where profit margins are already thin.

This project aims to address this gap by developing a hybrid predictive model that combines ARIMA for time-dependent trend analysis with XGBoost for advanced machine learning-based prediction. The model will analyse historical data to forecast fuel price trends and their projected influence on AirAsia's profitability, offering a more comprehensive and adaptable tool for financial planning and risk management. Beyond improving forecast accuracy, the project also seeks to uncover patterns in fuel cost fluctuations, economic conditions, and operational sensitivities that influence airline revenue and expenditures. The insights gained can be used to enhance strategic decision-making, optimize cost-control measures, and support the development of more resilient financial models. Ultimately, this project aspires to empower AirAsia with a data-driven approach to proactively navigate market uncertainty and maintain financial sustainability in an increasingly volatile aviation environment.

1.4 Research Questions

1. How accurately can ARIMA and XGBoost forecast AirAsia's profitability based on historical fuel price trends?

2. What are the key patterns and influencing factors behind fluctuations in fuel prices that affect airline profitability?
3. How can a hybrid forecasting model improve financial planning and risk mitigation for low-cost carriers like AirAsia?

1.5 Objectives of the Research

1. Develop and apply an ARIMA model to forecast fuel price trends over time.
2. Utilize XGBoost to model the nonlinear relationships between fuel prices and AirAsia's profitability.
3. Integrate both models into a hybrid framework to improve the accuracy of financial forecasting.

1.6 Scope of the Study

1. The project focuses on forecasting the profitability of AirAsia in relation to fuel price trends in Malaysia.
2. Historical data on fuel prices and AirAsia's financial performance will be utilized, primarily from open data platforms or official reports.
3. The study applies ARIMA for time series analysis and XGBoost for structured data modeling, combining them into a hybrid forecasting model.
4. The analysis is limited to economic and operational factors that influence profitability, with fuel price being the central external variable considered.

1.7 Significance of the Research

The significance of this research lies in its potential to provide a more accurate and data-driven approach to forecasting profitability in the airline industry, particularly for low-cost carriers like AirAsia. By developing a hybrid model that integrates ARIMA and XGBoost, this study aims to improve predictive accuracy in assessing the financial impact of fluctuating fuel prices—one of the most critical cost components in aviation operations.

The findings of this project can support more informed decision-making in areas such as cost management, risk mitigation, and strategic planning. In addition, the proposed forecasting framework may serve as a valuable tool for financial analysts, airline executives, and policymakers seeking to enhance the financial resilience and sustainability of aviation businesses in volatile economic conditions. Ultimately, the study contributes to advancing the application of machine learning and time series analysis in the field of aviation finance.

1.8 Structure of the Thesis

This thesis is organized into five comprehensive chapters, each addressing different aspects of the research in a systematic manner. The structure is designed to guide the reader from the research context through to the findings and implications of the study.

Chapter 1: Introduction

This chapter introduces the core research problem—forecasting AirAsia's profitability in the context of volatile fuel price trends. It outlines the background of the aviation industry, emphasizing the sensitivity of low-cost carriers like AirAsia to fluctuations in fuel costs. The chapter also presents the problem statement, research questions, objectives, scope, significance, and the overall structure of the thesis. The aim is to establish a clear understanding of why this research is relevant and necessary in today's dynamic airline and energy environment.

Chapter 2: Literature Review

This chapter provides a review of existing literature related to airline profitability, fuel price forecasting, and the application of time series and machine learning models such as ARIMA and XGBoost. It explores previous studies on cost drivers in the aviation industry, the role of predictive analytics, and hybrid forecasting techniques. Gaps in current research are identified, particularly the limited adoption of hybrid models in aviation financial forecasting within the Malaysian context. This review sets the foundation for the proposed methodological framework used in this study.

Chapter 3: Research Methodology

The methodology chapter describes the research design, data sources, tools, and techniques used to conduct the study. It details the process of collecting historical fuel price and financial performance data, data preprocessing steps, and the implementation of ARIMA and XGBoost models. The rationale for using a hybrid approach is explained, alongside the evaluation metrics used to assess model performance. This chapter ensures transparency and reproducibility by outlining every step taken during the forecasting process.

Chapter 4: Data Analysis and Results

This chapter presents the outcomes of the exploratory data analysis and model implementation. Descriptive statistics, trend visualizations, and diagnostics are provided to understand the structure of the data. The performance of both the ARIMA and XGBoost models is evaluated individually, followed by the integration and analysis of the hybrid model. Forecasting results are presented, interpreted, and discussed in relation to the research objectives. Insights into how fuel price movements influence AirAsia's profitability are highlighted.

Chapter 5: Discussion, Conclusion, and Future Work

In the final chapter, the findings of the study are discussed in depth. The research outcomes are connected back to the initial objectives and are compared with findings from previous studies to highlight their implications. Strategic recommendations are proposed for improving financial forecasting and risk management in the airline sector. Limitations of the study are acknowledged, and potential areas for future research are outlined, such as integrating additional economic indicators or applying the model to other regional carriers.

1.9 Summary

This chapter has introduced the research project focused on forecasting AirAsia's profitability based on historical fuel price trends using a hybrid ARIMA and XGBoost model. The problem statement identified the lack of an integrated and accurate predictive framework tailored to the Malaysian aviation context, highlighting the need for advanced forecasting techniques that combine time series analysis with machine learning.

The chapter also presented the research questions and objectives, which aim to develop a robust forecasting model capable of capturing both linear and nonlinear patterns in fuel pricing data and their relationship to AirAsia's financial performance. The scope and significance of the study were defined, emphasizing its practical value in supporting strategic planning, cost management, and risk mitigation in the airline sector.

Finally, the chapter outlined the structure of the thesis, providing an overview of the five chapters and how they collectively contribute to addressing the research problem. In essence, Chapter 1 has laid the groundwork for a data-driven investigation into financial forecasting in aviation, setting the stage for a deeper exploration of relevant literature, methodology, and analytical results in the chapters that follow.