Optimizing Bike Rental Fleet Distribution for Yulu

A Proposal report for the BDM capstone Project

Submitted by

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Declaration Statement

I am working on a Project titled “Data-Driven Strategies for Fleet Optimization and Rental Usage Enhancement at Yulu”. I extend my appreciation to **Yulu**, for providing the necessary resources that enabled me to conduct my project.

I hereby assert that the data presented and assessed in this project report is genuine and precise to the utmost extent of my knowledge and capabilities. The data has been gathered from secondary data sources and carefully analyzed to assure its reliability.

Additionally, I affirm that all procedures employed for the purpose of data collection and analysis have been duly explained in this report. The outcomes and inferences derived from the data are an accurate depiction of the findings acquired through thorough analytical procedures.

I am dedicated to adhering to the principles of academic honesty and integrity, and I am receptive to any additional examination or validation of the data contained in this project report.

I understand that the execution of this project is intended for individual completion and is not to be undertaken collectively. I thus affirm that I am not engaged in any form of collaboration with other individuals, and that all the work undertaken has been solely conducted by me. In the event that plagiarism is detected in the report at any stage of the project's completion, I am fully aware and prepared to accept disciplinary measures imposed by the relevant authority.

I understand that all recommendations made in this project report are within the context of the academic project taken up towards course fulfillment in the BS Degree Program offered by IIT Madras. The institution does not endorse any of the claims or comments.

Signature of Candidate: Milan Kumar Chandra

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Date: 06-07-2024

1. Executive Summary

Yulu Bike Rentals, founded in 2017 and headquartered in Bengaluru, India, is a pioneering shared low-speed electric two-wheeler service operating across major Indian cities, serving four million users with a fleet of 25,000 dockless EVs.

The company faces challenges in order to efficiently distribute its fleet of bikes to fulfil evolving demand from consumers at different times and locations. Yulu also has to identify and resolve issues that negatively impact the use of bike rentals, as these have resulted in a substantial decline in revenue in spite of its broad operations and expanding user base.

The project aims to utilize data analysis and machine learning approaches, the project seeks to optimize the distribution of Yulu's bike fleet and identify factors influencing the utilization of bike rentals. To create data-driven models and focused tactics, the method combines statistical analysis, time series analysis, machine learning, and data preparation using a combination of Python and Excel. Expected outcomes include an enhanced bike distribution strategy, identification of critical impact factors, and tactics that mitigate negative impacts, ultimately complementing customer satisfaction and boosting revenue.

2. Organization Background

Yulu Bike Rentals, founded in 2017 and headquartered in Bengaluru, India, is a pioneering company in the shared low-speed two-wheeler electric vehicle (EV) services sector. Serving four million users, it runs a fleet of 25,000 dockless shared electric vehicles in key cities like Bengaluru, Mumbai, Navi Mumbai, Delhi, Gurugram, and Kochi. By facilitating 10,000 daily travels and 280,000 last-mile deliveries, Yulu provides a sustainable alternative for urban mobility.

Yulu and Magna International collaborated to establish Yuma Energy in 2022, a battery-as-a-service (BaaS) initiative that facilitates effective battery replacements for Yulu users. Yulu recorded revenue of Rs 42.8 crore ($5.13 million) in FY2023 with strategic investments from Magna International, Bajaj Auto, and other investors. By FY-2026, the company hopes to go public through an IPO. Yulu, which is well-known for its inventive electric transportation solutions and job stability, attributes its success to wise investors and cooperative Indian regulators.

Website: www.yulu.bike

Proof of Originality: https://www.kaggle.com/datasets/devarajv88/yulu-datase

3. Problem Statement

1.1 **Problem statement 1:** Optimize Yulu's bike fleet distribution as efficiently as possible across various times and locations to accommodate customer demands.

1.2 **Problem statement 2:** Analyse and evaluate the factors that negatively impact Yulu's utilization of bike rentals, then develop targeted mitigation strategies for those factors.

4. Background of the Problem

While having a large user base and market presence, Yulu has experienced a significant drop in revenue recently. Several internal and external causes that are contributing to this drop have been recognized by the company. Internally, an imbalance between supply and demand caused by an inefficient fleet distribution has culminated in unavailability of bikes at critical times and locations, which has negatively impacted customer satisfaction and reduced recurring business.

External factors that negatively impact the use of shared electric cycles include heavy rainfall along with extreme temperature.Holidays, days off from work, and changing seasons all affect the demand for bike rentals, which Yulu has found challenging to foresee and which might result in shortage or surplus stock.

The primary causes of these problems are fluctuations in user behaviours based on by external factors like traffic and weather, as well as fluctuations in demand. All of these factors have not been properly taken into account by Yulu in their operational strategy. In order to solve these problems, Yulu has hired a consulting firm to investigate the factors affecting the Indian market's demand for shared electric bikes and develop targeted strategies for minimizing these factors, with the ultimate goal of maintaining and boosting revenue.

5. Problem Solving Approach

The project will make use of the dataset that Yulu has made available. This dataset includes statistics on 10,886 rows ranges of parameters related to their registered users, weather information, and count of total rental bikes. There is no need to manually acquire data or enter it into a spreadsheet because it has already been gathered and delivered.

We'll use a combination of Excel and Python to analyse Yulu's bike rental data, focusing on statistics and machine learning techniques.

1. Data Preparation and Exploration:
    - Excel:
        1. Organize and clean the raw data
        2. Create pivot tables to summarize bike usage by different factors
        3. Generate basic charts (bar charts, line graphs) for initial visualization
    - Python (pandas):
        1. Handle outliers and missing values
        2. Implement simple data modifications
2. Statistical Analysis:
    - Excel:
        - Calculate descriptive statistics (mean, median, standard deviation)
        - Use built-in statistical functions for correlation analysis
    - Python (pandas, SciPy):
        - Conduct more advanced statistical tests (t-tests, ANOVA)
        - Calculate correlations between variables
3. Time Series Analysis:
    - Excel:
        - Create time-based pivot tables and charts to visualize trends
    - Python (pandas, statsmodels):
        - Decompose time series into trend, seasonality, and residuals
        - Implement simple forecasting models (e.g., moving averages, exponential smoothing)
4. Machine Learning:
    - Python (scikit-learn):
        - Linear Regression: Predict bike demand based on various factors
        - Logistic Regression: Classify high vs. low demand periods
        - Decision Trees: Identify key factors influencing bike rentals
        - K-means Clustering: Group similar time periods or locations
5. Model Evaluation:
    - Python (scikit-learn):
        - Use train-test splits for model validation
        - Calculate basic evaluation metrics (e.g., MSE, R-squared, accuracy)
6. Visualization of Results:
    - Excel:

        - Create final summary tables and charts for reporting
    - Python (matplotlib, seaborn):
        - Generate more complex visualizations of model results and insights

Tools and Libraries:

Excel:

- Pivot tables and charts
- Basic statistical functions
- Data cleaning and initial exploration

Python:

- pandas: Data manipulation and analysis
- NumPy: Numerical computing
- SciPy: Scientific computing and statistical tests
- statsmodels: Time series analysis
- scikit-learn: Basic machine learning algorithms
- matplotlib and seaborn: Data visualization

Approach for Problem Statements:

1. Optimising the Distribution of the Bike Fleet:
    - Determine peak demand hours using time series analysis
    - Use linear regression to forecast demand considering the impact of various factors.
    - To group similar places or time periods by using K-means clustering
2. Identifying the Factors Influencing the Utilization of Rental Bikes
    - Perform correlation analysis to identify the key components
    - Use decision trees to show the importance of different factors.
    - Classify both high and low usage periods using logistic regression.

The primary focus of this condensed method is on machine learning models and statistical methods. For basic data management and visualization, it uses Excel; for more sophisticated analysis, it uses Python.

6. Expected Timeline

Work Breakdown Structure:

- **Collecting Data**: The first stage of the project involves gathering all the necessary information and data. It is crucial in establishing the basis for the whole project.
- **Preparing Proposal**: A project proposal is prepared using the data that was gathered. This explains the objectives, approaches, and the scope of the project.
- **Data Cleaning while waiting Proposal Approval**: To ensure the accuracy and accessibility of the gathered data, we start cleaning and organizing it while waiting for the proposal to be approved.
- **Finding Insights**: In this vital analytical stage, we look over the cleaned data to find relevant information that will direct the problem-solving process.
- **Finding Problem's Solution**: This phase focuses on developing and enhancing solutions to the problems that have been discovered using the information that was acquired.
- **Preparing Final Submission**: We gather all of the all findings, insights, and recommended solutions into a comprehensive as final submission.
- **Preparing Slides While waiting Final Approval**: we prepare presentation slides that briefly explain the project outcomes while the final submission is approved.
- **Final Approved:** This stage indicates the project's official approval .

- **Gantt chart**

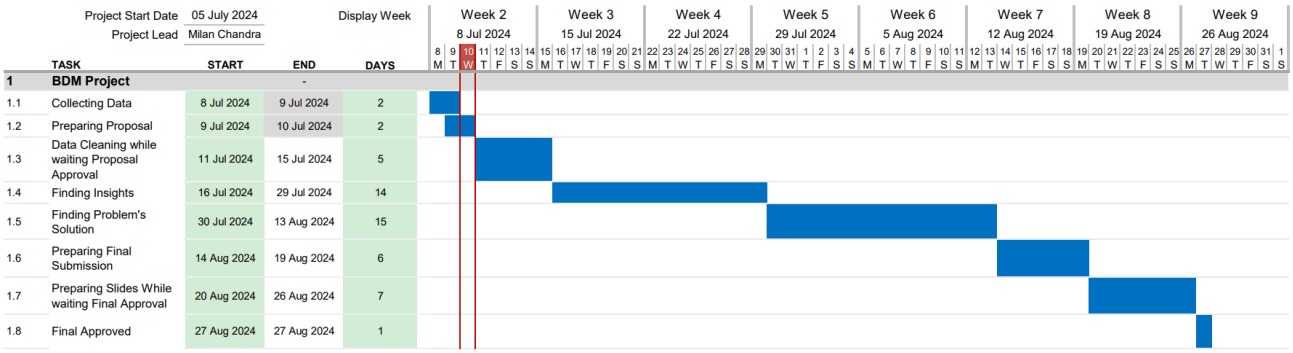

Figure 1 Expected timeline for completion of project.

7. Expected Outcome

1.1. **Optimal Bike Fleet Distribution:** Create a data-driven model to determine the most effective way to allocate all Yulu's fleet of bikes. In order to increase bike availability and match customer demand across various locations as well as times, this requires dynamic reallocation based on projected demand patterns.

1.2. **Identifying and Estimation of Utilization Impact Factors:** Analyse and measure the main factors that affect the use of bike rentals, including the season, day of the week, weather, and holidays. Using this information, Yulu is going to be able anticipate and lessen negative impacts on business operations.

1.3. **Strategies for Targeted Mitigation:** Provide focused approaches for addressing challenges that have a negative effect on bike utilization. These could include location-specific promotional campaigns, weather-based pricing adjustments, and discounts made during times of low usage. Yulu hopes to boost the customer experience, improve utilization during sluggish times, and possibly increase overall revenue through implementing these ideas into operation.