Taxi Payment Type Analysis

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1 Problem Statement

In the fiercely competitive taxi booking industry, the ability to maximize revenue remains a foundational pillar for both the sustainability of taxi services and the satisfaction of drivers. This report delves into an investigation of how payment methods—specifically card payments versus cash payments—affect fare pricing and overall revenue generation. Understanding this relationship is critical, as it offers insights into strategies that taxi drivers and companies can adopt to optimize earnings in an evolving market landscape.

2 Objective

The primary goal is to analyze the relationship between total fare amounts and the payment method used. Employing Python-based data analysis, statistical hypothesis testing, and effective data visualization techniques, this study focuses on determining whether trips paid via credit card consistently yield higher fares compared to those paid by cash. This insight aims to inform actionable recommendations for stakeholders in the taxi sector.

3 Methodology

The data source for this analysis is the New York City Yellow Taxi dataset from January 2020. After an initial acquisition, rigorous data cleaning steps were undertaken. This included removal of records with missing values, duplicates, and invalid or suspicious data entries to ensure integrity. The filtered dataset retained essential variables such as passenger count, trip distance, payment type, fare amount, and trip duration. These variables formed the foundation for exploratory analysis and subsequent hypothesis testing.

4 Exploratory Data Analysis

During the exploratory phase, only two payment types were considered: Credit Card (coded as 1) and Cash (coded as 2). To maintain data quality, trips reporting zero passengers or exhibiting negative values or extreme outliers were excluded. Analysis showed that trips paid by card displayed a modestly higher average fare and longer trip distances on average compared to cash-paid trips. These preliminary findings hinted at a potential correlation between payment method and fare amount.

Payment Type	**Mean Fare (USD)**	**Mean Trip Distance (miles)**
Credit Card	13.70	3.85
Cash	12.25	3.40

Furthermore, card payments accounted for approximately 68% of total transactions, indicating a dominant preference that may influence revenue dynamics.

5 Hypothesis Testing

To statistically verify the observed differences, the following hypothesis was formulated:

- H_0: There is no difference in average fare between card and cash payments.
- H_1: There is a significant difference in average fare between card and cash payments.

Using a two-sample t-test conducted on the cleaned dataset, the test results were as follows:

Statistic	Value
T-statistic	165.59
P-value	0.0

Given the p-value is effectively zero, we reject the null hypothesis with very high confidence, confirming that the difference in average fares between payment methods is statistically significant.

6 Business Insight

The significant disparity in average fare amounts between card and cash payments offers valuable business implications. By encouraging customers to favor credit card transactions, taxi drivers can potentially increase their per-trip revenue. This strategy aligns with broader trends towards cashless payments and can be integrated into driver incentives or promotional campaigns. Ultimately, leveraging such insights allows for data-driven decisions that enhance both driver earnings and customer convenience.

7 Tools Used

The data analysis leveraged a robust Python ecosystem including:

- **Pandas** for efficient data manipulation and cleaning.
- **Matplotlib** and **Seaborn** for insightful data visualization.
- **SciPy** and **Statsmodels** libraries for conducting rigorous statistical testing.

These tools collectively ensured the reliability and clarity of the analysis presented.

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Conclusion

This analysis conclusively demonstrates that payment type significantly impacts the fare amount in taxi trips, with card payments generating higher average revenues than cash. Such empirical evidence supports adopting strategies that promote credit card usage among passengers, thereby maximizing driver income and contributing to the sustainability of taxi services in a competitive environment.