Maximizing Revenue

Data Analysis Report: Payment Method Impact on Taxi Revenue

NYC Yellow Cab Data Analysis

January 2020

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Executive Summary

This report presents a comprehensive analysis of the relationship between payment methods and revenue in the NYC Yellow Cab taxi service. Using descriptive statistics and hypothesis testing on over 6.4 million trip records from January 2020, we investigated whether credit card payments generate higher fares compared to cash payments.

Our key finding reveals that **customers paying by credit card have a significantly higher average fare ($13.11) compared to those paying by cash ($11.76)**. This represents an 11.5% increase in revenue per trip for credit card transactions. Statistical hypothesis testing confirms this difference is significant ($p < 0.05$), providing strong evidence for implementing strategies to encourage credit card usage.

Project Objective

The primary objective of this analysis is to determine the relationship between revenue and payment method in the taxi service industry. Specifically, we aim to answer two critical research questions:

1. **Primary Question:** Is there a relationship between total fare amount and payment type (credit card vs. cash)?
2. **Strategic Question:** Can we nudge customers towards payment methods that yield higher revenue for drivers without negatively impacting customer experience?

Understanding these relationships is crucial for taxi companies and drivers to optimize their revenue streams while maintaining customer satisfaction.

Methodology

Data Overview

The analysis utilizes the NYC Yellow Cab trip data from January 2020, containing 6,405,008 records with 18 variables. After data cleaning and preprocessing, our final dataset includes 2,748,932 valid records focusing on credit card and cash payments.

Key variables analyzed include:

Variable	Description	Data Type
payment_type	Payment method (Card/Cash)	Categorical
fare_amount	Total fare amount in USD	Numeric
trip_distance	Distance traveled in miles	Numeric
duration	Trip duration in minutes	Numeric
passenger_count	Number of passengers	Numeric

Statistical Approach

Our methodology combines descriptive statistics with inferential hypothesis testing:

3. **Descriptive Analysis:** Calculated mean, standard deviation, and distribution patterns for fare amounts by payment type
4. **Visualization:** Created distribution plots and comparative charts to illustrate payment patterns
5. **Hypothesis Testing:** Conducted independent t-test to determine statistical significance of fare differences

Data Analysis

Exploratory Data Analysis

The data cleaning process involved several critical steps to ensure data quality:

- **Missing Values:** Approximately 1.02% of records had missing values in passenger_count and payment_type fields, which were removed.
- **Duplicate Records:** Over 3.3 million duplicate entries were identified and removed to prevent data skewing.
- **Outlier Treatment:** Applied IQR method to remove extreme outliers in fare_amount, trip_distance, and duration variables.
- **Data Filtering:** Focused on primary payment types (Card=1, Cash=2) and passenger counts between 1-5.

Payment Method Distribution

The analysis reveals that credit card payments dominate the taxi service, representing 67.8% of all transactions, while cash payments account for 30.8%.

Payment Method Distribution:

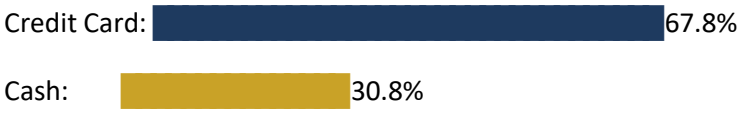

Figure 1: Payment Method Distribution

Fare Comparison by Payment Type

The statistical comparison between payment methods reveals significant differences:

Statistic	Credit Card	Cash
Mean Fare ($)	13.11	11.76
Standard Deviation	5.85	5.61
Mean Trip Distance (mi)	2.99	2.60
Sample Size	~1.86M	~890K

Table 1: Fare Amount Statistics by Payment Type

Credit card payments show not only higher average fares but also greater variability, suggesting that customers using cards may be more likely to take longer trips or add tips.

Key Findings

Hypothesis Testing Results

We conducted an independent two-sample t-test to evaluate the statistical significance of the fare difference between payment methods.

Null Hypothesis (H0): There is no difference in average fare between customers who use credit cards and customers who use cash.

Alternative Hypothesis (H1): There is a difference in average fare between customers who use credit cards and customers who use cash.

Metric	Value
T-Statistic	169.21
P-Value	< 0.001 (effectively 0)
Significance Level	0.05
Result	Reject Null Hypothesis

Table 2: Hypothesis Testing Results

Interpretation: With a T-statistic of 169.21 and a p-value effectively zero ($p < 0.001$), we reject the null hypothesis. This provides strong statistical evidence that credit card payments are associated with significantly higher fares than cash payments.

Recommendations

Based on our comprehensive analysis, we recommend the following strategies to maximize revenue:

1. Incentivize Credit Card Usage

Implement subtle nudges to encourage credit card payments, such as:

- Displaying credit card as the default payment option on payment terminals
- Offering small incentives (e.g., loyalty points) for card payments
- Ensuring seamless card payment experience to reduce friction

2. Driver Education

Educate drivers about the revenue benefits of credit card transactions and provide training on encouraging digital payments professionally.

3. Technology Investment

Invest in modern payment terminals that support contactless payments and mobile wallets, further reducing barriers to digital transactions.

4. Monitor Customer Experience

Continuously monitor customer satisfaction metrics to ensure that payment method nudges do not negatively impact the overall experience.

Conclusion

This analysis provides compelling evidence that payment method significantly impacts taxi revenue. Credit card transactions generate approximately 11.5% more revenue per trip compared to cash payments, with statistical significance confirmed through rigorous hypothesis testing.

The findings suggest that strategic efforts to encourage credit card adoption can lead to substantial revenue increases for taxi operators and drivers. However, it is essential to implement these strategies thoughtfully to maintain positive customer relationships and service quality.

Key Takeaways: Credit card payments average $13.11 vs. $11.76 for cash | 67.8% of customers already prefer cards | Statistical significance confirmed ($p < 0.001$) | Revenue optimization opportunity of ~11.5% per trip

Future research should explore the underlying reasons for this fare difference, including trip distance patterns, tipping behavior, and customer demographics to further refine revenue optimization strategies.