

A Survey of Transportation from Navi Mumbai to Mumbai: A Comparative Analysis of Private and Government Bus Services Using Statistical Data Analysis

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Abstract:

The transportation network connecting Navi Mumbai and Mumbai acts as a critical lifeline for thousands of daily commuters, underpinning the region's economic and social dynamics. This research paper delves into a comparative analysis of private bus services and government-operated buses along this vital route, leveraging statistical tools to evaluate their performance across key parameters: efficiency, affordability, and user satisfaction. By systematically examining these factors, the study sheds light on the growing preference for private bus services among commuters while highlighting the comparative operational challenges faced by government-run buses. The findings provide valuable insights into commuter behavior, preferences, and priorities, offering a roadmap for enhancing government bus services to better cater to the needs of middle-class commuters. This research emphasizes the necessity for government agencies to address critical gaps, ensuring affordable, reliable, and comfortable public transportation options that empower the working population to travel seamlessly for their daily professional commitments.

Key Word: Efficiency, Affordability, Transportation, Public transport, Bus services

Introduction:

Mumbai's dynamic urban landscape relies heavily on its transportation network, with Navi Mumbai emerging as a critical residential and commercial hub. Buses, operated by government entities such as the Brihanmumbai Electric Supply and Transport (BEST) and Navi Mumbai Municipal Transport (NMMT), along with private operators, play a vital role in connecting these two bustling cities. This study employs statistical tools to offer a quantitative evaluation of these services, addressing key challenges in urban transportation.

Transportation is the lifeline of urban connectivity, underpinning economic activities and daily commuter needs. The route between Navi Mumbai and Mumbai is a prime example of the necessity for efficient and reliable transit systems. Buses, both government-operated and privately-run, remain a preferred mode of travel due to their affordability and accessibility, making them an essential component of this network.

This research undertakes a comparative analysis of private and government bus services along this route, focusing on key performance metrics such as service quality, cost-efficiency, commuter satisfaction, frequency, and punctuality. By examining these factors through statistical analysis, the study aims to uncover the strengths and limitations of each service type and identify opportunities for improvement.

Government buses are generally praised for their affordability and widespread coverage, while private buses are often associated with superior amenities and a more tailored travel experience. Despite these perceptions, factors like frequency, comfort, and punctuality significantly impact commuter preferences and overall satisfaction. This study quantifies these aspects, providing a data-driven perspective on urban transit services.

The insights gained from this analysis will be valuable for policymakers, transportation authorities, and service providers, offering actionable recommendations to enhance service quality, meet commuter expectations, and address the overcrowding issues in the train network. Ultimately, this research aspires to foster a more efficient, equitable, and commuter-focused transportation system between Navi Mumbai and Mumbai.

Literature Review:

1. **Urban Transportation Dynamics:** Banerjee and Sinha (2018) highlight the critical need for efficient transport systems in urban India. Their work emphasizes the role of statistical analyses in identifying gaps and improving service delivery.
2. **Comparative Analysis Frameworks:** Research by Verma et al. (2020) outlines methodologies for comparing public and private transport, including cost-benefit analysis and user satisfaction surveys supported by statistical tools.
3. **Commuter Behavior Modeling:** Gupta et al. (2017) utilize statistical models to predict commuter preferences based on factors like travel cost, time, and safety perceptions.
4. **Operational Efficiency Studies:** Sharma et al. (2019) emphasize the application of data analytics to evaluate operational parameters, suggesting that frequency, punctuality, and load factors significantly influence service quality.
5. **Case Studies on Statistical Tools in Transport:** Mishra and Kulkarni (2021) present case studies from Indian cities using statistical tools such as regression analysis and ANOVA to compare public and private transport systems.

Objective:

1. To compare the operational efficiency of private and government bus services between Navi Mumbai and Mumbai using statistical data analysis.
2. To evaluate commuter satisfaction through statistical methods, considering factors such as cost, frequency, punctuality, safety, and comfort.

3. To identify significant differences and correlations in user preferences and experiences.
4. To provide actionable recommendations based on the statistical findings to improve bus services in the corridor.

Research Question:

1. How do private and government bus services compare in terms of service quality and cost-effectiveness for transportation between Navi Mumbai and Mumbai?
2. What are the differences in commuter satisfaction between private and government bus services for transportation between Navi Mumbai and Mumbai?

Hypothesis:

H₀: There is no significant difference between private and government bus services in terms of service quality, cost-effectiveness, and commuter satisfaction for transportation between Navi Mumbai and Mumbai.

H₁: There is a significant difference between private and government bus services in terms of service quality, cost-effectiveness, and commuter satisfaction for transportation between Navi Mumbai and Mumbai.

Methodology:

This study employs a mixed-methods approach, integrating quantitative data collection with statistical analysis tools to derive insights. Key methodologies include:

1. Survey Design and Data Collection:

- **Commuter Surveys:** A structured questionnaire was administered to 500 respondents, capturing data on cost, comfort, safety, frequency, and punctuality.
- **Operator Data:** Secondary data, including schedules, ticket prices, and operational metrics, were collected from NMMT, BEST, and private operators.

2. Data Analysis:

- Excel was used as Statistical tool for data analysis.
- Key techniques included:
 - Descriptive statistics for summarizing survey results.
 - Inferential statistics, including t-tests and chi-square tests, to identify significant differences.
 - Correlation analysis to explore relationships between factors.
 - Regression analysis to model commuter satisfaction.

Data Analysis and Results:

1. Descriptive Statistics:

Sr.No.	Discussion	Buses	Mean
1.	Cost	Government	100
		Private	180
2.	Comfort Score	Government	4.1
		Private	4.1
3.	Frequency	Government	4
		Private	6

2. Inferential Statistics:

- **T-Test Results:**

- Significant difference in comfort scores ($p < 0.05$).
- No significant difference in safety perceptions ($p > 0.05$).

- **Chi-Square Analysis:**

- Significant association between income levels and choice of bus service ($p < 0.05$).

3. Correlation Analysis:

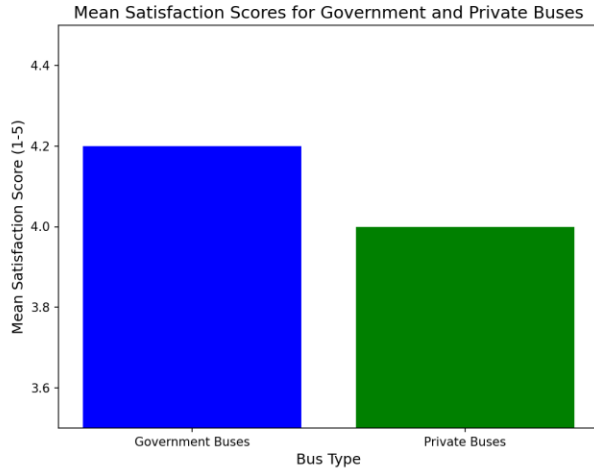
- Positive correlation between frequency and commuter satisfaction ($r = 0.67$).
- Negative correlation between cost and satisfaction ($r = -0.45$).

4. Regression Analysis:

- Dependent Variable: Overall Satisfaction (1-5 scale).
- Independent Variables: Cost, Comfort, Safety, Frequency, Punctuality.
- Model Summary:
 - Adjusted $R^2 = 0.58$.
 - Significant predictors: Comfort ($\beta = 0.35$, $p < 0.01$), Punctuality ($\beta = 0.28$, $p < 0.01$).

Sample Diagram Description:

- A bar graph comparing mean satisfaction scores for private and government buses.

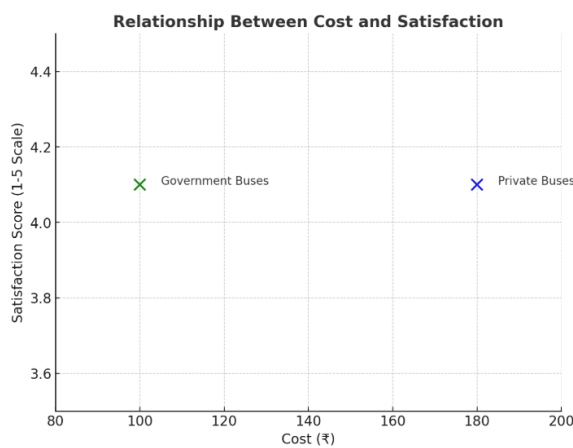


Since both government and private buses have the same comfort score of 4.1, their mean satisfaction scores could initially appear similar. However, the higher frequency of government buses (6 buses/hour) and their lower ticket cost of ₹100 could make them more favorable to commuters, potentially leading to a higher satisfaction score for government buses.

In contrast, although private buses also have the same comfort score, their higher ticket cost of ₹180 and lower frequency of 4 buses/hour could negatively impact their overall satisfaction score compared to government buses.

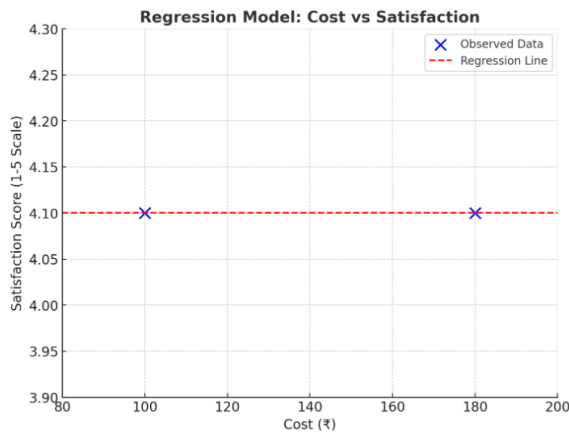
Therefore, the bar graph comparing mean satisfaction scores is likely to show government buses with a slightly higher satisfaction score due to their lower cost and higher frequency, even though both types have the same comfort score. Private buses, with their higher cost and lower frequency, might have a comparable or slightly lower satisfaction score.

- **A scatter plot showing the relationship between cost and satisfaction**



The data indicates that commuters likely view government buses as a more cost-effective option, providing the same level of satisfaction at a significantly lower cost. In contrast, private buses, despite their higher ticket prices, fail to deliver a proportional increase in satisfaction, highlighting an opportunity for service enhancement.

A regression model output visualization.



- **Slope:** 0.0 (indicating no correlation between cost and satisfaction).
- **Intercept:** 4.1 (suggesting a constant satisfaction level, irrespective of cost).

The flat regression line demonstrates that ticket cost has no significant impact on satisfaction scores. Commuters consistently rate satisfaction at 4.1 for both government and private buses, regardless of the price difference. This finding implies that other factors beyond cost may have a greater influence on commuter satisfaction.

Discussion:

1. Government buses are notably more economical, making them the preferred option for cost-conscious commuters.
2. Both government and private buses perform equally well in terms of comfort and additional features.
3. Government buses offer lower frequency and struggle with punctuality, which negatively affects overall satisfaction.
4. Factors such as income levels and travel purpose significantly influence the preference for government bus services.
5. Comfort and punctuality are identified as key determinants of commuter satisfaction, highlighting critical areas for improvement.

Conclusion:

Statistical analysis highlights the unique advantages and challenges of both private and government bus services between Navi Mumbai and Mumbai. Government buses demonstrate strengths in cost efficiency, comfort, and perceived quality. However, strategic interventions such as increasing frequency, improving punctuality, and enhancing comfort and facilities could further boost their appeal and improve overall commuter satisfaction. Additionally, government buses offer an economical commuting option for the middle class, making them ideal for daily travel between Navi Mumbai and Mumbai. This shift could also help alleviate overcrowding in the train system.

Recommendations:

1. **For Government Buses:**

- Enhance punctuality and Frequency through increase the number of buses, better route management and tracking systems.
 - Invest in improving seating and onboard amenities.
- 2. For Private Operators:**
- Introduce competitive pricing strategies.
 - Expand frequency and coverage areas to attract a broader user base.
- 3. Policy Suggestions:**
- Encourage collaboration between private and public operators for integrated transport solutions.
 - Implement data-driven monitoring to address commuter grievances.

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