



Mode Choice Analysis between Executive Rail and Sleeper Bus on the Surabaya – Jakarta Corridor Using Binary Logit Regression

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Abstract

Surabaya and Jakarta are two major cities in Indonesia that serve as national centers of business, economic activity, and government administration, resulting in high intercity mobility between them. The operation of the Trans-Java Toll Road has accelerated the growth of sleeper bus services, while executive rail remains a preferred mode due to its stable comfort and reliability. This study aims to identify passenger characteristics, analyze the probability of mode choice based on factors such as fare affordability, travel time, comfort, calmness, and safety, and propose service improvements for both modes. A revealed preference survey was conducted with two hundred respondents who had already selected either executive rail or sleeper bus for their Surabaya–Jakarta trip. The data were analyzed using binary logistic regression to model the probability of choosing each mode. The results show that most passengers belong to the choice-user category at 65.5 percent and are predominantly private-sector employees at 52.5 percent. The key determinant for selecting executive rail is the importance placed on calmness and comfort, yielding a predicted probability of 78.52 percent. In contrast, the dominant factor influencing sleeper bus selection is safety consideration, with a predicted probability of 96.52 percent. These findings indicate that executive rail attracts passengers seeking a quiet and comfortable travel environment, while sleeper buses appeal to travelers prioritizing safety and time efficiency supported by toll-road connectivity. The study concludes that service improvements should focus on enhancing comfort and safety to strengthen the attractiveness of both premium land transport modes along the Surabaya–Jakarta corridor.

Introduction

The Surabaya–Jakarta corridor constitutes one of the most critical intercity travel routes in Indonesia, reflecting the economic, administrative, and industrial prominence of both metropolitan areas (Hudalah et al., 2024; Hidayati et al., 2019). Surabaya functions as the capital of East Java Province and a major industrial center, while Jakarta serves as the national capital and the focal point of governmental and corporate activities.

Intensive economic interaction, business mobility, and population movement between these cities have generated persistently high travel demand across multiple transport modes,

consistent with the fundamental role of transport systems in supporting economic activity and spatial interaction.

According to Suraji et al. (2025) and Irawan et al. (2020) Over the past decade, the expansion of long-distance land transport infrastructure, most notably the completion of the Trans-Java Toll Road, has substantially altered the competitive dynamics of intercity mobility. This infrastructure development has significantly reduced travel times for road-based transport, enabling bus operators to introduce premium services, including sleeper buses, that increasingly compete with established rail services in terms of travel time, comfort, and pricing. Such shifts are consistent with the modal performance characteristics identified by Retno (2024) and Permadi et al. (2024) who emphasize speed, reliability, and service availability as key determinants of user preferences.



Figure 1. Map of the Planned Trans-Java Toll Road Network

The emergence of sleeper buses represents a structural transformation in Indonesia's intercity passenger transport market. Historically, executive-class rail services dominated the premium land-transport segment due to their reliability, comfort, and well-developed station infrastructure, in line with the modal classifications described by Puspitasari et al. (2024) and Setyoningrum (2020). Since the introduction of sleeper bus services around 2020, however, demand for this mode has increased rapidly, supported by advances in vehicle design, enhanced onboard amenities, and operational efficiency enabled by toll-road connectivity.

The expansion of sleeper-bus fleets by major operators indicates strong market acceptance and suggests a reconfiguration of passenger preferences. Consequently, executive rail and sleeper bus services now operate within comparable fare ranges and target similar market segments, creating a distinctive competitive environment among premium land-based modes. Despite the growing relevance of this competition, empirical research explicitly examining passenger mode choice between executive rail and sleeper bus services remains limited (Fearnley et al., 2018; Blainey et al., 2012; Knorr & Eisenkopf, 2022; Dobruszkes et al., 2022).

Existing studies on intercity travel behavior in Indonesia and comparable contexts have predominantly focused on competition between buses and private vehicles, buses and app-based ride services, or rail and air transport. Empirical analyses addressing competition between premium land-based modes serving similar passenger segments are scarce (Nkiriki et al., 2022). Given the rapid expansion of sleeper bus services and their increasing role in intercity mobility, updated and context-specific behavioral evidence is required.

Without such evidence, transport operators may struggle to optimize service attributes, and policymakers may lack robust empirical foundations for intercity transport planning and regulation. The broader mode-choice literature identifies travel time, cost, accessibility, and

reliability as fundamental determinants of passenger decisions (Ranjan & Sinha, 2025; Göransson & Andersson, 2023; Tam et al., 2011; Witchayaphong et al., 2020; Javaid et al., 2020). More recent studies have expanded this framework by incorporating service-quality attributes such as comfort, safety, calmness, and convenience, alongside socio-demographic characteristics including income, occupation, and travel purpose (Shiwakoti et al., 2022; Banki et al., 2018; Ojekalu et al., 2019).

Discrete choice models, particularly binary logistic regression, have been widely employed to quantify the probability of selecting one mode over another, consistent with utility-maximization principles (Srinivasan et al., 2009). Evidence from revealed preference (RP) and stated preference (SP) studies suggests that premium transport modes are often chosen based on perceived comfort, safety, and service reliability rather than solely on economic considerations. Nevertheless, mode-choice behavior remains highly context-specific, shaped by local infrastructure conditions, service availability, and cultural factors, as emphasized in system-behavior perspectives (Creutzig et al., 2024; Holman et al., 2021).

This reinforces the need for corridor-specific empirical investigation, particularly for newly emerging premium modes such as sleeper buses. To address this research gap, the present study adopts a behavioral modeling approach grounded in revealed preference data. A passenger survey is conducted among executive-rail users at Surabaya Gubeng Station and sleeper-bus users at designated departure pools, ensuring that observed choices reflect actual travel behavior rather than hypothetical preferences. The survey captures socio-demographic characteristics, trip attributes, and perceptions of key service-quality factors, including comfort, safety, fare affordability, and travel time (Yang et al., 2023; Ranjan & Sinha, 2025; Sen & Roy, 2025; Majumdar et al., 2021).

The collected data are subsequently analyzed using a binary logistic regression model to estimate the probability of choosing executive rail or sleeper bus. This analytical framework enables the identification of statistically significant determinants and facilitates interpretation of their relative influence on mode choice, consistent with established methodological approaches (Galdames et al., 2011; Majumdar et al., 2015; Calastri et al., 2019; Ramezani et al., 2018; Cullinane & Toy, 2000). The objectives of this study are threefold. First, it aims to identify and compare the socio-demographic and trip characteristics of passengers using executive rail and sleeper bus services on the Surabaya–Jakarta corridor.

Second, it seeks to quantify the probability of choosing each mode using binary logistic regression analysis. Third, the study evaluates the relative importance of service attributes, particularly comfort, calmness, safety, fare affordability, and travel time, in shaping passenger preferences. Collectively, these objectives contribute to a deeper understanding of premium intercity transport behavior in Indonesia and provide evidence-based insights for transport operators and policymakers. Based on theoretical foundations and prior empirical findings, the following hypotheses are formulated:

H1: Socio-demographic characteristics, including income, occupation, and age, significantly influence the choice between executive rail and sleeper bus.

H2: Trip-related factors, such as travel purpose and origin location, have a significant effect on intercity mode choice.

H3: Perceived service attributes, including comfort, calmness, safety, and fare affordability, significantly influence passenger mode choice.

H4: Passengers who assign higher importance to comfort and calmness are more likely to choose executive rail.

H5: Passengers who assign higher importance to safety considerations are more likely to choose sleeper bus.

Methods

Research Design and Approach

This study adopts a quantitative research design based on a revealed preference (RP) framework to examine intercity passenger mode choice between executive rail and sleeper bus services on the Surabaya–Jakarta corridor. The RP approach is employed to capture travelers' actual behavior under real market conditions, thereby ensuring strong external validity and avoiding hypothetical bias commonly associated with stated preference methods as emphasized by Ortúzar & Rizzi, (2007). This approach is particularly suitable for analyzing competition between existing transport modes whose service characteristics, fares, and travel times are directly experienced by users (Redman et al., 2013; Gimeno & Vila, 2007). A cross-sectional survey design is applied, collecting observations from passengers who had already completed their mode choice decision. The analytical framework combines descriptive statistical analysis with inferential econometric modeling, with binary logistic regression used to quantify the influence of socio-demographic, trip-related, and service-attribute variables on mode choice (Youssef et al., 2021).

Study Area and Competing Modes

The empirical analysis focuses on the Surabaya–Jakarta corridor, one of Indonesia's most important and heavily trafficked intercity routes, characterized by high travel demand and intense competition among transport modes. The characteristics of this corridor align with the transport system classifications described by Soni who highlight the importance of infrastructure, accessibility, and service quality in shaping travel behavior (Soni et al., 2024; Furindiani & Sulistyanningrum, 2026). Two competing modes are examined: (1) Executive Rail, operating between Surabaya Gubeng Station and major railway terminals in Jakarta, offering premium seating, air-conditioning, high reliability, and relatively stable travel times. These characteristics reflect the modal attributes described by Djoko Setijowarno and Frazila, particularly regarding comfort, dependability, and service availability; (2) Sleeper Bus, operating from multiple bus pools in Surabaya to Jakarta via the Trans-Java Toll Road, providing fully reclining sleeper seats, onboard entertainment, and enhanced comfort features. The competitiveness of road-based modes in long-distance travel is consistent with the modal performance factors discussed by Morlok and Bowersox.

Data Collection

Primary data were collected through on-site passenger surveys conducted at Surabaya Gubeng Station for executive-rail users and at designated sleeper-bus departure pools for bus users. Data collection employed a combination of face-to-face interviews and self-administered questionnaires to ensure respondent comprehension and data accuracy. Surveys were conducted over multiple days to capture variation in travel purpose and passenger characteristics. All completed questionnaires were screened to ensure completeness and internal consistency prior to analysis. The questionnaire consisted of four sections: (1) Socio-demographic characteristics (age, gender, occupation, income level, and vehicle ownership); (2) Trip characteristics (origin location, destination, travel purpose, and travel frequency); (3) Perceived service attributes (fare affordability, travel time, comfort, calmness, and safety); (4) Observed mode choice for the Surabaya–Jakarta trip.

Sampling Strategy

A total of 200 valid observations were obtained. The sample size satisfies commonly accepted requirements for binary logistic regression modeling, which recommend a minimum of 10–20 observations per explanatory variable to ensure stable parameter estimation and avoid overfitting (Pate et al., 2023; Dey et al., 2025; Dhiman et al., 2023; Bujang et al., 2018). Respondents were selected using convenience sampling at departure locations, subject to the criterion that they were undertaking a Surabaya–Jakarta trip on the survey day. The distribution of respondents across modes reflects observed usage patterns during the survey period, ensuring realistic representation of market conditions.

Variable Specification

The dependent variable is mode choice, defined as a binary outcome:

1 = Executive rail

0 = Sleeper bus

Explanatory variables include socio-demographic factors, trip characteristics, and perceived service attributes. Categorical variables were converted into dummy variables prior to estimation. Key independent variables include income level, occupation, origin location, travel purpose, perceived fare affordability, perceived comfort and calmness, perceived safety, and travel time to destination. Variable selection is grounded in transport mode-choice theory and supported by findings from previous empirical studies Fan & Chen (2020) and supported by findings from previous empirical studies, including Jotin and Lall.

Model Estimation and Evaluation

Binary logistic regression is used to model the probability of choosing executive rail relative to sleeper bus. The model is specified as:

$$\ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k$$

where (P) denotes the probability of choosing executive rail and (X1, X2, ..., Xk) represent the explanatory variables.

Model parameters are estimated using maximum likelihood estimation (MLE), consistent with the recommendations of Ortúzar and Willumsen. Statistical significance of individual coefficients is assessed using Wald tests. Overall model performance is evaluated using the Omnibus Test of Model Coefficients, the Hosmer–Lemeshow goodness-of-fit test, and pseudo-R² measures (Cox–Snell and Nagelkerke). Predictive performance is further assessed through classification accuracy, following the evaluation framework described by Steyerberg et al. (2010).

Results and Discussion

Descriptive Analysis

Respondent Characteristics

A total of 200 valid responses were obtained from passengers who had already selected either executive rail or sleeper bus for their Surabaya–Jakarta trip. Descriptive analysis indicates that 65.5% of respondents fall into the *paksawan* (choice user) category, implying that the majority of travelers possess sufficient financial capacity and access to alternative transport modes. This characteristic is consistent with the premium positioning of both executive rail and sleeper bus services.

In terms of occupation, private-sector employees constitute the largest group (52.5%), reflecting the strong business-related travel demand along the corridor. The age distribution is dominated by individuals of productive working age. Income levels vary across respondents but are generally higher among executive-rail users, suggesting that affordability and income stability play an important role in shaping mode choice. This pattern is consistent with classical transport-demand theory, which associates higher income levels with reduced fare sensitivity and greater preference for premium services.

Trip Characteristics

Most respondents reported traveling for work or business purposes, followed by personal or family-related trips. Spatial analysis of trip origins and destinations reveals a concentration in major urban districts of Surabaya and Jakarta, indicating high accessibility to Surabaya Gubeng Station and sleeper-bus departure pools such as Sinar Jaya Medaeng. These findings emphasize the role of terminal accessibility and proximity in intercity mode selection.

Mode Choice Distribution

The distribution of observed mode choice demonstrates that both executive rail and sleeper bus attract substantial demand. Executive rail is predominantly chosen by passengers prioritizing comfort, calmness, and reliability, whereas sleeper bus services appeal to travelers emphasizing safety perceptions, fare affordability, and flexible departure locations. This suggests that while the two modes compete within the same premium segment, they occupy partially differentiated market niches based on distinct service attributes.

Binary Logistic Regression Results

Binary logistic regression was employed to identify statistically significant determinants of intercity mode choice. Model estimation followed standard procedures, including the Omnibus Test of Model Coefficients, the Hosmer–Lemeshow goodness-of-fit test, and Wald statistics for individual parameters. Overall results indicate satisfactory model fit and explanatory power.

Executive Rail Choice Model

The regression results show that the probability of choosing executive rail is significantly influenced by:

X7: Monthly income

X10: Origin location

X12: Travel purpose

X21: Fare affordability

X24: Calmness and comfort

Among these variables, X24 (calmness and comfort) emerges as the most influential determinant. Table 1 presents the predicted probabilities for each response category. Passengers who assign the highest importance to calmness and comfort exhibit a 78.52% probability of choosing executive rail.

Table 1. Recapitulation of Logit and Probability Calculations Consideration of Calmness and Comfort

Variable	X		Constant	B	Y = Logit(P)	P	P%
	Definitely choose sleeper bus	1	-1.159	0.491	-0.668	0.338944819	33.89%

Consideration of Calmness and Comfort	Maybe choose sleeper bus	2			-0.177	0.455865165	45.59%
	Balanced choice	3			0.314	0.577861314	57.79%
	Definitely choose exclusive train	4			0.805	0.691043012	69.10%
	Maybe choose exclusive train	5			1.296	0.78516102	78.52%

Source: Author's calculation, 2026

Monthly income (X7) also shows a significant effect, supporting the hypothesis that higher-income individuals are more likely to select premium rail services due to lower fare sensitivity. Travel purpose (X12) further influences executive rail selection, with business travelers demonstrating a higher likelihood of choosing rail services, reflecting the importance of punctuality and reliability in business travel.

Sleeper Bus Choice Model

For sleeper bus users, the regression results indicate that the following variables significantly affect mode choice:

X14: Reason for using sleeper bus

X19: Travel time to destination

X25: Safety consideration

Among these, X25 (safety consideration) is the most influential variable. Table 2 presents the predicted probabilities for each response category. Passengers who perceive sleeper buses as highly safe exhibit a 96.52% probability of choosing this mode.

Table 2. Recapitulation of Logit and Probability Calculations Consideration of Safety

Variable	X		Constant	B	Y = Logit(P)	P	P%
Consideration of Safety	Definitely choose sleeper bus	1	4,149	-0,825	3,324	0,9652430372	96,52%
	Maybe choose sleeper bus	2			2,499	0,9240716865	92,41%
	Balanced choice	3			1,674	0,8421083966	84,21%
	Definitely choose exclusive train	4			0,849	0,7003573276	70,04%
	Maybe choose exclusive train	5			0,024	0,505999712	50,60%

Source: Author's calculation, 2026

This finding challenges the conventional assumption that rail modes are universally perceived as safer than road-based transport. Modern sleeper buses are equipped with enhanced safety features such as enclosed sleeper pods, CCTV surveillance, and regulated passenger movement, which may strengthen safety perceptions. The significance of travel time (X19) reflects the role of the Trans-Java Toll Road in improving bus travel efficiency. Reduced travel time has increased the competitiveness of sleeper buses relative to rail, and the variable X14 (reason for using sleeper bus) captures motivations such as departure-point proximity, flexible schedules, and the comfort of sleeper seating.

Conclusion

This study examined passenger mode choice between executive rail and sleeper bus services on the Surabaya Jakarta corridor using revealed preference data and binary logistic regression, and the results show that mode selection is significantly influenced by a combination of socio-

demographic characteristics, trip attributes, and perceived service quality. Income, origin location, travel purpose, fare affordability, comfort and calmness, reasons for using sleeper buses, travel time, and safety considerations were all found to be statistically significant determinants of passenger choice. Passengers who prioritize calmness and comfort have a high probability of choosing executive rail, indicating that comfort-oriented utility is the dominant factor for this mode, whereas passengers who place greater emphasis on safety are far more likely to choose sleeper buses, reflecting the growing perception of these services as safe, modern, and competitive alternatives supported by improved facilities and reduced travel times along the Trans-Java Toll Road. Overall, the findings confirm that socio-demographic factors, trip characteristics, and service attributes jointly shape passenger decision-making, validate all proposed hypotheses, and provide a comprehensive understanding of competitive dynamics between premium land-transport modes operating within the same corridor.

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