



Modeling public transport mode choice using stated preference: A comparative analysis of rail, bus, and shuttle services

Amelia Oktavia*

Universitas Malahayati, INDONESIA

Mira Wisman

Politeknik Negeri Lampung, INDONESIA

Article Info

Article history:

Received: Feb 27, 2026

Revised: August 30, 2026

Accepted: Sept 25, 2026

Keywords:

Intercity Transportation;
Mode Choice;
Multinomial Logit Model;
Public Transportation;
Stated Preference.

Abstract

Background: Growing intercity mobility increases the need for public transport services that respond effectively to travelers' preferences and service expectations. Understanding how passengers evaluate competing transport alternatives is therefore essential for improving mobility planning and service provision.

Aims: This study aimed to model public transport mode choice on the Kotabumi-Bandar Lampung corridor by examining passenger characteristics, identifying influential service attributes, and estimating choice probabilities for rail, bus, and shuttle services.

Method: A quantitative stated preference approach was employed with 384 respondents, comprising 234 offline and 150 online participants. Data were analyzed using validity and reliability tests, multiple linear regression, utility estimation, multinomial logit modeling, and Pearson correlation.

Results: Comfort was the leading consideration for rail users (27%), while fare was most prominent for bus (33%) and shuttle users (26%). The combined choice probabilities were 48.65% for rail, 25.86% for bus, and 25.49% for shuttle, indicating a clear preference for rail.

Conclusion: Rail emerged as the most preferred public transport alternative, while differences in mode-specific considerations highlight the importance of incorporating passenger preferences into intercity transport planning and service improvement.

To cite this article: Oktavia, A. & Wisman, M. (2026). Modeling public transport mode choice using stated preference: A comparative analysis of rail, bus, and shuttle services. *Journal of Advanced Sciences and Mathematics Education*, 6(3), 864-886.

INTRODUCTION

Bandar Lampung is a metropolitan city covering an area of approximately 197.22 km² and serves as one of the major centers of population movement in Lampung Province (Putra et al., 2022; Rahma et al., 2024). Its geographical characteristics, which include coastal and hilly areas, are accompanied by the concentration of educational facilities, government institutions, commercial activities, and various public services. These characteristics make the city an important destination for people traveling for education, employment, recreation, business, and other social and economic purposes. Passenger movements originate not only from surrounding municipalities and regencies but also from areas beyond Lampung Province. As the provincial capital, Bandar Lampung performs a strategic administrative function that generates regular movements of people between the city and other parts of the province. The city also functions as an economic center through which commercial activities, goods, services, and employment opportunities are concentrated and subsequently connected with surrounding regions. Such functions generate considerable mobility because individuals must travel between their places of origin and Bandar Lampung to fulfill diverse personal, educational, occupational, and economic needs. Transportation systems therefore constitute an essential component of the interaction between Bandar Lampung and its surrounding regions. The availability of effective transportation enables these movements to occur while connecting

*Corresponding author:

Amelia Oktavia, Universitas Malahayati, Indonesia
ameliaoktavia@malahayati.ac.id ✉

passengers with the activities and destinations they seek to access. Consequently, the continuing development of Bandar Lampung as an administrative, educational, and economic center increases the importance of reliable intercity transportation services that can accommodate diverse patterns of passenger mobility.

Travelers heading to Bandar Lampung can select from different transportation modes according to their individual purposes, needs, preferences, and travel circumstances. The availability of multiple alternatives provides passengers with flexibility in determining which mode offers the most appropriate combination of service characteristics for a particular journey (Leffler et al., 2024; Narayan et al., 2020; Zhou et al., 2025). Private vehicles may offer greater personal flexibility, but vehicle ownership does not necessarily imply that travelers consistently prefer to use them for every trip. For relatively long journeys, some travelers may choose public transportation because they consider it more appropriate in terms of cost, convenience, physical effort, or other travel considerations (Bösehans & Walker, 2020; Esztergár-Kiss et al., 2021; Thombre & Agarwal, 2021). Public transportation consequently represents an important alternative for connecting regional origins such as Kotabumi with Bandar Lampung. Along the Kotabumi–Bandar Lampung corridor, passengers can use rail, bus, and shuttle services, each of which provides distinct operational and service characteristics. The existence of these competing alternatives means that passengers must evaluate the relative advantages and disadvantages associated with each mode before making a travel decision. Increasing public transport use can also support more efficient collective mobility by reducing excessive dependence on individual vehicle movements. At the transportation-system level, greater utilization of public services has the potential to contribute to more efficient road use and to reduce pressures associated with congestion and vehicle-related emissions (Agaton et al., 2020; Benmessaoud et al., 2023; Mohammadi et al., 2024; rasheed, 2023). Understanding why passengers prefer one public transportation mode over another is therefore essential for developing services that are more responsive to the characteristics and expectations of intercity travelers.

The demand for public transportation is expected to become increasingly important as travel activities and regional mobility continue to develop. This condition requires public transport operators to continuously improve their services rather than relying solely on the basic function of transporting passengers between origins and destinations (Ceder, 2021; Ge et al., 2022; Merkert et al., 2020; Wong et al., 2020). Each transportation mode has particular strengths and limitations that influence its attractiveness from the passenger perspective. Rail, bus, and shuttle services may differ in terms of fare, waiting time, service availability, service frequency, travel time, departure punctuality, and arrival punctuality. Passengers may additionally consider comfort, safety, and overall service quality when determining which mode is most appropriate for their journey. These attributes indicate that transportation choice is a multidimensional decision in which passengers evaluate several aspects of a service simultaneously. The importance assigned to individual attributes may also differ among passengers because their socioeconomic characteristics, travel purposes, and mobility requirements are not homogeneous (Dixit & Sivakumar, 2020; Gadepalli et al., 2020; Mahani et al., 2026; Yousefzadeh Barri et al., 2025). Consequently, merely identifying the number of passengers using each transportation mode provides insufficient information for explaining the underlying structure of their preferences. A stated preference approach provides an analytical basis for examining passenger evaluations and translating differences in transportation attributes into measurable information concerning the relative attractiveness of competing alternatives. Modeling the comparative choice of rail, bus, and shuttle services can therefore provide a more systematic understanding of passenger preferences and support evidence-based improvements in intercity public transportation.

Existing research demonstrates that travel mode choice is influenced by a complex interaction of service attributes, socioeconomic characteristics, accessibility, attitudes, satisfaction,

and changing mobility conditions, with previous studies examining public–private modal shifts, public transport attractiveness, Mobility-as-a-Service, and broader travel behavior (Das et al., 2021; De Vos et al., 2022; Göransson & Andersson, 2023). Methodologically, mode-choice research has also progressed from conventional discrete-choice approaches toward mixed logit, machine-learning, and nonlinear predictive models, reflecting increasing efforts to capture heterogeneity and complex relationships in travelers' decisions (Jang et al., 2021; Li et al., 2024; Zhao et al., 2020). Studies focusing on intercity mobility have further investigated multimodal passenger choices, mobility networks, and sustainable transport services by considering attributes such as travel time, waiting time, ticket price, comfort, reliability, and safety (Feng et al., 2022; Xu et al., 2021; Yu et al., 2024). Nevertheless, the literature represented by these studies has predominantly concentrated on urban travel, shifts between public and private transportation, emerging mobility services, broad multimodal networks, or advanced predictive techniques, while comparatively limited attention has been directed toward the direct competition among conventional rail, bus, and shuttle services operating within the same regional intercity corridor, particularly in developing-country contexts. Furthermore, although service attributes have been widely recognized as determinants of travel decisions, evidence remains limited regarding how these attributes translate into mode-specific utilities and comparative choice probabilities when passengers simultaneously evaluate three conventional intercity public transport alternatives. This gap is particularly relevant because passengers may assign different importance to fare, waiting time, service availability, frequency, travel time, and schedule reliability across competing modes. Therefore, the present study extends existing mode-choice research by applying a stated preference approach to comparatively model rail, bus, and shuttle services on the Kotabumi–Bandar Lampung corridor, integrating passenger characteristics and service attributes with utility and choice-probability estimation to provide context-specific evidence for intercity public transport planning in Indonesia.

Accordingly, this study aims to model public transport mode choice on the Kotabumi–Bandar Lampung intercity corridor using a stated preference approach through a comparative examination of rail, bus, and shuttle services. The study initially identifies the demographic and travel characteristics of passengers using the three public transportation alternatives. It subsequently examines the considerations underlying passengers' preferences for each mode within the investigated corridor. Particular attention is given to differences in fare, waiting time, service availability, service frequency, travel time, departure punctuality, and arrival punctuality as attributes relevant to transportation choice. The analysis also considers broader passenger evaluations associated with comfort, safety, and service provision to provide a more comprehensive interpretation of mode preferences. These preference data are used to estimate the utility associated with the competing transportation alternatives within the analytical framework adopted in the study. The resulting utility values provide a quantitative basis for evaluating the relative attractiveness of rail, bus, and shuttle services. The study further estimates the probability of selecting each alternative to determine how passenger preferences are distributed among the three competing modes. Through this comparative approach, the research seeks to connect passenger characteristics and service considerations with quantitative estimates of intercity public transportation choice. Ultimately, the findings are expected to provide an empirical basis for passenger-responsive service improvement and transportation planning along the Kotabumi–Bandar Lampung corridor.

LITERATURE REVIEW

Public transport mode choice represents a behavioral decision in which travelers select an alternative from several available transportation services according to their individual needs and the

characteristics of each mode. In intercity travel, this decision becomes particularly important because passengers may face alternatives that differ considerably in cost, travel time, accessibility, service frequency, and operational flexibility (Guo & Yang, 2026; Huan et al., 2026; Li et al., 2021). Rail, bus, and shuttle services represent distinct forms of collective transportation, although they may compete for passengers traveling between the same origin and destination. Rail transportation generally operates according to fixed routes and schedules, whereas bus and shuttle services may provide different levels of departure frequency and operational flexibility. The characteristics of these services create trade-offs that passengers must consider when determining the most suitable alternative for their journeys (Bickel et al., 2026; Leffler et al., 2024; Pereira et al., 2024). Mode choice can therefore be understood as the outcome of passengers' comparative evaluation of the advantages and disadvantages associated with the available alternatives. This perspective implies that the attractiveness of a transportation mode cannot be assessed solely from its physical availability or passenger volume. Instead, understanding mode choice requires consideration of how travelers perceive and evaluate the attributes attached to each alternative. A comparative examination of rail, bus, and shuttle services is particularly relevant when these modes operate within a common intercity travel market. Accordingly, public transport mode-choice analysis provides a conceptual foundation for explaining how different service configurations contribute to passengers' transportation decisions.

Passenger characteristics constitute another important dimension in understanding public transportation preferences because individuals with different socioeconomic and travel profiles may evaluate the same transportation service differently. Demographic characteristics such as age and gender can provide contextual information regarding the composition of travelers using particular modes. Socioeconomic characteristics, including occupation, educational background, and income, may further distinguish passengers according to their resources and everyday mobility requirements (Gadepalli et al., 2020; Hidayati et al., 2021; Hunecke et al., 2020; Minhans, 2020; Silver et al., 2023). Travel-related characteristics such as destination and trip purpose also contribute to understanding why individuals undertake intercity journeys and what they may expect from transportation services. For example, passengers traveling for education, employment, recreation, family activities, or business may encounter different constraints regarding schedules, expenditure, and travel duration. These variations indicate that passengers should not be treated as a homogeneous population with identical transportation priorities. Within the Kotabumi–Bandar Lampung context, the analysis of mode choice therefore incorporates demographic and travel characteristics alongside passengers' evaluations of transportation services. Such information enables observed preferences to be interpreted within the broader characteristics of the passenger population rather than exclusively through operational attributes. Nevertheless, passenger characteristics alone do not determine transportation choices because travelers also respond to the performance and perceived benefits of competing services. Integrating passenger profiles with transportation attributes consequently provides a more comprehensive framework for interpreting differences in the selection of rail, bus, and shuttle services.

Service attributes provide the operational dimension through which passengers can compare competing public transportation alternatives. In the analytical framework of the present study, these attributes include fare, waiting time, service availability, service frequency, travel time, departure punctuality, and arrival punctuality. Fare represents the monetary cost incurred by passengers and may become particularly relevant for travelers with limited transportation budgets. Waiting time concerns the period passengers spend before accessing a service, while service frequency determines how often transportation alternatives are available within a particular operating period. Service availability reflects the extent to which passengers can access an alternative when transportation is required. Travel time represents the duration necessary to complete a journey and

can affect the efficiency perceived by passengers when comparing modes (Cornet et al., 2022; Dällenbach, 2020; Malichová et al., 2022; Pourhashem et al., 2022, 2024). Departure and arrival punctuality provide additional indicators of service reliability because schedule deviations may influence passengers' ability to organize subsequent activities. Beyond these measurable attributes, comfort, safety, and service quality may also contribute to passengers' overall assessments of transportation alternatives. The importance of individual attributes may differ across rail, bus, and shuttle services because each mode provides a different combination of cost, time, reliability, and convenience. Mode-specific examination of these attributes is therefore necessary to understand why an alternative may be attractive to one group of passengers but less preferred by another.

The stated preference approach provides a quantitative framework for examining how travelers evaluate transportation alternatives and their associated attributes. Rather than limiting transportation analysis to observed passenger volumes, stated preference data enable researchers to investigate travelers' expressed evaluations of factors underlying their transportation decisions. Within a mode-choice context, these evaluations can be transformed into quantitative information representing the relative attractiveness of competing alternatives. Utility is central to this analytical perspective because it provides a numerical representation of the preference associated with a transportation alternative based on the attributes included in the model. Higher relative utility indicates that an alternative provides a more favorable combination of characteristics within the specified analytical framework. Regression analysis can be employed to examine relationships between transportation attributes and preference measures and to construct utility functions for the alternatives under investigation. When more than two transportation alternatives are compared, a multinomial choice framework provides a mechanism for representing the distribution of preferences across several mutually competing options (Fale et al., 2025; Han et al., 2020; Kyi et al., 2026; Wang et al., 2023). The multinomial logit approach converts differences in utility into estimated choice probabilities, thereby allowing the relative likelihood of selecting each mode to be compared quantitatively. Such probability estimates provide information that complements descriptive assessments by indicating the relative position of rail, bus, and shuttle services within the same passenger market. The combination of stated preference, utility estimation, and probabilistic choice modeling therefore establishes the analytical basis for comparing competing intercity public transportation services.

A comparative perspective is particularly important for intercity transportation planning because service improvement should consider not only the performance of an individual mode but also its position relative to competing alternatives. Rail, bus, and shuttle services on the Kotabumi–Bandar Lampung corridor operate within the same general travel market while presenting passengers with different combinations of fare, travel time, operating frequency, capacity, and service conditions. Comparing these alternatives enables differences in passenger priorities to be identified and provides insight into the attributes associated with the relative attractiveness of each service. A mode with a lower fare, for instance, may not necessarily become the dominant alternative when passengers simultaneously consider waiting time, comfort, punctuality, or travel duration. Likewise, a service offering greater operational frequency may compete differently when its monetary cost or travel time differs from those of other alternatives. This multidimensional structure reinforces the importance of analyzing transportation choice through a framework that accommodates several service attributes simultaneously. Utility estimation provides a means of summarizing the attractiveness associated with these attributes, while choice probabilities facilitate direct comparison among the competing modes. Combining these measures with passenger characteristics further strengthens the interpretation of transportation preferences within a specific intercity corridor. The resulting framework positions mode-choice modeling not merely as a technique for identifying the most frequently preferred transportation alternative but as an

analytical mechanism for understanding the structure of competition among public transport services. Therefore, the integration of passenger characteristics, service attributes, stated preference, utility estimation, and multinomial choice probabilities provides the conceptual foundation for the comparative analysis of rail, bus, and shuttle services undertaken in this study.

METHOD

Study Area

This study employed a quantitative approach to examine passenger preferences and public transport mode choice on the Kotabumi–Bandar Lampung intercity corridor. The study was conducted in North Lampung Regency, Lampung Province, Indonesia, with data collection concentrated at transportation service points in Kotabumi. Three public transportation alternatives operating toward Bandar Lampung were investigated: rail, bus, and shuttle services. Data for rail passengers were collected at Kotabumi Railway Station, particularly in relation to the Kuala Stabas rail service. Bus-related data were collected at the PO Puspa Jaya ticket counter, while shuttle-related data were obtained through the Karona Travel service point. These locations were selected because they represented the operational points of the three transportation alternatives examined in the study. The three modes served the same general intercity travel corridor but differed in their operational and service characteristics. This setting therefore enabled passenger preferences toward competing transportation alternatives to be examined within a comparable origin–destination context. Both offline and online data collection mechanisms were incorporated to obtain information from transportation users. The study area consequently provided an empirical setting for comparing the relative preferences for rail, bus, and shuttle services on the Kotabumi–Bandar Lampung corridor.

Sample

The study involved a total sample of 384 respondents representing users of public transportation on the Kotabumi–Bandar Lampung corridor. Of these respondents, 234 participated through offline questionnaire administration, whereas 150 responses were obtained through online questionnaires. The offline sample consisted of 80 rail passengers, 69 bus passengers, and 85 shuttle passengers. The 150 online respondents were distributed randomly across the transportation modes included in the study. Combining offline and online responses was intended to provide the dataset used for examining passenger characteristics and transportation preferences. Respondents represented passengers with different demographic and travel characteristics, including gender, age, occupation, education, income, destination, and travel purpose. The inclusion of passengers from the three transportation alternatives enabled comparisons of their mode-specific considerations. Data from the offline and online samples were analyzed both separately and in combined form within the analytical procedures reported in the study. The resulting sample structure therefore supported comparative assessment of rail, bus, and shuttle preferences within the investigated intercity corridor.

Research Variables

The research variables were organized around transportation service attributes and the three transportation alternatives examined in the study. Seven independent variables were specified to represent attributes potentially associated with passengers' transportation preferences. The first variable was fare (X_1), representing the monetary cost associated with transportation use. The second was waiting time (X_2), while the third was service availability (X_3). Service frequency (X_4) represented the fourth attribute, reflecting the availability of transportation services across operating periods. The fifth variable was travel time (X_5), representing the duration required to complete the intercity journey. The remaining variables consisted of departure punctuality (X_6) and

arrival punctuality (X_7). Collectively, these seven attributes were used as explanatory variables in the quantitative analysis of transportation preferences. The transportation alternatives specified in the original study as the dependent variable were rail, bus, and shuttle. This variable structure provided the analytical basis for estimating utility and comparing the probability of choosing the three public transportation alternatives.

Instrument

Data were collected primarily through a structured questionnaire administered using both offline and online formats. The questionnaire was designed to obtain information concerning passenger characteristics, transportation preferences, and factors associated with public transport mode choice. Primary data consisted of questionnaire responses, passenger characteristics, and information concerning the factors considered in transportation selection. The study also incorporated secondary data obtained from institutions associated with the transportation services and from relevant previous studies. These secondary data included the population of North Lampung Regency, number of transportation fleets, ticket fares, service facilities, and other supporting information. Before further statistical analysis, the questionnaire items were subjected to validity testing using a significance level of 0.05. Reliability testing was subsequently conducted to evaluate the internal consistency of the questionnaire measurements. The original analysis interpreted reliability coefficients approaching 1 as indicating higher measurement reliability. The validated and reliable questionnaire data subsequently constituted the primary dataset for estimating passenger preferences and transportation choice probabilities.



Figure 1. Offline questionnaire data collection in Kotabumi: (a) survey of rail passengers at Kotabumi Railway Station; (b) survey of road-based public transport passengers at the bus/shuttle service point.

Data Analysis

Data analysis was performed using IBM SPSS Statistics 26 and involved validity testing, reliability testing, multiple linear regression, utility estimation, multinomial logit modeling, and Pearson correlation analysis. Multiple linear regression was applied to examine relationships between the specified transportation attributes and the preference measure used in the original analytical framework. The general utility specification adopted in the study was $U = a + a_1X_1 + a_2X_2 + \dots + a_nX_n$, where U denotes utility, a represents the constant, a_1 to a_n are regression coefficients, and X_1 to X_n represent the independent variables. The utility equations were derived from the multiple linear regression models selected according to the largest R^2 values and statistical significance below 0.05. Regression models were estimated for rail, bus, and shuttle services using offline, online, and combined questionnaire datasets. The resulting equations were then used to obtain utility values for the transportation alternatives. A multinomial logit model was subsequently applied because the choice set consisted of more than two alternatives, namely rail, bus, and

shuttle. Utility values were transformed into choice probabilities to quantify the relative likelihood of selecting each transportation mode. Pearson correlation analysis was additionally employed within the original analytical procedure to examine the strength of relationships between variables. Together, these analyses provided descriptive and quantitative evidence for comparing passenger preferences across the three public transportation alternatives.

Procedure

The research procedure consisted of sequential stages covering study preparation, data collection, instrument assessment, statistical modeling, and interpretation of transportation choices. The initial stage identified rail, bus, and shuttle services as the public transportation alternatives to be compared on the Kotabumi–Bandar Lampung corridor. Data collection was subsequently conducted through offline questionnaires at the designated transportation service points and through an online questionnaire. The offline survey produced 234 responses, consisting of 80 rail, 69 bus, and 85 shuttle respondents, while the online survey contributed another 150 responses. Primary questionnaire data were complemented with secondary information concerning population, transportation fleets, fares, facilities, and other supporting characteristics. The collected questionnaire data were then subjected to validity and reliability testing before proceeding to the main quantitative analyses. Multiple linear regression models were estimated for the transportation alternatives, and the regression equations satisfying the criteria specified in the original study were used to calculate utility values. The estimated utilities were subsequently incorporated into the multinomial logit procedure to determine the probability associated with rail, bus, and shuttle choices. Pearson correlation analysis was also conducted as part of the original statistical procedure, after which results from the offline, online, and combined datasets were compared. The final stage interpreted passenger characteristics, mode-specific considerations, utility values, and choice probabilities to determine the relative preference for the three public transportation alternatives on the Kotabumi–Bandar Lampung corridor.

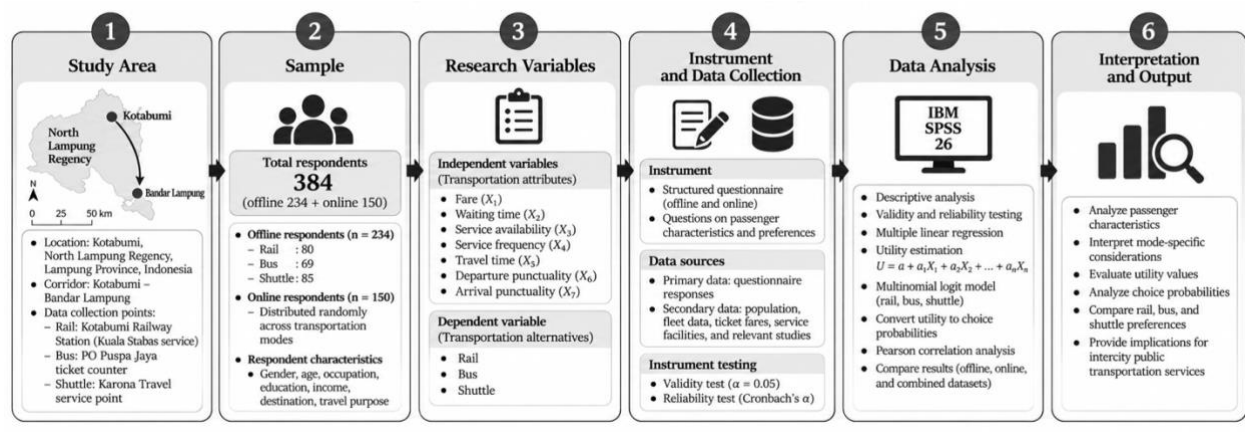


Figure 1. Research Method Flow

RESULTS AND DISCUSSION

Results

Instrument Validity and Reliability

The measurement instrument was evaluated before the main mode-choice analysis to ensure that the questionnaire items provided adequate empirical consistency. The validity assessment was conducted separately for the offline and online datasets and across the three transportation alternatives: rail, bus, and shuttle. For the offline dataset, all 14 questionnaire items were reported as valid because their item correlation coefficients exceeded the reported critical value of $r = 0.1295$.

The rail item correlations ranged from 0.580 to 0.803, while the corresponding values for bus ranged from 0.556 to 0.766. For shuttle, the offline item correlations ranged from 0.505 to 0.756. These results indicate that the items retained adequate relationships with the measured construct under the criteria adopted in the original study. A similar pattern was found for the online questionnaire. All 14 items were classified as valid using the reported critical value of $r = 0.159$. Rail item correlations ranged from 0.477 to 0.718, bus correlations ranged from 0.439 to 0.755, and shuttle correlations ranged from 0.301 to 0.704. Although the magnitude of several online item correlations was lower than that observed in the offline dataset, every item remained above the criterion reported in the original analysis. Consequently, no questionnaire item was eliminated before the subsequent statistical analysis. The reliability assessment further showed consistently high internal consistency across the questionnaire datasets. The overall questionnaire produced a Cronbach's alpha coefficient of 0.9364, which was categorized as very high in the original study. For the offline data, Cronbach's alpha values were 0.9322 for rail, 0.9183 for bus, and 0.9055 for shuttle. The corresponding online values were 0.8869, 0.8933, and 0.8748. Thus, all reported reliability coefficients exceeded 0.87, indicating that the instrument produced relatively stable responses across the three transportation alternatives and both modes of questionnaire administration.

Table 1. Summary of questionnaire validity and reliability

Dataset	Mode	Range of item correlations	Reported r critical	Cronbach's α	Interpretation
Offline	Rail	0.580–0.803	0.1295	0.9322	Very high
Offline	Bus	0.556–0.766	0.1295	0.9183	Very high
Offline	Shuttle	0.505–0.756	0.1295	0.9055	Very high
Online	Rail	0.477–0.718	0.159	0.8869	High
Online	Bus	0.439–0.755	0.159	0.8933	High
Online	Shuttle	0.301–0.704	0.159	0.8748	High

Survey Response Distribution

A total of 384 respondents participated in the study, consisting of 234 respondents who completed the questionnaire offline and 150 respondents who participated through the online survey. The offline responses represented approximately 61% of the total dataset, while the online responses accounted for approximately 39%. Within the offline sample, 80 respondents were associated with rail, 69 with bus, and 85 with shuttle services. This distribution provided representation of all three transportation alternatives and enabled both mode-specific and combined analyses. The offline survey was conducted over several days. Rail respondents were distributed across five survey days, with daily frequencies of 21, 16, 14, 13, and 16 respondents. Bus respondents were similarly collected over five days, with 12, 13, 16, 15, and 13 respondents, respectively. Shuttle responses were concentrated within three survey days, yielding 30, 27, and 28 respondents. The online survey collected 150 responses over four days, with 6 responses on the first day, followed by 36, 56, and 52 responses. The largest share of online data was therefore obtained on the third and fourth survey days, accounting for 37% and 35% of the online sample, respectively. The combination of offline and online data enabled the study to compare choice patterns obtained through two different questionnaire administration approaches. However, the original dataset was not balanced equally across transportation modes in the offline survey. This imbalance should therefore be considered when interpreting mode-specific descriptive distributions.

Table 2. Distribution of respondents

Survey format	Rail	Bus	Shuttle	Total	Percentage of total sample
Offline	80	69	85	234	61%
Online	—	—	—	150	39%
Combined	—	—	—	384	100%

Operational Characteristics of the Transportation Modes

The three transportation alternatives displayed clearly differentiated service characteristics. Rail transportation was represented by the Kuala Stabas service, operated using a CC 201 locomotive and an eight-car formation. The formation consisted of one staff carriage, five passenger carriages, one dining carriage, and one power-generating carriage. The service provided a total capacity of 384 passenger seats, including facilities intended for passengers with disabilities. Average daily ridership was reported at approximately 180–200 passengers. Available facilities included a waiting room, air-conditioned coaches, charging facilities, toilets at both the station and onboard the train, disability-accessible facilities, a prayer room, a canteen, masks, and tissues. Rail also offered the lowest fare among the three alternatives, at IDR 10,000 per passenger. Two departures were available, at 09:39 and 17:09, with an estimated travel time of approximately 1.5–2 hours.

Bus transportation was represented by Puspa Jaya, which operated medium buses on the corridor. The operator had 24 buses, each accommodating approximately 29–32 passengers. Average daily ridership ranged between 130 and 150 passengers. Passenger facilities included a waiting room, air-conditioned buses, and toilets. The bus fare was IDR 23,000, more than twice the rail fare but substantially lower than the shuttle fare. Services operated from 05:30 to 17:00 with a reported 30-minute headway. However, the estimated bus travel time was approximately 2.5–3 hours, making it the longest among the three alternatives.

Shuttle transportation was provided by Karona Travel. The operator maintained 18 shuttle vehicles with a capacity of 15 passengers per vehicle. Average ridership was reported at approximately 250–270 passengers per day, which was higher than the corresponding daily passenger estimates for rail and bus. Facilities included a waiting room, air-conditioned vehicles, toilets, snacks, and toll-road service. The shuttle fare was IDR 35,000, making it the most expensive alternative. Services operated from 05:30 to 19:00 at approximately 30-minute intervals. Despite its higher fare, shuttle travel time was estimated at 1.5–2 hours, comparable with rail and considerably shorter than bus travel time.

Taken together, these operational differences reveal distinct service trade-offs. Rail combined the lowest fare and relatively short travel time but offered fewer departure opportunities. Bus provided frequent departures and a moderate fare but required the longest travel time. Shuttle offered frequent departures and relatively short travel time but imposed the highest monetary cost. These contrasts provide an important empirical background for interpreting subsequent passenger preferences and utility estimates.

Table 3. Comparative operational characteristics of public transport services

Attribute	Rail	Bus	Shuttle
Service provider	Kuala Stabas	Puspa Jaya	Karona Travel
Type	Rail	Medium bus	Shuttle bus
Fleet/capacity	384 seats	24 buses; 29–32 seats each	18 vehicles; 15 seats each
Average passengers/day	180–200	130–150	250–270
Fare	IDR 10,000	IDR 23,000	IDR 35,000
Service period	09:39 and 17:09 departures	05:30–17:00	05:30–19:00
Headway	Fixed departures	30 min	30 min
Travel time	1.5–2 h	2.5–3 h	1.5–2 h
Main facilities	AC, toilets, waiting room, charging, prayer room, canteen	AC, waiting room, toilet	AC, waiting room, toilet, snack, toll-road service

Passenger Socio-Demographic Characteristics

The passenger sample was dominated by female respondents. Of the 384 respondents, 218 were female (57%), while 166 were male (43%). This distribution indicates a relatively modest gender difference but nevertheless shows greater female representation within the overall dataset. Age distribution was considerably more concentrated. The majority of respondents, 290 individuals (76%), were between 17 and 25 years old. A further 58 respondents (15%) were aged 26–35 years, while only 18 respondents (5%) belonged to the 36–45 age group. Respondents aged 46–55 years and those older than 56 each accounted for only 2% of the sample. The sample can therefore be characterized as predominantly young, which is relevant when interpreting transportation preferences because the findings largely reflect the travel behavior of younger users. This pattern was reinforced by occupational characteristics. Students constituted the largest category, accounting for 229 respondents (60%). Private-sector employees represented 14%, followed by civil servants or state-owned enterprise employees at 11%. Other occupational groups were considerably smaller, including homemakers (5%), teachers or lecturers (4%), entrepreneurs (3%), health workers (2%), retirees (1%), farmers (1%), and baristas (1%). The occupational structure therefore closely corresponds with the age distribution and indicates a strong student presence in the sample.

Educational attainment showed a similar concentration. Senior high school graduates represented 230 respondents (60%), followed by undergraduate degree holders at 96 respondents (25%). Diploma holders accounted for 10%, junior high school graduates for 3%, and postgraduate respondents for 2%. No respondent reported elementary school as the highest completed educational level. This profile indicates that most respondents had at least secondary education and that the sample also included a substantial group with higher education experience.

Table 4. Socio-demographic characteristics of respondents

Variable	Category	n	%
Gender	Male	166	43
	Female	218	57
Age	17–25 years	290	76
	26–35 years	58	15
	36–45 years	18	5
	46–55 years	9	2
	>56 years	9	2
	Student	229	60
Occupation	Civil servant/state-owned enterprise	41	11
	Private employee	53	14
	Entrepreneur	11	3
	Lecturer/teacher	16	4
	Homemaker	18	5
	Other occupations	16	4
Education	Junior high school	11	3
	Senior high school	230	60
	Diploma	39	10
	Bachelor's degree	96	25
	Postgraduate	8	2

Travel Characteristics

The destination data confirm the relevance of Bandar Lampung as the principal destination within the investigated corridor. A total of 347 respondents (90%) reported Bandar Lampung as their destination. Lampung Tengah was the second most common destination, but represented only 24 respondents (6%). Pesawaran accounted for 2%, while Lampung Selatan and Metro each represented approximately 1%. Destinations such as Lampung Timur and Tanggamus were represented by only one respondent each. The strong concentration toward Bandar Lampung

therefore confirms that the empirical dataset primarily captures travel movements directly associated with the Kotabumi–Bandar Lampung corridor. Travel purpose was more heterogeneous. School or university travel was the most frequent purpose, reported by 134 respondents (35%). Recreation or tourism followed with 107 respondents (28%), while family-related travel accounted for 75 respondents (20%). Employment-related journeys represented 54 respondents (14%), and business trips accounted for the smallest proportion, at 14 respondents (4%). The prominence of education-related travel is consistent with the relatively young age profile and the high proportion of students within the sample.

Income distribution further reflected this demographic structure. More than half of the respondents, 206 individuals (54%), reported having no income. Respondents earning IDR 1,000,000–2,500,000 represented 17%, followed by those earning IDR 2,500,000–5,000,000 at 15%. Eight percent earned below IDR 1,000,000, and only 7% reported monthly income above IDR 5,000,000. The concentration of respondents without income is therefore consistent with the dominance of student respondents and should be considered when interpreting the relatively strong importance assigned to fare in some transportation modes.

Table 5. Travel and income characteristics of respondents

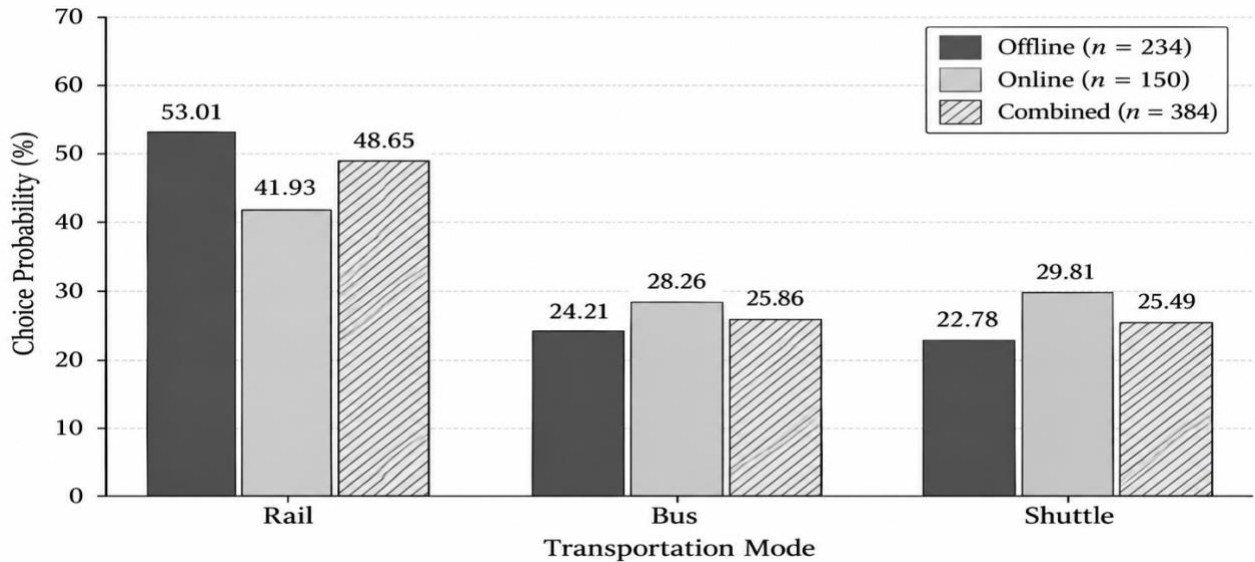
Variable	Category	n	%
Destination	Bandar Lampung	347	90
	Lampung Tengah	24	6
	Pesawaran	6	2
	Other destinations	7	2
Travel purpose	School/college	134	35
	Recreation/tourism	107	28
	Family	75	20
	Work	54	14
Income	Business	14	4
	No income	206	54
	< IDR 1,000,000	29	8
	IDR 1,000,000–2,500,000	65	17
	IDR 2,500,000–5,000,000	57	15
	> IDR 5,000,000	27	7

Factors Associated with Mode Preference

Passenger considerations differed substantially across transportation modes. Rail passengers most frequently identified comfort as a consideration, with 94 responses representing 27% of the recorded rail-related considerations. Waiting time ranked second at 23%, followed by fare and safety, both at 14%. Travel duration accounted for 12%, while service represented 9%. This distribution indicates that rail preference was not primarily driven by price despite rail having the lowest fare; instead, comfort emerged as the most frequently identified consideration. The pattern was different for bus users. Fare accounted for 33%, making it the dominant consideration, followed by waiting time at 21% and comfort at 18%. Service represented 13%, safety 9%, and travel duration 6%. The comparatively low share assigned to travel duration is notable given that bus had the longest estimated journey time among the three alternatives. Nevertheless, the descriptive data indicate that cost considerations were more prominent for bus users than journey duration. Shuttle users also placed the greatest emphasis on fare, which represented 26% of reported considerations. Comfort ranked second at 21%, followed by waiting time at 17%. Travel duration represented 14%, service 12%, and safety 11%. Compared with bus users, shuttle users therefore showed a more balanced distribution across price, comfort, waiting time, and travel duration. This may reflect the service configuration of shuttle transportation, which combined relatively short travel time with the highest fare.

Table 6. Distribution of considerations by transportation mode

Consideration	Rail, n (%)	Bus, n (%)	Shuttle, n (%)
Fare	49 (14%)	109 (33%)	91 (26%)
Waiting time	82 (23%)	70 (21%)	61 (17%)
Service	32 (9%)	42 (13%)	42 (12%)
Safety	50 (14%)	31 (9%)	39 (11%)
Comfort	94 (27%)	58 (18%)	74 (21%)
Travel duration	42 (12%)	21 (6%)	50 (14%)
Total recorded considerations	349	331	357

**Figure 2.** Distribution of passenger considerations across rail, bus, and shuttle services.

Regression Models for Offline and Online Data

Multiple linear regression was conducted separately for offline and online responses before the combined models were estimated. For the offline rail dataset, the final model excluded fare and included waiting time, service availability, service frequency, travel time, departure punctuality, and arrival punctuality. The model produced an R^2 of 0.854, the highest among all offline models. The corresponding equation was:

$$U_{rail,offline} = -0,020 + 0,164X_2 + 0,0121X_3 + 0,162X_4 + 0,0193X_5 + 0,197X_6 + 0,179X_7$$

For the online rail dataset, the model produced an R^2 of 0.746 and included fare, waiting time, service availability, service frequency, departure punctuality, and arrival punctuality, while travel time was not retained in the reported specification:

$$U_{rail,online} = -0,824 + 0,114X_1 + 0,25X_2 + 0,137X_3 + 0,296X_4 + 0,172X_6 + 0,197X_7$$

The offline bus model incorporated all seven independent variables and produced an R^2 of 0.818:

$$U_{bus,offline} = -0,073 + 0,117X_1 + 0,174X_2 + 0,233X_3 + 0,106X_4 + 0,077X_5 + 0,091X_6 + 0,220X_7$$

The largest reported coefficient in this model was associated with service availability ($X_3 = 0.233$), closely followed by arrival punctuality ($X_7 = 0.220$). The online bus model produced a lower R^2 of 0.714 and excluded travel time from the reported model:

$$U_{bus,online} = 0,713 + 0,118X_1 + 0,176X_2 + 0,112X_3 + 0,131X_4 + 0,172X_6 + 0,084X_7$$

For shuttle, the offline regression model included all seven attributes and generated an R^2 of 0.803. The corresponding model was:

$$U_{shuttle,offline} = 0,015 + 0,137X_1 + 0,108X_2 + 0,181X_3 + 0,149X_4 + 0,162X_5 + 0,156X_6 + 0,084X_7$$

The largest coefficient was associated with service availability ($X_3 = 0.181$), followed by travel time ($X_5 = 0.162$). The online shuttle model yielded an R^2 of 0.729 and excluded fare from the reported equation:

$$U_{\text{shuttle, online}} = 0.467 + 0.213X_2 + 0.161X_3 + 0.140X_4 + 0.134X_5 + 0.091X_6 + 0.127X_7$$

Across the six separate models, R^2 values ranged from 0.714 to 0.854. Offline models consistently produced higher R^2 values than the corresponding online models for rail, bus, and shuttle. The largest difference occurred for bus, where R^2 declined from 0.818 offline to 0.714 online. These values indicate that, under the modeling procedure used in the original study, the explanatory variables accounted for a relatively large proportion of variation in the modeled preference measures.

Table 7. Regression model summary

Mode	Dataset	R^2	Variables retained
Rail	Offline	0.854	$X_2, X_3, X_4, X_5, X_6, X_7$
Rail	Online	0.746	$X_1, X_2, X_3, X_4, X_6, X_7$
Bus	Offline	0.818	X_1-X_7
Bus	Online	0.714	$X_1, X_2, X_3, X_4, X_6, X_7$
Shuttle	Offline	0.803	X_1-X_7
Shuttle	Online	0.729	$X_2, X_3, X_4, X_5, X_6, X_7$

Combined Regression Models and Utility Values

When the offline and online datasets were combined, all seven variables were included in the reported regression equations for each transportation mode. The combined rail model generated the largest coefficient of determination, with $R^2 = 0.812$:

$$U_{\text{rail}} = -0.412 + 0.071X_1 + 0.203X_2 + 0.114X_3 + 0.206X_4 + 0.144X_5 + 0.190X_6 + 0.162X_7$$

Within this model, service frequency had the largest regression coefficient (0.206), followed closely by waiting time (0.203) and departure punctuality (0.190).

The combined bus model yielded $R^2 = 0.780$:

$$U_{\text{bus}} = 0.148 + 0.127X_1 + 0.159X_2 + 0.203X_3 + 0.114X_4 + 0.055X_5 + 0.111X_6 + 0.180X_7$$

The largest coefficient in the combined bus equation was associated with service availability (0.203), followed by arrival punctuality (0.180) and waiting time (0.159).

The combined shuttle model produced $R^2 = 0.784$:

$$U_{\text{shuttle}} = 0.122 + 0.110X_1 + 0.140X_2 + 0.175X_3 + 0.135X_4 + 0.149X_5 + 0.133X_6 + 0.109X_7$$

The largest coefficient was again associated with service availability (0.175), followed by travel time (0.149) and waiting time (0.140).

The utility calculations produced clear differences among the three modes. For the offline dataset, rail recorded a utility value of 4.504, compared with 3.721 for bus and 3.660 for shuttle. For the online dataset, rail again recorded the highest utility at 4.210, while shuttle slightly exceeded bus at 3.869 versus 3.815. When the datasets were combined, rail remained highest at 4.383, followed by bus at 3.751 and shuttle at 3.737. The small difference between bus and shuttle in the combined dataset indicates that these two alternatives had nearly equivalent estimated utilities, whereas rail remained clearly separated from both.

Table 8. Combined regression performance and estimated utility

Mode	Combined R ²	Offline utility	Online utility	Combined utility
Rail	0.812	4.504	4.210	4.383
Bus	0.780	3.721	3.815	3.751
Shuttle	0.784	3.660	3.869	3.737

Estimated Mode-Choice Probabilities

The estimated probabilities showed that rail had the highest probability of being selected across all three data configurations. In the offline sample, rail reached 53.01%, while bus and shuttle obtained 24.21% and 22.78%, respectively. Thus, rail exceeded bus by 28.80 percentage points and shuttle by 30.23 percentage points in the offline dataset. The online pattern was more balanced. Rail remained the largest alternative at 41.93%, but its share was notably lower than in the offline data. Shuttle reached 29.81%, while bus obtained 28.26%. The gap between rail and shuttle therefore narrowed to 12.12 percentage points, and the difference between bus and shuttle was only 1.55 percentage points. This result indicates substantially greater competition among the three modes in the online responses than in the offline sample. When offline and online responses were combined, rail accounted for 48.65% of the estimated choice probability. Bus accounted for 25.86%, while shuttle represented 25.49%. The difference between bus and shuttle in the combined dataset was only 0.37 percentage points, demonstrating near parity between these alternatives. Rail, however, remained approximately 22.8 percentage points ahead of each.

Table 9. Estimated mode-choice probabilities

Dataset	Rail (%)	Bus (%)	Shuttle (%)	Highest-ranked mode
Offline	53.01	24.21	22.78	Rail
Online	41.93	28.26	29.81	Rail
Combined	48.65	25.86	25.49	Rail

The original study additionally reported a set of probability percentages obtained in connection with its Pearson correlation procedure. Under this analysis, the offline shares were 54.00% for rail, 23.70% for bus, and 22.30% for shuttle. The online results were 41.84%, 28.18%, and 29.98%, respectively. The combined values were identical to the previously reported combined choice probabilities: 48.65% for rail, 25.86% for bus, and 25.49% for shuttle. The closeness of these values to the original probability estimates meant that the ranking of the transportation modes did not change: rail remained first, while bus and shuttle occupied closely competing positions.

Table 10. Comparison of reported probability estimates

Analytical result	Dataset	Rail (%)	Bus (%)	Shuttle (%)
Original probability estimate	Offline	53.01	24.21	22.78
	Online	41.93	28.26	29.81
	Combined	48.65	25.86	25.49
Pearson-based result reported in the original study	Offline	54.00	23.70	22.30
	Online	41.84	28.18	29.98
	Combined	48.65	25.86	25.49

Discussion

The findings demonstrate that public transport mode choice on the Kotabumi–Bandar Lampung corridor reflects an interaction between passenger characteristics and the distinct service configurations offered by rail, bus, and shuttle services. The respondent profile was strongly concentrated among younger travelers, with 76% aged 17–25 years, 60% identified as students, and 54% reporting no income, while education-related trips constituted the largest single travel-purpose category at 35%. This composition is important because transportation decisions are not independent of socioeconomic and trip characteristics, and previous stated-choice research has demonstrated substantial heterogeneity in responses to travel time, fare, accessibility, crowding, and

other service attributes across passenger groups (Eldeeb & Mohamed, 2020; Gholi et al., 2022; Göransson & Andersson, 2023; Kožul et al., 2025; Ranjan & Sinha, 2026). More recent intercity evidence similarly indicates that socioeconomic characteristics interact with travel behavior variables and that the effects of mode-choice determinants can vary considerably among population groups rather than operating uniformly across passengers. Within the present sample, the predominance of students and respondents without income provides a plausible contextual explanation for the importance attached to monetary cost, particularly among bus and shuttle users, although the present analysis does not establish a direct causal relationship between income and fare sensitivity. The concentration of 90% of respondents traveling toward Bandar Lampung also indicates that the estimated preferences largely represent a specific and relatively well-defined intercity travel market rather than heterogeneous movements across unrelated destinations. This corridor-specific structure strengthens the interpretation of rail, bus, and shuttle as alternatives competing for broadly comparable passenger movements. At the same time, it distinguishes the study from broader multimodal analyses involving substantially different trip distances, destinations, or transportation markets. Previous intercity transportation research has shown that mode choice can exhibit considerable heterogeneity and nonlinear responses to passenger and trip characteristics, with travel distance emerging as an important determinant in some intercity settings (Li et al., 2024). The present findings therefore extend this broader literature by demonstrating how mode competition manifests within a regional Indonesian corridor where conventional public transportation alternatives serve largely overlapping passenger movements.

A particularly important finding is that passengers did not evaluate rail, bus, and shuttle services according to an identical hierarchy of considerations. For rail, comfort represented the largest reported consideration at 27%, followed by waiting time at 23%, whereas fare accounted for only 14%; in contrast, fare ranked first for both bus (33%) and shuttle (26%), followed by waiting time and comfort for bus and comfort and waiting time for shuttle. This mode-specific pattern reinforces the view that public transport attractiveness is multidimensional and cannot be reduced to a single service characteristic. Previous reviews of public transport attractiveness and mode choice similarly emphasize that travelers' preferences emerge from combinations of service and travel characteristics rather than from one universally dominant determinant (Fitschen et al., 2024; Owais et al., 2026). Previous intercity multimodal research has also incorporated ticket price, in-vehicle time, waiting time, walking and access/egress time, transfer penalties, comfort, reliability, and security into generalized travel cost, demonstrating the multidimensional nature of passenger choice. Importantly, the operational data in the present study help explain why the relative importance of these attributes may vary by mode: rail charged only IDR 10,000 and required approximately 1.5–2 hours, bus charged IDR 23,000 with a 2.5–3-hour journey, and shuttle charged IDR 35,000 while requiring approximately 1.5–2 hours. Rail therefore combined the lowest monetary cost with a comparatively short journey, although it offered only two scheduled departures, whereas bus and shuttle operated at approximately 30-minute headways. The prominence of comfort among rail users suggests that its attractiveness cannot be interpreted simply as a consequence of low fare, just as the importance of fare among shuttle users demonstrates that cost remains salient even for passengers considering the highest-priced alternative. These results support a trade-off interpretation of mode choice in which passengers evaluate bundles of attributes rather than ranking alternatives according to a single objective indicator. Consequently, service improvement strategies should be mode-specific: increasing frequency may be especially relevant for rail, whereas maintaining affordability while improving comfort and temporal performance may be particularly consequential for road-based alternatives.

The regression results provide additional evidence that the structure of passenger preference varies across transportation modes and data-collection formats. The offline models produced R^2

values of 0.854 for rail, 0.818 for bus, and 0.803 for shuttle, whereas the corresponding online models yielded lower values of 0.746, 0.714, and 0.729. In the combined models, rail retained the largest R^2 at 0.812, followed by shuttle at 0.784 and bus at 0.780, indicating that the specified service attributes accounted for substantial variation in the preference measure under the analytical framework adopted in this study. The combined equations also revealed different coefficient patterns, with service frequency, waiting time, and departure punctuality relatively prominent in the rail equation, while service availability produced the largest reported coefficient for both bus and shuttle. This variation is theoretically reasonable because passengers may respond differently to the same attribute depending on the operating structure of the mode being evaluated. For example, frequency may assume greater practical relevance when a service has only limited scheduled departures, whereas availability may become particularly salient for road-based services whose attractiveness partly derives from greater temporal flexibility (de Almeida Costa et al., 2025; Fazi & Fransoo, 2025). Previous intercity modeling supports the broader principle that travelers' perceived generalized costs incorporate multiple temporal, monetary, convenience, reliability, and comfort dimensions rather than travel time and fare alone. Comparative methodological research has also shown that machine-learning and conventional logit models can agree on several aspects of behavioral interpretation while differing in predictive performance and their ability to capture nonlinear relationships. Recent intercity mode-choice research using machine-learning and explainable modeling techniques has likewise demonstrated significant nonlinear and interaction effects, highlighting complexities that may remain insufficiently represented by conventional linear specifications. Accordingly, the present regression results are informative for identifying mode-specific associations, but future research should test nonlinearities, interaction effects, and preference heterogeneity before interpreting the estimated coefficients as stable behavioral parameters across passenger populations.

The most consequential result concerns the relative utilities and resulting choice probabilities of the three transportation alternatives. Rail achieved the highest utility in the offline, online, and combined datasets, with values of 4.504, 4.210, and 4.383, respectively, whereas combined utilities for bus and shuttle were nearly identical at 3.751 and 3.737. This utility ranking translated into a rail choice probability of 53.01% in the offline dataset, 41.93% online, and 48.65% when both datasets were combined. Bus and shuttle accounted for 25.86% and 25.49% of the combined probability, respectively, producing a difference of only 0.37 percentage points between these two alternatives. Rail's leading position is consistent with its favorable combination of the lowest fare and a travel time comparable to shuttle and substantially shorter than bus, although the present model does not permit the observed probability advantage to be causally attributed to those characteristics alone. This finding nevertheless corresponds with the general principle identified in intercity choice research that passengers respond to combinations of monetary cost, temporal cost, comfort, reliability, and other components of perceived generalized cost (Bertsimas et al., 2020; Liu et al., 2025; Park et al., 2025; Peng et al., 2024). The result is also compatible with stated-choice research in which rail competes with other modes through combinations of travel time, fare, accessibility, and service-quality characteristics rather than through a single inherent modal advantage. At the same time, the decrease in rail probability from 53.01% offline to 41.93% online deserves attention because it indicates that the magnitude of rail's estimated advantage was sensitive to the dataset used. Shuttle, conversely, increased from 22.78% offline to 29.81% online, while bus increased from 24.21% to 28.26%, producing a considerably more balanced competitive structure in the online sample. These differences may reflect variation in respondent composition, survey administration, or unmeasured preference heterogeneity, but the available data do not allow these explanations to be distinguished empirically. Thus, the robust substantive conclusion is not that rail

possesses a fixed market share of approximately one half, but that rail consistently occupied the highest relative position across the three reported data configurations.

From a transportation-planning perspective, the findings suggest that strengthening intercity public transport on the Kotabumi–Bandar Lampung corridor requires differentiated interventions rather than a uniform service-improvement strategy. Rail already occupies the strongest modeled position, but its operational limitation lies in restricted departure availability, with only two scheduled departures compared with approximately 30-minute headways for bus and shuttle. Given that service frequency and waiting time had relatively prominent coefficients in the combined rail model, increasing temporal flexibility where operationally feasible could potentially strengthen rail attractiveness, although this proposition requires direct evaluation rather than being inferred as a proven causal effect. For bus, the prominence of fare in descriptive preferences and service availability in the combined regression model suggests that competitiveness depends on preserving affordability while ensuring convenient and dependable service provision. For shuttle, the combination of the highest fare, relatively short travel time, frequent departures, and the importance assigned to fare and comfort indicates a distinct market position centered on temporal convenience but constrained by monetary cost. These implications are consistent with previous evidence demonstrating that the attractiveness of public transportation depends on multiple dimensions of the travel experience and therefore requires attention to the attributes travelers value in specific contexts (Cornet et al., 2022; Friman et al., 2020; Ram et al., 2021; Sukhov et al., 2022). They also correspond with contemporary intercity research emphasizing that understanding heterogeneous passenger responses can support targeted market-share and transport-management strategies rather than generic interventions across all modes. Methodologically, however, the present findings should be interpreted within the boundaries of the adopted stated-preference and regression-based utility framework, particularly because contemporary mode-choice studies increasingly employ mixed logit, machine-learning, and nonlinear approaches to capture heterogeneity and complex interactions. Future studies could therefore estimate the three alternatives directly within a discrete-choice framework, examine socioeconomic interactions and willingness-to-pay measures, and test whether the observed rail advantage persists across different passenger segments and travel conditions. Overall, the study contributes corridor-specific evidence showing that rail currently occupies the strongest modeled competitive position, while the near-equivalent probabilities of bus and shuttle and the different attribute priorities across modes demonstrate that intercity public transport choice is fundamentally a multidimensional and heterogeneous decision process.

Implications

The findings provide practical implications for improving public transportation services along the Kotabumi–Bandar Lampung corridor. Rail demonstrated the highest utility and choice probability, indicating that its competitive advantages should be maintained while limitations in service frequency and departure flexibility are addressed. For bus services, the prominence of fare suggests that affordability should remain a priority alongside improvements in service availability and punctuality. Shuttle services should emphasize comfort, travel-time efficiency, and service convenience to justify their comparatively higher fares. The near-equivalent combined probabilities of bus and shuttle further indicate strong competition between these two alternatives. Service improvement should therefore be mode-specific because passengers assign different priorities to fare, waiting time, comfort, safety, service, and travel duration. The predominance of young passengers, students, and respondents without income also highlights the importance of maintaining accessible and affordable transportation options. Overall, these findings can support transport operators and policymakers in developing more passenger-responsive strategies to strengthen the attractiveness and performance of intercity public transportation.

Limitations and Suggestions for Future Research

This study has several limitations that should be considered when interpreting the findings. The analysis was limited to the Kotabumi–Bandar Lampung corridor, which restricts the generalizability of the results to other intercity transportation contexts. The sample was also dominated by young respondents, students, and individuals without income, potentially limiting the representation of other passenger groups. In addition, differences between the offline and online samples may have contributed to variations in the estimated mode-choice probabilities. The study examined a limited set of transportation attributes and therefore may not capture other relevant considerations influencing passenger decisions. Its reliance on stated preference data may also produce differences between reported preferences and actual travel behavior. Future studies should involve larger and more diverse samples across multiple intercity corridors. Combining stated and revealed preference data would provide stronger evidence of actual passenger choice behavior. More advanced discrete-choice models could also be employed to examine preference heterogeneity and interactions among transportation attributes. Future research should additionally simulate changes in fare, travel time, frequency, and punctuality to evaluate their potential effects on mode choice. These extensions could provide more robust evidence for developing effective and passenger-responsive intercity transportation policies.

CONCLUSION

This study demonstrates that public transport mode choice on the Kotabumi–Bandar Lampung corridor varies according to passenger characteristics and mode-specific considerations. The 384 respondents were predominantly female (57%), aged 17–25 years (76%), students (60%), and passengers without income (54%), while most traveled to Bandar Lampung (90%). Passenger priorities differed across modes, with comfort emerging as the primary consideration for rail (27%), whereas fare was the dominant consideration for bus (33%) and shuttle (26%). Waiting time was also consistently identified as an important consideration across the three transportation alternatives. The estimated probabilities showed that rail was the most preferred mode in both the offline (53.01%) and online (41.93%) datasets. The combined analysis similarly placed rail first with a probability of 48.65%, followed by bus at 25.86% and shuttle at 25.49%. The Pearson correlation-based results produced a comparable distribution and reinforced the relative preference for rail. Overall, rail emerged as the strongest public transport alternative within the investigated corridor, while bus and shuttle demonstrated nearly equivalent competitive positions. These findings highlight the importance of addressing mode-specific priorities, particularly comfort, fare, and waiting time, when improving intercity public transportation services on the Kotabumi–Bandar Lampung corridor.

AUTHOR CONTRIBUTIONS STATEMENT

Amelia Oktavia contributed to the conceptualization of the study, research design, development of the research instrument, data collection, statistical analysis, interpretation of the findings, and preparation of the original manuscript. Mira Wisman contributed to methodological refinement, data validation, interpretation of the research findings, supervision, critical review, and revision of the manuscript. Both authors contributed to the final review of the manuscript and approved the final version for publication.

REFERENCES

- Agaton, C. B., Collera, A. A., & Guno, C. S. (2020). Socio-economic and environmental analyses of sustainable public transport in the Philippines. *Sustainability*, 12(11), 4720. <https://doi.org/10.3390/su12114720>
- Benmessaoud, Y., Cherrat, L., & Ezziyyani, M. (2023). Real-time self-adaptive traffic management system for optimal vehicular navigation in modern cities. *Computers*, 12(4), 80. <https://doi.org/10.3390/computers12040080>
- Bertsimas, D., Ng, Y. S., & Yan, J. (2020). Joint frequency-setting and pricing optimization on multimodal transit networks at scale. *Transportation Science*, 54(3), 839–853. <https://doi.org/10.1287/trsc.2019.0959>
- Bickel, J., Geržinič, N., van Oort, N., de Bruyn, M., & Molin, E. (2026). Heterogeneity in route choice behaviour during unplanned train disruptions considering the possibility of teleworking. *Transportation Research Part A: Policy and Practice*, 203, 104708. <https://doi.org/10.1016/j.tra.2025.104708>
- Bösehans, G., & Walker, I. (2020). Do supra-modal traveller types exist? A travel behaviour market segmentation using goal framing theory. *Transportation*, 47(1), 243–273. <https://doi.org/10.1007/s11116-018-9874-7>
- Ceder, A. (2021). Urban mobility and public transport: Future perspectives and review. *International Journal of Urban Sciences*, 25(4), 455–479. <https://doi.org/10.1080/12265934.2020.1799846>
- Cornet, Y., Lugano, G., Georgouli, C., & Milakis, D. (2022). Worthwhile travel time: A conceptual framework of the perceived value of enjoyment, productivity and fitness while travelling. *Transport Reviews*, 42(5), 580–603. <https://doi.org/10.1080/01441647.2021.1983067>
- Dällenbach, N. (2020). Low-carbon travel mode choices: The role of time perceptions and familiarity. *Transportation Research Part D: Transport and Environment*, 86, 102378. <https://doi.org/10.1016/j.trd.2020.102378>
- Das, S., Boruah, A., Banerjee, A., Raoniar, R., Nama, S., & Maurya, A. K. (2021). Impact of COVID-19: A radical modal shift from public to private transport mode. *Transport Policy*, 109, 1–11. <https://doi.org/10.1016/j.tranpol.2021.05.005>
- de Almeida Costa, M., Kaddoura, I., Noll, A., Unterfinger, M., Balać, M., & Corman, F. (2025). Exploring the role of an underground logistics system in enhancing Swiss intermodal freight. *Transportation Engineering*, 21, 100375. <https://doi.org/10.1016/j.treng.2025.100375>
- De Vos, J., Singleton, P. A., & Gärling, T. (2022). From attitude to satisfaction: Introducing the travel mode choice cycle. *Transport Reviews*, 42(2), 204–221. <https://doi.org/10.1080/01441647.2021.1958952>
- Dixit, M., & Sivakumar, A. (2020). Capturing the impact of individual characteristics on transport accessibility and equity analysis. *Transportation Research Part D: Transport and Environment*, 87, 102473. <https://doi.org/10.1016/j.trd.2020.102473>
- Eldeeb, G., & Mohamed, M. (2020). Quantifying preference heterogeneity in transit service desired quality using a latent class choice model. *Transportation Research Part A: Policy and Practice*, 139, 119–133. <https://doi.org/10.1016/j.tra.2020.07.006>
- Esztergár-Kiss, D., Shulha, Y., Aba, A., & Tettamanti, T. (2021). Promoting sustainable mode choice for commuting supported by persuasive strategies. *Sustainable Cities and Society*, 74, 103264. <https://doi.org/10.1016/j.scs.2021.103264>
- Fale, M., Wang, Y., Rupnik, B., Kramberger, T., & Vizinger, T. (2025). Systematic review of transportation choice modeling. *Applied Sciences*, 15(17), 9235. <https://doi.org/10.3390/app15179235>
- Fazi, S., & Fransoo, J. C. (2025). Freight mobility as a service: Open platforms for synchromodal transport. *Transportation Research Part E: Logistics and Transportation Review*, 204, 104368. <https://doi.org/10.1016/j.tre.2025.104368>
- Feng, Y., Zhao, J., Sun, H., Wu, J., & Gao, Z. (2022). Choices of intercity multimodal passenger travel modes. *Physica A: Statistical Mechanics and Its Applications*, 600, 127500. <https://doi.org/10.1016/j.physa.2022.127500>

- Fitschen, P., Merfeld, K., Klein, J. F., & Henkel, S. (2024). Understanding the urban mobility challenge: Why shared mobility providers fail to attract car drivers. *Transport Policy*, 158, 104–111. <https://doi.org/10.1016/j.tranpol.2024.09.010>
- Friman, M., Lättman, K., & Olsson, L. E. (2020). Public transport quality, safety, and perceived accessibility. *Sustainability*, 12(9), 3563. <https://doi.org/10.3390/su12093563>
- Gadepalli, R., Tiwari, G., & Bolia, N. (2020). Role of users' socio-economic and travel characteristics in mode choice between city bus and informal transit services: Lessons from household surveys in Visakhapatnam, India. *Journal of Transport Geography*, 88, 102307. <https://doi.org/10.1016/j.jtrangeo.2018.08.017>
- Ge, L., Voß, S., & Xie, L. (2022). Robustness and disturbances in public transport. *Public Transport*, 14(1), 191–261. <https://doi.org/10.1007/s12469-022-00301-8>
- Gholi, H., Kermanshah, M., & Mamdoohi, A. R. (2022). Investigating the sources of heterogeneity in passengers' preferences for transit service quality. *Journal of Public Transportation*, 24, 100014. <https://doi.org/10.1016/j.jpubtr.2022.100014>
- Göransson, J., & Andersson, H. (2023). Factors that make public transport systems attractive: A review of travel preferences and travel mode choices. *European Transport Research Review*, 15(1), 32. <https://doi.org/10.1186/s12544-023-00609-x>
- Guo, J., & Yang, M. (2026). Perceptions of inter-city commuters toward high-speed rail and transfer services quality: An importance-performance analysis of the Suzhou-Shanghai corridor. *Transport Policy*, 179, 103985. <https://doi.org/10.1016/j.tranpol.2025.103985>
- Han, B., Ren, S., & Bao, J. (2020). Mixed logit model based on improved nonlinear utility functions: A market shares solution method of different railway traffic modes. *Sustainability*, 12(4), 1406. <https://doi.org/10.3390/su12041406>
- Hidayati, I., Tan, W., & Yamu, C. (2021). Conceptualizing mobility inequality: Mobility and accessibility for the marginalized. *Journal of Planning Literature*, 36(4), 492–507. <https://doi.org/10.1177/08854122211012898>
- Huan, N., Hess, S., Yamamoto, T., & Yao, E. (2026). Modelling intermodal traveller behaviour in mega-city regions: Simultaneous versus sequential estimation frameworks. *Transportation*, 53(1), 35–70. <https://doi.org/10.1007/s11116-024-10489-2>
- Hunecke, M., Groth, S., & Wittowsky, D. (2020). Young social milieus and multimodality: Interrelations of travel behaviours and psychographic characteristics. *Mobilities*, 15(3), 397–415. <https://doi.org/10.1080/17450101.2020.1732099>
- Jang, S., Caiati, V., Rasouli, S., Timmermans, H., & Choi, K. (2021). Does MaaS contribute to sustainable transportation? A mode choice perspective. *International Journal of Sustainable Transportation*, 15(5), 351–363. <https://doi.org/10.1080/15568318.2020.1783726>
- Kožul, N., Novačko, L., Babojelić, K., & Brlek, P. (2025). Stated preference approach in shaping urban sustainable multimodal transport: A literature review. *Systems*, 13(10), 853. <https://doi.org/10.3390/systems13100853>
- Kyi, E. P., Feng, T., Lan, J., & Liu, Y. (2026). Destination drone: A comprehensive analysis of Japanese consumer choice behavior and intentions for drone delivery services. *Research in Transportation Business & Management*, 67, 101673. <https://doi.org/10.1016/j.rtbm.2026.101673>
- Leffler, D., Burghout, W., Cats, O., & Jenelius, E. (2024). An adaptive route choice model for integrated fixed and flexible transit systems. *Transportmetrica B: Transport Dynamics*, 12(1), 2303047. <https://doi.org/10.1080/21680566.2024.2303047>
- Li, X., Ma, R., Guo, Y., Wang, W., Yan, B., & Chen, J. (2021). Investigation of factors and their dynamic effects on intercity travel modes competition. *Travel Behaviour and Society*, 23, 166–176. <https://doi.org/10.1016/j.tbs.2021.01.003>
- Li, X., Shi, L., Shi, Y., Tang, J., Zhao, P., Wang, Y., & Chen, J. (2024). Exploring interactive and nonlinear effects of key factors on intercity travel mode choice using XGBoost. *Applied Geography*, 166, 103264. <https://doi.org/10.1016/j.apgeog.2024.103264>
- Liu, Y.-A., Jing, Y., & Guo, S.-Y. (2025). Service attribute preferences of Air-HSR transfer process from a combined perspective of resource-matching, perceived risk, and value theories. *Journal of Advanced Transportation*, 2025(1), 7498989. <https://doi.org/10.1155/atr/7498989>

- Mahani, S. F., Oliveira, B. B., Patrício, L., Miguéis, V., Carravilla, M. A., & Oliveira, J. F. (2026). Behavior and factors of choice of urban travelers: A data-driven approach to sustainable mobility. *Transportation*. Advance online publication. <https://doi.org/10.1007/s11116-026-10765-3>
- Malichová, E., Cornet, Y., & Hudák, M. (2022). Travellers' use and perception of travel time in long-distance trips in Europe. *Travel Behaviour and Society*, 27, 95–106. <https://doi.org/10.1016/j.tbs.2021.12.003>
- Merkert, R., Bushell, J., & Beck, M. J. (2020). Collaboration as a service (CaaS) to fully integrate public transportation: Lessons from long-distance travel to reimagine mobility as a service. *Transportation Research Part A: Policy and Practice*, 131, 267–282. <https://doi.org/10.1016/j.tra.2019.09.025>
- Minhans, A., Chatterjee, A., & Popli, S. (2020). Public perceptions: An important determinant of transport users' travel behaviour. *Human Geographies – Journal of Studies and Research in Human Geography*, 14(2). <https://doi.org/10.5719/hgeo.2020.142.1>
- Mohammadi, R., Vosough, S., & Roncoli, C. (2024). Analysing the environmental and social impacts of a novel user-based transit signal priority strategy in a connected vehicle environment. *Journal of Advanced Transportation*, 2024(1), 8712813. <https://doi.org/10.1155/2024/8712813>
- Narayan, J., Cats, O., van Oort, N., & Hoogendoorn, S. (2020). Integrated route choice and assignment model for fixed and flexible public transport systems. *Transportation Research Part C: Emerging Technologies*, 115, 102631. <https://doi.org/10.1016/j.trc.2020.102631>
- Owais, M., Salah, A., & Shehata, H. M. (2026). Integrating machine learning and global sensitivity analysis for modeling public transport acceptance: Evidence from Egyptian cities. *Transportation Planning and Technology*. Advance online publication. <https://doi.org/10.1080/03081060.2026.2642868>
- Park, J., Choi, S., Kim, G., & Jo, H. (2025). Provision of metropolitan demand responsive transit and attitude's role in mode choice. *Transportation Research Part D: Transport and Environment*, 140, 104640. <https://doi.org/10.1016/j.trd.2025.104640>
- Peng, W., Teng, J., & Wang, H. (2024). Understanding heterogeneous passenger route choice in municipal rail transit with express and local trains: An empirical study in Shanghai. *Urban Rail Transit*, 10(2), 122–143. <https://doi.org/10.1007/s40864-024-00214-8>
- Pereira, R. H. M., Herszenhut, D., Saraiva, M., & Farber, S. (2024). Ride-hailing and transit accessibility considering the trade-off between time and money. *Cities*, 144, 104663. <https://doi.org/10.1016/j.cities.2023.104663>
- Pourhashem, G., Georgouli, C., Malichová, E., Straka, M., & Kováčiková, T. (2024). Factors influencing the perceived value of travel time in European urban areas. *Transportation*, 51(4), 1525–1545. <https://doi.org/10.1007/s11116-023-10376-2>
- Pourhashem, G., Malichová, E., Piscová, T., & Kováčiková, T. (2022). Gender difference in perception of value of travel time and travel mode choice behavior in eight European countries. *Sustainability*, 14(16), 10426. <https://doi.org/10.3390/su141610426>
- Putra, F. A., Wibowo, A., & Sidiq, I. P. A. (2022). Local climate zone (LCZ) in Bandar Lampung City. *International Journal of Remote Sensing and Earth Sciences*, 19(1), 69–78. <https://doi.org/10.30536/ijreses.v19i1.13791>
- Rahma, S., Triono, A., & A.T., M. E. P. (2024). Implementing social security programs for employees in Bandar Lampung: Challenges and recommendations. *Journal of Governance and Accountability Studies*, 3(2), 109–119. <https://doi.org/10.35912/jgas.v3i2.1873>
- Ram, Y., Gal-Tzur, A., & Rechavi, A. (2021). Identifying attributes of public transport services for urban tourists: A data-mining method. *Journal of Transport Geography*, 93, 103069. <https://doi.org/10.1016/j.jtrangeo.2021.103069>
- Ranjan, R., & Sinha, S. (2026). Influence of integrated multimodal travel information on commuter preferences and mode choice in urban areas. *Journal of Engineering and Applied Science*, 73(1), 59. <https://doi.org/10.1186/s44147-026-00918-7>
- Rasheed, M. R. (2023). *Moving forward: An assessment of Qatar's public transportation system and recommendations for future development* [Master's thesis, Politecnico di Milano]. POLITesi. <https://hdl.handle.net/10589/211512>

- Silver, K., Lopes, A., Vale, D., & da Costa, N. M. (2023). The inequality effects of public transport fare: The case of Lisbon's fare reform. *Journal of Transport Geography*, 112, 103685. <https://doi.org/10.1016/j.jtrangeo.2023.103685>
- Sukhov, A., Olsson, L. E., & Friman, M. (2022). Necessary and sufficient conditions for attractive public transport: Combined use of PLS-SEM and NCA. *Transportation Research Part A: Policy and Practice*, 158, 239–250. <https://doi.org/10.1016/j.tra.2022.03.012>
- Thombre, A., & Agarwal, A. (2021). A paradigm shift in urban mobility: Policy insights from travel before and after COVID-19 to seize the opportunity. *Transport Policy*, 110, 335–353. <https://doi.org/10.1016/j.tranpol.2021.06.010>
- Wang, K., Bhat, C. R., & Ye, X. (2023). A multinomial probit analysis of Shanghai commute mode choice. *Transportation*, 50(4), 1471–1495. <https://doi.org/10.1007/s11116-022-10284-x>
- Wong, Y. Z., Hensher, D. A., & Mulley, C. (2020). Mobility as a service (MaaS): Charting a future context. *Transportation Research Part A: Policy and Practice*, 131, 5–19. <https://doi.org/10.1016/j.tra.2019.09.030>
- Xu, G., Zhang, R., Xu, S. X., Kou, X., & Qiu, X. (2021). Personalized multimodal travel service design for sustainable intercity transport. *Journal of Cleaner Production*, 308, 127367. <https://doi.org/10.1016/j.jclepro.2021.127367>
- Yousefzadeh Barri, E., Farber, S., Jahanshahi, H., Tiznado-Aitken, I., & Beyazit, E. (2025). Exploring the joint impacts of income, car ownership, and built environment on daily activity patterns: A cluster analysis of trip chains. *Transportmetrica A: Transport Science*, 21(1), 2236235. <https://doi.org/10.1080/23249935.2023.2236235>
- Yu, W., Wen, H., Wang, W., Zhao, D., & Hua, X. (2024). On the calibration and improvement of human mobility models in intercity transportation system. *Physica A: Statistical Mechanics and Its Applications*, 653, 130116. <https://doi.org/10.1016/j.physa.2024.130116>
- Zhao, X., Yan, X., Yu, A., & Van Hentenryck, P. (2020). Prediction and behavioral analysis of travel mode choice: A comparison of machine learning and logit models. *Travel Behaviour and Society*, 20, 22–35. <https://doi.org/10.1016/j.tbs.2020.02.003>
- Zhou, H., Dorsman, J. L., Mandjes, M., & Snelder, M. (2025). A tour-based multimodal mode choice model for impact assessment of new mobility concepts and mobility as a service. *Transportation*, 52(3), 895–921. <https://doi.org/10.1007/s11116-023-10443-8>