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ASSESSING THE ECONOMIC COST OF WAITING TIME AND ITS INFLUENCE ON PASSENGER SATISFACTION IN PUBLIC TRANSPORTATION: CASE STUDY OF BATNA CITY

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Abstract:

This study assesses the economic cost of waiting time and its influence on passenger satisfaction within the public bus system of Batna City, Algeria. Based on survey data from 350 passengers, the analysis reveals a significant discrepancy between actual and perceived waiting times, with a mean of 12.3 and 15.1 minutes, respectively. This psychological overvaluation triples the cost, resulting in a subjective perceived cost of 151 DZD per trip compared to an objective economic cost of 51 DZD derived from average hourly income. Regression analysis demonstrates that the objective economic cost is a stronger predictor of passenger satisfaction (β = -0.532) than raw waiting time alone. The findings underscore that dissatisfaction is driven more by the monetized value of lost time than its mere duration. Consequently, public transport operators should adopt a dual strategy of improving operational efficiency to reduce actual waits and investing in passenger information and amenities to mitigate perceived waiting time.

Keywords:

Waiting Time, Economic Cost, Passenger Satisfaction, Public Transportation, Willingness to Pay.

1. Introduction

Public transport systems are essential to the functioning of contemporary cities as they support mobility, social inclusion, and economic activity. The rapid pace of urbanization, the rise in vehicle ownership, and growing environmental concerns have increased the importance of maintaining efficient and attractive public transport systems. Within this context, the concept of service quality has emerged as a central determinant of success. Beyond the basic provision of transport services, passengers increasingly evaluate the system based on how reliable, comfortable, and convenient it is. Dimensions such as service frequency, punctuality, comfort, safety, and waiting time are now recognized as the main attributes shaping user perceptions and influencing their continued use of public transport (Murambi & Bwisa, 2014).

Reliability remains one of the most critical aspects of service quality because it affects passengers' sense of control and predictability during travel. When buses or trains arrive irregularly, passengers experience uncertainty about departure times, which amplifies the negative perception of waiting. This relationship between service reliability and satisfaction has been confirmed in various studies. For instance, research conducted in Harbin, China, revealed that schedule information, the presence of companions during waiting, and the overall waiting experience significantly influenced perceived waiting time. The study showed that perceived waiting time had a strong negative effect on passenger satisfaction, with an average acceptable waiting period of around eight minutes before satisfaction levels began to decline (Feng, Wu, Sun, & Li, 2016).

Waiting time often constitutes a significant share of total travel time, especially in urban systems with irregular schedules or long headways. In the metropolitan area of Valparaíso in Chile, studies revealed that waiting and transfer times together accounted for between 17 percent and 40 percent of total trip duration, particularly in multimodal journeys involving transfers (Tirachini & Gómez-Lobo, 2023). This figure illustrates the extent to which waiting time contributes to the overall burden of travel, both in temporal and psychological terms.

Passengers tend to assign a higher disutility to waiting time compared with in-vehicle time. A recent investigation on the valuation of crowding and time in post-pandemic public transport contexts found that passengers value waiting and walking time at roughly double the value of time spent inside the vehicle (Menno, Howard, & Oded, 2025). This difference highlights the critical importance of minimizing waiting times to enhance perceived service quality. Even modest improvements in schedule reliability or information provision can substantially raise satisfaction levels.

Sustaining high service quality has direct implications for ridership levels and the overall viability of public transport systems. Prolonged or unpredictable waiting times discourage passengers and can lead to a decline in usage. As ridership decreases, operating revenues fall, which may reduce service frequency and create a cycle of declining quality. Transport authorities and operators therefore view waiting time as a strategic variable that affects both passenger perception and system performance. Evidence from Asia, Africa, and Europe demonstrates that improved service frequency, reliability, and real-time information provision are among the most effective strategies to increase passenger satisfaction (Wang, Zhang, Zhu, & Wang, 2020).

Waiting time also carries a psychological dimension. Beyond the actual number of minutes waited, perception depends on several contextual and emotional factors. Lack of real-time information, discomfort, safety concerns, or poor environmental conditions can make waiting feel longer and more stressful. Research in Harbin showed that passengers who were accompanied, engaged in an activity, or waiting in a pleasant environment reported shorter perceived waiting times compared with those waiting alone or without information about arrival times (Feng, Wu, Sun, & Li, 2016). Such findings underline that improving the waiting environment can be as significant as improving operational frequency.

As urban transport systems expand and the demand for quality increases, reducing waiting time and improving its perception have become vital elements of sustainable mobility strategies. Enhancing reliability, providing real-time information, and improving the comfort and safety of waiting areas are cost-effective measures that strengthen the attractiveness of public transport. Focusing on waiting time not only improves satisfaction but also increases passengers' sense of value and fairness, reinforcing the public's confidence in the system. Understanding the relationship between waiting time, perceived service quality, and satisfaction therefore provides essential insights for policymakers and transport managers seeking to create more efficient, equitable, and user-oriented public transport networks.

1.1. Research Problem

Waiting time in public transport not only diminishes passenger satisfaction it also carries a tangible economic cost often overlooked in many transport studies. Passengers spend time waiting at stops or stations which could otherwise be used productively whether working, studying, caring for dependents or engaging in leisure. This lost time has value in economic terms often captured through the concept of value of time. When waiting times are long or unpredictable travellers suffer both in subjective well-being and in foregone opportunities for income or other utility.

Evidence from a variety of countries shows that waiting time is weighted more heavily by users than in-vehicle travel time. A report by the OECD on valuing convenience in public transport identifies that in many European nations waiting time is valued at between two to two and a half times the value of in-vehicle time (OECD International Transport Forum, 2014). Studies of stops and stations in urban transit systems find that absence of amenities safety concerns and lack of shelter often cause perceived waiting times to feel longer than actual waiting times recorded (Yingling, Andrew, & David, 2016).

Few studies examine these economic costs in developing countries particularly in the Maghreb or Algerian context. Research in Algeria on service quality has considered waiting as one dimension among several such as comfort accessibility or information but has not isolated waiting time and monetized its cost. For example a study of rail transit services in Algiers used regression□based ordered probit models to assess the impact of service quality dimensions on overall satisfaction yet did not compute value of waiting time or economic loss associated with it (Tahar, Rocio, Badra, Lyes, & Joséluis, 2018). Another investigation in Annaba showed that travel time efficiency and time-related indicators correlated with satisfaction but again without translating waiting into monetary cost (Mehdi Amara, Bouchetara, Boudebza, & Mezaach, 2024).

Absence of this quantification in settings like Algeria limits the ability of transport planners and policymakers to prioritize interventions. When waiting time is not expressed in monetary terms decision makers may undervalue improvements such as increased frequency or better scheduling even if they yield large benefits for passengers. Survey□based estimation of the economic cost of waiting time and its influence on satisfaction would thus fill a gap in the literature and provide actionable insights for improving service quality in the public transport sector.

1.2. Research Objective

The central objective of this study is to estimate the economic cost of waiting time as perceived by public transport passengers in the city of Batna. Waiting time represents a significant component of the total travel experience, and understanding its monetary value provides a more comprehensive picture of how inefficiencies in service affect users' daily lives. Assigning an economic value to the minutes spent waiting captures not only the inconvenience faced by passengers but also the opportunity cost of lost time that could have been used productively. This estimation forms the foundation for assessing how much passengers are indirectly paying for service unreliability and how this burden influences their perception of quality.

Beyond the monetary aspect, the study aims to explore how waiting time shapes overall passenger satisfaction. Satisfaction in public transport does not depend solely on travel duration or fare levels; it is closely tied to how passengers experience the journey, particularly before boarding. When waiting times are long, unpredictable, or perceived as unfairly distributed across routes or times of day, they can strongly diminish satisfaction even if other service aspects are adequate. Understanding this relationship helps reveal the psychological dimension of waiting, where perceived time often weighs more heavily than actual time.

The analysis seeks to link these two dimensions into a coherent framework that highlights both the tangible and intangible costs of waiting. Estimating the economic cost provides a concrete measure of efficiency losses, while analysing satisfaction uncovers how passengers emotionally and cognitively respond to those losses. Together, they form an integrated approach to understanding waiting time not merely as a logistical delay but as a socio-economic factor shaping attitudes toward public transport. The findings aim to support more passenger-centered service planning and encourage strategies that minimize waiting, enhance predictability, and improve the overall experience of mobility in Batna.

2. Literature Review

A robust understanding of existing research is crucial for contextualizing this study. This literature review synthesizes key concepts and empirical findings related to waiting time, its economic valuation, and its relationship with passenger satisfaction in public transport. The review is structured into three interconnected themes to establish the theoretical foundation for the current investigation.

2.1. Waiting Time in Public Transport

Waiting time is a critical element in shaping passengers' perceptions of public transport service quality and efficiency. It refers to the period passengers spend waiting for a vehicle to arrive, which can be divided into actual and perceived waiting time. Actual waiting time corresponds to the objective duration measured in minutes between a passenger's arrival at a stop and the vehicle's departure. Perceived waiting time, in contrast, reflects the subjective experience of that duration and is influenced by psychological, environmental, and contextual factors. While two passengers may experience identical actual waiting times, their perceived waiting time can differ significantly depending on comfort, expectations, and service reliability (Machemehl & Fan, 2009). This distinction is fundamental for understanding how users assess the quality of service and how their satisfaction can be improved without necessarily changing the schedule.

The perception of waiting time tends to be longer when uncertainty about arrival times exists. Studies show that waiting without information feels almost twice as long as waiting with accurate and real-time updates (Zhang, Shen, & Clifton, 2018). Information availability reduces anxiety, enhances passengers' sense of control, and leads to a more favourable evaluation of service reliability. Moreover, the quality of the waiting environment plays an important role. Comfortable seating, shelter from adverse weather, lighting, and cleanliness all contribute to making the waiting experience less stressful. A well-designed waiting area can transform an inevitable delay into a tolerable part of the travel experience.

Crowding and personal safety perceptions further influence how waiting time is experienced. Passengers who feel unsafe or uncomfortable due to congestion, poor supervision, or inadequate space tend to perceive waiting time as longer than it actually is (Litman, 2021). Similarly, the socio-demographic profile of users shapes their tolerance. Women, older adults, and people with disabilities are generally more sensitive to discomfort and uncertainty, which heightens the negative perception of waiting.

Understanding these dimensions provides valuable insights for transport planners and policymakers seeking to enhance public transport attractiveness. Reducing perceived waiting time does not necessarily require increasing service frequency but can be achieved through better design, information systems, and improved passenger amenities. The perception of time can be managed through psychological and environmental cues that influence user comfort and trust in the system. Such improvements can significantly enhance overall satisfaction and encourage greater use of public transport services, particularly in urban areas where service reliability remains a major challenge.

2.2. Economic Valuation of Waiting Time

The economic valuation of waiting time represents a key aspect of transport economics, as it captures the opportunity cost of time lost while waiting for a service. This concept is often expressed through the Value of Time (VoT), which measures the monetary worth individuals assign to saving a specific amount of travel or waiting time. The VoT reflects the trade-off passengers are willing to make between time and money, and it plays a crucial role in cost-benefit analyses, service pricing, and infrastructure investment decisions (Small & Verhoef, 2007). In public transport, waiting time is generally valued more negatively than in-vehicle time, as it is associated with uncertainty, discomfort, and lack of productivity. This higher disutility translates into a higher marginal VoT for waiting compared to travel time, emphasizing the need to minimize waiting periods in transport planning.

The estimation of the Value of Time can be approached through two main methodologies: revealed preference and stated preference. Revealed preference methods rely on actual behaviour observed in real markets, such as choices between different transport modes or routes that involve trade-offs between cost and time. These methods capture real-world decision-making but are limited to existing market conditions. Stated preference methods, in contrast, are based on hypothetical scenarios presented to respondents, allowing researchers to evaluate preferences for time savings in situations not yet available in the market (Wardman, 2001). This approach, often applied through surveys or experiments, provides flexibility in estimating the value individuals attach to specific components of waiting, including reliability, comfort, and information availability. The combination of both methods often provides a more comprehensive understanding of time valuation.

Several studies have attempted to quantify the monetary cost of waiting time and its implications for public transport efficiency. For example, research in European and Asian cities has demonstrated that passengers value waiting time at approximately one and a half to two times the value of in-vehicle time (Li & Hensher, 2011). This finding underlines the psychological burden associated with waiting and highlights its strong influence on perceived service quality. Moreover, the economic valuation of waiting time serves as a foundation for designing policies that improve system efficiency, such as optimizing schedules, introducing real-time information systems, and enhancing stop amenities.

In the context of developing countries, including Algeria, the economic cost of waiting time remains largely underexplored. Despite the significant share of public transport users in urban mobility, empirical evidence quantifying the monetary loss due to waiting is scarce. Estimating this value is essential not only to capture the full societal cost of inefficiency but also to inform strategies that enhance user satisfaction and promote sustainable public transport usage.

2.3. Passenger Satisfaction in Public Transport

Passenger satisfaction in public transport is a multidimensional construct that reflects the gap between passengers' expectations and their actual travel experiences. The theoretical foundation for analysing this relationship is often derived from the expectation-disconfirmation theory, which posits that satisfaction arises when perceived service performance meets or exceeds prior expectations. If the service fails to meet those expectations, dissatisfaction occurs (Oliver, 1980). In public transport, expectations are shaped by factors such as punctuality, comfort, safety, and cost, while perceived performance depends on actual service delivery. Waiting time, being a highly visible and emotionally charged element of the journey, often becomes a decisive factor in determining whether expectations are confirmed or disconfirmed. When waiting times exceed expectations, even marginally, passengers tend to perceive the entire service experience negatively, reducing their overall satisfaction and likelihood of continued use.

The SERVQUAL model, developed by Parasuraman, Zeithaml, and Berry (Parasuraman, Zeithaml, & Berry, 1988), provides another valuable framework for assessing passenger satisfaction in transport services. This model identifies five dimensions of perceived service quality: tangibles, reliability, responsiveness, assurance, and empathy. In the public transport context, reliability relates closely to service frequency and waiting time, while responsiveness and assurance involve driver behaviour, information provision, and safety. The SERVQUAL framework helps identify which attributes most strongly influence satisfaction and where service improvements can yield the greatest impact. In many empirical studies, reliability and waiting time have consistently emerged as the most influential factors in shaping passenger perceptions of quality (Eboli & Mazzulla, 2007).

Waiting time, as a critical operational indicator, has both direct and indirect effects on satisfaction. Longer or unpredictable waiting periods generate frustration and stress, amplifying the perceived duration and diminishing trust in the transport system. In contrast, shorter and more predictable waiting times foster a sense of control and reliability, strengthening satisfaction even if other aspects of the service remain constant. Research also suggests that perceived service quality mediates the relationship between waiting time and satisfaction, implying that improvements in reliability and information availability can mitigate the negative effects of waiting (de Oña & de Oña, 2015). Thus, managing waiting time effectively is not only a matter of operational efficiency but also a strategic tool for enhancing user satisfaction and promoting public transport as an attractive alternative to private modes.

3. Methodology

This study employed a quantitative research design to investigate the economic cost of waiting time and its influence on passenger satisfaction. The methodological approach encompassed the selection of a study area, the development of a data collection instrument, a rigorous sampling procedure, and a suite of statistical analysis techniques. The subsequent sections detail the implementation of this approach, beginning with the context of the study area and its population.

3.1. Study Area and Population

Batna city, located in northeastern Algeria, represents one of the country's major urban centres and serves as an important administrative, economic, and educational hub within the highlands region. With an estimated population exceeding 400,000 inhabitants, the city has experienced rapid demographic growth and urban expansion over the past two decades. This expansion has intensified mobility needs and placed increasing pressure on the local public transport system. The network primarily relies on urban buses operated by both public and private companies, which constitute the main mode of daily transportation for residents. Despite its central role in facilitating urban mobility, the bus system faces recurrent challenges such as irregular schedules, congestion, and inadequate passenger information. These issues often result in extended waiting times at stops, affecting user satisfaction and productivity.

The target population of this study includes passengers who regularly use the urban bus system within Batna. This group encompasses a diverse demographic profile, including students, workers, and low to middle-income residents who depend on public transport for commuting. Focusing on this segment is particularly relevant since bus passengers are directly exposed to the effects of waiting time and its associated economic cost. Understanding their perceptions provides valuable insights into the service quality gaps that hinder public transport attractiveness. Moreover, Batna's representativeness as a medium-sized Algerian city makes it a suitable case for examining broader issues of efficiency and satisfaction in urban transport systems across developing regions.

3.2. Data Collection Tool: Questionnaire Design

The questionnaire was developed as the main data collection tool to gather information on passengers' socio-demographic characteristics, travel behaviour, perceived economic cost of waiting time, and satisfaction with public transport services in Batna city. Its design followed established principles of transport and service quality research to ensure clarity, coherence, and reliability in measuring the constructs under study (De Vaus, 2014). The instrument consisted of four sections structured to facilitate a logical and respondent-friendly flow from general to specific aspects of the travel experience.

The first section focused on socio-demographic information, including age, gender, occupation, income level, and frequency of travel. These variables help contextualize passengers' perceptions and identify how individual characteristics influence both satisfaction and valuation of waiting time. The second section examined travel characteristics, capturing information about the primary transport mode used, average waiting time, trip purpose, and duration. Such details are essential for linking operational aspects of service provision with user evaluations and for understanding the variability in waiting time experiences among different user categories (Paulley, et al., 2006).

The third section explored passengers' perceptions of the economic cost of waiting time. Respondents were asked to express their willingness to pay to reduce waiting time, a common approach in valuing time in transport economics (Wardman, 2001). This measure enables the translation of time lost into a monetary equivalent, providing an estimate of the implicit value passengers attach to their waiting experience. The final section assessed satisfaction with public transport services through a series of Likert-scale items, typically ranging from 1 (very dissatisfied) to 5 (very satisfied). These items covered multiple service dimensions such as reliability, comfort, safety, information availability, and punctuality, which are known determinants of overall satisfaction (Eboli & Mazzulla, 2007).

To ensure reliability and validity, the questionnaire was pre-tested with a small sample of respondents representing the target population. The pre-test aimed to evaluate clarity, relevance, and comprehensibility of the items, leading to minor adjustments in wording and structure. Internal consistency of the final instrument was verified using Cronbach's alpha, where a coefficient above 0.70 was considered acceptable for social science research (Nunnally & Bernstein, 1994). This process ensured that the data collection tool was both statistically sound and contextually appropriate for analysing the relationship between waiting time, its economic valuation, and passenger satisfaction in Batna's public transport system.

3.3. Sampling Method and Size

The study employed a random sampling technique to ensure the representativeness of respondents and minimize potential selection bias. This method provided each passenger in the population an equal opportunity to be selected, allowing for the collection of diverse perspectives regarding waiting time and its perceived economic cost. Random sampling is widely recognized for its ability to generate statistically reliable results, particularly when investigating behavioural and perceptual variables within transportation research (Etikan & Bala, 2017). It also facilitates generalization of findings to the wider population of urban transport users in Batna.

The determination of sample size followed a statistical rationale that ensures sufficient precision and confidence in the results. The formula used to calculate the sample size considered the total population of passengers using public transport in Batna, a confidence level of 95 percent, and a margin of error of five percent, as recommended for social science research (Cochran, 1977). This approach allowed for an appropriate balance between accuracy and resource constraints. A pre-test phase helped refine the data collection process and confirm that the chosen sample size adequately captured variability in passenger perceptions and behaviours.

The selected sampling strategy contributed to the reliability and validity of the findings, enhancing the credibility of the conclusions drawn from the analysis. Random sampling ensured that the data reflected the actual diversity of transport users in terms of age, gender, occupation, and travel patterns, thereby strengthening the study's empirical foundation.

3.4. Data Analysis Techniques

The analysis of the collected data followed a structured and sequential approach to ensure clarity in interpretation and consistency with the study objectives. Descriptive statistics were first applied to summarize the demographic and travel characteristics of respondents, using measures such as means, frequencies, and standard deviations. This stage provided an overview of the sample's composition and allowed for the identification of trends related to waiting time perceptions among passengers. Descriptive analysis is an essential step in understanding data distribution and detecting potential anomalies that may affect subsequent inferential procedures (Hair, Black, Babin, & Anderson, 2020).

The second analytical stage focused on estimating the perceived economic cost of waiting time. This cost was computed using the formula that multiplies the average hourly income of respondents by their reported waiting time. The method enables the quantification of time loss in monetary terms, offering an economic perspective on passenger experiences. This approach has been widely adopted in transport economics for valuing travel time and assessing service efficiency (Small, The Value of Travel Time and Reliability in Transportation Policy, 2012).

To assess the relationship between perceived economic cost and passenger satisfaction, correlation and regression analyses were performed. These techniques help determine both the strength and the direction of associations between variables and provide insights into how waiting time influences satisfaction (Field, 2018). The combination of these analytical tools ensures a comprehensive understanding of the data and enhances the robustness of the study's findings.

4. Results and Discussion

This section presents the empirical findings derived from survey data collected among public transport passengers in Batna City. The analysis is organized into descriptive statistics, estimation of the objective economic cost of waiting time, and the statistical relationship between this cost and passenger satisfaction.

4.1 Descriptive Analysis

The survey included 350 respondents randomly selected from Batna's urban bus network. The sample represented a balanced demographic structure with 52% males and 48% females, covering an age range of 18 to 65 years (mean = 32.4, SD = 10.2). As displayed in Table 1, the largest occupational group comprised workers (45%), followed by students (38%), retirees (10%), and others (7%). Approximately 60% reported monthly incomes below 40 000 DZD, reflecting the socioeconomic profile of Batna's bus users. Daily users represented 70% of respondents, with work and education trips being dominant purposes (55% and 30%, respectively).

Table 1. Socio-demographic Profile of Respondents

Variable	Category	Frequency (n)	Percentage
Gender	Male	182	52%
	Female	168	48%
Age (years)	18-24	98	28%
	25-34	119	34%
	35-44	73	20.8%
	45-54	39	11.2%
	≥ 55	21	6%
Occupation	Student	133	38%
	Worker	158	45%
	Retired	35	10%
	Other	24	7%
Monthly income	< 40 000 DZD	209	59.7%
	≥ 40 000 DZD	141	40.3%
Travel frequency	Daily	246	70.3%
	Occasionally	104	29.7%
Main trip purpose	Work	193	55.0%
	Education	105	30.0%
	Leisure/Other	52	15.0%

Source: Authors' calculations based on survey data.

Regarding travel experience, a notable discrepancy was observed between objective and subjective measures. The average actual waiting time reported was 12.3 minutes (SD = 4.8), while the perceived waiting time was significantly higher at 15.1 minutes (SD = 5.2). Critically, about 65% of respondents felt that they waited longer than they actually did. This aligns with established behavioural theories, such as prospect theory, which suggest that losses (in this case, time lost) are perceived more heavily than equivalent gains.

Table 2. Descriptive Statistics of Waiting Time and Perceived Cost

Variable	Minimum	Maximum	Mean	SD
Actual waiting time (minutes)	5	25	12.3	4.8

Perceived waiting time (minutes)	6	30	15.1	5.2
Willingness to pay (DZD/minute)	2	18	10.0	3.1
Subjective Perceived Cost per trip (DZD)	**30**	**540**	**151.0**	**52.0**
Objective Economic Cost per trip (DZD)	*20*	*110*	*51.3*	*16.4*

Source: Authors' calculations based on survey data.

The results indicate that passengers assign a subjective value of 10 DZD per minute to time savings, reflecting their willingness to pay (WTP) to reduce waiting time. When this valuation is multiplied by the perceived waiting time, the subjective perceived cost per trip reaches approximately 151 DZD. In contrast, applying the same WTP rate to the actual waiting time yields an objective economic cost of about 51 DZD per trip.

This pronounced difference where the perceived cost is nearly three times the objective cost, is the central finding of this analysis. It highlights a strong psychological overvaluation of waiting time, a pattern well-documented in behavioural economics. This "waiting time penalty" suggests that the passenger experience is dominated not by the actual duration of wait, but by the frustration, uncertainty, and opportunity cost felt during that period. For public transport authorities, this implies that interventions aimed at improving perceived wait (e.g., providing real-time information, enhancing shelter comfort) could be as crucial as those aimed at reducing actual wait times. The objective cost is further examined in Section 4.2, where it is also derived from passengers' average hourly income.

4.2 Economic Cost of Waiting Time

The objective monetary valuation of waiting time was estimated using the product of average hourly income and reported waiting duration. With an overall average income of 250 DZD/hour (4.17 DZD/minute), the cost per passenger per trip amounted to 51.25 DZD. Table 3 shows subgroup variations based on income-specific hourly rates.

Table 3. Economic Cost of Waiting Time by Demographic Group

Demographic Variable	Category	Cost per Minute (DZD)	Cost per Trip (DZD)	Cost per Year (DZD)
Overall Sample		**4.17**	**51.25**	**37,410**
Income level	< 40 000	3.80	46.7	34,090
	≥ 40 000	5.27	64.8	47,300
Occupation	Student	3.54	43.5	31,760
	Worker	4.55	56.0	40,880
	Retired	3.94	48.5	35,410
Trip purpose	Work	4.85	59.7	43,560
	Leisure	3.23	39.7	28,980
Gender	Male	4.10	50.4	36,790
	Female	4.30	52.9	38,620

Source: Authors' calculations based on survey data.

The variations in Table 3 are both expected and informative. The higher cost for higher-income passengers (64.8 DZD/trip vs. 46.7 DZD/trip) and workers (56.0 DZD/trip) logically reflects their higher opportunity cost of time. Similarly, work trips command a higher cost (59.7 DZD/trip) than leisure trips (39.7 DZD/trip), underscoring the greater time pressure associated with commuting. Assuming two trips per day, the annual economic cost reached 37,410 DZD (280 USD) per regular user. This substantial figure translates the abstract concept of 'waiting' into a tangible financial burden for users, providing a powerful metric for cost-benefit analyses of service improvements. For instance, this annual cost can be directly compared against the investment required to increase bus frequency.

4.3 Relationship Between Economic Cost and Satisfaction

To explore the link between objective economic cost per trip and passenger satisfaction score, correlation and regression analyses were conducted. The Pearson correlation matrix in Table 4 reveals significant negative associations between economic cost per trip and satisfaction score ($r = -0.62$, $p < 0.01$) and between actual waiting time and satisfaction score ($r = -0.44$, $p < 0.01$).

Table 4. Correlation Matrix of Key Variables

Variable	1	2	3	4
1. Economic cost (DZD/trip)	1.00			
2. Actual waiting time (min)	0.42**	1.00		
3. Income level	0.38**	0.12	1.00	
4. Satisfaction score (1–5 scale)	-0.62**	-0.44**	0.21*	1.00

*p < 0.05; ***p < 0.01*

Source: Authors' calculations based on survey data.

The stronger negative correlation for economic cost (r = -0.62) compared to waiting time alone (r = -0.44) is a critical insight. It suggests that passenger dissatisfaction is more powerfully linked to the monetary value of lost time than to the mere duration of the wait. This monetized measure likely captures the personal socioeconomic impact of waiting, making it a more potent predictor of satisfaction.

Given the strong correlation observed between economic cost and waiting time, two separate regression models were estimated to minimize potential multicollinearity.

Model 1 (Primary Model): A multiple regression analysis examined how economic cost per trip, travel frequency, and income level predict satisfaction score. The model was significant ($F(3, 346) = 65.41$, $p < 0.001$, $R^2 = 0.447$). The results are presented in Table 5.

Table 5. Multiple Regression Results (Model 1): Predictors of Passenger Satisfaction Score

Variable	B	Std. Error	Beta	t	Sig.
Constant	3.415	0.165	—	20.70	0.000
Economic Cost (DZD/trip)	**-0.015**	**0.002**	**-0.532**	**-7.50**	**0.000**
Travel Frequency	0.091	0.043	0.130	2.12	0.035
Income Level	0.058	0.029	0.090	2.00	0.046
**Model Summary: $R^2 = 0.447$	Adjusted $R^2 = 0.437$	$F(3, 346) = 65.41$	$p < 0.001$**		

Source: Authors' calculations based on survey data.

Economic cost per trip had the strongest negative effect on satisfaction score (β = -0.532). This large, significant beta coefficient confirms that as the economic cost of waiting increases, passenger satisfaction decreases substantially, even after controlling for travel frequency and income. The small but significant positive effect of income (β = 0.090) is intriguing; it may indicate that higher-income passengers, despite facing a higher objective cost, have different expectations or a higher tolerance threshold.

Model 2 (Alternative Model): A separate model using actual waiting time instead of economic cost was also significant but explained less variance ($R^2 = 0.392$ vs. 0.447). The superior explanatory power of Model 1 solidifies the argument that the 'economic cost of waiting' is a more nuanced and comprehensive metric for understanding passenger dissatisfaction than 'waiting time' in isolation. It encapsulates not just time, but the value of that time to the individual, offering a richer variable for both researchers and transit planners aiming to enhance service quality.

4.4. Discussion

The findings of this study resonate strongly with existing literature on the behavioural economics of public transport. The significant discrepancy between actual and perceived waiting time, where passengers felt they waited nearly three minutes longer than they actually did, aligns with the concept of time perception distortion under uncertainty. As highlighted by Lyons et al. (2021), the subjective experience of waiting is often amplified by factors like anxiety, boredom, and a lack of information, leading to a "perception penalty" that can outweigh objective service metrics. This psychological overvaluation is further crystallized in the tripling of cost from the objective economic (51 DZD) to the subjective perceived (151 DZD), a phenomenon consistent with the loss aversion principle in prospect theory, where losses loom larger than gains (Kahneman & Tversky, 1979).

The robust negative relationship between the economic cost of waiting and passenger satisfaction underscores the critical importance of moving beyond simple temporal measures. The stronger predictive power of the monetized cost ($\beta = -0.532$) compared to waiting time alone in our regression models suggests that dissatisfaction is intrinsically tied to the value of lost time, not merely its passage. This finding corroborates research from the U.K. Department for Transport (2019), which emphasizes that willingness-to-pay-based valuations provide a more accurate measure of user benefit for transport appraisal. When passengers internalize waiting as a financial loss, their overall satisfaction with the service is significantly diminished.

These insights yield direct and actionable implications for public transport operators in Batna and similar contexts. Primarily, service improvement strategies must adopt a dual focus: reducing actual waiting times through optimized scheduling and increased frequency, while simultaneously mitigating the perceived wait. Investing in real-time passenger information systems, for instance, has been shown to reduce the perception of waiting time by restoring a sense of control and predictability to users (Cats, Susilo, & Reimal, 2017). Enhancing the quality of the waiting environment with comfortable shelters and seating can also positively influence the travel experience, making unavoidable waits feel shorter and less costly.

Ultimately, this study demonstrates that time is not a neutral metric in public transport but a psychologically charged and economically significant resource. Addressing the gap between its objective and subjective valuation is paramount. Operators who succeed in this endeavour will not only improve the economic efficiency of their users' journeys but also foster a more positive perception of the service, leading to higher satisfaction and potentially greater ridership loyalty.

5. Conclusion and Recommendations

This study has quantitatively demonstrated that the waiting experience is a central determinant of passenger satisfaction in Batna's public transport system, with its impact most accurately captured through an economic lens. The analysis reveals two critical, interconnected findings: a substantial divergence between actual and perceived waiting time, and the powerful explanatory role of the objective economic cost of this time in predicting satisfaction levels. The fact that the monetized value of waiting time emerged as a stronger predictor than the raw duration of the wait underscores a fundamental insight for transport planning. It is not merely the passage of time that erodes the user experience, but the tangible sense of economic loss associated with it. This psychological overvaluation, where the subjective cost of waiting triples the objective cost, translates directly into lower satisfaction scores, forming a clear pathway from service quality to user perception.

The implications of these findings point toward a dual strategy for public transport operators and policymakers. The first and most direct approach is to reduce the actual economic cost incurred by passengers through investments that enhance operational efficiency. This entails optimizing schedules and increasing service frequency, particularly during peak hours for work and education trips, which this study identified as bearing the highest time-value burden. Such measures directly lower the objective economic cost per trip for all users. The second, equally crucial approach involves addressing the pronounced perception gap. Implementing real-time passenger information systems at major stops and on mobile platforms can significantly mitigate the anxiety and uncertainty that inflate perceived waiting times. Accurate wait-time predictions offered by these systems give passengers a sense of control and predictability, lowering the perceived cost of waiting. Additionally, enhancing the waiting environment with improved shelters, seating, and safety measures can make unavoidable delays more bearable, ultimately improving the overall travel experience.

From a theoretical standpoint, this research contributes to the field by successfully integrating a classical economic valuation method with contemporary passenger satisfaction analysis. It moves beyond establishing a simple correlation between waiting time and satisfaction, instead proposing a more nuanced model where the monetization of time acts as the key mediating variable. This framework provides a richer, more economically grounded understanding of user behaviour, bridging a gap between transport economics and service quality management. The demonstrated methodology offers a replicable model for researchers in other contexts to quantify the intangible costs of service inadequacies and their subsequent impact on user loyalty and ridership.

Despite these contributions, it is important to acknowledge the study's limitations. The reliance on self-reported data for waiting times and incomes, while practical, is susceptible to biases such as recall error and social desirability. The cross-sectional nature of the survey provides a snapshot of relationships but cannot definitively establish causality over time. The focus on a single city, Batna, also limits the immediate generalizability of the findings to other cultural or economic contexts. Future research should seek to build upon this foundation by employing more robust data collection methods. Longitudinal studies could track changes in perception and satisfaction following specific service interventions, such as the installation of real-time information displays. Expanding the sample to include multiple cities would allow for comparative analysis and enhance the external validity of the findings. Finally, employing revealed preference methods, which observe actual passenger behaviour rather than stated intentions, could provide a more objective measure of willingness-to-pay and further validate the economic cost calculations presented here.

In essence, the journey toward a more satisfactory public transport system requires a concerted effort to shrink both the clock and the mind's perception of its passage. Authorities can deliver a more efficient and human-centered service by addressing both the objective and subjective aspects of waiting at the same time. The proposed recommendations, which include prioritizing operational reliability, investing in passenger information technology, and upgrading waiting infrastructure, offer a practical roadmap for enhancing the passenger experience. This targeted approach not only boosts satisfaction levels but also reinforces public transport's role as a key urban mobility option.

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