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ANALYSIS OF THE EFFECTIVENESS OF RAILWAY SERVICE IN LAMPUNG ON THE TANJUNG KARANG STATION – KOTABUMI STATION ROUTE

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Abstract

This study aims to analyze the effectiveness of railway services in Lampung on the Tanjung Karang–Kotabumi route from the users' perspective using a quantitative survey-based approach. The research focuses on Rajabasa (economy class) and Kuala Stabas (premium class) train services. Data were collected through Likert-scale questionnaires and secondary sources using an *accidental simple random sampling* technique. The variables include traveler characteristics, travel characteristics, and transportation system facilities. Data validity and reliability were tested before being analyzed using the *Classification and Regression Tree* (CART) method. The results indicate that service effectiveness is strongly influenced by the quality of interaction between staff and passengers as well as the condition of physical carriage facilities. Staff attributes emerge as the most dominant factor with the highest satisfaction scores, while management aspects remain the primary weakness. Differences in facility quality between premium and economy classes and accessibility issues in premium services were also identified. The CART model reveals that integrated operational and service quality is the key determinant, with staff attributes as the strongest predictor. The optimal model was obtained at a 1.5 threshold with high accuracy.

Keywords: *Service Effectiveness, Railway, CART, Passenger Satisfaction, Transportation.*

INTRODUCTION

At present, railway transportation in Lampung constitutes an effective and widely preferred mode of mass transit among the public. Tanjung Karang Station serves as the primary departure and arrival hub for passengers boarding and alighting from trains. The station is located in Gunung Sari Subdistrict, Enggal District, Bandar Lampung City, and is categorized as a Class A major station under the Regional Division IV Tanjung Karang. In addition to Tanjung Karang Station, other major stations in Lampung include Rejosari Station and Kotabumi Station. Besides these major stations, several smaller stations also facilitate passenger boarding and alighting. Based on data from PT Kereta Api Indonesia Regional Division IV Tanjung Karang (2025), there are two active passenger train services operating in 2025. First, the Rajabasa economy-class train operates from Tanjung Karang Station to Kertapati Station, passing through 23 intermediate stations. Second, the Kuala Stabas premium-class train runs from Tanjung Karang Station to Baturaja Station, with 14 stops along the route. In addition, several train services are no longer operational as of 2025, including the Sriwijaya train (a mixed business and executive class service) on the Tanjung Karang–Kertapati route, and the Seminung commuter train (KRD type) operating between Tanjung Karang and Kotabumi.

The existence of railway transportation reflects the fundamental role of transport as a basic human need, enabling the movement of people and goods from one place to another. Transportation is defined as the activity of moving goods and passengers from an origin to a destination (Abbas Salim, 2000). A transportation system comprises infrastructure, vehicles, operational management, and human resources that together form a network of services and facilities. Key factors influencing passengers' mode choice can be utilized to improve public transport services, including railways (Pavlyuk & Gromule, 2010). Attribute-based models grounded in respondent characteristics and travel behavior (Vidana Bencomo et al., 2018) highlight the importance of statistical analysis in identifying determinants of mode choice, based on user characteristics, needs, and travel preferences. Railway service performance is a crucial aspect of public mobility, particularly in Lampung. The Tanjung Karang–Kotabumi route represents one of the main corridors used for various purposes, including work, education, leisure, and other daily activities. Therefore, evaluating the effectiveness of railway services along this route is essential to enhance service quality and user satisfaction. In its development, railway services offer multiple classes, including economy and premium services, each differing in comfort, pricing, facilities, and service effectiveness. Service effectiveness is a critical factor in improving customer satisfaction and operational efficiency. Elements such as punctuality, comfort, facility quality, and staff performance significantly influence passengers' perceptions of service quality. Accordingly, a comprehensive analysis is required to assess service effectiveness. The Classification and Regression Tree (CART) method is one analytical approach that can be employed to examine the relationship between service variables and their effectiveness. This method enables the identification of key factors influencing service performance, thereby providing a robust basis for improving the quality of railway services in the future.

METHOD

This study aims to analyze the effectiveness of railway services in Lampung from the users' perspective using a quantitative survey-based approach. The research begins with problem identification, literature review, and determination of the study location on the Tanjung Karang–Kotabumi route, focusing on the Rajabasa (economy class) and Kuala Stabas (premium class) trains. Data collection employs both primary data (questionnaires using a Likert scale distributed through direct surveys and Google Forms) and secondary data obtained from relevant institutions. The sampling technique uses probability sampling with an *accidental simple random sampling* method, while the sample size is determined using the Sugiyono formula. The research variables include traveler characteristics, travel characteristics, and transportation system facility characteristics, which are further operationalized into measurable indicators. The collected data are tested for validity and reliability before being analyzed using the *Classification and Regression Tree* (CART) method to identify the key factors influencing the effectiveness of railway services in Lampung.

RESULTS AND DISCUSSION

Respondent Characteristics

The respondents in this study were 100% of train passengers who had used the Rajabasa Economy Class and Kuala Stabas Premium Class trains. The aim was to compare train facilities. The sample size was 320 people.

Validity and Reliability Test

All attributes were valid, with a Corrected Item-Total Correlation > 0.3 and a significance level of 0.000. High reliability, with Cronbach's Alpha values of 0.969 (economy class) and 0.970 (premium class), indicated data consistency.

Descriptive Statistics

The most influential service dimension on economy class trains was employee characteristics, with the highest mean score of 3.54 and a standard deviation of 0.80, indicating a 22.67% difference in opinion compared to the overall average of respondents. The least influential service dimension was environmental characteristics, with the lowest mean score of 3.08. and shows a standard deviation of 0.94, indicating a 30.62% difference in opinion compared to the overall average of respondents.

Table 1. Description of Economy Class Train Service Dimensions

Item	Indicator	Mean	Standard Deviation	Variation (%)
1	Punctuality	3.38	0.84	24.85%
2	Accessibility	3.36	0.80	23.81%
3	Capacity	3.38	0.79	23.37%
4	Ticket Price	3.42	0.72	21.05%
5	Environmental Characteristics	3.08	0.94	30.52%
6	Management Characteristics	3.25	0.86	26.46%
7	Organizational Characteristics	3.35	0.79	23.58%
8	Worker Characteristics	3.54	0.80	22.60%
Total Mean		**3.34**		

The most influential service dimension on premium trains is employee characteristics, with the highest mean score of 3.56 and a standard deviation of 0.84, indicating a 23.48% difference in opinion compared to the overall average. The least influential service dimension is accessibility, with the lowest mean score of 3.31 and a standard deviation of 0.84, indicating a 25.28% difference in opinion compared to the overall average.

Table 2. Description of Premium Train Service Dimensions

Item	Indicator	Mean	Standard Deviation	Variation (%)
1	Punctuality	3.51	0.84	23.93%
2	Accessibility	3.31	0.84	25.38%
3	Capacity	3.43	0.77	22.45%
4	Ticket Price	3.37	0.79	23.44%
5	Environmental Characteristics	3.36	0.86	25.60%
6	Management Characteristics	3.34	0.79	23.65%
7	Organizational Characteristics	3.40	0.80	23.53%
8	Worker Characteristics	3.56	0.84	23.60%
Total Mean		**3.41**		

CART Analysis Results

The CART analysis of premium train services used different thresholds (1.5, 2.5, and 3.5) to binarize effectiveness into low (0) or high (1). The results showed a threshold of 1.5 as the best, with an average cross-validation (CV) accuracy of 96.25% and a test accuracy of 95.31%. The lowest root Gini index (0.1635) indicated good initial class separation, with the primary split at "workers" ≤ 1.5. The tree had 7 split nodes, was simple, and highly interpretable.

Table 3. Gini Index for Threshold 1.5 – Premium

Node	Gini Index
0	0.1635
1	0.3299
2	0.375
6	0.0339
8	0.065
10	0.0791
12	0.0858

Tabel 4. Best Split Threshold 1.5 – Premium

Node	Feature	Threshold
0	Worker	1.5
1	Time	1.5
2	Environment	1.5
6	Management	3.5
8	Accessibility	3.5
10	Environment	3.5
12	Time	3.0

Pruning with Cost Complexity Pruning (CCP) alpha shows stable accuracy up to high alpha, without significant overfitting. Confusion matrix threshold 1.5: TN=6, FP=1, FN=2, TP=55. Precision 0.98, recall 0.96, F1-score 0.97.

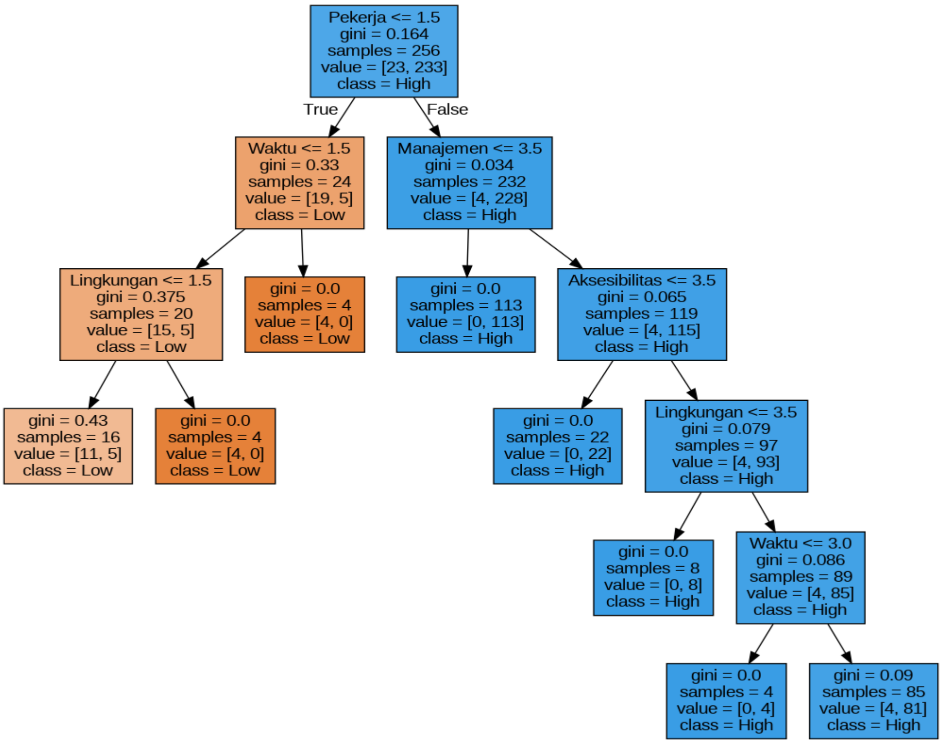

Figure 1. Threshold 1.5 Tree – Premium

For economy, a threshold of 1.5 is also optimal, with an accuracy of 95.31% and a mean CV of 95.94%. Root split on "workers" ≤ 1.5, tree with 8 split nodes. Gini index root 0.99999 (high initial, rapidly decreasing). Best splits focus on workers, capacity, tickets, and the environment.

Table 5. Gini Index Threshold 1.5 - Economy

Node	Gini Index
0	0.999987237
1	0.99898368
2	0.998836564
3	0.9984375
8	0.999981897
10	0.999912777
12	0.999893898
14	0.999884591

Table 6. Best Split Threshold 1.5 – Ekonomi

Node	Feature	Threshold
0	Worker	1.5
1	Capacity	2.0
2	Ticket	1.5
3	Environment	2.5
8	Environment	3.5
10	Capacity	3.5
12	Worker	3.0
14	Management	3.5

Pruning shows a gradual increase in impurity, a robust model. The confusion matrix is similar in premium for thresholds 1.5 and 2.5, with 3.5 being slightly different. Overall, CART identifies workers as the primary predictor in both classes.

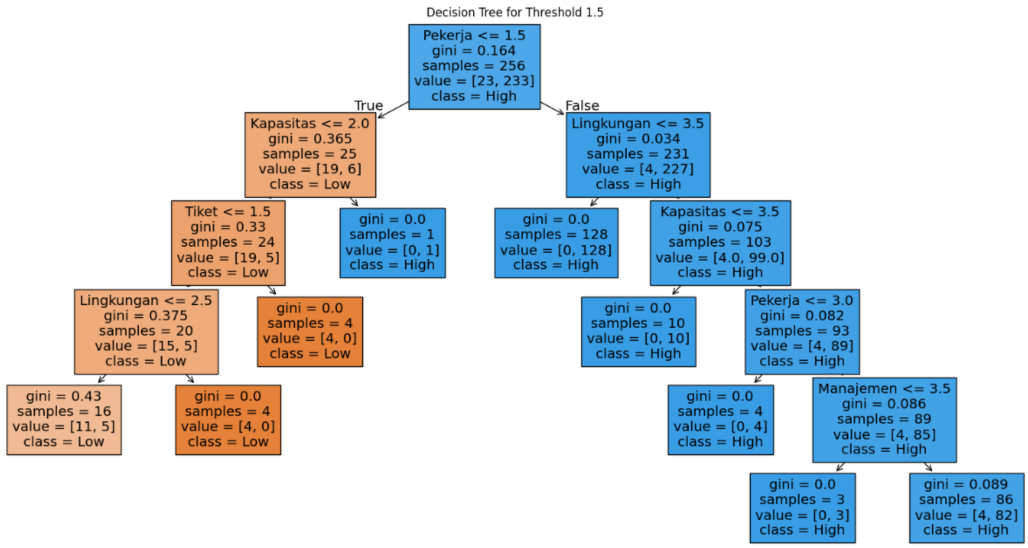

Figure 2. Threshold Tree 1.5 – Economy

Factor Analysis

Overall, the factor analysis of premium train services indicates that the eight measured attributes—*Time, Accessibility, Capacity, Ticketing, Environment, Management, Organization,* and *Staff*—are highly interrelated and can be reduced into a single dominant factor. This factor can be interpreted as *"Integrated Operational and Service Quality,"* which comprehensively represents customer perceptions of the effectiveness of premium train services.

Factor Analysis of Premium Train Services

Data Feasibility Test (KMO and Bartlett's Test)

a. Kaiser-Meyer-Olkin (KMO) Test
   The KMO value is 0.915. This value is categorized as excellent (well above the minimum threshold of 0.5).
b. Bartlett's Test of Sphericity
   The test shows a significance value (Sig.) of 0.000. This indicates that there is a statistically significant correlation among the variables.

Thus, the data are highly suitable for further analysis using factor analysis.

Table 7. KMO and Bartlett's Test for Premium Train Services

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.915
Bartlett's Test of Sphericity	Approx. Chi-Square	2645.254
	df	28
	Sig.	.000

The premium test analysis value in each variable can be seen: For Anti-image correlation all > 0.8. High communalities, the highest capacity of 0.886. Total variance: one factor eigenvalue 6.071, explain 75.883%. Scree plot steep fault after factor 1. Component matrix: capacity 0.941, organization 0.909, management 0.906 strongest.

Table 8. Communalities of Premium Train

	Initial	Extraction
Waktu	1.000	.613
Aksesibilitas	1.000	.657
Kapasitas	1.000	.886
Tiket	1.000	.779
Lingkungan	1.000	.759
Manajemen	1.000	.822
Organisasi	1.000	.827
Pekerja	1.000	.728

Extraction Method: Principal Component Analysis.

Table 9. Total Variance Explained of Premium Train

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.071	75.883	75.883	6.071	75.883	75.883
2	.569	7.111	82.994			
3	.445	5.558	88.552			
4	.269	3.363	91.914			
5	.247	3.091	95.005			
6	.170	2.126	97.131			
7	.119	1.489	98.621			
8	.110	1.379	100.000			

Extraction Method: Principal Component Analysis.

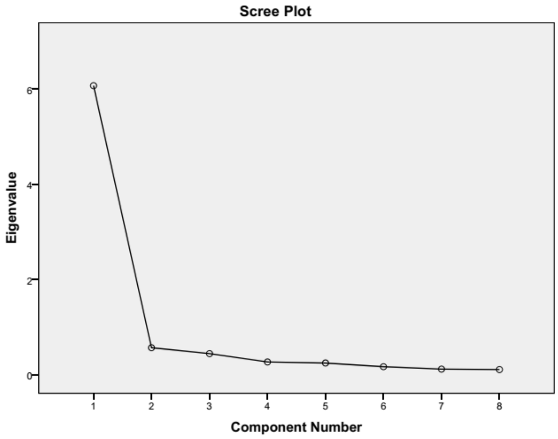

Figure 3. Scree Plot of Premium Train

Table 10. Component Matrix of Premium Train

	Component
	1
Waktu	.783
Aksesibilitas	.810
Kapasitas	.941
Tiket	.882
Lingkungan	.871
Manajemen	.906
Organisasi	.909
Pekerja	.854

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Factor Analysis of Economy-Class Trains

Data Feasibility Test (KMO and Bartlett's Test)

a. KMO Test, The Kaiser-Meyer-Olkin (KMO) value obtained is 0.903, which falls into the "excellent" category.
b. Bartlett's Test, The test result shows a significance value (Sig.) of 0.000, confirming that the variables are significantly correlated.

Thus, the data are highly suitable for further analysis using factor analysis.

Table 11. KMO and Bartlett's Test of Economy-Class Trains

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.903
Bartlett's Test of Sphericity	Approx. Chi-Square	2712.790
	df	28
	Sig.	.000

The value of the economic train test analysis in each variable can be seen: For the Anti-image variable, all correlations are > 0.857 for the environment. Communalities for management are the highest at 0.858. The total variance for one factor is 6.073, explaining 75.914%. The scree plot has a steep break after factor 1. Component matrix: All variables demonstrate very strong loadings, with the three highest being Management (0.927), Capacity (0.919), and Organization (0.906).

Table 12. Communalities of Economy-Class Train

	Initial	Extraction
Waktu	1.000	.651
Aksesibilitas	1.000	.792
Kapasitas	1.000	.844
Tiket	1.000	.814
Lingkungan	1.000	.611
Manajemen	1.000	.858
Organisasi	1.000	.821
Pekerja	1.000	.682

Extraction Method: Principal Component Analysis.

Table 13. Total Variance Explained of Economy-Class Train

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.073	75.914	75.914	6.073	75.914	75.914
2	.584	7.304	83.218			
3	.449	5.612	88.831			
4	.324	4.048	92.879			
5	.188	2.347	95.226			
6	.162	2.028	97.254			
7	.128	1.601	98.856			
8	.092	1.144	100.000			

Extraction Method: Principal Component Analysis.

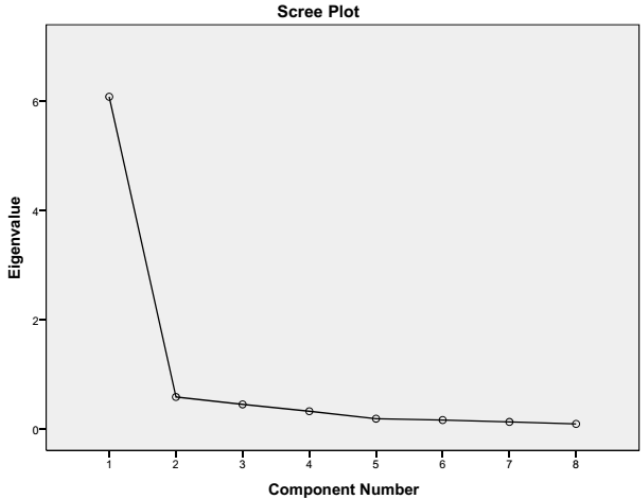

Figure 4. Scree Plot of Economy-Class Train

Table 14. Component Matrix of Economy-Class Train

	Component 1
Waktu	.807
Aksesibilitas	.890
Kapasitas	.919
Tiket	.902
Lingkungan	.782
Manajemen	.927
Organisasi	.906
Pekerja	.826

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Conclusion for Each Attribute

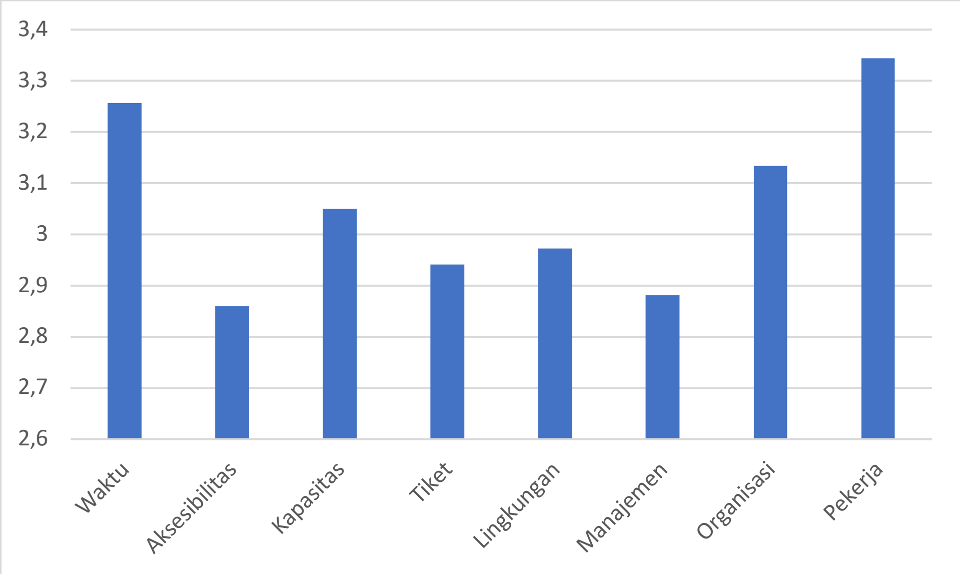

Figure 5. Attribute Evaluation Graph for Premium Train Services

Based on the attribute evaluation graph, premium train services exhibit varying levels of customer satisfaction across different aspects. The highest-rated attribute is *"staff"* (employees/service personnel), with a score of approximately 3.35, followed by *"time"* (punctuality) with a score above 3.25. This indicates that passengers highly appreciate the performance, professionalism, and friendliness of the staff, as well as the reliability of train schedules. In contrast, the lowest-rated attributes are *"accessibility"* (ease of reaching the station/train), with a score of around 2.85, and *"management"*, with a score slightly below 2.9. These findings suggest that although onboard service quality is considered very good, passengers perceive shortcomings in terms of accessibility and overall service management.

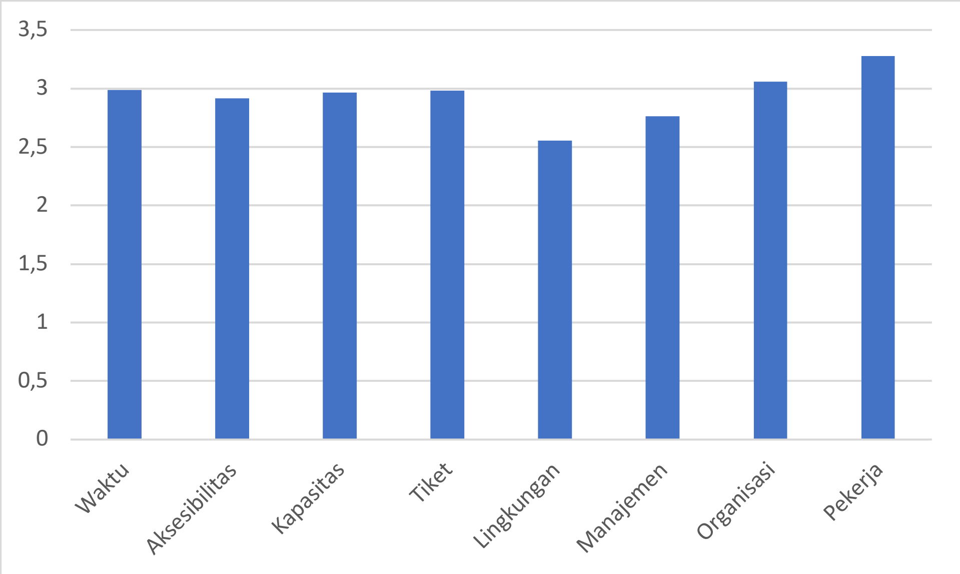

Figure 6. Attribute Evaluation Graph for Economy Train Services

For economy-class train services, the pattern reveals distinct strengths and weaknesses. Similar to premium services, the *"staff"* attribute emerges as the strongest, with a score of approximately 3.25, followed by *"organization"* with a score slightly above 3.0. Several core attributes such as *"time," "accessibility," "capacity,"* and *"ticketing"* receive relatively solid and consistent evaluations, ranging between 2.9 and 3.0. However, two prominent weaknesses are evident: *"environment"* (comfort, cleanliness, and facilities), which records the lowest score (approximately 2.55), and *"management"* (around 2.75). This suggests that although staff performance and basic operational aspects are perceived positively, the quality of the physical environment and management practices remain the primary concerns for economy-class passengers.

Through a comparison of the two graphs, several important conclusions regarding both service classes can be drawn:

1. Common strength in staff (personnel)
   The most notable finding is that *"staff"* consistently receives the highest rating across both service classes. This indicates that the quality of human resources both in terms of service delivery and professionalism—is consistently strong and serves as the backbone of customer satisfaction.
2. Shared weakness in management.
   In contrast, *"management"* consistently ranks among the lowest-rated attributes in both services. This indicates the presence of structural or systemic issues in service management perceived by both premium and economy passengers, making it a critical area for improvement.
3. Key distinction in the physical environment.
   The most significant difference between the two services lies in the *"environment"* attribute. In premium trains, this attribute receives a moderate score (around 2.97), whereas in economy trains, it drops significantly to the lowest level (around 2.55). This confirms that the main difference in perceived service quality lies in physical comfort, including cleanliness, facility conditions, and overall travel atmosphere.
4. Unique issue in accessibility.
   An interesting finding emerges in the *"accessibility"* attribute. It appears as a weakness in premium services (lowest score), yet is rated relatively well in economy services. This may be attributed to higher expectations among premium passengers or the possibility that economy train schedules and station locations are more accessible to the majority of users.

Discussion

Based on the results of the analysis, an in-depth evaluation of premium train service performance can be presented. Factor analysis reveals that premium train passengers do not perceive the eight service attributes time, accessibility, capacity, ticketing, environment, management, organization, and staff as separate elements. Instead, these attributes are highly interrelated and form a single factor that can be interpreted as *integrated operational and service quality*. This indicates that customer perceptions are holistic, where strengths or weaknesses in one aspect significantly influence the overall assessment of the service. The fact that this single factor explains approximately 76% of the total variance confirms the highly integrated nature of passenger experience.

From a predictive perspective, the CART analysis clearly identifies which attributes serve as the main determinants of service effectiveness. The best and most stable model (using a threshold of 1.5) shows that *staff* (service personnel) is the most crucial predictor. This attribute acts as the root split in the decision tree, meaning that a low evaluation of staff performance is the strongest indicator of an overall low perception of service effectiveness. Following staff performance, the next significant determinants are *time* (schedule punctuality) and *environment* (physical comfort on the train). These findings are important as they provide a clear roadmap regarding the key leverage points for maintaining or improving perceived service quality.

When linked to actual satisfaction data from the bar chart, a more comprehensive picture emerges. The *staff* attribute, identified as the most important predictor in the CART analysis, also receives the highest satisfaction rating from passengers (score of 3.35). This represents a fundamental strength of premium service, where the most influential element is also the best-performing one. However, the bar chart also highlights clear areas of weakness. The attributes *accessibility* (ease of reaching the station/train) and *management* consistently receive the lowest ratings from passengers. Although not the primary predictors in the CART model, the low scores of these attributes significantly reduce the holistic perception of *integrated service quality* identified in the factor analysis.

Based on the synthesis of these analyses, several key aspects should be evaluated to improve premium train service quality:

1. The main priority is to maintain staff excellence. Staff performance is the most valuable asset, as it is both the best-performing attribute and the primary determinant of service effectiveness. Continuous investment in training, welfare, and recruitment is therefore essential.
2. Improvements should focus on the weakest points, namely *accessibility* and *management*. Although not the main drivers of service failure according to the CART analysis, low satisfaction scores in these areas undermine the overall service quality perception. Improvements may include better physical access to stations, transport integration, and enhanced management transparency and responsiveness.

3. Secondary predictive attributes should be closely monitored. *Time* and *environment* must be consistently maintained, as any decline in punctuality or onboard comfort poses a significant risk to overall service effectiveness.

Similarly, factor analysis for economy-class train services indicates that all eight service attributes combine into a single dominant factor, namely *integrated operational and service quality*. This implies that economy passengers also perceive services holistically, rather than evaluating each attribute in isolation. The strength of this relationship, where one factor explains 75.914% of the total variance, suggests that a decline in one aspect can significantly damage the overall service perception.

Predictive analysis using CART further identifies the most influential attributes in determining service effectiveness. The best and most stable model (threshold 1.5) achieves the highest cross-validation accuracy (95.94%) and the lowest variability. Similar to premium services, *staff* is identified as the root split, confirming that staff performance is the strongest single predictor of service effectiveness. Very poor staff performance becomes the main signal of an ineffective service. Other important attributes identified in the model include *capacity*, *ticketing*, and *environment*.

When related to actual satisfaction data, one key finding emerges. The *staff* attribute, as the most important predictor, consistently receives the highest satisfaction rating (score of 3.25), forming the foundation of economy service strength. However, the service exhibits a significant weakness in the *environment* attribute (comfort, cleanliness, facilities), which receives the lowest rating overall (score of 2.55). In addition, *management* is also among the lowest-rated attributes. This critical weakness in the physical environment becomes the main factor reducing the holistic perception of *integrated service quality*, despite strong staff performance.

Based on the synthesis of these analyses, several important aspects should be considered to improve economy train service quality:

1. Maintaining staff performance as the main asset. Staff excellence is the primary pillar of service effectiveness and must be preserved and continuously developed.
2. Urgent improvements in the physical environment. The *environment* attribute represents the most critical weakness and must be addressed immediately, particularly in terms of cleanliness, facility functionality (e.g., toilets and air conditioning), and overall comfort.
3. Addressing recurring management issues. Low ratings in *management*, also observed in premium services, indicate systemic issues that require deeper evaluation at the organizational level.
4. Maintaining supporting attributes. Attributes such as *capacity* and *ticketing*, identified as important predictors and rated relatively well, must be preserved to sustain overall service perception.

Based on the comparison between premium and economy train services, several important conclusions can be drawn. Both services share a common strength in staff performance, which consistently receives the highest ratings and serves as the most crucial predictor of service effectiveness. At the same time, both share a common weakness in *management*, indicating systemic issues that need improvement. The key distinction lies in the *physical environment*. While it is considered adequate in premium services, it becomes the primary weakness in economy services. This difference is critical, as factor analysis shows that passengers in both classes perceive service as a holistic *integrated quality*, meaning that poor physical conditions in economy services can significantly damage overall perceptions despite strong staff performance. Finally, a unique finding indicates that *accessibility* is a weakness in premium services but not a concern for economy passengers, suggesting differences in expectations or logistical challenges specific to each service class.

CONCLUSION

Based on the results of the analysis and evaluation of railway service effectiveness, several key conclusions can be drawn as follows:

1. The level of service effectiveness on the Tanjung Karang–Kotabumi route is generally highly influenced by the quality of interactions between staff and passengers, as well as the condition of the physical facilities within the train carriages. Staff or service personnel attributes represent a fundamental strength, as they achieved the highest satisfaction scores in both premium (3.35) and economy (3.25) service classes. However, there are systemic issues in the management aspect, which consistently received the lowest ratings across both service classes. A significant disparity in quality is observed in the physical environment of the carriages, where the premium class is considered relatively adequate, while the economy class identifies this aspect as a primary weakness. In addition, accessibility emerges as a particular challenge for premium services, as reflected by its relatively lower score compared to the economy class.

2. The application of the *Classification and Regression Tree* (CART) method reveals that service attributes do not operate independently but instead interact holistically to form a dominant factor, namely integrated operational and service quality. Through this model, staff or service personnel attributes are identified as the strongest single predictor (*root split*) in determining the perceived effectiveness of services from the passengers' perspective. The study finds that the use of a threshold value of 1.5 represents the most stable and accurate model, with cross-validation accuracy reaching 96.25% for premium class and 95.94% for economy class. In addition to staff-related factors, punctuality and the condition of the physical environment of the carriages also emerge as important supporting variables that significantly predict future perceptions of service effectiveness.

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