Jurnal Siber Transportasi dan Logistik (JSTL)
E-ISSN: 2987-6923
P-ISSN: 2988-2516
+62 822 1012 3600 https://research.e-siber.org siberpublisher.info@gmail.com
DOI: https://doi.org/10.38035/jstl.v4i2.1092

Operational Planning for Railway Services Based on Passenger Demand Forecasting during The Eid Transportation Period

Devi Ratnasari[1], Gatot Amar Dwi Hartono[2], Totok Suryono[3], Haniva Mulyani[4]
[1]Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, devira492@gmail.com
[2]Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, gatotamardh@gmail.com
[3]Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, tsuryono@gmail.com
[4]Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, hanivamulyani12@gmail.com

Corresponding Author: devira492@gmail.com[1]

Abstract: The Eid al-Fitr Transportation Period represents the peak season with the highest passenger demand for intercity railway services in Indonesia. According to the Ministry of Transportation's mobility survey, the number of travelers was projected to decline from 193.6 million in 2024 to 146.48 million in 2025. This trend also affected the Taksaka Train operating on the Gambir–Yogyakarta round-trip route, which experienced fluctuations in passenger volume over the past three years following the discontinuation of its afternoon service in 2025. Previous studies on railway operation planning have generally not integrated seasonal passenger demand forecasting with specific scheduling decisions during the Eid al-Fitr transportation period. Therefore, this study aims to develop an operational plan recommendation for the Taksaka Train based on passenger demand forecasting to support operational decision-making prior to the 2026 Eid al-Fitr Transportation Period. The study employs simple linear regression analysis using passenger departure and arrival data from Gambir Station for the 2023–2025 period. The forecasting results indicate an upward trend in passenger demand for 2026, reaching an estimated 49,541 passengers, representing an increase of approximately 6,773 passengers (15.8%) compared to 42,768 passengers in 2025. These findings suggest the existence of unmet passenger demand, particularly for afternoon departures. Accordingly, this study recommends reconsidering the reactivation of the Taksaka afternoon service in the 2026 operational planning.

Keyword: Operation Pattern Planning, Passenger Demand Prediction, Linear Regression, Eid Transportation, Taksaka Train.

INTRODUCTION

Railway transportation is a prominent mass transit mode characterized by high carrying capacity, more predictable punctuality, and energy efficiency, making it effective for intercity travel. Operational performance evaluations across various services, such as those conducted on the Pariaman Express train on the Padang–Pariaman route, demonstrate the important role of railways in supporting passenger mobility in Indonesia (Wahab et al., 2025). These operational characteristics are equally critical for premium intercity services such as the Taksaka Train, particularly during the Eid Transportation period when transportation demand surges significantly alongside the tradition of homecoming (*mudik*). One service significantly affected is the Taksaka Train on the Gambir–Yogyakarta round-trip route. Nationally, the number of Eid travelers in 2025 declined from 193.6 million (2024) to 146.48 million people (Kementerian Perhubungan RI, 2025); however, operational data from Gambir Station during the 2025 Eid period showed the opposite trend, with a peak volume of 18,125 passengers on 30 March 2025 and an occupancy rate of 84%. This gap between national and local trends indicates that demand patterns on premium routes such as Taksaka possess distinct characteristics that require route-specific analysis. This phenomenon indicates that passenger demand patterns on individual railway routes do not necessarily follow national travel demand trends. Previous studies have demonstrated that passenger demand patterns vary significantly across time periods, underscoring the need for demand-specific service planning (van der Knaap et al., 2024). Therefore, a predictive approach capable of supporting pre-operational decision-making is needed, enabling the formulation of operational patterns that are more responsive to changes in passenger demand. This study develops a passenger demand forecasting model as the basis for formulating operational planning recommendations for the Taksaka Train to support service planning during the Eid Transportation period.

Various studies have developed passenger demand forecasting methods using statistical and artificial intelligence approaches. Simple linear regression is widely adopted for its ability to depict demand growth trends with relatively modest data requirements (Cahyo et al., 2025). Beyond regression, recent studies have also employed SARIMA, Holt–Winters, and machine learning-based approaches to improve forecasting accuracy (Cahyani et al., 2026). Artificial Neural Network approaches offer the capacity to capture nonlinear relationships in time-series data (Sidabutar et al., 2026), while Monte Carlo simulation is more commonly used to project demand uncertainty across various scenarios (Amelia & Karo Karo, 2024). However, these studies are generally aggregated at the national level or by service class and have not considered demand segmentation by route or specific service, particularly in a seasonal context such as the Eid transportation period. This gap reveals that the application of forecasting methods to specific route and period case studies such as the Taksaka Train during Eid remains underexplored. Most prior studies position forecasting as the final research objective — for instance, developing and validating forecasting methods without extending the results into operational decision-making (Fan et al., 2023). As a result, the utilization of forecast results as a basis for operational decision-making remains relatively limited, particularly for intercity railway services during periods of seasonal demand.

Studies on railway operational planning have focused predominantly on line capacity, headway, and rolling stock requirements. Research on the operational pattern of the Mempawah–Sanggau corridor, for instance, emphasized rolling stock demand calculations based on line capacity and travel time (Faishal & Triana, 2018). Passenger flow fluctuations have been shown to directly affect key operational parameters such as train dwell time, underscoring the need for schedule and capacity planning that can adapt to real-time demand dynamics (Pang et al., 2023). Approaches that more directly connect passenger demand to operational patterns have begun to emerge, as seen in studies of the Sindro and Arjonegoro Commuter Line patterns based on demand and passenger preferences (Herza et al., 2025). However, such approaches remain limited to short-distance commuter services and have not been widely applied to long-distance intercity railway services with seasonal demand characteristics such as those during the Eid transportation period. Recent studies indicate that daily and seasonal demand pattern changes need to be integrated into service plan formulation so that service capacity can more accurately accommodate demand dynamics (van der Knaap et al., 2024). This gap demonstrates that the integration of seasonal demand forecasting and operational pattern decisions for premium intercity services such as the Taksaka remains underexplored.

Based on this gap, prior research has not widely integrated historical-data-based passenger demand forecasting methods with operational planning in a direct manner for specific route and period case studies. Most studies still treat demand forecasting and operational planning as separate inquiries, and are more frequently conducted at the national level or for long-term projections (Faishal & Triana, 2018; Sidabutar et al., 2026). The novelty (*State of the Art*) of this study therefore lies in integrating forecast results based on historical data as the direct basis for formulating railway operational planning recommendations during the Eid Transportation period — producing an approach that connects demand analysis with operational decision-making, particularly regarding the feasibility of reinstating the previously discontinued afternoon departure schedule. This approach aligns with recent research trends that integrate demand forecast results into data-driven transportation service planning (van der Knaap et al., 2024). With this approach, the study is expected to contribute a more operationally responsive planning model for fluctuating seasonal demand in premium railway services.

Based on the above, the research questions are formulated as follows:

1. How did the passenger volume of the Taksaka Train fluctuate during the Eid Transportation period from 2023 to 2025?
2. How many passengers are projected for the Taksaka Train during the 2026 Eid Transportation period based on simple linear regression analysis?
3. What operational pattern planning for the Taksaka Train is appropriate based on the passenger demand forecast for the 2026 Eid Transportation period?

METHOD

This study employs a quantitative approach using simple linear regression applied to historical passenger volume data of the Taksaka Train during the Eid Transportation period from 2023 to 2025. This approach aims to produce a passenger demand forecasting model that can serve as a decision support tool in formulating railway operational planning recommendations for the Eid Transportation period. Forecast results are subsequently integrated with service capacity analysis, occupancy rates, trip frequency, and operational patterns to produce operational recommendations aligned with demand projections.

Data were collected from two sources. Primary data were obtained through direct observation at the operational environment of Gambir Station, covering passenger volume, arrival-departure patterns, and the operational dynamics of the Taksaka Train during the 2025 Eid Transportation period. Secondary data were obtained from PT Kereta Api Indonesia (Persero), comprising: (1) daily passenger volumes of the Taksaka Train during the 2023–2025 Eid Transportation periods, from H-10 to H+10, classified by four departure schedules (Taksaka Morning, Midday, Afternoon, and Night) and travel direction (Gambir departures and arrivals); (2) passenger occupancy rates for the same period; and (3) the 2025 Railway Timetable (*Grafik Perjalanan Kereta Api* / GAPEKA) as the reference for line capacity and existing operational patterns.

Research variables consist of the independent variable (X) — the number of passengers during prior Eid Transportation periods (2023–2025) — and the dependent variable (Y) — the projected number of passengers for the 2026 Eid Transportation period. Simple linear regression was chosen for its ability to represent the trend relationship between these variables in a straightforward yet representative manner for three-year time-series data, following approaches used in similar studies (Cahyo et al., 2025; Sidabutar et al., 2026).

The regression equation used is:

$$\mathbf{Y = a + bX}$$

where Y is the projected number of passengers in 2026, X is the historical passenger data from 2023–2025, b is the regression coefficient, and a is the constant, each calculated using the standard least squares formula (Sugiyono, 2021). Calculations were performed separately for each departure schedule (Morning, Midday, Afternoon, Night) and each direction (departure and arrival) to obtain a more detailed picture of demand distribution compared to an aggregate model.

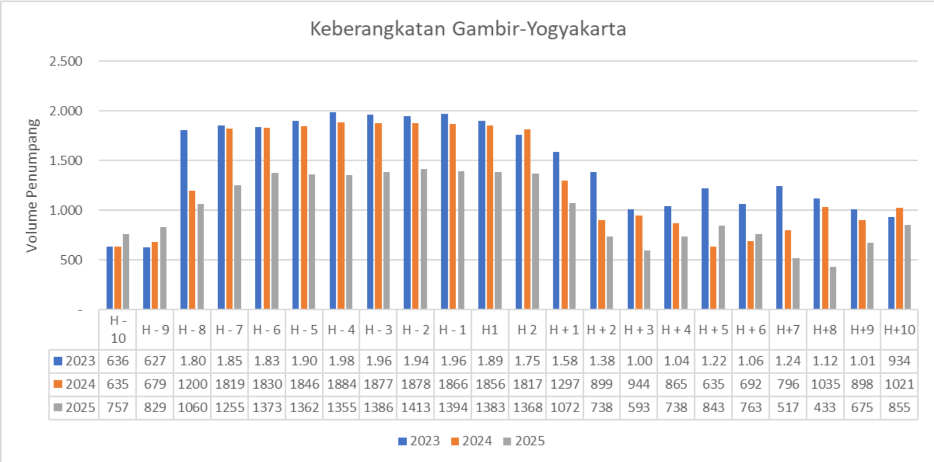
Forecast results were subsequently used to calculate the additional trip frequency needed, by dividing the projected daily passenger volume by the seating capacity of one Taksaka Train set (452 seats). Operational pattern recommendations were formulated by considering the existing travel time, line capacity, and minimum headway on the longest track segment as technical constraints in proposing additional schedules.

RESULTS AND DISCUSSION

Results

Passenger Data Characteristics 2023–2025

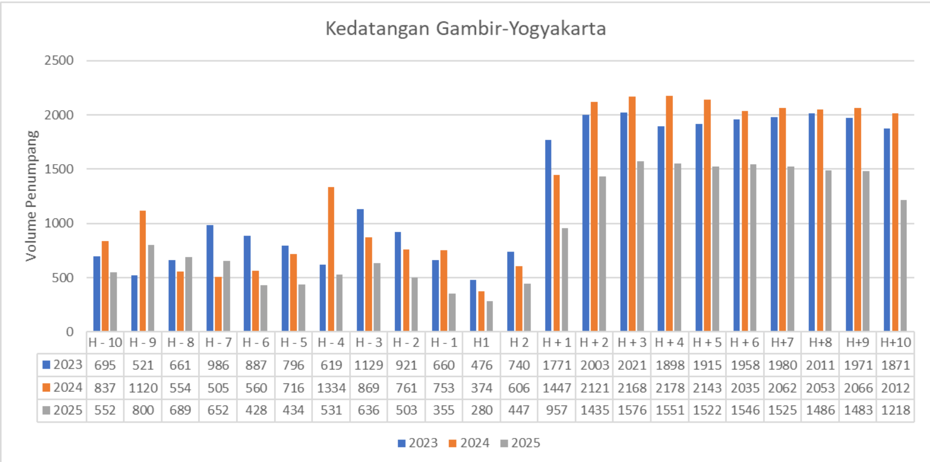
Taksaka Train passenger volume data for the Gambir–Yogyakarta route over the past three Eid Transportation periods (2023–2025) show an inconsistent year-on-year pattern. Passenger volume in 2023 was higher than in 2024 and 2025, while 2025 experienced a significant decline. This decline is directly associated with changes in the number of services: in 2023 and 2024, the Taksaka Train operated with four departure schedules (Morning, Midday, Afternoon, Night), whereas in 2025 the Afternoon schedule was discontinued, leaving only three schedules (Morning, Midday, Night).



	H - 10	H - 9	H - 8	H - 7	H - 6	H - 5	H - 4	H - 3	H - 2	H - 1	H1	H 2	H + 1	H + 2	H + 3	H + 4	H + 5	H + 6	H+7	H+8	H+9	H+10
2023	636	627	1.80	1.85	1.83	1.90	1.98	1.96	1.94	1.96	1.89	1.75	1.58	1.38	1.00	1.04	1.22	1.06	1.24	1.12	1.01	934
2024	635	679	1200	1819	1830	1846	1884	1877	1878	1866	1856	1817	1297	899	944	865	635	692	796	1035	898	1021
2025	757	829	1060	1255	1373	1362	1355	1386	1413	1394	1383	1368	1072	738	593	738	843	763	517	433	675	855

Source: PT Kereta Api Indonesia (Persero), 2025

Figure 1. Passenger Volume Graph – Gambir to Yogyakarta Departures



	H - 10	H - 9	H - 8	H - 7	H - 6	H - 5	H - 4	H - 3	H - 2	H - 1	H1	H 2	H + 1	H + 2	H + 3	H + 4	H + 5	H + 6	H+7	H+8	H+9	H+10
2023	695	521	661	986	887	796	619	1129	921	660	476	740	1771	2003	2021	1898	1915	1958	1980	2011	1971	1871
2024	837	1120	554	505	560	716	1334	869	761	753	374	606	1447	2121	2168	2178	2143	2035	2062	2053	2066	2012
2025	552	800	689	652	428	434	531	636	503	355	280	447	957	1435	1576	1551	1522	1546	1525	1486	1483	1218

Source: PT Kereta Api Indonesia (Persero), 2025

Figure 2. Passenger Volume Graph – Gambir to Yogyakarta Arrivals

Existing Operational Pattern

Based on GAPEKA 2025 data, the Taksaka Train covers a distance of 512,588 m (Gambir–Yogyakarta) with a travel time of 367 minutes (6 hours 7 minutes), yielding an average operational speed of 83 km/h. The current frequency is 3 round trips per day. The minimum headway, calculated based on the longest track segment (Ciledug–Ketanggungan Station, 16 km), is 16 minutes, with the line capacity on that segment reaching 250 trains/day — well above the Taksaka Train's operational requirements, and therefore not a constraint for additional trips.

Table 1. Existing Operational Characteristics of the Taksaka Train Based on GAPEKA 2025

Parameter	Value
Route distance	512,588 m
Travel time	367 minutes (6 hours 7 minutes)
Average speed	83 km/h
Current frequency	3 round trips/day
Minimum headway	16 minutes
Line capacity (longest segment)	250 trains/day

Source : Gapeka 2025 Data

The results of simple linear regression analysis on historical data from 2023–2025 yield the following projected passenger volumes for the Taksaka Train during the 2026 Eid Transportation period:

Table 2. Projected Taksaka Train Passenger Numbers for 2026 by Operating Schedule

Schedule	Direction	Forecast 2026	Actual 2025	Actual 2024	Actual 2023
Morning	Departure	6,010	7,594	5,564	8,955
Morning	Arrival	6,931	7,199	6,243	7,123
Midday	Departure	7,802	7,613	8,867	7,950
Midday	Arrival	6,267	6,102	7,455	6,531
Afternoon	Departure	4,746	Not in operation	6,399	7,937
Afternoon	Arrival	3,302	Not in operation	6,904	9,086
Night	Departure	7,053	6,955	7,229	6,945
Night	Arrival	7,430	6,102	9,382	5,750
Total	Departure	25,611	22,162	28,269	31,787
Total	Arrival	23,930	20,606	29,274	28,490

Source: Research Results

In total, departure passenger volume is projected to rise from 22,162 (2025) to 25,611 (2026), and arrival volume from 20,606 to 23,930. Both figures indicate a recovery trend following the sharp decline in 2025, though not yet matching the 2023–2024 levels. This pattern suggests that the discontinuation of the Afternoon schedule in 2025 may have contributed to the decline in passenger volume, and the projected increase in 2026 indicates potential demand recovery for that schedule.

Based on the combined projection of outbound flows (H-5 to H+2) and return flows (H+1 to H+5), total passengers per schedule during the 2026 Eid Transportation period are estimated as follows:

Table 3. Projected Passenger Occupancy for 2026

Schedule	Total Passengers 2026	Projected Occupancy
Night	14,483	146%
Midday	14,069	141%
Morning	12,941	130%
Afternoon	8,048	82%

Source: Research Results

The Taksaka Night and Midday schedules emerge as those with the highest demand, with projected occupancy rates of over 140% — indicating excess demand relative to the capacity of a single train set. The Afternoon schedule, while showing the lowest projected volume and occupancy, still demonstrates an upward trend compared to 2025 when it was discontinued entirely —indicating that passenger demand for the Afternoon schedule still exists. These findings are consistent with (van der Knaap et al., 2024) who demonstrated that passenger demand patterns are heterogeneous across railway routes. These findings indicate that route-specific demand characteristics should be considered in transportation service planning.

Additional Trip Frequency Requirements

The projected daily passenger volume per schedule was calculated by dividing total passengers over the 22-day Eid Transportation period (H-10 to H+10) by the capacity of one Taksaka Train set (452 seats, comprising 8 executive carriages with 50 seats each and 2 luxury carriages with 26 seats each) to determine trip frequency requirements:

Table 4. Trip Frequency Requirements Based on Forecast Results

Schedule	Passengers/Day	Frequency Required
Morning	588	2 trips
Midday	640	2 trips
Afternoon	366	1 trip
Night	658	2 trips

Source: Research Results

The preliminary calculation indicates a minimum requirement of 7 trips (one direction) or 14 train trips (both directions). However, this study recommends increasing the Taksaka Afternoon frequency to 2 trips (rather than 1), for two reasons: first, to redistribute the passenger load currently concentrated on the Night schedule (146% occupancy), preventing demand from clustering on a single schedule; second, to provide a departure option in the 18.00–19.00 WIB time range, accommodating the mobility patterns of passengers who complete work activities in the afternoon. With this adjustment, the total trip requirement becomes 8 trains (4 round trips), representing an increase of 2 trips compared to the existing operational pattern under GAPEKA 2025 (6 trains/3 round trips).

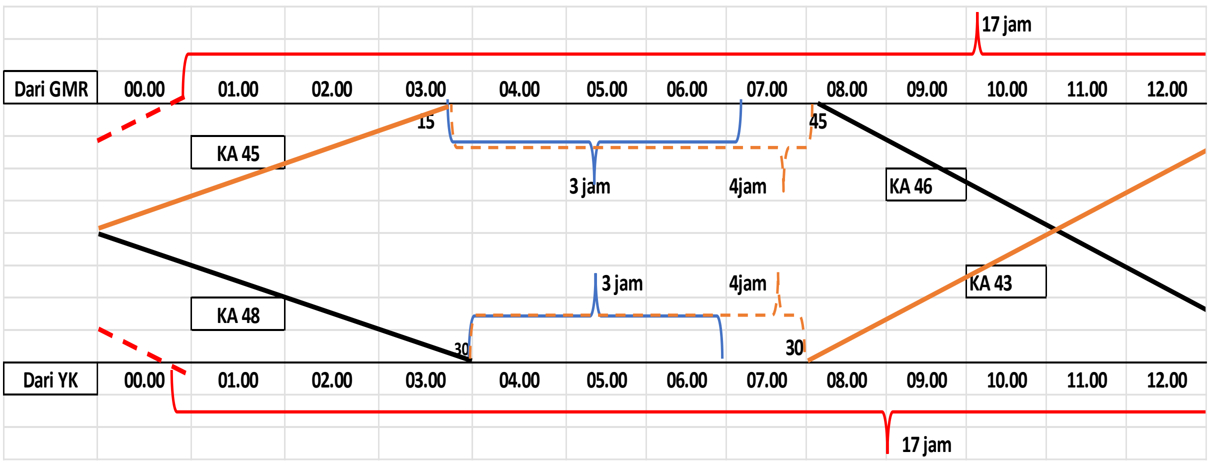


Figure 3. Operational Pattern Diagram 00:00–12:00

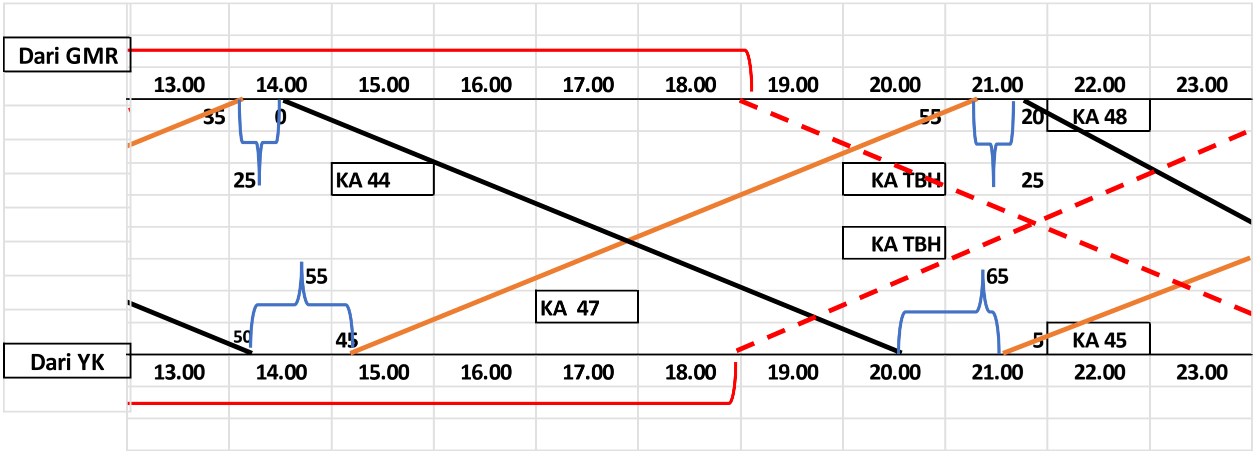


Figure 4. Operational Pattern Diagram 13:00–23:00

Proposed Operational Pattern for the Taksaka Train 2026

Based on the forecast results and frequency calculations, an additional Taksaka Afternoon trip is proposed in each direction, with the following specifications: departure at 18:30 WIB from the origin station, with an estimated travel time of 6 hours 15 minutes and arrival at 00:30 WIB. This trip is proposed as a Special Train (*Kereta Luar Biasa / KLB*) designated through a Railway Decree (*Maklumat Kereta Api / Malka*) and announced via an Official Notice (*Warta Maklumat / WAM/PPK*), without amending GAPEKA 2025 as the reference for regular services — the additional slot is inserted through crossing and overtaking adjustments during the H-10 to H+10 period (22 operating days, or 44 additional train trips).

Table 5. Proposed Operational Pattern of Taksaka Train Departures Gambir–Yogyakarta

TAKSAKA TRAIN DEPARTURE GAMBIR - YOGYAKARTA				
TRAIN NO	**TRAIN NAME**	**ROUTE**	**DEPARTURE**	**ARRIVAL**
46	TAKSAKA	GMR - YK	07.45	13.50
46L	TAKSAKA LUXURY SLEEPER	GMR - YK	07.45	13.50
44	TAKSAKA	GMR - YK	14.00	20.10
44L	TAKSAKA LUXURY	GMR - YK	14.00	20.10
10000	TAKSAKA (ADDITIONAL)	GMR - YK	18.30	00.30
10000L	TAKSAKA LUXURY SLEEPER (ADDITIONAL)	GMR - YK	18.30	00.30
48	TAKSAKA	GMR - YK	21.20	03.30
48L	TAKSAKA LUXURY SLEEPER	GMR - YK	21.20	03.30

Source: Research Results

Table 6. Proposed Operational Pattern of Taksaka Train Arrival Gambir–Yogyakarta

TAKSAKA TRAIN ARRIVAL GAMBIR - YOGYAKARTA				
TRAIN NO	**TRAIN NAME**	**ROUTE**	**DEPARTURE**	**ARRIVAL**
43	TAKSAKA	YK - GMR	07.30	13.35
43L	TAKSAKA LUXURY	YK - GMR	07.30	13.35
45	TAKSAKA	YK - GMR	21.05	03.15
45L	TAKSAKA LUXURY	YK - GMR	21.05	03.15
47	TAKSAKA	YK - GMR	14.45	20.54
47L	TAKSAKA LUXURY	YK - GMR	14.45	20.54
10001	TAKSAKA (ADDITIONAL)	YK - GMR	18.30	00.30
10001L	TAKSAKA LUXURY SLEEPER (ADDITIONAL)	YK - GMR	18.30	00.30

Source: Research Results

Discussion

1. Passenger Fluctuation Patterns of the Taksaka Train 2023–2025

The findings show that passenger fluctuations of the Taksaka Train over the past three years did not directly follow national trends, but were instead more strongly influenced by operational decisions — specifically the discontinuation of the Afternoon schedule in GAPEKA 2025. This indicates that apparent demand decline in aggregate data does not always reflect a decrease in market interest, but may instead result from supply constraints. Unlike previous railway passenger demand forecasting studies that utilized aggregated national-level data (Sidabutar et al., 2026) this study shows that, at the route level, changes in passenger volume are influenced more by operational policies than by national demand trends. These findings suggest that operational factors played an important role in shaping passenger distribution on the Taksaka route during the observation period.

2. Taksaka Train Passenger Forecast for 2026 and Its Implications for Capacity

Linear regression forecasts indicate a passenger recovery trend in 2026 (25,611 departures, 23,930 arrivals), though not yet reaching 2023–2024 levels. Separating forecasts by departure schedule reveals significant occupancy gaps between schedules — Taksaka Night and Midday are projected to experience excess demand (occupancy >140%), while Taksaka Afternoon falls well below (82%).

This approach is consistent with (Cahyo et al., 2025) who demonstrated that the linear regression method can be utilized as a basis for forecasting passenger demand. Inter-schedule occupancy gaps of this kind would not be identifiable if forecasting were performed only in aggregate totals without separation by departure schedule.

3. Taksaka Train Operational Pattern Planning Based on 2026 Demand Forecast

Based on the forecast results, this study recommends adding the Taksaka Afternoon to 2 trips rather than the minimum 1 trip indicated by the calculation. This recommendation is based on considerations of redistributing the passenger load from the Night schedule, which is experiencing excess demand, and adjusting departure times (18:00–19:00 WIB) to the mobility patterns of passengers who complete work activities in the afternoon.

This approach aligns with (Herza et al., 2025), who directly linked demand and passenger preferences to operational pattern formulation, lbeit in the context of short-distance commuter services. This study extends that approach to the context of long-distance intercity services with seasonal demand characteristics. These results also differ from previous operational planning studies that primarily focused on line capacity and long-term rolling stock requirements (Faishal & Triana, 2018), as this study explicitly uses short-term seasonal forecast results as the basis for operational decisions.

The key finding of this study is that simple linear regression-based passenger demand forecasting, when segmented by specific departure schedule, is capable of revealing inter-schedule occupancy gaps that are not visible in aggregate prediction models, and that these gaps can be directly translated into concrete operational recommendations in the form of frequency additions and departure time adjustments. This finding demonstrates that a decline in demand for a premium railway service does not always reflect a decline in market interest, but may instead be a consequence of supply constraints arising from prior operational decisions — thereby enriching the understanding of the integration of seasonal demand forecasting into intercity railway operational planning.

Operational Feasibility Analysis Based on N-Slag Operational Pattern :

The forecast results indicate that Taksaka Train passenger volume during the 2026 Eid Transportation period is projected to increase compared to 2025. This increase suggests the need to evaluate the applied operational pattern so that service capacity can accommodate passenger demand growth. Therefore, in addition to demand considerations, an analysis of the operational feasibility of adding trips is also required to ensure that the resulting recommendations can be realistically implemented.

Based on the N-Slag operational pattern analysis, the regular Taksaka Train set still has approximately 20 hours of operational time with an idle time of approximately 3.5 hours within a single daily operational cycle. This indicates that the regular operational pattern has been utilized optimally in accordance with the schedule set out in GAPEKA 2025. However, this idle time is insufficient to accommodate the addition of one afternoon round trip without affecting the regular trip cycle. Therefore, reinstating the Taksaka Afternoon service requires the provision of one additional train set so as not to disrupt the existing rolling stock rotation. These results indicate that the recommendation to add afternoon trips is operationally feasible, as it does not require changes to the existing regular operational pattern but only requires the addition of a dedicated train set to serve the additional trip. This approach enables a more even passenger distribution, reducing potential excess occupancy on midday and night schedules, and providing passengers with more flexible departure options during the Eid Transportation period, consistent with the principle of aligning operational patterns with passenger demand characteristics as demonstrated by (Herza et al., 2025).

These findings indicate that operational pattern planning should not rely solely on passenger demand forecasting results but should also consider rolling stock availability and train operation cycles. This approach is consistent with (van der Knaap et al., 2024), who emphasized the importance of understanding variations in demand patterns as a basis for transportation service planning. The integration of demand analysis and operational analysis thus produces more realistic recommendations that can serve as the basis for decision-making in formulating the Taksaka Train's operational pattern during the Eid Transportation period.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. Fluctuations in Taksaka Train passenger volume during the 2023–2025 Eid Transportation periods indicate that changes in passenger volume are not solely influenced by national demand trends, but are also affected by applied operational policies. The discontinuation of the afternoon service in GAPEKA 2025 appears to have contributed to the redistribution of passengers across departure schedules, affecting the occupancy rate of each trip.
2. Simple linear regression analysis projects Taksaka Train passenger volume during the 2026 Eid Transportation period to reach 49,541 passengers, an increase of approximately 6,773 passengers (15.8%) compared to the 2025 actual figure of 42,768 passengers. These results indicate a tendency toward increased passenger demand following the decline that occurred in the previous year.
3. Based on forecast results and occupancy rate analysis, service capacity requirements on regular schedules are projected to increase, particularly for midday and night trips. Accordingly, reinstating the Taksaka Train afternoon service is worth considering as an alternative to distribute passenger demand more evenly, increase travel time flexibility, and improve service effectiveness during the Eid Transportation period.

   Operational feasibility analysis using the N-Slag operational pattern indicates that the addition of afternoon trips can be implemented without disrupting the regular operational cycle, by providing one additional train set as a dedicated rolling stock. This finding demonstrates that the proposed operational planning recommendations are not based solely on passenger demand forecasts, but also take into account operational feasibility considerations, making them more realistic to implement.
4. The contribution of this study lies in integrating passenger volume forecasting using simple linear regression with railway operational pattern analysis as the basis for formulating operational recommendations. This approach provides an alternative in

supporting decision-making regarding the addition of trips and the allocation of service capacity in accordance with seasonal demand characteristics.

Limitations

This study has several limitations. First, the forecasting model was constructed based on historical Taksaka Train passenger volume data during the 2023–2025 Eid Transportation periods and has not yet been validated using actual 2026 Eid Transportation data. Second, the simple linear regression model used considers only historical passenger trends without incorporating external variables such as fare policies, economic conditions, schedule changes, or competition from other modes of transportation that could potentially influence passenger demand. Additionally, this study focused solely on the Taksaka Train service, and therefore the findings cannot be generalized to all intercity railway services.

Recommendations

Based on the findings, PT Kereta Api Indonesia (Persero) is recommended to utilize passenger volume forecast results as one basis for formulating operational patterns during the Eid Transportation period, particularly in determining the need for additional trips, adjusting departure schedules, and evaluating service capacity for each operating schedule. Reinstating the Taksaka Train afternoon service may be considered as a strategy to optimize passenger distribution, reduce occupancy imbalances between trips, and improve service flexibility during peak periods. Additionally, implementing the N-Slag operational pattern with one additional train set could serve as an implementation alternative that maintains the efficiency of regular operations.

Future research is recommended to validate the model using actual 2026 Eid Transportation data to measure forecast accuracy. Research may also be developed by comparing simple linear regression with other forecasting methods, such as ARIMA, Random Forest, or Long Short-Term Memory (LSTM), and by expanding the research scope to other intercity railway services to produce a more comprehensive operational planning model.

In addition to considering the addition of trips, periodic evaluation of train set capacity and occupancy rates for each departure schedule is also needed to ensure that operational patterns can be adapted to changes in passenger demand characteristics.

Author Contributions

The first author was responsible for research conceptualization, methodology development, research coordination, interpretation of results, and manuscript preparation and revision. The second author contributed to data collection, data processing and analysis, drafting the initial manuscript, and visualization of research results. The third author contributed to research supervision, validation of analysis results, academic input, and critical review of the manuscript substance. The fourth author contributed to the final review process, manuscript editing, and overall validation of the article prior to publication. All authors have read, approved, and are responsible for the final version of the article.

REFERENCES

Amelia, T. A., & Karo Karo, I. M. (2024). Analisis prediksi jumlah penumpang kereta api menggunakan metode monte carlo (studi kasus : PT. KAI wilayah sumatera barat). 8(4), 4444–4450. https://doi.org/10.36040/jati.v8i4.9935

Cahyani, G. I., Ningsi, B. A., & Arofah, I. (2026). Seasonal time series forecasting of Indonesian railway passengers: A comparison of Holt–Winters and SARIMA. *AXIOM : Jurnal Pendidikan Dan Matematika*, *15*(1), 28. https://doi.org/10.30821/axiom.v15i1.25570

Cahyo, S. D., Murtopo, A. A., & Santoso, B. A. (2025). Penerapan Metode Regresi Linier untuk Prediksi Jumlah Penumpang Kereta Api. *RIGGS: Journal of Artificial Intelligence and Digital Business*, *4*(3), 986–993. https://doi.org/10.31004/riggs.v4i3.2061

Faishal, M., & Triana, S. (2018). Analisis Pola Operasi Mempawah-Sanggau Kalimantan Barat. *RekaRacana: Jurnal Teknil Sipil*, *4*(1), 11–21. https://doi.org/10.26760/rekaracana.v4i1.11

Fan, D., Yang, F., Ji, J., & Zhang, Z. (2023). Research on Railway Passenger Volume Forecast Based on the Spline Interpolation and IPSO-Gradient Difference Acceleration Rule. *Journal of Advanced Transportation*, *2023*. https://doi.org/10.1155/2023/6645119

Herza, D. F., Imron, N. A., & Leliana, A. (2025). Kajian Pola Operasi Commuter Line Sindro dan Commuter Line Arjonegoro Berdasarkan Demand dan Preferensi Penumpang. *Jurnal Perkeretaapian Indonesia (Indonesian Railway Journal)*, *9*(1), 67–77. https://doi.org/10.37367/jpi.v9i1.361

Kementerian Perhubungan RI. (2025). *Survei Potensi Pergerakan Masyarakat Angkutan Lebaran 2025*. https://kemenhub.go.id/post/read/survei-potensi-pergerakan-masyarakat-angkutan-lebaran-2025,-menhub-dudy--potensi-pergerakan-capai-146,48-juta-orang,-puncak-arus-mudik-28-maret-2025

Pang, Z., Wang, L., Wang, S., Li, L., & Peng, Q. (2023). Dynamic train dwell time forecasting: a hybrid approach to address the influence of passenger flow fluctuations. *Railway Engineering Science*, *31*(4), 351–369. https://doi.org/10.1007/s40534-023-00311-7

Sidabutar, S. S. S., Sitohang, S. T., Samosir, M. J., Simatupang, Y. A., & Hardinata, J. T. (2026). Perbandingan Metode Regresi Linier dan Artificial Neural Network dalam Memprediksi Jumlah Penumpang Kereta Api Nasional. *Jurnal Komputer Teknologi Informasi Sistem Informasi (JUKTISI)*, *4*(3), 2125–2132. https://doi.org/10.62712/juktisi.v4i3.822

Sugiyono. (2021). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D* (Cetakan Ke). Alfabeta.

van der Knaap, R. J. H., de Bruyn, M., van Oort, N., Huisman, D., & Goverde, R. M. P. (2024). Clustering railway passenger demand patterns from large-scale origin–destination data. *Journal of Rail Transport Planning and Management*, *31*(May 2023), 100452. https://doi.org/10.1016/j.jrtpm.2024.100452

Wahab, W., Tri Julianto, B., Danovand, F., & Roza, A. (2025). Evaluasi Kinerja Operasional Kereta Api Pariaman Ekpress (Studi Kasus: Stasiun Padang - Stasiun Pariaman). *JICE (Journal of Infrastructural in Civil Engineering)*, *7*(01), 61–70. https://doi.org/10.33365/jice.v7i01.1015