

Analysis of Passenger Distribution at Cikoko LRT Station in 2025

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Abstract

The rapid growth of population mobility in urban areas such as Jakarta requires an efficient, integrated, and sustainable public transportation system. Cikoko LRT Station, as one of the strategic nodes in the Jabodetabek LRT network, plays a crucial role in supporting inter-zone connectivity within the Jabodetabek region. This study aims to analyze the distribution patterns of passenger movement at the station using a descriptive quantitative approach. Primary data was obtained through a questionnaire survey of LRT passengers, while secondary data on passenger numbers was obtained from PT Kereta Api Indonesia (KAI). The analysis was conducted using two modeling approaches: the Furness Method and the Doubly Constrained Gravity Model (DCGR), calibrated using a combined obstacle ODMatrixrix encompassing distance, time, and cost aspects. The analysis results show that each method has its own characteristics in mapping inter-regional passenger movements. These findings are expected to inform the formulation of public transportation policies that are adaptive to urban mobility needs.

Keywords: Transportation Modeling, LRT Cikoko, trip distribution

1. INTRODUCTION

Rapid urban growth has triggered an increase in transportation needs, especially in metropolitan areas such as Jakarta. The ever-increasing population density has led to high mobility among the community and a demand for public transportation. The Jakarta Provincial Government has responded to this by implementing an efficient, integrated, and environmentally friendly transportation policy. One of the modes being developed is Light Rail Transit (LRT), a rail-based transportation system designed to serve urban travel. The Jabodetabek LRT is one of the main networks connecting the Jabodetabek area, with Cikoko LRT Station as one of its key points.

Cikoko Station plays a strategic role in serving the movement of people in the business, residential, and public facility areas of South Jakarta. This station is connected to other modes of transportation such as the KRL Commuter Line at Cawang Station and TransJakarta at the Cawang – Cikoko bus stop. However, in practice, various operational challenges remain, such as delays in train schedules, long queues on the platforms, and disruptions to supporting facilities. Incidents like sudden braking and elevator malfunctions have caused delays in passenger flow and led to complaints from users. The imbalance between service capacity and passenger numbers presents a unique challenge in station management.

If these conditions are not addressed immediately, public interest in public transportation could potentially decline and the use of private vehicles could increase again. Therefore, further study is needed on passenger movement distribution at Cikoko LRT Station. This study aims to identify accessibility and service issues, as well as provide an overview of passenger distribution patterns that can serve as a reference for decision-making to improve the quality of public transportation in the future.

1.1. Transportation Planning and Modeling

Transportation planning is a strategic process for developing a safe, efficient, and affordable mobility system to support the movement of people and goods [1]. This process must adapt to changes in land use, economic growth, and travel patterns. To respond to future needs, analyses are conducted to project transportation demand, both for public transportation and private vehicles. One commonly used method is the Four-Stage Transportation Planning Model, which includes trip generation, trip distribution, mode choice, and network loading. This model helps understand travel patterns based on population data, land use, and transportation conditions, and serves as the foundation for policy development and infrastructure planning [2].

1.2. Definition of Trip Distribution

Trip distribution is a process in transportation planning that aims to determine the direction and number of trips from the origin zone to the destination zone [3]. This stage continues the trip generation process and serves to describe the pattern of movement between zones based on generation and attraction data. Trip distribution is crucial because it reflects the interaction between land use and the transportation system. These distribution patterns help identify potential transportation issues such as congestion or delays, thereby serving as the foundation for developing efficient and targeted transportation policies and planning.

1.3. Analysis of Trip Distribution Using the Furness Method

The Furness method is a method for calculating movement distribution that falls under the double constrained approach and was developed by Furness in 1965. This method belongs to the group of growth factor methods and is used to adjust the Values in the origin-destination ODMatrixrix iteratively until a balance is achieved between movement generation and attraction. The advantage of this method lies in its simpli and ease of application in transportation planning.

Theoretically, this method is based on the principle of minimizing expected information or maximizing entropy, so that the distribution of movements remains consistent with the established basic pattern. Therefore, the Furness method is considered a reliable tool for analyzing travel distributions, particularly in urban transportation planning studies. Systematically, the Furness method can be expressed in the following equation [4].

$$T_{id} = t_{id} \cdot E_{id} \quad (1)$$

Defined as:

T_{id} = estimated OD Matrixed number of trips in the future from origin zone i to destination zone d.

t_{id} = total number of existing trips from origin zone i to destination zone d.

E_i = growth factor applicable in origin zone i.

E_d = growth factor applicable in destination zone d.

1.4. Analysis of Trip Distribution Using the Gravity Method

Gravity models are the most commonly used synthesis method in transportation planning due to their simplicity and ease in describing trip distributions [5]. These models assume that the number of trips between two zones is influenced by the “mass” of the origin and destination zones (such as population or economic activity) and slowed down by obstacles such as distance, time, or cost. This model is effective for use in various scales of analysis, both interregional and intra-urban. One of its advanced forms is the Doubly Constrained Gravity (DCGR) model, which sets constraints on the generation and attraction Values to ensure that the travel distribution results align with initial estimated ODMatrixes. The DCGR model describes the interdependent relationships between zones without rigid route constraints, with the total number of trips between zones already predetermined [6]. Mathematically, it can be written as follows:

$$T_{id} = O_i \cdot D_d \cdot A_{id} \cdot B_d \cdot f(C_{id}) \quad (2)$$

With,

$$A_{id} = \frac{1}{\sum d(B_d \cdot D_d \cdot f_{id})} \text{ and } B_d = \frac{1}{\sum d(A_i \cdot O_i \cdot f_{id})} \quad (3)$$

Defined as:

T_{id} = estimated OD Matrixed number of trips in the future from origin zone i to destination zone d.

O_i = total trip generation from origin zone i.

D_d = total trip attraction to destination zone d.

A_i = adjustment factor for origin zone.

B_d = adjustment factor for destination zone.

$f(C_{id})$ = travel resistance function from i to d, typically a function of distance, time, or cost.

1.5. Conformity Test OD Matrix

Conformity Test Origin-Destination Matrix (OD MATRIX) is an evaluation method used to measure the extent to which a travel distribution model is able to reflect actual movement patterns between origin and destination zones within an area. One method of model suitability testing is to use Standard Deviation (SD) and Mean Absolute Percentage Error (MAPE), where SD measures the level of error based on the total square difference between the model results and the observed data, while MAPE evaluates the accuracy of predictions based on the average absolute percentage error in the estimates [7]. The equations can be defined as follows:

$$SD = \sqrt{\sum i \sum d \left[\frac{(\hat{T}_{id} - T_{id})^2}{N(N-1)-1} \right]} \quad (4)$$

$$MAPE = \frac{\sum |T_{id} - \hat{T}_{id}|}{\sum T_{id}} \times 100\% \quad (5)$$

Defined as:

- \hat{T}_{id} = future movement from origin zone i to destination zone d.
 T_{id} = current movement from origin zone i to destination zone d.
 n = number of pairs from origin zone i to destination zone d.
 N = total number of data used in OD Matrixriks.

2. RESEARCH METHODOLOGY

This study uses a descriptive quantitative approach to analyze passenger movement distribution at Cikoko LRT Station (CKK), one of the strategic stations in the Jabodebek LRT network that is integrated with other modes of transportation such as the KRL Commuter Line and TransJakarta. This station serves two main lines, namely the Cibubur Line and the Bekasi Line, and covers the areas of Central Jakarta, South Jakarta, East Jakarta, West Jakarta, North Jakarta, and surrounding areas such as Depok, Bekasi, and Tangerang, making it a key node in the urban transportation system.

Primary data was collected from 220 respondents through an online questionnaire using probability sampling with random sampling techniques. The data collected includes origin and destination variables as primary variables, as well as supporting variables such as gender, occupation, monthly income, purpose of travel, distance, travel time, transportation costs, travel frequency, mode of transportation, and waiting time. Travel distribution analysis was conducted using the Double Constrained Gravity Model (DCGR) and Furness method, performed iteratively until convergent results were obtained between generation and attraction based on the ODMatrix combined obstacle matrix.

3. RESULTS AND DISCUSSION

3.1. Generation and Attraction Variable Data

Based on the questionnaire and the results of research related to trip generation and trip attraction that has been conducted, the generation and attraction equations as well as the generation and attraction data for passenger movements in each zone were obtained. This information forms the basis for the process of distributing trips using the specified model.

Table 1: Variable Data for Generation Analysis

No	Zone	Trip Attraction Y	Age (X1)	Education Level (X3)	Purpose of Travel (X6)	Frequency of Travel (X10)	Mode of Transportation (X11)
1	Jakarta Pusat	5	34	3	3	10	1
2	Jakarta Barat	6	34	5	3	7	2
3	Jakarta Utara	4	23	5	3	7	2
4	Jakarta Timur	11	32	4	2	11	1
5	Jakarta Selatan	51	31	4	3	7	2
6	Tangerang	4	26	5	2	3	2
7	Tangerang Selatan	5	24	4	2	7	1
8	Bekasi	12	33	4	3	9	2
9	Kabupaten Bekasi	3	26	3	4	6	2
10	Bogor	10	31	4	2	8	1
11	Depok	5	26	4	2	6	1
TOTAL		116	318	44	28	82	19

Table 2: Variable Data for Attraction Analysis

No	Zone	Trip Attraction (Y)	Age (X1)	Education Level (X3)	Occupation (X4)	Income (X5)	Purpose of Travel (X6)	Distance Traveled (X7)	Frequency of Travel (X10)	Mode of Transportation (X11)
1	Jakarta Pusat	13	24	4	5	2	4	20	9	2
2	Jakarta Barat	6	31	4	3	3	2	27	7	2
3	Jakarta Utara	3	26	4	2	3	3	8	10	2
4	Jakarta Timur	16	28	4	4	2	3	18	8	2
5	Jakarta Selatan	44	29	4	4	3	3	19	8	2
6	Tangerang	2	26	3	3	2	4	30	3	2
7	Tangerang Selatan	2	36	5	5	3	3	35	13	2

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8	Bekasi	3	29	5	7	3	4	35	6	2
9	Kabupaten Bekasi	2	26	5	4	5	3	25	19	1
10	Bogor	5	28	4	6	3	4	21	8	2
11	Depok	8	25	3	4	2	3	30	5	2
TOTAL		104	304	44	46	28	35	267	96	18

3.2. Generation and Attraction Modeling Analysis

After all X variables are substituted into the Generation and Attraction equations in each zone, the Y analysis Value is obtained. This Value is then used to calculate the number of passenger departures and arrivals by multiplying the percentage of the Y analysis result by the total number of passengers. The number of passengers used is derived from January 2025 data, as this month represents stable and normal operational conditions and is free from biases caused by seasonal fluctuations such as long holidays. Additionally, passenger growth during this month is relatively low and consistent, making it the most representative for analysis. The Generation and Attraction Values for each zone are presented in the table below.

Table 3: Generation Values for Each Zone

No	Zone	Value Y analisis	Persentase Generation	Total Departures 2025	Total of Generation
1	Jakarta Pusat	8	7%	125748	8566
2	Jakarta Barat	15	13%		16163
3	Jakarta Utara	7	6%		7766
4	Jakarta Timur	10	9%		10736
5	Jakarta Selatan	48	41%		51617
6	Tangerang	2	1%		1713
7	Tangerang Selatan	7	6%		7865
8	Bekasi	3	3%		3417
9	Kabupaten Bekasi	2	2%		2094
10	Bogor	11	10%		12431
11	Depok	3	3%		3379
		116	100%		125748

Table 4: Attraction Values of Each Zone

No	Zone	Value Y analisis	Persentase	Total Arrivals 2025	Total of Attraction
1	Jakarta Pusat	16	15%	125748	19381
2	Jakarta Barat	8	8%		9673
3	Jakarta Utara	2	2%		2541
4	Jakarta Timur	14	13%		17104
5	Jakarta Selatan	43	42%		53252
6	Tangerang	4	3%		4315
7	Tangerang Selatan	2	2%		2315
8	Bekasi	2	2%		2644
9	Kabupaten Bekasi	2	2%		2324
10	Bogor	6	6%		7863
11	Depok	5	5%		6171
		104	100%		127583

To obtain the Origin-Destination Matrix (ODM), a simple proportional distribution method is used, which involves multiplying the number of Generations in the origin zone by the Attraction percentage of the destination zone. The initial Origin-Destination Matrix (ODM) for LRT Cikoko passengers in 2025 is provided in the table below.

Table 5: OD Matrix Starting Zone

ZONE	1	2	3	4	5	6	7	8	9	10	11	oi	Oi	Ei
1	0	870	229	1539	4791	388	388	238	209	707	555	9915	11478	1.158
2	3290	0	431	2904	9040	732	732	449	395	1335	1048	20356	21659	1.064
3	1581	789	0	1395	4344	352	352	216	190	641	503	10363	10407	1.004
4	2185	1091	286	0	6005	487	487	298	262	887	696	12683	14386	1.134

5	10507	5244	1377	9273	0	2339	2339	1433	1260	4263	3345	41381	69166	1.671
6	349	174	46	308	958	0	78	48	42	141	111	2254	2295	1.018
7	1601	799	210	1413	4399	356	0	218	192	650	510	10348	10539	1.018
8	696	347	91	614	1911	155	155	0	83	282	221	4556	4579	1.005
9	426	213	56	376	1171	95	95	58	0	173	136	2799	2806	1.003
10	2530	1263	332	2233	6953	563	563	345	303	0	806	15892	16658	1.048
11	688	343	90	607	1890	153	153	94	82	279	0	4379	4527	1.034
dd	23853	11133	3148	20661	41461	5621	5342	3397	3019	9359	7931	134926		
Dd	25612	12783	3357	22604	70373	5702	3059	3494	3072	10391	8155		168501	
Ed	1.074	1.148	1.066	1.094	1.697	1.014	0.573	1.029	1.018	1.110	1.028			1.249

3.3. Trip Distribution Computation with the Furness Model for 2025

In this method, the distribution of movements from the origin zone in the future is proportional to the distribution of movements in the present. The results are then multiplied by the growth rate of the destination zone and origin zone alternately until the total Origin-Destination Matrix (ODM) cells for each direction are equal to the total desired Origin-Destination Matrix (ODM) cells.

Table 6: Origin-Destination Matrix (ODM) 2025 Furness Method No. 1

ZONE	1	2	3	4	5	6	7	8	9	10	11	oi	Oi	Ei
1	0	1007	265	1782	5547	449	449	275	242	819	643	11478	11478	1.000
2	3501	0	459	3089	9619	779	779	478	420	1420	1115	21659	21659	1.000
3	1588	792	0	1401	4362	353	353	217	190	644	505	10407	10407	1.000
4	2479	1237	325	0	6811	552	552	338	297	1006	789	14386	14386	1.000
5	17562	8765	2302	15499	0	3910	3910	2396	2106	7125	5592	69166	69166	1.000
6	355	177	47	313	976	0	79	48	43	144	113	2295	2295	1.000
7	1631	814	214	1439	4480	363	0	222	196	662	519	10539	10539	1.000
8	699	349	92	617	1921	156	156	0	84	284	223	4579	4579	1.000
9	427	213	56	377	1174	95	95	58	0	173	136	2806	2806	1.000
10	2652	1324	348	2341	7288	591	591	362	318	0	845	16658	16658	1.000
11	711	355	93	627	1953	158	158	97	85	288	0	4527	4527	1.000
dd	31605	15034	4199	27486	44131	7407	7123	4491	3981	12566	10479	168501		
Dd	25612	12783	3357	22604	70373	5702	3059	3494	3072	10391	8155		168603	
Ed	0.810	0.850	0.799	0.822	1.595	0.770	0.430	0.778	0.772	0.827	0.778			1.001

Example of iteration 1 calculation correction Generation T₂₁:

$$\begin{aligned}
 T_{id} &= t_{id} \times E_i \\
 &= 3290 \times 1,064 \\
 &= 3501
 \end{aligned}$$

Table 7: Origin-Destination Matrix (ODM) 2025 Furness Method No. 2

ZONE	1	2	3	4	5	6	7	8	9	10	11	oi	Oi	Ei
1	0	857	212	1465	8845	346	193	214	187	677	500	13496	11478	0.851
2	2837	0	367	2541	15338	600	335	371	324	1175	867	24755	21659	0.875
3	1287	674	0	1152	6956	272	152	168	147	533	393	11734	10407	0.887
4	2009	1052	260	0	10861	425	237	263	229	832	614	16782	14386	0.857
5	14232	7453	1840	12746	0	3010	1679	1864	1625	5892	4351	54693	69166	1.265
6	288	151	37	258	1556	0	34	38	33	119	88	2601	2295	0.882
7	1321	692	171	1183	7145	279	0	173	151	547	404	12067	10539	0.873
8	567	297	73	507	3063	120	67	0	65	235	173	5167	4579	0.886
9	346	181	45	310	1873	73	41	45	0	143	106	3164	2806	0.887
10	2149	1126	278	1925	11621	455	254	281	245	0	657	18992	16658	0.877
11	576	302	75	516	3115	122	68	75	66	239	0	5153	4527	0.879
dd	25612	12783	3357	22604	70373	5702	3059	3494	3072	10391	8155	168603		
Dd	25612	12783	3357	22604	70373	5702	3059	3494	3072	10391	8155		168501	
Ed	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000			0.999

Example of iteration 2 calculation correction Generation T₂₁:

$$\begin{aligned}
 T_{id} &= t_{id} \times E_i \\
 &= 3501 \times 0,801 \\
 &= 2837
 \end{aligned}$$

For further calculations, an iterative process was carried out repeatedly using the Furness method until the distribution of trips between the origin zone and the destination zone reached the expected equilibrium level. This process was carried out gradually until a stable result was obtained, namely at the 16th iteration, where the difference between the Generation and Attraction Values was within the acceptable tolerance limit.

Table 8: Origin-Destination Matrix (ODM) 2025 Furness Method No. 16

ZONE	1	2	3	4	5	6	7	8	9	10	11	oi	Oi	Ei
1	0	542	137	935	8511	226	125	140	122	432	326	11495	11478	0.999
2	1896	0	247	1690	15380	408	225	252	220	781	589	21689	21659	0.999
3	881	455	0	785	7148	190	105	117	102	363	274	10420	10407	0.999
4	1302	672	170	0	10562	281	155	173	151	537	404	14407	14386	0.999
5	17986	9284	2342	16032	0	3875	2135	2392	2091	7412	5583	69132	69166	1.000
6	196	101	25	174	1588	0	23	26	23	81	61	2298	2295	0.999
7	892	460	116	795	7232	192	0	119	104	367	277	10553	10539	0.999
8	388	200	51	346	3146	84	46	0	45	160	120	4585	4579	0.999
9	237	123	31	212	1925	51	28	32	0	98	74	2810	2806	0.999
10	1445	746	188	1288	11722	311	172	192	168	0	449	16680	16658	0.999
11	389	201	51	347	3158	84	46	52	45	160	0	4533	4527	0.999
dd	25612	12783	3357	22604	70373	5702	3059	3494	3072	10391	8155	168603		
Dd	25612	12783	3357	22604	70373	5702	3059	3494	3072	10391	8155	168501		
Ed	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999		

The Furness method stopped at the 16th iteration, indicating that the number of movements had converged and produced consistent and accurate results, with a Generation of 160,607 passengers and an Attraction of 162,655 passengers. The OD Matrix results of the iteration were then plotted into the Easyfit software to determine the distribution of movements. This graph illustrates the probability of a certain number of movements (passenger frequency) occurring within a specific unit of time or space.

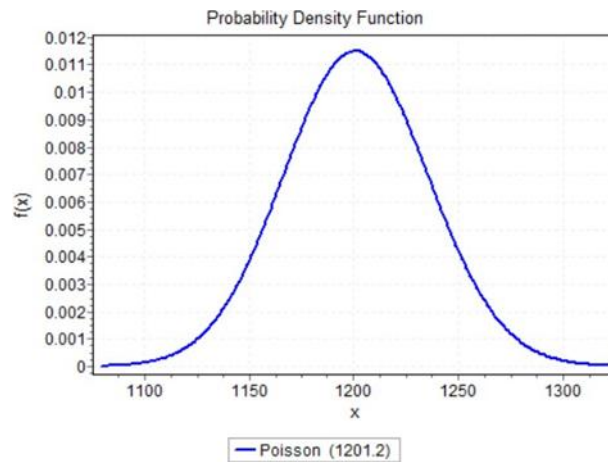


Figure 1. Poisson Distribution Graph Furness Method 2025

From the graph above, the equation is known and the Value $\Lambda = 1740.3$ is obtained. The Value λ in the Poisson distribution represents the average number of events.

3.4. Trip Distribution Computation with the Furness Model for 2025

In the analysis of travel distribution using the two-boundary Gravity method, the OD Matrix of resistance is compiled to represent the level of resistance between zone based on three main components, namely travel costs, travel time, and distance. Data is obtained through a questionnaire survey, then each component is normalized using the Min-Max method to ensure they are on a comparable scale. After that, the three OD Matrices are combined using equal weights, namely 0.33 for each component.

Table 9: OD Matrix Combined Impedance

ZONE	1	2	3	4	5	6	7	8	9	10	11
1	0.477	0.573	0.260	0.318	0.402	0.416	0.416	0.469	0.260	0.510	0.455
2	0.745	0.841	0.528	0.587	0.670	0.685	0.685	0.737	0.528	0.779	0.724

3	0.693	0.790	0.476	0.535	0.619	0.633	0.633	0.685	0.476	0.727	0.672
4	0.680	0.777	0.463	0.522	0.606	0.620	0.620	0.672	0.463	0.714	0.659
5	0.488	0.585	0.271	0.330	0.414	0.428	0.428	0.480	0.271	0.522	0.467
6	0.591	0.688	0.374	0.433	0.517	0.531	0.531	0.583	0.374	0.625	0.570
7	0.373	0.469	0.156	0.214	0.298	0.312	0.312	0.365	0.156	0.406	0.351
8	0.788	0.884	0.571	0.630	0.713	0.728	0.728	0.780	0.571	0.822	0.767
9	0.319	0.415	0.102	0.161	0.244	0.259	0.259	0.311	0.102	0.353	0.298
10	0.504	0.600	0.287	0.345	0.429	0.443	0.443	0.496	0.287	0.537	0.482
11	0.504	0.601	0.287	0.346	0.430	0.444	0.444	0.496	0.287	0.538	0.483

The combined resistance OD Matrix was then calibrated to obtain the beta (β) parameter Valuee using a linear regression approach in accordance with the Hyman (1969) method. In this study, the Tanner resistance function was used because it was appropriate for the characteristics of the data. The calibration results showed a beta Valuee of 0.482, which was then used in the resistance factor calculation. The following is an example of the resistance factor OD Matrix calculation.

$$\begin{aligned}
 f(C_{id}) &= (\exp(-\beta \cdot C_{id})) \\
 &= (\exp(-0,423 \cdot 0,482)) \\
 &= 1,224
 \end{aligned}$$

Table 10: OD Matrix Impedance Function

ZONE	1	2	3	4	5	6	7	8	9	10	11
1	1.224	1.275	1.116	1.144	1.186	1.193	1.193	1.219	1.116	1.241	1.213
2	1.371	1.428	1.250	1.282	1.328	1.336	1.336	1.366	1.250	1.391	1.359
3	1.341	1.397	1.223	1.254	1.300	1.307	1.307	1.337	1.223	1.360	1.329
4	1.334	1.389	1.217	1.247	1.292	1.300	1.300	1.329	1.217	1.353	1.322
5	1.230	1.281	1.122	1.150	1.191	1.199	1.199	1.225	1.122	1.247	1.219
6	1.284	1.338	1.172	1.201	1.244	1.252	1.252	1.280	1.172	1.303	1.273
7	1.171	1.220	1.068	1.095	1.135	1.141	1.141	1.167	1.068	1.188	1.160
8	1.396	1.454	1.273	1.305	1.353	1.361	1.361	1.391	1.273	1.416	1.384
9	1.145	1.192	1.044	1.070	1.109	1.116	1.116	1.141	1.044	1.161	1.134
10	1.238	1.289	1.129	1.157	1.199	1.206	1.206	1.233	1.129	1.255	1.227
11	1.238	1.290	1.129	1.158	1.200	1.207	1.207	1.234	1.129	1.256	1.227

Using the general equation (2), the Gravity Method (DCGR) can be calculated as follows.

Table 11: OD Matrix Asal Tujuan (OD Matrix) 2025 Metode Gravity DCGR Iterasi Ke – 10

ZONE	1	2	3	4	5	6	7	8	9	10	11	oi	Oi	Ei	Ai
1	0	990	254	1698	4818	410	198	194	194	717	563	10035	11478	1.144	0.000007
2	2891	0	421	2815	7988	680	328	458	321	1188	933	18023	21659	1.202	0.000008
3	1424	809	0	1386	3935	335	162	226	158	585	460	9480	10407	1.098	0.000008
4	1981	1125	288	0	5473	466	225	314	220	814	639	11546	14386	1.246	0.000008
5	10449	5935	1521	10173	0	2458	1187	1656	1161	4295	3372	42207	69166	1.639	0.000007
6	330	187	48	321	912	0	37	52	37	136	106	2167	2295	1.059	0.000008
7	1683	956	245	1639	4651	396	0	267	187	692	543	11259	10539	0.936	0.000007
8	599	340	87	583	1654	141	68	0	67	246	193	3978	4579	1.151	0.000008
9	460	261	67	448	1271	108	52	73	0	189	148	3078	2806	0.912	0.000007
10	2498	1419	363	2432	6901	588	284	396	278	0	806	15964	16658	1.043	0.000007
11	679	385	99	661	1875	160	77	108	75	279	0	4397	4527	1.030	0.000007
dd	22993	12408	3392	22155	39476	5742	2619	3743	2699	9141	7763	132133			
Dd	25612	12783	3357	22604	70373	5702	3059	3494	3072	10391	8155		168501		
Ed	1.114	1.030	0.990	1.020	1.783	0.993	1.168	0.933	1.138	1.137	1.050			1.275	
Bd	1.033	1.083	0.931	0.957	0.997	1.004	1.004	1.029	0.931	1.050	1.023				

From the results obtained, it is known that the iteration of the Origin-Destination Matrix using the Gravity Method stops at the 10th iteration with a total of 132,331 generations and 132,331 passengers. The OD Matrix iteration results are then plotted in Easyfit software to determine the distribution graph.

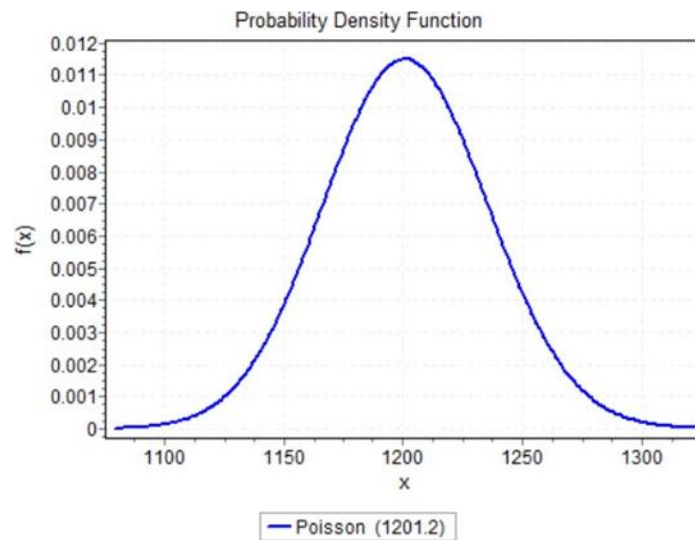


Figure 2. Poisson Distribution Graph Gravity Method DCGR 2025 From the graph

above, the equation is known and the Value is obtained $\Lambda = 1201.2$.

3.5. Model Testing

Based on the distribution of passenger movements using the OD Matrix method, the distribution of passenger movements using the Furness method and the Gravity DCGR method, the Trip Distribution model test can be calculated using Standard Deviation (SD) and Mean Absolute Percentage Error (MAPE) with equations (4) and (5). The results of the SD and MAPE calculations between the two methods are presented in the following table.

Table 12. Perbandingan Value SD dan MAPE Furness dan DCGR

No	Model	Square Error	Abs. Error	SD	MAPE
1	Furness	268155662	54.73	149.56	49.76%
2	DCGR dengan Fungsi Hambatan Tanner	5343743	14	21.11	12.51%

4. CONCLUSIONS

This study analyzes passenger movement distribution at Cikoko LRT Station using a quantitative approach with two calculation methods, namely the Furness Method and the Doubly Constrained Gravity Model (DCGR). The calculation results show that the Furness Method converged at the 16th iteration with a total Generation of 160,607 passengers and a total Attraction of 162,655 passengers. Meanwhile, the DCGR method has a lower convergence rate despite producing smaller standard deviation and MAPE Values. This indicates that each method has its own advantages, but the Furness Method is considered more stable and consistent iteratively.

Distribution testing using EasyFit software shows that the modeling results from both methods follow a Poisson distribution pattern, with $\lambda = 1.740.3$ for the Furness method and $\lambda = 1.234.9$ for DCGR. The higher λ Valuee in the Furness method indicates a more intensive and even distribution of movement between zones. Based on the regional analysis, South Jakarta is recorded as the zone with the highest Generation and Attraction Valuees, while Bekasi Regency and South Tangerang have the lowest contributions. Considering aspects of convergence, statistical distribution, and zone characteristics, the Furness Method is deemed more representative for modeling passenger movement distribution at Cikoko LRT Station. These results are expected to serve as a reference in supporting sustainable urban transportation planning that is responsive to customer needs.

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