American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-6, Issue-11, pp-183-186
www.ajer.org
Research Paper Open Access

Analysis of Gravity Model with Tanner Barrier Function Influenced By Entropy of Land Use Integrated

Chaeranita H.F[1], Dr. Sobri Abusini, M.T[2], Prof. Marjono, M.Phil[3]
[1,2,3]*Department of Mathematics, Post Graduate F. MIPA, Brawijaya University, Malang, Indonesia*
Corresponding Author: chaeranitachf@gmail.com; sobri@ub.ac.id; marjono@ub.ac.id

ABSTRACT: *The distribution of movement is one of the important steps in transportation, which at this stage is shown in the form of Destination Matrix (MAT). MAT is a matrix that states the movement of a person from a region to another region for various reasons, whether for reasons of education, work, shopping, and so on. The Gravity model is influenced by the Tanner resistance function and the integrated Land use Entropy is used to calculate the future MAT. There are parameters $\beta = -0.048$ and $\gamma = 0.225$ which respectively show the cost of a person performing the movement and the integrated land use Entropy. Ampenan, Sekarbela, Mataram, and Selaparang sub-districts are used as research areas. The result of the prediction of future MAT forecast indicates that the movement from Ampenan sub-district to Selaparang sub-district is the highest total movement of 17,421.*

Keywords: *Gravity Model, Tanner Barrier Function, Entropy Land Use Integrated*

Date of Submission: 08-11-2017 Date of acceptance: 22-11-2017

I. INTRODUCTION

The era of globalization as it is today makes transportation a fundamental and important need to be fulfilled. The need for transportation arises as a result of human needs requiring a movement that will link a land use and other land use.Changing the location of urban land use, creating new problems in meeting daily needs. Frequent transportation problems are congestion, accidents, pollution generated, and other problems. Therefore, there needs to be transportation planning to minimize the transportation problems.The city of Mataram is a city that requires transportation planning for the future, because Mataram City is located on the island of Lombok which is a tourist area. There are four sub-districts in Mataram which are the study in this research, which is Ampenan, Sekarbela, Mataram and Sekarbela sub-districts.

The model for transport planning used is the distribution of movement. The distribution of the trip or trip distribution is the stage that predicts the movement from the origin zone to a particular zone considering the influence of the level of accessibility between the zones and the rate of rise and pull of movement. This stage can be described in the form of Destination Matrix (MAT).Tamin (2000) says that a simple and often used method of synthesis by researchers is the Gravity Model. The model for estimating the flow of MAT traffic in transportation planning and modeling is the Gravity Model with double boundaries, namely the limits of the rise and the pull of movement. In the model there is an obstacle function that refers to a person's ease in doing movement (cost, distance, time, etc.). In the resistance function there is an β parameter that must be calibrated.

The previous research which discussed the Gravity Model is Murat (2010) which uses the function of resistance bar and exponential negative and uses Hyman Algorithm to calibrate the parameter β. Grange et al., (2010) using Gravity Model and Entropy Model with multi objective. Li et al (2011) used the Gravity Entropy Maximization Model with a quadratic cost limit. Abdel-Aal (2014) uses the Gravity Model with Maximum Likelihood calibration process. Novacko et al (2014) uses the Gravity Model with a Module calibration on PTV Visum Software. Luo (2015) uses the Gravity Model and Maximum Entropy Model and calibration using the Hyman Algorithm.

In contrast to Luo's (2015) research, this Research discusses the Gravity Model influenced by the integrated land use entropy and Tanner's obstacle function, where in the area of origin i and destination d there are several land uses. In addition to the β parameter, there are parameters that show the diversity of land use of a zone, which is indicated by the parameter γ.

II. METHOD

Primary data collection is done by household survey in Mataram City. There are 4 sub-districts in Mataram which are the study areas, namely Ampenan, Sekarbela, Mataram and Selaparang districts. Determining the number of samples used, data on the number of Households from each sub-districts (source: sub-districts in 2016 (BPS) number), as shown in the following table:

Table 1. Number of Households in Mataram City

No.	Districs	Households
1.	Ampenan	22.862
2.	Sekarbela	17.376
3.	Mataram	21.323
4.	Selaparang	24.976
	Total Household	86.537

Household sampling is done by using Proportional Random Sampling method. With the following formula:

$$n = \frac{T - t_o}{t_1}$$

If:

n =Number of samples studied
T =Time available for research
t_o =Sampling time
t_1 =Time used to fill out the questionnaire

Based on the above formula, the Ampenan sub-district requires 47 samples, Sekarbela sub-district requires 36 samples, Mataram sub-district 44 samples and Selaparang sub-district 52 samples. The sub-districts will then be written in the form of 1, 2,3,4 respectively.

III. RESULT AND DISCUSSION

*3.1 **Survey Result Data***

The required survey data are as follows:

Table 2. Existing MAT of Mataram City

Source \ Purpose	1	2	3	4	o_i	O_i
1	23	23	33	33	112	47.646,08
2	6	16	59	26	107	5.491,09
3	12	16	91	29	148	31.888,49
4	14	21	65	56	156	33.283,78
d_d	55	76	248	144	523	
D_d	36.299,10	12.573,29	23.493,83	45.943,22	36.299,10	118.309,43

Tabel 3. Average Movement Cost$\boldsymbol{C_{id}}$

Source \ Purpose	1	2	3	4
1	Rp. 6,5,-	Rp. 4,5,-	Rp. 10,0,-	Rp. 7,0,-
2	Rp. 17,0,-	Rp. 5,5,-	Rp. 10,5,-	Rp. 14,0,-
3	Rp. 12,5,-	Rp. 8,5,-	Rp. 10,5,-	Rp. 9,5,-
4	Rp. 17,0,-	Rp. 15,5,-	Rp. 13,0,-	Rp. 9,0-

The data needed next is Entropy for integrated land use, the calculation using the following formula:

$$H_{i,k} = -\sum_{k=1}^{n_k} P_{i,k} \ln P_{i,k}$$

To calculate proportion$P_{i,k}$, used the following formula:

$$P_{i,k} = \frac{(x_{i,k})(p_{i,k})}{(\sum X_{i,k})(\sum pt_{i,k})}$$

If:

$H_{i,k}$	=	Entropy of land use of various types $k = 1,2 \dots, n_k$ in the sub−district i.
$P_{i,k}$	=	Proportion of Entropy use type land k in the sub−district i.
$x_{i,k}$	=	Type of land use k in the sub−district i.
$p_{i,k}$	=	Proportion of land use type k in the sub−district i.
	=	$\frac{x_{i,k}}{X_{i,k}}$.
$X_{i,k}$	=	Total land area type k in the sub−district i.
$pt_{i,k}$	=	Total proportion of land use type k in the sub−district i.
	=	$\frac{\sum x_{i,k}}{\sum X_{i,k}}$.

The integrated land use entropy is a combination of the interaction of the land use Entropy derived from a sub-district *i* = 1,2,3,4 to a d to sub-district *d* = 1,2,3,4. The formula of integrated land use Entropy is:

$$H_{id,k} = H_{i,k} + H_{d,k}$$

The following table shows Entropy for integrated land:

Table 4. Entropy of Integrated Land Use of each Kecamatan

Source \ Purpose	1	2	3	4
1	2,0492074	3,0782938	4,1543217	4,1480451
2	1,0290863	1,0290863	3,134200	3,1279240
3	4,1543217	2,1051142	2,1051142	4,2039519
4	4,1480451	3,1279240	4,2039519	2,0988376

3.2 Calculation of Gravity Model with Influence of Entropy of Land Use Integrated

Calibration The gravity model in this study used multiple linear regression analysis. The calibrated parameters are the parameters β and γ each showing the cost of movement and the Land Use Entropy. With the help of SPSS Software, then obtained eter paraeter value is -0,048 and γ is 0,225. Gravity Model calculation formula with average moving cost influence and integrated land use Entropy are:

$$T_{id} = O_i D_d A_i B_d C_{id}^{-\beta} e^{-\beta C_{id}} e^{-\gamma h_{id}}$$

If:

T_{id}	=	Movement from the origin zone *i* to the destination zone *d*.
O_i	=	The number of moves originating from the original zone *i*.
D_d	=	The number of moves leading to the destination zone *d*.
d_{id}	=	Distance between place of origin and destination.
k	=	Constants.

$$B_d = \frac{1}{\sum_i \left(A_i O_i f(C_{id})\right)} \qquad \text{For all } d,$$

$$A_i = \frac{1}{\sum_d \left(B_d D_d f(C_{id})\right)} \qquad \text{For all } i,$$

Using the previously mentioned data and formulas, the following is the Gravity Model calculation table with the average effect of movement cost and the integrated land use Entropy.

Table 5. Final MAT with Gravity Model

Source \ Purpose	1	2	3	4	o_i	O_i	A_i
1	16776	4368	9081	17421	47646	47646	1,15791E-06
2	2300	461	737	1993	5491	5491	6,31553E-07
3	8240	3893	8473	11281	31888	31888	9,91585E-07
4	8984	3850	5203	15247	33284	33284	8,21122E-07

d_d	36299	12573	23494	45943	118309		
D_d	36299	12573	23494	45943		118309	
B_d	8,88792	9,43639	9,88425	11,3763			

IV. CONCLUSION

The result of the analysis shows that the highest total movement is as follows:

a. Total movement from Ampenan sub-district to Selaparang sub-district, which is 17,421,
b. Total movement from Sekarbela sub-district to Ampenan sub-district, 2,300,
c. Total movement from Mataram sub-district to Selaparang sub-district, which is 11,281,
d. Total movement from Selaparang sub-district to Selaparang sub-district, which is 15,247.

REFERENCES

[1] Abdel-Aal, M. M. M. 2014. Calibrating a Trip Distribution Gravity Model Stratified by the Trip Purpose for The City of Alexandria. *Alexandria Engineering Journal*, 53, 677-689.

[2] Grange, L.; D. Fernandez, E. dan Cea, J. D. 2010. A Consolidated Model of Trip Distribution. *Transportation Research PartE*, 46, 61–75.

[3] Luo, X. Q. 2015. The Proof of Gravity Model with Negative Exponential Land-Mixed Entropy and Similar to the Method of Hyman Calibration Tecnology. *The Open Civil Engineering Journal,* 9, 1035-1040.

[4] Makwana, R. J.; Zala, L. B. dan Amin, A. A. 2015. Calibration of Gravity Model: A Case Study of Avkuda Region. *International Journal of Advance Research in Engineering, Science &Technology (IJAREST),* Vol 2, Issue 5.

[5] Murat, C. H. 2010. Sample Size Needed for Calibrating Trip Distribution and Behavior of The Gravity Model. *Journal of Transport Geography*, 18, 183–190.

[6] Novack, L.; Simunovic, L. dan Krasic, D. 2014. Estimating of Origin-Destination Trip Matrices for Small Cities. *Promet – Traffic & Transportation*, Vol. 26, No. 5, 419-428.

[7] Tamin, Ofyar. Z. 2000. *Perencanaan dan Permodelan Transportasi.* Edisi Kedua. Penerbit ITB. Bandung.

[8] Xiang, L. Zhangfeng, Q. Lixing, Y. dan Keping, L. 2011. Entropy Maximization Model for The Trip Distribution Problem with Fuzzy and Random Parameters. *Journal of Computational and Applied Mathematics*, 235, 1906-1913.

Chaeranita H.F Analysis of Gravity Model with Tanner Barrier Function Influenced By Entropy of Land Use Integrated.” American Journal of Engineering Research (AJER), vol. 6, no. 11, 2017, pp. 183-186.