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ANALYSIS OF THE RELATIONSHIP BETWEEN FACTORS THAT INFLUENCE USER SATISFACTION IN GOJEK USING THE FUZZY DEMATEL METHOD

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ABSTRACT

Gojek is one of the most popular online transportation services in Indonesia. The success of Gojek is closely tied to user satisfaction. There are five factors influencing user satisfaction: service quality factor (A), price factor (B), ease of use factor (C), perceived benefit factor (D), and online servicescape factor (E). This research aims to identify which factors most significantly affect user satisfaction with Gojek services among students of the Mathematics Department at UNP. This study in applied research that is described using fuzzy DEMATEL and employs primary data obtained from questionnaire responses. The population of this study consists of students from the Mathematics Department at FMIPA UNP who enrolled in 2022, with a sample size of 75 students using the proportional random sampling technique. The results of this research indicate a significant relationship between the service quality factor (A) and price factor (B). With respective y coordinates of 0.583 and 2.074, the researcher can conclude that the price factor has the most significant influence on user satisfaction with Gojek among students of the Mathematics Department at FMIPA UNP in the 2022 cohort.

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1. INTRODUCTION

In the current modern era, transportation plays a crucial role in people's daily lives, such as commuting to work, going to school, shopping, and delivering goods [1]. However, the high mobility of urban communities gives rise to issues such as traffic congestion. This leads to the inefficiency and ineffectiveness of urban community mobility in carrying out their activities. Therefore, online transportation has become one of the reliable and potentially profitable service sectors, supported by the advancement of communication and information technology (the internet) [2].

One of the popular online transportation providers in Indonesia currently is Gojek [3]. Gojek is a leading on-demand platform in Southeast Asia and a pioneer in the multi-service ecosystem. Founded by Nadiem Makarim in 2010 in Jakarta and Gojek is one of the providers of online transportation services under PT. Aplikasi Karya Anak Bangsa [4], Gojek initially provided motorcycle taxi bookings through a call center in the Jakarta area. However, in 2015, Gojek innovated by launching an online application that allowed users to track the location of drivers picking them up. As of July 2020, Gojek has been downloaded over 120 million times and operates in more than 200 cities across Indonesia [5].

Users of the Gojek application only need to order a motorcycle taxi through the app and will be picked up by a driver who accepts the request. Gojek not only serves passengers but also provides various other services, such as parcel delivery, food ordering, online taxis, and many more [6]. Gojek has become a favorite among the workforce, especially among the younger generation [7]. For example, students without personal vehicles, those in a hurry and avoiding traffic jams, or students from out of town who are not familiar with the streets can benefit from Gojek services [8]. However, this research aims to identify which factors most influence Gojek user satisfaction among students.

According to Kandanpully and Hu (2007), satisfaction is based on the first service experience. Service users will rate during the first experience when using the service, if they feel that the service is good, users are likely to use the service again and tell others about it. Leverlock (1996) identifies user satisfaction as an important factor in customer loyalty and shows positive signs of correlation among them [9]. Therefore, transportation service providers are competing to attract consumers by improving service, ease of booking, fleet comfort, punctuality, and so forth [10].

There are five main factors that can influence user satisfaction: Product Quality, Service Quality, Emotional factors, Price, and Convenience. However, in this study, which involves a service, the product quality will be replaced with Online Servicescape (Tjiptono, 2005). Therefore, this research utilizes five factors that affect user satisfaction, namely Service Quality (A), Price (B), Convenience (C), Perceived Benefits (D), and Online Servicescape (E) [11].

2. RESEARCH METHODS

2.1 Data Sources

In this study, primary data were sourced from all 259 students enrolled in the Mathematics Department of the Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang, in the 2022 intake year. Based on the calculation of the sample size using the Slovin formula, this method involved selecting a subset of individuals from the population in such a way that each individual had an equal chance of being chosen. In this study, all 259 students enrolled in the Mathematics Department of the Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang, in the 2022 intake year were considered as the population. From this population, a sample size of 75 individuals was selected using the simple random sampling technique. This ensured that each student had an equal opportunity to be included in the sample, thereby providing a representative subset of the larger population for the study.

2.2 The Fuzzy DEMATEL Method

The fuzzy DEMATEL method is necessary in this research because it combines fuzzy theory and the DEMATEL method. At the end of 1971, the Decision-Making Trial and Evaluation Laboratory

(DEMATEL) technique was first used by Fontela and Gabus, and by 1976 it had been applied in managing various complex global issues in the fields of science, politics, and economics, taking into account the attitudes of experts (Gabus and Fontela, 1972; Gabus and Fontela, 1973). The DEMATEL method is a method for constructing and analyzing structural models to analyze the influence of complex relationships between criteria. Additionally, DEMATEL can also be used to identify and analyze dominant criteria in a system [12]. However, in a fuzzy environment, it is very difficult to make decisions for complex factors. To address this issue, Lin and Wu have presented a model that utilizes DEMATEL in a fuzzy environment to obtain more accurate analysis [13]. In the fuzzy DEMATEL method, a fuzzy linguistic scale is used, with levels of "influence" varying across 5 linguistic words: "Not influential, Very low influence, Low influence, High influence, and Very high influence" [14].

Table 1. **The Fuzzy Linguistic Scale**

Linguistic terms	Scale	Triangular Fuzzy Number (TFN)
Not influential	0	(0, 0, 0.25)
Very low influence	1	(0, 0.25, 0,50)
Low influence	2	(0.25, 0.50, 0.75)
High influence	3	(0.50, 0.75, 1.00)
Very high influence	4	(0.75, 1.00, 1.00)

Based on **Table 1**, it outlines linguistic terms, corresponding scale values, and their respective Triangular Fuzzy Numbers (TFN) used to assess the level of influence. For instance, a scale value of 0 corresponds to the linguistic term "Not influential," with TFN (0, 0, 0.25), indicating a negligible impact. Conversely, a scale value of 4 signifies "Very high influence," with TFN (0.75, 1.00, 1.00), suggesting a significant impact.

Here are the steps for using the fuzzy DEMATEL method [15]:

Step 1: *Direct-relation matrix (T)*

The Direct relation matrix (T) is obtained directly from the questionnaire results without averaging first.

$$T = [t_{ij}] = \begin{bmatrix} t_{11} & t_{12} & \cdots & t_{1n} \\ t_{12} & t_{22} & \cdots & t_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ t_{1n} & t_{n2} & \cdots & t_{nn} \end{bmatrix}$$

Step 2: *Designing fuzzy linguistic variables*

Fuzzy linguistic variables or Triangular Fuzzy Numbers (TFN) are used to transform complex structural models of cause-effect relationships of a criterion into a more manageable form.

Step 3: *Transformation of Triangular Fuzzy Number (TFN) into the initial direct-relation matrix (F).*

The initial direct relation matrix F is a table containing crisp values. Crisp values are obtained from TFN calculations using the Converting Fuzzy Data into Crisp Score (CFCS) method. According to Opricovic and Tzeng (2003), this calculation is performed in five ways:

a) Normalization:

$$xu_{i,j}^{n} = (u_{i,j}^{n} - min\ l_{i,j}^{n})/\Delta_{min}^{max}, \tag{1}$$

$$xm_{i,j}^{n} = (m_{i,j}^{n} - min\ l_{i,j}^{n})/\Delta_{min}^{max}, \tag{2}$$

$$xl_{i,j}^{n} = (l_{i,j}^{n} - min\ l_{i,j}^{n})/\Delta_{min}^{max}, \tag{3}$$

where

$$\Delta_{min}^{max} = max\ u_{i,j}^{n} - min\ l_{i,j}^{n}. \tag{4}$$

b) Compute left and right normalized value:

$$xls_{i,j}^{n} = xu_{i,j}^{n}/(1 + xm_{i,j}^{n} - x\ l_{i,j}^{n}) \tag{5}$$

$$xrs_{i,j}^{n} = xu_{i,j}^{n}/(1 + xu_{i,j}^{n} - x\ m_{i,j}^{n}) \tag{6}$$

c) Compute total normalized crisp values:

$$x_{i,j}^{n} = \frac{[xls_{i,j}^{n}(1-xls_{i,j}^{n})+xrs_{i,j}^{n}\ x\ x\ rs_{i,j}^{n})]}{[1-xls_{i,j}^{n}+xrs_{i,j}^{n}]} \tag{7}$$

d) Compute crisp values:

$$z_{i,j}^{n} = min\ l_{i,j}^{n} + x_{i,j}^{n}\ x\ \Delta_{min}^{max} \tag{8}$$

e) Integrate crisp values:

$$z_{i,j} = 1/h(z_{i,j}^{1} + z_{i,j}^{2}+\ldots+z_{i,j}^{h}) \tag{9}$$

Step 4: *Normalize the direct-relation matrix (S)*

$$K = \frac{1}{max_{1\leq i\leq n}\sum_{j=1}^{n} t_{ij}}, i,j = 1,2,\ldots,n \tag{10}$$

$$S = K\ x\ T \tag{11}$$

with each row and column summing up to a scale of $0 \leq x \leq 1$.

Step 5: *Attain the total-relation matrix (M), which can be determined by the equation.*

$$M = S(I - S)^{-1} \tag{12}$$

Step 6: *Produce a causal diagram*

The number of rows and columns in total relationship matrix M is denoted separately as D and R, with D as the dispatcher vector and R as the receiver vector. The level of central role (D+R) represents the magnitude of influence from one criterion to another. Meanwhile, the relationship level (D-R) represents the influence between criteria. If (D-R) > 0 or positive, then criterion x has a greater influence on other criteria. Conversely, if (D-R) < 0 or negative, then criterion x receives more influence from other criteria. A causal diagram is a diagram that shows the relationship between each criterion. To form the horizontal and vertical axes on the causal diagram, values (D+R) and (D-R) are required. The horizontal axis is formed from the value (D+R), which represents the level of a central role. Meanwhile, the vertical axis is formed from the value (D-R), which represents the level of the relationship.

$$M = [m_{ij}], i,j = 1,2,\ldots,n \tag{13}$$

$$D = \left[\sum_{j=1}^{n} m_{ij}\right]_{nx1} = [t_i]_{nx1} \tag{14}$$

$$R = \left[\sum_{i=1}^{n} m_{ij}\right]_{nx1} = [t_j]_{nx1} \tag{15}$$

3. RESULTS AND DISCUSSION

Data analysis in this research utilized Excel and Maple. The analysis was conducted based on the data analysis techniques previously proposed. The steps to be taken in this fuzzy DEMATEL method are as follows.

3.1 Compiling the Direct-Relation Matrix (T)

The direct-relationship matrix T in the fuzzy DEMATEL method is obtained from the questionnaire filling results. Data from each questionnaire are inputted into the form of matrices without being averaged first. In the direct relationship matrix, if the value $i = j$ then the influence of that factor is valued at 0 because it is not possible for a factor to influence itself. The same steps are also taken to fill in the other direct relationship matrices until questionnaire number 75. **Table 2** represents the Direct Relationship Matrix of the first questionnaire.

Table 2. Direct-Relation Matrix

	A	B	C	D	E
A	0	1	2	3	3
B	4	0	2	1	2
C	2	2	0	4	4
D	1	3	4	0	1
E	4	1	2	4	0

Based on **Table 2**, the direct-relation matrix displays the relationships between different variables A, B, C, D, and E. Each cell in the matrix represents the strength of the direct relationship between two variables. The table provides insight into the direct relationships among the variables, with higher values indicating stronger connections.

3.2 Set up Direct-Relation Matrix T

The transformation of the direct relation matrix T into a Triangular Fuzzy Number (TFN) form is according to the scale in **Table 1.**

Table 3. The Linguistic Scale Direct-Relation Matrix ($\mathbf{T_1}$)

	A			B			C			D			E		
A	0.00	0.00	0.00	0.00	0.25	0.50	0.25	0.50	0.75	0.50	0.75	1.00	0.50	0.75	1.00
B	0.75	1.00	1.00	0.00	0.00	0.00	0.25	0.50	0.75	0.00	0.25	0.50	0.25	0.50	0.75
C	0.25	0.50	0.75	0.25	0.50	0.75	0.00	0.00	0.00	0.75	1.00	1.00	0.75	1.00	1.00
D	0.00	0.25	0.50	0.50	0.75	1.00	0.75	1.00	1.00	0.00	0.00	0.00	0.00	0.25	0.50
E	0.75	1.00	1.00	0.00	0.25	0.50	0.25	0.50	0.75	0.75	1.00	1.00	0.00	0.00	0.00

Based on **Table 3**, the linguistic scale direct-relation matrix (T_1) provides a representation of the direct relations between factors A, B, C, D, and E. Each cell in the table indicates the degree of relation between two factors, ranging from 0 to 1. For example, in the cell where factor A intersects with factor E, the value is 0.25, indicating a moderate level of relation between these two factors. Conversely, in the cell where factor B intersects with factor D, the value is 0.75, indicating a high level of relation between them. The table helps in understanding the strength of relationships between different factors, which is crucial for further analysis and decision-making processes.

3.3 Transformation of Triangular Fuzzy Number (TFN) into the Initial Direct Relation Matrix F

From the results of TFN transformation, an initial-direct relation matrix F is created. The initial-direct relation matrix F is obtained from the transformation results of TFN into crisp values using the CFCS method. The following is an example calculation of the initial direct relation matrix for the first questionnaire using the CFCS method.

Normalization of elements in the direct relationship matrix is done using **Equation (1)-(7)** with $n = 1$ because it is the first person.

$$max\ u_{i,j}^{1} = 1$$

$$min\ l_{i,j}^{1} = 0$$

$$\Delta_{min}^{max} = 1 - 0 = 1$$

$$xu_{i,j}^{1} = \frac{(0.5 - 0)}{1} = 0.5$$

$$xm_{i,j}^{1} = \frac{(0.25 - 0)}{1} = 0.25$$

$$xl_{i,j}^{1} = \frac{(0 - 0)}{1} = 0$$

$$xls_{1,2}^{1} = 0.5/(1 + 0.25 - 0) = 0.40$$

$$xrs_{1,2}^{1} = 0.5/(1 + 0.50 - 0.25 = 0.40$$

$$x_{1,2}^{1} = \frac{[0.40(1-0.40)+0.40\ x\ 0.40)]}{[1-0.40+0.40]} = 0.4$$

The crisp value can be found using **Equation (8).**

$$z_{1,2}^{1} = 0 + 0.4\ x\ 1 = 0.4$$

The same steps are taken to find the initial values of the direct relation matrix from F_2 to F_{75}.

3.4 Combining crisp values

Combining crisp values is done by calculating the average value of all initial direct relation matrices that have been formed. Combining crisp values can be done using **Equation (9)** with h=75 because the number of respondents is 75 people. **Table 4** shows the initial direct relation matrix F values, which are the average results of 75 questionnaires.

Table 4. The Initial Direct-Relation Matrix (F)

	A	B	C	D	E	JB
A	0.000	0.648	0.844	0.844	0.840	3.177
B	0.799	0.000	0.794	0.782	0.786	3.160
C	0.757	0.738	0.000	0.796	0.771	3.062
D	0.765	0.732	0.796	0.000	0.752	3.046
E	0.775	0.745	0.750	0.793	0.000	3.063
JK	3.096	2.864	3.185	3.215	3.148	

Based on **Table 4**, the initial direct-relation matrix (F) displays the strengths of the relationships between different factors (labeled A, B, C, D, E) as well as a total score for each factor labeled JB. The values in the table represent the degree of influence one factor has on another, with higher values indicating stronger influence. Additionally, the total score for each factor (JK) provides an overall assessment of the factor's influence, considering its relationships with other factors.

3.5 Set Up the Generalized Direct-Relation Matrix S

Based on the sum of each element in the rows and columns, according to **Equation (10)**, the highest value is taken from the sum of the rows, which is 3.177, and the sum of the columns, which is 3.215. Then, the value of K is determined by selecting the maximum value from the highest sum of the rows and columns. The value obtained is 0.311031241.

According to **Equation (11)**, the normalization of the direct relationship matrix will be obtained by multiplying the value K with the initial direct relation matrix F. The results of this calculation can be seen in **Table 5**.

Table 5. The Generalized Direct-Relation Matrix (S)

	A	**B**	**C**	**D**	**E**
A	0.000	0.202	0.263	0.263	0.261
B	0.248	0.000	0.247	0.243	0.244
C	0.236	0.230	0.000	0.248	0.240
D	0.238	0.228	0.248	0.000	0.234
E	0.241	0.232	0.233	0.247	0.000

Based on Table 5, the generalized direct-relation matrix (S) is presented, where the values represent the normalized direct relationships between each pair of factors (A, B, C, D, E). Each row and column correspond to a specific factor, with the values indicating the strength of the relationship between factors. The values in the matrix are obtained by multiplying the initial direct relation matrix F with the value of K, which is determined based on the maximum sum obtained from the rows and columns of the initial matrix. Then, each element in the initial matrix F is multiplied by K to obtain the normalized values presented in **Table 5**.

3.6 Set up The Total-Relation Matrix M

Equation (12) is used to find the total relationship matrix M by multiplying the normalization matrix (S) and then inversing it. The calculation of the total relationship matrix can be performed using the MAPLE software. The results of these calculations can be seen in **Table 6.**

Table 6. The Total-Relation Matrix (M)

	A	B	C	D	E
A	5.420	5.267	5.756	5.804	5.701
B	5.594	5.075	5.721	5.764	5.663
C	5.456	5.143	5.394	5.634	5.534
D	5.435	5.117	5.566	5.412	5.503
E	5.460	5.141	5.580	5.634	5.337

Based on **Table 6**, the total-relation matrix (M) presents a matrix of values representing the relationships between different factors (A, B, C, D, E) in the analyzed system. Each cell in the matrix contains a numerical value indicating the strength of the relationship between the corresponding pair of factors. Higher values suggest stronger relationships, while lower values indicate weaker relationships.

3.7 Summing Up the Row and Column Values

Sum the row and column values in the total relation matrix, denoted separately as D and R. The value D is referred to as the dispatcher vector, while the value R is referred to as the receiver vector. Calculations are performed using **Equation (13)** to **Equation (15)**. The calculation results can be seen in **Table 7**.

Table 7. Dispatcher Vector and Receiver Vector

D	27.948	27.817	27.161	27.033	27.152
R	27.365	25.743	28.017	28.248	27.738

3.8 Set Up Degrees of Central Role and Relation

The value (D+R) represents the central role level, and (D-R) represents the relationship level. In the fuzzy DEMATEL method, the level of central role $(D_x + R_x)$ represents the magnitude of influence from one factor to another. The relationship level $(D_x - R_x)$ indicates the influence between factors. If $(D_x - R_x) >$, then factor x exerts more influence on other factors. Conversely, if $(D_x - R_x) < 0$, then factor x receives more influence from other factors.

Table 8. Degrees of Central Role and Relation

	D+R	D-R
A	55.313	0.583
B	53.560	2.074
C	55.178	-0.856
D	55.281	-1.215
E	54.890	-0.586

3.9 Causal Diagram

Based on the values of (D+R) and (D-R) that have been obtained, a causal diagram is created with (D+R) as the horizontal axis and (D-R) as the vertical axis. Using Microsoft Excel, the causal diagram, as shown in **Figure 1**, is obtained.

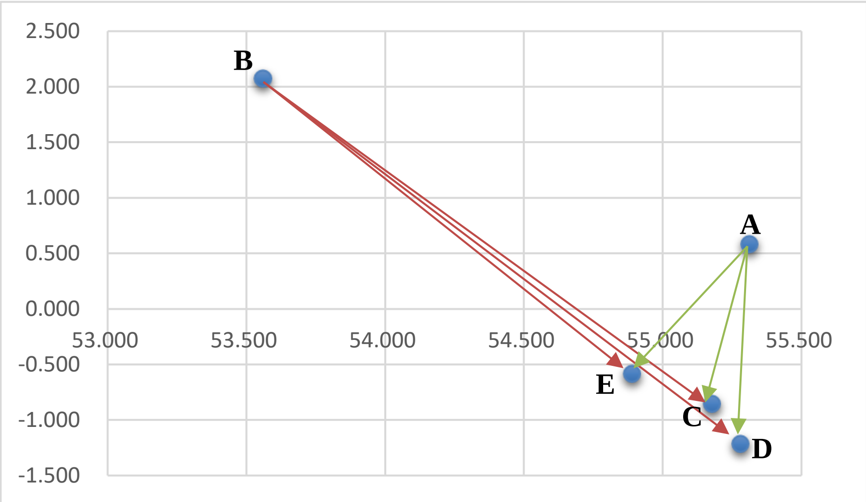

Figure 1. Fuzzy DEMATEL Causal Diagram

Based on **Figure 1**, it is found that the service quality factor (A) and price (B) have positive values, indicating that these factors influence other factors. Meanwhile, the ease factor (C), perceived benefits (D), and online servicescape (E) have negative values, indicating that these factors receive more influence from other factors.

4. CONCLUSIONS

This study in applied research was conducted on Mathematics students of the Faculty of Mathematics and Natural Sciences, UNP, who enrolled in 2022 and are users of Gojek services. The type of data used in this research is primary data obtained by distributing questionnaires. The variables measured in this study are factors affecting Gojek users' satisfaction, such as service quality, price, convenience, perceived benefits, and online servicescape.

After applying the fuzzy DEMATEL method, it can be concluded that the factor that most influences the satisfaction of Mathematics students of the Faculty of Mathematics and Natural Sciences, UNP, who enrolled in 2022, towards Gojek services is the price factor. For further research, it is advisable to use more factors so that it can be more selective in determining the factors that most influence Gojek users' satisfaction. In addition to using fuzzy DEMATEL, there are several other fuzzy methods recommended, such as fuzzy AHP, fuzzy TOPSIS, fuzzy ANP, and so on.

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