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Assessment and Evaluation of Public Transportation System Using Similar Method to the Fuzzy Ideal Option

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ABSTRACT: Public transport systems improved quality of life. Safety, Health, reduce wasted time residents, strengthen social ties, increased movement speed, universal accessibility, from the dramatic benefits of a strong and efficient public transport systems are considered social life right now. The purpose of this study was to assess and prioritize public transport systems from the perspective of Mashhad's citizens on basic parameters such as safety, comfort, cost and time and the procedure is similar to the fuzzy ideal option. The results indicate that the public transportation systems metro rail the lowest interval 1.47 to 1.85 with a maximum distance from an ideal solution, fuzzy and anti-fuzzy ideal. On the other hand suggests that a similarity index value index includes the largest and most convenient form of urban rail public transportation from the point of view of citizens.

Keywords: Fuzzy, Metro Rail, Similarity Index, Transportation

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INTRODUCTION

Transport system is a major consumer of energy. In fact, most of the world's oil is consumed by public transport. Hydrocarbon fuels used in this sector, cause CO2 emission and this is the most important factor causing global climate change.

increasing number of vehicles haunt city crossovers and un responding to the Urban travel demand regarding to stops sometimes lasting several kilometres cause most of this traffic to stop with turned vehicles motor on and this is associated with gasoline or petrol burning. Adaptation of some plans to reduce stopping times and lower vehicle fuel consumption will help conserving energy and lowering sound and environmental pollution (Ahmadzadeh and Valipour, 2006). Other transport systems impacts include sound pollution and traffic. Another strategy to reduce mentioned pollution involves increase the efficiency of transport vehicles. Moving from inter-urban travel of personal cars to other modes of transport, particularly public electric vehicles (such as a subway, urban light train, trolley bus) in which electricity from overhead lines or third rails is provided, causes energy consumption, pollution creating and emission and traffic congestion to be reduced considerably.

Public transportation, especially the subway system has accounted heightening quality of life. Safety, health, reduction of time waste for citizens, strengthening social relationships, increasing movement speed and universal accessibility are from the dramatic benefits of using robust public transportation systems for and today's social life and efficient. And appropriate integration of transport aspects and balancing of them with each other can be accounted for future mobility needs.

Studies show that public transport consumes energy four times less than private cars per passenger per kilometre. Consequently, with higher proportion of public transport, improved energy efficiency will be achieved. One of the main factors in choosing the appropriate means of public transport is travel time. So with higher rate of transport, it will take larger share of the market. Developing specific lines may improve speed and arrangement of the public transport system. Allocating Underground and Surface tracks to the rail transport made them more attractive and more competitive against personal cars and proved their economic efficiency in most cities.

It should be noted that rate of public transport speed rather than private cars in Tokyo is 1.57 vs. 1 and in Osaka it is 1.5 vs. 1.

In Hamburg, rate of public transport is 81% that is 31% faster than India Mumbai personal cars.

If an efficient public transport system can be well-developed, it would play an important role in reducing the time spent for traveling and thus it provides more free time for citizens so that could specify it to their social activities.

Direct costs imposed on society by public transportation, when the population density exceeds 20 people per hectare, may be less than private cars. Although the public transport sector, represented its share of its responsibility to reduce harm to the environment and continues this effort, but we should know that rate of carbon emission derived by public transportation per passenger is lower than that of private cars.

Traffic mortality is 40% of all deaths. In many countries, road accidents are the source of death in the age group of 15 to 30 years. There is positive association

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between the number of people killed or suffered from injury on the roads and the number of travels made by private cars in the community.

Public transportation, which includes all transport systems, must have the following characteristics:

The passengers travel not in their own car.

The travel takes place by group not individually.

This is why in many countries, taxies are not considered as a part of public transportation.

This event is gradually taking place in Iran, too. Public transport usually refers to rail and bus systems (Saniei Monfared, 2001). There are many reasons that confirm the preference of public transport than private transport system. Fewer vehicles have different advantages in various aspects such as congestion, safety, air pollution, energy consumption and etc. than the other options. That is why any attempt to persuade people to use public transport such as buses reduce many problems caused by urban development - especially in big cities - but in the other hand, a good transportation system to meet the needs of citizens (Allsop, 2001).

Some apparent characteristics of urban public transportation system:

Each of urban transportation systems has characteristics, benefits and defects. So it's not necessary to look for a specific system which is most suitable for a certain volume of urban traffic and the most suitable situation always comes up with different sets of systems (Saniei monfared, 2001). An idealistic urban transportation system is fast, cheap, convenient (Ramzanpoor, 2007).

Fuzzy Logic features

Fuzzy Logic states that everything is relative.

Being fuzzy means that one thing is multi valued and this means that in answering to each question, there are three or more choices, perhaps unlimited range of choices, not just exist in the final selection. It means that analogue mode was used instead of binary mode and infinite shades of grey between black to white is assumed (Hosseini, 2002).

In fuzzy logic, exact reasoning as borderline cases are considered to approximate reasoning. In fuzzy logic, everything is up. Any system can reasonably be fuzzy. In fuzzy logic, knowledge as a variable or an equivalent set of constraints on the set of fuzzy variables is applied, can be interpreted

Inference, as the process of expanding the limits of the variable should be considered (Ghayyoumi, 2002).

Fuzzy matrix has multiple rows and columns. Columns in the matrix of environmental factors and weighting have been identified in the previous step, and they brought it rows project activities can be written. The method of fuzzy matrix components at the confluence of activity and environmental parameters, if there is an effect, the effect of using 10 criteria and fuzzy logic to the components by using fuzzy logic is environment.

Fuzzy logic is used because it always evaluates the effects of ambiguity and uncertainty of environmental information and there is no possibility to accurately measure the effects of the environment. Fuzzy sets logic Phased as theory math modelling formulating math ambiguity and uncertainty in the impact assessment tool is very efficient and useful for this purpose (Lootsma, 1997).

Review of literature

Faraji Molaei et al. (2012) studied public urban transportation system stability with an emphasis on (BRT). Results indicated that the usage of fast buses would reduce costs in various aspects of health and medicine.

Shariat Mohymani et al. (2011) provided an applicant framework to design of Origin - Destination (shuttle) public transport systems which could be used in small cities of Iran.

Dawoudian et al. (2013) used fuzzy ideal similarity method for prior shipping of green space for three regions of Mashhad.

MATERIAL AND METHODS

Mashhad, Razavi Khorasan Province, with a population of 2600000 people and 204 square kilometres in the North East of Iran and the longitude 59 degrees 15 minutes and 60 degrees 36 minutes latitude 35 degrees 43 minutes to 37 ° C and 8 located minutes.

Method similar to fuzzy ideal option (Fuzzy Topsis)

This method was first presented by Yun and Huang were welcomed by researchers and various users (Hwang and Yoon 1981).So that in many cases recently of multi-criteria decision-making methods for the various projects, the alone or in combination with other methods such as the method of AHP and FAHP, etc. The genetic algorithm is used (Ye, 2010).

In this way, the options are ranked based on similarity to an ideal solution, so that more than one option looked like a perfect solution, the value is the more. Define the concept of "ideal solution" and "similarity to ideal solution" is used. "Ideal solution" in any unique sense solution is the best that is generally not available in practice and try to get it close.

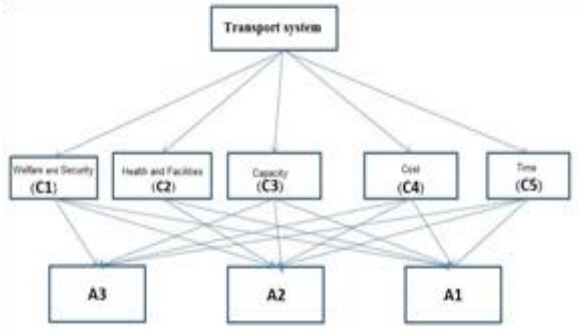
Define the concept of "ideal solution" and "similarity to ideal solution" is used. "Ideal solution" in any unique sense solution is the best that is generally missing in action and try to close it'd be. In order to solve the ideal size of a fuzzy similarity measure anti idea Al, the distance it idea of the ideal and anti-ideal solution LNB measure have taken and options based on the ratio of the distance of the solution Total distance from the ideal solution concept to anti idea evaluation and ranking - are classified in.

If a problem of Multi Criteria Decision Making criteria and m there is an option to choose the best option is using a similar idea to solve all the procedure is as follows (Ataie, 2001).

In a similar way to the classical ideal option for determining the weights of criteria and rank layout options and determine the exact values be used. Many cases of human thought and this uncertainty is the uncertainty of the A growing body of making hallways. In this case, it is better to use a method similar to the method of fuzzy making decision, fuzzy ideal option is one such methods.

In this case, the matrix elements of decision-making or weight standards or both by the variables of the language are presented by fuzzy numbers, and thereby assess the methodological problems similar to the choices is the idea dominants classical (Ataie, 2010).

Phase I:



RESULTS AND DISCUSSION

Hierarchical structure

The study of triangular fuzzy numbers are used $\widetilde{x_{ij}}=(a_{ij}, b_{ij}, c_{ij})$, operator option i (i = 1,2, ..., m) is in the in relation to the criterion j (j = 1,2, ..., n).

If the Committee decides to be a member of rank k .k fuzzy classification decisions $\widetilde{x_{ijk}} = (a_{ijk}, b_{ijk}, c_{ijk})$ triangular fuzzy number for i = 1,2, ..., m and j = 1, 2, ..., n, the combination of fuzzy classification according to ratin $\widetilde{x_{ij}}=(a_{ij}, b_{ij}, c_{ij})$ option is the following equations can be obtained by:

$$a_{ij} = \min_k\{a_{ijk}\}$$
$$b_{ij} = \frac{\sum_{k=1}^{k} b_{ijk}}{k}$$
$$c_{ij} = \max_k\{c_{ijk}\}$$

Step 2: decision matrix and the weight vector of criteria options in terms of various evaluation criteria and fuzzy decision matrix and fuzzy weight vector (below) is made up.

Table 1. Linguistic variables to rank the options

Corresponding fuzzy numbers	Linguistic variable
(0,0,1)	Very low
(0,1,3)	low
(1,3,5)	somewhat low
(3,5,7)	Appropriate
(5,7,9)	Largely
(7,9,10)	very
(9,10,10)	Very much

Table 2. Linguistic variables to Evaluation important of criteria

Corresponding fuzzy numbers	Linguistic variable
(0,0,0.1)	Very low important
(0,0.1,0.3)	Low important
(0.1,0.3,0.5)	somewhat low importan
(0.3,0.5,0.7)	Mid-importance
(0.5,0.7,0.9)	Somewhat important
(0.7,0.9,1)	important
(0.9,1,1)	Very important

The coefficient of multiple criteria decision-making at this stage can be defined as follows:

$$\widetilde{w_j} = [\widetilde{w_1}, \widetilde{w_2}, \dots, \widetilde{w_n}]$$

Member k is the rank of the recipient if committee k fuzzy classification decisions $\widetilde{w_{jk}} = (w_{jk1}, w_{jk2}, w_{jk3})$, triangular fuzzy number for j = 1,2, ... , n, the combination of fuzzy classification according to rating criteria $\widetilde{w_j} = (w_{j1}, w_{j2}, w_{j3})$the option to can be obtained by the following relations:

$$w_{ij} = \min_k\{w_{jk1}\}$$
$$w_{j2} = \frac{\sum_{k=1}^{k} w_{jk2}}{k}$$
$$w_{j3} = \max_k\{c_{jk3}\}$$

Step 3: Scale out the fuzzy decision matrix

Because x_{ij} fuzzy form, then certainly r_{ij} is too fuzzy, linear scale for Scale-up of the various criteria scales into a comparable scale is used. Because it is number fuzzy triangle, element the decision matrix no scale to measure positive and negative following relations (respectively) will be:

$$\widetilde{r_{ij}} = (\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*})$$
$$\widetilde{r_{ij}} = (\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}})$$
$$c_j^* = \max_j c_{ij}$$
$$a_j^- = \min_i a_{ij}$$

Step 4: Determine the fuzzy weighted decision matrix Scale:

According to different criteria weights and fuzzy decision matrix multiplication coefficient can't weight of each criterion in the amorphous matrix phase scale and comes under the hand:

$$\widetilde{v_{ij}} = \widetilde{r_{ij}}.\widetilde{w_j}$$

That $\widetilde{w_j}$ expresses the ratio of the measure c_j is. So the decision matrix with fuzzy weights is as follows:

$$\tilde{V} = [\widetilde{v_{ij}}]_{m\times n}\ i = 1,2,\dots,m; j = 1,2,\dots,n$$

Since fuzzy numbers are so:

$$\widetilde{r_{ij}} = \widetilde{r_{ij}}.\widetilde{w_j} = \left(\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*}\right).(w_{j1}, w_{j2}, w_{j3})$$
$$= \left(\frac{a_{ij}}{c_j^*}.w_{j1}, \frac{b_{ij}}{c_j^*}.w_{j2}, \frac{c_{ij}}{c_j^*}.w_{j3}\right)$$
$$\widetilde{r_{ij}} = \widetilde{r_{ij}}.\widetilde{w_j} = \left(\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}}\right).(w_{j1}, w_{j2}, w_{j3})$$
$$= \left(\frac{a_j^-}{c_{ij}}.w_{j1}, \frac{a_j^-}{b_{ij}}.w_{j2}, \frac{a_j^-}{a_{ij}}.w_{j3}\right)$$

Step 5: Calculate the fuzzy ideal solution (FPIS, A *) and the fuzzy ideal solution anti-ideal (FNIS, A-):

Solving fuzzy ideal and anti-ideal solution phase, respectively, are defined as:

$$A^* = \{\widetilde{v_1}^*, \widetilde{v_2}^*, \widetilde{v_3}^*, \dots, \widetilde{v_n}^*\}$$
$$A^- = \{\widetilde{v_1}^-, \widetilde{v_2}^-, \widetilde{v_3}^-, \dots, \widetilde{v_n}^-\}$$

That $\tilde{v}_i^*$ is the best value in all the options and $\tilde{v}_1^-$ worst of all the options in measure can be. Activity is obtained from the following expressions is:

$$\tilde{v}_j^* = \underset{k}{Max}\{\tilde{V}_{ij3}\} \quad i = 1,2,\dots,m, \qquad j = 1,2,\dots,n$$
$$\tilde{v}_j^- = \underset{i}{Min}\{\tilde{v}_{ij1}\} \quad i = 1,2,\dots,m, \qquad j = 1,2,\dots,n$$

Options that A * and A- being, they represent respectively the options are quite good and quite worse.

Step 6: Calculate the distance of the solution ideal anti, fuzzy ideal

The distance of each alternative from the ideal and anti-ideal solution phase, respectively, calculated from the relationship is:

$$S_j^* = \sum_{j=1}^{n} d(\tilde{v}_{ij}, \tilde{v}_j^*) \ , i = 1,2,\dots,m$$
$$S_j^- = \sum_{j=1}^{n} d(\tilde{v}_{ij}, \tilde{v}_j^-) \ , i = 1,2,\dots,m$$

$D(\tilde{M}_1, \tilde{M}_2)$ distance between two fuzzy numbers is that if (a1, b2, c3) and (a2, b2, c2) be two triangular fuzzy number, interval number is equal to:

$$d_v = (\tilde{m}_1, \tilde{m}_2) = x$$
$$= \sqrt{\frac{1}{3}[(a_1 - a_2)^2 + (b_1 - b_2)^2 + (c_1 - c_2)^2]}$$

Step 7: Calculate the similarity index:

The following formula is used to calculate the similarity index can:

$$CC_i = \frac{S_j^-}{S_j^* + S_j^-} \quad i = 1,2,\dots,m$$

Step 8: Ranking of options at this stage, given the similarity index, options are ranked so that -index options are more pressing priority.

Table 3. Decision matrix

	C1	C2	C3	C4	C5
A1	(0,0,1)	(3,5,7)	(3,5,7)	(5,7,9	(0,1,3)
A2	(5,7,9)	(5,7,9)	(5,7,9)	(1,3,5)	(3,5,7)
A3	(9,10,10)	(7,9,10)	(7,9,10)	(1,3,5)	(1,3,5)

Table 4. Weight vector matrix

Weight	Criteria
(0.3,0.5,0.7)	C1
(0.9,1,1)	C2
(0.5,0.7,0.9)	C3
(0.5,0.7,0.9)	C4
(0.5,0.7,0.9)	C5

Table 5. Scale out fuzzy decision matrix

A3	A2	A1	
(0.9,1,1)	(0,0,0.1)	(0.5,0.7,0.9)	C1
(0.7,0.9,1)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	C2
(0.7,0.9,1)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	C3
(0.2,0.33,1)	(0.11,0.14,0.2)	(0.2,0.33,1)	C4
(0.11,0.33,0.55)	(0.33,0.55,0.77)	(0,0.11,0.33)	C5

Table 6. Scale Weighted fuzzy decision matrix

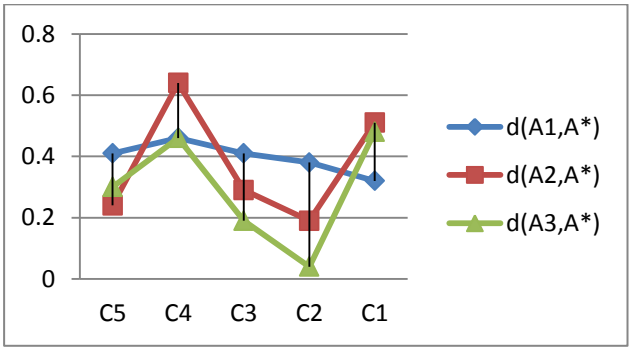
A3	A2	A1	
(0.27,0.5,0.7)	(0,0,0.07)	(0.15,0.35,0.63)	C1
(0.63,0.9,1)	(0.45,0.7,0.9)	(0.27,0.5,0.7)	C2
(0.35,0.63,0.9)	(0.25,0.49,0.81)	(0.15,0.35,0.63)	C3
(0.1,0.23,0.9)	(0.05,0.09,0.18)	(0.1,0.23,0.9)	C4
(0.02,0.23,0.49)	(0.08,0.38,0.69)	(0,0.07,0.29)	C5

Table 7. (FPIS, A*) and (FNIS, A-)

A-	A*	
(0.15,0,0.27)	(0.63,0.07,0.7)	C1
(0.27,0.45,0.63)	(0.7,0.9,1)	C2
(0.15,0.25,0.35)	(0.63,0.81,0.9)	C3
(0.1,0.05,0.1)	(0.9,0.18,0.9)	C4
(0,0.08,0.02)	(0.29,0.69,0.49)	C5

Table 8. Distance from the ideal solution

d(A3,A*)	d(A2,A*)	d(A1,A*)	
0.48	0.51	0.32	C1
0.04	0.19	0.38	C2
0.19	0.29	0.41	C3
0.46	0.64	0.46	C4
0.3	0.24	0.41	C5



Graph 1. Distance of each alternative from ideal solution

Table 9. Distance from anti- ideal solution

d(A3,A⁻)	d(A2,A⁻)	d(A1,A⁻)	
0.31	0.14	0.28	C1
0.39	0.39	0.05	C2
0.4	0.4	0.17	C3
0.47	0.47	0.47	C4
0.28	0.28	0.15	C5

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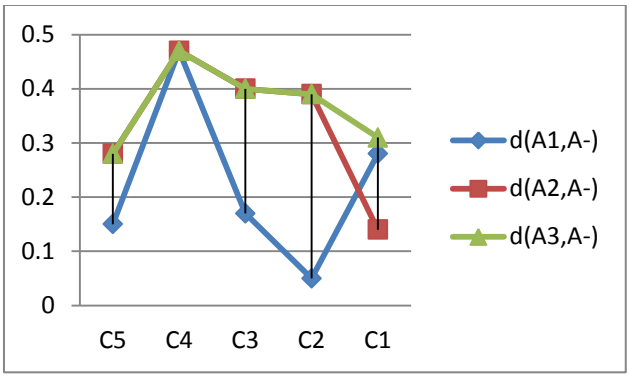

Graph2. Distance of each alternative from anti -ideal solution

Similarity index

The similarity index between zero and one, and everything changed desired options near more ideas. Therefore, Rank classified on the basis of similarity index options will be. Thus, option that has the highest similarity index is first and setting out .The lowest similarity index is ranked last will (Kabassi andVirvou 2004).

Table 10. Compare distance of fuzzy ideal and anti-ideal solution and similarity index for 3 options

A3	A2	A1	
1.47	1.87	1.98	distance of each alternative from ideal solution
1.85	1.68	1.11	distance of each alternative from anti - ideal solution
0.55	0.47	0.36	Similarity index

CONCLUSIONS

Public transport systems are always for the welfare of the general public who are embedded in each city. Administrators and program planners should therefore ¬ passenger services with higher coefficients and aggregated to fulfil. Select the type of transport system can be aware of the negative effects of economic, social and environmental issues arising from reduced car traffic. Most appropriate includes public transit from the perspective of citizens.

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