

Urban - Regional Studies and Research Journal 4<sup>th</sup> Year – No. 16 - Spring 2013 ISSN (online): 2252-0848 ISSN (Print): 2008-5354 http://uijs.ui.ac.ir/urs

# Innovation and presentation of RALSPI model: a new method for evaluating alternatives and assessment of development level of settlements

#### M. Taghvaei, R. Sheykh Beygloo

Received: June 08, 2011/ Accepted: April 10, 2012, 1-6 P

# Extended Abstract

# **1- Introduction**

In this paper, Ranking Alternatives by Substitution Possibilities of Limiting Indicators (RALSPI) method is proposed as a Multiple Criteria Decision Making (MCDM) method. Many MCDM methods have been developed over the years, but little is known about their shortcomings on similar problems. This study explores the main faults of some of the classical MCDM methods including SAW, TOPSIS, AHP, Numerical Taxonomy LINMAP. and Morris. The rationale for such selection has been that most of these are among the most popular and widely used methods in regional studies of classifying the development level of settlements, and each method reflects a

#### Author (s)

M. Taghvaei

Professor of Geography and Urban Planning, University of Isfahan, Isfahan, Iran

R. Sheykh Beygloo (🖂)

Assistant Professor of Geography and Urban Planning, Shiraz University, Shiraz, Iran e-mail: r baygloo@yahoo.com different approach to solve MCDM problems. The RALSPI method resolves significant shortcomings of these methods.

# 2- Theoretical bases

The typical MCDM problem is concerned with the task of ranking a finite number of decision alternatives, each of which is explicitly described in terms of different characteristics (also often called attributes, decision criteria, or objectives) which have to be taken into account simultaneously. MCDM plays a critical role in many real-life problems; it is hard to accept an MCDM method as being accurate all the time (Wang and Triantaphyllou, 2008). Several methods have been proposed for solving MCDM problems. The major criticism of MCDM methods is that different techniques may yield different results when applied to the same problem, apparently under the same assumptions and by a single DM (Zanakis et al., 1998). Voogd (1983) found that, at least 40% of the time, each technique produced a different result from any other technique.

Practitioners seem to prefer simple and transparent methods (Hobbs et al., 1992). According to Hobbs et al. (1992) a good experiment should satisfy the following conditions:

Compare methods that are widely used, represent divergent philosophies of decision making or claimed to represent important methodological improvements.

Address the question of appropriateness, ease of use and validity.

Well controlled, uses large samples and is replicable.

Compares methods across a variety of problems.

Problems involved are realistic.

This experiment satisfies all conditions except the fourth one.

# **3- Discussion**

The efficiency of a method is not merely a function of the theory supporting it or how rigorous it is mathematically speaking. The other aspects which are also very important, relate to its ease of using, user understanding and faith in the results, and method reliability (Hobbs et al., 1992).

This section presents a new systematic MCDM approach, RALSPI, for evaluating and ranking alternatives. In fact, the RALSPI is a systematic method for decision problems with many criteria and alternatives. The algorithm for the proposed approach will be developed in eight steps. In decisional this method, process is decomposed into a hierarchy of criteria clusters, criteria, and alternatives. The RALSPI procedure is as follows: (In the RALSPI method, the decision matrix and the weight vector w are given as crisp values a priori.)

Step 1: classifying all criteria into some major categories

First, it is necessary to categorize criteria according to thematic homogeneity. It is preferred that the number of criteria lie in various groups be balanced. This rule facilitates the management of studied criteria. (N: number of all studied criteria; k: number of criteria categories; n: number of criteria related to each category)

Step 2: Normalization of the criteria

The RALSPI method first converts the various criteria dimensions into nondimensional criteria. For a sets of benefit attributes, each normalized criterion Iij is calculated as follows:

$$I_{ij} = \frac{x_{ij} - x_{\min j}}{x_{\max j} - x_{\min j}}$$

The value of the Iij is computed on a scale of 0-1 where 0 corresponds to the minimum, and 1 to the maximum assigned value for the corresponding indicator.

Step 3: Classifying the amount of Iij into three levels

In this step, three levels for each criterion are defined so that different values are attributed to these levels, as follows:

$$L_{1}: 0/80 < I_{ij} \le 1/00 \rightarrow v = 3$$
$$L_{2}: 0/50 < I_{ij} \le 0/80 \rightarrow v = 2$$
$$L_{3}: 0/00 \le I_{ii} \le 0/50 \rightarrow v = 1$$

Step 4: Defining different groups of development for each criteria category based on sum of the level values

The calculations of this step (formula 1) are separately done for each criteria category which has been represented in step 1.

(1)  
$$g = \sum_{j=1}^{n} v_j$$

where g is the level value of development group, n is the number of criteria related to

each category, and vj denotes the level value of criterion j.

For example, if one of the major categories consist of 7 criteria and normalized value of all these criteria lie in the interval of (0.80, 1.00], then g=21; because in this example, the level value of each criterion is 3 and so, the sum of the level value of all criteria will be 21. Now, if normalized value of one of these criteria lies in the interval of (0.50, 0.80], then g=20. This means that an increase or decrease in the normalized value of a typical criterion so that it changes the related level value (v) as much as one score, leads to an increase or decrease or decrease of the level value of development group (g) as much as one score. Based on

this rule, we can define 2n+1 development groups for every criteria category with n criteria. For example, if one of the criteria categories consists of 7 criteria, the number of development groups will be 15. In this example, maximum and minimum level value of development group is 21 and 7, respectively. The level value of 21 is related to the condition in which normalized value of all 7 criteria lie in the interval of (0.80, 1.00], and the level value of 7 occurs when normalized value of all criteria lie in the interval of [0.00, 0.50]. Process calculating the level value of development group of major criteria categories is presented in Table 1.

	-						~ •	
Tabla 1	Droooce o	foolouloting	the lovel	voluo of	dovolonmon	t around o	fmoior	oritorio
Table L.	11000550		the level	value or	uevelupmen	ι ει σαρό σ	і шатог	CILICITA
						· • · · · ·		

categories											
		level value of									
Development group	criterion	criterion	criterion •••••		criterion	development					
	1	2	3	••	n	group (g)					
group 1th		$\bigcirc$		• • • • •	$\bigcirc$	2.5					
	V=3	V=3	V=3		V=3	311					
group 2th	$\cap$	$\bigcirc$	$\bigcirc$	• • • • • •	$\bigcirc$						
	v=3	v=3	v=3	• • •	v=2	3n-1					
:		:	:	• • • • • •	:	:					
		•	•	•••	•	·					
group (2n+1)th	$\bigcirc$	$\bigcirc$	$\bigcirc$	••••	$\bigcirc$						
	v=1	v=1	v=1	• • •	v=1	n					

Based on this procedure, maximum and minimum of g will be 3n and n, respectively.

Step 5: Specifying the possible maximum and minimum score for each of the development groups

This step is devoted to calculating the possible maximum and minimum scores of Development groups.

In RALSPI method, each appraisal criterion is not assumed to be of equal importance because the appraisal criteria have various meanings. There are many methods that can be employed to determine weights, such as the eigenvector method, weighted lease square method, entropy method, AHP etc. The method which is

chosen depends on the nature of the problem. However, for a given criteria weight vector w(w1, w2, ..., wn) where  $\sum w_j=1$ , the weighted normalized criterion can be calculated by multiplying its normalized form (Iij) with its associated weight (wj).

The possible maximum score of development for each group  $(P_{\max S_g})$  is the possible highest value of sum of the weighted criteria, and the  $P_{\min S_g}$  is the lowest one.

(2)  

$$P_{\max S_s} = p_{\max} \{ \sum_{j=1}^{n} I_j w_j \}$$
,  $g = n, n+1, ..., 3n$ 

(3)  

$$P_{\min S_g} = p_{\min} \{\sum_{j=1}^{n} I_j w_j\}$$
,  $g = n, n+1, ..., 3n$ 

Step 6: Calculating the level value of development group (g) of alternatives with respect to each of the major criteria categories

In this step, one of the tripartite values (v=1 or 2 or 3) is assigned to each alternative with respect to each criterion, performance (criterion based on its value). normalized Then, for each alternative, related development group and g value in each major criteria category is determined

Step 7: Calculating score of alternatives with respect to each individual major criteria category by formula (4)

n

$$S_{ik} = \frac{\sum_{j=1}^{j=1} I_{ij} w_j}{P_{\max S_{g_i}}} \times P_{\min S_{(g_i+1)}}$$

Step 8: Calculating total scores for each individual alternative

The total scores for alternatives are computed by summing their values of the all criteria categories.

(5)

$$S_i = \sum S_{ik}$$

The value of Si lies in the interval [0, 1]. The best decision alternative will be the one with the biggest overall value in this interval.

# 4- Conclusion

This paper presents a new Multiple Criteria Decision Making (MCDM) approach, i.e., Ranking Alternatives by Limiting Substitution Possibilities of Indicators (RALSPI), for solving multiple criteria problems. In fact, RALSPI is a new, simple, and straightforward evaluating system with a coherent methodological basis, and resolves significant shortcomings of other current related methods; so, this proposed evaluating method is to alternatives and assessing development level of settlements.

**Keywords:** Evaluating alternatives, Assessment of development level, Multiple Criteria Decision Making, RALSPI model, Iran.

# Reference

- Akbari, Nematollah and Zahedi Keyvan, Mahdi (2008), Application of ranking and Multi-criteria decision making methods, imo, Tehran.
- Asgharpoor, Mohammad Javad (2008), Multi-criteria decision makings, Tehran University.
- Badri, Seyyed Ali and Akbarian Ronizi, Saeedreza (2006), Comparative study of application of the methods of assessment development level in regional studies,

Geography and development, No. 4, pp. 5-22.

- Badri, Seyyed Ali et al. (2006), Determining development level of rural areas of Kamyaran sub-province, Geographical Researches, No. 82, pp. 116-130.
- Bakhtiari, Sadegh; Dehaghanizadeh, Majid and Hoseynpoor, Seyyed Mojtaba (2006), Investigation of provinces of Iran from the point of view of Human Development Index, Knowledge and Development, No. 19, pp. 11-39.
- Chu, M-T; J. Shyu and G-H Tzeng (2006), Comparison among three analytical methods for knowledge communities group-decision analysis, Expert Systems with Applications, doi,10.1016/j.eswa.2006.08.026.
- Czira'ky, D.; J. Sambt; J. Rovan and J. Puljiz (2006), Regional development assessment, A structural equation approach, European Journal of Operational Research, No. 174, pp. 427-442.
- Emes, Joel and Tony Hahn (2001), Measuring Development: an Index of Human Progress, «Public Policy Sources», No. 36, Fraser Institute, Vancouver, Canada.
- Hadder, R. (2000), Development Geography, Routledge, London.
- Hamidi, Naser (2003), Application of operational research in urbanization process, Urban Management, No. 15&16, Tehran.
- Hekmatnia, Hasan and Moosavi, Mirnajaf (2006), Application of Model in Geography with emphasis on urban and regional planning, Elme Novin, Yazd.
- Hobbs, B. J.; V. Chankong; W. Hamadeh and E. Stakhiv (1992), Does choice of multi-criteria method matter? An experiment in water resource planning, Water Resources Research, No. 28, pp. 1767-1779.

- Jadidi Miandashti, Mahdi (2006), Balanced distribution of financial resources through determining development level, Economical researches, No. 11&12, pp. 17-41.
- Janic, M. and A. Reggiani (2002), An Application of the Multiple Criteria Decision Making (MCDM) Analysis to the Selection of a New Hub Airport, EJTIR, No. 2, pp. 113-141.
- Martic', M. and G. Savic' (2001), An application of DEA for comparative analysis and ranking of regions in Serbia with regards to social-economic development, European Journal of Operational Research, No. 132, pp. 343-356.
- Naraghi, Yoosef (1991), development and Undeveloped countries, Analytical study on theoretical-historical aspects of not developing, Stock company of publication, Tehran.
- Openhaym, Norbert, (2000), Applied models in urban and regional problems analysis, Manoochehr Tabibian, Tehran University.
- Papadopoulos A. and A. Karagiannidis (2008), Application of the multi-criteria analysis method Electre III for the optimisation of decentralised energy systems, Omega, No. 36, pp. 766-776.
- Poormohammadi, Mohammadreza (2006), Urban land use planning, Samt, Tehran.
- Rezvani, Mohammadreza and Sahneh, Bahman (2005), Assessment of development level of rural areas using fuzzy logic, village and development, No. 8, pp. 1-32.
- Tsaur, S. H.; T. Y. Chang and C. H. Yen (2002), The evaluation of airline service quality by fuzzy MCDM, Tourism Management, No. 23, pp. 107-115.
- UNDP (1997), Nigerian human development report, UNDP, Lagos.

- Voogd, H. (1983), Multi-criteria Evaluation for Urban and Regional Planning, Pion, London.
- Wang, X. and E. Triantaphyllou (2008), Ranking irregularities when evaluating alternatives by using some ELECTRE methods, Omega, No. 36, pp. 45-63.
- Wu, H. Y.; G. H. Tzeng and Y. H. Chen (2009), a fuzzy MCDM approach for evaluating banking performance based on Balanced Scorecard, Expert Systems with Applications, No. 36, pp. 10135-10147.
- Xu, Xiaozhan (2001), The SIR method: A superiority and inferiority ranking method for multiple criteria decision making, European Journal of Operational Research, No. 131, pp. 587-602.
- Yevseyeva, I. et al. (2007), SMMA-Classification Anew Method for Nominal Classification, Helsinki School of Economics Working Paper, Helsinki, pp. 1-19.

TCN

- Yu L.; X. Hou; M. Gao and P. Shi (2010), Assessment of coastal zone sustainable development: A case study of Yantai, China, Ecological Indicators, No. 10, pp. 1218-1225.
- Zanakis, S. H.; A. Solomon; N. Wishart and S. Dublish (1998), Multi-attribute decision making: A simulation comparison of select methods, European Journal of Operational Research, No. 107, pp. 507-529.
- Ziari, Keramatollah (2004), Schools, Theories and Models of Regional Planning, Yazd University.
- Ziari, Keramatollah; Zanjirchi, Seyyed Mahmood and Sorkh Kamal, Kobra (2010), Investigation and Ranking of development level of sub-provinces of Khorasan Razavi using TOPSIS model, Human Geography Researches, No. 72, pp. 17-30.