Compare the Multiple Criteria Decision Methods of Human Development Index, Factor and Cluster Analysis to Assess the Development Level of Cities in West Azerbaijan Province

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ABSTRACT

Each study is based on a technique and the role of these methods is very important in results of the research. If appropriate flexibility methods do not select for data analysis, achieve to acceptable results decrease with high executive coefficients. Given the importance of research methods, the aims of this study is identifying three models of HDI, factor analysis and cluster analysis, evaluate and express three models to analyze ranking in Western Azerbaijan cities. This research feature is to combine models with spatial analysis. The research hypothesis is that these three models have no significant difference together in the rating of development of cities. To test this hypothesis and to achieve research goal, first 41 indexes was selected and then demographic development, socio, economic, cultural, health, and communications transport and infrastructure of the city was evaluated and then the rating of development were performed using three models and cities were classified in five groups developed to undeveloped. The results indicate that the performance is the same for all three models in the evaluation of development level of cities.

KEYWORDS: Western Azerbaijan, cluster analysis, HDI model, factor analysis, cities

1. INTRODUCTION

The characteristic of the current Third World Urbanization is inconsistency and injustice (Varesi and others, 2007: 2, quoted in Castells, 1977, Roberts, 1978, Gugler, 1982, Armstrong and McGee, 1985) which inconsistency including, the inequality in distribution of the facilities and services. That is caused the inequality in the development level of geographic areas (here city). Thus, decision must be made in a multi-dimensional space. In such circumstances multi criteria decision making[1], note that in this method, assumes that each of these criteria are separate dimension, can be used (Zebardast, 2001: 15). Identification and analysis of the areas in aspects of environmental, economic, social and regional is the first step in the planning process of area development. Bottlenecks and limitations of areas are specified with this procedure and will attempt to resolve them. Scientific and experience weakness in this field, cause to the failure of many programs (Motiei Langroodi, 2007: 13). Now if we accept this definition that, planning is an attempt to create appropriate framework in which the planner can attempt to achieve an optimal solution (lee, 1973: 2). The first step in planning is to identify the current status (Khakpour and Razavi, 2010: 4). Accordingly, this study sought to examine the development status in each of the cities of West Azarbaijan province. Decision could be the most important challenge for experts and analysts in solving various problems, in other words, man is always faced with the problems that to analyze them require the use of different criteria. However, each of these criteria is not equal importance. For make correct decisions about these kinds of issues, we need ways that in addition to a combination of all criteria, show the priority of each criterion than each other (Rahnama and Kazemi, 2011: 102). Therefore, various methods and patterns have been proposed to support decision-making during recent decades. Multi-criteria decision making problems including the variety of methods that comparing these models is one of the objectives of this study.

1- **Research assumptions**

In the present study, the following hypothesis has been followed:

1- It seems that many differences exist in the development of West Azerbaijan province.

2- It seems that the use of various methods don't show the differences in development level, in other words, the results show a high correlation in different ways.

1- Multi Criteria Decision Making

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2- RESEARCH METHODOLOGY

Research method in this study is descriptive analysis from the perspective of applied development research. Analysis model of the research is based on relationship between concepts, dimensions, components and indicators. Method of data collection is in the form of document and library and it has been extracted by visiting organizations and offices across the province and available statistics. Statistical Society is the cities of West Azerbaijan province in 2011, which includes 42 cities. Hierarchical of overall indexes was prepared to achieve indexes and required information was collected based on them.

3- Applied indicators and methods

In this research, 7 different kinds of development (including the development of population, social development, economic development, health care development, development of transport and communications, cultural development and urban infrastructures development) were calculated based on 41 different indicators in the province of West Azerbaijan and then using three methods considered in this study (HDI, factor analysis and cluster analysis) were calculated to provide the necessary data to compare models. These steps are presented in the following graph.

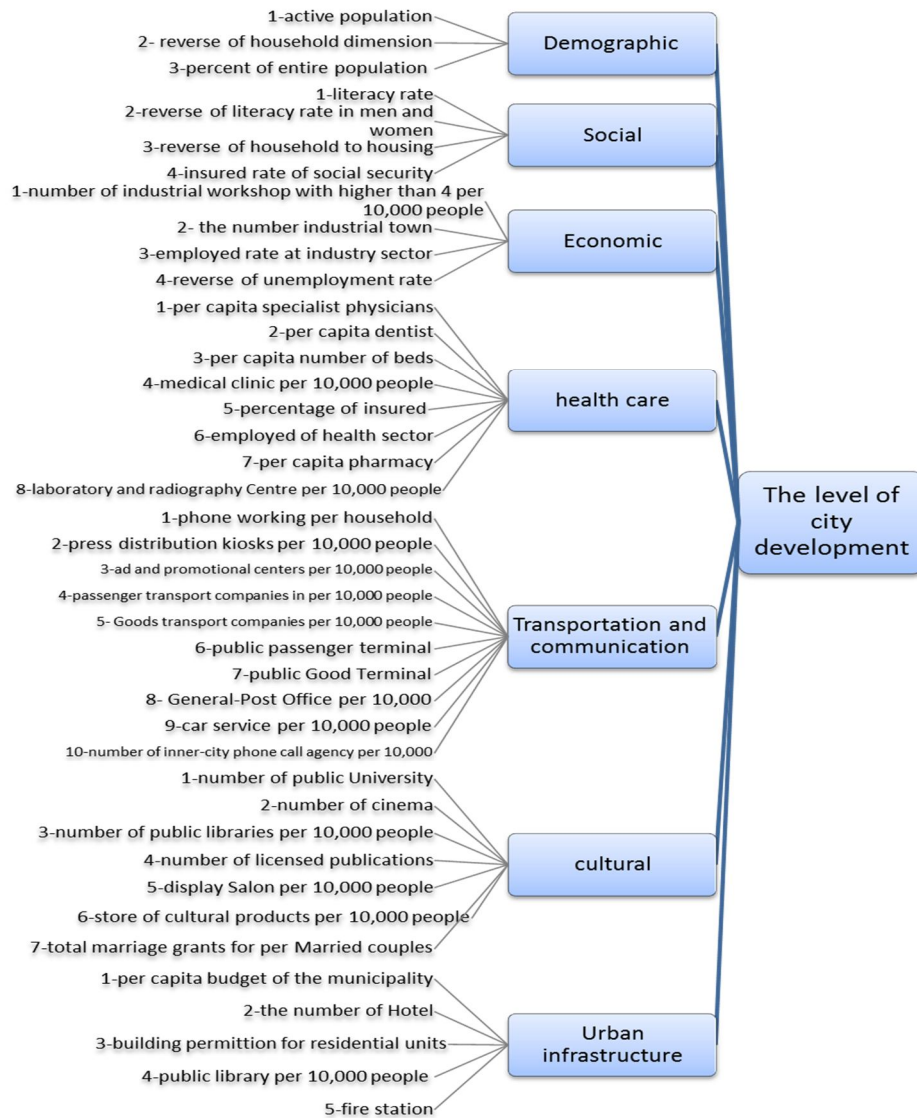Indexes and examined variables of the research

Figure 1. Investigated indicator and variables of the research

4- Describing the models

5-1-HDI model

The model of human development indicator (HDI) is used by UNDP (United Nations Development Program) to calculate the human development indicator in different countries. It is a model for ratings human development in terms of the same importance for all indicators. In this model, three indicators of life expectancy, literacy percentage and per capita income are applied to rate regions and cities, but its formula and method are also used for other classifications. The overall structure of model is as follows:

$$X_i = \frac{MaxX_i - X_i}{MaxX_i - MinX_i}$$

The second stage in this method is defining the average indicator for each regions and cities.

$$X_j = 1/n \sum X_{ij}$$

The third stage in this method is the calculation of human development. Its value is between zero and one. The closer value to 1 presents more development degree.

$$HDI = (1 - X_i)$$

5-2-factor analysis

One of the statistical methods for analyzing the information contained in data collection is factor analysis method. This method was introduced by Karl Pearson and Charles Spearman and used for measuring intelligence in the first time. It is now used for determining the most effective variables when there are number of variables and the relationships between them are unknown.

In this method the variables are put in several factors in a way which the percentage of variance will reduce from first factor to the subsequent ones. , the most important purpose of using factor analysis is to reduce the size of data and determine the most effective variables in formation of the phenomenon (Kalantari, 1995: 148). The following steps run a factor analysis (Bayazidi, 2009):

-Select the appropriate variables: appropriate variables for factor analysis are factors which are at distance measurement level and have acceptable coefficient measurement for variables' validity. There are several methods for measure and assess the appropriateness of variables such as KMO method. This value extracts from the following formula and must be at least 0.7 (Khorasani, 1996: 215).

$$KMO = \frac{\sum \sum r_{ij}^2}{\sum \sum r_{ij}^2 + \sum \sum a_{ij}^2}$$

Factor extraction; the aim of factor analysis is to summarize variables in several factors. So to perform factor analysis, the method of factor extraction and its determining criteria should be specified.

5-3-Cluster Analysis

Cluster analysis is a statistical method to identify groups or homogeneous clusters (Taghvai and Shafi'i, 2009: 63). In leveling the places in the cluster method, places are located in a level are very similar to each other and yet they have considerably differences with places of other levels (Mousavi and Hekmatnia, 2006: 236). In other words, the purpose of cluster analysis is primarily based on certain characteristics identify relatively homogeneous groups or clusters. In the hierarchical cluster analysis method, firstly each case (Here cities) is selected as a separate "cluster", and then are integrated based on its "similarity[2]" or "difference[3]" in terms of analysis traits with other clusters. Thus larger and larger clusters are formed until all of them are placed all in one cluster.

There are several criteria for calculating and estimating the similarity or difference between the cases that most common ones used in this research is "Squared Euclidian Distance[4]".Based on these criteria, the distance between two cases is the "sum of differences squared in the values of variables", which is calculated according to the following formula:

$$D(X,Y) = \sum_{i=1}^{n=k} (x_i - y_i)^2$$

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[2] -Similarity
[3] -Difference
[4] - Squared Euclidian Distance

An important issue in the cluster analysis is the number of appropriate and optimum clusters, which is determined using the agglomeration[5] table of clusters. The smallest difference coefficient is related to the stage in which the most homogenous clusters are combined together and vice versa the highest coefficients is related to the combination of clusters that are non similar. Thus, the coefficient of lack of the similarity or distance is the main criterion of decision to continue or stop clustering. Based on these methods, typically point of optimum (optimum) to stop combination process is where the ratio of distance suddenly rises between two adjacent clusters. In this case, the appropriate point to stop this composition is the stage before increase or a sudden coefficient jump and then next clusters will be considered "appropriate clustering [6]" (Hair and Anderson, 1990:293-349 and SPSS/PC Advance Statics, 1988: B71-10).

5- Determine the degree of development

In this part, result of development degree is presented in the cities of Azerbaijan based on three models below and then results are compared with each other.

6-1- HDI analysis Results

For the final assessment, HDI, human development index that was presented based on a formula was calculated based on 7-fold data. Evaluation of results shows that; Orumieh is in the fully developed row and any cities don't place in developed row and other cities are located in the three next groups.

Table 1. Levels of development based on HDI

Development	Name of city
Fully developed	Orumieh
Developed	Mako, Poldasht, Mahabad, Shahin Dej, Miandoab
Interstitial	Salmass, Oshnavieh, Tekab, Shout, Boukan, Sardasht, Khoy, Siah Cheshmeh, Noghdeh, Piranshahr, Noushin, Mahmoodabad, Firuragh, Qara Ziauddin, Bazarghan, Chaharborj, Sylvaneh, Symyneh , Taze shahr, Avajig, Zarabad, Mohamadyar, Qushachy, Rabt, Sarv, Gardekshaneh, Abuoghly, Dizaj, Diz,Keshavarz, Nazok olya, Gotur, Nalus, Mirabad, Khalifan, Baroogh
Undeveloped	Marganler

6-2- factor analysis results

To conduct a factor analysis, calculated HDI indicators and Spss software were used. The results suggest that 2 factors cover over than 81 percent of cumulative variances of total data. Two methods of principal component analysis and varimax rotation were conducted for analysis. The following table shows that the amount of KMO is 0.77 and the results, significant level and freedom degree are acceptable.

Table 2. Acceptability of the model

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.772
Bartlett's Test of Sphericity	Approx. Chi-Square	270.607
	Df	21
	Sig.	.000

The following table indicates the importance of each factor. It shows that the first factor with special weight of 3.22 covers 46 % of data variance and the second factor with special weight of 2.48 covers 35.5% of data variance. Both of them totally cover 81.5% of data variance which is a considerable number.

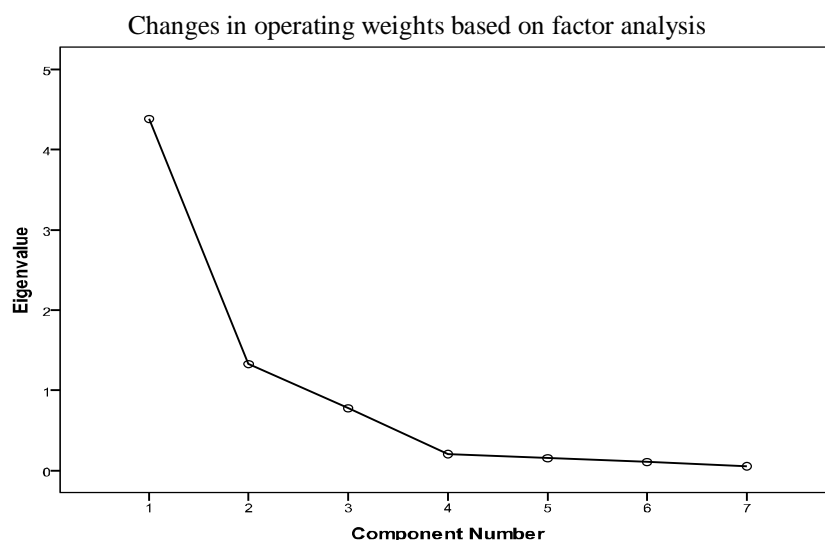[5] - Agglomeration Schedule
6 -Good solution

Changes in operating weights based on factor analysis

Table 3. Weight and variance of evaluated factor

Factor	Indicator's weight	Variance%	Total variance %
1	3.229	46	46
2	2.48	35.5	81.55

Variables from the analysis were identified as the first factor: the cultural infrastructure and the second factor: social - demographic and the results of their mean that is reflects the development level as follows.

Table 4. Development level based on factor analysis

Development	Name of city
Fully developed	Orumieh
Developed	Mako
Interstitial	Mahabad, Poldasht
Undeveloped	Miandoab , Shahin Dej , Salmass , Oshnavieh , Boukan , Tekab , Piranshahr
Fully Undeveloped	Khoy, Siah Cheshmeh, Noghdeh, , Noushin, Mahmoodabad, Firuragh, Qara Ziauddin, Bazarghan, Chaharborj, Sylvaneh, Symyneh , Taze shahr, Avajig, Zarabad, Mohamadyar, Qushachy, Rabt, Sarv, Gardekshaneh, Abuoghly, Dizaj, Diz,Keshavarz, Nazok olya, Gotur, Nalus, Mirabad, Khalifan, Baroogh, Marganler

6-3-Results of cluster analysis

In the hierarchical cluster analysis, it is essential to find an appropriate number of indicators and it is obtained through the agglomeration table and clustering coefficient, it means that where indices coefficient make a significant change, is convenient location to determine the number of clusters. In this research, the appropriate number of clusters is 3 based on the following accumulation schedule.

Table 5. Accumulation index cluster analysis

Stage		Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
		Cluster 1	Cluster 2		Cluster 1	Cluster 2	
dimension0	1	14	38	.002	0	0	7
	2	29	37	.003	0	0	10
	3	6	22	.004	0	0	8
	4	30	41	.006	0	0	9
	5	27	39	.007	0	0	14
	6	13	32	.008	0	0	13
	.	.	.	.	.	.	.
	.	.	.	.	.	.	.
	41	1	15	2.518	40	0	0

Surveying the results including dendrogram graph of cluster analysis shows, Orumieh city is located in a cluster itself and 16 other cities in second cluster and other cities are located in three clusters.

Table 6. Urban clusters and each cluster

Clusters	Name of city
The third cluster	Orumieh
The second cluster	Shout, Mako, Poldasht, Siah Cheshmeh, Qara Ziauddin, khoy, Salmass, Oshnaviyeh, Noghdeh, Mahabad, Piranshahr, Mahmoodabad, Bukan, Shahin Dej, Tekab, sardasht
The first cluster	Noushin, , Firuragh, , Bazarghan, Chaharborj, Sylvaneh, Symyneh , Taze shahr, Avajig, Zarabad, Mohamadyar, Qushchy, Rabt, Sarv, Gardekshaneh, Abuoghly, Dizaj Diz, Keshavarz, Nazok olya, Gotur, Nalus, Mirabad, Khalifan, Baroogh, Marganler

6-   SUMMARY AND CONCLUSIONS

As the evaluation of values obtained these models show, there are many differences at development level in cities of Azarbaijan province and based on all models, Orumieh is located with a large difference in the urban hierarchy of this province. (The following map is depicted the results of proportion the HDI model to factor analysis model to distinguish of the cluster analysis results. Thus, the first hypothesis of this research is confirmed.

To assess the relationship between the results of three models, which were presented its results in the previous section, Pearson correlation method. The results show; There is a high correlation between the variables; it means that the correlation between all models is above 80 percent and nearly a significant level of 100% which it is significant amount in research in the humanities. Thus, the second hypothesis of this research is also confirmed.

Table 7. Correlation between the results of different models

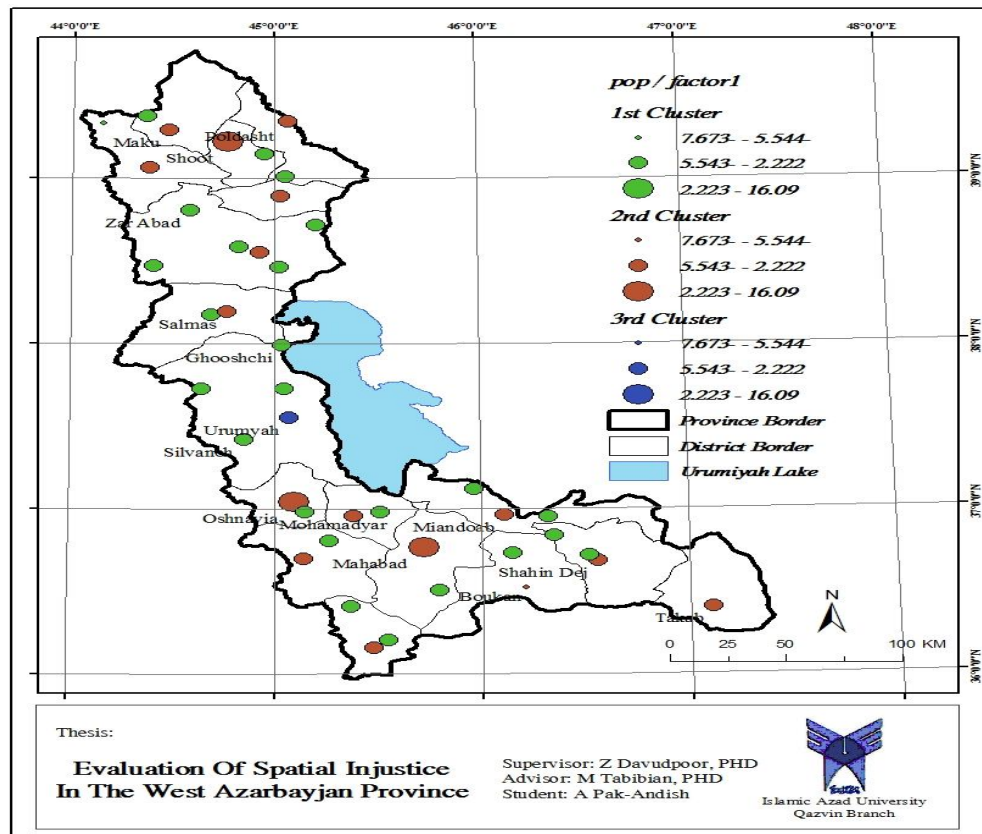|		HDI	Factor Analysis	Cluster Analysis
HDI	Pearson Correlation	1	.985**	.819**
	Sig. (2-tailed)		.000	.000
Factor Analysis	Pearson Correlation	.985**	1	.829**
	Sig. (2-tailed)	.000		.000
Cluster Analysis	Pearson Correlation	.819**	.829**	1
	Sig. (2-tailed)	.000	.000	
**. Correlation is significant at the 0.01 level (2-tailed).				

Figure 2. The map of three models results

REFERENCES

1. Asayesh, Hussein. (2007): principles and methods of regional planning. Payame Noor University publishing, Tehran, Iran
2. Statistics book of Western Azerbaijan province. Governor: conscience planning
3. Pakzad, Jahanshah. (2007). articles on concepts of architecture and urban design, first edition, Tehran: samin publishing.
4. Taghvaei, m. (2011) "the analysis of inequalities in regional development in Iran", Journal of human geography research, issue 74, pp. 168-176
5. Taghvai, m. (2010). an analysis on the status of information and communication technology and its role in the management and urban planning (case study: the city of najafabad). Journal of geography and planning (University of Tabriz), vol. 15, no. 31, 25-49.
6. Jahad daneshgahi of University of Mashhad. (2011) Khorasan Razavi province preparation project: Mashhad Provincial Governor of Khorasan Razavi province
7. Hajipour, Khalil. (2006). neighborhood planning in creating sustainable urban management. Summer fine art magazine, no. 6, 37-46.
8. Hekmat nia, h. and mirnajaf (2006). Application of models in geography with an emphasis on urban and regional planning, publishing a new science
9. Delfous, Olivier (1995), the geographic space, siroos Sahami, EA. Mashhad: nika publishing
10. Renee shorts, John. (2009). the theory of critical assessment, Dr. Keramat Allah ziari. Tehran, Tehran University publications
11. Rahnama mohamadrahim., Abbas zade, GH. (2008). the principles of physical form of model town. Mashhad, Iran: Mashhad jahad publications
12. Zebardast, esfandiar. (2001): application of hierarchical analysis in the process of urban and regional planning. Fine arts magazine, issue 10, pages 21-13.
13. Sarabi. (2010). Investigation of residential land use in the city of Yazd, the quarterly journal of urban studies and research, no.3, pp. 70-43.
14. Ghanbari haft cheshme, hosseinzadeh, Delir. (2005): determining the degree of city development in Western Azerbaijan (1996). Journal of geography and regional development, issue 5, pages 22-1.
15. Statistical Center of Iran. (2012). the results of the consus 2011. Tehran: Iran's statistics Center
16. Motiee langroodi, Hassan. (2007): rural planning with emphasis on Iran. Mashhad, Iran: Mashhad jahad publications.
17. Masoumi ashkori, Seyed Hasan. (2006): principles of regional planning. Tehran: payam publishing.
18. Nazarian, a. a., (1994), the hierarchy of Iran's cities, geographical researches quarterly journal, issue number 32, vol. 10, no. 1, spring
19. Warasi, hamidreza. (2006). Investigation the effects of urban service distribution in spatial imbalance,case study: the city of Isfahan. Journal of geography and development.
21. Bayazidi, e. (2009). The analysis of questionnaire data with the help of SPSS software. Tehran: publishing Abed
22. Khorasani, a. (1996). Introduction to SPSS software application in statistical research, Tehran: vertical publications
23. Kalantari, KH. (1996). the process and analysis of data on economic and social research. Tehran: sharif publishing