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ORIGINAL RESEARCH PAPER

Analysis of spatial distribution of Tehran Metropolis urban services using models of urban planning

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ABSTRACT: The process of spatial distribution of urban services in order to provide equitable access to opportunities and reduced regional disparities, and earning the highest citizen satisfaction are among the main challenges facing urban management. This requires knowledge of the current status of spatial distribution of public services in the city, followed by optimal resource allocation under varying circumstances. This analytical-comparative study aimed to investigate the spatial distribution of urban public services, and rank different districts of Tehran in terms of benefiting from public services. To achieve this goal, quantitative models of planning, including factor analysis, composite Human Development Index, taxonomical model and standardization method were used. For the final ranking of districts of Tehran, the sum of numerical value of each district was calculated in four ways. Based on this method, districts 1, 3, 22, 12 and 6 were ranked first to fifth, and districts 13, 10, 8, 17 and 14 were ranked last, respectively. Using cluster analysis model, different districts of Tehran metropolis were clustered on the basis of numerical value of districts in the models used. Based on above-mentioned results, districts 1, 3, 12, 22, 6 and 21, with a final score of 66 and above, included in the first cluster and identified as over-developed districts; and districts 14, 10, 8 and 17, with a final score of 13 or less, included in the fifth cluster and identified as disadvantaged districts.

KEYWORDS: *Human development index (HDI); Public services; Rankings; Spatial distribution; Tehran; Urban districts*

INTRODUCTION

Imbalance between urban areas and various urban sectors in terms of benefiting from urban services and facilities, and poor distribution of urban land uses is one of the objective fields that preoccupy the minds of planners and city managers. Taking the common criteria for regional planning in to account, these inequalities can be identified, and the condition of districts is determined in terms of benefiting from the development indicators. In acquiring this knowledge, the present study was conducted to assess the state of development of municipal districts of Tehran, as well as to examine their ranking, and compare the existing methods of evaluation. After the introduction and measurement of indicators, factor analysis method, composite method of Human Development Index (HDI), taxonomical model and standardization method were used for this purpose.

From the geographical point of view, the urban social justice is synonymous with a fair distribution of

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facilities and resources among different urban districts and equal access to them (Sharifi, 2006). The important issue of equitable distribution of resources, as a strategy for social justice, is the manner of distribution of services and capabilities among urban districts (Harvey, 1997). Therefore, in geographical assessment of cities, different subjects such as urban ideology (ideology governing the city), social justice, quality of public access to the basic needs, determining the location of all organizations and civil facilities such as factories, parks, hospitals, commercial and industrial residential areas, cultural areas, airports, passenger terminals and educational facilities, clinics, areas of leisure, social spheres and dozens of urban subjects should be taken into account with regard to the urban spaces (Shokouei, 1994). Because, realization of social justice in the cities eventually leads to the satisfaction of citizens regarding their lifestyle and will contribute to political stability and national sovereignty; and failure in equitable distribution of social justice will lead to social crisis and complex problems (Sharifi, 2006). Therefore, the most important mission of urban planners and managers is to try to achieve the ideal of "equal opportunity" in the access of different groups of urban community to urban services, and eliminate conflicts in providing educational, and health opportunities and the like (Hataminezhad et al., 2008). On the other hand, conscious action of urban managers in spatial distribution of social benefits for the aim of reducing spatial inequalities (Hugget, 1996) and improving the quality of physical environment, and thereby enhancing the quality (Lynch, 2002) and achieving sustainability require analytical understanding of the current situation by analyzing balance, wherein they seek the optimal allocation of resources with the most suitable combinations to address inequalities (Harvey, 1997). This understanding of the status of environmental justice is achieved by managers and urban planners, whose research will provide a real and important basis for corrective measures (Deakin, 1996). Hence, the need for in-depth studies in the field of facility and service distribution in different areas of the city, with the aim of identifying deficiencies and deprivations, is an essential issue. In developing countries, including Iran, there has always been an imbalance between population growth and provision of urban facilities and equipment. The most important consequence of this spatial expansion, is the increase in "urban poverty" in an area and a scope broader than the main city; and ultimately the unfair distribution of resources (Rahnamaei, 1990); so that a brief overview of the process of urban development of Tehran in recent centuries, especially during the country's industrialization program, clearly show how phenomena such as uneven development of industries and services were able to lead to inconsistencies in the use of urban land in less than half a century, and imbalances in the distribution of facilities and public services in the areas of Tehran through geographic changes in population, the spread of urbanization culture and consumer culture, the incidence of human ecological flows, such as rural to urban migration, and the influx of city dwellers in the capital and industrial centers. The spatial appearance of the local and regional imbalances in Tehran could be observed in the formation of rich and poor neighborhoods, the indiscriminate use of personal cars for trips within the city, the use of a certain stratum of society (low-income) of public transport, and finally the exponential trend of urban trips (Pourahmad et al., 2009). During the five-time national census, the population of Tehran increased from 1,500,000 in 1956 to 7705036 in 2006. In the meantime, the highest population growth rate was related to years between 1949 and 1964 (9.27%) (Hadipour, 1999). This phenomenal growth during the studied period, caused by the transformation of Tehran to a metropolitan, has been a result of the increasing role of government in socio-economic affairs, relying on oil exports and the integration of Iran with the world capitalist system.

Due to major changes in Tehran metropolis in the last half century, including population growth, spatial-physical expansion, structural changes and the emergence of concentration, and also considering the elimination of regional inequalities, as one of the major issues of policy making in the Third Development Plan (Noorbakhsh, 2003), and as disparities in the distribution of services in the cities, leaving behind the urban development, is now one of the challenges of urban management in responding to citizens, and by examining the inequalities in the distribution of services and identification of spatial patterns of injustice in the city, it can be realized which of the services are in poor condition; and which urban districts or neighborhoods suffer from injustices; so that, the urban management could reduce the spatial disparities through conscious practice in the spatial distribution of public services and social benefits, improving the quality of life and

guaranteeing the sustainable urban development (Dadashpoor and Rostami, 2011). The aim of this study was to investigate and analyze the spatial distribution of public services in the metropolis of Tehran, and determination of the status and rank of each of the 22 districts of Tehran Metropolis in terms of facilities and services with the use of planning models.

MATERIALS AND METHODS

The method of data collection in this study is comparative-analytical, and its statistical population is composed of urban services in 22 districts of Tehran Municipality (Fig. 1). Data were collected based on desk-documentary method. For this purpose, research data and related information were extracted through referring to the Comprehensive Plan of Tehran in 2002, a detailed plan for 22 districts of Tehran, and the Statistical Yearbook of Tehran Municipality in the years 2009 and 2006 (Table 1). Districts of Tehran were ranked using HDI compost models and methods, the main components, numerical taxonomy and the standardization methods. In addition, the cluster analysis method was used to cluster districts of Tehran, based on the numerical value of each of the districts using 4 above-mentioned methods. ArcGIS and SPSS were used to analyze data.

John Stuart Mailer is the first to use the term "social justice" in its modern sense. In his view, the social justice is realized when society gives equal treatment to all those who have the same qualifications (Miller, 1999). The concept of social justice has entered into geographical literature since the 1960s; however, this kind of anthropogeography which tries to achieve social justice, dates back to more than a century based on suggestions made by Petro Kropotkin on combating poverty, European nationalism and racism (Shokouei,

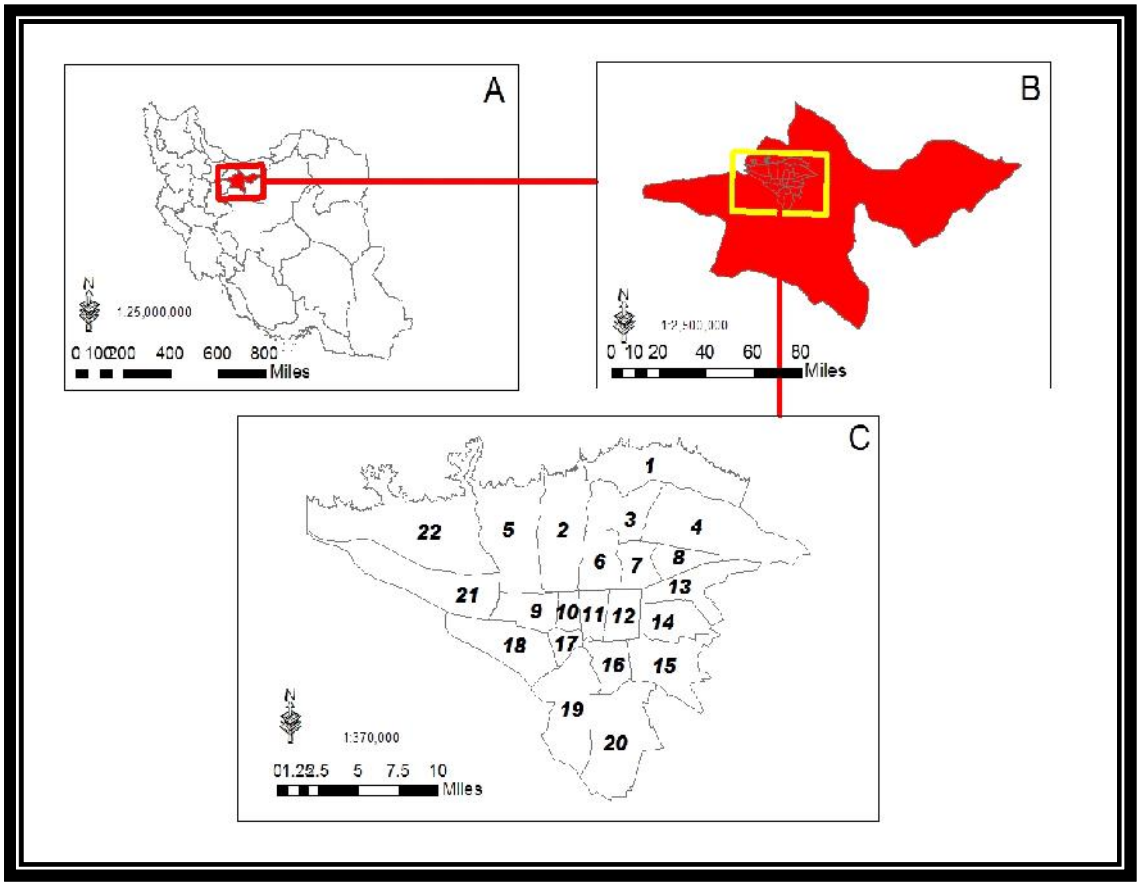

Fig. 1: Map showing study area within Iran (a) and Tehran province (b) 22 districts of Tehran (c)

2003, Hataminezhad et al., 2008). In 1991, the Committee on Social and Cultural Geography in the Institute of British Geographers published a report on social justice and Geography, which analyzes the winners and losers of the society. David Smith in 1996, in his valuable work entitled "geography and social justice" stated: "Geography should be linked with social justice in theory and practice. Without social justice, geography lacks the strength needed to make the human life good and desirable" (Smith, 1996). Even, the true democracy is possible when accompanied by social justice (Shokouei, 2007). The first systematic work on space and social inequality has been done by Robert Park. Given the unequal nature of urban space, he addresses the special role of domination in the creation of this unequal space (Afrough, 1998). Perhaps it can be argued that for the first time, the term "geographical development" was introduced against social and cultural rights by Harold Wood, professor of Geography at McMaster University in Canada.

distributive justice; because the public interest, needs and entitlements cannot be taken into account without distributive and allocative criteria. Also, any urban planning which is based on social justice in the city must be effective in distribution of needs, public benefits and entitlements, as well as in their allocation.

DISCUSSION AND RESULTS

Composite human development index

According to the United Nations, human development indicator examines the human welfare in each country; while other classic indicators have just an engineering approach to the economy, and consider the volume of each macroeconomic variable (United Nations, 2003). To determine the degree or level of development in districts of Tehran, indicators related

Table 1: Per capita of urban services uses in different districts of Tehran

Districts	Commercial	Education	High-educational	Religious	Cultural	Tourism	Medical	Recreational	Sport	Administrative	Green space	Installations and equipment	Transport and storage	Street network
1	0.68	1.60	3.23	0.25	2.75	0.62	1.72	2.15	0.56	3.58	6.64	1.03	0.37	26.57
2	1.82	0.82	0.43	0.13	0.03	0.20	0.40	0.02	0.17	0.51	5.85	0.90	0.47	28.63
3	9.01	1.48	1.02	1.13	2.53	0.73	0.84	0.28	4.10	7.29	10.53	0.75	0.83	27.29
4	0.80	0.77	1.60	0.14	0.14	0.12	0.30	0.04	0.31	1.51	16.26	1.51	1.21	20.46
5	0.63	1.12	1.36	0.13	0.09	0.00	0.21	1.15	0.49	0.39	6.58	1.28	2.31	21.38
6	2.44	1.41	8.71	0.18	0.79	0.16	3.11	0.12	0.67	4.88	5.89	0.81	1.17	25.73
7	0.61	0.70	0.28	2.15	0.04	0.02	1.13	0.02	0.42	1.37	0.66	0.60	0.20	10.98
8	0.61	0.62	0.00	0.10	0.03	0.04	0.13	0.00	0.26	0.33	1.01	0.13	1.17	12.19
9	0.97	0.57	1.45	0.14	0.02	0.06	0.26	0.00	1.09	1.14	1.13	0.16	60.12	15.61
10	1.28	0.52	0.00	0.13	0.24	0.00	0.32	0.16	0.07	0.23	0.49	0.29	0.40	6.92
11	2.95	1.10	0.00	0.56	0.00	0.00	0.80	0.00	0.12	2.57	1.21	0.13	1.95	11.30
12	7.15	1.39	0.43	0.99	0.96	0.41	1.10	0.00	0.38	3.89	2.68	0.29	4.08	13.13
13	0.88	0.80	0.10	0.20	0.10	0.05	0.51	0.00	0.42	0.76	0.80	0.92	0.53	13.55
14	1.46	0.62	0.06	0.11	0.01	0.05	0.00	0.00	0.03	0.32	1.82	0.35	0.06	9.40
15	0.94	0.94	0.23	0.18	0.16	0.01	0.17	0.00	0.48	0.36	9.41	0.47	2.56	11.68
16	1.39	1.60	0.05	0.20	0.32	0.00	0.31	0.09	0.82	0.89	5.70	1.46	11.88	13.35
17	4.18	0.55	0.00	0.19	0.10	0.00	0.12	0.05	0.17	0.21	1.30	0.11	0.55	8.00
18	5.10	1.44	0.18	0.16	0.07	0.00	0.27	0.00	0.54	1.01	8.00	0.95	4.34	21.02
19	9.11	0.99	1.11	0.10	0.01	0.00	0.18	0.00	0.97	0.13	6.47	0.92	0.25	14.63
20	0.63	1.22	0.26	0.24	0.25	0.00	0.60	0.00	0.70	0.36	2.56	0.94	4.33	16.17
21	0.69	1.42	2.59	0.18	0.57	0.00	1.64	0.00	4.12	0.20	22.34	1.08	31.46	51.96
22	0.93	1.68	44.46	0.29	0.10	0.00	0.11	0.00	52.89	2.44	213.34	1.94	14.97	41.89

Based on: Tehran Municipality Urban Development Department, 2002. Tehran comprehensive plan, detailed plan for 22 districts. Tehran: Tehran municipality. Available at: http://services1.tehran.ir/portals/0/Tehran-Detail-Plan/index.html; Department of Statistics, Planning and Budget Organization of Tehran Municipality Information and Communication Technology, (2006-2009). Statistical Yearbook of 2006 to 2009. Tehran municipality, Iran. Available at: http://www.tehran.ir/portals/0/other/1388/352/annual%20report%2086-for%20web-13881216-092137.swf

to each factor were calculated in conjunction with each other, as consolidated indicators, using HDI. This indicator was built in three stages as Eq. 1. The first step in this method is to determine the extent to which each urban district is deprived, taking into account all the variables (Farmand and Shahidi, 1993; Ziyari, 2009; Maleki, 2011).

$$DS\ ij = \frac{\text{Max xij} - \text{Actual Value xij}}{\text{Max xij} - \text{Min xij}} \quad (1)$$

Where DSij is Deprivation Score, which is the deprivation indicator for the j^{th} district, according to the i^{th} indicator. Deprivation range of each region will be between zero and one; because based on definition, the maximum level of deprivation or the maximum level of entitlement will be zero; and the minimum level of deprivation or the maximum level of entitlement will be 1. The second step in this procedure is to define the average indicator or mean deprivation indicator j. In other words, at this point, the mean indicator is used as Eq. 2.

$$DS\ ij = \frac{1}{n}\sum_{i=0}^{n} S_{ij} \quad (2)$$

The third step in this method determines the measurement of human development or the degree or level of development in urban districts. The mentioned indicator is the difference of 1 from average deprivation (Eq. 3), which is usually in the range of Zero to 1.

$$HDI = (1\text{-}DS_{ij}) \quad (3)$$

Results showed that from among the total 22 districts of Tehran, districts 3, 1, and 22 are at the highest level of development and districts 8, 17 and 14 are at the lowest level of development. In general, it can be said that the northern areas of city has better service per capita than other areas. For example, the basis for the organization of district 1 has been developed based on the growth pattern of the region, and its settlements systems, which over time has been strengthened with the public use. The main center of city; i.e. the area of Tajrish Square, as the oldest independent urban center of Tehran, is located in this region; which has been of great importance since the early development of Tehran. One of the oldest and the most important urban routs of Tehran; i.e. Valiasr and Shariati (old road to Shemiranat) avenues reach to this center. Uses of each main core are combined based on the current situation and their completion. The center of the region of Tajrish Square and bridge is composed of service, commercial, administrative, health, leisure and religious uses. Tajrish market, Shrine Saleh, Tajrish Shohada hospital and commercial uses in the scope of municipality, from Qods square to Tajrish square, are located in this center (Shahr Consulting Engineers, 2005).

Also District 8, is ranked last (among 22 district), in terms of having urban public services. Some of the features of these districts include their low per capita of commercial uses (6.10), higher educational uses (0.00), cultural uses (0.03), recreational uses (0.00) and sport uses (3.88) (Table 2).

Table 2: HDI of 22 districts of Tehran

Districts	HDI*	Ij	Rank
1	0.44	0.56	2
2	0.18	0.82	9
3	0.54	0.46	1
4	0.16	0.84	12
5	0.20	0.80	7
6	0.32	0.68	4
7	0.16	0.84	14
8	0.03	0.97	22
9	0.11	0.89	17
10	0.05	0.95	19
11	0.16	0.84	13
12	0.31	0.69	5
13	0.11	0.89	16
14	0.05	0.95	20
15	0.08	0.92	18
16	0.19	0.81	8
17	0.04	0.96	21
18	0.17	0.83	10
19	0.17	0.83	11
20	0.12	0.88	15
21	0.22	0.78	6
22	0.35	0.65	3

*Human Development Index

Factor analysis

In this study, 22 districts of Tehran were ranked based on Tehran metropolitan urban services and using Principal Component Analysis (PCA) analysis. This means that type R of the research indicators was determined using SPSS and factor analysis model.

Bartlett's Test, confirmed the significance of the factor analysis at the level of 0.99 percent. As a result, the studied indicator was converted to 4 in the factor analysis through varimax rotation; so it covers a total of 83.63% of the variance and indicates the satisfactory factor analysis and the studied indicators (Table 3).

In the regional development studies, after the variables were converted to indicators, differences in scale should be resolved in the next stage; because the fundamental insufficiency of relevant studies to the degree or level of development of districts and towns, inequalities, and lack of regional imbalances in Iran lead to lack of attention to resolve differences of scale and equalize the weight of indicators (Ziari and Jalalian, 2008). In this study, the modified method of dividing by the average principal component analysis was used to resolve differences in scale. Composite index of the modified principal component analysis can be achieved through the following Eq. 4 and 5 (Kalantari, 2011).

$$CI = \sum_{i=1}^{n} \frac{X_{ij}}{X_i} \times W_{ij} \quad (4)$$

$$I = CI \quad (5)$$

The results of factor analysis showed that district 22 with a score of 35.54 is ranked the highest and district 14, with the score of around 3.4 is ranked the lowest from among the 22 districts. The highest standard deviation, from among the considered uses, is the green space, which present a most uneven distribution of these uses in the city of Tehran; so that the northern and even southern districts of Tehran have relatively acceptable per capita compared with per capita of the master plan. However, the central districts of the city including districts 7, 14 and 17 have the lowest per capita of green space (Department of Urban Planning and Architecture, 2003). Also, per capita of tourism services and catering (including restaurant, hotels, inns, motels and apartments), with the lowest standard deviation, has a good and fair spatial distribution among the 22 districts of Tehran metropolis (Table 4).

Numerical taxonomy

Taxonomical analysis is one of the methods of grading districts in terms of the degree of development. Numerical taxonomy analysis is a special type of this method. Anderson (1949) was the first researcher who used this method in classification of flowering plants. This method is capable of dividing a collection (set) to the subsets of a more or less homogeneous nature, and providing a scale used for planning to identify the degree of development (Kalantari, 2011). In this method,

Table 3: The final extracted factors and their related specific amount

Factor name	Cumulative percent of variance	Percent of the variance	The special value
1	20.75	20.75	3.32
2	37.09	16.34	2.61
3	52.57	15.47	2.47
4	66.81	14.24	2.27

Table 4: Ranking of districts of Tehran, using factor analysis

Districts	Composite index	Rank
1	30.70	3
2	10.64	9
3	32.04	2
4	8.96	12
5	12.58	7
6	17.67	5
7	10.62	10
8	4.27	20
9	11.04	8
10	4.46	19
11	8.98	11
12	17.69	4
13	6.12	18
14	3.40	22
15	6.57	17
16	8.71	13
17	4.07	21
18	7.88	14
19	7.48	16
20	7.80	15
21	12.87	6
22	32.54	1

for determination of units or a variety of homogenous subjects in a 3D vector space, variance and correlation analysis will be able to divide a set into subsets of a more or less homogeneous nature, without the use of regression. Therefore, this method can be used as a benchmark for social and economic development of the used area (Badri, 1990). In this model, 3 districts have the most stable municipal services, which can be characterized by a high per capita of commercial and cultural uses, as well as tourism services, sport, administrative, fire stations uses, and especially per capita of urban green space (98.64 meters per person in 2009). After district 3, districts 1, 12, 22 and 6, are in the rank, respectively. Districts 14, 17 and 10 have the lowest level of municipal services in Tehran, respectively (Table 5).

Standardization method

This model is a method for determination of regional inequalities and the ranking of districts in a land arena. This method reveals the differences between districts. The overall structure of this model is as Eq. 6.

$$SS_{ij} = \frac{X_{ij} - \overline{X_i}}{s_i} \quad (6)$$

Where SSij is the standardized score of indicator i for district j;
Xij represents the value of indicator i for district j;
$\overline{Xi}$, is the indicators Mean;
Si, is the Standard deviation indicator i. In the next step, the standardized score for each of indicators of studied districts are added together; and the result is divided by the total number of indicators. The obtained score (Eq. 7), is the average standard score or development index (DI), which as a single indicator, allows the possibility of comparing districts in terms of activities.

$$SS_j = \frac{1}{n}\sum_{i=1}^{n} SS_{ij} \quad (7)$$

SSj: indicator for District j
n: number of indicators

The following table provides the standardized scores of districts of Tehran, as a composite indicator for 18 studied indicators. Accordingly, in a similar vein to previous methods, in this way districts located in the north of Tehran (1, 3 and 22) enjoy the most municipal services, and districts 14, 10 and 17 enjoy the lowest municipal services (Table 6). Some of the main problems of district 17, which is ranked 20 in terms of benefiting from urban services, can be as follows:
- The poor quality of residential context and problems arising from high population density, intensive residential context, poor accesses, and environmental

Table 5: The distribution of services in the districts of Tehran based on numerical taxonomy method

District	CI*	DI**	Rank
1	11.13	0.54	2
2	12.87	0.63	7
3	9.88	0.48	1
4	13.25	0.65	9
5	13.05	0.64	8
6	12.11	0.59	5
7	13.43	0.65	13
8	14.65	0.71	19
9	14.30	0.70	18
10	14.85	0.72	20
11	13.33	0.65	11
12	11.68	0.57	3
13	13.96	0.68	17
14	15.01	0.73	22
15	13.86	0.68	15
16	13.31	0.65	10
17	14.96	0.73	21
18	13.41	0.65	12
19	13.89	0.68	16
20	13.47	0.66	14
21	12.86	0.63	6
22	11.80	0.58	4

*Composite Index
**Development Index

Table 6: Ranking of districts of Tehran, in terms of municipal services based on standardization model

Districts	Z*	Σ	Rank
1	0.82	14.01	2
2	0.16	2.64	6
3	1.17	18.65	1
4	-0.07	-1.17	11
5	0.02	0.39	7
6	0.34	5.48	5
7	-0.10	-1.62	14
8	-0.46	-7.28	19
9	-0.26	-4.15	17
10	-0.56	-9.01	21
11	-0.05	-0.84	9
12	0.47	7.49	4
13	-0.33	-5.28	18
14	-0.61	-9.75	22
15	-0.18	-2.88	15
16	-0.10	-1.58	13
17	-0.56	-8.94	20
18	-0.08	-1.30	12
19	-0.22	-3.55	16
20	-0.06	-0.99	10
21	0.01	0.18	8
22	0.65	10.33	3

*z-score is also known as a standard score

pollution due to the sewage entering into streams and pathways on rivers and passages.
- Severe shortage of sports, cultural, green space, medical and educational services, especially in the central areas of the district.
- Traffic problems and traffic caused by the conversion of all streets in the district to the vehicles parking spaces.
- The lack of land uses and trans-regional and attractive urban performances.

Final ranking of Tehran districts in integrated models

For the final ranking of Tehran districts, in terms of benefiting from studied indicators, numerical value of each of the districts was summed using four methods of HDI, principal components, standardization and the technique of numerical taxonomy. Accordingly, the areas with higher numerical scores enjoy higher levels of entitlement; so that districts 1, 3 and 22 are at the highest level and districts 14, 17 and 8 are at the lowest level of development (Table 7).

After scoring on the basis of the numerical value in the models used, they were clustered based on cluster analysis model (Fig. 2). Accordingly, 22 districts of Tehran were clustered in following five clusters:

1. Districts with a final score of 66 and above were included in the first cluster and identified as overdeveloped districts. Because of the noticeable difference in the final score, districts were divided into two sub-clusters. Districts 3 and 1 were included in the first cluster; and districts 22, 12, 6 and 21 were included in the second cluster.
2. Districts the final score of which is between 43 and 63 are included in the second cluster and identified as upward developed districts. Four districts of 5, 2, 4 and 11, are in this cluster, respectively.
3. Districts with the final score between 38 and 48 were clustered in the third cluster, and they were named as semi wealthy districts. Districts 16, 18, 7 and 20 were included in the third cluster.
4. Districts with the final score of 23 to 33 were clustered in the fourth cluster; and they were named as downward developed districts. Districts 19, 9, 15 and 13 were included in this cluster.
5. Finally, districts with the final score of 13 or less were clustered in deprived districts; i.e. cluster 5. District 14 with a final score of 6 was included in the lowest cluster. Districts 10, 8 and 17 were also included in this cluster.

For spatial analysis of the level of entitlement of different districts of Tehran, the final score obtained through the combination of the four models, was entered in ArcGIS, and the entitlement level map was produced based on the results of cluster analysis (Fig. 3).

Table 7: Ranking of districts of Tehran, in terms of benefiting from municipal services in integrated models

Districts	Sum of scores	Z*	DI**	CI***	HDI****	The final rank
1	83	21	21	20	21	2
2	61	17	16	14	14	8
3	87	22	22	21	22	1
4	48	12	14	11	11	9
5	63	16	15	16	16	7
6	73	18	18	18	19	5
7	41	9	10	13	9	13
8	12	4	4	3	1	20
9	32	6	5	15	6	16
10	13	2	3	4	4	19
11	48	14	12	12	10	10
12	76	19	20	19	18	4
13	23	5	6	5	7	18
14	6	1	1	1	3	22
15	27	8	8	6	5	17
16	48	10	13	10	15	11
17	9	3	2	2	2	21
18	44	11	11	9	13	12
19	33	7	7	7	12	15
20	38	13	9	8	8	14
21	66	15	17	17	17	6
22	81	20	19	22	20	3

* Z-score is also known as a standard score
** Development Index
***Composite Index
****Human Development Index

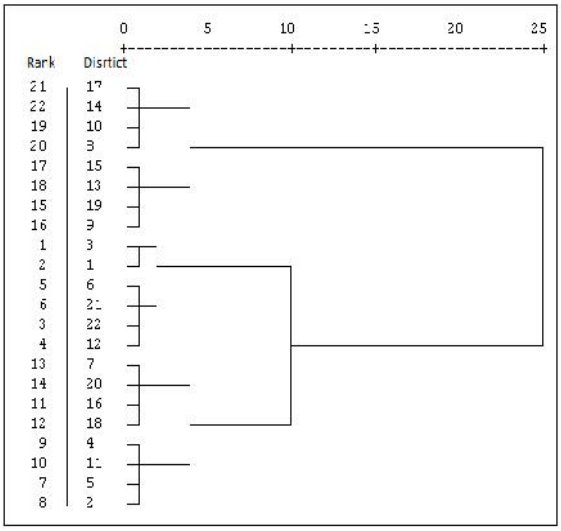

Fig. 2: Tree draw, Cluster analysis

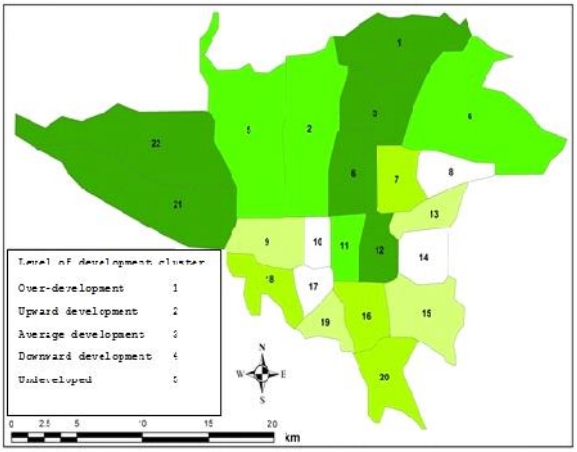

Fig. 3: level of development cluster

CONCLUSION

This study aimed to evaluate and rank the districts of Tehran in terms of benefiting from urban public services using analytical-comparative method. For this purpose, planning quantitative models, including models of factor analysis, the composite method of the HDI, Taxonomical technique and standardization method were used. The results of the calculations in the composite model of HDI suggested that districts 1, 3 and 22, had the highest degree of development, respectively; and districts 8, 17 and 14 were at the lowest level of development. The results of factor analysis indicated that district 22, with a score of 32.54, and district 14, with a score of 3.4 were ranked the highest and the lowest from among the 22 districts of Tehran, respectively. Also, based on the output of taxonomical model, district 3 was ranked first, district 1 was ranked second, district 12 was ranked third and district 10 was ranked the last. Finally, according to the standardization model, districts 3, 1, and 22 were identified as the most developed and district 14, 10 and 17 as the most deprived districts. For the final ranking of districts of Tehran in terms of benefiting from the studied indicators, the numerical value of each of the areas was calculated in four ways. Based on this technique, districts 1, 3, 22, 12 and 6 were

ranked first to fifth, respectively; and districts 13, 10, 8, 17 and 14, were ranked last, respectively. Finally, based on the final ranking of districts, 22 districts of Tehran metropolis were ranked in the compilation clustering models using cluster analysis; so that districts 1, 3, 12, 22, 6 and 21 were included in the first cluster; districts 5, 2, 4 and 11 were included in the second cluster, districts 16, 18, 7 and 20 were included in the third cluster, districts 19, 9, 15 and 13 were clustered in the fourth cluster, and the districts 14, 10, 8 and 17 were clustered in the fifth cluster. In general, the results of models applied in the research, particularly cluster analysis showed unfair distribution of facilities and municipal services in the metropolis of Tehran; and hence deprived areas include 4 districts of 14, 10, 8 and 17 which should be considered as the first priority for planning, and downward developed districts 19, 9, 15 and 13, as the second priority, and districts 16, 18, 7 and 20 as the third priority for development.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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