Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

Determining the priority of hospital projects using the electric particle system method

Bijan Taheri1, Alireza Lork*, Babak Aminnejad3, Amir Hossein Gandami4

1-Department of Civil Engineering, Kish International Branch, Islamic Azad University, Kish Island, Iran

2-Department of Civil Engineering, Karaj Branch, Islamic Azad University, Karaj, Iran

3-Department of Civil Engineering, Safadasht Branch, Islamic Azad University, Tehran, Iran

4-Amir H. Gandomi is anARC DECRA Fellow at the Faculty of Engineering andInformation Technology, University of Technology Sydney, Australia.

Abstract: - In the upcoming research, after collecting information about the population of the target cities, the variables related to the location of the target cities, including the distance to the provincial capital and the deprivation of the region, and the variables related to hospital facilities, including the number of university beds available, the number of non-university beds available, the number of hospital beds The number of university beds predicted in 1404 and the number of non-university beds predicted in 1404 are discussed based on a reliable and close logical relationship between the priority of hospital projects and the population and location of target cities and indicators related to hospital facilities. Based on the position of the particles, the distance between them and according to the distance and amount of charge of each particle (option), the force on each particle (for each index separately) is calculated. The prioritization of cities (options) for the implementation of hospital projects is done for everyone based on the total forces applied to each particle (option). Any option with a higher total load has a higher priority for the implementation of hospital projects. The results of the research show that the charged particle method is a suitable method for determining the priority of implementing hospital projects. Therefore, by determining the relevant indicators in the implementation of construction projects and the initial numerical ranking of each project based on the planned indicators and determining the position of each option, it is possible to prioritize properly, accurately and documented by the method of the electric particle system. Projects in progress achieved. Based on this, option number 1 with a total of 34254, second option with a total of 30317, third option for implementation priority with a total of 26217 and fourth option with a total of 25946 were examined in the fourth priority among 430 options.

Keywords: determining priority, hospital project, electric particle system, non-university beds, location of target cities, indicators of hospital facilities

1. Introduction

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

The increasing demand for prioritization of complex and large-scale projects in the engineering community on the one hand, and economic issues and savings in the provision of materials on the other hand, have turned the prioritization of project implementation into an important issue in project management and construction issues. In the meantime, the use of meta-exploratory methods, due to their characteristics, has become popular as a powerful tool in prioritizing projects and optimizing the allocation of facilities [1]. Multi-criteria decision-making techniques are superior to other methods due to the evaluation of different options and are one of the most widely used decision-making techniques. Also, these techniques are capable of quantitative and qualitative assessment of standards; This is the weak point of traditional techniques. In the face of multi-criteria decision-making problems, there are various techniques, among which we can mention simple weightless method, TOPSIS and hierarchical analysis process. The results of recent research show that in many cases, the process of hierarchical analysis has not been able to correctly reflect human cognitive processes, especially in situations where problems are not fully defined or solving problems involves uncertain data [2]. Often, decision makers provide uncertain and inaccurate answers to judge and evaluate a problem. In fact, ambiguity and fuzziness are prominent features of a decision-making problem, so it seems necessary that a suitable decision-making model takes these considerations into consideration. One of the efficient techniques in dealing with uncertain and fuzzy conditions is fuzzy hierarchical analysis. This method has been successfully used in many valid studies for fuzzy evaluation and multi-criteria problems [3].

Optimization methods are divided into two categories, exact and approximate. Exact methods are able to find the optimal solution accurately, but they are not efficient enough in the case of hard optimization problems, and their execution time increases exponentially according to the dimensions of the problems. Approximate methods are able to find good solutions (near optimal) in short solution time for hard optimization problems. Approximate methods are divided into three categories of heuristic, meta-heuristic and ultra-heuristic methods [4]. The two main problems of heuristic algorithms are their involvement in local optimal points and premature convergence to these points. Meta-heuristic algorithms are presented to solve these heuristic algorithm problems. Meta-heuristic algorithms are one of the types of approximate optimization algorithms that have solutions that go from local optimal points and can be used in a wide range of problems [5]. The system of charged particles is one of meta-exploration methods that is inspired by electrical physics and Newtonian mechanics. has taken. In the physics of electricity, the electric charge of each particle creates an electric field around it, and this field can affect other charged particles. The properties of the electric field around the charged particle are determined by Coulomb's and Gauss' laws. Using these rules, the CSS algorithm defines a number of optimal candidates, each of which is called a charged particle, and each particle can apply electric force to other particles. According to Newton's second law, this force will make particles move and change their location [6].

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

2. Review of the literature

Attention should be paid to the new perspectives of standards and the development of local and regional standards and the reduction of the tendency to establish national indicators without previous flexibility and the complexities of the pattern of people's needs and demands in different cultural, geographical formats, etc. which is insisted by the planners of the Ministry of Health and Medical Education of the country. Therefore, according to the patterns of the leveling system of inpatient and specialized medical services in the country, at this stage, the minimum and sometimes optimal limits of medical equipment needed by each part of the inpatient service system, including inpatient treatment (1) city (2) district (3) regional (4) polar (5) and country (6) has shown that the specialization of resources in the dimension of medical equipment can be done in a way that is closer to reality. and that birth certificate is matched with these standards, it can calculate the deviation from the standard of each hospital unit and different hospitals as a whole, and then move towards the standard based on the financial resources, the priorities of the officials of the specific income of each unit and the amount of credit of each hospital's property acquisition In fact, the above division model has been chosen as a prism or umbrella model, at the top of which is the national center (hospital) and at the base are inpatient treatment hospitals [7].

Principles of Analytical Hierarchy Process (AHP)

In the hierarchical analysis process, the elements are first compared in pairs and a pairwise comparison matrix is formed, then the relative weight of the elements is calculated using this matrix. In general, a pairwise comparison matrix is shown as follows. in which the i-th element is preferred over the j-th element. By knowing the aijs, the weight of the elements, i.e. the Wis, is obtained.

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix} \quad A = \left[a_{ij}\right] \, i, j = 1,2, \dots, n$$

One of the advantages of the hierarchical analysis process is to control the consistency of the decision, in other words, always in the hierarchical analysis process, you can calculate the degree of consistency of the decision and judge whether it is good or bad, or whether it is acceptable or rejected. Every comparison matrix A couple may be compatible or incompatible. In the case that this matrix is compatible, the calculation of the weights is simple and it is obtained by normalizing the elements of each column, but in the case that it is incompatible, the calculation of the weights is not simple, and four main methods have been proposed to obtain them, which are [8]:

Least Squares Method

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

Logarithmic least squares method

Special vector method

Approximate methods (row sum, column sum, arithmetic mean, geometric mean)

Therefore, the approximate methods give acceptable answers and the calculations are much simpler. To obtain the desired coefficients, the approximate geometric mean method was used. In this method, the geometric mean of the elements of each row is calculated and then the resulting vector is normalized to obtain the weights. For normalization, the geometric mean of each line is divided by the sum of the geometric means.

One of the most efficient decision-making techniques of Hierarchical Analysis Process was proposed to solve decision-making problems with multiple criteria (MCDM) using a regular hierarchical structure. which is based on pairwise comparisons and defines issues with different criteria and complex variables in a clear and comprehensible way and finally gives managers the possibility to examine different scenarios. Hierarchical analysis enables decision makers to determine the mutual and simultaneous effects of many complex and uncertain situations. This process helps decision makers to set priorities based on their goals, knowledge, and experience. So that they consider their feelings and judgments accurately. To solve decision-making problems through AHP, the problems must be defined and explained carefully and with all the details, and the details must be drawn hierarchically [10].

After the options and indicators are determined, pairwise comparisons are made between the indicators, and in the next step, pairwise comparisons are made between the options for each indicator. To measure the incompatibility rate, the following steps should be taken [11]:

Calculation of weighted sum (WSV): The matrix of pairwise comparisons is multiplied by the vectors of relative weights and the "weighted sum vector" is calculated.

Computation of compatibility vector (CV): The elements of the weighted sum vector are multiplied by the inverse of the relative weights vectors.

Calculation of the largest eigenvalue of the matrix of pairwise comparisons: to calculate this part, the average of the elements of the compatibility vector is calculated.

Calculation of the inconsistency index (CI): This index is obtained from the difference of the largest eigenvalue of the matrix and the number, divided by the number minus one.

$$CI = \frac{\lambda_{\max} - n}{n-1}$$

Calculating the inconsistency rate (CR): which is obtained from the following equation:

$$CR = \frac{CI}{CR}$$

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

If the smaller inconsistency rate is equal to 0.1, in pairwise comparisons, there is consistency and the work can be continued. Otherwise, the decision maker should reconsider the pairwise comparisons.

Delphi and modified Delphi method

The Delphi method is a structured communication method or technique that was originally invented and developed for the purpose of systematic and interactive forecasting by relying on the deliberation of experts. This method used in future research mainly pursues goals such as discovering innovative and reliable ideas or providing appropriate information for decision making. The Delphi method is a structured process for collecting and classifying the knowledge available to a group of experts, which is done through the distribution of questionnaires among these people and the controlled feedback of the answers and opinions received. (creating opinion or opinion), antithesis or antithesis (opinion and opposing opinion) and finally synthesis (new agreement and consensus) has been formed, which is created after the process of building a new theory. According to Helmer, Delphi is a useful communication tool between a group of experts that makes it easy to formulate opinions of group members [12].

The basis and foundation of the Delphi method or technique is that the opinion of experts in any scientific field is the most correct opinion regarding the prediction of the future; therefore, unlike survey research methods, the validity of the Delphi method depends on the scientific validity of the participating experts. Participants in Delphi research include 5 to 20 people. The minimum number of participants depends on how the research method is designed. In this method, a board (panel) of experts is formed in which the communication between the members is done by the chairman or supervisor of the board. The internal communication of the participants is anonymous and the opinions, predictions and tendencies are not attributed to their providers. The publication of this information is done without announcing the identity of the providers. The main elements in the basic Delphi methods are [13]:

• Structuring the flow of information

• Presentation of snacks to the participants

• Not disclosing the identity of the participants

Although there are significant differences in the application of the Delphi method, Delphi research usually begins with a questionnaire designed by a small team and sent to a larger group of experts. Questionnaires are arranged in such a way that it is possible for the audience to express their individual reactions while inferring and understanding the raised issue. When the questionnaires are returned, the range of responses and the reasons given by the experts for their responses are reviewed and summarized. At this stage, the items that are not related to the goals of the research field are removed, and in this way, common negative issues in intragroup

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

interactions (related to the field of social psychology) are avoided [14]. After that, the summary report is sent to the experts. The experts are allowed to change their answers based on the results, and these second round results are re-evaluated by the researchers. In this way, over time and with the progress of the work, the views of the audience will match the topic. This process continues until a consensus is reached on the opinions or it is determined that the experts do not agree [15].

The most important point in the Delphi method is to overcome the negative points in conventional committees. Non-disclosure, controlled feedback and statistics-based responses are the most important features of Delphi. Delphi is not a rigid statistical method for predicting the future. The lack of sampling, the uncertainty of future events, and the lack of well-defined and known processes for conducting Delphi studies are just a few of the things that distinguish Delphi from controlled scientific methods; But a Delphi study is valuable for problems that do not require rigorous analytical techniques: for example, when data are insufficient or uncertain, or when real samples are not available, or when it is difficult to get people together to discuss an issue. Because the Delphi technique relies on anonymity, controlled feedback, and statistical group response, and therefore avoids the influence of prominent individuals in discussion groups or group pressure for conformity, a valid consensus of experts can be obtained using this technique.

The steps of the Delphi method are [16]:

Formation of the implementation team and supervision of Delphi implementation

Selection of one or more delegations (panels) to participate in the activities. The members of these boards are usually experts in the field of research.

Launching the questionnaire setting activities for the first round

Examining the questionnaire from a written point of view (resolving inferential ambiguities, etc.)

Sending the first questionnaire to the members of the delegations

Analyzing the answers received in the first round

Preparing the second-round questionnaire (necessary revisions)

Sending the second-round questionnaire to the members of the delegations

Analyzing the answers received in the second round (steps 7 to 9 continue until achieving stability in the answers found)

Report preparation by the processor team

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

The most important point in this process is the understanding of the goals of applying the Delphi method by the participants. In case of misunderstanding, we will face irrelevant answers from the participants. Respondents must have sufficient knowledge in the relevant field and be familiar with the subject literature of the discussed category; But at the same time, it may not be necessary to have a very high level of expertise in the field in question. The output of the Delphi method is nothing but a theory. This theory is as valid as the opinions of the participants. The views and opinions of the participants are summarized based on statistical relationships and not based on majority and minority votes. Although the expertise and viewpoint of the participants is higher, the output obtained will be better [17].

3. Electric particle system method

All meta-heuristic algorithms have two aspects: exploration and exploitation. The first aspect causes the entire space of the problem to be searched, and the second aspect causes the proper answers to be kept at each stage and the search continues around them. The charged particle system algorithm also has controls for these cases. In problems with discrete variables, with the loss of the accuracy of the variables while rounding them to predetermined values, it is necessary to strengthen the exploration aspect of the problem, and as a result, the possibility of new solutions outside the problem space increases, and in fact, the constraints of the variable axis are violated. . Constraint violation can be problem-oriented or variable-oriented. This means that in case of violation of the main constraints, the problem-oriented violation occurs, and if the location vector domains of the variables are outside the problem space, the variable-oriented violation has occurred [18].

In the particle assembly algorithm, in order to solve problem-oriented and variable-oriented violations, the Fly-back mechanism has been presented. In this mechanism, any particle that moves outside the acceptable space is returned to its previous location. In other words, in such cases, the algorithm will not make a new move, and this problem causes the efficiency of the algorithm to decrease. Kaveh and Talat Ahri have presented the useful fly-to-boundary mechanism in the charged particle system algorithm. In this method, the particles that go out of the problem space are guided to the boundaries of the acceptable space by averaging. In this way, in addition to solving the problem of violating the constraints, a new move is also made, and due to the probability of the optimal solution occurring in the vicinity of the boundaries, the probability of approaching the final solution of the problem also increases [19].

In order to prevent the variables from leaving the limits and to control the violation of the variable-oriented restrictions, an initial idea can be to prevent assigning values outside the limits to the variables. By using this method in the present research, the optimization process usually ended without results. The reason for this can be explained in the occasional change of some reservoirs. In other words, due to the loss of the characteristics of the variables, the

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

optimization process does not take its correct path. With this explanation of the method that seems appropriate, it can be acceptable to scale all the variables of a variable and make it proportional. By using this operation, acceptable and uniform results have been obtained in optimization problems. By scaling the variables and fitting them to the permissible domain of the problem, the algorithm parameters are set automatically [20]. In other words, implicitly, the parameters of the problem in each step will be determined by the algorithm itself, and as a result, the user will not need to change the parameters of the algorithm, and the answers of different iterations will be significantly closer to each other.

4. Research method

The application of the charged particles method in this research is weighting and ranking of factors affecting the implementation of hospital projects, although in general this method is designed to facilitate decision making. Its common uses include the following [21]:

As a tool for selecting projects for action in order to take or continue or stop them in strategic management.

As a tool for risk analysis and planning by considering different factors and approaches.

The charged particle method involves different options in decision-making and has the possibility of sensitivity analysis on criteria and sub-criteria. This process facilitates judgment and calculations. It also shows the degree of compatibility and incompatibility of the decision, which is one of the advantages of this technique in multi-criteria decision making for prioritization. The electric (charged) particle method is one of the newest systems designed for decision-making with multiple criteria, because this technique provides the possibility of formulating the problem in a hierarchical manner and also has the possibility of considering different quantitative and qualitative criteria in the problem. This process involved different options in decision-making and has the possibility of sensitivity analysis on criteria and sub-criteria. In addition, it is based on coefficients that facilitate judgment and calculations. It also shows the degree of consistency and inconsistency of the decision, which is one of the advantages of this technique in multi-criteria decision making. In addition, it has a strong theoretical basis and is based on obvious principles.

The method of the electric particle system can be described in 8 steps:

Assume the number N_p of charged particles and determine their initial position in the search space.

Determine the merit of each particle among other particles. This operation is possible by determining the value of the objective function for each particle and then sorting them according to merit. Save N_cm particle in CM memory for future use

Calculate the charge of each particle using the following equation:

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

q_i=(fit (i)-fitworst)/(fitbest-fitworst) ,i=1,2,…,N_(p)

that fitbest and fitworst represent the highest and lowest value of the fitness function among all electric particles and fit (i) represents the fitness of the ith particle. The merit function is defined as the inverse of the objective function.

Determine the resultant of the forces acting on each particle. The forces acting on the jth particle can be expressed by the following relationship [22]:

F_j=q_j ∑_(i,i≠j)▒〖p_ij (x_i-x_j)(q_i/r^3 d_ij.i_1+q_i/(d_ij^2) 〖.i〗_2) 〗 ; j=1,2,…,N_p (2)

d_ij, which represents the distance between particles, is defined by the following relationship:

d_ij=‖X_i-X_j ‖/(‖〖(X〗_i+X_j)/2-X_best ‖+ε) (3)

In the last two relations, X_i and X_j are the position vector of i and j and X_best is the position vector of the best available particle and ε is a small positive number. r is the charge radius of each particle, which can be defined according to the dimensions of the problem and is usually assumed equal to one. With the help of the coefficients i_1 and i_2, the appropriate relationship to determine the force is determined according to the position of the particles and their radius:

i_1=1 ,i_2=0 ⇔ d_ij<r (4)

i_1=0 ,i_2=1 ⇔ d_ij≥r

The probability of a particle moving towards other particles is determined by p_ij:

p_ij=1 ⇔ (fit (i)-fitbest)/(fit(j)-fit(i))>rand ⋁fit (j)>fit(i) (5)

p_ij=0 other wise

The position of each new particle is determined by the following relation [23]:

X_(j,new)=〖rand〗_j1.k_a.F_j/m_j .Δt^2+〖rand〗_j2.k_v.V_(j,old).Δt+X_(j,old)6()

where Vj,old is the speed of the jth particle, which is initially assumed to be zero; $randj1$ and $randj2$

two random values between zero and one; Δt is the time interval of movement, which is usually assumed equal to one; ka and kv are the acceleration and velocity coefficients and mj is the mass of the jth particle, which is assumed to be equal to the charge of that particle qj.

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

Speed and acceleration coefficients are used in this method to control exploration and exploitation, and a discrete optimization problem, the following coefficients will work to reach the optimal solution:

$$k_v=2;\ k_a=0.5\ (1+iter/itermax\ ) \quad (7)$$

7. If, after the fifth step, a particle leaves the defined space of the problem, correct its position using a process based on harmony search. As another method, the particle can be returned to its previous position or use the method presented in this article.

8. Save the best answers in the load memory and remove the inappropriate answers from the memory.

9. Repeat steps 2 to 7 until one of the criteria for ending the repetition is fulfilled. The termination criterion can be one of the following:

- The predefined maximum number of iterations has been reached.

- The predefined maximum number of iterations has been reached without updating the load memory.

5. Collecting the required data

In this thesis, after collecting the data related to the population of the target cities, the variables related to the location of the target cities, including the distance to the provincial capital, the deprivation of the region and special situations, and the variables related to the hospital facilities, including the number of available university beds, the number of non-university beds. Available, the number of university beds predicted for 1404 and the number of non-university beds predicted for 1404 are discussed to build a reliable and close logical relationship between the priority of hospital projects and the population and location of target cities and indicators related to hospital facilities. Information about the location and hospital facilities of 432 target cities is given in the following table:

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
1	Ardabil	625,350	-	-	1,185	452	1,875	625
2	Pars-abad	183,274	72	-	181	58	286	183

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
3	Mashgin-shahr	154,731	95	-	202	-	278	155
4	Khalkhaal	89,502	111	-	173	-	147	90
5	Germi	793,580	112	1	131	-	97	79
6	Namin	62,597	28	-	47	-	63	63
7	Bile-sovar	53,046	164	1	66	-	53	53
8	Kausar	22,834	50	-	38	-	58	23
9	Nir	21,530	38	-	-	-	22	-
10	Sareen	18,328	30	-	-	-	19	19
11	Esfahan	2,431,724	-	-	3,319	5,192	5,291	5,168
12	Kashan	528,535	-	-	945	248	1,501	529
13	Khomeini shahr	346,577	15	-	116	-	520	347
14	Najaf Abad	346,011	32	-	489	278	519	440
15	Lanjan	284,991	50	-	161	148	285	285
16	Flowerjan	270,793	23	-	264	-	406	271
17	Shahinshah-meymeh	254,374	27	-	193	-	254	254
18	Shahreza	173,216	83	-	232	-	260	173
19	Mobarake	163,075	66	-	142	-	163	163
20	Borkhar	132,700	102	-	90	-	133	133
21	Aran-va -bidgol	121,137	-	-	140	-	121	121
22	Golpayegan	97,651	175	-	98	-	146	98
23	Samirom	80,333	164	-	93	-	80	80
24	Tyrannva kron	77,586	56	-	34	-	78	78
25	Faridan	54,080		-	87	-	113	54
26	Natanz	47,670	131	-	62	-	80	-
27	Ardestan	45,641	124	-	99	-	64	-
28	Nain	42,558	144	-	68	-	69	-

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
29	Fereydounshahr	38,648	181	1	59	-	39	-
30	Dahagan	37,409	105	-	34	-	37	-
31	Khansar	35,824	161	-	81	-	36	-
32	Chadgan	35,207	120	-	45	-	35	-
33	Boin-va-miandesht	26,192	170	-	20	-	26	-
34	Khur-va-biabank	21,420	386	-	21	-	21	-
35	Karaj	1,733,491	-	-	2,028	-	3,556	2,553
36	Fardis	596,255	17	-	-	-	596	596
37	Savoj-blag	319,013	50	-	143	-	319	319
38	Nazarabad	187,056	40	-	101	-	187	187
39	Eshtehard	46,478	66	-	47	-	46	-
40	Taleghan	202,634	96	-	10	-	21	-
41	Ilam	252,626	-	-	558	167	549	799
42	Dehlorn	70,509	207	1	88	-	71	71
43	Chardavol	61,647	80	1	79	-	62	62
44	Ivan	53,171	37	1	72	-	53	53
45	Abadanan	51,409	167	1	75	-	51	51
46	Dareh Shahr	46,958	127	1	80	-	54	-
47	Mehran	32,012	84	1	79	-	50	-
48	Malekshahi	22,710	80	1	-	-	23	-
49	Badreh	16,775	85	1	-	-	17	-
50	Sirvan	15,475	90	1	-	-	17	-
51	Tabriz	1,925,360	-	-	3,341	2,036	6,888	2,400
52	Maragheh	285,165	138	-	357	-	845	285
53	Marand	266,017	70	-	193	-	399	266
54	Mianeh	198,557	164	-	81	-	298	199

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
55	Osku	171,868	35	-	87	-	172	172
56	Ahar	167,806	107	-	207	-	252	168
57	Shabestar	147,055	68	-	115	-	147	147
58	Bonab	146,481	121	-	226	-	220	146
59	Sarab	136,109	131	-	213	-	136	136
60	Malekan	120,883	144	-	100	-	121	121
61	Azarshahr	119,788	58	-	94	-	160	120
62	Bostanabad	102,911	60	-	99	-	103	103
63	Ajabshir	76,939	98	-	66	-	104	77
64	Herris	75,029	88	-	40	-	75	75
65	Jolfa	66,639	135	-	92	-	67	67
66	Hashtroud	62,113	120	-	139	-	84	62
67	Varzghan	57,173	88	1	50	-	65	57
68	Caleyber	50,088	170	1	66	-	89	50
69	Khoda-farin	35,830	174	-	-	-	36	36
70	Char-oymagh	33,740	40	1	49	-	66	34
71	Orumieh	1,155,407	-	-	1,663	883	2,289	1,415
72	Khoy	388,144	-	-			831	387
73	Mian-do-ab	304,183	163	-	168	-	460	304
74	Bukan	279,156	185	1	335	-	453	279
75	Mahabad	262,989	120	-	327	-	557	263
76	Salmas	218,238	91	-	218	-	338	218
77	Piranshahr	154,190	121	1	128	-	162	154
78	Naghadeh	141,761	87	-	156	-	286	142
79	Sardasht	131,966	213	1	172	-	835	132
80	Maku	105,208	285	-	190	-	220	105
81	Shahin-dezh	102,660	222	1	125	-	150	103

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
82	Takab	89,447	303	1	121	-	158	89
83	Oshnavieh	82,040	72	1	85	-	123	82
84	shout	61,827	262	1	53	-	62	62
85	Chay-pareh	52,511	-	1	70	-	92	53
86	Chaldran	50,033	223	1	61	-	86	50
87	Poldasht	46,824	256	1	128	-	64	47
88	Bushehr	447,613	-	-	425	438	671	596
89	Dashtestan	114,988		-	287	48	115	115
90	Kangan	161,601	202	1	190	35	242	162
91	Ganaveh	153,630	131	1	164	-	230	154
92	Dashti	129,398		-	107	-	129	129
93	Tangestan	114,988	143	1	61	-	115	115
94	Asaluyeh	110,868	278	-	-	-	111	111
95	Jam	105,011	265	1	-	75	105	105
96	Dayyer	90,862	202	1	50	-	91	91
97	Deylam	52,210	200	1	71	-	52	52
98	Tehran	10,186,969	-	-	14,420	17,669	29,319	28,861
99	Shahriar	867,666	36	-	196	382	868	868
100	Islamshahr	639,630	25	-		304	640	640
101	Baharestan	625,300	20	-		-	625	625
102	Malaard	439,881	43	-		-	440	440
103	Pakdasht	409,187	42	-	195	-	409	409
104	Rey		10	-		75		
105	Ghods	369,162	28	-		57	369	369
106	Robat-Karim	339,875	41	-	171	-	340	340
107	Varamin	330,812	53	-	164	230	496	331
108	Qrachak	313,785	40	-	90	-	314	314

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
109	Pardis	997,105	41	-		79	197	197
110	Damavand	146,296	71	-	98	-	262	146
111	Pishva	100,967	62	-		-	101	101
112	Shemiranat	55,122	-	-		-	100	55
113	Firuzkoh	39,125	141	-	48	-	71	39
114	Shahr e Kord	346,267	-	-	922	181	1,067	346
115	Lordeghan	229,779	164	-	8	-	345	230
116	Brojen	134,223	63	-	246	-	209	134
117	Farsan	104,413	35	-	113	-	234	104
118	Kiyar	55,862	35	-	52	-	56	56
119	Ardal	53,938	74	1	58	-	54	54
120	Kohrang	45,516	89	1	22	-	46	-
121	Saman	37,934	25	-	-	-	38	-
122	Ben	31,041	15	-	-	-	31	-
123	Birjand	285,297	-	-	1,027	270	1,075	699
124	Ghaenaat	126,839	108	-	182	-	252	127
125	Tabas	79,279	272	-	160	-	227	79
126	Darmiaan	58,642	200	1	47	-	59	59
127	Nebandan	56,169	192	1	52	-	56	56
128	Ferdows	49,699	199	1	137	-	300	50
129	Sarbish	44,716	67	-	45	-	48	-
130	Zirkooh	43,839	50	-	32	-	96	-
131	Sayrayaan	36,368	162	1		-	69	-
132	Khosef	30,132	36	-		-	32	-
133	Boshrouyeh	28,455	291	1		-	77	-
134	Mashhad	3,832,396	-	-	5,014	2,947	8,027	6,632
135	Neyshabour	513,363	-	-	522	63	981	513

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
136	Sabzevar	348,064	-	-	790	-	1,050	348
137	Torbat-Jaam	304,158	-	1	312	58	456	304
138	Torbat-Heydarieh	255,245	-	-	240	143	484	255
139	Gouchan	198,281	132	-	237	-	297	198
140	Kashmar	191,652	237	-	179	-	287	192
141	Chenaran	176,143	54	-	91	-	176	176
142	Khaaf	157,916	276	1	148	-	158	158
143	Taybad	133,589	239	1	151	-	134	134
144	Faremaan	112,496	87	-	142	-	203	112
145	Sarakhs	110,812	202	1	108	-	111	111
146	Gonabad	100,851	-	-	275	-	348	101
147	Bardescan	85,940	280	-	144	-	107	86
148	Dar-agz	82,218	264	1	148	-	103	82
149	Binalood	79,133	75	-		-	79	79
150	Zaveh	76,923	100	1		-	77	77
151	Rashtkhar	68,962	9	-	27	-	69	69
152	Bakhrezr	62,060	219	-		-	62	62
153	Jovein	61,915		1		-	62	62
154	Khalil-abad	58,748	255	-		-	72	59
155	Mahwalat	58,417		-	31	-	58	58
156	Jogataai	55,878	92	1	55	-	56	56
157	Firuzeh	42,656	22	-	5	-	43	43
158	Khoushab	42,249	314	-		-	42	-
159	Kalaat	41,177	155	1	41	-	41	-
160	Bajstan	35,461	51	-	40	-	40	-
161	Davarzan	24,898	20	-		-	25	-
162	Bojnourd	320,898	-	-	1,452	178	964	321

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
163	Shirvan	144,700	62	-	286	-	307	145
164	Aspharayen	119,325	-	-	173	-	233	119
165	Maneh-va-Samalghan	100,724	80	1	53	-	117	101
166	Raz-va-jarglan	58,626	108	-		-	65	59
167	Farouj	48,780	96	-	44	-	49	49
168	Jaajarm	36,312	160	1	58	-	58	20
169	Gharmeh	25,224	152	1		-	25	25
170	Ahvaz	1,386,990	-	-	2,622	2,016	4,224	2,588
171	Dezful	472,737	-	-	558	174	1,126	473
172	Abadan	317,404	-	-	411	250	492	515
173	Bandar Mahshahr	315,467	111	-	202	173	473	315
174	Shoush	219,049	34	-	200	-	219	219
175	Izeh		178	1	176	-		
176	Shushtar	241,977	-	-	296	42	404	242
177	Behbahan	192,294	-	-	278	114	458	192
178	Andimeshk	182,518	157	-	179	-	274	183
179	Khorramshahr	182,054	-	1	264	-	440	182
180	Shadegan	147,453	82	1	191	-	222	147
181	Ramhormez	121,148	220	-	191	-	145	24
182	Masjed-soleyman	120,768	147	1	217	66	385	121
183	Dasht-azadegan	114,986	200	1	216	-	172	115
184	Caroon	112,731	10	-	344	-	310	113
185	Bagh Malek	112,212	140	1	126	-	251	112
186	Bowie	102,735	150	-		-	103	103
187	Omidiyeh	98,318	127	1	89	83	98	98

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
188	Gotvand	69,710	118	1	48	-	70	70
189	Ramshir	57,503	101	1	46	-	58	58
190	Hamidiyah	57,245	97	-		-	57	-
191	Andika	50,715	60	1		-	51	-
192	Hoveyzeh	41,406	88	1		-	41	-
193	Handijan	41,274	193	1	26	-	41	-
194	Laali	40,423	869	1	45	-	40	-
195	Haftakal	23,552	97	1		-	23	-
196	Aghajaari	18,798	142	-	58	-	25	-
197	Zanjan	560,060	-	-	1,183	331	1,652	560
198	Khdabandeh	176,723	60	-	162	-	379	177
199	Abhar	162,794	101	-	296	94	244	163
200	Khormadreh	73,003	93	-	134	-	128	73
201	Taarom	50,109	100	1	39	-	50	50
202	Maah-neshan	42,356	107	1	41	-	42	-
203	Ijroud	39,365	80	1	16	-	39	-
204	Soltanieh	31,672	45	-	-	-	32	-
205	Shahrood	264,993	-	-	781	123	787	265
206	Semnan	238,197	-	-	430	239	564	238
207	Damghan	114,165	114	-	202	-	304	117
208	Garmsar	93,840	116	-	144	-	184	94
209	Mehdishahr	57,543	16	-	59	-	130	58
210	Miami	46,929	64	-	30	-	47	-
211	Sorkheh	18,815	23	-	-	-	19	-
212	Aradan	16,828	100	-	24	-	17	-
213	Zahedan	789,732	-	-	1,189	328	2,014	790
214	Chabahar	327,834	331	1	271	-	492	328

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
215	Iranshahr	294,294	-	1	509	-	449	294
216	Saravan	225,042	333	1	242	-	265	225
217	Rask	221,771	489	-	75	-	222	222
218	Khash	204,095	180	1	181	-	306	204
219	Zabul	194,520	-	1	566	30	782	195
220	Nikshahr	205,340	191	1	145	-	308	205
221	Konarak	115,317	308	1		-	115	115
222	Bampur	38,312	24				69	69
223	Sib-va-suran	99,916	330	1		-	100	100
224	Zahak	87,940	218	1	112	-	114	88
225	Mehrestan	82,872	331	-		-	83	83
226	Delgan	79,675	606	1		-	80	80
227	Hirmand	75,122	580	1	60	-	75	75
228	Qasrqand	71,713	507	-		-	72	72
229	Fanoj	57,723	507	-		-	58	58
230	Nimrooz	56,913		-		-	57	57
231	Mirjaveh	53,257	84	-	9	-	53	53
232	Hamoon	48,161	203	-		-	48	48
233	Shiraz	2,011,998	-	-	4,109	2,509	6,499	4,493
234	Marvdasht	354,296	49	-	319	-	531	354
235	Cazeroon	291,619	131	-	312	-	437	292
236	Jahram	249,942	-	-	534	-	697	250
237	Larestan	240,525	-	-	371	-	362	241
238	Fasaa	224,410	-	-	504	-	627	224
239	Darab	220,715	257	-	273	-	253	221
240	Firozabad	133,002	114	-	174	-	20	833
241	Mamasani	128,741	60	-	199	-	141	129

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
242	Neyriz	124,101	220	-	150	-	186	124
243	Abadah	110,452	273	-	202	-	174	110
244	Eghlid	12,710	209	-	153	-	103	103
245	Laamerd	100,540	423	-	175	-	151	101
246	Sepidan	99,737	81	-	145	-	100	100
247	Qovar	91,887	53	-	-	-	92	92
248	Zarrindasht	80,184	80	1	68	-	80	80
249	Gir-va- karzin	77,997	186	1	54	-	78	78
250	Estahban	75,420	180	-	129	-	101	75
251	Mehr	71,013	330	1	46	-	71	71
252	Kharameh	60,099	85	-	68	-	60	60
253	Gerash	58,957	-	-	193	-	274	59
254	Khoram-bid	55,343	188	-	80	-	60	55
255	Bowanat	55,229	231	-	52	-	55	55
256	Farrashband	49,797	178	1	59	-	50	50
257	Rostam	48,621		-	-	-	64	-
258	Arsanjan	46,802	145	-	47	-	47	-
259	khonj	46,503	107	1	67	-	47	-
260	Sarvestan	41,751	87	-	45	-	42	-
261	Pasargad	32,992	133	-	85	-	33	-
262	Beyrom	15,440	132		-	-	15	-
263	Evaz	45,797	42		-	-	46	-
264	Qazvin	658,696	-	-	1,345	656	1,665	659
265	Alborz	267,994	145	-	-	82	268	268
266	Takestan	190,499	38	-	129	140	190	190
267	Boin Zahra	135,720	62	-	79	-	136	136
268	Ab-yek	104,318	58	-	38	70	104	104

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
269	Aavaj	48,330	119	-	-	-	48	-
270	Qom	1,585,762	-	-	1,716	693	2,379	1,586
271	Sanandaj	598,459	-	-	1,394	249	1,137	568
272	Sqqez	259,736	191	1	260	67	385	257
273	Marivan	221,377	132	1	300	-	221	221
274	Baneh	179,913	249	1	107	-	180	180
275	Qarveh	158,941	92	-		-	159	159
276	Kamyaran	116,612	72	-		-	117	117
277	Bijar	101,086	143	1	157	-	116	101
278	Divan-darreh	90,744	97	1	100	-	91	91
279	Dehglan	72,576	54	1	42	-	73	73
280	Sarovabad	50,950	98	1	44	-	51	51
281	Kerman	837,190	-	-	3,284	1,074	2,067	1,854
282	Sirjan	347,482	-	-	257	193	521	347
283	Rafsanjan	428,297	-	-	659		652	428
284	jiroft	373,171	-	-	426	75	615	373
285	bam	270,741	-	-	308	83	443	271
286	Zarand	156,545	86	-		191	235	157
287	Roudbar-jonub	120,120	317	1	100	-	120	120
288	Shahrbabak	114,603	242	-	109	-	115	115
289	Kahnouj	115,592	97	1	190	-	306	116
290	Reagan	86,567	30	1	57	-	87	87
291	Baft	95,313	156	-		-	143	95
292	Anbarabad	93,426	260	1	-	-	100	93
293	Bradsir	92,911	69	-	91	-	93	93
294	Qale-ganj	86,691	167	1	61	-	87	87
295	Fahroj	87,561	60	1		-	88	88

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
296	Manojan	74,463	397	1	86	-	74	74
297	Narmashir	75,258	40	-	35	-	75	75
298	ravar	48,956	132	-	63	-	49	-
299	Arzouyeh	43,643		-		-	44	-
300	Anar	21,789	95	-	51	-	22	-
301	Rabor	40,075	172	-		-	40	-
302	Faryab	38,532	326	-		-	39	-
303	Juhbanan	24,031	177	1	46	-	24	-
304	Kermanshah	1,139,663	-	-	1,994	797	1,855	1,140
305	Islamabad Gharb	148,132	65	-	168	-	233	148
306	Sarpol -e-Zahab	89,739	143	1	84	-	135	90
307	Sanqar	85,867	65	-	136	-	86	22
308	Harsin	82,386	55	-	100	-	82	82
309	Kangaravar	80,142	96	-	88	-	80	80
310	Javanrud	79,041	93	1	120	-	119	79
311	Sahneh	74,402	64	-	77	-	112	74
312	Paveh	63,544	125	1	84	-	64	64
313	Gilane-garb	59,944	145	1	52	-	60	60
314	Ravansar	50,112	69	1	-	-	50	50
315	Daalaahou	37,840	30	1	-	-	38	-
316	Salaas- Babajani	37,033	160	1	-	-	37	-
317	Qasr-e-shirin	25,162	175	1	42	-	25	-
318	Boyer Ahmad	245,938	-	-	522	133	683	346
319	Kohkiloyeh	125,522	130	1	247	-	227	152
320	Gach-saran	143,153	122	-	140	84	312	143
321	Dena	49,072	130	1	-	-	64	-

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
322	Bahmei	43,992	140	1	-	-	44	-
323	Charaam	38,694	180	1	-	-	39	-
324	Lendeh	25,162	233	1	-	-	25	-
325	Baasht	25,021	113	1	-	-	25	-
326	Gorgan	526,154	-	-	1,148	428	1,942	526
327	Gonbad-e kavous	381,449	95	-	598	334	850	381
328	Aliabad	153,566	42	-	152	-	154	154
329	Agh-ghalaa	145,462	42	-	143	-	154	145
330	Kalale	128,408	124	1	194	-	193	128
331	Azadshahr	105,796	77	-	65	-	106	106
332	Ramiyan	93,464	79	-	38	-	94	94
333	Turkmen	87,689	42	-	156	-	243	88
334	Minoo-dasht	83,139	101	-	146	-	160	83
335	Kurdkouy	77,587	31	-	216	-	161	78
336	Gomishan	75,905	63	1	-	-	76	76
337	Galikesh	69,236	110	-	-	-	91	69
338	Marave Tappeh	66,723	215	1	-	-	91	67
339	Bandar-e-gaz	53,489	48	-	122	-	160	53
340	Rasht	991,978	-	-	1,135	1,198	2,268	1,650
341	Talesh	207,989	103	-	156	66	312	208
342	Lahijan	173,673	42	-	212	85	261	174
343	Roudsar	152,791	70	-	162	-	153	153
344	Langroud	145,832	57	-	161	-	146	146
345	Bandar Anzali	144,101	40	-	166	-	216	144
346	Someh -saraa	129,649	29	-	135	-	130	130
347	Astana Ashrafieh	112,089	34	-	116	-	112	112

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
348	Roud-bar	98,185	64	-	149	-	201	98
349	Fuoman	95,687	29	-	89	-	96	96
350	Astara	94,595	176	-	143	-	123	95
351	Rezvanshahr	72,421	69	-	7	-	72	72
352	shaft	56,210	28	-	29	-	56	56
353	Masal	54,575	53	-	54	-	55	55
354	Siahkal	48,693	45	-	29	-	49	-
355	amlash	44,806	74	-	23	-	45	-
356	Khorramabad	539,287	-	-	2,302	576	1,664	539
357	Borujerd	347,604	106	-	422	48	521	348
358	Doroud	44,462	100	-	188	56	44	-
359	Kuhdasht	177,456	96	-	236	-	396	177
360	Delfan	78,522	80	1	134	-	79	79
361	Aligudarz	146,445	149	-	253	-	220	146
362	Selsele	80,455	308	-	67	-	80	80
363	Azna	79,791	127	-	87	-	80	80
364	Poldakhter	78,522	116	-	81	-	79	79
365	Doreh	44,462	60	-	84	-	44	-
366	Roumeshkan	41,589	110	-	-	-	42	-
367	Babol	597,502	-	-	1,244	185	1,476	598
368	Saari	628,303	-	-	1,222	474	942	628
369	Amol	541,150	72	-	665	137	677	451
370	Ghaemshahr	369,096	22	-	310	294	554	369
371	Behshar	189,574	49	-	301	104	458	190
372	Tonenkabon	186,611	225	-	247	62	450	187
373	Nowshahr	157,251	163	-	106	-	236	157
374	Babolsar	152,099	59	-	29	38	152	152

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
375	Nour	136,512	114	-	153	-	164	137
376	Neka	134,243	26	-	96	54	134	134
377	Chalus	132,708	170	-	227	101	199	133
378	Mahmud-abad	110,538	91	-	91	-	111	111
379	Jouybar	87,139	23	-	95	-	87	87
380	Ramsar	84,137	249	-	257	-	200	84
381	Fereydunkenar	68,247	70	-	172	-	123	68
382	Maan-rood		60	-	-	-		
383	Abbas Abad	59,345	201	-	-	-	59	59
384	Swad-kouh	76,753	100	1	91	-	114	77
385	Galugah	46,366	201	-	52	-	46	-
386	Swadkoh Shomali	27,917	120	-	-	-	28	-
387	Klardasht	28,082	218	-	-	-	28	-
388	Simorgh	21,782	120	-	-	-	22	-
389	Arak	602,493	-	-	1,116	520	1,327	602
390	Saveh	322,982	-	-	264	222	484	323
391	Shazand	119,704	37	-	-	81	120	120
392	Khomein	106,923	-	-	160	-	243	107
393	Zarandiya	72,797	100	-	73	-	104	73
394	Mahallat	56,346	118	-	87	-	56	56
395	Khandab	54,998	86	-	26	-	55	55
396	Delijan	52,558	149	-	85	-	60	53
397	Komijan	37,102	102	1	36	-	37	-
398	Farahan	29,520	100	-	30	-	30	-
399	Tafresh	25,365	91	-	82	-	25	-
400	Ashtian	16,654	91	-	45	751	17	-

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
401	Bandar Abbas	864,879	-	-	827	-	1,746	1,000
402	Minab	318,091	102	-	328	-	477	318
403	Bandar-e-Lengeh	195,549	327	-	186	-	293	196
404	Qeshm	182,830	153	-	179	-	183	183
405	Roodan	152,801	160	-	181	-	153	153
406	Bastak	98,772	236	1	108	-	99	99
407	Hajiabad	85,437	167	1	84	-	85	85
408	Jask	72,257	328	1	76	-	72	72
409	Khamir	68,899	99	1	72	-	69	69
410	Parsian	62,086	428	1	139	-	150	62
411	Sirik	56,107	182	1	35	-	56	56
412	Beshagard	43,053	261	1	31	-	43	-
413	Abu Musa	9,083	341	1	20	-	17	-
414	Hamedan	664,022	-	-	1,637	401	1,599	664
415	Malayer	283,530	86	-	319	172	425	284
416	Nahaavand	175,594	109	-	464	-	246	176
417	Kabudar-agang	123,811	59	1	99	-	124	124
418	Bahar	116,956	18	-	30	-	117	117
419	Razan	105,666	87	1	147	-	151	106
420	Toyserekan	99,851	91	-	145	-	205	100
421	Asadabad	99,098	54	-	162	-	250	99
422	Famenin	38,656	64	-	44	-	52	-
423	Yazd	719,398	-	-	1,167	-	1,079	719
424	Meybod	109,933	55	-	214	1,293	162	109
425	Ardakan	107,350	61	-	233	-	187	107
426	Mehriz	56,692	39	-	172	-	148	57
427	Abar-kuh	56,493	149	1	73	-	85	56

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	city option,	population,	distance to the provincial capital, (Km)	deprivation,	number of university beds,	number of non-university beds,	number of university beds, 1404,	number of non-university beds, 1404
428	Bafgh	55,719	119	-	151	-	100	56
429	Taft	48,100	22	-	266	-	225	-
430	Khatam	40,067	50	1	93	-	73	-
431	Ashkzar	35,688	22	-	-	-	150	-
432	Behabad	18,872	206	-	-	-	19	-

6. Determining the priority of hospital projects using the electric particle method

The method of prioritizing charged (electrical) particles is one of the newest methods of prioritization. This technique is based on the concept that the chosen option should have the least distance with the positive ideal solution (the best possible state) and the greatest distance with the negative ideal solution (the worst possible state). In the charged particle method, the chosen option should have the shortest distance from the ideal solution and the farthest distance from the most inefficient solution. The meaning of the index is the characteristics or performance parameters that are relevant for prioritizing items. One of the important advantages of this method is that objective and subjective indicators and criteria can be used at the same time. In this method, quantitative and qualitative criteria are involved in the topic of location, the output of which can determine the priority order of the options and express this priority quantitatively. This method takes into account the contrast and compatibility between indicators, and it is suitable for its simple and fast working method. Also, the results of this model are completely consistent with experimental methods. In this research, the indicators include the population, the location of the target cities and variables related to hospital facilities, including the number of university beds available, the number of non-university beds available, the number of university beds predicted for 1404 and the number of non-university beds predicted for 1404 is.

The load value of each item based on each index is obtained from the following relationship:

$$q_i=(432-i)/431 \quad (9)$$

where i is the rank of each option for each index.

To use the charged particles method in this research, 100 iterations of the algorithm (itermax=100) are used. The acceleration factor (k_a) is equal to 0.5 at the beginning (iter=0)

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

and equal to one for the last iteration (iter=100). The new position of each particle after each iteration of the algorithm is obtained from the following equation:

X_(j,new)=k_a.F_j/q_j +X_(j,old) (10)

The initial position of each particle (item) is considered the distance to the center of the province. The position of the particles is updated until the difference between two consecutive values reaches below one kilometer or the number of repetitions reaches 100. Based on the final position of the particles (items), the distance between the particles is obtained from the following equation:

d_ij=2|X_i-X_j |/(〖(X〗_i+X_j))<r=1 (11)

As a result, i_1=1, i_2=0. Therefore, the force on each particle will also be obtained from the following relationship:

F_j=q_j ∑_(i,i≠j)▒〖d_ij.q_i (x_i-x_j)〗 ; j=1,2,…,432 (12)

Prioritization of cities (options) for the implementation of hospital projects based on the total forces entered per particle (option), for population indicators, deprivation, the number of available academic beds, the number of non-academic beds available, the number of academic beds of the year 1404 and the number of non-academic beds in 1404. Any option with a higher total load has a higher priority for the implementation of hospital projects. According to the population and location of the target cities and hospital facilities, the priority of each city for the implementation of hospital projects is determined according to the following table:

No.	Total Score	Rank	No.	Total Score	Rank	No.	Total Score	Rank
1	23370	254	145	22214	219	289	25284	274
2	30517	54	146	23543	249	290	26996	100
3	23695	198	147	26926	303	291	23229	165
4	29362	20	148	25606	352	292	20904	328
5	27740	209	149	31430	44	293	25342	204
6	25224	317	150	20525	54	294	28435	122
7	18331	427	151	28599	254	295	25793	215
8	23010	224	152	26763	332	296	21198	258
9	22834	28	153	27202	371	297	26597	359
10	23256	280	154	25681	61	298	28257	44
11	25294	145	155	19240	386	299	16717	284
12	24101	261	156	33081	45	300	19734	173
13	18365	316	157	29735	95	301	31354	53
14	30700	43	158	19039	253	302	23333	341
15	27423	130	159	27823	214	303	21833	299

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	Total Score	Rank	No.	Total Score	Rank	No.	Total Score	Rank
16	28916	140	160	29080	307	304	20206	380
17	30180	126	161	19877	363	305	21449	71
18	25359	314	162	17923	374	306	21780	17
19	22858	178	163	24185	341	307	19511	226
20	19459	212	164	23398	319	308	22940	305
21	28193	341	165	25088	367	309	23573	63
22	26944	400	166	21264	378	310	29665	195
23	33783	15	167	30396	87	311	25932	156
24	31086	140	168	27999	83	312	24853	165
25	19810	207	169	18270	318	313	23954	221
26	19577	419	170	27237	29	314	28722	158
27	23797	70	171	30652	314	315	32328	338
28	18158	391	172	29186	415	316	22310	61
29	30428	120	173	30893	293	317	31302	67
30	23207	210	174	17603	257	318	27160	389
31	21403	427	175	23711	294	319	27274	148
32	17790	34	176	29057	347	320	31187	101
33	22230	36	177	33042	26	321	31408	90
34	24672	165	178	26871	87	322	33649	34
35	27134	26	179	21566	344	323	24938	171
36	20375	322	180	28553	145	324	27986	185
37	29171	21	181	24608	59	325	33779	42
38	19799	330	182	28751	182	326	14774	432
39	23401	75	183	29863	404	327	24587	52
40	25441	310	184	18054	165	328	27021	208
41	21395	290	185	25439	149	329	25375	155
42	26882	264	186	18186	112	330	21495	82
43	23478	110	187	28527	80	331	22195	195
44	30338	34	188	27385	264	332	24867	99
45	21349	71	189	25820	421	333	21583	284
46	22263	361	190	25486	159	334	28968	157
47	22603	273	191	24622	115	335	18563	40
48	16894	401	192	17740	349	336	22258	329
49	24109	38	193	30098	70	337	19983	344
50	16666	138	194	25590	346	338	19588	31
51	31069	15	195	21860	205	339	30306	39

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	Total Score	Rank	No.	Total Score	Rank	No.	Total Score	Rank
52	23851	173	196	28392	349	340	29128	363
53	27916	198	197	22853	50	341	30771	275
54	29936	178	198	24519	190	342	24998	426
55	27449	311	199	26765	137	343	25398	212
56	28134	368	200	27006	342	344	25962	83
57	26783	37	201	22946	265	345	18041	345
58	22757	52	202	22234	178	346	25726	263
59	34254	1	203	22754	138	347	27235	278
60	24195	90	204	28317	342	348	24322	343
61	21565	242	205	24350	210	349	22316	295
62	22181	252	206	22407	131	350	28298	376
63	18367	134	207	25946	4	351	20386	370
64	19228	136	208	29974	408	352	24601	312
65	27258	90	209	22608	223	353	17892	354
66	30597	39	210	26787	311	354	28760	198
67	25677	144	211	30766	145	355	21937	259
68	23379	378	212	18908	207	356	25342	229
69	28317	107	213	28099	148	357	15279	429
70	29876	74	214	19808	228	358	23668	345
71	25764	198	215	19444	275	359	25064	377
72	28789	78	216	23939	376	360	28250	354
73	21530	271	217	23804	301	361	24079	319
74	21582	285	218	24874	241	362	27827	293
75	26957	143	219	22242	372	363	25107	416
76	26693	158	220	28683	414	364	21902	30
77	26268	288	221	21249	95	365	22221	243
78	29900	46	222	21106	207	366	15162	21
79	20489	270	223	25910	134	367	22883	293
80	22435	289	224	25649	410	368	20513	288
81	30340	39	225	29879	260	369	29783	99
82	17661	216	226	30172	180	370	24969	287
83	21070	325	227	24684	55	371	24570	341
84	19594	157	228	31159	45	372	27128	338
85	26867	102	229	30956	24	373	27091	396
86	25442	193	230	26675	214	374	27417	258
87	23174	307	231	25883	385	375	22843	183

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	Total Score	Rank	No.	Total Score	Rank	No.	Total Score	Rank
88	25790	421	232	28740	213	376	17572	415
89	23367	109	233	21131	167	377	22737	387
90	28077	324	234	26709	284	378	18957	347
91	19655	128	235	27422	116	379	22155	304
92	26651	392	236	29713	194	380	26442	94
93	26300	327	237	25919	201	381	19138	324
94	22338	222	238	24318	338	382	24647	255
95	26217	2	239	27463	118	383	21509	290
96	23905	333	240	28528	8	384	28638	209
97	22413	421	241	22990	283	385	25667	296
98	23438	77	242	23694	199	386	31352	215
99	25569	377	243	26141	71	387	31036	228
100	24080	358	244	25045	227	388	19159	425
101	30754	320	245	23205	124	389	27701	50
102	28651	297	246	25293	228	390	21693	246
103	25273	35	247	24014	263	391	29539	105
104	26128	9	248	30317	4	392	22153	25
105	21748	311	249	33436	65	393	25737	28
106	22031	306	250	27019	414	394	28802	364
107	27591	47	251	27572	316	395	32672	78
108	24606	127	252	25720	149	396	22294	107
109	32781	50	253	20153	35	397	22645	409
110	26977	138	254	20077	219	398	20714	307
111	22487	398	255	24369	280	399	26388	397
112	17434	182	256	24459	215	400	29797	183
113	23048	355	257	31453	303	401	21277	268
114	20795	130	258	26745	109	402	28646	374
115	33460	106	259	25902	152	403	21161	214
116	26779	14	260	19198	308	404	30030	252
117	25823	350	261	27083	308	405	22564	309
118	30209	253	262	27885	119	406	25438	92
119	23716	144	263	27899	65	407	22550	266
120	26950	337	264	28045	80	408	23710	157
121	31906	42	265	24395	339	409	15933	395
122	22855	195	266	22523	30	410	25867	364
123	27289	79	267	25579	190	411	25022	199

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

No.	Total Score	Rank	No.	Total Score	Rank	No.	Total Score	Rank
124	14951	74	268	17681	180	412	26310	297
125	27896	97	269	28279	215	413	24726	165
126	23585	64	270	30369	264	414	19620	219
127	22179	185	271	22428	127	415	26729	325
128	26976	128	272	30467	37	416	29128	387
129	26472	297	273	19520	89	417	22660	366
130	25193	253	274	25936	354	418	20112	282
131	24786	228	275	24772	398	419	17610	219
132	25819	265	276	31627	366	420	26463	139
133	29431	184	277	20507	275	421	24686	299
134	24495	126	278	27332	75	422	20496	253
135	31723	89	279	24183	76	423	24392	195
136	27460	165	280	26009	244	424	27747	186
137	22377	284	281	19061	222	425	19649	234
138	26523	274	282	25077	314	426	22473	209
139	22371	346	283	16374	393	427	15742	412
140	28703	242	284	27672	98	428	24381	267
141	20853	221	285	26174	101	429	28639	36
142	29499	87	286	22382	192	430	29901	197
143	28429	114	287	25519	347	431	23416	189
144	28962	98	288	22944	373	432	27468	192

7. Conclusion

In the research that was conducted, after collecting information about the population of the target cities, the variables related to the location of the target cities, including the distance to the provincial capital and the deprivation of the region, and the variables related to hospital facilities, including the number of university beds available, the number of non-university beds available, the number of beds University beds predicted for 1404 and the number of non-university beds predicted for 1404 were discussed based on a reliable and close logical relationship between the priority of hospital projects and the population and location of the target cities and indicators related to hospital facilities. The load value of each option is obtained based on each index according to the numerical ranking based on that index. The initial position of each particle (option), the distance to the center of the province, is considered. The position of the particles is updated until the difference between two consecutive values reaches less than a kilometer or the number of repetitions reaches 100. Based on the position of the particles, the distance between them and according to the distance and amount of charge

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

of each particle (option), the force on each particle (for each index separately) was obtained. Prioritization of cities (options) for the implementation of hospital projects based on the total forces entered per particle (option), for population indicators, deprivation, the number of available university beds, the number of non-university beds available, the number of university beds in 1404 And the number of non-university beds in 1404 was done. Any option with a higher total load has a higher priority for the implementation of hospital projects. The results of the research show that the charged particle method is a suitable method for determining the priority of implementing hospital projects. Therefore, by determining the relevant indicators in the implementation of construction projects and the initial numerical ranking of each project based on the planned indicators and determining the position of each option, it is possible to prioritize properly, accurately and documented by the method of the electric particle system. Projects in progress achieved. Among the results obtained, the priority of implementation is that among the above options, the first option for implementation with a total of 34254, the second option with a total of 30317, the third option for implementation priority with a total of 26217 and the fourth option with a total of 25946 in the fourth priority out of 430 The option was considered.

Refrences

[1] Triantaphyllou, E. (2011). "Two new cases of rank reversals when the AHP and some of its additive variants are used that do not occur with the Multiplicative AHP." Journal of Multi-Criteria Decision Analysis 10 (1): 11-25.
[2] Tummala, V. and Y. Wan (2014). "On the Mean Random Inconsistency Index of the Analytic Hierarchy Process (AHP)." Computers & Industrial Engineering 27(1-4): 401-404.
[3] Salo, A. and R. Hamalainen (2011). "On the Measurement of Preference in the Analytic Hierarchy Process." Journal of Multi-Criteria Decision Analysis 6(6): 309-319.
[4] Stam, A. and P. Duarte Silva (2013). "On Multiplicative Priority Rating Methods for AHP." European Journal of Operational Research 145 (1): 92-108.
[5] Ji, P. and R. Jiang (2013). "Scale transitivity in the AHP." Journal of the Operational Research Society 54 (8): 896-905.
[6] Tummala, V. and Y. Wan (2014). "On the Mean Random Inconsistency Index of the Analytic Hierarchy Process (AHP)." Computers & Industrial Engineering 27(1-4): 401-404.
[7] Firouz Jamali, Income Based on Location and Design of Hospitals, Volume 11-Number 2 - (2011-6), Hospital Quarterly
[8] Engineer Mohammad Reza Ardalani + Engineer Hoda Ardalani, 5-volume collection of hospital construction, research and editing
[9] Johnson, C., W. Beine, et al. (2011). "Right-Left Asymmetry in an Eigenvector Ranking Procedure." Journal of Mathematical Psychology 19 (1): 61-64.

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

[10] Jones, D. and S. Mardle (2014). "A Distance-Metric Methodology for the Derivation of Weights from a Pairwise Comparison Matrix." Journal of the Operational Research Society 55 (8): 869-875.
[11] Sayed, T., Abdelwahab, W., Navin, F., 2020. Identifying accident-prone location using fuzzy pattern recognition. J. Transp. Eng. 121, 352-358.
[12] Triantaphyllou, E. (2011). "Two new cases of rank reversals when the AHP and some of its additive variants are used that do not occur with the Multiplicative AHP." Journal of Multi-Criteria Decision Analysis 10(1): 11-25.
[13] Salo, A. and R. Hamalainen (2011). "On the Measurement of Preference in the Analytic Hierarchy Process." Journal of Multi-Criteria Decision Analysis 6(6): 309-319.
[14] Stam, A. and P. Duarte Silva (2013). "On Multiplicative Priority Rating Methods for AHP." European Journal of Operational Research 145(1): 92-108.
[15] Leskinen, P. and J. Kangas (2020). "Rank reversal in multi-criteria decision analysis with statistical modelling of ratio-scale pairwise comparisons." Journal of the Operational Research Society 56(7): 855-861.
[16] Ji, P. and R. Jiang (2013). "Scale transitivity in the AHP." Journal of the Operational Research Society 54(8): 896-905.
[17] Johnson, C., W. Beine, et al. (2011). "Right-Left Asymmetry in an Eigenvector Ranking Procedure." Journal of Mathematical Psychology 19(1): 61-64.
[18] Jones, D. and S. Mardle (2014). "A Distance-Metric Methodology for the Derivation of Weights from a Pairwise Comparison Matrix." Journal of the Operational Research Society 55(8): 869-875.
[19] Persaud, B., Lyon, C., Nguyen, T., 2019. Empirical Bayes procedure for ranking sites for safety investigation by potential for safety improvement. Transp.Res. Rec. 1665, 7–12 .
[20] Triantaphyllou, E. (2011). "Two new cases of rank reversals when the TOPSIS and some of its additive variants are used that do not occur with the Multiplicative TOPSIS." Journal of Multi-Criteria Decision Analysis 10(1): 11-25 .
[21] Tummala, V. and Y. Wan (2014). "On the Mean Random Inconsistency Index of the Analytic Hierarchy Process (AHP)." Computers & Industrial Engineering 27(1-4): 401-404 .
[22] Salo, A. and R. Hamalainen (2011). "On the Measurement of Preference in the Analytic Hierarchy Process." Journal of Multi-Criteria Decision Analysis 6(6): 309-319 .
[23] Stam, A. and P. Duarte Silva (2013). "On Multiplicative Priority Rating Methods for TOPSIS." European Journal of Operational Research 145(1): 92-108.