Intelligent Automation And Soft Computing, 2020
Vol.26,no.4,741–748
DOI: 10.32604/iasc.2020.010108

Research on Maximum Return Evaluation of Human Resource Allocation Based on Multi-Objective Optimization

Hong Zhu[1,2]

1. Xi'an Jiaotong University,Shaanxi,710049,China
2. Shaanxi XueQian Normal University,Shaanxi,710100,China
Mailing address: No. 28, Xianning West Road, Xi 'An City, Shaanxi Province

ABSTRACT
In this paper, a human resource allocation method based on the multi-objective hybrid genetic algorithm is proposed, which uses the multi-stage decision model to resolve the problem. A task decision is the result of an interaction under a set of conditions. There are some available decisions in each stage, and it is easy to calculate their immediate effects. In order to give a set of optimal solutions with limited submissions, a multi-objective hybrid genetic algorithm is proposed to solve the combinatorial optimization problems, i.e. using the multi-objective hybrid genetic algorithm to find feasible solutions at all stages and the bilateral matching of the scientific research projects and participants. First, the mathematical description of the bilateral matching problem supporting members grouping is given. On this basis, a bilateral matching multi-objective decision-making model is established with the objective of optimizing three actual indexes of reasonable grouping. According to the characteristics of the model, a multi-objective genetic algorithm-based solution method is designed. Based on the matching model, a human resource management system based on a browser/server architecture is designed to improve the practicability. Finally, an example is given to demonstrate the effectiveness and feasibility of the model.

KEY WORDS: Human resource allocation, Hybrid genetic algorithm, Multi-objective optimization, Multi-stage decision making.

1 INTRODUCTION

RESOURCE allocation problem refers to the process of resource allocation in various projects or business units in order to maximize profits or minimize costs. The main research problem of resource allocation is to find a allocation scheme that can assign limited resources to several tasks under given resource constraints to achieve objective optimization (Sheu, J. P., Chang, G. Y., Wu, S. H., & Chen, Y. T, 2013). People usually use genetic algorithm to solve multi-objective optimization problems, which is called multi-objective evolutionary algorithm or multi-objective genetic optimization. Genetic algorithm has the basic characteristics of multidirectional and global searching, which can maintain the set of potential solutions for a long time(Gong, Z., Zhang, H., Forrest, J., Li, L., &Xu, X. . 2015). Starting from the point set, we can search for the global optimal solution. The essential characteristic of genetic algorithm is that it can operate the set of candidate solutions. By using the relationship between the natural genes in each chromosome, and then using information fusion to calculate the optimal solution of the gene operator, the most practical results are obtained. In the genetic algorithm introduced in this paper, the intelligent calculation process of the algorithm is used to conduct discontinuous calculation and simulation of the solved target, and then the hybrid genetic algorithm is combined to solve the multi-objective and multi-stage human resources allocation problem (Pridmore, D. et,al.2014).

Although some scientific research projects have received high investment, it is difficult to convert them into practical projects, which has limited effect on promoting productivity. In other words, there is a

CONTACT Hong Zhu :affluent@163.com

contradiction. Although the scientific and technological achievements of scientific research institutions and institutions of higher learning increase annually, the products and technologies of enterprises are on the low side compared with those of other countries (Lukáš Pop, ZbyněkSokol, & Hanslian, D. 2016).

There are many reasons for the above problems, such as university, government and enterprise departments in planning, management, evaluation and other management system factors, or science and technology projects when the neglect of results transformation and market demand, promotion and late tracking (Nagaraj, B., and P. Vijayakumar,2012). However, none of the studies concerned the microcosmic causes. First of all, scientific research teams need to take full account of teamwork and resource matching and optimization. The team has sufficient resources, including human resources, funds, material resources and time, to enhance the implementation of the guarantee (Baskey, H. et,al.2014). Secondly, in the process of project execution, team members share information and learn from each other, and may also produce mutual interference and conflict problems. How heterogeneous team members create open discussion links for knowledge sharing, initiative for self-management, rapid integration into the problem and find solutions, and translate different opinions and ideas into the promotion of team creativity are key issues (Belingardi, G.,& Scattina, A, 2016).

Therefore, the optimized organizational scheme (combination and optimization of resource advantages) and perfect management have an important impact on the final project results or results of the team. Domestic policies specifically state that "effective measures should be explored to stimulate the enthusiasm and vitality of innovative talents, Strengthening the Motivation of Innovative Personnel, and Realizing the Full Utilization and Achievement of Their Talents ". This shows that the importance of team member selection has risen to the height of national innovation(Harahap, R, et. al. 2014).

2 MULTI CRITERIA HUMAN RESOURCE ALLOCATION NETWORK MODEL

2.1 Multi Criteria Human Resource Allocation Network Model Construction

FIRSTLY, the network model is used to replace the multi-criteria human resource allocation model, and the progress of human resources is expressed in a staged way. Therefore, multi-stage decision based hybrid genetic algorithm can be adopted (Huang, P. et, al. 2015). The problem of finding solutions on a possible selection set is optimized by some criteria, and the following points are formally used to represent the multi-objective optimization problem without losing generality (Igel, C. 2007).

Taking a scientific research project as an example, assuming that team members can only participate in one project at most at each stage, the matching between project members and project topics is a one-to-many bilateral matching problem. Early research on bilateral matching focuses on marriage matching, which belongs to one to one bilateral matching. Generally, the solution is based on whether the attributes of the buyer and the seller are satisfied or not, which is translated into the constraint satisfaction problem. In addition, a one to many bilateral matching decision method considering stable matching conditions is also proposed (Rao, R. V., & Patel, V. 2013). However, most of the existing matching algorithms consider finding an optimal matching, that is, there is only one optimization objective. A few studies turn a one-to-many bilateral matching problem into an equivalent one-to-one bilateral matching problem, and then, under stable matching conditions, a multi-objective automatic capture model is constructed (Sindhya, K., Miettinen, K., & Deb, K. 2013). The criterion of objective solution is to minimize the sum of principal values. ShenGuojun applies multi-objective genetic algorithm to the optimization of human resource allocation to minimize the total cost of human resource allocation and maximize the total efficiency of allocation decision-making. There are few researches on one-to-many bilateral matching decision-making, and there is no research on the application of one-to-many matching decision-making to scientific research management (Patel, R. 2013). In order to improve the efficiency of scientific research management, this paper constructs three optimization objectives with intrinsic conflicts to ensure the rationality of grouping based on the grouping of personnel in the process of scientific and technological project management. The goal layer includes project objectives and personal goals, the former is specified in the organizational level as the knowledge needs of scientific research projects that must be achieved in order to achieve the objectives, and the latter as the desire and personal expertise of individuals to participate in projects. Therefore, it is necessary to organically integrate multiple scientific research projects with multiple members through the algorithm to form a project group (Yan, J.,& Li, L. 2013).

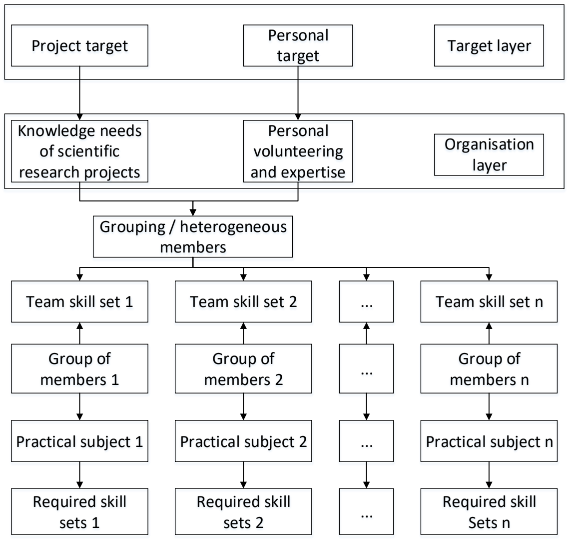

Figure 1. Practice group grouping framework

Teachers in charge of projects publish a number of scientific research projects, corresponding to the various skills required and the number of people required. Members input the mastery of various skills according to their actual situation, such as programming language development ability, imagination, creativity, logical reasoning ability, information search ability, expression ability and so on (Balakrishnan, 2019). On the premise of satisfying the first volunteer, we recommend some members who can not satisfy the first volunteer to form a team with complementary ability and good completion ability. The algorithm continues to run until all members are assigned to a particular topic(Li, X., Wang, D., Li, K., &Gao, Z. 2013).

2.2 Mathematical Expression of Network Model

In this section, we mainly discuss how to construct relevant expressions by mathematical model in the problem of two-standard resource allocation. M employees are allocated to n different projects to maximize profits and minimize costs under resource constraints. The model is represented by the following two-criteria integer programming model (Elhossini, A., Areibi, S., & Dony, R. 2014):

$$\max\ z_1(y) = \sum_{i=1}^{n} f_1(y_i) \tag{1}$$

$$\max\ z_2(y) = \sum_{i=1}^{n} f_2(y_i) \tag{2}$$

$$s.t.\ G_0(y) = \sum_{i=1}^{n} g_i(y_i) \le M,\ y_i = 0,1,\ldots,M\ \forall i \tag{3}$$

According to the above mathematical model, it can be extended to a new mathematical model of multi-objective optimization. In the dual criteria resource allocation problem, n different tasks are assigned to M employees to maximize profits and minimize costs under resource constraints. The double criteria integer programming model is shown as follows (Jingmei Li, et al.2017):

$$\max\ z_1(x) = \sum_{i=1}^{n}\sum_{j=0}^{M} p_{ij}\, x_{ij} \tag{4}$$

$$\max\ z_2(x) = \sum_{i=1}^{n}\sum_{j=0}^{M} C_{ij}\, x_{ij} \tag{5}$$

$$s.t.\ G_0(x) = \sum_{i=1}^{n}\sum_{j=0}^{M} j x_{ij} \le M \tag{6}$$

$$G_i(x) = \sum_{j=0}^{m} x_{ij} = 1, \forall i, x_{ij} = 0 or 1, \forall i, j \tag{7}$$

Parameters and variables in the model:

I represents the local store index (i=1,2,..., N);

J indicates salesperson index (j=1,2,..., M);

N represents the total number of local stores.

M indicates the total number of salesmen.

CIJ indicates the cost of local I when distributing J salesmen;

PIJ indicates the profit of local I when distributing J salesmen.

Decision variable Xij = 1 (if J salesperson is assigned to the district)

Xij = 0 (or vice versa);

The model has p goals, namely F1 (x),..., FP (x), where x Rn is a vector or n decision variable(Xin Li,et al.2017).

2.3 Multi-Objective Genetic Algorithm Solution

The M+2 objective function in the model has different dimensions, and each parameter is closely related, which can be solved by multi-objective genetic algorithm. The algorithm retains the basic framework of the single objective genetic algorithm, in which the characteristics of fast nondominant ordering among individuals are used for calculation(Pan S,et,al.2017).

The population is screened, crossover and mutation operations are performed, and the approximate optimal solution is obtained by iterating several algebras repeatedly (Shivendra Shivani, et al.2017).

Main flow of matching algorithm: the population size is SZ, the algebra is gen, and the optimization process is the following five steps. (a) Random generation of initial population; b) Fast non-dominated population sorting; c) Computing individual crowding degree, using crowding degree comparison operator and selection operator to screen the population, eventually reducing the population size to sz; d) Evolutionary operation on the population to get the offspring population, the offspring population and the parent population merge; Repeat steps B - step D and iterate Gen times(ManishaChahal,et,al.2017).

Individual gene coding: the gene sequence is transformed into a solution matrix in the following way: for an individual's gene A, it contains two sequences Z and C. Sequence Z, an arrangement of 1-N, with Zi representing the participants; Sequence C, such that CJ [alpha j, beta j] and j <Jcj = N; Z from left to right is divided into c1, c2,... The cM segment, that is, assign the corresponding CJ students to the topic TJ, thus we can get the solution matrix X(K Vijayalakshmi, P Anandan. 2020).

Fast non dominated sorting: populations are sorted according to Pareto optimal order, and each individual is divided into a specific non-dominant layer and given priority. The higher the priority of the non-dominant layer, the higher the priority. Call a = (A1, A2,... (an) by B = (B1, B2,... (BN) dominating, if and only if Bi is less than AI, (I = 1, 2,... N, and at least one I makes Bi < AI. Set P'is initially empty, and each time an individual a that is not in P'is selected from the population P, A is compared with other individuals in P's. If any individual B in P'is dominated by a, then the individual B in P'is deleted; if a is dominated by any individual B in P', A is not included in P', otherwise a is placed. Enter P'. Repeat the above steps until | P'|= | P |, when the individuals in P'are ranked in the non-dominant hierarchy, the individuals in the same layer have the same priority, and the more advanced the individuals in the non-dominant hierarchy, the better the solution they represent.

Congestion comparison operator: in order to understand the distribution of other solutions around each solution, the sum of the distance differences between two individuals adjacent to each subobjective function (called crowding degree in this paper) is calculated. Because individuals in the same non-dominant layer have the same priority, in order to compare the advantages and disadvantages between them, the density between individuals in the same non-dominant layer can be calculated. If there are many other individuals near an individual, the value of the individual is relatively small (because it can be replaced by nearby individuals); On the contrary, the value of the individual is relatively large, and the individual is considered to have higher fitness.

Selection operator: the tournament selection method is used to select Stour individuals randomly from the population (Stour is a pre-determined parameter), and then the best individual is selected as the parent according to the crowding comparison operator. Repeat this process until the individual's choice is completed.

Evolution operator: because of the particularity of the problem itself, the genetic crossover operator of individual gene is not suitable. Evolution operator is used instead of mutation operator and crossover operator to ensure the diversity of gene in population. A) randomly generate an integer [0, N] and randomly select the logarithm of P on the sequence Z for interchange; b) randomly generate a decimal number [0, 1], if [mu > _, _] is a given parameter, then randomly generate an integer k * J, and change C K into a random number C k', where c'k [alpha j, beta j] is adjusted. The other CJ makes the new sequence C still satisfy the sigma J =Jcj = N.

3 SOLUTION METHOD BASED ON HYBRID GENETIC ALGORITHM

Human resource allocation problem is a kind of problem that adopts the allocation of various resources for fusion analysis under the condition of determining the objective, and then adopts the mathematical model for optimal allocation to minimize the total cost and maximize the profit. In 1998, Gen and Kim combined local optimization with traditional genetic algorithm, and proposed hybrid genetic algorithm. Local search is local development near chromosomes, while genetic search is global development among populations. Genetic local search can be realized in many ways. Two common forms are lamarckian evolution and bard cloud effect. The former puts the resulting chromosomes back into the population; the latter only changes fitness, but the genotype remains unchanged. Bard-Yun's strategy can sometimes converge to the global optimal solution, while Lamarck's strategy can only converge to the local optimal solution by using the same local search (as shown in Figure 2).

3.1 Initialization Phase

The solution to the above problem is to find an optimal path at the beginning and end, that is, a path with the highest profit and the lowest cost. Therefore, each individual structure represents a path, that is, the sequence representation of a node in a chromosome. The chromosome structure is shown in Figure 3.

In order to design suitable chromosomes by using multi-objective hybrid genetic algorithm, we first consider the optimal allocation path in the following four stages, in which the dotted line represents the optimal allocation path. As shown in Figure 4, a random selection element from 0 to 12 in each phase can be used; the optimal four-phase configuration path can be designed in the following shape.

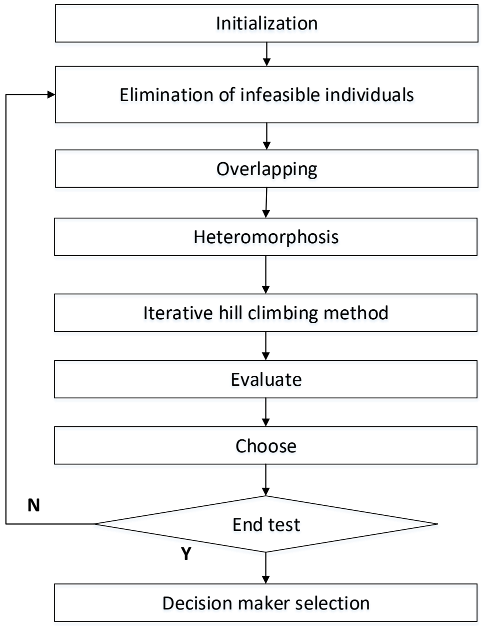

Figure 2. Solution method based on Hybrid Genetic Algorithm

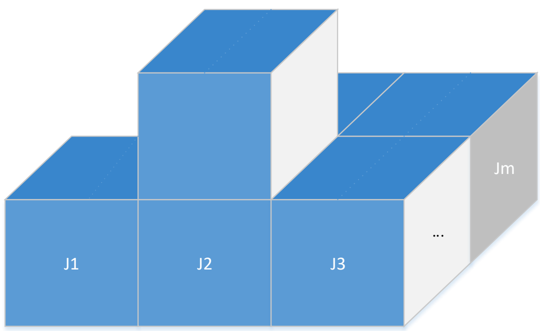

Figure 3. The chromosome structure

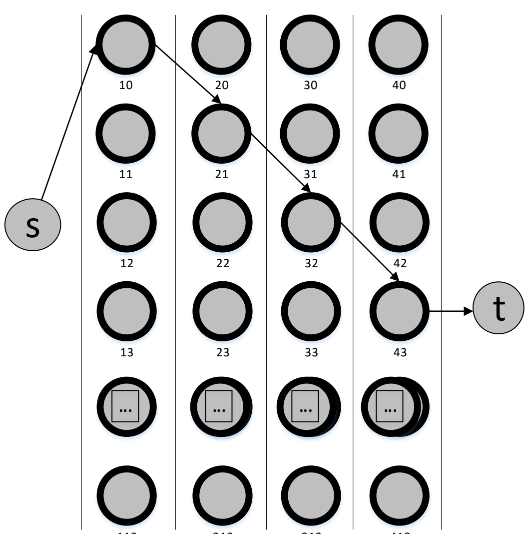

Figure 4. Example of optimal configuration path

Among them, the index (stage) 1 represents path selection 0, indicating that form S will be assigned to the first element in place 1. Index 2 represents path selection 1, indicating that the first element of the form will be assigned to the second element in place 2. The index 3 represents path selection 2, and the second element of the form is assigned to the third element in place 3. Finally, index 4 represents path selection 3, indicating that the third element of the form is assigned to the fourth element in place 4, and also indicating the completion of human resource allocation (as shown in Figure 5).

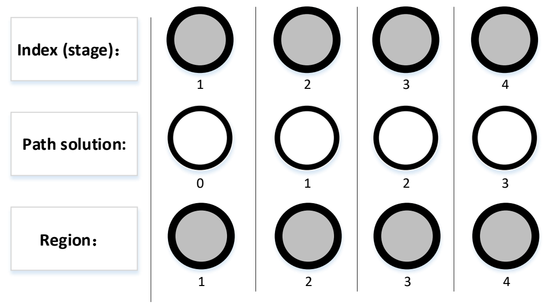

Figure 5. The chromosome structure of the configuration paths in four regions.

3.2 Crossover Operator

In this paper, we propose a unified crossover operator that generates a random mask with independent genes and then exchanges related genes between parent masks. A mask is essentially a continuous binary string. The mask can be passed on to the parent gene and its parity. Obviously, crossover operator can adjust the task partition between machines. The purpose of the crossover is to replace the next population by information exchange between two parental chromosomes.

Two new progeny chromosomes are produced. The example is shown in Figure 6.

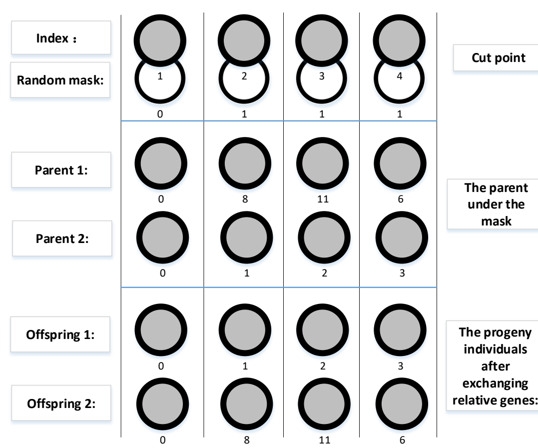

Figure 6. Cross operation

3.3 Mutation Operator

Variation is a random process in which one genotype is replaced by another, in the form of gene renewal. Every gene has a probability of random mutation. In this paper, we use two random permutation operators, and then carry out random mutations on two genes, so that one gene is replaced by a new one, as shown in Figure 7. In Figure 6, assuming a gene is in Phase 2, and the possible states are {1}, {8} and {16} (i.e., selecting a possible state 1 or 8), the mutated gene {8} may be {1} or {16} or still {8}.

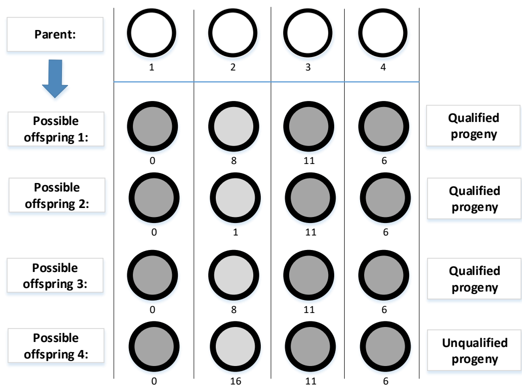

Figure 7. Mutation operation

The interesting thing here is that all the progeny chromosomes produced have the following characteristics: only some of the progeny chromosomes are qualified; the n-stage chromosome length is only n-1, which saves a lot of computational memory.

3.4 Evaluation of Non dominated Solutions

In principle, there are great differences between multi-objective optimization problems and single objective optimization problems. In a single objective situation, the most important position is to strive for the best solution. In the case of multi-objective, because of the incomparability and conflict between the targets, there is not necessarily an optimal solution for all the targets. A solution may be optimal on a certain target while the worst in other goals. Therefore, in the case of multi-objective, there usually exists a set of solutions which cannot be compared with each other simply, and it is possible to improve any objective function only by sacrificing at least one other objective function. If and only if a point in S is in a non dominant position in Z, this point is efficient.

3.5 Selection Operator

The selection (regeneration) operator improves the average population quality by providing better opportunities for the better chromosomes to be copied to the next generation of chromosomes. The essence of genetic algorithm is Darwin's natural selection principle. This selection can guide the genetic algorithm to search better regions in search space. In this study, roulette selection is used as a selection mechanism. In the process of algorithm calculation, individuals in each generation are selected according to the probability value corresponding to the ratio of individual fitness and overall fitness, which means that the next generation usually receives individual copies in proportion to the importance of fitness. Like natural genetic systems, selectors use the idea of survival of the fittest to select chromosomes from paired populations. Then, the best copy of the chromosome was the largest and the worst chromosome was eliminated. According to the following formula, the selection of variables is not random, but proportional to their fitness in the population.

$$P(x_i) = \frac{f(x_i)}{\sum_{j=1}^{n} f(x_j)} \tag{8}$$

Among them, f (Xi) represents the fitness value of the I chromosome and N represents the population size.

4 MULTI CRITERIA HUMAN RESOURCE ALLOCATION CASE CALCULATION

IN order to expand business, two managers and their salesmen from different places can be assigned to four new shops in other places. The average profit and cost of an enterprise in the past four years can be illustrated by an example. For example, at present, the company plans to expand its business to overseas markets. If the company intends to establish subsidiaries in Japan, Australia, Europe, China and other countries and regions, Assuming that no other special factors are taken into account, the firm can achieve maximum profits and minimum costs only in the past four years. How to assign and arrange the salesmen of each group or team is a multi-criteria human resource allocation problem in solving the multi-stage combinatorial optimization problem of salesmen. In other words, the problem is to assign two managers and their salespeople from different places to four new stores elsewhere in order to expand their business overseas. The expected cost is shown in Table 1, and the expected profit is shown in Table 1.

Double standard human resource allocation is the primary problem to solve the multi-stage combination. How to determine the optimal human resource allocation path is the problem to be solved. Aiming at the complexity of dynamic process, the problem of multi-stage and multi-objective network in five stages is considered, including 54 nodes and 533 arcs. Table 3 shows the total number of Pareto solutions for a feasible process.

Table 1. Expected cost and expected efficiency

Region ID	Salesperson			Salesperson		
	1	2	3	4	5	6
1	1.00	1.00	1.00	1.00	1.00	1.00
2	0.86	0.85	0.91	0.81	0.84	0.95
3	2.00	2.00	2.00	1.00	1.00	1.00
4	2.00	2.00	2.00	1.00	1.00	1.00
5	2.00	2.00	2.00	1.00	1.00	1.00

Table 2. Expected cost

Feasible process design	Amount
Grade quantity	5
Number of nodes	54
Arc number	533
Total number of Solutions	34,645

At present, the urgent problem to be solved is how to determine the optimal multi-criteria human resources allocation path according to the current function while considering the minimum cost and maximum profit function. In order to obtain the solution of the problem effectively, this complex network problem can be solved by multi-objective hybrid genetic algorithm. The parameter setting of multi-objective hybrid genetic algorithm is shown in Table 3.

Table 3. Expected efficiency

Parameter	parameter values
Population size	100
The largest generation of population	2000
Cross rate	0.1
Variation rate	0.3
Local search rate	0.3

By setting the parameter operator and running the multi-objective hybrid genetic algorithm, the multi-criteria optimal human resource allocation path can be obtained, and the ideal point with Pareto solution can also be obtained. When solving the multi-stage combinatorial optimization of salesman allocation problem, the optimal solution of corresponding cost, profit and satisfaction can be found. Simulation experiments can be carried out by computer. According to the experimental results. From the experimental results, we can see that the best path of optimal solution can be obtained at cost =217 and profit =440.

5 CONCLUSION

FOR multi stage combinatorial optimization problems, a multi criteria human resource allocation model is proposed. In order to obtain the solution of the problem accurately and effectively, a multi-objective hybrid genetic algorithm is adopted, and an example is given to prove the effectiveness of the method. According to the simulation results, the optimal human resource allocation with multiple criteria can be obtained, such as the multi-criteria human resource allocation with multi-stage combinatorial optimization in the salesman allocation problem solving.

According to the multi-stage combinatorial optimization of human resource allocation in the salesman allocation problem, the second group of human resource allocation is mainly considered: Luke, the manager of New York Branch 11, Alexis, and two salesmen are allocated to the Shanghai Branch; the third group, Car-son, the manager of Las Vegas Branch 4, and Vice-Manager of Las Vegas Branch 4. Manager Isabelle and his nine salespeople were assigned to the Shanghai Branch; group 4: Antonio, manager of Chicago Branch 2, Haley, deputy manager, and his 11 salespeople were assigned to the Shanghai Branch. Due to discrepancies with economic performance, the first group does not need to assign any staff from the Losangeles branch. Therefore, business owners can be the best decision makers, maximizing profits while minimizing costs.

Aiming at the multi-criteria human resource allocation problem of multi-stage combinatorial optimization in the salesman allocation problem, this paper proposes a multi-objective hybrid genetic algorithm and obtains the optimal decision effectively. In addition, in order to prove the good performance of the method, an example is given at last. According to the numerical results, it can be inferred that the Pareto optimal solution can be obtained by considering both the multi-objective optimization model and the multi-stage decision-making.

6 REFERENCES

Balakrishnan, Nagaraj, Arunkumar Rajendran, and Karthigaikumar Palanive l. (2019). "Meticulous fuzzy convolution C means for optimized big data analytics: adaptation towards deep learning." International Journal of Machine Learning and Cybernetics: 1-12.

Baskey, H. B., Akhtar, M. J., & Shami, T. C. (2014). Investigation and performance evaluation of carbon black- and carbon fibers-based wideband dielectric absorbers for x-band stealth applications. Journal of Electromagnetic Waves & Applications, 28(14), 1703-1715.

Belingardi, G., & Scattina, A. (2016). Experimental evaluation of a fully recyclable thermoplastic composite. Composite Structures, 140, 21-35.

Elhossini, A., Areibi, S., & Dony, R. (2014). Strength pareto particle swarm optimization and hybrid ea-pso for multi-objective optimization. Evolutionary Computation, 18(1), 127-156.

Gong, Z., Zhang, H., Forrest, J., Li, L., & Xu, X. (2015). Two consensus models based on the minimum cost and maximum return regarding either all individuals or one individual. European Journal of Operational Research, 240(1), 183-192.

Harahap, R., Jeumpa, K., Hadibroto, B., Harahap, R., Jeumpa, K., & Hadibroto, B. (2014). Drainage systems for flood control in medanselayang, indonesia, based on rainfall intensity and drainage evaluation. Journal of Civil Engineering Research, 4(3A), 233-236.

Huang, P., Wang, Y., Huang, G., & Augenbroe, G. (2015). Investigation of the ageing effect on chiller plant maximum cooling capacity using bayesianmarkov chain montecarlo method. Journal of Building Performance Simulation, 9(5), 529-541.

Igel, C. (2007). Covariance matrix adaptation for multi-objective optimization. Evolutionary Computation, 15(1), 1.

Jingmei Li, Zhigao Zheng, QiaoTian, Guoyin Zhang, FangyuanZheng, Yuanyuan Pan(2018). Research on tridiagonal matrix solver designing based on combination of processors. Computers & Electrical Engineering. Vol. 62, pp. 1-16.

Li, X., Wang, D., Li, K., & Gao, Z. (2013). A green train scheduling model and fuzzy multi-objective optimization algorithm. Applied Mathematical Modelling, 37(4), 2063-2073.

Lukáš Pop, Zbyněk Sokol, & Hanslian, D. (2016). A new method for estimating maximum wind gust speed with a given return period and a high areal resolution. Journal of Wind Engineering & Industrial Aerodynamics, 158, 51-60.

Manisha Chahal, Sandeep Harit, Krishn K. Mishra, Arunkumar Sangaiah, Zhigao Zheng (2017). A Survey on Software-Defined Networking in Vehicular Ad Hoc Networks: Challenges, Applications and Use Cases. Sustainable Cities and Society,,35(11):830-840.

Nagaraj, B., and P (2012).Vijayakumar. "Evolutionary computation based controller tuning—a comparative approach." Int J Indian Pulp Paper Tech Assoc 24, no. 2 : 85-90.

Pan S, Sun W, Zheng Z (2017). Video segmentation algorithm based on superpixel link weight model. Multimedia Tools and Applications, 76(19): 19741--19760.

Patel, R. (2013). Multi-objective optimization of two stage thermoelectric cooler using a modified teaching–learning-based optimization algorithm. Engineering Applications of Artificial Intelligence, 26(1), 430-445.

Pridmore, D., Chen, C., Killinger, K., Peters, K., Hollander, J., & Hafron, J. (2014). Mp76-09 factors associated with poor return of urinary function after robotic assisted radical prostatectomy: evaluation of expanded prostate cancer index composite (epic) scores. Journal of Urology, 191(4), e885-e885.

Rao, R. V., & Patel, V. (2013). Multi-objective optimization of heat exchangers using a modified teaching-learning-based optimization algorithm.Applied Mathematical Modelling, 37(3), 1147-1162.

Sheu, J. P., Chang, G. Y., Wu, S. H., & Chen, Y. T. (2013). Adaptive k -coverage contour evaluation and deployment in wireless sensor networks.Acm Transactions on Sensor Networks, 9(4), 1-31.

Shivendra Shivani, Shailendra Tiwari, Krishn K. Mishra, Zhigao Zheng, Arun K. Sangaiah (2017). Providing security and privacy to huge and vulnerable songs repository using visual .Multimed Tools Appl .

Sindhya, K., Miettinen, K., & Deb, K. (2013). A hybrid framework for evolutionary multi-objective optimization. IEEE Transactions on Evolutionary Computation, 17(4), 495-511.

Xin Li, Zhihan Lv, Zhigao Zheng, Chen Zhong, IhabHamziHijazi, Shidan Cheng(2017). Assessment of lively street network based on Geographic information system and Space Syntax. Multimedia Tools and Applications. 76, 17, 17801–17819.

Yan, J., & Li, L. (2013). Multi-objective optimization of milling parameters – the trade-offs between energy, production rate and cutting quality. Journal of Cleaner Production, 52(4), 462-471.

K Vijayalakshmi, P Anandan.(2020). Global Levy Flight of Cuckoo Search with Particle Swarm Optimization for Effective Cluster Head Selection in Wireless Sensor Network. *Intelligent Automation And Soft Computing* ,26(1):61-70

7 DISCLOSURE STATEMENT

NO potential conflict of interest was reported by the authors.

8 NOTES ON CONTRIBUTORS

Hong Zhu, Master, Assistant Professor. Graduated from the Northwest University in 2009.Worked in Shaanxi XueQian Normal University. Her research areas of interest include sociology, employment and entrepreneurship of college students, human resource management, and educational administration, etc.