



Payame Noor University



Control and Optimization in Applied Mathematics (COAM)

Vol. 1, No. 1, Spring-Summer 2016(41-53), ©2016 Payame Noor University, Iran

# A New Measure for Evaluating the Efficiency of Human's Resources in University

A. Heydari<sup>1</sup>, H. R. Yousefzadeh\*<sup>2</sup>

<sup>1,2</sup>Department of Mathematics, Payame Noor University,  
P.O. Box. 19395-3697, Tehran, Iran.

Received: February 22, 2015; Accepted: May 2, 2015.

**Abstract.** In this paper we try to introduce a new approach and study the notion of efficiency under a multi objectives linear programming problem in the university by using analysis of hierarchy process (AHP). To this end, we first extract some effective parameters due to efficiency offices in university and then prioritized these parameters by the AHP method. Hence, we could classify the most important factors of people's dissatisfaction in the offices and could underlie further studies in related offices to evaluate the efficiency and also effective factors for increasing the efficiency. More clearly, a mathematical model is suggested to calculate the amount of efficiency under a multi objectives linear programming problem and then it is solved by using the existing methods. Note that in order to examine the approach's performance, the Payame Noor University of Mashhad (PNUM) is selected as a case study. Numerical experiments are included to illustrate the effectiveness of the proposed approach.

**Keywords.** Efficiency, AHP method, Multi objectives linear programming problem.

**MSC.** 90C70; 93C42.

---

\* Corresponding author

a\_heidari@pnu.ac.ir; usefzadeh.math@pnu.ac.ir

<http://mathco.journals.pnu.ac.ir>

## 1 Introduction

Efficiency is an extent, deep and beautiful notion but is ambiguous issue. Whenever an activity is active, efficiency can be defined and even improved. Nowadays, efficiency is a national priority in the economies, even in developed or developing countries.

The advantages of efficiency are reachable, if we could measure and calculate it more precisely and analyze the related results. The existence of comprehensive plan and ways which are selected for improvement are the main parts efficiency's computations. In the process of manufacturing and production, resources or physical and non-physical elements are defined as inputs. The obtained results in any system are referred to "outputs". In general, productivity or efficiency is defined as the ratio of outputs to inputs.

There are usually two ways to considered inputs and outputs, namely, physical and currency units. If there are different kinds of inputs or different kinds of outputs measured by different scales then one cannot collect them together. Hence, he must use a common scale for all items. In this case, the currency unit is the most common and straightforward scale to use.

Efficiency of human's resources is one of the most important types of efficiency in the context. The higher in amount of efficiency is, the better in human's performance is. In this paper the input of human's resources are considered in terms of three parameters: the duration of working time, the number of employees and finally amount of employees' payments. The efficiency of human's resources can be defined as the ratio of corresponding outputs (the clients' satisfaction is defined as output) to its inputs. There are different viewpoints about effective components on efficiency of human's resources. Some important cases are " instructing employees, using cooperative management systems and implementation of offers system, corporation commitment, job satisfaction, job culture, responsibility conscience, social discipline, re-engineering of systems" (To study more details, see [10]). In regard to importance role of human's resources in increasing productivity and efficiency, in this paper we choosed Payame Noor university Mashhad (PNUM) as a case study and analyzed the obtained results. The remainder of the paper continues with a brief literature review of the analytic hierarchy process (AHP) and vector optimization problem. In Section 2, a new measure for the concept of productivity in university is defined and tries to evaluate the productivity in a critical office PNUM by determining and prioritizing the main factors and corresponding parameters in that office. The computational experiments and its results are given in Section 3. The conclusions are presented in Section 4.

### 1.1 Analysis of hierarchy process

The analytic hierarchy process (AHP) is a structured technique for organizing and analyzing complex decisions, based on mathematics and psychology. It was developed by Thomas L. Saaty in the 1970s and has been extensively studied and refined since then.

(For more details, see [8]). He proved that this method is suitable for decision making problems especially when one should select an option between some specific available options. The procedure of using the AHP can be summarized as (See [8] for more details):

1. Model the problem as a hierarchy containing the decision goal, the alternatives for reaching it, and the criteria for evaluating the alternatives.
2. Establish priorities among the elements of the hierarchy by making a series of judgements based on pairwise comparisons of the elements. For example, when comparing potential purchases of commercial real estate, the investors might say they prefer location over price and price over timing.
3. Synthesize these judgements to yield a set of overall priorities for the hierarchy. This would combine the investors' judgements about location, price and timing for properties A, B, C, and D into overall priorities for each property.
4. Check the consistency of the judgement.
5. Come to a final decision based on the results of this process.

The AHP method tries to transfer qualitative scales to quantitative scales. At the beginnings, one should identify the important factors (or elements) that effect on decision making problem and by a hierarchy process. The main objective function will be placed at the top and decision options should be placed at the bottom of the hierarchy process. The AHP method consists of some main branches which are named scales and sub-scales or the criterions and sub-criterions of the problem. Determining the relative priority between effective factors in each level of hierarchy process is the next step in the AHP method. To this end each pair of factors compares together in the AHP method. These comparisons will be done by means of constructing a pairwise compared matrix named "paired comparison matrix". In the next step, relative weights of scales and sub-scales are calculated by different methods such as arithmetic mean, geometric mean, Eigen value vector and etc. For example, we do these steps by the arithmetic mean method in paired comparison matrix  $A = [a_{ij}]_{m \times n}$  (See [8] for more details):

$$M_i = \frac{\sum_{j=1}^n \tilde{a}_{ij}}{n} \quad i = 1, \dots, m$$

where  $\tilde{a}_{ij} = \frac{a_{ij}}{A_j}$  and  $\tilde{A}_j = \sum_{i=1}^m a_{ij}$ , ( $i = 1, \dots, m, j = 1, \dots, n$ ).

One of the advantages of the AHP method is the control of system's compatibility in which the compatibility indicator (C.I.) is defined as follows:

$$C.I. = \frac{\lambda_{max} - n}{n - 1} \quad (1)$$

where  $\lambda_{max}$  is the maximum eigenvalue of paired comparison matrix and  $n$  is the number of objectives (goals) which are compared to each other (For more details see [10, 4]). The acceptable region of inconsistency in each system depends on decision maker, but in general, Saaty offers that if inconsistency of the system is greater than 0.1, it is better to reconsider our judgements [1]. The final step of the AHP method is merging the obtained values (weights). To do that, we multiply the scales or subscales' weights by relative weight of each element and then sum all of them for decision making options. The modelling of quantitative and qualitative factors is the main ability of the AHP method. Hence, this method can be used in different fields such as politics, management,

social and civil engineering, medicine, medical care, data networks, designing, agriculture science and etc. [14, 13, 12, 5].

## 1.2 Vector optimization problem

Multi-objective optimization (also is known as multi-objective programming vector optimization, multi criteria optimization, multi attribute optimization or Pareto optimization) is an area of multiple criteria decision making, that is concerned with mathematical optimization problems involving more than one objective function to be optimized simultaneously. Multi-objective optimization has been applied in many fields of science, including engineering, economics and logistics (See [4] to study more in details)

There are many methods for solving multi objective linear programming problems such as possibilities function method, general criterion method, method of bounded objective functions, method of function grading, and method of weighted objective functions. In this paper we used the last method, which is explained briefly as follows (For more details see [3]):

Suppose that vector function  $F(X) = (f^1(x), \dots, f^t(x))$  is a vector of different objective functions, that each one should be minimized. We define a fixed weight  $\alpha_i$  for each objective function  $f^i(x)$  ( $i = 1, 2, \dots, t$ ). It is worth noting that these weights depend on priority of assigned functions. If

$$\alpha_i > 0 \quad i = 1, 2, \dots, t$$

Then we define  $\omega(x) = \sum_{r=1}^t \alpha_r f^r(x)$  as a new objective function for the given problem. A feasible solution that minimizes the objective function  $\omega(x)$ , is the Pareto solution of multi-objective system. In other word, the problem is transfer to (2):

$$\begin{aligned} \min \quad & \omega(x) = \sum_{r=1}^t \alpha_r f^r(x) \\ \text{s.t.} \quad & x \in K \end{aligned} \tag{2}$$

where  $K$  is a feasible space of constraints. It is clear that defining new different weights might yields new optimal solutions.

## 2 Mathematical model of productivity

As it is mentioned, the productivity ( $Pr$ ) is defined as the ratio of outputs related to the products or services to the available inputs. In the other word,

$$Pr = \frac{\text{Outputs}}{\text{Inputs}} \tag{3}$$

The high level of productivity is achieved when not only the quality but also the quantity values is measured. With regard to the definition of the productivity, i.e. (3), the ratio of each output to the corresponding input can be concluded. This kind of productivity is called as "partial productivity" and the ratio of total outputs to the total inputs is defined as "total productivity". By referring to (3), improvement in productivity arises at cases in Table 1 ( See e.g. [9]).

**Table 1:** Different cases for increasing productivity values

Case1	Case2	Case3	Case4	Case5
$\frac{\text{output}\downarrow}{\text{input}\downarrow}$	$\frac{\text{output}\uparrow}{\text{input}\uparrow}$	$\frac{\text{output}-}{\text{input}\downarrow}$	$\frac{\text{output}\uparrow}{\text{input}-}$	$\frac{\text{output}\uparrow}{\text{input}\downarrow}$

In this table, the notation "-" denotes the elements are fixed and unchanged, the notations " $\downarrow$ " and " $\downarrow\downarrow$ " indicate decrease and more decrease in corresponding elements, respectively. Similarly, the notations " $\uparrow$ " and " $\uparrow\uparrow$ " indicate increase and more increase in corresponding elements, respectively. Precisely, output and input contain both quality and quantity values.

## 2.1 Evaluation of productivity

As it is mentioned, in every organization, human resources have special role to determine the productivity value. In this paper, the productivity's evaluation of human resources is studied in a specific department of the PNUM which is explained as follows:

**Definition 1.** The main part of the system is called "organization". Each organization consists of some "departments" and each department is divided to some "offices".

In this paper the PNUM is defined as the organization.

**Definition 2.** "Bottleneck" is said to department(s) or office(s) where the rate of clients to the corresponding employees is greater than other departments or offices is important section of organization, with respect to priority and creditability.

At the beginning, we suggested an algorithm to show the process of our work more clearly. Based on suggested algorithm, to determine the priority of different departments, we gathered the clients', employees' and directors' statements for the each office and then we assigned a weight to each office. Hence, for evaluating productivity value, the office with maximum weight is considered as target.

Based on questionnaire and examinations, supplier office, student affairs, graduate studies office, archive office, exams office can be considered as bottlenecks in PNUM.

The results of our examinations show that the education office, graduated studies office and post graduate studies office can be considered as the main bottleneck office in PNUM.

With respect to the viewpoints of chairman of university and dean of education and also director for the each department, the subjects such as reward in cash or punish and then record them in employee's document, respect and attention, persuasive days-off are the main factors to improve the performance of employees in that organization. With regard to the mentioned bottleneck offices and also the specified priorities which were predefined in the university, the post graduate studies office is selected to evaluate the corresponding value of productivity.

## 2.2 Main Factors and corresponding parameters

Based on our investigations, we find out three factors: system's structure (or system's factor), employee's factor and student's factor are main factors that are affected the value of clients' dissatisfaction (especially students' dissatisfaction) in the post graduate studies office. Each factor consists of some different parameters (See Table 2).

According to Table 2, amount of clients' dissatisfaction in the post graduate studies office for each parameter  $p$  in the corresponding factor  $q$  ( $x_{pq}$ ), can be obtained as follows: for each factor  $q$ , ( $q = 1, 2, 3$ ) and each corresponding parameter  $p$ ,  $x_{pq}$  is equal to average values of last two columns (80%-99% and Effective columns). By considering the obtained value (i.e.  $x_{pq}$ ) and constructing the corresponding paired comparison matrix and then applying the AHP method, we can calculate the parameters' weight. Hence, according to the parameters' weight, the effective parameters in each factor (or in total) are ranked in the post graduate studies office.

Note that the values of other columns of Table 2 can be used to rank the parameters with the same weight. In other word, the higher in value of column 60% -80%, the higher in its rank for the corresponding parameters with same weight. It is repeated for other columns respectively. If all columns' values for two parameters are the same then the ranking parameters are done randomly. It is note that all of data information in tables is gathered from directors', employees', directors' and chairman's offices.

## 2.3 AHP performance for proper ranking

By regarding the AHP method, and obtained value of  $x_{pq}$  in the previous subsection, we can properly ranking the parameters of each three factors in the PNUM. For doing so, we should first define the priority value according to Table 3 (See e.g. [6, 4, 1]).

For the sake of brevity, we only present the results obtained by choosing the student's factor and explain the corresponding obtained results in details. However, in Appendix, some results obtained by choosing other factors are also presented and briefly discussed.

The corresponding data for each parameter of the student's factor are given in Table 4. Five effective parameters are considered for the student's factor. The weights and so the ranks of parameters for student factor are given in Table 4.

**Table 2:** Corresponding parameters for three factors

Factors	rows	Parameters	Influence (%)						
			No Effect	Under 20%	20%-40%	40%-60%	60%-80%	80%-99%	Effective
Student's Factor	A1	Lack of acquaintance from organization's chart	0	13.79	10.35	24.14	10.35	27.58	13.79
	A2	Do not take into account the educational chart by student	3.45	13.8	6.9	13.8	27.58	24.13	10.34
	A3	Absence of students in a appropriate time	6.9	13.8	13.8	3.45	24.13	27.58	10.34
	A4	Do not take into account the proper laws by student	6.9	17.25	3.45	13.9	24.13	27.58	6.89
	A5	Others	0	0	0	0	0	0	0
System's Factor	B1	Lake of relevant and appropriate law	0	2.68	10.35	0	13.8	13.68	30.49
	B2	Ambiguity in the description or how to use relevant laws	0	13.79	3.45	6.9	17.25	27.58	31.03
	B3	Lack of informing news about the current and new laws	0	17.24	3.45	6.9	10.35	31.03	31.03
	B4	Influence of personal viewpoints about the law's interpretation	10.34	13.8	6.9	6.9	20.69	17.25	24.14
	B5	Lake of appropriate physical space for to work	0	17.25	13.79	10.35	20.69	6.89	31.03
	B6	Lake of appropriate educational facilities to work	0	17.24	10.35	10.35	13.79	17.24	31.03
	B7	Lake of appropriate welfare facilities to work	0	17.24	6.9	17.24	6.9	20.69	31.03
	B8	Quick change about related laws to the works	0	6.9	13.79	6.9	20.69	20.69	31.03
	B9	Inadequate information on the website	0	6.89	13.79	10.35	27.58	17.25	24.14
	B10	Others	0	0	0	0	0	0	0
Employees' Factor	C1	Lack of the staff's information about the relevant laws	0	13.8	10.34	13.8	17.25	20.68	24.13
	C2	The staff's inappropriate treatment with the client	6.9	10.35	3.45	0	20.69	34.48	24.13
	C3	Do not work accurately and also on time by the staff	0	3.45	10.35	13.8	20.69	31.03	20.68
	C4	Staff abuse to student w.r.t existence laws	3.45	10.9	3.45	20.69	24.14	27.58	13.79
	C5	Do not take into account the laws by staff	3.45	10.35	10.35	6.89	24.14	17.24	27.58
	C6	Non respecting for the law by staff	0	10.35	6.9	17.25	27.58	24.13	13.79
	C7	Other	0	0	0	0	0	0	0

**Table 3:** Definition of priority values used in the AHP method for PNUM

Priority value	Explanation
1	If the value of two numbers are equal
3	If difference of two numbers is smaller than 10
5	If difference of two numbers is greater than 10 and smaller than 20
7	If difference of two numbers is greater than 20 and smaller than 50
9	If difference of two numbers is greater than 50 and smaller than 100

The rows of Table 4 indicate the percentage affection of each parameter that causes the clients' dissatisfaction in the post graduate studies office. The first column depicts the five corresponding parameters to the student's factor. Two ended columns consist of parameters' weight which is obtained by the AHP's method and consequently the resulted rank. Note that, based on the AHP computation since the second and the forth parameter's weight (i.e. weights of parameters A2 and A4) are the same, then their ranks are defined according to the maximum values of sixth column of Table 4 (i.e. 27.58 and

**Table 4:** The results of AHP, the weight and the rank of student's parameters

Parameters	Results of AHP							Weights	Rank
	Influence (%)								
	No Effect	Under 20%	20% -40%	40% -60%	60% -80%	80% -99%	Effective		
A1	0	13.79	10.35	24.13	10.35	27.58	13.79	0.418	1
A2	3.45	13.8	6.9	13.8	27.58	24.13	10.34	0.132	3
A3	6.9	13.8	13.8	3.45	24.13	27.58	10.34	0.256	2
A4	6.9	25.17	3.45	138	24.13	27.58	6.89	0.132	4
A5	0	0	0	0	0	0	0	0.036	5

24.13 for parameters A2 and A4 respectively). Hence, rank of parameter A2 is greater than rank of parameter A4.

The obtained results show that the parameter A1 with weight 0.418 has the highest rank and the parameter A5 with weight 0.036 has the lowest rank. In other word, the influence of parameter A1 (i.e. the lack of acquaintance from organization's chart) in the student's factor is more than other parameters in clients' dissatisfaction from the post graduate studies office.

### 3 Evaluation of efficiency

In general, one measure to for evaluating the productivity of human resources in a university can be defined as the amount of student's satisfactory (i.e. it is considered as output) with respect to facilities and circumstances of that university which are known as inputs. But the student's satisfaction may not be only a suitable criterion to evaluate the productivity. Since a good measure must be considered in terms of different but comprehensive parameters such as employee's satisfaction, quantity and quality of available facilities and etc. in which, we call them employees' satisfaction. Because it is clear that the increment and distribution the facilities in an organization properly are, increase the amount of employees' satisfaction is.

Hence, in this paper, the productivity measure is defined by (4). We remind that in this paper, the monetary unit's equivalent is considered for all factors in our computations.

$$Pr = \frac{\text{Outputs}}{\text{Inputs}} = \left| \frac{\text{Amount of student's satisfaction}}{\text{Amount of employee's satisfaction}} \right| \quad (4)$$



Now we describe each part of  $Pr$  in (4) in details:

### 3.1 Amount of employee's satisfaction

Consider the relation (5) in order to calculate the amount of employee's satisfaction in a given office ,

$$S_{em} = \frac{\text{Current situation}}{\text{Ideal situation}} \quad (5)$$

It is worth noting that only one semester is considered for evaluating the productivity of PNUM.

Based on our interviews and questionnaire which have been done and fill out by employees in the post graduate studies office and the data are confirmed by directors, it is declared that in a given semester the value of  $S_{em}$  in terms of their total incomes can be stated as the ratio of their real incomes (concluded salary, reward and service charge) to their ideal incomes. In other words, we have,

$$S_{em} = \frac{68000000}{80000000} = 0.85$$

Data are transferred to monetary units according to the viewpoints of chairman offices. According to our investigations, if the values  $w_{pq}$  and  $\theta_{pq}$ , respectively be the weight and corresponding monetary unit's equivalence for factor  $q$  and corresponding parameter  $p$  and the value  $k_q$  be the number of parameters in factor  $q$ , then we can transfer the student's satisfaction ( $S_{st}$ ) to monetary unit's equivalence. Hence it is stated as (6):

$$S_{st} = \frac{\sum_{q=1}^3 \sum_{p=1}^{k_q} \theta_{pq} (1-w_{pq})}{\sum_{q=1}^3 \sum_{p=1}^{k_q} \theta_{pq}} \quad (6)$$

To illustrate in details, regarding the obtained investigations and knowledge of chairman in university, we now compute the value of student's satisfaction for the student's factor ( $q = 1$ ) by considering all corresponding parameters, i.e. A1-A5 (see Table 2).

$$S_{st} = \frac{0.58 (500000) + 0.87 (7000000) + 0.74 (11000000) + 0.87 (4000000) + 0.96(0)}{22500000} = 0.8.$$

Hence, by using (4), the productivity value ( $Pr$ ) is calculated by

$$Pr = \frac{0.8}{0.85} = 0.94$$

### 3.2 Multi objectives employee's satisfaction

It is clear that in general, in one hand, we cannot restrict the people's satisfaction in only specific case and the other hand, it is impossible to consider all corresponding items. Therefore, to evaluate this important measure exactly, we have to consider different parameters with more effective role.

In sequel, to clarify the subject more, we calculate the amount of employee's satisfaction by considering two main objectives, namely, increase in payments (or incomes) for each employee and increase the facilities in a given office.

For evaluating the amount of  $S_{em}$ , suppose that for each employee, variables  $x_1, x_2, x_3$  and  $x_4$  indicate the monetary unit's equivalences for amount of working times (salary), environment situation (e.g. number of staff in that office, position and staff's degree and etc.), other payments (such as reward, service charge, etc.) and finally facilities and equipment which are allotted to each employee, respectively. By regarding the investigation and also personal interviews, the employee's satisfaction can be formulated as a mathematical programming problem. To this end, a simple mathematical model with multi objective function is suggested. The related constraints (which are according to the directors' and chairman's statements) are given by (8)-(11).

Initial and in-person inter news conducted with employee, implies that the level of salary with respect to other payments for each employee is approximately 3 to 1 and the ratio of monetary value of the environment situation to facilities and equipment which are allotted to each employee is 2.

$$\text{Maximize } \{ f_1 = 3x_1 + x_3, f_2 = 2x_2 + x_4 \} \quad (7)$$

$$\text{s.t. } x_1 + x_3 \leq 60,000,000 \quad (8)$$

$$x_4 + x_2 \leq 65,000,000 \quad (9)$$

$$x_1 + x_2 \leq 95,000,000 \quad (10)$$

$$x_4 \leq 20,000,000 \quad (11)$$

According to the directors' and employees' viewpoints in that office, each of the objective function in (7) has the same weights  $w_1, w_2$  where  $w_1 + w_2 = 1$  and  $w_1$  and  $w_2$  are nonnegative. Take  $w_1 = w_2 = 0.5$  and solve the problem with objective function  $w_1(f_1) + w_2(f_2)$  we have:

$$x_1 = 50,000,000, x_2 = 45,000,000, x_3 = 10,000,000 \text{ and } x_4 = 45,000,000.$$

Hence, the optimal value is:

$$Z = 0.5(110,000,000) + 0.5(160,000,000) = 135,000,000$$

and according to employees' and directors' statements, in the best ideal situation, the value of employee's satisfaction is obtained as below:

$$x_1 = 75,000,000, x_2 = 45,000,000, x_3 = 17,500,000 \text{ and } x_4 = 30,000,000$$

Then the ideal value is:

$$Z = 0.5(120,000,000) + 0.5(242,500,000) = 181,250,000.$$

And the amount of employee's satisfaction:

$$S_{em2} = \frac{135000000}{181250000} = 0.74.$$

Hence, by (4) the amount of productivity of the post graduate's studies office is

$$Pr = \frac{0.8}{0.74} = 1.08,$$

i.e. the given office will be unit is productive if the costs and the budges are distributed properly and specially according to the optimal solution.

Note that the obtained value of  $Pr$  indicates that the amount of clients' satisfaction is greater than the amount of current employee's satisfaction.

**Table 5:** The results of AHP, the weight and the rank of system's parameters

Parameters	Results of AHP							Weights	Rank
	Influence (%)								
	No Effect	Under 20%	20%-40%	40%-60%	60%-80%	80%-99%	Effective		
B1	0	20.68	10.35	0	13.8	2068	34.49	0.136	3
B2	0	13.79	3.45	6.9	17.25	27.58	31.03	0.175	2
B3	0	17.24	3.45	6.9	10.35	31.03	31.03	0.245	1
B4	10.34	13.79	6.9	6.9	20.69	17.24	24.14	0.047	8
B5	0	17.25	13.79	10.35	20.69	6.89	31.03	0.029	9
B6	0	17.24	10.35	10.35	13.79	17.24	31.03	0.073	6
B7	0	17.24	6.9	17.24	6.9	20.69	31.03	0.097	5
B8	0	6.9	13.79	6.9	20.69	20.69	31.03	0.097	4
B9	0	6.89	13.79	10.35	27.58	17.25	24.14	0.047	7
B10	0	0	0	0	0	0	0	0.010	10

#### 4 Conclusions

This paper tries to find a measure to calculate and improve the efficiency of human's resources in the post graduate studies office in Payame Noor University of Mashhad (PNUM). Evaluating the efficiency of human's resources can be done whenever people are the main factor in a specified organization. It is noted that the important factors for a successful scheduling are individual, job and environment [11]. Therefore we considered student's, employee's and system's factor which affects the evaluations of any office's productivity. Our investigations show that the post graduate studies office is the most

**Table 6:** The results of AHP, the weight and the rank of employee's parameters

Parameters	Results of AHP							Weights	Rank
	Influence (%)								
	No Effect	Under 20%	20% -40%	40% -60%	60% -80%	80% -99%	Effective		
C1	0	13.8	10.34	13.8	17.25	20.68	24.13	0.124	4
C2	6.9	13.35	3.45	0	20.69	34.48	24.13	0.314	1
C3	0	3.45	10.35	13.8	20.69	31.03	20.68	0.211	2
C4	0	10.35	3.45	20.69	24.14	27.58	13.79	0.092	5
C5	3.45	10.35	10.35	6.89	24.14	17.24	27.58	0.160	3
C6	0	10.35	6.9	17.25	27.58	24.13	13.79	0.055	6
C7	0	0	0	0	0	0	0	0.018	7

important offices in PNUM and then it is selected for more examination of its productivity. By considering the clients' satisfaction and regarding to the corresponding parameters due to each factors and using the AHP method, we ranked the parameters and then three factors. By knowing that the amount of productivity is depends on the employees' and clients' satisfaction. Hence a new measure for evaluating the amount of productivity in the post graduate studies office ( $Pr$ ) is suggested by the ratio of amount of students' satisfaction to the amount of employees' satisfaction. Based on experimental results we concluded the considered office is productive, relatively. The experimental results show that if the costs and budgets are distributed properly, one can improve the productivity by the value  $Pr \geq 1$ . In other word, we can concluded that the amount of clients' satisfaction is greater than the amount of current employees' satisfaction. It is worth noting that improving the current situations such as increasing the number of employees, increasing their salaries, increasing the students' knowledge and etc. can be affected the amount of students' satisfaction, directly or indirectly.

## Appendix

The corresponding data for the parameter of the system's and employee's factors in post graduated studies office in PNUM are given in Table 5 and 6 respectively. Ten and seven effective parameters (according to the directors' and chairman's statements) are considered for the these factors respectively. The corresponding weights and so the ranks of parameters for these factors are given in Tables 5 and 6.

## References

- [1] Akhundi R. N. (2007). “ Mathematical structure of fuzzy for AHP method ”, Master Thesis, Ferdowsi University of Mashhad.
- [2] Bessent A., Bessent W., Kennington J., and Reagan B. (1982). “ An application of mathematical programming to assess productivity ”, Houston Independent school District, INFORMS.
- [3] Dezgahi A. (1376). “ The study of fuzzy multi objectives linear programming ”, Master Thesis, Ferdowsi University of Mashhad.
- [4] GhodsiPour H. (2009). “ Analysis of hierarchy process (AHP) ”, Amir Kabir University Publications, (in Persian).
- [5] GhodsiPour H. (2006). “ Topics in multi-objectives programming multi-criterions decision making ”, Amir Kabir University Publications.
- [6] Ghomi S. (2010). “ Creating intelligent feedback for categorizing fuzzy multi-criterions AHP ”, Master Thesis, Ferdowsi University of Mashhad.
- [7] Katta G. (1983). “ Linear programming ”, John Wiley & Sons.
- [8] Olsen D. (2008). “ Multiple-criteria decision- making methods ”, Marandiz Publications.
- [9] Oreiee K. (2009). “ Productivity in industry ”, Jahad Daneshgahi Publications.
- [10] Pirayesh R. (2008). “ Productivity management ”, Zanjan University Publications.
- [11] Putti J. (1986). “ Understanding productivity ”, Federal Publications.
- [12] Sabeghi S. (2013). “ Increasing productivity of human resources in Payame Noor University of Mashhad ”, Master Thesis.
- [13] Sakhaee B. (2012). “ Using fuzzy sets of type 2 in AHP method ”, Master Thesis, Ferdowsi University of Mashhad.
- [14] Zibae M. (2006). “ Supporting systems for AHP via fuzzy logic ”, Master Thesis, Ferdowsi University of Mashhad.

## ارائه راهکاری مفید برای محاسبه بهره‌وری حاصل از کارکرد منابع انسانی در دانشگاه

حیدری ع.

دانشیار ریاضی کاربردی

ایران، تهران، گروه ریاضی، دانشگاه پیام نور، صندوق پستی ۳۶۹۷-۱۹۳۹۵.

a\_heidari@pnu.ac.ir

یوسف زاده ح. ر.

استادیار ریاضی کاربردی - نویسنده مسئول

ایران، تهران، گروه ریاضی، دانشگاه پیام نور، صندوق پستی ۳۶۹۷-۱۹۳۹۵.

usefzadeh.math@pnu.ac.ir

### چکیده

در این مقاله به معرفی معیاری جدید جهت ارزیابی مفهوم بهره‌وری در قالب یک مسئله برنامه ریزی خطی چندهدفه پرداخته شده است. برای انجام این مهم، از فرایند تحلیل سلسله مراتبی (AHP) استفاده خواهد شد. برای انجام این مهم، پس از آشنایی با فرایند تحلیل سلسله مراتبی (AHP) به رتبه‌بندی پارامترهای تاثیرگذار بر میزان بهره‌وری پرداخته می‌شود. سپس با استفاده از روش‌های حل مسئله برنامه ریزی خطی چندهدفه و یافتن اداره حائز اهمیت (گلوگاه) در دانشگاه پیام‌نور مشهد، به کمک روش AHP مهم‌ترین علل نارضایتی مراجعان از آن اداره که در عدم ارتقای بهره‌وری آن نقش دارند را مشخص کرده و با حل مسئله برنامه ریزی خطی چندهدفه به ارزیابی بهره‌وری آن می‌پردازیم و برای بهبود و ارتقای آن چاره‌اندیشی می‌کنیم. در پایان به نتایج بدست آمده اشاره شده است.

### کلمات کلیدی

بهره‌وری، فرایند تحلیل سلسله مراتبی، مسئله برنامه ریزی خطی چندهدفه.