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Research Article

PRIORITIZING AND RANKING EDUCATIONAL CLASSES USING AHP AND FUZZY TOPSIS (CASE STUDY: MEHRPUYAN INSTITUTE OF HIGHER EDUCATION, MASHHAD)

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ABSTRACT
Evaluation of the quality of the training classes due to the nature of it needs certain techniques. This article has tried to provide appropriate methods in assessing the quality of training classes using a variety of assessment and rankings techniques. Therefore, analysis hierarchical process (AHP) has been used in order to prioritize and find the amount of the quality importance of training classes. Particular methods are necessary to evaluate the performance of each class based on quality indicators and collect data as well as theory of quality assessment of training classes because of its nature. Theory of fuzzy collection was used to evaluate the performance of each class based on quality indicators and data collection .Finally, TOPSIS method has been used to rank the classes and compare them.

Keywords*: Quality Of Training Classes, Analysis Hierarchical Process, Topsis, Fuzzy Collection Theory*

INTRODUCTION
Learning science as an inevitable social necessity , on most experts` opinions, has important and special position in development affairs .This importance is particularly obtained from the fact that humans only thanks to the training along with their education will be able to make unlimited abilities in the field of action (Pvrarm, 2002).
According to the importance of training in economic, social, and cultural development, assessment of training quality has been focused by training planners and policy makers. Information obtained from the assessment indicates quality of trainees` activities, students, trainers and lecturers, informational resources, libraries, and education management.

Expression of the problem
Because of being quality of training, assessment and evaluation of its efficacy is also too difficult, because a considerable number of factors and variables affect it [9]. Despite the fact that various methods have been provided to assess the quality of service, too old and traditional methods are being used in most Iranian organizations including questionnaires in which their fluency and permanency is controversial as well as Liker spectrum is widely being used having some choices like very low, low ,… .Certainly, some factors have higher effects on the quality of educational classes and need to be concentrated more in assessing each class and this issue is one of the factors of being current weak assessments. Moreover , when these methods are not practical because responders do not have certain ideas ,meaning that they do not have a certain definition for quality variables in their minds, a range needs to be defined and this is disadvantage of existing methods. Therefore, they greatly help to solve this problem using these indicators for determining and identifying the appropriate criteria in order to assess the training classes as well as assess their performance.

If current trend of assessing training classes continues, weak and strong aspects of classes cannot be found and consequently effective steps to improve them cannot be taken forward. Conducting this research seems vital regarding above issues and since assessing training classes is one of the basic needs of any educational organizations.

Decision –making techniques and using the ones of this course of science is one of the choices that can greatly affect in this regard. Need and dependence of planning and its procedures to make optimum decision in each step is highly basic and inseparable in any programs in that it is too difficult to imagine "planning" and "decision making" separately . Decision making and optimum choice in planning has the most important and highest software role and like what Stealing has indicated, nowadays, the role of decision in development is not less than the role of resources (Meier and Gerald And Dudley Sears, 1989).

So, making decision is not an easy task in many cases, particularly, when being dealt with a considerable number of variables and you need prioritizing decision-making units according to their relative importance (Silvert, W. 2000).

Complexity of panning environment, pluralism of information, and frequent problems in which we are facing in the world today does not accept the logic of one-dimension thinking. Natural complexity of many decision-making environment in today`s world has necessitated the comprehensive view in decision making as well as applying different people with various occupations, skills, experience, resume ,scientific views along with using "group decision-making techniques and multi-function ones (Phillis and Andriantiatsaholiniaina, 2001).

Brail and his colleagues, in a research, used multi- criteria decision making method using Prato principle and multi-purpose view (Baril, Chantal, 2013).In another research, Muskets and colleagues have used multi- criteria decision making method for ranking investing companies with fuzzy approach (Person, 2001). Juridical and Tinsel used correlation coefficient for selecting multi- criteria decision-making criteria in their research (Zhang and Huaguang, 2006). Sotudeh and colleagues have used multi- criteria decision-making techniques in assessing the constructional projects in Iran which that have applied fuzzy analysis hierarchical process (Yurdakul, 2009).

Zadeh and colleagues used fuzzy multi- criteria decision making and TOPSIS in allocation of operators` tasks of factories (Azadeh Ali, 2011).

In this research , three basic questions have been used using multi-criteria decision making (MCDM) and fuzzy collection after identifying assessing indicators of training classes from Students` Evaluation of Educational Quality (SEEQ).

1. How much is the importance of each criterion and education-quality indicators?
2. How is the performance of each training classes (in statistical society under study)?
3. How is prioritizing of training classes to each other?

Research literature

Vast library study has been done to assess and extract appropriate criteria and indicators for this research and various models have been investigated.

Of the researches which have been done in this field, an article entitled "educational motivation of companies and education quality of trainees "can be named (Bloom B, and Kazemi, A, 1960). This research is paying attention to input more than output despite of most existing researches in the area of assessing education quality (Taylor and Taghipur, 1998) and has taken the quality of education in an organization in to account in organizing education and doing the work in that education effects are highly obtainable (Kianmanesh, 1979). This research has taken 9 main indicators in to account being effective on the education quality (Bloom and Kazemi, 1960). In another research conducted regarding the application of TQM and ISO principles for development of guarantee system of high-education quality, investigated of effect of comprehensive quality management as well as ISO principles on education quality in Thailand universities. Criteria and indicators were widely selected and assessed in this research.

Above research included for main criteria including input, process, output, and beneficiaries in that input criteria are made of 8 indicators, process from 3 indicators, output from 2 indicators and beneficiaries from 5 indicators. Among conducted researches , complete and multi-dimension questionnaire of university students` assessing of education quality in Sydney University of Australia using SEEQ model in which its efficacy as a useful tool for improving the education in various researches has been confirmed (Mikhailov, 2004) which is the base of this research.

Since this model focuses more on assessment aspect of university education quality, some indicators have been normalized and more appropriate indicators have been used. Finally, Kronbakh Alfa coefficient of 0.95 was obtained to measure the validity of model which shows high degree of validity.

RESEARCH METHOD

Assessing process of educational classes has been made of four main steps in this research, its summary is shown in Figure (1).

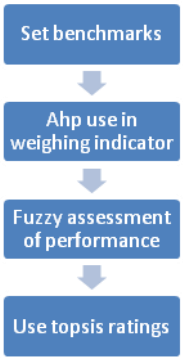

Figure (1): assessing process of educational classes

In the first step, a suitable model for finding assessing criteria of educational classes were selected after library study.

In the second step, these criteria were compared and ranked using relevant criteria and using the help of analysis hierarchical process technique.

In the third step, fuzzy collection was used for assessing the performance of educational classes.

In final step, these classes were ranked using obtained information from step 2 (weigh matrixes) and step 3 (decision matrix) as well as TOPSIS technique.

General approach of planning mathematics in order to assess and determine the priority of decision-making units

In one question of assessment with n number of decision-making units 3(DMU), general approach of mathematics planning is looking for a vector of priorities in the form of $W = (w_1, w_2, \ldots, w_n)^T$ where wi express the numerical weight or amount of importance of each decision-making unit. If we normalize W vector and total sum of components or wi weights is considered unified ,then, wi numbers indicate ,in addition to determine their priorities, relative importance of each of units under study in the overall setting .This affair is particularly important in affairs relevant to resource allocation, strategic planning , risk analysis , path selection ,and human resource planning (Phillis and Andriantiatsaholiniaina, 2001).

The assessment base of units is their comparison based on a number of units in which it may be qualitative or quantity. This comparison is done regarding the quantity criteria according to their amounts

as well as qualitative criteria according to opinions and judgments of experts in the area of under- study subject with the help of AHP and nine-element L spectrum(Faskhodi and Molaghsemi, 2004).

$$A_k = \{a_{ijk} \mid i = 1,2,\ldots,n-1 \;;\; j = 1,2,\ldots,n\} \;,\; k = 1,2,\ldots,k$$

If the number of commenting people (Decision Maker :DM) is considered k , and number of decision – making units in 3 even comparisons is considered n and we show them with index of iandj , each decision-making individual will have a set of The definitive comparative judgments in the frame of reciprocal matrix used in AHP in that :

$$A = [a_{ij}] \quad , \quad a_{ij} = 1/a_{ji} \quad , \quad a_{ij} = 1 \quad if \quad i = j$$

Where a_{ijk} represents relative importance of it unit in the opinion of decision-maker K. In each even - comparison matrix in AHP technique which always an inverse square matrix, we will have for each k individual:

So it clear that each pair comparison matrix of n decision-making unit is only need to have $n(n-1)/2$ number of even comparison by decision-making individual(Fskhvdy Amini, 2002).

The issue of assessing decision-making units in GFPP model is finally finding the vector $W = (w_1, w_2, \ldots, w_n)^T$ from priorities of group weights in that the ratio of $\frac{w_i}{w_j}$ is almost close to initial judgments [19]:

$$\frac{w_i}{w_j} \approx a_{ijk}$$

Fuzzy logic

General ambiguity and uncertainty of human science and particularly planning and decision-making environments need methods to make investigation and mathematics formulation of inaccurate and bad defined of this science possible to provide. Fuzzy collection theory and fuzzy logic of tools are highly considered effective and suitable. Fuzzy –collection theory, which was first introduced by Iranian scientist of California University in 1965, is a mathematical theory designed for modeling and mathematical formulation of existing ambiguities and inaccuracy in identifying procedures (Lootsma, 1997). Application is included in many areas of science such as natural, biological ,social, engineering, ,computer ,systematic as well as management , planning and decision- making (Klir and Folger 1988). The theory of fuzzy collection provides tools which can be used to convert justification method and human decision- making in to mathematical formulation and this mathematical formulation can be used in terms of different science and technology areas.

Fuzzy logic has provided natural technique tool for assessing phenomena and affairs due to its competitive capability with human intelligence and its own systematic approach in investigating the mysterious conditions and situations which common mathematics is not applicable (Andriantiatsaholiniaina and Kouikoglou and Phillis, 2004). Fuzzy theory and logic is a scientific tool which has provided the possibility and permission of simulation of dynamism in a system without the need for thorough mathematics description and using qualitative and quantity data (Shirland, 2003).

Fuzzy theory is known the most common method for discussion of uncertainty while analyzing group and multi-criteria decision-making .Fuzzy logic also removes the gap between assessments and scientific and systematic measurement with simultaneous consideration of social targets and has provided a tool for converting the vast and extensive spectrum of information-visible data ,quantity information ,opinions and mental judgments ,and social needs with a natural language for explaining the effects of environment.

Elements of fuzzy collection

In classic or definitive collections, one member of main collection is a member or not in a given collection. Membership is a definitive collection of F can be defined by membership function for each member of X from the main collection as follows:

$$\mu_F(x)=\begin{cases}1 & x\in F\\ 0 & x\notin F\end{cases}$$

Fuzzy numbers

Each fuzzy collection is defined by a membership function. The principle of membership function has a great importance in fuzzy collection. Therefore, the way of defining membership function for any fuzzy collection is a basic issue.

There are two main points of views for determining one membership function. The first point of view is using experts` knowledge because fuzzy collections are usually used for formulation of human knowledge. In the second point of view, collected data is used for determining membership function by various sensors.

Triangular fuzzy numbers

Triangular fuzzy number of A or simply triangular number with membership function of $\mu_A(x)$ on R is defined as follows:

$$\mu_A(x)=\begin{cases}\dfrac{x-a}{b-a}, & a\le x\le b;\\ \dfrac{c-x}{c-b}, & b\le x\le c;\\ 0, & x<a \text{ or } x>c.\end{cases}$$

In above equation, $[a,c]$ is a range of backrest and the point of $(b,1)$ is the peak and the third line of the equation can be omitted. (Figure (2))

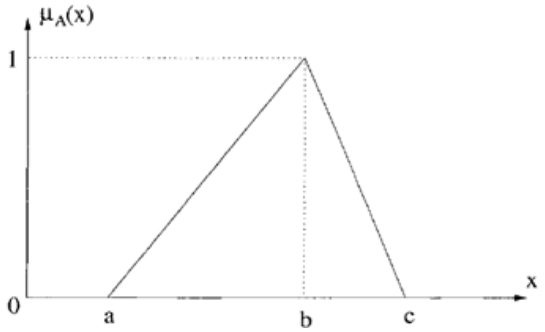

Figure (2): Triangular fuzzy number

In applications, the point of $b\in(a,c)$ is often located in the middle of backrest, meaning $b=\dfrac{a+c}{2}$.

Verbal variables

As it was indicated, the questionnaire is with the aim of obtaining experts` opinions regarding the effective elements on applying Internet-bank services .Thus, experts are ought to express these “amounts”

through variables. Experts encounter troubles using some variables with definite values, therefore, it is obvious that qualitative variables give more freedom to experts. Using some qualitative variables such as "low", "medium" ,"high" will somewhat solve the above problems. Individuals' opinions toward qualitative variables such as low or high are not similar. Since experts have different characteristics, they have a variety of opinions. If questions are answered by various opinions, variable analysis will be invalid. Experts will respond to questions with equal opinions defining range of qualitative variables. Thus, qualitative variables are defined as trapezoid fuzzy numbers like (Chang ping-teng,1998)
. Low (0,0,2,4) ; medium (3,4,6,7);high(6,8,10,10).

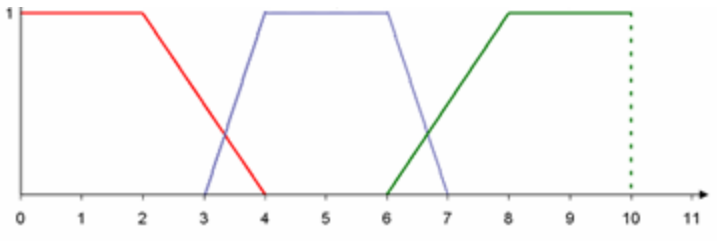

Figure (3)

TOPSIS method

TOPSIS method is one of the most common techniques used in MCDM issues which has the main role in developed models in order to select suppliers. The best choice in TOPSIS method is the one with minimum distance from positive ideal solution(PIS) and maximum distance from negative ideal solution (NIS). In most situations, definite data seems insufficient for modeling real situation. Human judgments have ambiguous nature and cannot be expressed by clear numerical data. Therefore, using oral variables instead of numerical values seems more appropriate. In other words, weight of criteria and choice ranking are stated by verbal variables.

Fuzzy-TOPSIS method

As it was indicated, human thoughts are always accompanied by uncertainty and this uncertainty is effective in decision making so fuzzy decision-making methods are used. One of these methods is fuzzy TOPSIS. Matrix of decision- making elements or indicators` weights are defined like in fuzzy or fuzzy-number way related to and /or both of them.

Decision matrix of D which is m*n matrix and vector of weight indicators toward was input algorithm need to be created before starting the algorithm.

$$D = \begin{array}{c} \\ A_1 \\ \vdots \\ A_i \\ \vdots \\ A_m \end{array} \begin{array}{c} \begin{array}{cccccc} x_1 & \cdots & x_j & \cdots & x_n \end{array} \\ \begin{bmatrix} \tilde{x}_{11} & \cdots & \tilde{x}_{1j} & \cdots & \tilde{x}_{1n} \\ \vdots & & \vdots & & \vdots \\ \tilde{x}_{i1} & \cdots & \tilde{x}_{ij} & \cdots & \tilde{x}_{in} \\ \vdots & & \vdots & & \vdots \\ \tilde{x}_{m1} & \cdots & \tilde{x}_{mj} & \cdots & \tilde{x}_{mn} \end{bmatrix} \end{array} \qquad \tilde{x}_{ij} = (a_{ij}, b_{ij}, c_{ij})$$

$$W = (\tilde{w}_1, \ldots, \tilde{w}_j, \ldots, \tilde{w}_n) \qquad ; \quad \tilde{w}_j = (\alpha_j, \beta_j, \chi_j)$$

Where $\tilde{x}_{ij}$ and $\tilde{w}_j$ are triangular fuzzy numbers.

First step: To normalize decision matrix

First, decision matrix needs to be normalized in order to have "Without a scale" elements. To meet this, maximum of each column x_j^+ and minimum of each column x_j^- are determined and r_{ij} values which are normalized x_{ij} are calculated using following equations.

When x_{ij} s are fuzzy, triangular number of $\tilde{x}_{ij}=(a_{ij},b_{ij},c_{ij})$ or trapezoid number of $\tilde{x}_{ij}=(a_{ij},b_{ij},c_{ij},d_{ij})$, r_{ij} s are certainly fuzzy, too.

If fuzzy numbers are in triangular format and $\tilde{x}_j^-=(a_j^-,b_j^-,c_j^-),\tilde{x}_j^+=(a_j^+,b_j^+,c_j^+)$ are maximum and minimum scores, respectively, then

$$\tilde{r}_{ij}=\begin{cases}\tilde{x}_{ij}(/)\tilde{x}_j^+=\left(\frac{b_{ij}}{c_j^+},\frac{c_{ij}}{b_j^+},\frac{d_{ij}}{a_j^+}\right), \\ \tilde{x}_j^-(/)x_{ij}=\left(\frac{b_j^-}{c_{ij}},\frac{c_j^-}{b_{ij}},\frac{d_j^-}{a_{ij}}\right),\end{cases}$$

Second step: Obtaining weighing normalized matrix
Matrix elements of weighing normalized matrix is obtained through the following equation:
For triangular fuzzy numbers:

$$\begin{cases}\tilde{v}_{ij}=\tilde{r}_{ij}(.)\tilde{w}_j=\left(\frac{a_{ij}}{c_j^+},\frac{b_{ij}}{b_j^+},\frac{c_{ij}}{a_j^+}\right)(.)(\alpha_j,\beta_j,\chi_j)=\left(\frac{a_{ij}}{c_j^+}.\alpha_g,\frac{b_{ij}}{b_j^+}.\beta_j,\frac{c_{ij}}{a_j^+}.\chi_j\right) \\ \tilde{v}_{ij}=\tilde{r}_{ij}(.)\tilde{w}_j=\left(\frac{a_j^-}{a_{ij}},\frac{b_j^-}{b_{ij}},\frac{c_j^-}{c_{ij}}\right)(.)(\alpha_j,\beta_j,\chi_j)=\left(\frac{a_j^-}{c_{ij}}.\alpha_j,\frac{b_j^-}{b_{ij}}.\beta_j,\frac{c_j^-}{a_{ij}}.\chi_j\right)\end{cases}$$

The first equation is for the situation in which j criterion is positive and the second equation is for situation in which j criterion is negative.

Step 3: Obtaining 7 Positive Ideal Solution which is shown by A^+ and Negative Ideal Solution which is shown by A^-.

Fuzzy-number ranking procedures are used to compare fuzzy numbers and determine $\tilde{v}_j^+,\tilde{v}_j^-$ .According to this method, $\tilde{v}_{ij}$ fuzzy –number rank which is shown by $M(\tilde{v}_{ij})$ is defined as following:

$$M(v_{ij})=\frac{-a_{ij}^2+c_{ij}^2-a_{ij}.b_{ij}+c_{ij}.b_{ij}}{3(-a_{ij}+c_{ij})}$$

After obtaining $M(\tilde{v}_{ij})$, $\tilde{v}_{ij}$ which has the maximum value of $M(\tilde{v}_{ij})$,for each j column, is introduced as $\tilde{v}_j^+$ and $\tilde{v}_{ij}$ which has the minimum value of $M(\tilde{v}_{ij})$ is introduced as $\tilde{v}_j^-$.

Step4: Obtaining distance value of each choice compared to PIS and NIS (S_i^+,S_i^-).
For fuzzy data, distance between two fuzzy numbers are defined as following according to Zadeh.

$$M(v_{ij})=\frac{-a_{ij}^2+c_{ij}^2-a_{ij}.b_{ij}+c_{ij}.b_{ij}}{3(-a_{ij}+c_{ij})}$$

Which this equation is extensible for triangular fuzzy numbers.

If $v_j^- = (a^-, b^-, c^-)$, $v_j^+ = (a^+, b^+, c^+)$ is

It is noted that D_{ij}^+, D_{ij}^- numbers are definite numbers.

calculated by multiplying the weight indicator by indicator weight which is shown in the left column of table (1) .Final weights of each indicator point out reveal the amount of importance of that indicator.

Table (1): Final weight of indicators

The final weight of each indicator	indicators	Weight Scales	Scales
0.03738	Challenging and exciting to be	0.2567	Scientific value, learn and apply the lessons
0.06903	Impact facilitate		
0.5452	Being practical lessons		
0.04151	Needs related content		
0.0295	Interest in teaching	0.1455	Teacher enthusiasm to topic
0.0516	Class dynamics		
0.02429	Master of wit and amiability		
0.04345	Teaching methods		
0.03873	Transparency Description Master	0.1567	Clear topics
0.05557	Detailed presentation of lessons		
0.06246	In accordance with the objectives of Contents		
0.04771	Students participate in class	0.1072	Collaborative partnerships
0.03729	Help transfer knowledge		
0.02572	Allow students to critique		
0.0353	Relations between teachers and students	0.0867	Access to instructor
0.0200	Eager professor Students		
0.03528	Access to master		
0.0232	Comparison of different theories	0.1242	Extensive content
0.01831	Appropriate training volume		
0.01675	Offering views of others		
0.05179	Entries up to date		
0.01783	Provide practical examples.		
0.01692	Feedback from teaching	0.0615	Test and scores
0.01420	Fair assessment		
0.01142	Testing correlate with teaching		
0.02057	The practical exam		
0.03955	Applicability book	0.0680	Duties outside the classroom
0.02253	Being effective assignments		

$$D_{ij}^{+}=\begin{cases}1-\dfrac{c_{ij}-a^{+}}{b^{+}+c_{ij}-a^{+}-b_{ij}} & for(b_{ij}<b^{+})\\ 1-\dfrac{c^{+}-a_{ij}}{b_{ij}+c^{+}-a_{ij}-b^{+}} & for(b^{+}<b_{ij})\end{cases}$$

$$D_{ij}^{-}=\begin{cases}1-\dfrac{c^{-}-a_{ij}}{b_{ij}+c^{-}-a_{ij}-b^{-}} & for(b^{-}<b_{ij})\\ 1-\dfrac{c_{ij}-a^{-}}{b^{-}+c_{ij}-a^{-}-b_{ij}} & for(b_{ij}<b^{-})\end{cases}$$

Step 5: Calculation the relative closeness of each choice to ideals $\left(C_i^{+}\right)$.This indicator is defined for mixing the values of S_i^{+},S_i^{-} and consequently comparison of choices. It can be calculated as follows:

$$C_i^{+}=\frac{S_i^{+}}{S_i^{+}+S_i^{-}}$$

Step 6: Choice ranking according to descending C_i^{+} can be ranked.

Statistical society and sample volume

The statistical society of this research includes all participants in classes of Mehrpuian Institute of higher education in Mashhad who have received education in Mehr semester 1392 .These classes include:

1. Assessment and risk management with 20 participants
2. Assessment of economic projects with 20 participants
3. Advanced accountancy with 30 participants
4. Logistic management in industry with 24 participants
5. Financial engineering with 30 participants

Also, opinions of 15 experts were used to collect experts` views for determination of criteria importance including all trainers and lecturers.

Final weight of indicators

The first question of this research was regarding the weight importance of each of indicators.

Findings obtained from AHP technique in table (1) indicates the proportion of the weight of each of indicators to its own criterion. Final weight is

The second question in this research was the performance of each of training classes in statistical society. These opinions were calculated using average fuzzy –collection theory after data collection according to oral statements of table (2)

Table (2): Verbal statements

Fuzzy numbers	Verbal expressions
$(0,0.1,0.3)$	Very low
$(0.1,0.3,0.5)$	Low
$(0.3,0.5,0.7)$	medium
$(0.5,0.7,0.9)$	High
$(0.7,0.9,1)$	Very high

Finally, performance of each class was obtained after fuzzifying by the method of the center of gravity. TOPSIS technique was used for final ranking of these classes. First, in this technique, weight matrix and decision matrix need to be made. Weight matrix are obtained in table (1) and decision matrix is 5*28 which the fuzzified numbers of each class are. Rank of each class in terms of closeness to positive ideal response and being far from negative ideal response are in table (3).

Table (3) Final Table

The final score	Class name	RANK
0.588	Evaluation of economic projects	1
0.570	Assessment and Risk Management	2
0.549	Logistics Management in Industry	3
0.493	Financial Engineering	4
0.399	Advanced Accounting	5

Furthermore, these classes are ranked using most possible scores and definite numbers in order to have comparable results. Ranking Correlation coefficient of Spearman ranking results of fuzzy and definite methods are 0.977 which it confirms high Correlation of findings from these two methods.

CONCLUSION

In current research, the most important effective factors on educational classes of Mehrpuian Institute of higher education in Mashhad were identified and ranked. In this regard, appropriate criteria were extracted after investigating research background and interviews with experts and reception of their opinions and these criteria were compared and ranked with the help of analysis hierarchical process technique .Then model of Students` Evaluation of Educational Quality (SEEQ) using multi-criteria decision -making method and fuzzy collections were used. After that, each of classes were ranked using TOPSIS method. Results from fuzzy TOPSIS showed that educational classes are as following:

1. Assessment of economic projects
2. Assessment and risk management
3. Logistic management in industry
4. Financial engineering

Advanced accountancy

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