

Studies on the Sports Anxiety in the Fuzzy Clustering-Based Competitive Sports

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Abstract: The psychological factor is a very important factor in the modern competitive sports games and sometimes it can often determine the outcome of the games. In order to obtain excellent results in competitive sports games, the athletes take high-load, high-pressure and high-intensity training for a long time and thus they would have some psychological problems, such as pre-game stress and anxiety, but if these problems are not solved in time, they will gradually accumulate and expand, making the athletes have aggressive behaviors, which are offensive and can affect the sports performance. Based on the factors of sports anxiety in the competitive sports, the paper adopts the clustering method of fuzzy equivalence relation to make accurate and objective division of the sample data and based on this, puts forward a new evaluation method of the sports anxiety in the competitive sports and by using this evaluation method, we can judge the anxious psychology of the athletes in the competitive sports fundamentally and the coaches can take targeted guidance measures against the problems faced by the athletes and thus help the athletes with heavy psychological pressure overcome the adverse factors that would cause psychological problems and promote the healthy and normal development of their mind and body and the improvement of the competition results.

Keywords: Anxiety, competitive sports, fuzzy clustering

INTRODUCTION

Anxiety is a nervous and frightened emotional state formed by the frustrated self-esteem and self-confidence or the aggravated sense of failure and guilt because of the threats that the objectives cannot be achieved or the obstacles cannot be overcome (Annemarie and Roland, 2011). The anxiety generated under the circumstance of sports is called sports anxiety, which is a common emotional reaction in the sports community and its generality and effect on the sports operation make the sports psychologists and athletes, coaches and the general sporters pay special attention to it Dilip *et al.* (2010).

Over the years, most of the studies on the sports anxiety in the Sports Psychology are based on the anxiety theory of Spielberg, the studies on adjusting the personality variables of the sports anxiety also focus on Spielberg's trait anxiety accordingly and they rarely involve other influencing factors such as the personality variable, environmental condition and the importance of the competition, which is clearly not enough to comprehensively understand the moderators of the sports anxiety and help the athletes to effectively control the sports anxiety (Frank *et al.*, 2008). This study attempts to adopt the way of cluster analysis to study the relationship between the various influencing factors and the sports anxiety psychology, so as to develop a method that can effectively judge the sports anxiety (Akbar *et al.*, 2011).

Cluster analysis is based on the properties of the sample, to use mathematical methods to determine the

affinities between the samples in a quantitative manner according to the similarity or difference indicators and cluster the samples in accordance with the degree of the affinity (Ankit *et al.*, 2011; Peng *et al.*, 2010; Cen *et al.*, 2009). Firstly, we make use of the fuzzy equivalence relations-based fuzzy clustering technology to obtain the best classification of the sample; then, we make forecasting according to the theory of fuzzy similarity of the fuzzy mathematics; finally, we get the anxiety state of the athletes under the different influencing factors (Ling *et al.*, 2011; Markou and Kassomenos, 2010; Magdalena *et al.*, 2012). Thus the coaches and the athletes can take targeted adjustment measures to alleviate anxiety. This study can be regarded as an application of the clustering methods in the sports anxiety.

THE CAUSES OF SPORTS ANXIETY AND ITS FEATURES

The main causes for the athletes' sport anxiety include the fear of failure, the fear of success (they fear they must assume greater responsibilities after success and meet the rising social demands and expectations), the fear of injury as well as the fear of social reactions (parents, peers, audiences, leaders, news media, etc.). The uncertainty of the sports competitions is the root cause of sports anxiety (Behroz *et al.*, 2011).

In order to consciously evaluate and control the sports anxiety to maximize the sports performance, we should know about the features of sports anxiety (Claudio and Laura, 2007; Anne, 2010; Graham and

Table 1: The table of the factors influencing the sports anxiety

		Time of game		Sports experience			Cognitive assessment			Results of the game			Own level			Emotional character			
		Pre-game	In the game	Post-game	Inexperienced	Less experienced	Experienced	Over-estimate	Normal estimate	Underestimate	Unimportant	Generally important	Very important	Lower	General	Higher	Pessimistic	General	Optimistic
Anxiety index																			
Time of game	Pre-game	70			73	68	58	65	60	58	61	67	73	75	72	61	76	68	59
	In the game		63		67	64	52	63	57	55	56	63	65	70	68	54	67	64	54
	Post-game			68	70	67	56	64	58	56	60	66	71	73	70	61	76	67	58
Sports experience	Inexperienced	65	60	58	68		60	58	61	67	73	75	72	61	76	68	58	65	
	Less experienced	63	57	55		52	57	55	56	63	65	70	68	54	67	64	52	63	
	Experienced	64	58	56			64	58	56	60	66	71	73	70	61	76	67	56	64
Cognitive assessment	Over-estimate				68	58	65	60			67	73	75	72	61	76	68	76	69
	Normal estimate	63	57	55	56	63	65		68		67	63	57	55	58	61	67	73	58
	Under-estimate	64	58	56	60	66	71			61	76	64	58	56	55	56	63	65	55
Results of the game	Unimportant	60	58	61	67	73	75	72	61	76	68			61	56	60	66	71	56
	Generally important	57	55	56	63	65	70	68	54	67		57		56	76	68	76	68	76
	Very important	58	56	60	66	71	73	70	61	76			56	60	58	61	67	73	58
Own level	Lower	60	58	61	67	73	75	72	61	76	68	60	58			56	63	65	55
	General	63	57	55	56	63	65	70	68	54	67	63	57		56		66	71	56
	Higher	64	58	56	60	66	71	73	70	61	76	64	58			61	67	73	58
Emotional character	Pessimistic	60	58	61	67	73	75	72	61	76	68	60	58	61	68	54	67		
	General	57	55	56	63	65	70	68	54	67	64	57	55	56	70	61		64	
	Optimistic	57	55	56	63	55	56	68	50	63	64	54	53	53	61	76			61

James, 2010). Through the access to relevant information and in combination with relevant examples, the analysis and evaluation of the factors influencing the sports anxiety mainly start from the following six aspects and the quantitative indexes are shown in Table 1.

The first is the sports anxiety and time. At the different stages of the game, the sports anxiety level is different. The sports anxiety increases gradually as the game time approaches. For example, from one week before the game to the point of the beginning of the game, the anxiety of some athletes will rise, but there are also athletes whose anxiety declines when they get on with play and rises again after the game and besides, the post-game anxiety will continue for some time.

The second is the sports anxiety and sports experience. The experienced athletes differ significantly from the inexperienced athletes and the difference is different in different sports items. For example, the experienced gymnasts have higher pre-game anxiety than the inexperienced athletes; while in the items of skydiving, basketball and wrestling, etc., the inexperienced athletes have higher pre-game anxiety than the experienced athletes.

The third is the sports anxiety and the cognitive assessment. The level of the pre-game anxiety changes with the athletes' estimate of the game, the importance of the game and the situational pressure felt and faced by them. Competing with weaker opponents, the athletes will have lower pre-game anxiety; competing with stronger opponents, the athletes will have higher pre-game anxiety. But it is not true that, the stronger the opponent is, the higher the level of the anxiety will be. The level of the anxiety often reach the top before the key games that determines the ranking. The pre-game

anxiety is not very high when the opponent is obviously stronger than himself. Researches show that, the scale of the game affects the change of the level of the pre-game anxiety and the larger the scale of the game is, the higher the level of the anxiety will be.

The fourth is the sports anxiety and the results of the game. The result of the game exerts a great influence on the change of the post-game anxiety. In most cases, the defeat in the game results in the rise of the level of anxiety; the success in the game leads to the decline of the level of the anxiety. But there are special circumstances. The success of the game is related to the goal of the athlete, the victory does not necessarily mean success and the failure does not necessarily mean un-success. The change of anxiety in this case depends primarily on the cognitive level of athletes.

The fifth is the sports anxiety and the own level of the athletes. When the athlete has a high level, his self-confidence will be enhanced. Including, if he has ever participated in the game and won all the games, he will be more certain of success and his pre-game anxiety will be correspondingly lower, but on the other hand, the high-level athletes also have anxiety or ever deeper anxiety when they are worried about that their own level cannot be performed at the right level.

The sixth is the sports anxiety and the emotional character. Under normal circumstances, if the athletes have more pleasant emotions than negative emotions, keep optimistic and vibrant, remain hopeful for life, show more stable mood and excel in controlling and adjusting their mood, their emotional response matches the environment, the response strength conforms to the situation that causes the response, then the sense of anxiety will be significantly lower.

Based on the above six factors, the degree of the anxiety of athletes in competitive sports can be divided into three levels, which are mild anxiety, general anxiety and severe anxiety, signed as U_1 , U_2 and U_3 respectively. The influencing factors of the anxious psychology include the time of the game, the sports experience, the cognitive assessment, the result of the game, the own level and the emotional character, which are signed as x_1 , x_2 , x_3 , x_4 , x_5 and x_6 respectively. Use certain mathematical methods to merge the samples studied or the variables into several categories, so that all the individuals in each category are closely related and the individuals in different category are relatively alienated. Based on this, apply the method of fuzzy clustering to analyze and judge the state of anxiety according to the six influencing factors of the athletes' anxiety in the competitive sports.

THE ANALYTIC APPLICATIONS OF FUZZY CLUSTERING TO THE SPORTS ANXIETY

The theoretical definition of fuzzy clustering:

Definition 1: An appropriate classification shall meet the following three conditions:

- **Reflexivity:** That is, any object must belong to the same category with itself.
- **Symmetry:** That is, if the object u and object v belong to the same category, v and u should also belong to the same category.
- **Transitivity:** That is, if object u and object v belong to the same category, while object v and object w belong to the same category, then u and w should also belong to the same category.

The relations that meets the above three conditions is an equivalence relation. Therefore, the fuzzy clustering analysis is based on fuzzy equivalence relation.

Definition 2: If the fuzzy relation matrix $\bar{R} \in M_{n \times n}$ meets reflexivity and symmetry, \bar{R} is called fuzzy compatibility relation; the fuzzy compatibility relation that meets the transitivity is called fuzzy equivalence relations.

Definition 3: (The transitive closure of fuzzy relations) for the Union $U = \{u_1, u_2, \dots, u_n\}$, set \bar{R} as the fuzzy relation in U , if the fuzzy relation $t(\bar{R})$ in U meets:

- $(t(\bar{R}))^2 \subseteq t(\bar{R})$
- $\bar{R} = t(\bar{R})$
- Set \bar{R} as the transitive relation of Union U , $\bar{R} \subseteq \bar{R}_1$ and, there must be $t(\bar{R}) \subseteq \bar{R}_1$, then $t(\bar{R})$ is called the transitive closure of \bar{R}

The concrete solution procedure of the operations involved in the model:

Use the square method to calculate the transitive closure of \bar{R} : Let $\bar{R} \in M_{n \times n}$ be a fuzzy compatibility matrix, then there is a positive integer $m \leq n$ and let \bar{R}^m be a fuzzy equivalence matrix, calculate the square $\bar{R} \rightarrow \bar{R}^2 \rightarrow \bar{R}^4 \rightarrow \dots \bar{R}^{2^k} \rightarrow \dots$ successively from the fuzzy matrix \bar{R} . $\bar{R}^m \circ \bar{R}^m = \bar{R}^m$ When appears for the first time, it show that \bar{R}^m has already had transitivity, \bar{R}^m is the transitive closure $t(\bar{R})$ calculated and $t(\bar{R})$ is a fuzzy equivalence matrix.

Clustering principle: Select the appropriate trust level $\lambda \in [0, 1]$, calculate, $t(\bar{R})_\lambda$ which is the λ cutting matrix of $t(\bar{R})$, then classify according to $t(\bar{R})_\lambda$ and the classification obtained is the equivalence classification on the level of λ .

Set $t(\bar{R}) = (\bar{r}_{ij})_{n \times n}$ and $t(\bar{R})_\lambda = (\bar{r}_{ij}(\lambda))_{n \times n}$, then,

$$\bar{r}_{ij}(\lambda) = \begin{cases} 1 & \bar{r}_{ij} \geq \lambda \\ 0 & \bar{r}_{ij} < \lambda \end{cases}$$

For $u_i, u_j \in U$, if $\bar{r}_{ij}(\lambda) = 1$, then the objects of u_i and u_j are classified as the same category on the level of λ . When λ takes different values in $[0, 1]$, the corresponding classification will also change.

Make the systematical clustering dendrogram: In order to visually see the degree of correlation between the objects classified, we usually grade the different elements r_{ij} in $t(\bar{R})$ from big to small: $1 = \lambda_1 > \lambda_2 > \dots > \lambda_m$. Let λ take the appropriate value in $[\lambda_m, 1]$ and then we get a series of classifications according to $t(\bar{R})_{\lambda_1}$. If this series of the classifications are drawn on the same chart, we get the systematical clustering dendrogram.

The judgment method of fuzzy clustering: There is an infinite number of fuzzy partition matrix and the total of this fuzzy partition matrix is known as fuzzy partition space. The standard of the optimal classification is that the square of the distance between the sample and the cluster center is the smallest. As a sample belongs to the various categories according to the different degree of membership, so we should also consider its distance from the cluster center of each class. Stepwise clustering method requires iterative calculation, the calculation load is heavy and it must be carried out on a computer. After calculating the optimal fuzzy partition matrix, we must also obtain the corresponding conventional partition. At the moment, we can put the cluster centers obtained into the computer, input the sample one by one again and compare them with each cluster center, then the sample belongs to the cluster center that it is most like.

Table 2: The sample data table

The factors influencing the anxious psychology of the athletes						
Sample no.	Time of the game x_1	Sports experience x_2	Cognitive assessment x_3	Results of the game x_4	Own level x_5	Emotional character x_6
u_1	0.70	0.60	0.75	0.55	0.70	0.65
u_2	0.80	0.70	0.80	0.70	0.75	0.75
u_3	0.60	0.60	0.40	0.60	0.55	0.55
u_4	0.85	0.80	0.70	0.80	0.85	0.85
u_5	0.65	0.50	0.45	0.70	0.55	0.50
u_6	0.80	0.85	0.65	0.75	0.80	0.80

Method one: Put the samples to be tested- $V = \{v_1, v_2, \dots, v_m\}$ into the original sample- $U = \{u_1, u_2, \dots, u_m\}$, constitute a new problem and carry out clustering analysis again, so as to get the best clustering, then the clustering of the samples to be tested can be judged.

Method two: Calculate each similarity coefficient of the elements in the samples to be tested- $V = \{v_1, v_2, \dots, v_m\}$ and the original sample- $U = \{u_1, u_2, \dots, u_m\}$ to identify the greatest similarity coefficient and then the clustering of the samples to be tested can be judged.

By comparing the two judgment methods, we can see that method two is much simpler than method one, it has less calculation steps and it is convenient. This study adopts method two to cluster the samples to be tested. Using this method, the number of categories must be known in advance and if the number of categories is irrational, it will have to calculate again. This cannot do better than applying the fuzzy equivalence relations-based systematical clustering method, which can get the cluster center, i.e., the various types of model sample, which is often precisely required. Therefore, we can use the results of the fuzzy equivalence relations as the initial classification and then obtain better results through the iterative method.

The modeling process of fuzzy clustering: The test objects are from the provincial sports teams and the items mainly include the track and field, balls, swimming, weightlifting and taekwondo. Before the game, by filling out the athlete anxiety status inventory, carry out targeted test to the athletes that participate in the competitive sports and by adopting the anxiety influencing factors, summarize the sample data (Table 2, calculate by percentile system and then normalize). Select six athletes for the sample, $U = \{u_1, u_2, u_3, u_4, u_5, u_6\}$. Suppose we are very familiar with the status of the six athletes, let this be the known samples, among which, $\{u_1\}$ is in the state of mild anxiety $\{u_2, u_4, u_6\}$, is in the state of general anxiety, $\{u_3, u_5\}$ is in the state of severe anxiety. Use the fuzzy clustering method of the fuzzy equivalence relations to carry out classified validation to the samples. Adopt the geometric mean minimum similarity coefficient formula to calculate the similarity coefficient for all

samples, thus get the fuzzy relation matrix \bar{R} and then use the “square” method to obtain the transitive closure \bar{R}^* of \bar{R} .

Among which, u_{ij} shows the degree of the No. i object being influenced by the No. j object, the tabular meaning is the degree of the six samples being influenced by the various factors, but the factors influencing the anxiety of the athletes are in various aspects and the six factors will have an integrated impact, so we must obtain the anxiety composite index of the sample through analysis, which needs to use the mathematical method, i.e., the fuzzy clustering analysis algorithm we used in this study.

U is a finite union, the fuzzy relations in U can be expressed in the fuzzy matrix, signed as U^* and the fuzzy matrix in the mathematical form is shown as follows:

$$U^* = \begin{pmatrix} 0.70 & 0.60 & 0.75 & 0.55 & 0.70 & 0.65 \\ 0.80 & 0.70 & 0.80 & 0.70 & 0.75 & 0.75 \\ 0.60 & 0.60 & 0.40 & 0.60 & 0.55 & 0.55 \\ 0.85 & 0.80 & 0.70 & 0.80 & 0.85 & 0.85 \\ 0.65 & 0.50 & 0.45 & 0.70 & 0.55 & 0.50 \\ 0.80 & 0.85 & 0.65 & 0.75 & 0.80 & 0.80 \end{pmatrix}$$

Use the geometric mean minimum similarity coefficient (i.e., Judgment method two):

$$r_{ij} = \frac{\sum_{k=1}^6 (X_{ik} \wedge X_{jk})}{\sum_{k=1}^6 \sqrt{X_{ik} \cdot X_{jk}}}$$

Calculate the similarity coefficient r_{ij} ($i, j = 1, 2, \dots, 6$) and obtain the fuzzy relations matrix \bar{R} of 6×6 :

$$\bar{R} = \begin{pmatrix} 1.0000 & 0.9373 & 0.9056 & 0.8931 & 0.8854 & 0.9011 \\ 0.9373 & 1.0000 & 0.8596 & 0.9429 & 0.8662 & 0.9526 \\ 0.9056 & 0.8596 & 1.0000 & 0.8257 & 0.9491 & 0.8431 \\ 0.8931 & 0.9429 & 0.8257 & 1.0000 & 0.8331 & 0.9689 \\ 0.8854 & 0.8662 & 0.9491 & 0.8331 & 1.0000 & 0.8515 \\ 0.9011 & 0.9526 & 0.8431 & 0.9689 & 0.8815 & 1.0000 \end{pmatrix}$$

As R does not satisfy transitivity, use the “square” method to obtain the fuzzy equivalence matrix R^* and use the square substructure synthesis method to obtain t (\bar{R}):

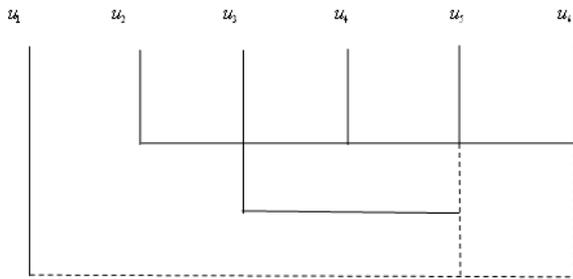


Fig. 1: The systematical clustering dendrogram when $\lambda = 0.7899$

$$\bar{R}^2 = \bar{R} \circ \bar{R} = \begin{pmatrix} 1.0000 & 0.9373 & 0.7433 & 0.8102 & 0.6373 & 0.6946 \\ 0.9373 & 1.0000 & 0.5460 & 0.7904 & 0.6305 & 0.8235 \\ 0.8930 & 0.5460 & 1.0000 & 0.4988 & 0.8114 & 0.7454 \\ 0.7893 & 0.7202 & 0.7448 & 1.0000 & 0.6727 & 0.8643 \\ 0.8634 & 0.5630 & 0.7653 & 0.8730 & 1.0000 & 0.6297 \\ 0.6359 & 0.8875 & 0.7904 & 0.5130 & 0.6038 & 1.0000 \end{pmatrix} \in \bar{R}$$

$$\bar{R}^4 = \bar{R}^2 \circ \bar{R}^2 = \begin{pmatrix} 1.0000 & 0.7718 & 0.6726 & 0.6362 & 0.6146 & 0.6593 \\ 0.7718 & 1.0000 & 0.5460 & 0.7904 & 0.5630 & 0.8235 \\ 0.6726 & 0.5460 & 1.0000 & 0.4648 & 0.8114 & 0.5053 \\ 0.6362 & 0.7904 & 0.4648 & 1.0000 & 0.4817 & 0.8813 \\ 0.6146 & 0.5630 & 0.8114 & 0.4817 & 1.0000 & 0.5257 \\ 0.6593 & 0.8235 & 0.5053 & 0.8813 & 0.6038 & 1.0000 \end{pmatrix} \in \bar{R}^2$$

$$\bar{R}^8 = \bar{R}^4 \circ \bar{R}^4 = \begin{pmatrix} 1.0000 & 0.7718 & 0.6726 & 0.6362 & 0.6146 & 0.6593 \\ 0.7718 & 1.0000 & 0.5460 & 0.7904 & 0.5630 & 0.8235 \\ 0.6726 & 0.5460 & 1.0000 & 0.4648 & 0.8114 & 0.5053 \\ 0.6362 & 0.7904 & 0.4648 & 1.0000 & 0.4817 & 0.8813 \\ 0.6146 & 0.5630 & 0.8114 & 0.4817 & 1.0000 & 0.5257 \\ 0.6593 & 0.8235 & 0.5053 & 0.8813 & 0.6038 & 1.0000 \end{pmatrix} = \bar{R}^4$$

Therefore,

$$t(\bar{R}) = \bar{R}^4 = \begin{pmatrix} 1.0000 & 0.7718 & 0.6726 & 0.6362 & 0.6146 & 0.6593 \\ 0.7718 & 1.0000 & 0.5460 & 0.7899 & 0.5630 & 0.8235 \\ 0.6726 & 0.5460 & 1.0000 & 0.4648 & 0.8114 & 0.5053 \\ 0.6362 & 0.7899 & 0.4648 & 1.0000 & 0.4817 & 0.8813 \\ 0.6146 & 0.5630 & 0.8114 & 0.4817 & 1.0000 & 0.5257 \\ 0.6593 & 0.8235 & 0.5053 & 0.8813 & 0.6038 & 1.0000 \end{pmatrix}$$

Select an appropriate value of the confidence level $\lambda \in [0, 1]$ and carry out systematical clustering by $t(\bar{R})$ -the cutting matrix of λ . Firstly, grade the elements in $t(\bar{R})$ from big to small, then use the λ cutting matrix of R^* ($\lambda \in [1, 0]$), to make the systematical clustering dendrogram for U , as to the number of categories that needs to be cut, select the appropriate value and thus get the conclusion of classification. According to the known sample classification, let $\lambda = 0.7899$:

$$t(\bar{R})_{0.7899}^4 = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 \end{pmatrix}$$

Use the systematical clustering dendrogram to classify $\{u_1, u_2, u_3, u_4, u_5, u_6\}$.

When $\lambda = 0.7899$, the systematical clustering dendrogram is shown in Fig. 1.

It can be known from the analysis of the Figure: The classification status includes $\{u_1\}$, $\{u_2, u_4, u_6\}$ and $\{u_3, u_5\}$. The above process is the analytic process of the whole fuzzy clustering and under the influence of the six factors influencing the anxious psychology in the competitive sports, the six samples- $\{u_1, u_2, u_3, u_4, u_5, u_6\}$ have different anxiety indexes, but the comprehensive analysis still has analogy.

RESULTS ANALYSIS

By selecting the athlete samples whose anxiety state has been known to carry out fuzzy clustering analysis, we get the best value of λ in $[r_m, 1]$, then apply to the other sample analysis and make use of the geometric mean similarity coefficient to get the similarity coefficient between the other randomly-selected samples and the known samples, the similarity between the randomly-selected samples and the known samples can be judged after sorting and thus the anxiety state of the athletes represented by the random samples can be determined.

This study has selected six athletes as the sample, $U = \{u_1, u_2, u_3, u_4, u_5, u_6\}$ and the known sample $\{u_1\}$ is in the state of mild anxiety, $\{u_2, u_4, u_6\}$ is in the state of general anxiety and $\{u_3, u_5\}$ is in the state of severe anxiety. When $\lambda = 0.7899$, the sample classification of the fuzzy clustering conforms to the actual situation and the classification is correct, so the classification is taken as the influencing indexes of the athletes' anxiety. The assessment method: Carry out psychological tests to and normalize the evaluation object u_m , make use of the geometric mean minimum similarity coefficient to calculate the similarity coefficients-and between u_m and $u_1, u_2, u_3, u_4, u_5, u_6$ and use r_m to make accurate classification of u_m .

Case study: Suppose that two athletes have received anxiety test, they need cluster analysis, the normalization results of the test values of the two athletes are: $v_1 = (0.85, 0.53, 0.72, 0.7, 0.9, 0.85)$ and $v_2 = (0.51, 0.47, 0.62, 0.43, 0.58, 0.72)$. Use the geometric mean minimum similarity coefficient, i.e., judgment method two, to carry out clustering and select the formula:

$$r_{ij} = \frac{\sum_{k=1}^m (u_{ik} \wedge u_{jk})}{\sum_{k=1}^m (u_{ik} \vee u_{jk})}$$

Calculate the similarity coefficient between the two samples to be tested and the six known samples and we get the following results respectively:

$$r_{1i} = (0.80, 0.85, 0.49, 0.81, 0.56, 0.74), i = 1, 2, 3, 4, 5, 6$$

$$r_{2j} = (0.67, 0.75, 0.83, 0.69, 0.68, 0.74), j = 1, 2, 3, 4, 5, 6$$

Through sorting, we get:

$$0.85 > 0.81 > 0.80 > 0.74 > 0.56 > 0.49$$

$$0.83 > 0.75 > 0.74 > 0.69 > 0.68 > 0.67$$

That is:

$$r_{12} > r_{14} > r_{13} > r_{16} > r_{15} > r_{11}$$

$$r_{23} > r_{22} > r_{26} > r_{24} > r_{25} > r_{21}$$

r_{1m} and r_{2m} are $r_{12} = 0.85$ and $r_{23} = 0.83$, thus we can determine that the similarity coefficient between the sample to be tested (v_1) and the known sample (u_2) is the biggest, so v_1 and u_2 belong to the same category and they are the athletes in the state of mild anxiety; the similarity coefficient between the sample to be tested (v_2) and the known sample (u_3) is the biggest, so v_2 and u_3 belong to the same category and they are the athletes in the state of severe anxiety. The case is the application of fuzzy clustering, which is used to judge the anxiety state of the tested athletes.

CONCLUSION

Sports anxiety is common in the competitive sports and this study has firstly analyzed the causes of the sport anxiety and its features, established the evaluation model of the athletes's anxiety through the equivalence relations-based fuzzy clustering analysis method and realized the evaluation of the athletes' anxiety in competitive sports. It is proved that, this method can judge the pre-game anxiety of athletes correctly and objectively and get the result that that athlete is in the state of mild anxiety, general anxiety or severe anxiety. Then the coaches and athletes can take appropriate scientific and effective methods to adjust the anxiety according to the difference in the stages of the game, the status of the sports experience, the cognitive assessment, the result of the game, the own level and the emotional character, so as to relieve anxiety and achieve better competition results.

REFERENCES

Akbar, J., H. Talebi and S.S. Seed, 2011. The relationship between sport orientation and competitive anxiety in elite athletes. *Proc-Soc. Behav. Sci.*, 30: 1161-1165.

- Ankit, P., P.B. Nigel, D. Gerard, R. Ashish, W. Keith *et al.*, 2011. Application of principal component and hierarchical cluster analysis to classify fruits and vegetables commonly consumed in Ireland based on in vitro antioxidant activity. *J. Food Compos. Anal.*, 24(2): 250-256.
- Anne, M.J., 2010. A mind-body approach for precompetitive anxiety in power-lifters: 2 case studies. *J. Chiropract. Med.*, 9(4): 184-192.
- Annemarie, S.D. and S. Roland, 2011. Extra-curricular sport participation: A potential buffer against social anxiety symptoms in primary school children. *Psychol. Sport Exerc.*, 12(4): 347-354.
- Behroz, K., S. Abdulmir and D. Yaghob, 2011. Comparison relation between mental skills with sport anxiety in sprint and endurance runners. *Proc-Soc. Behav. Sci.*, 30: 2280-2284.
- Cenk, B., D. Irem and M.T. Birgonul, 2009. Comparing the performance of traditional cluster analysis: Self-organizing maps and fuzzy C-means method for strategic grouping. *Exp. Syst. Appl.*, 36(9): 11772-11781.
- Claudio, R. and B. Laura, 2007. Perceived impact of anger and anxiety on sporting performance in rugby players. *Psychol. Sport Exerc.*, 8(6): 875-896.
- Dilip, R.P., O. Hatim and T. Marisa, 2010. Sport-related performance anxiety in young female athletes. *J. Pediat. Adolescent Gynecol.*, 23(6): 325-335.
- Frank, E.A., C.R. Glyn and M.P. Anne, 2008. Achievement goals and gender effects on multidimensional anxiety in national elite sport. *Psychol. Sport Exerc.*, 9(4): 449-464.
- Graham, J.M. and T.N. James, 2010. The effect of "green exercise" on state anxiety and the role of exercise duration, intensity and greenness: A quasi-experimental study. *Psychol. Sport Exerc.*, 11(3): 238-245.
- Ling, J., A.H. Robert and J.B. Nancy, 2011. Ozone pollution regimes modeled for a summer season in California's San Joaquin Valley: A cluster analysis. *Atmos. Environ.*, 45(27): 4707-4718.
- Magdalena, H., B. Janette, L. Christina, T. Nirenberg, R. Longabaugh *et al.*, 2012. Identifying subtypes of dual alcohol and marijuana users: A methodological approach using cluster analysis. *Addict. Behav.*, 37(1): 119-123.
- Markou, M.T. and P. Kassomenos, 2010. Cluster analysis of five years of back trajectories arriving in Athens, Greece. *Atmos. Res.*, 98(2-4): 438-457.
- Peng, L., Z. Shengli and Z. Runchu, 2010. A cluster analysis selection strategy for supersaturated designs. *Comput. Stat. Data An.*, 54(6): 1605-1612.