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SOME APPLICATIONS OF THE CHOICE THEORY. FINDING OF THE CHOICE WITH THE FIXED FRACTION PROCEDURE.

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Abstract: *The choice forecasting is one of the most researched problem in Economics and Social Theory. This paper presents some practical studies and shows how the statistical technics can be used to design and analyze the human preference behavior. In many practical examples the choice functions are not rationalizable. This problem has often treated by embedding the non-rational choice function into a new rational one. If we take in consideration the new results from the fuzzy theory which perfectly design the vague character of human preferences, then seams to be better to treat the choice forecasting using the sum-fuzzy implementation of a choice function. Here we applied an original procedure for this aim.*

Keywords: *decision making, choice function, artificial learning*
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1 Introduction

Since Richter [7] has give the rational choice function concept, many researchers started to apply the fuzzy rationality for these functions see [1, 2, 6, 8]. However the major result from this research area was stated by Luo [5] which developed the results of Barrett et al [2] and of Luo et al [4]. Our paper starts from these statements and from one of the artificial learning procedure presented by Dumiterscu [3], then we studies a practical choice case where we show how the fuzzy approach improves the study results and what are the study results when we use fixed fraction procedure.

2 An practical example

The following example is from the marketing area. Suppose that a pearson must chose a namely product that exists made by four companies. The choice set is:

$$X = \{x_1, x_2, x_3, x_4\}$$

If the preference relation $\succ$ is gave by the price, then: $x_4 \succ x_3 \succ x_2 \succ x_1$. The choice function C is:

$P(X)$	x_1	x_2	x_3	x_4	x_1x_2	x_1x_3	x_1x_4	x_2x_3	x_2x_4	x_3x_4	$x_1x_2x_3$
C	x_1	x_2	x_3	x_4	x_2	x_3	x_4	x_3	x_4	x_4	x_3

If the choice is the second preference, the choice function C is:

If the preference is the second one then the choice function is not rationalizable. This example prove the importance of using the fuzzy theory to forecast a human choice.

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$x_1x_2x_4$	$x_1x_3x_4$	$x_2x_3x_4$	$x_1x_2x_3x_4$
x_4	x_4	x_4	x_4

$P(X)$	x_1	x_2	x_3	x_4	x_1x_2	x_1x_3	x_1x_4	x_2x_3	x_2x_4	x_3x_4	$x_1x_2x_3$
C	x_1	x_2	x_3	x_4	x_1	x_1	x_1	x_2	x_2	x_3	x_2

3 Fixed fraction algorithm results

In [4, 5] Luo define the a fuzzy relation and a matrix representation of the fuzzy binary relation

Definition 1.. *A fuzzy binary relation on X is a function r_R,*

$$r_R : X \times X \to [0,1]$$

which gives for (x,y) a real umber from $[0,1]$ such that

$$r_R\,(x,y) \in (0,1] \qquad \textit{if } (x,y) \in R$$

and

$$r_R = 0 \qquad \textit{if } (x,y) \notin R$$

and the matrix representation is

$$\mathbf{M(r_R)} = \begin{pmatrix} r_R(x_1,x_1) & r_R(x_1,x_2) & \dots & r_R(x_1,x_n) \\ r_R(x_2,x_1) & r_R(x_2,x_2) & \dots & r_R(x_2,x_n) \\ \vdots & \vdots & \vdots & \vdots \\ r_R(x_n,x_1) & r_R(x_n,x_2) & \dots & r_R(x_n,x_n) \end{pmatrix}$$

Luo [5] states and proves a theorem that makes possible the finding of matrix representation using the percepron artificial learning rule. Our algorithm use another artificial learning rule, namely the fixed fraction procedure.
The fixed fraction procedure is described by Dumitrescu [3] and is an artificial learning method that uses a linear decision function depending of a weight vector.

$$g : \mathbf{R^n} \to \mathbf{R}$$

$$g(z) = w^T z$$

where

$$w = (w_1, w_2, \dots, w_n)^T$$

is a weight vector and

$$z = (z_1, z_2, \dots, z_n)^T$$

is an input vector.
This training method find the optimal weight vector that correct classifies all the elements from a learning set.
The correction of the weight vector is: modify w into $w - c\frac{w^T z}{||z||^2}z$, if $w^T z \le 0$, where $c > 0$.

$x_1x_2x_4$	$x_1x_3x_4$	$x_2x_3x_4$	$x_1x_2x_3x_4$
x_2	x_3	x_3	x_3

With our algorithm we find the following matrix representation for the practical example which is presented in the previous section.

$$\mathbf{W} = \begin{pmatrix} 1.00 & 0.48 & 0.33 & 0.22 \\ 0.14 & 0.47 & 0.51 & 0.13 \\ 0.28 & 0.77 & 0.50 & 0.46 \\ 0.23 & 0.87 & 0.45 & 0.67 \end{pmatrix}$$

4 Conclusions

Our approach is more suitable to be used for this concrete example. The individual forecasting preferences are better designed with fuzzy theory.

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