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Appraise testees' behavior in the individual tests using fuzzy logic

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ABSTRACT

Background: In this paper, by using fuzzy logic a new method offered that appraise the behavior of testee in individual tests. **Objective:** Behavioral observation includes some criteria. They are often qualitative. **Results:** Therefore, in this method at first qualitative variables convert into quantitative variables, then classification using expert panel is determine, membership functions of fuzzy sets are define and traditional scores converted into fuzzy scores. centroid used for defuzification. Finally, by using the t-test, obtains scores are evaluated.

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INTRODUCTION

One of the most important principles of individual tests is observe the testees' behavior in the test session. With this observation is that results interpretations of other factors are meaningful. In other words, testees' behavior observation is the most important advantage of individual tests than the group tests. Individual tests that have many strengths, weaknesses, too. One of those cases, entering subjective judgment to the measurement process. Human behavior, according to human nature, with vast complexity and uncertainty. In addition, in the behavioral assessments, classifications' criteria are qualitative and mismatch, the proofer is faced with a wide variety of irregular data. Certainly this makes the conclusions difficult and unreliable.

The importance of behavior observation, ambiguities and complexities of the target group and uncertainty in the results requires systematic process in the measurement. The attributes are expressed; fuzzy logic can be useful and indispensible role to play in this area. Not only in this particular subject, but in all areas of behavioral science that deals with the ambiguities and complexities of human behavior, the fuzzy system is available a powerful tool for researchers.

2. Related work:

Fuzzy logic, which was developed in 1965 by Professor Nasser Lotfi Zadeh, in 1970, entered the field of psychology [1]. Lot, but not enough research has been done in behavioral science by using fuzzy logic. Kushwaha in [5] described the role of fuzzy systems in psychological research and investigated the relationship between anxiety and stimulus. khademi in [4] assessed Educational performance of students with collaborative management and integration of fuzzy systems. Mssaro in [6] for speech perception contrasted the traditional model and fuzzy model. Hamam in [3] offered a fuzzy logic system for evaluating quality of experience of haptic-Based Applications. Haghani in [2] modeling the academic achievement with fuzzy system.

3. Fuzzification of appraise process:

3.1 Classification:

Dr H. Pasha Sharifi in [7] introduced following 14-fold criteria for appraise the testee's behavior in the test session.

1. Tests' comprehension
2. Compatibility with the Location
3. Amount of interest
4. Amount of cooperation

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Advances in Environmental Biology, 8(21) October 2014, Pages: 543-547

5. Diction
6. Power of Expression
7. Attentive and careful
8. Esteem
9. Attempt
10. Insist on doing task
11. Flexibility
12. Reaction to encouragement
13. The lack of reaction to the defeat
14. Perceptions and self-assessment

Classification criteria for the systematic measurement are mismatch. For example the classification of two criteria is as follows:

- Tests' comprehension

a) The purpose of testing is to fully understand
b) The purpose of testing is to some extent understand
c) The purpose of testing does not understand

- Power of Expression

a) Excellent
b) Good
c) Medium
d) Weak
e) Very weak

Thus, we considered scores range from 0 to 100 for quantifying and classification.

3.2 Fuzzification:

Fuzzy sets for all criteria defined as follow:

VL: Very Low, L: Low, M: Moderate, H: High, VH: Very High

For more flexible we used trapezoidal fuzzy sets. Draw a diagram and define the membership functions.

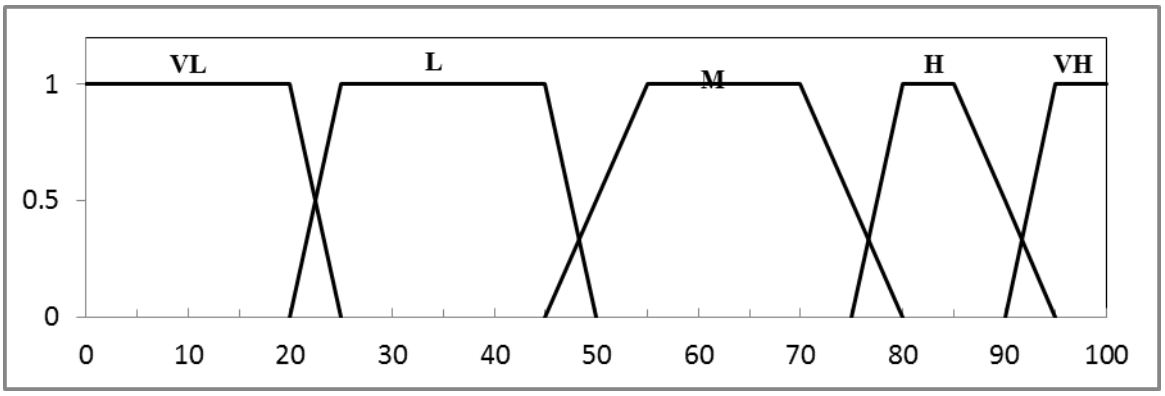

Fig. 1: Diagram of fuzzy sets

$$\mu_{VL}(x) = \begin{cases} 0 & x < 0 \\ 1 & 0 \le x \le 20 \\ \frac{25-x}{5} & 20 \le x \le 25 \\ 0 & x \ge 25 \end{cases}$$

$$\mu_{L}(x) = \begin{cases} 0 & x \le 20 \\ \frac{x-20}{5} & 20 \le x \le 25 \\ 1 & 25 \le x \le 45 \\ \frac{50-x}{5} & 45 \le x \le 50 \\ 0 & x \ge 50 \end{cases}$$

$$\mu_{M}(x) = \begin{cases} 0 & x \le 45 \\ \frac{x-45}{10} & 45 \le x \le 55 \\ 1 & 55 \le x \le 70 \\ \frac{80-x}{10} & 70 \le x \le 80 \\ 0 & x \ge 80 \end{cases}$$

Advances in Environmental Biology, 8(21) October 2014, Pages: 543-547

$$\mu_H(x) = \begin{cases} 0 & x \le 75 \\ \frac{x-75}{5} & 75 \le x \le 80 \\ 1 & 80 \le x \le 85 \\ \frac{95-x}{10} & 85 \le x \le 95 \\ 0 & x \ge 95 \end{cases} \qquad \mu_{VH}(x) = \begin{cases} 0 & x \le 90 \\ \frac{x-90}{5} & 90 \le x \le 95 \\ 1 & 95 \le x \le 100 \\ 0 & x \ge 100 \end{cases}$$

3.2.1 Intersection of fuzzy sets:

$$\mu_c(x) = \min\left[\mu_A(x), \mu_B(x)\right]$$

3.3 Defuzzification:

$$Area = \int_{t_1}^{t_2} \mu_c(x)dx$$

$$Moment = \int_{t_1}^{t_2} x\mu_c(x)dx$$

$$Centroid = \frac{\int_{t_1}^{t_2} x\mu_c(x)dx}{\int_{t_1}^{t_2} \mu_c(x)dx}$$

Example::

Suppose obtained scores of behavior Appraisal a sample, accordance with the table1. First characterized the membership functions of fuzzy sets, then with Intersection of fuzzy sets, $\mu_c(x)$ are determine.

Table 1: Scores of behavior Appraisal of sample

$\mu_C(x)$	membership functions					traditional scores	Criteria	row
	$\mu_{VH}(x)$	$\mu_H(x)$	$\mu_M(x)$	$\mu_L(x)$	$\mu_{VL}(x)$			
1	0	0	0	1	0	43	tests' comprehension	1
0.3	0	0	0.3	0.4	0	48	Compatibility with the Location	2
1	0	0	0	1	0	30	amount of interest	3
0.4	0	0	0	0.4	0.6	22	amount of cooperation	4
0.7	0	0	0.7	0	0	52	Diction	5
1	0	0	0	0	1	12	Power of Expression	6
0.2	0	0	0	0.8	0.2	24	attentive and careful	7
1	0	0	1	0	0	65	esteem	8
0.7	0	0	0.7	0	0	73	attempt	9
0.1	0	0.8	0.1	0	0	79	insist on doing task	10
1	0	1	0	0	0	80	flexibility	11
1	1	0	0	0	0	95	reaction to encouragement	12
0.9	0	0.9	0	0	0	86	The lack of reaction to the defeat	13
1	1	0	0	0	0	98	perceptions and self-assessment	14

Calculations are done for defuzzification. How to calculate the fuzzy scores with a sample (x=73) explain:

$$Area = \int_{45}^{80} \mu_c(x)dx = \int_{45}^{55} \frac{x-45}{10}dx + \int_{55}^{70} dx + \int_{70}^{80} \frac{80-x}{10}dx = 25$$

Advances in Environmental Biology, 8(21) October 2014, Pages: 543-547

$$Moment = \int_{45}^{80} x\mu_c(x)dx = \int_{45}^{55} \frac{x^2 - 45x}{10} dx + \int_{55}^{70} xdx + \int_{70}^{80} \frac{80x - x^2}{10} dx = 1562.5$$

$$Centroid = \frac{\int_{t_1}^{t_2} x\mu_c(x)dx}{\int_{t_1}^{t_2} \mu_c(x)dx} = \frac{1562.5}{25} = 62.5$$

All traditional scores convert into fuzzy scores. The results are shown in table2.

t-test using for evaluated the significance differences between traditional scores and fuzzy scores. Null hypothesis is no significant difference. The data of table2 are used.

Table 2: Fuzzy scores

D^2	D	Fuzzy scores	traditional scores	Criteria	row
64.00	8.00	35	43	tests' comprehension	1
210.25	-14.50	62.5	48	Compatibility with the Location	2
25.00	-5.00	35	30	amount of interest	3
169.00	-13.00	35	22	amount of cooperation	4
110.25	-10.50	62.5	52	Diction	5
0.03	0.18	11.82	12	Power of Expression	6
148.35	12.18	11.82	24	attentive and careful	7
6.25	2.50	62.5	65	esteem	8
110.25	10.50	62.5	73	attempt	9
272.25	16.50	62.5	79	insist on doing task	10
16.00	-4.00	84	80	flexibility	11
1.23	-1.11	96.11	95	reaction to encouragement	12
4.00	2.00	84	86	The lack of reaction to the defeat	13
3.57	1.89	96.11	98	perceptions and self-assessment	14
$\sum D^2 = 1140.44$	$\lvert\sum D\rvert = 5.64$	$\bar{X} = 57.24$ $\sigma = 28.01$	$\bar{X} = 57.64$ $\sigma = 28.64$		

$$t = \frac{|\sum D|}{\sqrt{\frac{n\sum D^2 - (\sum D)^2}{n-1}}} = \frac{|5.64|}{\sqrt{\frac{15966.16 - 31.8}{13}}} = 0.16$$

t table with degrees of freedom N=14-1=13 and α=0.01 is t=3.012. So the calculated t is less than t table, therefore the null hypothesis is true. Thus the two scoring methods have not significance differences.

Conclusions:

Using the systematic classification, definition of membership functions and selection centroid model for defazzification, a method offered that minimizes the proofer subjective judgment; this method is also covered uncertainty in the behavioral observing. t-test are shown that is no significant difference in the scoring of both traditional and fuzzy methods. Therefore this method is useful and can be used in individual tests.

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