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 defuzzification. Finally, by using the t-test, obtains scores are evaluated.

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:

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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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.

![Diagram of fuzzy sets](image_url)

**Fig. 1:** Diagram of fuzzy sets

\[
\mu_{VL}(x) = \begin{cases} 
0 & x < 0 \\
\frac{1}{25-x} & 0 \leq x \leq 20 \\
\frac{1}{10} & 20 \leq x \leq 25 \\
0 & x \geq 25 
\end{cases}
\]

\[
\mu_{L}(x) = \begin{cases} 
0 & x \leq 20 \\
\frac{x-20}{5} & 20 \leq x \leq 25 \\
1 & 25 \leq x \leq 45 \\
\frac{50-x}{5} & 45 \leq x \leq 50 \\
0 & x \geq 50 
\end{cases}
\]

\[
\mu_{M}(x) = \begin{cases} 
0 & x \leq 45 \\
\frac{x-45}{10} & 45 \leq x \leq 55 \\
1 & 55 \leq x \leq 70 \\
\frac{80-x}{10} & 70 \leq x \leq 80 \\
0 & x \geq 80 
\end{cases}
\]
3.2.1 Intersection of fuzzy sets:

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

3.3 Defuzzification:

\[
\text{Area} = \int_{x_1}^{x_2} \mu_c(x) \, dx \\
\text{Moment} = \int_{x_1}^{x_2} x \mu_c(x) \, dx \\
\text{Centroid} = \frac{\int_{x_1}^{x_2} x \mu_c(x) \, dx}{\int_{x_1}^{x_2} \mu_c(x) \, dx}
\]

Example:

Suppose obtained scores of behavior Appraisal a sample, accordance with the table 1. First characterized the membership functions of fuzzy sets, then with Intersection of fuzzy sets, \( \mu_c(x) \) are determine.

<table>
<thead>
<tr>
<th>( \mu_c(x) ) membership functions</th>
<th>traditional scores</th>
<th>Criteria</th>
<th>row</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \mu_{\text{VF}}(x) )</td>
<td>( \mu_{\text{H}}(x) )</td>
<td>( \mu_{\text{M}}(x) )</td>
<td>( \mu_{\text{L}}(x) )</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.3</td>
<td>0</td>
<td>0</td>
<td>0.3</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.4</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.7</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0.7</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.1</td>
<td>0</td>
<td>0.8</td>
<td>0.1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.9</td>
<td>0</td>
<td>0.9</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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

\[
\text{Area} = \int_{45}^{80} \mu_c(x) \, dx = \int_{45}^{55} \frac{x - 45}{10} \, dx + \int_{55}^{70} \mu_{\text{H}}(x) \, dx + \int_{70}^{80} \frac{80 - x}{10} \, dx = 25
\]
Moment = \int_{45}^{80} x\mu_c(x)\,dx = \int_{45}^{55} \frac{x^2 - 45x}{10} \,dx + \int_{55}^{70} x\,dx + \int_{70}^{80} \frac{80x - x^2}{10} \,dx = 1562.5

Centroid = \frac{\int_{45}^{80} x\mu_c(x)\,dx}{\int_{45}^{80} \mu_c(x)\,dx} = \frac{1562.5}{25} = 62.5

All traditional scores convert into fuzzy scores. The results are shown in table 2.

t-test using for evaluated the significance differences between traditional scores and fuzzy scores. Null hypothesis is no significant difference. The data of table 2 are used.

Table 2: Fuzzy scores

<table>
<thead>
<tr>
<th>D^2</th>
<th>D</th>
<th>Fuzzy scores</th>
<th>traditional scores</th>
<th>Criteria</th>
<th>row</th>
</tr>
</thead>
<tbody>
<tr>
<td>64.00</td>
<td>8.00</td>
<td>35</td>
<td>43</td>
<td>tests' comprehension</td>
<td>1</td>
</tr>
<tr>
<td>210.25</td>
<td>-14.50</td>
<td>62.5</td>
<td>48</td>
<td>Compatibility with the Location</td>
<td>2</td>
</tr>
<tr>
<td>25.00</td>
<td>-5.00</td>
<td>35</td>
<td>30</td>
<td>amount of interest</td>
<td>3</td>
</tr>
<tr>
<td>169.00</td>
<td>-13.00</td>
<td>35</td>
<td>22</td>
<td>amount of cooperation</td>
<td>4</td>
</tr>
<tr>
<td>110.25</td>
<td>-10.50</td>
<td>62.5</td>
<td>52</td>
<td>Diction</td>
<td>5</td>
</tr>
<tr>
<td>0.03</td>
<td>0.18</td>
<td>11.82</td>
<td>12</td>
<td>Power of Expression</td>
<td>6</td>
</tr>
<tr>
<td>148.35</td>
<td>12.18</td>
<td>11.82</td>
<td>24</td>
<td>attentive and careful</td>
<td>7</td>
</tr>
<tr>
<td>6.25</td>
<td>2.50</td>
<td>62.5</td>
<td>65</td>
<td>esteem</td>
<td>8</td>
</tr>
<tr>
<td>110.25</td>
<td>10.50</td>
<td>62.5</td>
<td>73</td>
<td>attempt</td>
<td>9</td>
</tr>
<tr>
<td>272.25</td>
<td>16.50</td>
<td>62.5</td>
<td>79</td>
<td>insist on doing task</td>
<td>10</td>
</tr>
<tr>
<td>16.00</td>
<td>-4.00</td>
<td>84</td>
<td>80</td>
<td>flexibility</td>
<td>11</td>
</tr>
<tr>
<td>1.23</td>
<td>-1.11</td>
<td>96.11</td>
<td>95</td>
<td>reaction to encouragement</td>
<td>12</td>
</tr>
<tr>
<td>4.00</td>
<td>2.00</td>
<td>84</td>
<td>86</td>
<td>The lack of reaction to the defeat</td>
<td>13</td>
</tr>
<tr>
<td>3.57</td>
<td>1.89</td>
<td>96.11</td>
<td>98</td>
<td>perceptions and self-assessment</td>
<td>14</td>
</tr>
</tbody>
</table>

\[ \sum D^2 = 1140.44 \]

\[ |\sum D| = 5.64 \]

\[ \bar{X} = 57.24 \]

\[ \bar{X} = 57.64 \]

\[ \sigma = 28.01 \]

\[ \sigma = 28.64 \]

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

The 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 defuzzification, 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.

REFERENCES

