

The decision-making process in learners' failure using fuzzy scale

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Abstract

This study aims to determine how to use an ambiguous scale to assess student performance and proficiency, whether students perform well or poorly in subjects such as

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reading comprehension, vocabulary, and punctuation. In this study, Sugeno Integral is a good choice for decision-making. Although other scales may be better than the one used, Sugeno Integral is easier to use than different scales, as evidenced by the results obtained.

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1. Introduction

The fuzzy set theory can be applied in a variety of situations in which human decision-making is critical [1,2]. Fuzzy systems can be applied in a wide range of fields, including medicine, robotics, and artificial intelligence. Gokmen et al. used fuzzy set theory to evaluate student achievement in biological applications [3]. It is also used in medical applications and other fields [4,5].

Numerous higher-order interactions, including the Choquet integral [6], the Bonferroni mean (BM) operator, the Parameter asymmetric mean (MSM) operation, and the Muirhead mean (MM) driver, have already been investigated to combine the reasons. Taking into account that the Dombi procedure [7] does have the majority of Liu et al. [8] expanded the BM operator and provided a series of clustering methods integrating Dombi operation and BM operation in intuitionistic fuzzy (IF) environments, demonstrating significant advantages with a generic variable. The BM operators and Dombi operations below into a two-language non-disruptive, and stochastic linguistic framework. Fuzzy context q-rung orthopedically, accordingly. The fuzzy set is a non-classical set such as intuitionistic sets [9], soft sets [10], and neutrosophic set [11] all of these are studied in recent years.

Academic success is determined by various factors such as Intelligence Quotient (IQ) or Intellectual Capacity, Attending or Consistency, Topic Interest, and Accountability. Exams or tests are used to assess pupils' academic performance, and the results show their development. Fuzzy measurements are useful for representing information or states of mind [12]. Using the Fuzzy measure (FM) and its Sugeno Integral component for evaluating student failure reasons is one of the critical areas of research being carried out by researchers at the University of Bath in the UK to improve student performance in subjects such as mathematics, physics, and engineering. The current study focuses on the importance of regularity criteria and investigates the use of the (FM) and its accompanying Sugeno Integral in student assessment for failure causes.

2. Preliminaries

Definition 2.1: [1] Let $\alpha = \{A_i | i \in I\}$ be a collection of subsets of any set X . We say α is σ -algebra if, (i) $\emptyset, X \in \alpha$, (ii) $\cap_{i \in \Delta} A_i \in \alpha$, for any $\Delta \subseteq I$, (iii) $\cup_{i \in \Delta} A_i \in \alpha$, for any $\Delta \subseteq N$. Also, we say (X, α) is a measurable space.

Definition 2.2: [2] Let (X, α) be measurable space and $\mu: \alpha \rightarrow R^+$ be a function. We say (X, α, μ) is a measure space. If $\mu(\emptyset) = 0$, $\mu(\alpha) = 1$, $\mu(\cup_{i=1}^{\infty} E_i) = \sum_{i=1}^{\infty} \mu(E_i)$ with $E_i \cap E_j = \emptyset$, where $E_i \in \mathcal{B}$ and $\mathcal{B}$ is σ -algebra.

Definition 2.3: [2] Let $X = \{x_1, x_2, x_3, \dots, x_n\}$ be the set of criteria, and $\mathcal{P}(X)$ be the power set of X . A continuous or semi-continuous map is a fuzzy measure (FM) on X , $\mu: \mathcal{P}(X) \rightarrow R^+$, such that,

1. $\mu(X) = 1$ & $\mu(\emptyset) = 0$.
2. If $K, W \in \mathcal{P}(X)$, such that, $K \subseteq W$ then $\mu(K) \leq \mu(W)$.

Definition 2.4: [2] Suppose that $X = \{x_1, x_2, x_3, \dots, x_n\}$. The nonnegative set function – Measure (Sugeno's ξ -FM) is as follows $h_\xi: \mathcal{P}(X) \rightarrow [0, 1]$ is sufficient, $h_\xi(X) = h_\xi(M) + h_\xi(N) + \xi h_\xi(M) + \xi h_\xi(N)$, $\forall M, N \in \mathcal{P}(X)$ whenever $M \cap N = \emptyset$ and $\xi \in (-1, \infty)$ is the parameter. Furthermore, if $X = \{x_1, x_2, x_3, \dots, x_n\}$. The $h_\xi(X)$ can be calculated using the formula below

$$\begin{aligned} h_\xi(X) = & \sum_{i=1}^n h_\xi(\{x_i\}) + \xi \sum_{i=1}^{n-1} \sum_{j=2}^n h_\xi(\{x_i\}) h_\xi(\{x_j\}) + \\ & \xi^2 \sum_{i=1}^{n-2} \sum_{j=2}^{n-1} \sum_{k=3}^n h_\xi(\{x_i\}) h_\xi(\{x_j\}) h_\xi(\{x_k\}) + \\ & \xi^{n-1} h_\xi(\{x_1\}) h_\xi(\{x_2\}) \dots h_\xi(\{x_n\}) \end{aligned} \quad (7)$$

Construction of ξ -FM: we will examine in this part how a (FM) can be used to assess whether a student has done well or otherwise in subjects such as reading comprehension, vocabulary, and punctuation.

3.1 Studying Problem

Student failure is a significant issue many academic institutions face. There are several reasons why students fail the examination system. Therefore, there must be a scale that determines the students' competence level. The scale used in this study is the Sugeno Integral. This scale was used in the scope of the current research to evaluate students regularly. One can predict the critical success criteria and the probability of success. After speaking with several students and their teachers from a particular institute, it was found that students fail the exam for various reasons. We will summarize all the six cases we used in this work in Table 1:

Table 1
The summaries of the six instances.

Failure Reasons	Criteria
Poor participation in class or irregularity brought on by travel or money issues, etc.	Attendance or Consistency (P_1)
Fear of exams, excessive confidence, incorrect reading and Comprehension practices accidents, illnesses, and psychological stress unexpected family member death.	Inescapable circumstances (P_2)

Not paying attention	Knowledge quotient (P_3)
Incorrect instructional practices, a low motivation, etc.	Favorite topic (P_4)
Pupils' careless actions, absence of commitment and time management. peer relations, absence of adulthood, etc.	Duty (P_5)
Different differences between students	Individual differences (P_6)

Table 2 lists some of the most common reasons for failure. As a set of Criteria, we create the ξ -FM. Let $X = \{P_1, P_2, P_3, P_4, P_5, P_6\}$. Educationalists from the Education Department were chosen as experts in this case study. Table (2) illustrates Experts' judgment of the relative importance of passing grades based on a short survey in which They were asked to evaluate the importance of these six Parameters (expressed as passing scores).

Table 2
Expert evaluation of the relative significance of passing grades

P_1	P_2	P_3	P_4	P_5	P_6
0.6	0.8	0.6	0.9	0.7	0.6

The interdependency between the selected criteria is computed using Sugeno's ξ -FM. The value of the parameter is computed as $\xi + 1 = (1 + 0.6\xi) \cdot (1 + 0.8\xi) \cdot (1 + 0.6\xi) \cdot (1 + 0.9\xi) \cdot (1 + 0.7\xi) \cdot (1 + 0.6\xi)$ using Eq. (1). $\xi + 1 = (1 + 0.6\xi) \cdot (1 + 0.8\xi) \cdot (1 + 0.6\xi) \cdot (1 + 0.9\xi) \cdot (1 + 0.7\xi) \cdot (1 + 0.6\xi)$. We acquire 6 roots of the above problem by solving the fifth-degree equation. One of these two kinds is complex conjugates. As a result, we discard two complex roots. $(-1, \infty)$. The remaining amounts are 0, -0.7246923 , and 1.52963 . Also, $1.52963 \notin (-1, \infty)$. As a result, the permitted values are 0 and 0.7246923 . Because the value is negative, the criteria have a negative multiplicative impact. However, if $\xi = 0$, the measure becomes additive, implying that there are no relationships between the qualities $P_1 = 0.6 = P_3 = P_6$, $P_2 = 0.8$, $P_4 = 0.9$, $P_5 = 0.7$, which is not the case. As a result, $\xi = -0.7246923 \in (-1, \infty)$. Because there are five criteria, we must define (64) subgroups of criteria, as shown in Table 2. Similarly, the additional values can be calculated using Eq. (1) The calculated values are shown in Tables 3 and 4, demonstrate the interdependence of them.

Table 3
Interdependencies measure how dependent people are on each other. M_i 's

Between twocriteria	ξ -Measure
P_1, P_2	0.8547
P_1, P_3	0.9634
P_1, P_4	0.8398
P_1, P_5	0.8373
P_2, P_3	0.9826
P_2, P_4	0.8893
P_2, P_5	0.8992
P_3, P_4	0.9752
P_3, P_5	0.9642
P_4, P_5	0.9265

Table 4
The interdependencies is measure among three criteria's

Among three criteria	ξ -Measure
P_1, P_2, P_3	0.8998
P_1, P_2, P_4	0.9227
P_1, P_2, P_5	0.8199
P_1, P_2, P_6	0.9276
P_1, P_3, P_4	0.8856
P_1, P_3, P_5	0.9255
P_1, P_3, P_6	0.9729
P_1, P_4, P_5	0.8887
P_1, P_4, P_6	0.9115
P_1, P_5, P_6	0.9772
P_2, P_3, P_4	0.9862
P_2, P_3, P_5	0.9361
P_2, P_3, P_6	0.9773
P_2, P_4, P_5	0.9862
P_2, P_4, P_6	0.9589
P_2, P_5, P_6	0.9720
P_3, P_4, P_5	0.9639
P_3, P_4, P_6	0.8988
P_3, P_5, P_6	0.9809
P_4, P_5, P_6	0.9783

Table 5
The interdependencies is measure among four criteria's

Among four criteria	ξ -Measure
p_1, p_2, p_3, p_4	0.8704
p_1, p_2, p_3, p_5	0.9027
p_1, p_2, p_3, p_6	0.9192
p_1, p_2, p_4, p_6	0.9466
p_1, p_2, p_4, p_5	0.8973
p_1, p_3, p_4, p_5	0.9527
p_1, p_3, p_4, p_6	0.9747
p_1, p_3, p_5, p_6	0.9689
p_1, p_3, p_4, p_6	0.9477
p_1, p_4, p_5, p_6	0.9085
p_2, p_3, p_4, p_6	0.9699

Table 6
The interdependencies is measure among five criteria's

Among five criteria	ξ -Measure
p_1, p_2, p_3, p_4, p_5	0.8286
p_1, p_2, p_3, p_4, p_6	0.8987
p_1, p_2, p_4, p_5, p_6	0.9297
p_1, p_3, p_6, p_4, p_5	0.8889
p_1, p_2, p_3, p_4, p_5	0.9729
p_2, p_3, p_4, p_5, p_6	0.8688
p_1, p_2, p_3, p_4, p_5	0.9042
p_2, p_3, p_6, p_4, p_5	0.8999
p_4, p_2, p_3, p_4, p_5	0.9152
p_2, p_3, p_4, p_1, p_5	0.9953
p_2, p_3, p_4, p_6, p_5	0.9883

According to the Table 2 the $p_4 = 0.9$ is the highest degree interdependency, while p_1, p_3 and p_6 equals 0.6 are the lowest degree of interdependency. Also, in Table 3 the pairs $p_2, p_3 = 0.9826$, and after that $p_3, p_5 = 0.9642$ have the highest degree of interdependency, whilst the pair $p_1, p_5 = 0.8373$ has the lowest degree of interdependency. The calculated estimates of interdependencies among three and four criteria are also included in Table 4, respectively. We see that $p_2, p_3, p_4 = 0.9862$ the highest degree of interdependency but $p_1, p_2, p_5 = 0.8199$ has the lowest degree of

interdependency. Also, $P_1, P_3, P_4, P_6 = 0.9747$ is the highest degree interdependency as seen in Table 5, but the lowest degree of interdependency is $P_1, P_2, P_3, P_4 = 0.8704$. Finally, in Table 6. A measure of interdependence the strongest interdependence is $P_2, P_3, P_4, P_1, P_5 = 0.9953$ and the absence of $P_1, P_2, P_3, P_4, P_5 = 0.8286$ results in the lowest value as seen in Table 6. The proper index will not be represented by the simple arithmetic mean of these criteria because they are not independent. In terms of the ξ –FM, we use Sugeno Integration to integrate these six criteria.

Conclusion

In order to assist students in making decisions about pursuing a research group or review course throughout their undergraduate education, a model based on Sugeno Integral technology was used in this work. The criteria included in this paper are "Independent", "Attendance or Consistency", "Inescapable circumstances", "Knowledge quotient", "Favorite topic", "Duty" and "Individual differences". In order to provide assessments of materiality and dependency among the six main variables for predicting student failure, the Sugeno integration—which serves as an aggregation tool for the six case studies—was used in this study. The results of the case research indicate that consistency is one of the most essential requirements for passing the test. which also affects the score indicator. A greater probability of success is indicated by the index having a higher value. Researchers should use multi-criteria decision-making techniques, such as TOPSIS-fuzzy AHP, to study these cases of problems and get better results and decisions.

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