Analyzing the Level of Anxiety Disorders of Final-Year Students by Applying the Fuzzy Mamdani Method

Virdyra Tasril[1], Muhammad Iqbal[2], Febby Madonna Yuma[3]

Information Technology, Computer Systems
Universitas Pembangunan Panca Budi
Medan, Indonesia
virdyra@dosen.pancabudi.ac.id, muhammadiqbal@dosen.pancabudi.ac.id

Information System
STMIK Royal Kisaran
Asahan, Indonesia
febbyyuma@gmail.com

(*) Corresponding Author

Abstract

Anxiety disorders are included in mental health disorders that are more or less experienced by society. The focus of this study was samples of final-year students who felt this disorder both psychologically and psychologically. Disorders often experienced by the average panic disorder worry from thesis guidance to conducting the final trial due to student unpreparedness and lack of confidence. The purpose of this study is to obtain the results of an analysis of the results of the diagnosis of anxiety disorders in final-year students. The indicators used are three variables, physical, cognitive, and behavioral, each with its symptoms. The fuzzy Mamdani method is used with the help of Matlab software to analyze the results. Based on five samples of students with anxiety disorders experienced by final-year students aged 20-22, the largest was in cognitive disorders, and the lowest was in behavioral variables.

Keywords: Fuzzy Method; Mamdani Method; Anxiety Disorder; College Student

Abstrak

Gangguan kecemasan dikategorikan kedalam gangguan kesehatan mental yang sedikit banyak dialami oleh masyarakat. Fokus penelitian ini mengambil sampel pada mahasiswa tingkat akhir yang merasakan gangguan ini baik secara psikis maupun psikologis. Gangguan yang sering dialami rata-rata gangguan panik, khawatir dimulai saat bimbingan skripsi hingga melakukan sidang akhir. Dikarenakan faktor ketidaksiapan mahasiswa dan rasa kurang percaya diri. Tujuan dari penelitian ini yaitu untuk mendapatkan hasil analisis hasil diagnosa gangguan kecemasan terhadap mahasiswa tingkat akhir. Indikator yang digunakan ada 3 variabel yaitu fisik, kognitif dan perilaku dimana masing-masingnya memiliki gejala tersendiri. Untuk menganalisa hasil analisa fuzzy metode mamdani digunakan dengan bantuan software Matlab. Berdasarkan 5 sampel mahasiswa diperoleh gangguan kecemasan yang dialami oleh mahasiswa tingkat akhir usia 20-22 persentase terbesar pada gangguan kognitif dan persentase gangguan terendah pada variabel perilaku.

Kata kunci: Metode Fuzzy; Mamdani; Anxiety Disorder; Mahasiswa

INTRODUCTION

Every day we as humans experience various situations and even events that can trigger the emergence of anxiety. For example, among students, there are sudden exams, assignment presentations, being late for lectures, assignment deadlines, and others. Anxiety is a natural reaction experienced by any human being, which is considered a response to conditions that are considered frightening. However, if the anxiety is excessive and not by the problem, it can lead to disorders that hinder a person's life activities (Saleh, 2019).

Excessive anxiety in students can experience psychosomatic problems, a thesis which is one of the factors that cause student anxiety. The thesis is one of the factors of student anxiety, which begins when filling out KRS. There is no idea what cases will be submitted in the thesis report,

constrained consultation with the supervisor face-to-face, and some students disappear without news and lose contact with the supervisor (Ismunu, Purnomo, & Subardjo, 2020).

The results of (Pravina, Sugihartono, & Hidayat, 2020) research examined the level of depression experienced by students of the Faculty of Computer Science who were taking a thesis using machine learning in the hope of early detection of depressive disorders experienced by students, had 65 case data, with an accuracy rate of 76.92%.

This research was conducted (Asrori, 2015) to see how Cognitive Therapy for Behavior reduces the anxiety level of social anxiety disorder. The subjects used in his research were students who had social anxiety criteria.

An anxiety disorder is a psychological disorder related to mental disorders (Tasril & Sari, 2022). Anxiety disorders can cause sufferers to experience high and excessive anxiety accompanied by certain signs and symptoms (Diferiansyah, Septa, & Lisiswanti, 2016). Many people think that anxiety disorders are mental disorders, and some don't even realize they have them (Rustam & Nurlela, 2021).

For this reason, this research analyzes the fuzzy Mamdani method to get the results of diagnosing anxiety disorders of final-year students, whether they have anxiety disorders with low, medium, or high levels.

His research (Pravina et al., 2020) explained that mental health disorders can attack anyone, including students. Students are seen as young, smart, and vibrant, so they are often far from thoughts of mental disorders. Meanwhile, every human being must have problems as well as students.

According to (Darmawati, 2017), the research results show that the diagnosis estimates obtained with the Mamdani method fuzzy logic provide results that are still within the diagnostic interval of the doctors who treat these diseases.

Fuzzy logic uses IF-THEN rules to represent the cases used in fuzzy sets. This method can use a computer as a diagnostic tool for doctors or psychiatrists (Tasril & Sari, 2022).

The Mamdani Fuzzy Method is also known as the Max-Min Method. This method was first introduced by Ebrahim Mamdani in 1975 (Matondang, Kusumawati, & Abidin, 2012).

In his writing (Santya, Miftah, Saepudin, Mandala, & Gustian, 2017), to obtain output results from the use of fuzzy methods, four stages are needed, namely; Formation of fuzzy sets, Implication functions, Rule composition, and Defuzzification stages, where the results of defuzzification can determine the results of decisions taken.

Fuzzy Mamdani is part of FIS (Fuzzy Inference System), used to draw conclusions or make the best decisions in uncertain problems. Fuzzy Mamdani uses linguistic rules and has a Fuzzy algorithm that can be analyzed mathematically, making it easier to understand (Muzarafah & Marlina, 2022).

The advantage of the Mamdani Fuzzy Method is that it is more specific, which means that in carrying out the Fuzzy Mamdani process, it looks more at the conditions that will occur for each fuzzy part so that later it will produce more accurate decisions.

RESEARCH METHODS

Expert systems are one of the fields of artificial intelligence techniques that are quite attractive because of their use in various fields, both in science and business, which have proven to be very helpful in making decisions and have a broad application (Siahaan, 2020).

The method used in this research is related to expert systems using the fuzzy Mamdani method. In his writing (Hendrawan, Haris, Rasywir, & Pratama, 2020), the Mamdani method is not only in the limitation process for the MIN-MAX value. However, the sum approach is also used to produce a fuzzy set solution for all of the fuzzy region's outputs.

The first stage in using fuzzy methods is the formation of fuzzy sets, where at the Mamdani method stage, input and output variables are divided into one or more fuzzy sets (Marbun & Harefa, 2020).

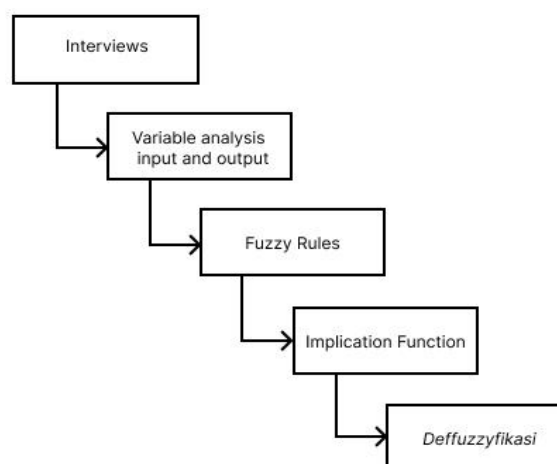The following figure 1 shows the stages of the research method carried out.

Figure 1. Stages Of The Research Method

From the stages of the method above, the first method used is the interview stage to find out the fears experienced by final-year students. Several input variables will be used to diagnose anxiety disorders from the interview results. The final result obtained is the result of defuzzification in the form of the level of student anxiety disorder.

Types of research

This study uses quantitative research with the help of Mamdani fuzzy sets to determine the value. Data were obtained through interviews with guidance students. And they are also interviewing psychologists related to symptoms associated with anxiety disorders.

The input, output, and membership function variables are determined from the data obtained. After that, fuzzy rules are made based on a combination of fuzzy sets of input variables. After that, make an implication function to get the final defuzzification to result to check the accuracy of the affirmation obtained.

Procedure

Based on interviews conducted with psychology and referring to research (Saleh, 2019), the variables used are taken based on the characteristics of anxiety. The following description can be seen in Table 1 below.

Table 1. Characteristics of Anxiety

No	Characteristics	Signs
1	Physical	Restlessness, nervousness. Hand or limb trembling. Sweating a lot. Difficult to speak. Hard palpitations or rapid heartbeat. The voice trembles. Fingers or limbs become cold. Frequent urination. Face feels flushed.
2	Behavioral	Avoidance behavior. Inherent and dependent behavior. Shaken behavior
3	Cognitive	Worrying about something. Disturbing feelings of fear or apprehension of something happening in the future. The belief that something terrible is about to happen, with no clear explanation. Fear of losing control. Fear of inability to solve problems. Worrying about trivial things. Unable to eliminate negative thoughts. Difficulty concentrating or focusing attention.

Data analysis technique

From the data in Table 1 above, the questionnaire distributed to students contains questions about the characteristics of anxiety. Where a Likert scale is used to represent the survey's results. The results are used for each variable in the value interval 1-100.

Additionally, it establishes a membership function, a curve illustrating how data input points are translated into membership degree values with a range of 0 to 1. (Ikhwan, 2019).

The following five samples of student data analysis results are taken, which can be seen in Table 2.

Table 2. Data Analysis Result

Variable	M1	M2	M3	M4	M5
Kognitive	76,5	58,4	56	60,8	38
Behavior	42,8	46,4	44	50	19,9
Physical	47,6	59,6	39,2	45,2	36,7

RESULTS AND DISCUSSION

The study results used linear descending, triangular, and linear ascending membership degree functions.

a. Variable analysis input and output

Based on the variable characteristics of anxiety above, the input variables are Physical, Behavioral, and Cognitive. Each variable contains indicators that serve as benchmarks to obtain a representative value for each variable. The following table 2 is the fuzzy set.

Table 2. Fuzzy Domain Set

	Variable Name	Himpunan	Domain
Variable Input	Physical	Low	[0 40 50]
		Middle	[40 50 60]
		High	[50 60 100]
	Cognitive	Low	[0 40 50]
		Middle	[40 50 60]
		High	[50 60 100]
	Behavioral	Low	[0 40 50]
		Middle	[40 50 60]
		High	[50 60 100]
Variable Output	Results	Low	[0 40 50]
		Middle	[40 50 60]
		High	[50 60 100]

The following is a description of the triangle curve implemented using Matlab for input variables and output variables.
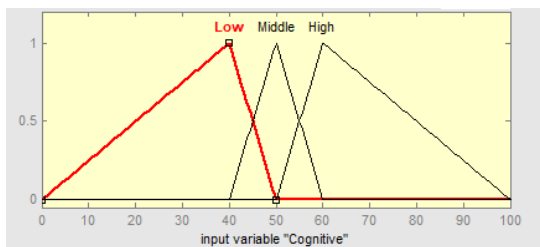

Figure 2. The curve for cognitive variables

Figure 2 above is a curve representation for cognitive variables. The curve used is a curve in the form of a triangle.
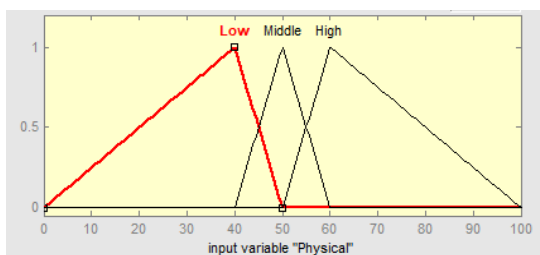

Figure 3. The curve for physical variables

Figure 3 above is a curve representation for physical variables. The curve used is a curve in the form of a triangle.
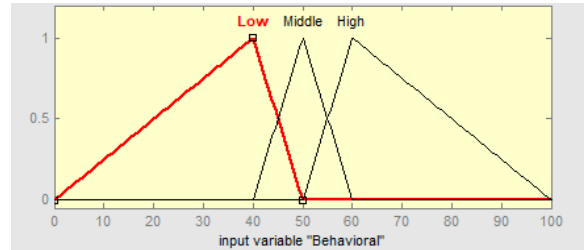

Figure 4. The curve for behavioral variables

Figure 4 above is a curve representation for the behavior variable. The curve used is a curve in the form of a triangle.
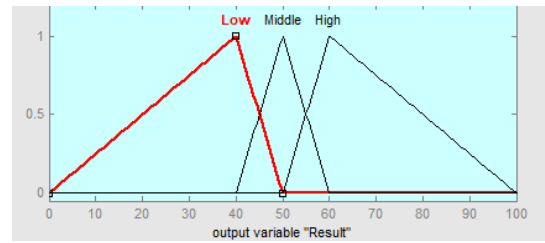

Figure 5. Curve for Result

Figure 5 above is a curve representation for the output variable in the form of results. The curve used is a curve in the form of a triangle with the results in low, medium, and high categories.

The membership function used for each variable is formulated as follows:

μ[x] = Low

$$\mu[x] = \begin{cases} 0; & x \geq 50 \\ (50 - x) / (50 - 40); & 40 \leq x \leq 50 \\ 1; & x \leq 40 \end{cases}$$

μ[x] = Middle

$$\mu[x] = \begin{cases} 0; & x \leq 40 \text{ atau } x \geq 60 \\ (x - 40) / (50 - 40); & 40 \leq x \leq 50 \\ (60 - x) / (60 - 50); & 50 \leq x \leq 60 \end{cases}$$

μ[x] = High

$$\mu[x] = \begin{cases} 0; & x \leq 50 \\ (x - 50) / (60 - 50); & 50 \leq x \leq 60 \\ 1; & x \geq 60 \end{cases}$$

b. Fuzzy Rules

Here are some rules formed from all input and output variables with as many as nine rules. The following can be seen in Table 3.

Table 3. Fuzzy Rules

No	Rules
1	IF (Cognitive is Low) and (Physical is Middle) and (Behavioral is Low) then (Result is Low).
2	IF (Cognitive is Low) and (Physical is Low) and (Behavioral is Low) then (Result is Low)
3	IF (Cognitive is Low) and (Physical is Middle) and (Behavioral is Middle), then (Result is Low)
4	IF (Cognitive is Middle) and (Physical is Low) and (Behavioral is Low), then (Result is Low)
5	IF (Cognitive is Middle) and (Physical is Middle) and (Behavioral is Middle), then (Result is Middle)
6	IF (Cognitive is High) and (Physical is Middle) and (Behavioral is Middle), then (Result is Middle)
7	IF (Cognitive is High) and (Physical is High) and (Behavioral is Middle) then (Result is High)
8	IF (Cognitive is High) and (Physical is Middle) and (Behavioral is High) then (Result is High)
9	IF (Cognitive is High) and (Physical is High) and (Behavioral is High), then (Result is High)

c.   Implication Function

The implication function used for fuzzy Mamdani is the Min method. Then the results of the implication function of each rule, using the MAX method to compose between all rules.

The implication function used for fuzzy Mamdani is the Min method. Then the results of the implication function of each rule, using the MAX method to compose between all rules. In this result, the application is assisted by using Matlab software, and the following is in the picture below.
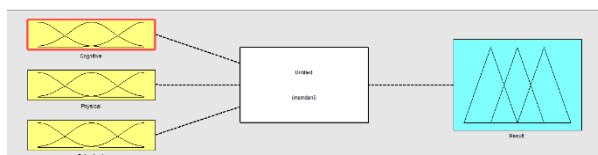

Figure 6. Fuzzy Variable Input dan Output

Figure 6 shows the results of a curve representation for input variables and output variables using Matlab.
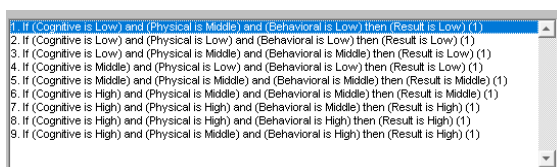

Figure 7. Fuzzy Rules in Matlab

d.   Figure 7 results from a rule formed using the IF AND THEN rule. In this study, nine rules were formed Defuzzyfikasi

The last stage of this fuzzy method produces an output. The method used at this stage is the

centroid method (Muflihunna, 2022). The following results can be seen in Figure 8 and Figure 9 below using student case studies.
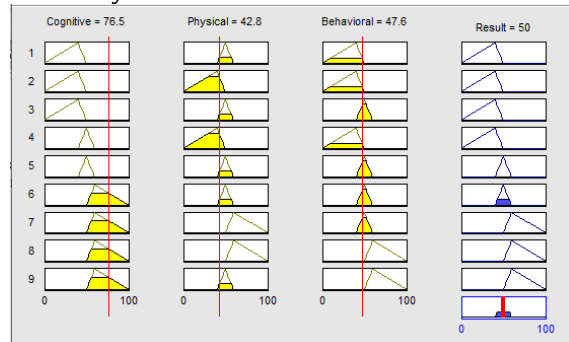
Case Study M1:

Figure 8. Rule Viewer M1

Figure 8 above where for input value Cognitive = 76.5, Physical = 42.8, behavior = 47.6 and output result = 50. To produce analysis results in order 6 with the rule: IF (Cognitive is High) and (Physical is Middle) and (Behavioral is Middle) then (Result is Middle).
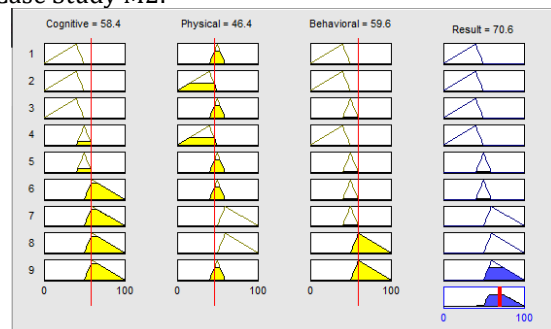
Case Study M2:

Figure 9. Rule Viewer M2

Figure 9 above where for input value Cognitive = 58,4, Physical = 46.4, behavior = 59.6, and output result = 70.6.

To produce analysis results in order 9 with the rule: IF (Cognitive is High) and (Physical is High) and (Behavioral is High) then (Result is High).

CONCLUSIONS AND SUGGESTIONS

Conclusion

The study results, which were concluded using five student samples, obtained that a large percentage of anxiety disorders experienced by final-year students aged 20-22 are in cognitive impairment, and the lowest is in behavioral variables. The results of the analysis of the three input variables using the Mamdani method are quite accurate in diagnosing the level of student

anxiety disorders so that they can detect a symptom early.

Suggestion

To get the level of accuracy, further research can be done by manually searching and can use different variables.

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