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Implementation of the K-Means Clustering Algorithm to Determine the Promotion Strategy of Institut Agama Kristen Negeri Tarutung

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Abstract—*This research aims to determine the strategy for recruiting new students at IAKN Tarutung. Currently, competition between state and private universities in accepting new students is increasingly competitive. This is proven by the decreasing trend of prospective students registering at IAKN Tarutung, especially in the Cultural and Religious Tourism study program (as the research sample). Based on data from active students in The Cultural and Religious Tourism Study Program, the K-Means algorithm can be implemented to assist decision-making in determining effective promotional targets for the following year. The results of the research show that data processing for students from the classes of 2021, 2022, and 2023 shows different trends based on Criterion 1 (high school or equivalent vocational school graduates), Criterion 2 (student achievement at their school of origin), and Criterion 3 (community economic ability). Based on data from Criterion 1, criterion 2, and criterion 3, it is stated that promotional strategies must continue to be carried out in all high schools or equivalent vocational schools (public and private) and provide scholarships for prospective Cultural and Religious Tourism study program who are outstanding or economically disadvantaged.*

I. INTRODUCTION

The rapid development of information technology covers almost all sectors such as the economy, industry, education, and other areas of life (Rashid & Kausik, 2024; Roztocki et al., 2019). This results in the availability of extensive data that can store important information with several processes (Nasution et al., 2021; Plekhanov et al., 2023; Wang, 2024). The application of information technology in education can also produce abundant data, starting from learning process data and personal data of teachers and students (Jud et al., 2023). In a higher education institution, a large amount of data is stored as historical data, which continues to grow, such as student data (Ma, 2024; Plekhanov et al., 2023; Razavian et al., 2024).

The process of admitting new students to a university result in additional data collection every year and creates a large amount of data in the database (Nasution et al., 2021). Students who are undergoing the selection process for admission to a university usually provide profile data on campus. The stored data will be integrated into each faculty and related study program. The data will then be used for student administration purposes as part of the learning process during lectures at the university. IAKN Tarutung is one of the state universities under the auspices of the Ministry of Religion located in North Sumatra. IAKN Tarutung offers postgraduate programs and three faculties, namely FISHK, FIPK, and FIT. Each faculty has several study programs that can be chosen by students. Young

learners to obtain education develop their potential and channel their interests. The New Student Admissions activity at IAKN Tarutung is a routine activity held every year to recruit new students. IAKN Tarutung always improves the quality of facilities and infrastructure, teaching staff, education staff, administration, and other facilities and infrastructure to attract prospective new students. However, it is very unfortunate that information about each faculty and study program is not well distributed. Moreover, the emergence of many other universities in the North Sumatra region and Indonesia has created very tight competition for IAKN Tarutung in accepting new students.

Currently, the competition between state and private universities to accept new students is getting tighter (Jud et al., 2023). Some people spend a lot of money on promotional media and some offer various offers such as affordable tuition fees, promises of easy jobs after graduation, and so on (PrastYesbudi et al., 2024). Therefore, careful planning is needed in determining the scope of promotion to achieve the target of accepting new students each year and expectations to produce the best human resources to support quality national development in the future. postgraduate students (Haleem et al., 2022; Jud et al., 2023; Naibaho, 2019; PrastYesbudi et al., 2024).

The application of information technology in the field of promotion can help campuses manage data that can store valuable and useful information so that it has its own added value so that the desired goal is achieved in recruiting students with the best potential (Haleem et al., 2022; Wahyudi & Arroufu, 2022). (United Kingdom: 2020). Promotion is the key to success for a university that wants to introduce its campus environment to attract the attention of prospective applicants (Bengnga & Ishak, 2018; Haleem et al., 2022; Wahyudi & Arroufu, 2022).

Promotion requires precise planning so that all promotional objectives can be achieved so that competition also increases in each region with the dissemination of targeted information (Gómez-Olmedo et al., 2024; R. Kumar et al., 2025). The large collection of student data obtained by generating big data will be an opportunity to find information from many groups based on data characteristics on campus. (Firat & Gungor, 2009; S. Kumar et al., 2021; Nasution et al., 2021; Saltz, 2021), Many student data sets are formed so that effective and efficient campus promotion goals can be determined.

One of the causes of the decline in the number of students in higher education is the inappropriate planning of promotional strategies that will have an impact on the fluctuation of the number of new students (Abbas et al., 2019; Dwivedi et al., 2021; Valero & Van Reenen, 2019). This large amount of data can be processed using data mining science. Data mining is designed to explore data to find consistent patterns by applying the patterns found to new subgroups (Handoko et al., 2020; Li et al., 2025; Peng et al., 2024; Shu & Ye, 2023).

Data collection for new student admissions can be done using the K-Means clustering method, which groups data into several groups based on data similarities, while data that has different characteristics will be grouped into other clusters that have the same similarities (Darmansah & Wardani, 2021; Hu & Su, 2008; Park et al., 2025). K-Means clustering has the advantage of being able to create large data sets quickly and efficiently (Bang & Jhun, 2014; Fuss et al., 2016) to help decision-makers determine effective promotion goals for the coming year (Bengnga & Ishak, 2018).

To meet expectations regarding the number of new students accepted each year, this study was conducted to analyze and process data on new student admissions for 2021-2023 at IAKN Tarutung to obtain information that can help determine promotion goals in the following year. The data attributes that will be used in this study focus on the type of school of origin (Senior High School, Vocational School, Or Equivalent), The Success/Failure of Education, and the economic situation of the student's family, which should help and provide information to the PMB team. conducting promotions in various schools in Indonesia, especially in the North Sumatra region. Processing these data attributes will produce several groupings to determine job promotion targets at IAKN Tarutung.

II. RESEARCH METHODOLOGY

The method used in this study is an applied method, namely the researcher applied the Data Mining method with the K-Means Clustering algorithm to the data of students of the Cultural and Religious Tourism study program from 2020 to 2023 at the State Christian Institute to be analyzed and grouped according to regional distribution and according to school of origin based on the cumulative achievement index during the first two semesters, namely one grade and second grade. To carry out the K-Means Clustering process, of course, requires a lot of data and according to what is needed, in this study, the researcher used data from students of the Cultural and Religious Tourism study program from 2020 to 2023 at the State Christian Institute (IAKN) Tarutung. Data collection at IAKN Tarutung is sufficient by attaching a research permit letter from IAKN Tarutung and attaching a research proposal to the academic section of IAKN Tarutung. After receiving a reply from IAKN Tarutung, the data can be taken to the student data section by copying the data according to the needs that have been written in the proposal. For the coding process of various

commands and functions needed to build an application with the K-Means Clustering algorithm, Microsoft Visual Studio 2010 was used. The first stage carried out by the researcher was to create a web application system design using the DFD method. (Data Flow Diagram) and ERD (Entity Relationship Diagram). The DFD method is a system design method that explains the flow and process information in the system being built, while the ERD method is a system design method that describes the database design model of the system being built. The following is the system design.

III. RESULT AND DISCUSSION

A. Initial Data

Student criteria data consists of three aspects, namely:

1. Type of secondary school of origin (Senior High School, Vocational School, or equivalent), hereinafter referred to as Criteria K1.
2. The student achievements while at high school or equivalent (student achievements include ever having ranked in the top 10 or received other academic awards), hereinafter referred to as Criteria K2.
3. The economic situation of the student's family (the economic capacity of the student's family), hereinafter referred to as the K3 Criteria.

Table 3.1 Performance Weighting 1

No	Type of Secondary School	Score
1	Senior High School	9
2	Vocational School Equivalent	8

Table 3.2 Performance Weighting 2

No	Student achievement at school	Score
1	Achievement	9
2	Underachievement	8

Table 3.3 Performance Weighting 3

No	The economic situation of students	Score
1	Capable	9
2	Less capable	8

1. **Student data for the Cultural and Religious Tourism study program consists of three batches 2021, 2022, and 2023. Data on Cultural and Religious Tourism Study program, 2021 intake**

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Table 3.4 Data for Cultural and Religious Tourism Study Program, 2021 intake before Weighting

No	Name of Students	Criteria 1	Criteria 2	Criteria 3
		Type of School of Origin	Achievement	Economic Conditions
1	Yunvinus Molama	Senior High School	No	Less Fortunate
2	Melkisedek Wuwute	Senior High School	No	Less Fortunate
3	Fifin Murnikmat Lase	Vocational School	Yes	Less Fortunate
4	Gebri Margaretha Verbauli	Senior High School	Yes	Capable
5	Meilani Lida Siahaan	Senior High School	Yes	Capable
6	Evi Agustina Harianja	Vocational School	No	Capable
7	Juliana Marbun	Senior High School	No	Capable
8	Nelli Oktavisari Silitonga	Vocational School	Yes	Less Fortunate
9	Severoni Lase	Senior High School	No	Less Fortunate
10	Yestin Harefa	Vocational School	No	Capable
11	Naomi Angel Veronika Hutagalung	Senior High School	No	Capable
12	Kristiawan Ndraha	Senior High School	Yes	Less Fortunate
13	Melista br.Marbun Lumban Gaol	Senior High School	Yes	Capable
14	Mira Silitonga	Senior High School	Yes	Capable
15	Pernando Panjaitan	Senior High School	Yes	Capable
16	Putra Rata Harefa	Senior High School	Yes	Capable
17	Cari Nosta Adil Laoli	Senior High School	No	Less Fortunate
18	Elisabeth Oktavia Sihombing	Senior High School	Yes	Capable

19	Ezra Angelita Simanjuntak	Vocational School	No	Capable
20	Gladys Sitanggang	Senior High School	Yes	Capable
21	HelmaYesna Hutasoit	Senior High School	No	Capable
22	Ensiklira Silaban	Senior High School	Yes	Capable
23	Jonathan Mark Manullang	Vocational School	No	Less Fortunate
24	Jupita Sianturi	Senior High School	No	Less Fortunate
25	Paian Jonatan Nababan	Senior High School	No	Capable
26	Romasi Ernawati.S	Senior High School	No	Capable
27	Sebastinus Gulo	Senior High School	No	Less Fortunate
28	Eska Romauli Simamora	Senior High School	Yes	Capable
29	Fairy Sinaga	Vocational School	No	Capable
30	Putri Ayu Andriani Simanjuntak	Senior High School	Yes	Capable
31	Christien	Senior High School	Yes	Capable
32	Dini Resavita Hariandja	Vocational School	No	Capable
33	Esra Silali	Senior High School	No	Capable
34	Ifo Siska Sigalingging	Senior High School	Yes	Less Fortunate
35	Repalita Gulo	Vocational School	No	Capable
36	Putri Sapta Maria Silitonga	Senior High School	No	Capable
37	Santa TiaSenior High School	Senior High School	Yes	Less Fortunate
38	Sanovida Tamba	Senior High School	Yes	Capable
39	Pontianus Rekaman Halawa	Vocational School	No	Capable

2. The data for the Cultural and Religious Tourism study program from the 2021 intake after weighting is shown in Table 3.5 below

Table 3.5 Data for Cultural and Religious Tourism study program, 2021 intake after

No	Name	Criteria 1 Type of School of Origin	Criteria 2 Achievement	Criteria 3 Economic Conditions
1	Yunvinus Molama	9	8	8
2	Melkisedek Wuwute	9	8	8
3	Fifin Murnikmat Lase	8	9	8
4	Gebri Margaretha Verbauli Hutagalung	9	9	9
5	Meilani Lida Siahaan	9	9	9
6	Evi Agustina Harianja	8	8	9
7	Juliana Marbun	9	8	9
8	Nelli Oktavisari Silitonga	8	9	8
9	Severoni Lase	9	8	8
10	Yestin Harefa	8	8	9
11	Naomi Angel Veronika Hutagalung	9	8	9
12	Kristiawan Ndraha	9	9	8
13	Melista br.Marbun Lumban Gaol	9	9	9
14	Mira Silitonga	9	9	9
15	Pernando Panjaitan	9	9	9
16	Putra Rata Harefa	9	9	9
17	Cari Nosta Adil Laoli	9	8	8
18	Elisabeth Oktavia Sihombing	9	9	9
19	Ezra Angelita Simanjuntak	8	8	9
20	Gladys Sitanggang	9	9	9
21	Helmayana Hutasoit	9	8	9
22	Ensiklira Silaban	9	9	9
23	Jonathan Mark Manullang	8	8	8

24	Jupita Sianturi	9	8	8
25	Paian Jonatan Nababan	9	8	9
26	Romasi Ernawati.S	9	8	9
27	Sebastinus Gulo	9	8	8
28	Eska Romauli Simamora	9	9	9
29	Fairy Sinaga	8	8	9
30	Putri Ayu Andriani Simanjuntak	9	9	9
31	Christien	9	9	9
32	Dini Resavita Hariandja	8	8	9
33	Esra Silali	9	8	9
34	Ifo Siska Sigalingging	9	9	8
35	Repalita Gulo	8	8	9
36	Putri Sapta Maria Silitonga	9	8	9
37	Santa TiaSenior High School Tambunan	9	9	8
38	Sanovida Tamba	9	9	9
39	Pontianus Rekaman Halawa	8	8	9

3. Data on Cultural and Religious Tourism Study Program, class of 2022, Data on Cultural Religious Tourism Study Program for the 2022 intake before weighting is shown in Table 3.6 below.

Table 3.6 Data for the Cultural and Religious Tourism study program, class of 2022 before weighting

No	Name	Criteria 1	Criteria 2	Criteria 3
		Type of School Origin	Achievement	Economic Conditions
1	Noak Yasai	Senior High School	No	Less Fortunate
2	Selfianus Pahabol	Senior High School	No	Less Fortunate
3	Iman Peris Toansiba	Senior High School	No	Less Fortunate
4	Imerlina Laia	Senior High School	Yes	Less Fortunate
5	Melisa Manurung	Senior High School	Yes	Less Fortunate
6	Gabby Ribkamawaty Siburian	Senior High School	Yes	Less Fortunate
7	Pebrianto Nababan	Senior High School	No	Less Fortunate
8	Trinitas Harefa	Senior High School	Yes	Less Fortunate
9	Gabriel Evandio Hutabarat	Vocational School	Yes	Less Fortunate
10	Heri Santoso Simanjuntak	Senior High School	Yes	Less Fortunate
11	Zefanya Simalango	Senior High School	Yes	Capable
12	Alvin Juliyanto Lase	Senior High School	Yes	Less Fortunate
13	Dita Larissa	Senior High School	Yes	Less Fortunate
14	Pernando Panjaitan	Vocational School	No	Less Fortunate
15	Apri Twenty Sirait	Senior High School	Yes	Less Fortunate
16	Garry Anderson Nainggolan	Senior High School	Yes	Capable
17	Joel Fernandes Gultom	Vocational School	No	Capable
18	Yonathan Pusran Hutajulu	Senior High School	No	Capable
19	Chalvin Christian Sihite	Vocational School	No	Capable
20	Dewi Sartika Sari Sinamo	Senior High School	No	Capable
21	Ebenezer Nianggolan	Vocational School	No	Capable
22	Erwand Daniel Sihotang	Senior High School	No	Capable
23	Eyendri Hondo	Senior High School	Yes	Capable
24	Guna Ernawati Sinamo	Vocational School	No	Capable
25	Mariska Sihite	Senior High School	Yes	Capable
26	Sofy Anisa Sri Asina Nababan	Senior High School	No	Capable
27	Ardin Jultriman Mendrofa	Senior High School	Yes	Capable
28	Milawati Pasaribu	Senior High School	Yes	Capable
29	Rohani Andika Sari Hutabalian	Vocational School	No	Capable
30	Rona Sumantri Lumbantungkup	Senior High School	No	Capable

31	Siska Mariana Hutagalung	Senior High School	No	Less Fortunate
32	Tessalonika Hutapea	Senior High School	Yes	Capable
33	Sondang Paulina Pasaribu	Senior High School	Yes	Capable
34	Suardin Zega	Senior High School	Yes	Capable
35	Yossi Pratiwi Pardosi	Vocational School	Yes	Capable
36	Wantri Novita Tampubolon	Senior High School	Yes	Capable

4. Data on the Cultural and Religious Tourism study program class of 2022 after weighting is shown in Table 3.7 below.

Table 3.7 Data Cultural and Religious Tourism study program class of 2022 after weighting

No	Name	Criteria 1	Criteria 2	Criteria 3
		Type of School of Origin	Achievement	Economic Conditions
1	Noak Yasai	9	8	8
2	Selfianus Pahabol	9	8	8
3	Iman Peris Toansiba	9	8	8
4	Imerlina Laia	8	9	8
5	Melisa Manurung	9	9	8
6	Gabby Ribkamawaty Siburian	9	9	8
7	Pebrianto Nababan	9	8	8
8	Trinitas Harefa	8	9	8
9	Gabriel Evandio Hutabarat	8	9	8
10	Heri Santoso Simanjuntak	9	9	8
11	Zefanya Simalango	9	9	9
12	Alvin Juliyanto Lase	9	9	8
13	Dita Larissa	9	9	8
14	Pernando Panjaitan	8	8	8
15	Apri Twenty Sirait	9	9	8
16	Garry Anderson Nainggolan	9	9	9
17	Joel Fernandes Gultom	8	8	9
18	Yonathan Pusran Hutajulu	9	8	9
19	Chalvin Christian Sihite	8	8	9
20	Dewi Sartika Sari Sinamo	9	8	9
21	Ebenezer Nianggolan	8	8	9
22	Erwand Daniel Sihotang	9	8	9
23	Eyendri Hondo	9	9	9
24	Guna Ernawati Sinamo	8	8	9
25	Mariska Sihite	9	9	9
26	Sofy Anisa Sri Asina Nababan	9	8	9
27	Ardin Jultriman Mendrofa	9	9	9
28	Milawati Pasaribu	9	9	9
29	Rohani Andika Sari Hutabalian	8	8	9
30	Rona Sumantri Lumbantungkup	8	8	9
31	Siska Mariana Hutagalung	9	8	8
32	Tessalonika Hutapea	9	9	9
33	Sondang Paulina Pasaribu	9	9	9
34	Suardin Zega	9	9	9
35	Yossi Pratiwi Pardosi	8	9	9
36	Wantri Novita Tampubolon	9	9	

5. Data on the Cultural and Religious Tourism study program for the 2023 intake before weighting is:

Table 3.8 Data Cultural and Religious Tourism study program, class of 2023 before weighing

No	Name	Criteria 1	Criteria 2	Criteria 3
		Type of School Origin	Achievement	Economic Conditions
1	Dinda Nesa Gamalie Br Silitonga	Senior High School	Yes	Capable
2	Josep Harianja	Senior High School	Yes	Capable
3	Efra Zerika Sitio	Vocational School	Yes	Less Fortunate
4	Ardi Yesnto Halawa	Senior High School	No	Capable
5	Puspa Wahyu Pratiwi	Senior High School	Yes	Less Fortunate
6	Rivan Nababan	Vocational School	Yes	Less Fortunate
7	Josua Simatupang	Senior High School	No	Capable
8	Dian Febrian Firmanto	Senior High School	Yes	Less Fortunate
9	Niar Elizabeth Geofani Panjaitan	Vocational School	Yes	Less Fortunate
10	EsraYesnti A Siahaan	Senior High School	No	Capable
11	Adelina Angelica Sibagariang	Senior High School	Yes	Capable
12	Yoni Pransiska Simanjuntak	Vocational School	Yes	Less Fortunate
13	Masriara Lubis	Senior High School	Yes	Less Fortunate
14	Aldo Sampetua Tambunan	Senior High School	Yes	Less Fortunate
15	Andre David Ario Lumban Gaol	Vocational School	No	Capable
16	Indah Sari	Senior High School	Yes	Capable
17	Johannes Parera	Vocational School	No	Capable
18	Rotua Br Purba	Senior High School	Yes	Less Fortunate
19	Mery Grecelyta Sianipar	Vocational School	Yes	Less Fortunate
20	Winda Lovika Putri Silalahi	Senior High School	No	Capable
21	Indah Amelia V. Simanullang	Senior High School	No	Capable
22	Arina Tiurma Manalu	Senior High School	Yes	Less Fortunate
23	Hiyos Fiter Sababalat	Senior High School	Yes	Less Fortunate
24	Rugun Panggabean	Vocational School	Yes	Less Fortunate
25	Elisabet Sitompul	Senior High School	Yes	Less Fortunate
26	Isak Lumbantobing	Vocational School	Yes	Capable
27	Pria Sitompul	Senior High School	No	Capable
28	Savana Pane	Senior High School	No	Capable
29	Ricardo Sagala	Senior High School	Yes	Capable
30	Sadar Fernando Siahaan	Senior High School	No	Capable
31	Rona Sari Ayu Simamora	Senior High School	Yes	Less Fortunate
32	Nahael Marudut Amin Mungkur	Senior High School	No	Capable
33	Ida Natalria Tumangger	Senior High School	No	Capable
34	Weimi Erinda Berutu	Vocational School	Yes	Less Fortunate
35	Desinta Riana Tumangger	Senior High School	Yes	Less Fortunate

6. The data for the Cultural and Religious Tourism study program for the 2023 intake after weighting is shown in Table 3.9 below.

Table 3.9 Data Cultural and Religious Tourism study program, class of 2023 after weighting

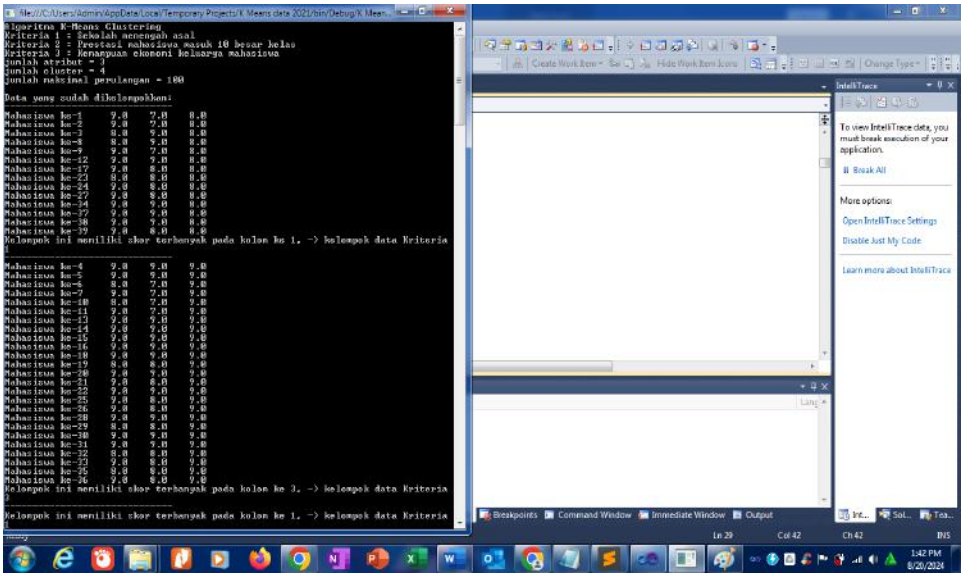
No	Name	Criteria 1	Criteria 2	Criteria 3
		Type of School of Origin	Achievement	Economic Conditions
1	Dinda Nesa Gamalie Br Silitonga	9	9	9
2	Josep Harianja	9	9	9
3	Efra Zerika Sitio	8	9	8
4	Ardi Yanto Halawa	9	8	9
5	Puspa Wahyu Pratiwi	9	9	8

6	Rivan Nababan	8	9	8
7	Josua Simatupang	9	8	9
8	Dian Febrian Firmanto	9	9	8
9	Niar Elizabeth Geofani Panjaitan	8	9	8
10	Esrayanti A Siahaan	9	8	9
11	Adelina Angelica Sibagariang	9	9	9
12	Yoni Pransiska Simanjuntak	8	9	8
13	Masriara Lubis	9	9	8
14	Aldo Sampetua Tambunan	9	9	8
15	Andre David Ario Lumban Gaol	8	8	9
16	Indah Sari	9	9	9
17	Johannes Parera	8	8	9
18	Rotua Br Purba	9	9	8
19	Mery Grecelyta Sianipar	8	9	8
20	Winda Lovika Putri Silalahi	9	8	9
21	Indah Amelia V. Simanullang	9	8	9
22	Arina Tiurma Manalu	9	9	8
23	Hiyos Fiter Sababalat	9	9	8
24	Rugun Panggabean	8	9	8
25	Elisabet Sitompul	9	9	8
26	Isak Lumbantobing	8	9	9
27	Pria Sitompul	9	8	9
28	Savana Pane	9	8	9
29	Ricardo Sagala	9	9	9
30	Sadar Fernando Siahaan	9	8	9
31	Rona Sari Ayu Simamora	9	9	8
32	Nahael Marudut Amin Mungkur	9	8	9
33	Ida Natalria Tumangger	9	8	9
34	Weimi Erinda Berutu	8	9	8
35	Desinta Riana Tumangger	9	9	8

B. Testing

The following are the results of testing data on the Cultural and Religious Tourism study program from the 2021, 2022, and 2023 intakes using the K-Means Clustering algorithm using Microsoft Visual Studio 2010.

1. The results of the 2021 intake of Cultural and Religious Tourism study program data testing can be seen in Figure 3.1. the following



Based on Figure 3.1, it is shown that from 100 tests (iterations) conducted, only two groups can be formed. The first group based on Criteria 1 (school of origin of Senior high School equivalent) consists of 14 students or equivalent to 35.89%. Then, the second group based on Criteria 3 (student economic ability) consists of 25 people or equivalent to 64.10%.

The results of the data testing of the Cultural and Religious Tourism Study Program in the year 2022 showed that from 100 tests (iterations) carried out, three groups could be formed. The first group was based on Criteria 3 (student economic ability) of 15 people or equivalent to 41.66%. Then the second group was based on Criteria 1 (school of origin of SMA or equivalent vocational school) of 15 students or equivalent to 41.66%. Then, the third group was also based on Criteria 1 of 6 people or equivalent to 16.66%. 3.

The results of the data testing of the Cultural and Religious Tourism study program in the year 2023 showed that from 100 tests (iterations) carried out, three groups could be formed. The first group was based on Criteria 2 (student achievement while at school) of 17 people or equivalent to 48.57%. Then the second group was based on Criteria 3 of 11 students or equivalent to 31.42%. Then, the third group was also based on Criteria 2 again of 7 people or equivalent to 20%.

IV. CONCLUSION

Based on the results of the research that has been conducted, the following are the conclusions that can be obtained, among others.

1. Based on the data testing of the Cultural and Religious Tourism Study Program, class of 2021, can only form two groups. The first group based on Criteria 1 (school of origin of Senior high School or equivalent) as many as 14 students or equivalent to 35.89%. Then, the second group based on Criteria 3 (student economic ability) as many as 25 people or equivalent to 64.10%. This shows that the majority of students who register for the study program are dominated by the economic ability of the student's family.
2. Based on the data testing of the Cultural and Religious Tourism Study Program, the class of 2022 formed three groups. The first group is based on Criteria 3 (student economic ability) as many as 15 people or equivalent to 41.66%. Then the second group based on Criteria 1 (school of origin of Senior high school or equivalent) as many as 15 students or equivalent to 41.66%. Then, the third group is also based on Criteria 1 as many as 6 people or equivalent to 16.66%. The results show that students who register for the Cultural and Religious Tourism Study Program are based on the same dominance of Criteria 1 and Criteria 3.
3. Based on the data testing, students in the 2023 Cultural and Religious Tourism Study Program formed three groups. The first group is based on Criteria 2 (student achievement while at school) as many as 17 people or equivalent to 48.57%. Then the second group is based on Criteria 3 as many as 11 students or equivalent to 31.42%. Then, the third group is also based on Criteria 2 again as many as 7 people or equivalent to 20%. The results show that the majority of students in the Cultural and Religious Tourism Study Program are based on Criteria 2 (achievement while at their original school).
4. The data testing of students in the 2021, 2022, and 2023 classes, shows different trends based on Criteria 1 (high school or equivalent vocational high school graduates), Criteria 2 (student achievement while at their original school), and Criteria 3 (community economic ability).
5. Promotion strategies must continue to be implemented in all high schools or equivalent vocational schools, providing scholarships for prospective Cultural and Religious Tourism Study Program who excel or are economically disadvantaged.

REFERENCES

[1] Abbas, J., Aman, J., Nurunnabi, M., & Bano, S. (2019). The Impact of Social Media on Learning Behavior for Sustainable Education: Evidence of Students from Selected Universities in Pakistan. *Sustainability*, *11*(6), 1683. https://doi.org/10.3390/su11061683

[2] Bang, S., & Jhun, M. (2014). Weighted Support Vector Machine Using K-Means Clustering. *Communications in Statistics - Simulation and Computation*, *43*(10), 2307–2324. https://doi.org/10.1080/03610918.2012.762388

[3] Bengnga, A., & Ishak, R. (2018). Prediksi Jumlah Mahasiswa Registrasi Per Semester Menggunakan Linier Regresi Pada Universitas Ichsan Gorontalo. *ILKOM Jurnal Ilmiah*, *10*(2), 136–143. https://doi.org/10.33096/ilkom.v10i2.274.136-143

[4] Darmansah, D. D., & Wardani, N. W. (2021). Analisis Pesebaran Penularan Virus Corona di Provinsi Jawa Tengah Menggunakan Metode K-Means Clustering. *JATISI (Jurnal Teknik Informatika Dan Sistem Informasi)*, *8*(1), 105–117. https://doi.org/10.35957/jatisi.v8i1.590

[5] Dwivedi, Y. K., Ismagilova, E., Hughes, D. L., Carlson, J., Filieri, R., Jacobson, J., Jain, V., Karjaluoto, H., Kefi, H., Krishen, A. S., Kumar, V., Rahman, M. M., Raman, R., Rauschnabel, P. A., Rowley, J., Salo, J., Tran, G. A., & Wang, Y. (2021). Setting the future of digital and social media marketing research: Perspectives and research propositions. *International Journal of Information Management*, *59*, 102168. https://doi.org/10.1016/j.ijinfomgt.2020.102168

[6] Firat, M., & Gungor, M. (2009). Generalized Regression Neural Networks and Feed Forward Neural Networks for prediction of scour depth around bridge piers. *Advances in Engineering Software*, *40*(8), 731–737. https://doi.org/10.1016/j.advengsoft.2008.12.001

[7] Fuss, C. E., Berg, A. A., & Lindsay, J. B. (2016). DEM Fusion using a modified k-means clustering algorithm. *International Journal of Digital Earth*, *9*(12), 1242–1255. https://doi.org/10.1080/17538947.2016.1208685

[8] Gómez-Olmedo, A. M., Eizaguirre Diéguez, M., & Vicente Pascual, J. A. (2024). Redefining success in innovative crowdfunding projects: Empirical evidence of effective mindful consumption promotion in Kickstarter. *Journal of Innovation & Knowledge*, *9*(4), 100558. https://doi.org/10.1016/j.jik.2024.100558

[9] Haleem, A., Javaid, M., Asim Qadri, M., Pratap Singh, R., & Suman, R. (2022). Artificial intelligence (AI) applications for marketing: A literature-based study. *International Journal of Intelligent Networks*, *3*, 119–132. https://doi.org/10.1016/j.ijin.2022.08.005

[10] Handoko, S., Fauziah, F., & Handayani, E. T. E. (2020). IMPLEMENTASI DATA MINING UNTUK MENENTUKAN TINGKAT PENJUALAN PAKET DATA TELKOMSEL MENGGUNAKAN METODE K-MEANS CLUSTERING. *Jurnal Ilmiah Teknologi Dan Rekayasa*, *25*(1), 76–88. https://doi.org/10.35760/tr.2020.v25i1.2677

[11] Hu, Y.-C., & Su, B.-H. (2008). Accelerated k-means clustering algorithm for colour image quantization. *The Imaging Science Journal*, *56*(1), 29–40. https://doi.org/10.1179/174313107X176298

[12] Jud, J., Hirt, C. N., Rosenthal, A., & Karlen, Y. (2023). Teachers' motivation: Exploring the success expectancies, values, and costs of the promotion of self-regulated learning. *Teaching and Teacher Education*, *127*, 104093. https://doi.org/10.1016/j.tate.2023.104093

[13] Kumar, R., Mukherjee, S., & Bose, I. (2025). Metaverse advertising and promotional effectiveness: The route from immersion to joy. *Decision Support Systems*, *189*, 114386. https://doi.org/10.1016/j.dss.2024.114386

[14] Kumar, S., Kar, A. K., & Ilavarasan, P. V. (2021). Applications of text mining in services management: A systematic literature review. *International Journal of Information Management Data Insights*, *1*(1), 100008. https://doi.org/10.1016/j.jjimei.2021.100008

[15] Li, Y., Yin, H., Dong, F., Cheng, W., Zhuang, N., Xie, D., & Di, W. (2025). The key to green water-preserved mining: Prediction and integration of mining rock failure height by big data fusion simulation algorithm. *Process Safety and Environmental Protection*, *193*, 1015–1035. https://doi.org/10.1016/j.psep.2024.11.096

[16] Ma, Y. (2024). Simulation and Implementation of Intelligent Network Technology System Based on Big Data. *Procedia Computer Science*, *247*, 545–552. https://doi.org/10.1016/j.procs.2024.10.065

[17] Naibaho, F. R. (2019). Sistem Pendukung Keputusan Dalam Penentuan Dosen Terbaik Di IAKN Tarutung Dengan Menggunakan Kombinasi Metode Likert dan Metode VIKOR. In *Seminar Nasional Sains & Teknologi Informasi (SENSASI)* (Vol. 2, Issue Tantangan & Peluang di Bidang Pendidikan untuk Menghadapi Era Disrupsi pada Teknologi RI 4.0). http://seminar-id.com/prosiding/index.php/sensasi/article/view/335

[18] Nasution, M. K. M., Sitompul, O. S., Elveny, M., & Syah, R. (2021). Data science: A Review towards the Big Data Problems. *Journal of Physics: Conference Series*, *1898*(1), 012006. https://doi.org/10.1088/1742-6596/1898/1/012006

[19] Park, B., Park, C., Hong, S., & Choi, H. (2025). Sparse kernel k-means clustering. *Journal of Applied Statistics*, *52*(1), 158–182. https://doi.org/10.1080/02664763.2024.2362266

[20] Peng, C., Chen, J., Wan, S., & Xu, G. (2024). A Quarterly High RFM Mining Algorithm for Big Data Management. *Computers, Materials & Continua*, *80*(3), 4341–4360. https://doi.org/10.32604/cmc.2024.054109

[21] Plekhanov, D., Franke, H., & Netland, T. H. (2023). Digital transformation: A review and research agenda. *European Management Journal*, *41*(6), 821–844. https://doi.org/10.1016/j.emj.2022.09.007

[22] Prastyabudi, W. A., Alifah, A. N., & Nurdin, A. (2024). Segmenting the Higher Education Market: An Analysis of Admissions Data Using K-Means Clustering. *Procedia Computer Science*, *234*, 96–105. https://doi.org/10.1016/j.procs.2024.02.156

[23] Rashid, A. Bin, & Kausik, M. A. K. (2024). AI revolutionizing industries worldwide: A comprehensive overview of its diverse applications. *Hybrid Advances*, *7*, 100277. https://doi.org/10.1016/j.hybadv.2024.100277

[24] Razavian, B., Hamed, S. M., Fayyaz, M., Ghasemi, P., Ozkul, S., & Tirkolaee, E. B. (2024). Addressing barriers to big data implementation in sustainable smart cities: Improved zero-sum grey game and grey best-worst method. *Journal of Innovation & Knowledge*, *9*(4), 100593. https://doi.org/10.1016/j.jik.2024.100593

[25] Roztocki, N., Soja, P., & Weistroffer, H. R. (2019). The role of information and communication technologies in socio-economic development: towards a multi-dimensional framework. *Information Technology for Development*, *25*(2), 171–183. https://doi.org/10.1080/02681102.2019.1596654

[26] Saltz, J. S. (2021). CRISP-DM for Data Science: Strengths, Weaknesses, and Potential Next Steps. *2021 IEEE International Conference on Big Data (Big Data)*, 2337–2344. https://doi.org/10.1109/BigData52589.2021.9671634

[27] Shu, X., & Ye, Y. (2023). Knowledge Discovery: Methods from data mining and machine learning. *Social Science Research*, *110*, 102817. https://doi.org/10.1016/j.ssresearch.2022.102817

[28] Valero, A., & Van Reenen, J. (2019). The economic impact of universities: Evidence from across the globe. *Economics of Education Review*, *68*, 53–67. https://doi.org/10.1016/j.econedurev.2018.09.001

[29] Wahyudi, T., & Arroufu, D. S. (2022). Implementation of Data Mining Prediction Delivery Time Using Linear Regression Algorithm. *Journal of Applied Engineering and Technological Science (JAETS)*, *4*(1), 84–92. https://doi.org/10.37385/jaets.v4i1.918

[30] Wang, L. (2024). Enhancing tourism management through big data: Design and implementation of an integrated information system. *Heliyon*, *10*(20), e38256. https://doi.org/10.1016/j.heliyon.2024.e38256