



## Application of the Hybrid Model Analysis of the Combination of Decision Tree and Agglomerative Hierarchical Clustering Ward models in Mapping Potential School Distribution to support Marketing Management Strategy at Private Universities in Aceh

Yuli Asbar<sup>1\*)</sup>, Sapnabiby<sup>1</sup>, Angga Pratama<sup>2</sup>, Janner Simarmata<sup>3</sup>, Abror<sup>4</sup>,  
Mutammimul Ula<sup>2</sup>

<sup>1</sup>Fakultas Ekonomi dan Bisnis, Universitas Malikussaleh, Indonesia

<sup>2</sup>Fakultas Teknik, Prodi Sistem Informasi, Universitas Malikussaleh, Indonesia

<sup>3</sup>Fakultas Pendidikan Teknologi Informatika dan Komputer Universitas Negeri Medan, Indonesia

<sup>4</sup>Fakultas Ekonomi, Universitas Negeri Padang, Indonesia

yuliasbar@unimal.ac.id\*, sapnabiby@unimal.ac.id, jannersimarmata@unimed.ac.id,

abror094@fe.unp.ac.id,

anggapratama@unimal.ac.id, mutammimul@unimal.ac.id

<sup>\*)</sup>Corresponding email: yuliasbar@unimal.ac.id

688

### Abstrak

Private universities in Indonesia can prepare marketing promotion strategies to maintain the level of competition with state universities. This marketing strategy is useful for facing increasingly fierce competition with other tertiary institutions. The methodology for preparing strategies to attract schools includes data on accreditation status, job opportunities, the number of teaching staff at Masters and Doctoral levels, facilities and infrastructure, and access to campus locations. Then carry out an analysis of the interests of the majors with many enthusiasts and conduct a mapping analysis of schools based on students who are accepted at private tertiary institutions by displaying the results of the mapping based on the mapping. The research data consisted of 58 school origins scattered throughout the Aceh region. This study aims to see potential school groups presented in the mapping. The likely group is a school that contributes a lot of students to private tertiary institutions. Meanwhile, the decision tree model aims to see student interest in each of the selected majors. Then it can make it easier for tertiary institutions to group and map student interests in each school in Aceh. The results of the study are 3 clusters using the ward method consisting of 47 sets for the first cluster, 5 clusters for the second cluster, and 6 clusters for the third cluster. The results of the distribution of student distribution can be seen from the Sc2020 centroid point. The value of variable C1 is -1.029370233, C2 is 1.362317602, and C3 is 0.006784028. Furthermore, Sc2021 for variable C1 is -1.071678582, C2 is 1.349864235, and C3 is 0.052693694. SSE score results with Meureudu High School 1 data in 2020 worth 3, in 2021 with a total of 3, and in 2022 with a score of 6. The final result of the SSE score is 0.589044382, which has cluster 1. Meanwhile, Lhoksukon public high school has a value of -0,490870318—further data on SMA Negeri 1 Syamtalira Bayu with the result that the SSE value is -0.3926255. Furthermore, man 2 Bireun with a value of 3.043395973 with cluster 3. The results of this study for grouping with the value of the color brightness level get the highest cluster by donating many students at the college.

**Keywords:** Clustering, Student interest, Ward Model, K-means, Mapping

DOI Number: 10.48047/nq.2022.20.19.NQ99064

NeuroQuantology 2022; 20(19): 688-701

### 1. Introduction

The existence of educational institutions is essential for the running of education. Institutions must maintain the student ratio to

survive in the world of education. The university must increase student interest so they can study at educational institutions and compete with other universities. At least this is an



extraordinary demographic impact in terms of university competition, and educational institutions must have a good management strategy for a long time. (Kotler, Philip, 1981; Smith, Lois R., n.d.; Woliktol et al., 2022).

Universities must quickly adapt to changes and market needs in the world of work, and the market needs to be able to attract student interest that is adapted to current world developments. (Smith, Lois R., n.d.).

One of the strategic marketing planning techniques used through the business sector. By making adjustments, tertiary institutions can better serve students and the community to be able to develop a sustainable environmental analysis system. (Dooris M. J., Kelley J. M., 2004; Rowley, 1997).

Macro-marketing is widely seen as a way to encourage economic growth, and macro-marketing is concerned with designing an efficient and fair marketing system to be able to identify strategic planning given various college or university management in attracting enrollment for these students and the innovations that are often done during the period for the development of technology in education. Universities improve educational standards and concentrate on increasing productivity and growth for students in terms of teaching and learning education (Hussain & Khan, 2021; Shirley, 1983; Visvizi et al., 2018).

This institution focuses on developing and improving educational models by integrating information and communication technology (ICT) into learning. Instruments for social accountability are essential because they can significantly contribute to the teaching and learning process and encourage the development of knowledge that can assist in improving higher education strategies to attract students' interest. (Casanova et al., 2011; Daniela et al., 2017; Lee & Choi, 2017).

The marketing strategy aims to increase prospective students' knowledge about excellence in choosing a college. (Hemsley-Brown, Jane, 2006), Educational institutions can identify marketing strategies and predictions

from various perspectives to attract the interest of prospective customers/students, and these factors influence the selection of universities. The existence of analysis in developing management strategies in promotions can predict job levels and career opportunities work to attract interest in developing higher education strategies. (Bigelow B. F., Bilbo D., Mathew, M. Ritter L., 2015; Karol, Nathaniel H. & Ginsburg, 1980).

The application of cluster analysis in seeing the student interest in choosing a tertiary institution is essential in strategic management, given the number of students contributing to each school. This requires mapping in identifying marketing strategies from various perspectives in attracting student interest (Li Maohua, 2017; Soutar, Geoffrey N., 2002).

The importance of tertiary institutions in analyzing market segments to determine models of marketing activities in attracting student interest. The cluster analysis can produce a good performance at each university in preparing future strategies, and the cluster model analysis can deliver better performance (Quinn J. T., Olinsky A. D., Schumacher P. A., 2015; Widiarta, I. Made, M. Nur Fietroh, 2022)

Cluster analysis can determine variables in market segmentation at each tertiary institution. The application of market segmentation can be seen in the cluster analysis at each tertiary institution. Variables in viewing the potential to reveal the characteristics of each market segment based on its measurability, availability, and capabilities (Lin, 2002).

One of the variables that can be used is psychographic variables, where these variables can increase the strength of e-consumer preferences. (Liu, 2019).

Market segmentation based on psychographic variables can be used to view consumers with different demographics and geographic characteristics. (Nadanyiova M., 2019).

For application to private tertiary institutions, psychographic variables significantly influence cluster analysis segmentation results so they will be used for this study. Besides determining the variables, selecting the segmentation method is another aspect that needs to be considered. The method that is commonly used in market segmentation is cluster analysis. (Govindasamy, 2018)

K-Means is one of the cluster analysis methods applied to market segmentation for PTS. This method can provide the most effective results to describe the prestige of student seekers. (Casidy & Wymer, 2018).

There are three main activities in a marketing strategy called the holy trinity of marketing (Schlegelmilch, 2016). These activities consist of segmentation, targeting, and positioning (STP). Of the three stages, market segmentation is the first step in creating a buying leading strategy that determines the results of the following stages. (Arsova M., 2019).

The use of market segmentation is also applied to financial services targeting customer deposits. (Makgosa et al., 2016). In addition, manufacturing and trading companies operating in the coffee market use market segmentation to identify consumer needs and expectations. (Maciejewski et al., 2019). Market segmentation can build an effective form of communication through various media based on the characteristics of each market segment. (Goodrich et al., 2020).

Educational services in tertiary institutions can be carried out by looking at market segmentation and can be used as a guideline for school or tertiary management to build effective communication with prospective students. Universities can better use market segmentation to understand prospective students' needs and expectations so that the services provided by tertiary institutions are more valuable for students who wish to enroll in these tertiary institutions (Ula et al., 2021). Market segmentation is used in Customer

Relationship Management (CRM), and market segmentation can be seen in activity patterns, including segmentation, targeting, and positioning (STP). These activities can support promotional strategies to attract prospective students. The existence of three market segments is the first step in creating a leading buying strategy that determines the results of the stages in the Marketing Strategy Analysis by looking at the level of student interest in majors at tertiary institutions. (Arsova M., 2019).

This study aims to identify student market segments using agglomerative clustering analysis using the ward model. the results of the research can see the mapping of each school as seen from the many interests of students according to the interests of each school. The market segmentation applied to tertiary institutions aims to know the target of prospective students based on the highest number of elections, which can help determine the model for marketing segmentation mapping activities. With this research, universities can carry out more accurate and efficient promotions based on clusters. Furthermore, the analysis of agglomerative clustering clusters with the ward model can be used for segmenting the tertiary market and can see each cluster analysis by mapping in viewing schools in the field of interest to provide the best results on mapping.

## 2. Literature review

### 1. Education Marketing Strategy Analysis

Identification of the market in attracting students is carried out by analyzing and determining the objectives to be achieved from the implementation of the promotion by looking at the targets that existed before the promotional activities began, thus facilitating the process of implementing management strategies (Kalenskaya, 2015; Keller, 2012; Lockhart, 2011).

A marketing Plan needs to be done to help the management to carry out the



marketing. College strategy can be seen in Strengths, Weaknesses, Opportunities, and Threats (Naudé & Ivy, 1999). Marketing in the world of education today is very much needed to attract the interest of prospective new students. The model stored in the database makes it easier to see marketing strategies. The identification of market segments can be seen by future students based on the use of the system in the field of social media (Constantinides & Zinck Stagno, 2011; Malešević et al., 2021; Walter et al., 2022).

## 2. Decision Tree Classification Method and Ward Model

Classification is one of many strategies to determine the status of students' interest in entering school, and in this classification, using a decision tree. The Decision Tree algorithm serves as the basis for the C4.5 algorithm. Decision trees can be built using the capacity classification algorithm C4.5 (Decision Trees).

Clustering is a method for finding data that has similarities between one data on a product and interests that are interrelated with one another. (Calantone & Di Benedetto, 2007),

There are two types of clustering methods used in data clustering: hierarchical clustering and non-hierarchical clustering. (Satria, 2016). Use of Ward's Clustering Method model to minimize the variance between objects in one cluster by producing several groups in an optimal cluster (Rahmawati et al., 2016; Starczewski, 2017). The clustering method has different interval values. The clustering results consist of hierarchical grouping with dendrograms in showing the results of the clustering method with interval-valued clustering methods and the existence of a hierarchical direction of the dendrogram in the ward method process. (Ogasawara & Kon, 2021). K-means clustering is a non-hierarchical data grouping method that classifies data into one or more clusters. (Nugraha A., Perdana M. A. H., Santoso H. A., Zeniarja J., Luthfiarta A., 2018). Data with the exact nature are grouped in one cluster. Data with different characteristics are grouped with other clusters so that the data in one set has a trim level of variation.

## 4. Method

The research method for the Strategy Decision Tree Analysis of Student Interests in Private Universities in Aceh is as follows:

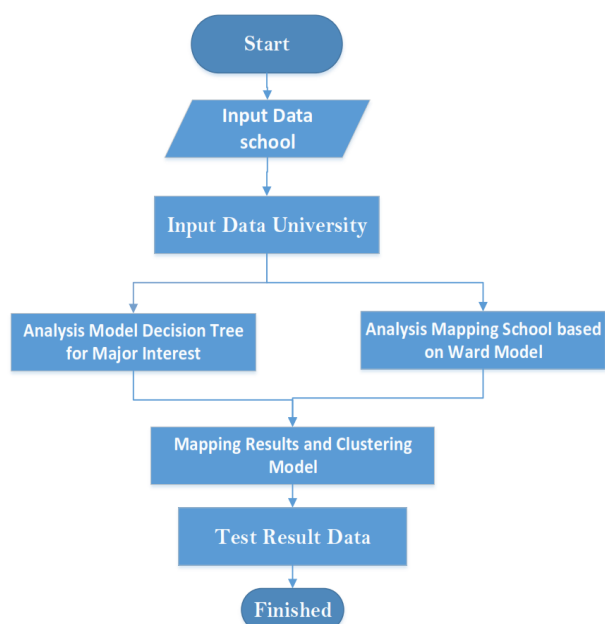


Figure 1. Decision Tree

### 3. Results and Discussion

#### A. Ward Model Calculation Results

##### 1. School Data For Model wards

As for the School Data Input for Model Ward Application of Analysis on Mapping Marketing Management Strategy Student Interests at Private Universities in Aceh for the interest of universities entering higher education from the total survey data are as follows:

Table 1. School Data

Number	School	2020	2021	2022
1	10100575 - Sman 1 Meureudu	3	6	3
2	10101174 - Sma Negeri 1 Lhoksukon	4	1	2
3	10101190 - Sma Negeri 1 Syamtalira Aron	3	1	4
4	10101192 - Sma Negeri 1 Tanah Luas	4	4	3
5	10101305 - Sma Negeri 1 Syamtalira Bayu	5	6	5
6	10101311 - Sma Negeri 1 Kuta Makmur	1	1	3
7	10101881 - Sman 1 Peureulak	2	1	1
8	10105620 - Sma Negeri 2 Lhokseumawe	5	1	5
9	10105622 - Sman 4 Lhokseumawe	1	2	1
10	10105625 - Smkn 1 Lhokseumawe	2	1	17
11	10105626 - Smkn 2 Lhokseumawe	8	8	3
...	...	...	...	...
...	...	...	...	...
53	69947570 - Sma Swasta Nurul Islam	6	5	2
55	69964064 - Sma Plus Al-Fata	5	1	3
56	69970305 - Sma Swasta Terpadu Al-Furqan	2	1	2
57	69970964 - Smks Kafilul Yatim	4	2	1
58	P9952650 - Pkbn Al Manna	3	11	1

692

##### 2. Standardization Stages for Model wards

As for the standardization stages for Model Ward Analysis on Mapping Marketing Management Strategy Student Interests at Private Higher Education, then to look at the data on the 2020 - 2022 sc scores at each school are as follows:

Table.2 Value of sc 2020-2022

Number	School	2020	2021	2022	Sc2021	Sc2022
1	10100575 - Sman 1 Meureudu	3	6	3	-1,3585	-0,58904
2	10101174 - Sma Negeri 1 Lhoksukon	4	1	2	1,450086	-0,49087
3	10101190 - Sma Negeri 1 Syamtalira Aron	3	1	4	1,099013	-0,58904
4	10101192 - Sma Negeri 1 Tanah Luas	4	4	3	0,396866	-0,49087
5	10101305 - Sma Negeri 1 Syamtalira Bayu	5	6	5	1,450086	-0,3927
6	10101311 - Sma Negeri 1 Kuta Makmur	1	1	3	0,221329	-0,78539
7	10101881 - Sman 1 Peureulak	2	1	1	-0,48082	-0,68722
8	10105620 - Sma Negeri 2 Lhokseumawe	5	1	5	0,221329	-0,3927
...	...	...	...	...	...	...
...	...	...	...	...	...	...
55	69964064 - Sma Plus Al-Fata	5	1	3	-0,48082	3,043396
56	69970305 - Sma Swasta Terpadu Al-Furqan	2	1	2	-0,48082	1,472611
57	69970964 - Smks Kafilul Yatim	4	2	1	0,747939	1,472611
58	P9952650 - Pkbn Al Manna	3	11	1	0,747939	2,454352



### 3. Result of distance value

The distance values are obtained from the standard sc2020-sc2022 up to the 58th iteration distance. The following results from the value of each analysis distance on the mapping of student interests in marketing management strategies are as follows:

Table 3. Distance Value Results

	1	2	3	4	5	6	7	.	56	57	58
1	0	0,09174	0	0,09174	0,19348	0,19348	0,09174	...	0,09174	0,09174	0
2	0,0917	0	0,09174	0	0,09174	0,29522	0,19348	...	0,19348	0	0,09174
3	0	0,09174	0	0,09174	0,19348	0,19348	0,09174	...	0,09174	0,09174	0
4	0,0917	0	0,09174	0	0,09174	0,29522	0,19348	...	0,19348	0	0,09174
5	0,1934	0,09174	0,19348	0,09174	0		0,29522	...	0,29522	0,09174	0,19348
6	0,1934	0,29522	0,19348	0,29522	0,39696	0	0,09174	...	0,09174	0,29522	0,19348
7	0,0917	0,19348	0,09174	0,19348	0,29522	0,09174	0	...	0	0,19348	0,09174
...	...	...	...	...	...	...	...	...	...	...	...
56	0,0917	0,19348	0,09174	0,19348	0,29522	0,09174	0	...	0	0,19348	0,09174
57	0,0917	0	0,09174	0	0,09174	0,29522	0,19348	...	0,19348	0	0,09174
58	0	0,09174	0	0,09174	0,19348	0,19348	0,09174	...	0,09174	0,09174	0

### 4. Results of the Value Scaling and Final

The results of the Value Scaling and Final. Cluster values are used as objective functions. Two objects will be combined if they have a minor objective function among the possibilities in the results of the ward method as follows:

Table 4. SSE Value Results

Number	School	2020	2021	2022	Sc	Final Clusters
1	10100575 - Sman 1 Meureudu	3	6	3	-0,58904	1
2	10101174 - Sma Negeri 1 Lhoksukon	4	1	2	-0,49087	1
3	10101190 - Sma Negeri 1 Syamtalira Aron	3	1	4	-0,58904	1
4	10101192 - Sma Negeri 1 Tanah Luas	4	4	3	-0,49087	1
5	10101305 - Sma Negeri 1 Syamtalira Bayu	5	6	5	-0,3927	1
6	10101311 - Sma Negeri 1 Kuta Makmur	1	1	3	-0,78539	1
7	10101881 - Sman 1 Peureulak	2	1	1	-0,68722	1
8	10105620 - Sma Negeri 2 Lhokseumawe	5	1	5	-0,3927	1
9	10105622 - Sman 4 Lhokseumawe	1	2	1	-0,78539	1
...	...	...	...	...	...	...
12	10107083 - Sma Negeri 1 Bireuen	28	14	36	1,865307	2
22	10107101 - Sma Negeri 3 Bireuen	21	8	42	1,178089	2
23	10107102 - Sma Negeri 1 Kuala	41	7	24	3,14157	2

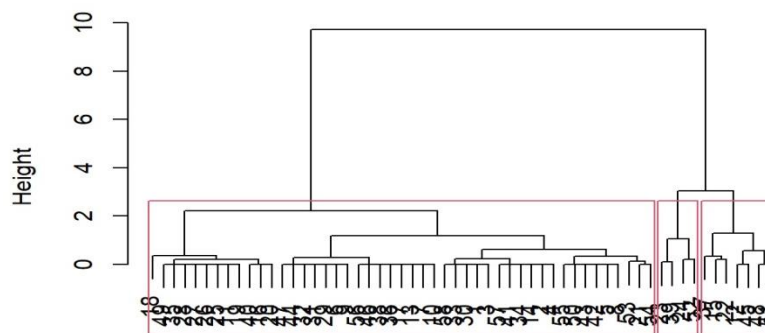




Number	School	2020	2021	2022	Sc	Final Clusters
24	10107106 - Smk Negeri 1 Bireuen	32	29	41	2,258003	2
45	10113785 - Mas Darul Ulum Lhokseumawe	28	7	26	1,865307	2
15	10107090 - Sma Negeri 1 Peudada	19	14	12	0,981741	3
37	10113753 - Man 4 Bireuen	17	9	11	0,785393	3
39	10113756 - Man 2 Bireuen	40	13	11	3,043396	3
48	69848999 - Sma Negeri 1 Jeumpa	24	12	14	1,472611	3
51	69907803 - Sma Sukma Almubarakah	24	2	2	1,472611	3
52	69945354 - Smk Swasta Al-Hidayah	34	10	1	2,454352	3

Following are the results of each value from the ward model clustering with values for each Phase 2 Cluster, namely S1, S2, S3, S4, S5, S6-13, S14, S16, 17-21,25-38,40-43 for cluster 1, the values are S12, S22, S23, S24, S45, while for the Cluster 3 stage are S15, S37, S39, S48, S51, S52. The final stages of the cluster dendrogram are as follows:

**Cluster Dendrogram**



**Figure 2. Final Result of Cluster Dendrogram**

**B. Calculation Results of the Decision Tree Classification**

As for the values of the variables used in choosing majors, including accreditation, job opportunities, the number of Master and Doctoral lecturers in a department of facilities and infrastructure, and the results of the classification in the form of suggestions for prospective students in choosing majors at a private tertiary institution in Aceh, then, based on the variable table, decide on the selection of majors based on predetermined variables. The following are the results of calculating the Classification Decision Tree Analysis of the Decision Tree Strategy of Student Interests at Private Higher Education in Aceh follows :

$$\begin{aligned}
 \text{Entropy (Total)} &= \left( \left(-\frac{23}{50}\right) \times \log_2\left(\frac{23}{50}\right) + \left(-\frac{13}{50}\right) \times \log_2\left(\frac{13}{50}\right) + \left(-\frac{14}{50}\right) \times \log_2\left(\frac{14}{50}\right) \right) \\
 &= 1,535 \\
 \text{Entropy (Good Accreditation)} &= \left( \left(-\frac{20}{24}\right) \times \log_2\left(\frac{20}{24}\right) + \left(-\frac{2}{24}\right) \times \log_2\left(\frac{2}{24}\right) + \left(-\frac{2}{24}\right) \times \log_2\left(\frac{2}{24}\right) \right) = 0,817 \\
 \text{Entropy (Excellent Accreditation)} &= \left( \left(-\frac{1}{13}\right) \times \log_2\left(\frac{1}{13}\right) + \left(-\frac{6}{13}\right) \times \log_2\left(\frac{6}{13}\right) + \left(-\frac{6}{13}\right) \times \log_2\left(\frac{6}{13}\right) \right) = 1,314 \\
 \text{Entropy (Superior Accreditation)} &= \left( \left(-\frac{2}{13}\right) \times \log_2\left(\frac{2}{13}\right) + \left(-\frac{5}{13}\right) \times \log_2\left(\frac{5}{13}\right) + \left(-\frac{6}{13}\right) \times \log_2\left(\frac{6}{13}\right) \right) = 1,460 \\
 \text{Entropy (Lots of Job Opportunities)} &= \left( \left(-\frac{18}{31}\right) \times \log_2\left(\frac{18}{31}\right) + \left(-\frac{2}{31}\right) \times \log_2\left(\frac{2}{31}\right) + \left(-\frac{11}{31}\right) \times \log_2\left(\frac{11}{31}\right) \right) = 1,241 \\
 \text{Entropy (Few Lecturers)} &= \left( \left(-\frac{6}{19}\right) \times \log_2\left(\frac{6}{19}\right) + \left(-\frac{11}{19}\right) \times \log_2\left(\frac{11}{19}\right) + \left(-\frac{3}{19}\right) \times \log_2\left(\frac{3}{19}\right) \right) = 1,402 \\
 \text{Entropy (Many Lecturers)} &= \left( \left(-\frac{17}{31}\right) \times \log_2\left(\frac{17}{31}\right) + \left(-\frac{2}{31}\right) \times \log_2\left(\frac{2}{31}\right) + \left(-\frac{11}{31}\right) \times \log_2\left(\frac{11}{31}\right) \right) = 1,261 \\
 \text{Entropy (Sufficient Sarpras)} &= \left( \left(-\frac{5}{19}\right) \times \log_2\left(\frac{5}{19}\right) + \left(-\frac{10}{19}\right) \times \log_2\left(\frac{10}{19}\right) + \left(-\frac{3}{19}\right) \times \log_2\left(\frac{3}{19}\right) \right) = 1,415 \\
 \text{Entropy (Complete Sarpras)} &= \left( \left(-\frac{18}{31}\right) \times \log_2\left(\frac{18}{31}\right) + \left(-\frac{3}{31}\right) \times \log_2\left(\frac{3}{31}\right) + \left(-\frac{11}{31}\right) \times \log_2\left(\frac{11}{31}\right) \right) = 1,312
 \end{aligned}$$



$$\text{Gain (Accreditation)} = 1,535 - \left( \left( \frac{24}{50} \times 0,817 \right) + \left( \frac{13}{50} \times 1,314 \right) + \left( \frac{13}{50} \times 1,460 \right) \right) = 0,421$$

$$\text{Gain (Job Opportunities)} = 1,535 - \left( \left( \frac{19}{50} \times 1,384 \right) + \left( \frac{31}{50} \times 1,241 \right) \right) = 0,239$$

$$\text{Gain (Number of Lecturers)} = 1,535 - \left( \left( \frac{19}{50} \times 1,402 \right) + \left( \frac{31}{50} \times 1,261 \right) \right) = 0,220$$

$$\text{Gain (Infrastructure-Sarpras)} = 1,535 - \left( \left( \frac{19}{50} \times 1,415 \right) + \left( \frac{31}{50} \times 1,312 \right) \right) = 0,184$$

The following table shows the gain value of the decision tree. The decision tree analysis of student interest strategies at private universities in Aceh is as follows:

Table 9. Gain Decision Tree Value Results

attributes	Branch	Amount	C1	C2	C3	Entropy	Gain
Total		50	23	13	14	1,535	
Accreditation	Good	24	20	2	2	0,817	0,421
	Excellent	13	1	6	6	1,314	
	Superior	13	2	5	6	1,460	
Job Opportunities	Few	19	5	11	3	1,384	0,239
	Many	31	18	2	11	1,241	
Number of Lecturers	Few	19	6	11	3	1,402	0,220
	Many	31	17	2	11	1,261	
Infrastructure	Enough	19	5	10	3	1,415	0,184
	Complete	31	18	3	11	1,312	

### C. Implementation of the Decision Tree Classification Model

The results of the implementation of the decision tree classification analysis decision tree strategy of student interest in private tertiary institutions in Aceh are as follows:

#### 1. Data from Decision Tree Results and Ward Model Implementation

The following is the recap result of students' decision tree classification analysis of decision tree analysis of student interest strategies at private tertiary institutions in Aceh as follows:

#### Rekap Siswa

Nib	Nama Siswa	Akreditasi	Peluang Kerja	Jumlah Dosen S3	Jumlah Dosen S2	Sarana Prasarana	Hasil	Saran	Waktu Periksa
NIS220910-034753	UCOK	baik	sedikit	1	8	lengkap	C1	- Program Studi Teknik Material - Program Studi Teknik Logistik	2022-09-12
NIS22220910-033616	AMRI	unggul	banyak	3	14	lengkap	C5	- Program Studi Teknik Sipil - Program Studi Teknik Industri	2022-09-12
NIS22220910-033634	AJENG	bsekali	banyak	3	10	lengkap	C3	- Program Studi Sistem Informasi - Program Studi Teknik Informatika	2022-09-12
Nib	Nama Siswa	Akreditasi	Peluang Kerja	Jumlah Dosen S3	Jumlah Dosen S2	Sarana Prasarana	Hasil	Saran	Waktu Periksa

Figure 3. Decision Tree Results

### D. Mapping Implementation with Ward Model

#### 1. Student College University Data

The results of data analysis on mapping student interest in marketing management strategies at private tertiary institutions in Aceh are as follows:





Data Uniki

Tambah data Uniki

Data Uniki

Search:











#	Nama Sekolah	GeoJSON	Jumlah Tahun 2020	Jumlah Tahun 2021	Latitude	Longitude	Action
1	SMA Negeri 1 Jeumpa	geojson/NibYyJULEhHJcn2Wn2a9cuNuaTnN8RtNAAKLY5C.json	16	21	5.205129866329087	96.65913612216453	 
2	SMA SWASTA SUKMA BANGSA	geojson/QHZpTRzq0TKy9NT58F1L5JQzX0zMrYf6QtBEdp7.json	2	7	5.197543151379448	96.6849417476435	 
3	SMAS islam Darul Ulum Tanah Mirah	geojson/yJldKG3O9hQWsuQsEmrrEnmKCq5L6AHY1UlqxGix.json	4	5	5.1922811063439145	96.75055675142981	 
4	SMA SWASTA TERPADU AL-FURQAN	geojson/hxFeUxA0MVJWLUZVCB8IBO7hwxkq0EbyKLGW2QQ.json	2	3	5.1947431356280225	96.80892461581399	 
5	MAN 1 Bireuen	geojson/lzQj5l2T2tT6EtnV0FVezR13WN3Y3FgMHZ6ZHxj.json	11	12	5.2098629630176685	96.36673412057775	 

Figure 4. Higher Education Data

## 2. Private Higher Education Mapping

The results of data analysis on mapping student interest in marketing management strategies at private tertiary institutions in Aceh are as follows:

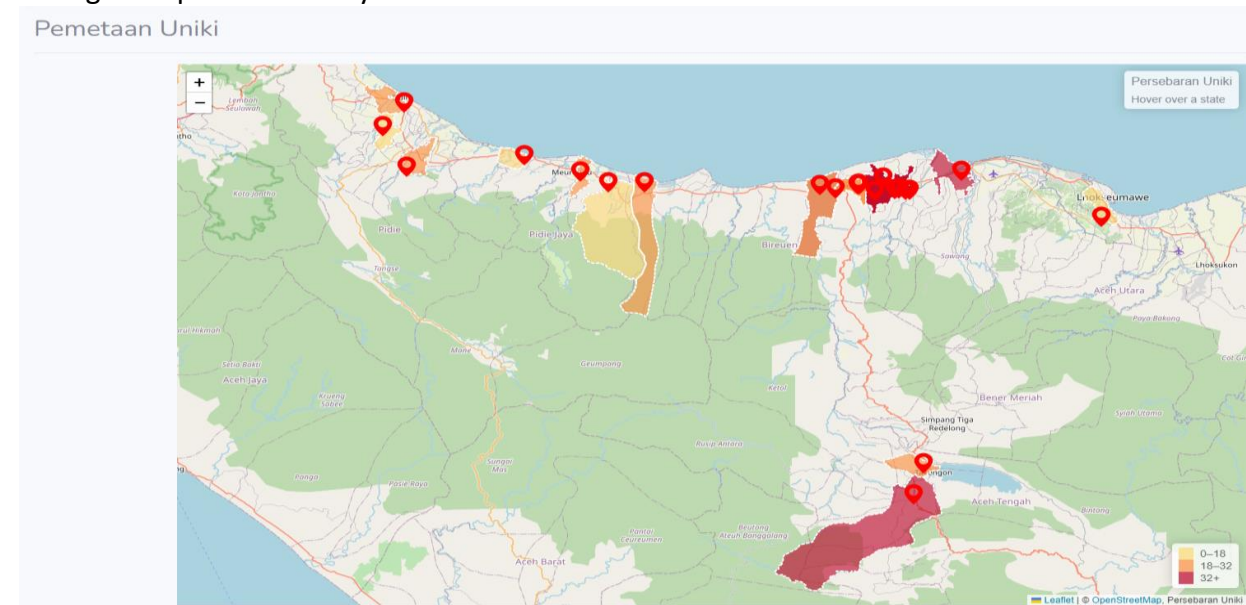


Figure 5. Mapping results of the distribution of student interest schools

The mapping page displays a visual map of the distribution of schools interested in private tertiary institutions. In this mapping, there are three groupings distinguished by three

colors. The dense color means the school's interest in the university is increasing, and the medium color means that there are not too many schools of interest in private tertiary institutions. In contrast, the last color is less, indicating little interest in these universities.

### 3. Student Distribution Results

The results of the distribution of student interest mapping in marketing management strategies at private tertiary institutions in Aceh are as follows:

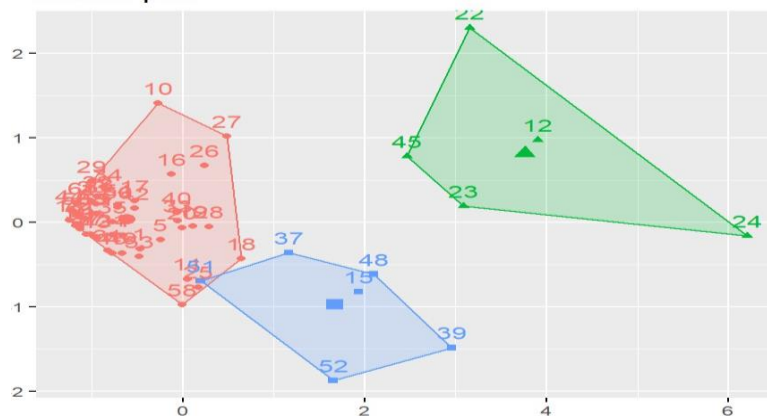


Figure 6. Student distribution results

The results of the distribution of student distribution for school origin with the first cluster results S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12, S13, S14, S16, S17, S18, S19, S20, 21, S22, S23, S24, S25, S26, S27, S28, S29, S30, S31, S32, S33, S34, S35, S36, S37, S38. Next, for the second cluster for values S12, S22, S23, S24, and S45. As for the Cluster 3 stage, they are S15, S37, S39, S48, S51, and S52.

### 4. Conclusion

The conclusions from the Marketing Management Strategy at Private Higher Education in Aceh are as follows:

1. Cluster analysis applied to grouping can produce segment profiles based on school origin. The cluster analysis looks at the distribution of students who donate a lot of students based on school origin.

2. The results of the ward model as seen from the dendrogram, there are 3 clusters, and for each cluster in the dendrogram calculation, there are ward model results for each origin of public high school 1 land area results of the sse scale value  $-0.490870318$  cluster 1. SMKN 2 school Lhokseumawe scale value sse  $-0.098174064$  is in cluster 1. while state high school 1 Bireuen and state high school 3 Bireuen with grades 1.865307209 and 1.178088764 are in cluster 2. Lastly MAN 4 Bireuen school, the value of the sse scale is 0.785392509 in cluster 3, MAN 2 school Bireuen sse 3.043395973 scale value is in cluster 3.
3. With the results of the implementation of the decision tree model, it will make it easier for private tertiary institutions to see interests that match the talent. The value of the attributes that affect

student interest is accreditation with a good entropy value of 0.8175, excellent 1.314, and Excellent with a value of 1.460 and a gain value of 0.421. While the last attribute is facilities and infrastructure, with a gain value of 0.184.

### Acknowledgment

1. This research is funded through research activities. Research grants in 2022 from the Ministry of Education, Culture, Research, and Technology funds
2. Malikussaleh University, through LPPM, has helped complete this research.
3. Dean of the Faculty of Economics and Business, the entire team of lecturers who have given their approval and motivation in carrying out this research activity

### Reference

- Arsova M., T. R. (2019). Strategy for market segmentation and differentiation: contemporary marketing practice. *Journal of Economics*, 4(1), 27–35.
- Bigelow B. F., Bilbo D., Mathew, M. Ritter L., & E. J. W. (2015). Identifying the most effective factors in attracting female undergraduate students to construction management. *International Journal of Construction Education and Research*, 11(3), 179–195.
- Calantone, R. J., & Di Benedetto, C. A. (2007). Clustering product launches by price and launch strategy. *Journal of Business & Industrial Marketing*, 22(1), 4–19.

<https://doi.org/10.1108/08858620710722789>

- Casanova, D., Moreira, A., & Costa, N. (2011). Technology Enhanced Learning in Higher Education: results from the design of a quality evaluation framework. *Procedia - Social and Behavioral Sciences*, 29, 893–902.  
<https://doi.org/10.1016/j.sbspro.2011.11.319>
- Casidy, R., & Wymer, W. (2018). A taxonomy of prestige-seeking university students: strategic insights for higher education. *Journal of Strategic Marketing*, 26(2), 140–155.  
<https://doi.org/10.1080/0965254X.2016.1182573>
- Constantinides, E., & Zinck Stagno, M. C. (2011). Potential of the social media as instruments of higher education marketing: a segmentation study. *Journal of Marketing for Higher Education*, 21(1), 7–24.  
<https://doi.org/10.1080/08841241.2011.573593>
- Daniela, L., Kalniņa, D., & Strods, R. (2017). An Overview on Effectiveness of Technology Enhanced Learning (TEL). *International Journal of Knowledge Society Research*, 8(1), 79–91.  
<https://doi.org/10.4018/IJKSR.2017010105>
- Dooris M. J., Kelley J. M., T. J. F. (2004). Strategic planning in higher education. *New Directions for Institutional Research*, 5–11.



- Goodrich, K., Swani, K., & Munch, J. (2020). How to connect with your best student prospects: Saying the right things, to the right students, in the right media. *Journal of Marketing Communications*, 26(4), 434–453.  
<https://doi.org/10.1080/13527266.2018.1514319>
- Govindasamy, R. (2018). Cluster Analysis of Wine Market Segmentation – A Consumer Based Study in the Mid-Atlantic USA. *ECONOMIC AFFAIRS*, 63(1), 151–157.  
<https://doi.org/10.30954/0424-2513.2018.00150.19>
- Hussain, S., & Khan, M. Q. (2021). Student-Performulator: Predicting Students' Academic Performance at Secondary and Intermediate Level Using Machine Learning. *Annals of Data Science*.  
<https://doi.org/10.1007/s40745-021-00341-0>
- Kalenskaya, N. V. (2015). Marketing Strategy of Higher Education Institutions. *Mediterranean Journal of Social Sciences*.  
<https://doi.org/10.5901/mjss.2015.v6n1s3p146>
- Karol, Nathaniel H., & Ginsburg, S. G. (1980). *Managing the higher education enterprise*. Wiley.
- Keller, Kotler. (2012). *Marketing Management* (P. Hall, Ed.).
- Kotler, Philip, P. E. M. (1981). Strategic planning for higher education. *The Journal of Higher Education*, 52(5), 470–489.
- Lee, J., & Choi, H. (2017). What affects learner's higher-order thinking in technology-enhanced learning environments? The effects of learner factors. *Computers & Education*, 115, 143–152.  
<https://doi.org/10.1016/j.compedu.2017.06.015>
- Li Maohua, Z. Z. (2017). The application of cluster analysis in economics science. *2016 2nd International Conference on Education, Social Science, Management and Sports (ICESMS 2016)*.
- Lin, C. (2002). Segmenting customer brand preference: demographic or psychographic. *Journal of Product & Brand Management*, 11(4), 249–268.  
<https://doi.org/10.1108/10610420210435443>
- Liu, C. (2019). *Research on the Status Quo and Countermeasures of HR Company's Inventory Management*. Aalto University School of Business.
- Lockhart, J. M. (2011). *How to Market Your School: A Guide to Marketing, Communication, and Public Relations for School Administrators*. R&L Education.
- Maciejewski, G., Mokrysz, S., & Wróblewski, Ł. (2019). Segmentation of Coffee Consumers Using Sustainable Values: Cluster Analysis on the Polish Coffee Market. *Sustainability*, 11(3), 613.  
<https://doi.org/10.3390/su11030613>
- Makgosa, R., Matenge, T., & Mburu, P. (2016). Hybrid Segmentation in the Financial Services Market: Targeting Saving Consumers. *Family and Consumer Sciences Research Journal*, 44(4), 447–468.  
<https://doi.org/10.1111/fcsr.12168>



- Malešević, A., Barać, D., Soleša, D., Aleksić, E., & Despotović-Zrakić, M. (2021). Adopting xRM in Higher Education: E-Services Outside the Classroom. *Sustainability*, 13(14), 7522. <https://doi.org/10.3390/su13147522>
- Nadanyiova M., G. L. (2019). *The impact of psychographic segmentation on marketing communication in transport company. . Transport Means - Proceedings of the International Conference.*
- Naudé, P., & Ivy, J. (1999). The marketing strategies of universities in the United Kingdom. *International Journal of Educational Management*, 13(3), 126–136. <https://doi.org/10.1108/09513549910269485>
- Nugraha A., Perdana M. A. H., Santoso H. A., Zeniarja J., Luthfiarta A., P. A. (2018). Determining the senior high school major using agglomerative hierarchial clustering algorithm. *In 2018 International Seminar on Application for Technology of Information and Communication*, 225–228.
- Ogasawara, Y., & Kon, M. (2021). Two clustering methods based on the Ward's method and dendrograms with interval-valued dissimilarities for interval-valued data. *International Journal of Approximate Reasoning*, 129, 103–121. <https://doi.org/10.1016/j.ijar.2020.11.001>
- Quinn J. T., Olinsky A. D., Schumacher P. A., S. R. M. (2015). Cluster analysis and persistence in college majors. *Journal of Applied Research in Higher Education*.
- Rahmawati, L., Widya Sihwi, S., & Suryani, E. (2016). ANALISA CLUSTERING MENGGUNAKAN METODE K-MEANS DAN HIERARCHICAL CLUSTERING (STUDI KASUS : DOKUMEN SKRIPSI JURUSAN KIMIA, FMIPA, UNIVERSITAS SEBELAS MARET). *Jurnal Teknologi & Informasi ITS smart*, 3(2), 66. <https://doi.org/10.20961/its.v3i2.654>
- Rowley, D. J. (1997). *Strategic Change in Colleges and Universities: Planning to Survive and Prosper. Jossey-Bass Higher and Adult Education Series.* Jossey-Bass Inc.
- Satria, R. A. A. F. (2016). Perbandingan Kinerja Metode Ward Dan KMeans Dalam Menentukan Cluster Data Mahasiswa Pemohon Beasiswa (Studi Kasus : Stmik Pringsewu). *J. Teknol. Megister*, 2(1), 12–26.
- Schlegelmilch, B. B. (2016). *Segmenting Targeting and Positioning in Global Markets* (pp. 63–82). [https://doi.org/10.1007/978-3-319-26279-6\\_4](https://doi.org/10.1007/978-3-319-26279-6_4)
- Shirley, R. C. (1983). Identifying the levels of strategy for a college or university. *Long Range Planning*, 16(3), 92–98.
- Smith, Lois R., S. T. C. (n.d.). Marketing planning for colleges and universities. *Long Range Planning*.
- Soutar, Geoffrey N., J. P. Turner. (2002). Students' preferences for university: A conjoint analysis. *International Journal of Educational Management*.



Starczewski, A. (2017). A new validity index for crisp clusters. *Pattern Analysis and Applications*, 20(3), 687–700.  
<https://doi.org/10.1007/s10044-015-0525-8>

Menarik Minat Peserta Didik Baru di SMP Negeri 7 Kendari. *Jurnal Pendidikan Dan Pengajaran (JPP)*, 2(3), 143–153.  
<https://doi.org/10.51454/jpp.v2i3.160>

Ula, M., Pratama, A., Asbar, Y., Fuadi, W., Fajri, R., & Hardi, R. (2021). A New Model of the Student Attendance Monitoring System Using RFID Technology. *Journal of Physics: Conference Series*, 1807(1).  
<https://doi.org/10.1088/1742-6596/1807/1/012026>

701

Visvizi, A., Lytras, M. D., & Daniela, L. (2018). Chapter 19 Education, Innovation and the Prospect of Sustainable Growth and Development. In *The Future of Innovation and Technology in Education: Policies and Practices for Teaching and Learning Excellence* (pp. 297–305). Emerald Publishing Limited.  
<https://doi.org/10.1108/978-1-78756-555-520181015>

Walter, N., Asgari, O., & Cleff, T. (2022). What role does the brand play? Measuring the impact of customer-based brand equity on the selection of MBA programs at Dutch business schools. *Journal of Marketing for Higher Education*, 1–23.  
<https://doi.org/10.1080/08841241.2022.2048430>

Widiarta, I. Made, M. Nur Fietroh, A. I. (2022). Analisis Strategi Promosi Mahasiswa Baru Universitas Teknologi Sumbawa menggunakan Data Mining. *JISIP (Jurnal Ilmu Sosial Dan Pendidikan)*, 6(2).

Woliktol, N., Arfin, A., & Kabiba, K. (2022). Strategi Pemasaran Sekolah dalam

