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Simple Multi Attribute Rating Technique to Determine Resignation of Prospective New Students

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ABSTRACT

Prospective new students will apply to one or more of the colleges, and choose more than one major. Prospective new students who are declared to have passed more than one university will choose a better college, and will withdraw from other universities. Universities that are not re-registered will suffer losses and must look for other prospective new students. So a decision support system for the resignation of prospective new students was built using the Simple Multi Attribute Rating Technique (SMART) method by selecting the criteria and weight stages, to determine the factors supporting the decision. The criteria used to build this system are grades, parents' income, majors and location. This decision support system can assist the staff of the new student admissions committee in obtaining data in the form of a list of prospective new students who re-register and resign. Based on the results of testing on the system, the accuracy value is 86.96%. So it can be concluded that this system has been able to be used for the selection of prospective new students.

1. Introduction

The number of universities in the country is one of the advancements that cannot be denied for educational institutions today. Higher education is one of the means to continue to the vocational level of interest. The number of universities is currently a challenge for each higher education institution to get prospective students, where each prospective university student has a different background. Prospective new students choose and register for one or more majors and also choose one or more Universities, where the results of each application submitted will influence the decision of the prospective student. Decision making made by prospective students also affects the targets of each university. A prospective new student is declared to have graduated from a university but does not continue to re-register. So the university cannot meet the target that has been set.

To overcome this problem, a decision support system is needed that can recommend the choices of these prospective new students. Decision support system (DSS) is a computer system that processes data into information for making decisions on specific semi-structured problems. It can also be said that part of a computer-based information system includes a knowledge-based system or knowledge management that is used to support decision making in an organization or company [1] or a system that can assist in decision making to determine policies that are carried out appropriately, efficiently, and effectively. [2]. The objectives of the Decision Support System in the decision-making process are [11]: 1). Assist managers in making decisions, not replacing them. 2). Focus on effective decisions, not efficient decisions. 3). Help answer semi-structured problems.

The Simple Multi Attribute Rating Technique (SMART) method is a multi-criteria and comprehensive decision-making method by taking into account quality and quantitative matters [3]. The SMART method is

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based on the theory that each alternative consists of a number of criteria that have a value and each criterion has a weight to describe how important its value is compared to other criteria [4]. The SMART method is more often used because of its simplicity in responding to the needs of decision makers and analyzing responses [5].

The decision to withdraw prospective new students using the SMART method involves several criteria, namely grades, parents' income, majors and location. This research can help the new student admissions committee in predicting and knowing that the prospective student is re-registering or not re-registering from the criteria that support the application decision. Based on the existing problems, it is proposed to study the Simple Multi Attribute Rating Technique (SMART) to Determine the Decision of Resignation of Prospective New Students.

Some research on determining the decision to accept new students, namely, based on research [6] on the Decision Support System for Admission of New Students and the Selection of Majors Based on Interests and Talents Using the Fuzzy Multiple Decision Making Method, Simple Additive Weighting and Bubblesort Case Study at SMK Telekomunikasi Tunas Harapan Conclusion This research makes it easy for the committee to determine students who are accepted and students who are not accepted based on existing criteria and provide major recommendations for students who are accepted.

Based on research [7] discussing the Application of Decision Trees to Analyze the Possibility of Resignation of Prospective New Students where this study tested the data, this study was conducted aimed at helping the administrators predict the number of possible students who will re-register.

While the research uses the Simple Multi Attribute Rating Technique method, which is carried out by [8] in his research the Decision Support System for Admission of New Students on the Achievement Path at the Adisujipto Technology College Using the Simple Multi Attribute Rating Technique, from this study it can be concluded about new student admissions, especially the achievement path. using the web-based Simple Multi Attribute Rating Technique method. This method is quite effective to be applied in the admission of new students at the Adisujipto High School of Technology.

According to [9] in a study entitled Web-Based Decision Support System for Café Selection Using the SMART (Simple Multi-Attribute Rating Technique) Method (Case Study: Samarinda City), it can be concluded that this study provides decision-making information media for consumers to decide on café choices. Appropriate and in accordance with the wishes of consumers and provide convenience for cafe consumers in determining the desired criteria.

Meanwhile [10] research entitled Car Selection Decision Support System Using the Simple Multi-Attribute Rating Technique (SMART) Method, in this study the selection of a car needs to be considered several aspects that are needed. This Decision Support System helps consumers in choosing the best car according to consumer needs.

2. Method

2.1. Research Method

The research methods to be carried out include problem identification, data collection, system analysis, application development, and application testing. The method can be seen in the following figure:

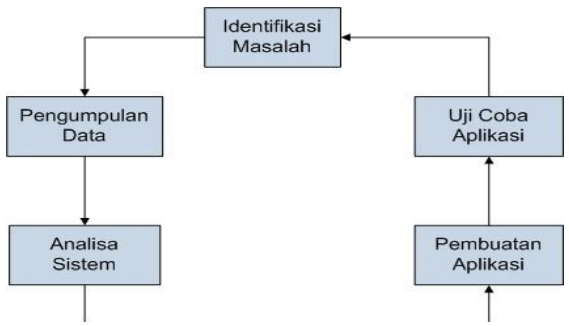

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Fig 1. Research Method

In making the resignation application for prospective new students using the SMART method, there are several stages of the research procedure, namely:

a. Identification of problems; At this stage, identification of the possibility of resignation of prospective new students is carried out when they are declared to have been accepted at a university.
b. Data collection; The data is taken from graduation data at the time of acceptance of new students at the Bengkalis State Polytechnic. The amount of data collected from the admissions committee of prospective new students is data on grades, parents' income, majors and locations.
c. System analysis; The system design uses the Unified Modeling Language (UML) tool, starting from making use cases, sequence diagrams, activity diagrams, class diagrams, ERD, data dictionary, interface design (input/output). Making the system is done using a web-based programming language.
d. Application Development; This application is made using PHP programming language and the database used is MySQL, using hypertext markup language (HTML 5), Cascading Style Sheet (CSS 3) and jQuery because the system is implemented based on web.
e. Application Trial; At this stage, all applications are tested using black box testing.

2.2. Proposed System Analysis

The analysis of the proposed application system is a website that supports the resignation of prospective new students, where the staff and admin of new student admissions know that these prospective students will re-register or resign from the Bengkalis State Polytechnic and receive processed data from this application. Where will make it easier for the committee to accept new students.

Fig 2. Proposed System Analysis

In making a decision support system (SPK) application for the resignation of prospective new students at the Bengkalis State Polytechnic using the Simple Multi Attribute Rating Technique (SMART) method. The steps in solving the problem using the SMART method, namely:

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Fig 3. Decision Support System Process Flowchart using the SMART Method

2.3. System Design Using Use Case Diagrams

Use case diagrams describe the functional system and the actors involved in it. The following is a use case diagram of a new student resignation decision support system using the Simple Multi Attribute Rating Technique (SMART) method. In the use case diagram that is designed there are two actors, namely the admissions committee for new students and Deputy Director 1 for academics.

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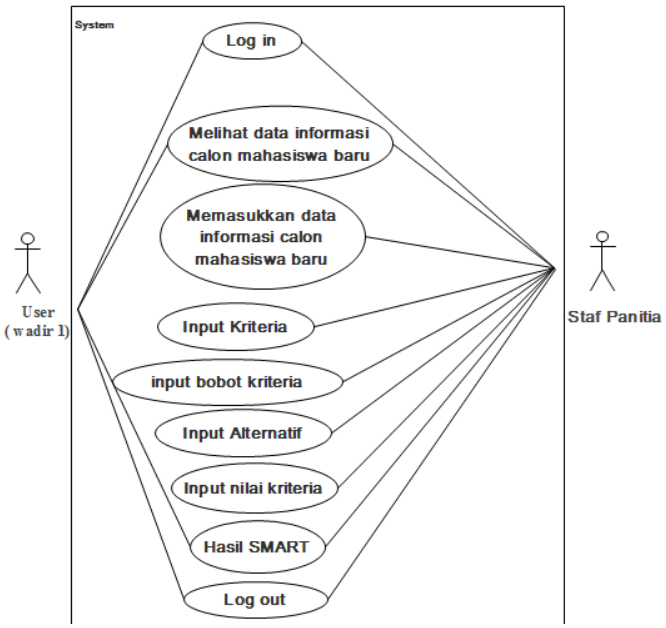

Fig 4*Use Case Diagram*

2.4. Entity Relationship Diagram (ERD)

Entity Relationship Diagram (ERD) is the relationship between each table in the application database for the decision support system for the selection of promotional media. There are six interrelated tables, as shown in the following figure 5,

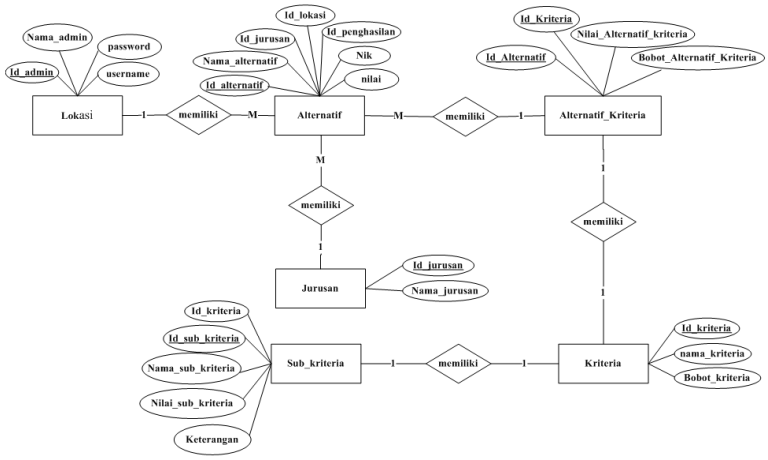

Fig 5 *Entity relationship Diagram (ERD)*

3. Result and Discussion

The Simple Multi Attribute Rating Technique (SMART) method [1].is a method used with the aim of getting results in the form of decisions based on the value obtained from each alternative.

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3.1. Weighting Criteria Analysis

There are four criteria in determining the decision to resign prospective new students, namely,The value criteria can be seen in table 1,

Table 1
Grade Weight

No	C1	Paramer	Bobot
1.	C1 >=80	Very high	3
2.	60 < C1 < 80	medium	2
3.	C1 < 60	low	1

Table 1 is the value criterion (C1) by matching the alternative weight values. Parental Income Criteria are shown in table 2,

Table 2
Parent's Income Weight

No	C2	Parameter	Bobot
1.	C2 >= Rp. 5 Juta	Very high	3
2.	Rp. 2 juta < C2 < Rp. 5 Juta	medium	2
3.	Rp. 500 Ribu< C2 < Rp. 2 Juta	low	1

Table 2 is the income criteria of parents (C2) by matching the alternative weight values. Major criteria can be seen in table 3,

Table 3
Department Weight

No	C3	Parameter	Bobot
1.	Teknik Informatika (TI), ADM, Sipil	Very high	3
2.	Teknik Elektro (TM), Teknik Mesin	medium	2
3.	Kapal, Maritim	low	1

Table 3 is the criteria for the Department (C3) by matching the alternative weight values. Location criteria can be seen in table 4,

Table 4
Location Weight

No	C4	Parameter	Bobot
1.	City center	Very high	3
2.	Countryside	medium	2
3.	Out of town	low	1

Table 4 is the location criteria (C4) by matching the alternative weight values. The weights for the most important criteria are shown in table 5,

Table 5
Comparison of weights for the most important criteria

No	Criteria	Bobot
1.	Grade	35
2.	Parental Income	35
3.	Department	20
4.	Location	10
	Total	100

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Table 5 is a comparison of the weights for the most important criteria from one criterion to another.Then calculate the normalization of the criteria weights, the weights obtained will be normalized where the weights of each criterion obtained will be shared with the results of the sum of each criterion weight.

$$nw_j = \frac{wj}{\sum_{n=1}^{k} wn} \quad (1)$$

- *nwj*=normalisasi bobot kriteria ke-j
- k = jumlah kriteria
- *wn* = bobot kriteria ke-n

The weight normalization of the most important criteria is shown in table 6,

Tabel 6
Normalisasi bobot kriteria yang paling penting

No	Criteria	Bobot	Bobot Relatif (wj1)
1.	Grade	35/100	0,35
2.	Parental Income	35/100	0,35
3.	Department	20/100	0,2
4.	Location	10/100	0,1

Table 6 obtained the results of normalizing the weight of the criteria based on the most important criteria. Next is to find the weight normalization of the least important criteria. The weights for the unimportant criteria are shown in table 7,

Table7
Comparison of weights for unimportant criteria

No	Criteria	Bobot
1.	Grade	45
2.	Parental Income	45
3.	Department	30
4.	Location	10
	total	130

Table 7 is a comparison of weights for unimportant criteria from one criterion to another. Normalization of weights of unimportant criteria is shown in table 8,

Table 8
Normalization of weights of unimportant criteria

No	Criteria	Bobot	Bobot Relatif (wj2)
1.	Grade	45/130	0.3461538461538462
2.	Parental Income	45/130	0.3461538461538462
3.	Department	30/130	0.2307692307692308
4.	Location	10/130	0.0769230769230769

From table 8 above, the results of the normalization of criteria weights have been obtained based on the least important criteria. Next is to find the average value of the two normalized weights above.

Table 9
Average weight of the second value Normalization

No	Criteria	Bobot Relatif (wj1)	Bobot Relatif (wj2)	Bobot Relatif (wj2)
1.	Grade	0,35	0.3461538461538462	0.3480769230769231
2.	Parental Income	0,35	0.3461538461538462	0.3480769230769231
3.	Department	0,2	0.2307692307692308	0.2153846153846154
4.	Location	0,1	0.0769230769230769	0.0884615384615385

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From table 9, the average weight of the two normalizations has been obtained. The next step is to determine an alternatef value based on each criterion.

Table 10
Alternative scores against each criterion

No	prospective new students	Grade	Parental Income	Department	Location
1.	Abdul Rahmansyah Hasibuan	3	1	1	1
2.	Adil Huda Wicaksana	1	3	3	1
3.	Agus Arianto	2	2	3	3

3.2 Discussion

a. Alternative Weighting Analysis (Utility Value)

In the weighting of alternatives using single-attribute utilities that reflect how well each alternative is seen from each criterion. Conversion formula to find personal alternative weights based on specified criteria and adapted to the case. This stage is to give a value on all criteria for each alternative. In this field an expert estimates the value of an alternative on a scale of 10-100. The equation for the utility value is as follows,

$$u_{ij} = \frac{(c\max - cout)}{(c\max - c\min)} 100 \qquad (2)$$

- Uij = nilai ultility kriteria ke-j untuk alternatifke-i
- cmax = nilai kriteria maksimal
- cmin = nilai kriteria minimal
- cout I = nilai kriteria ke-i

Next determine the utility value for each criterion,

1) Grade

The calculation of the value for the sub-criteria value is carried out as follows.

The grade of prospective new students(u_{ij}) = $\frac{(maksimun - jumla\ h\ nilai\ diperole\ h)}{(maksimun - minumun)} x\ 100$

High school grade of Abdul Rahmansyah Hasibuan = (3 – 3) / (3 – 1) x 100 = 0
High school grade of Adil Huda Wicaksana = (3 – 1) / (3 – 1) x 100 = 100
High school grade of Agus Arianto = (3 – 2) / (3 – 1) x 100 = 50

2) Parental Income

The calculation of the value for the Parental Income sub-criteria is carried out as follows.

Parents Income Value (u_{ij}) = $\frac{(maksimun - jumla\ h\ nilai\ diperole\ h)}{(maksimun - minumun)} x\ 100$

Income Value of Abdul Rahmansyah Hasibuan's parents= (3 – 1) / (3 – 1) x 100 = 100
Income Value of Adil Huda Wicaksana's parents = (3 – 3) / (3 – 1) x 100 = 0
Income Value ofAgus Arianto's parents = (3 – 2) / (3 – 1) x 100 = 50

3) Department

The calculation of the value for the Department's sub-criteria is carried out as follows.

Department value(u_{ij}) = $\frac{(maksimun - jumla\ h\ nilai\ diperole\ h)}{(maksimun - minumun)} x\ 100$

Department value Abdul Rahmansyah Hasibuan = (3 – 1) / (3 – 1) x 100 = 100
Department value Adil Huda Wicaksana = (3 – 3) / (3 – 1) x 100 = 0
Department value Agus Arianto = (3 – 3) / (3 – 1) x 100 = 0

4) Location

The calculation of the value for the Location sub-criteria is carried out as follows.

Location value (u_{ij}) = $\frac{(maksimun - jumla\ h\ nilai\ diperole\ h)}{(maksimun - minumun)} x\ 100$

Location valueAbdul Rahmansyah Hasibuan = (3 – 2) / (3 – 1) x 100 = 50
Location valueAdil Huda Wicaksana = (3 – 1) / (3 – 1) x 100 = 100
Location valueAgus Arianto = (3 – 3) / (3 – 1) x 100 = 0

After obtaining the weight value of each alternative, then using the linear utility function model by the Simple Multi Attribute Rating Technique (SMART).

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Abdul Rahmansyah Hasibuan's Overall Score = (0 x 0.3480769230769231) + (100 x 0.3480769230769231) + (100 x 0.2153846153846154) + (100 x 0.0884615384615385) = 65.1923076923077
Adil Huda Wicaksana's Overall Score = (0 x 0.3480769230769231) + (100 x 0.3480769230769231) + (100 x 0.2153846153846154) + (100 x 0.0884615384615385) = 43.65384615384616
Agus Arianto's Overall Score = (50 x 0.3480769230769231) + (50 x 0.3480769230769231) + (0 x 0.2153846153846154) + (0 x 0.0884615384615385) = 34.807692307692312

Table 11
Overall Rating

No	Name	Overall score	Rating	Information
1.	Abdul Rahmansyah Hasibuan	65.1923076923077	1	non-re-registration
2.	Adil Huda Wicaksana	43.65384615384616	2	re-registration
3.	Agus Arianto	34.80769230769231	3	re-registration

The range of values for the resignation decision support system for prospective new students uses the Simple Multi Attribute Rating Technique (SMART) method.

Table 12
Overall score range for re-registration and non-re-registration

Overall score range for re-registration and non-re-registration		
No	Score	information
1.	1 – 49	re-registration
2.	50 – 100	non-re-registration

b. New Student Resignation System Display

This system is used by the new student admissions committee to see recommendations for prospective new students who re-register and who do not re-register based on the criteria and sub-criteria that have been set. The display of criteria data in the form of the name of the criteria and the weight value of the required criteria is shown in Figure 6 and the display of the sub-criteria in the form of the name of the criteria for the weight value, description and required sub-criteria is shown in Figure 7.

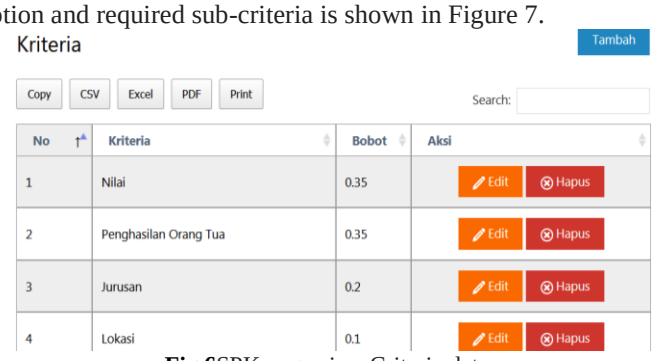

Fig 6SPK page view Criteria data

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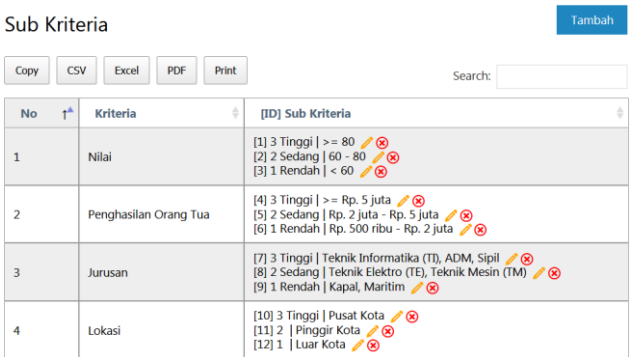

Sub Kriteria

Tambah

Copy CSV Excel PDF Print Search:

No	Kriteria	[ID] Sub Kriteria
1	Nilai	[1] 3 Tinggi | >= 80 [2] 2 Sedang | 60 - 80 [3] 1 Rendah | < 60
2	Penghasilan Orang Tua	[4] 3 Tinggi | >= Rp. 5 juta [5] 2 Sedang | Rp. 2 juta - Rp. 5 juta [6] 1 Rendah | Rp. 500 ribu - Rp. 2 juta
3	Jurusan	[7] 3 Tinggi | Teknik Informatika (TI), ADM, Sipil [8] 2 Sedang | Teknik Elektro (TE), Teknik Mesin (TM) [9] 1 Rendah | Kapal, Maritim
4	Lokasi	[10] 3 Tinggi | Pusat Kota [11] 2 | Pinggir Kota [12] 1 | Luar Kota

Fig7 Sub-criteria SPK Page Display

The results of the calculation of the SPK regarding prospective new students who re-register and who do not re-register using the method analysis (SMART) can be seen in the form of tables and graphs

No	Nama Siswa	Nilai	Penghasilan Orang Tua	Jurusan	Lokasi
-					
-	Bobot	0.35	0.35	0.2	0.1
Daftar Ulang					
1	Soviabella	>= 80	>= Rp. 5 juta	Teknik Informatika (TI), ADM, Sipil	Pusat Kota
2	Adil Huda Wicaksana	>= 80	>= Rp. 5 juta	Teknik Informatika (TI), ADM, Sipil	Luar Kota
3	Afis	>= 80	>= Rp. 5 juta	Kapal, Maritim	Pinggir Kota
4	Agus Arianto	60 - 80	Rp. 2 juta - Rp. 5 juta	Teknik Informatika (TI), ADM, Sipil	Pusat Kota
5	Dicky Mahyendra	< 60	>= Rp. 5 juta	Teknik Informatika (TI), ADM, Sipil	Luar Kota
6	Siti NurFatimah	60 - 80	Rp. 2 juta - Rp. 5 juta	Teknik Informatika (TI), ADM, Sipil	Pusat Kota

Fig 8 Display of data for prospective new students who have re-registered

Tidak Daftar Ulang					
61	Abdul Rahmansyah Hasibuan	60 - 80	Rp. 2 juta - Rp. 5 juta	Kapal, Maritim	Luar Kota
62	Afrizal	< 60	Rp. 500 ribu - Rp. 2 juta	Kapal, Maritim	Luar Kota
63	Diny manily	< 60	Rp. 500 ribu - Rp. 2 juta	Teknik Informatika (TI), ADM, Sipil	Luar Kota
64	Surade Kirana	< 60	Rp. 500 ribu - Rp. 2 juta	Teknik Informatika (TI), ADM, Sipil	Luar Kota
65	Nurzimah	>= 80	Rp. 500 ribu - Rp. 2 juta	Teknik Elektro (TE), Teknik Mesin (TM)	Luar Kota

Fig 9 Display of data for prospective new students who did not re-register

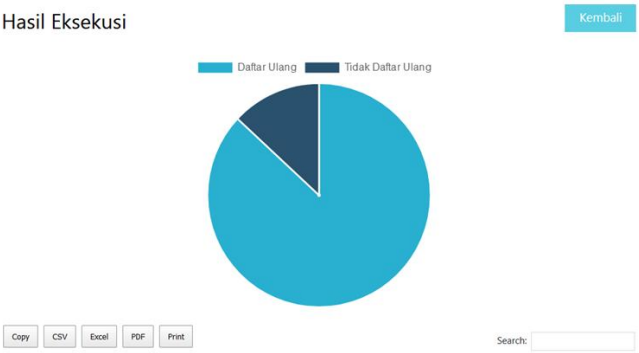

Fig 10 Graph of SPK Calculation Results

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Real data presentation of the new student resignation decision system using the Simple Multi Attribute Rating Technique (SMART) method. The calculation of the value for the presentation of real data from the system is carried out as follows.

a. Calculation of correct prediction data value= $\frac{(prediksi\ \ benar)}{(total\ \ data\ )}\ x\ 100\%$

Value Calculation of the overall prediction data is correct= $\frac{(60)}{(69\ )}\ x\ 100\%$ = 86.96%

b. The calculation of the value of the prediction data is wrong= $\frac{(prediksi\ \ salah\ )}{(total\ \ data\ )}\ x\ 100\%$

Value The overall calculation of the prediction data is wrong= $\frac{(9)}{(69\ )}\ x\ 100\%$ = 13.04%

The results of real data testing on the system showed that the truth value was 86.96% with an error accuracy of 13.04%.

4. Conclusion

Based on the results of research that has been carried out and testing with a decision support system for the resignation of prospective new students, it can be concluded that:

a. The system built using the Simple Multi Attribute Rating Technique (SMART) method can recommend prospective new students who re-register and those who do not re-register.
b. The results of the trial obtained an accuracy value of 86.96% of the truth of the comparison data.
c. The output of the decision support system is in the form of data reports of prospective new students who re-register and do not re-register which can be seen in tables and graphs.

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