

Implementation of Moderate Multiple Regressions (MMR) Methods in Decision Support System Providing Scholarships for Outstanding Student Education Aid at Udayana University

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Abstract: Scholarships are usually awarded to students who are considered achievers. Only so far the intended or assumed new achievement students are measured from the quantity of GPA Achievement Index (GPA) only, so many students are given to the students, but very few achievements obtained by students who can improve the university index. To achieve the achievements both regionally, nationally, and internationally, then in addition to high GPA, also required creativity and high innovation of students, especially those who get a scholarship. So it is necessary to re-analyze the patterns used as the basis for consideration in the scholarship application, so that the achievement targets achieved by the scholarship recipients both at the regional, national and international levels are increased, by incorporating the components / attributes of creativity and innovation in the components of the scholarship pattern. The method used in the preparation of this scholarship is Moderate Multiple Regression (MMR) as a modeling method in decision support system (Decision Support System), where all components of the achievement are GPA, Student Creativity Program (PKM), and innovations which has been done given weight in accordance with the level of achievement. Then do filtering to result of weighting from each component of achievement by method of MMR so that obtained by compilation variable from moderate multiple regression. After getting some MMR model, it is done by optimizing the pattern by calculating multivariate pla from every existing model. The model with the highest multivariate placement will be the optimal pattern in the provision of scholarships for student learning assistance

Keywords: Innovation, Scholarship, Decision Support System, Moderate Multiple Regression

1. Introduction

The granting of scholarships for study aid to students at Udayana University after analyzing the result is not positively correlated to student achievement in regional, national, and international level. Where from the data that exist especially in the Faculty of Mathematics and Natural Sciences (FMIPA), scholarship recipients who do PKM as a component of creativity is only 11.5% in the academic year 2015/2016 as many as 27 PKM titles, from about 312 scholarship recipients. While from 27 PKMyang titles, only 2 (two) pass national level (PIMNAS). While from the existing data, the average student's GPA in the FMIPA is above 3.0, so it becomes a big question that has not been studied, why high academic ability of students ($IPK \geq 3,0$) that should creativity and innovation is also high, why does not correlate well.

Therefore, it is necessary to include other components / attributes other than GPA in balancing the scholarship grants to students, ie creativity components / attributes such as PKM and entrepreneurship, and also incorporating the components / attributes of innovation that are done. Of these three components / attributes will form a thread of red thread of student achievement, where students whose high GPA means mastery of good knowledge. For students who master the knowledge well, it will have many creative and innovative ideas to produce a work both in the form of PKM and innovation lannya. Appropriate modeling and formulation in the provision of scholarships for student learning as Decision Support System (DSS) to provide scholarships for study aid for students at Udayana University. With the basics knowledge

of computational statistics, so that statistically and computationally can be obtained a good and optimal model, by applying the method of Moderate Multiple Regression (MMR). In MMR, the weighting of each component / attribute of the scholarship is done nominally so that multiple regression methods may work

2. Literature Review

2.1. Understanding Scholarship

Scholarships are educational tuition fees for those who are educated or cultivated to assist in completing their education. Scholarship assistance will be given to those who excel. According to Law Number 20 Year 2003 on National Education, the government is obliged to provide scholarships for students whose parents do not have the ability to finance their education, and for those who excel, as outlined in Article 12 paragraph 1c. In addition, Law Number 12 Year 2012 on Higher Education, article 76 paragraph 2a also states that the government should provide scholarships for outstanding students. Assistance in education costs, especially academic achievement improvement scholarships (PPA) is given by the government based on the criteria:

- 1) Students who have limited economic ability,
- 2) Students who have co-or extra-curricular achievements (reasoning, interests and talents) at the national or international level,
- 3) Students who have $IPK \geq 3,0$

So the achievement of reasoning field, interest and talent is one of the important requirement in giving scholarship to

Volume 7 Issue 1, January 2018

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students, which has been ruled out in consideration of scholarship and only focused on GPA only.

While the high student's GPA will be correlated with the students' reasoning power to produce achievement in the field of creativity and innovation from the students. Creativity and innovation are achievements in the field of reasoning, innate and talent of students who need to be included as a factor of consideration that should be included in the model / formulation, in order to stimulate students to excel in the field of reasoning, interest and talent if they want to get scholarships and not enough just have a high GPA.

2.2 Moderate Multiple Regression Method (MMR)

Moderate Multiple Regression Method (MMR) is a method to determine the effect of a certain effect (Xi) on a certain factor (Y) to get the weight of any effect on the factor to be sought (Adrew F. Hayes, 2014). This MMR method will give weight to any effect added to the Xi effect (eg first effect X, then added M and W effect) as follows:

$$Y = b_1X + b_2M + b_3W + b_4XM + b_5XW$$

Where :

b1, b2, b3 = the weight of each effect X, M, and W

b4, b5 = base weight of XM and XW effects

X = Curricular (GPA)

M = Creativity variable

W = Innovation variable

XM = correlation effect of X and M

XW = correlation effect of X and W

The workings of this MMR method first mekalukan forward chaining from the effects of X, M and W marginally, then perform forward chining on the effect of X with the effect of M and W, thus forming a triangular interaction (Laurenz L. Meier, 2008) by performing calculations the correlation value between the main variables X with the additional variables that correlate with X are the M and W variables such as the following chart:

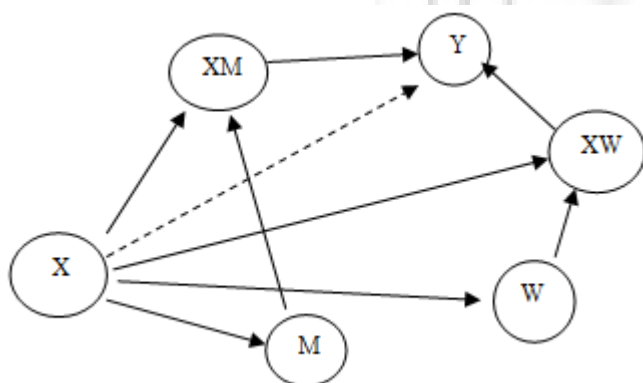


Figure 1: Workflow MMR Method

2.2. Certainty Factor Method (CF)

Certainty Factor is one of the techniques used to overcome uncertainty in decision making. Certainty factor according to Nur Anjas Sari (2013) expresses trust in an event (fact or hypothesis) based on evidence or expert judgment. Certainty

factor uses a value to assume a degree of confidence in a data as follows:

$$CF(M, W) = MB(M, W) - MD(M, W)$$

Where :

CF(M, W) = Certainty factor hypothesis affected by evidence e is known with certainty

MB(M, W) = Measure of belief against hypothesis K if given evidence e (between 0 and 1)

MD(M, W) = Measure of disbelief against hypothesis I if given evidence e (between 0 and 1)

From some forward chaining pattern of MMR method, the probability value will be calculated by certainty factor method. Each probability value obtained is compared to obtain the highest probability value to obtain the level of confidence / certainty of the selected model.

In this study, the objective to be achieved is how to formulate the support pattern of the decision of the scholarship grant aid to the student optimally. From that purpose, then the special purpose is how to implement algorithm of moderate multiple regression (MMR) in calculation and filtering the weight of component / attribute of scholarship, and how to do process of optimization of existing pattern.

By performing a weighting process on each component that is taken into consideration in the award of scholarship, it will normalize the component so that it can reduce the risk of data outlier which often mess up the decision. After component data is normal, component data filtering is also required to reduce the data of small value but the number of many will also contribute to the wrong decision.

Then a probabilistic process is done to get the best pattern model by finding the highest probability using certainty factor method. All of these stages will be conducted during the research process and will be implemented in the form of a Scholarship Information System (SIMBA) as the outcome of the research. SIMBA will automatically conduct a clarification against all participants who volunteered to compete in obtaining scholarships appropriately and fairly in accordance with socio-economic conditions, academic ability, level of creativity and innovation. In addition to that, SIMBA which is applied as the implementation of scholarship system, in the future is expected to increase students' creativity and innovation and will be able to improve student achievement in academic and non academic field to improve Udayana University grade.

3. Research Methods

3.1. Proposed Scholarship Grant Criteria

In order to accelerate student achievement in the field of curricular, co-curricular and extracurricular, in this research the researcher proposes criteria of scholarship to the students, especially scholarship of Academic Achievement Improvement (PPA). This scholarship is taken as the focus of research because the type of scholarship PPA requires IPK and student keaktifan prospective scholarship recipients. In this research keaktifan translated in the form

of PKM (PKM-GT, PKM-M, PKM-P, PKM-KC, PKM-W, PKM-AI) as a variable of creativity and make tools / technology that is contested as a variable of innovation

in the pattern / model, then proceed by entering the correlation variables between the marginal variables with the X variable into the model. So get the model of MMR algorithm as follows:

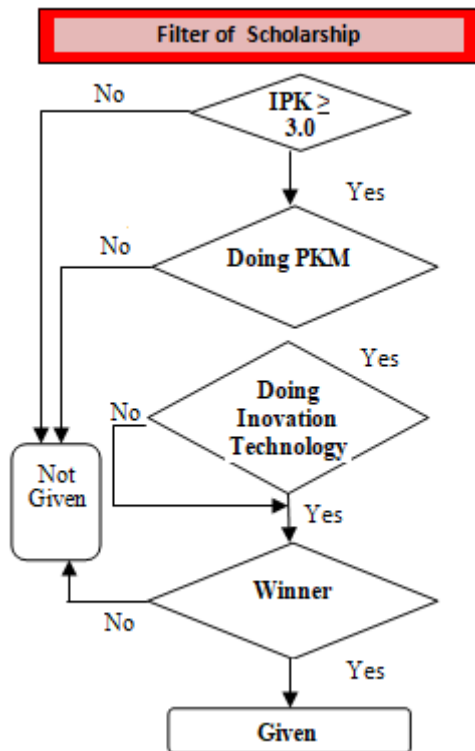


Figure 2: Proposed Scholarship Flowchart Pattern

3.2. Moderate Multiple Regression Algorithm (MM)

Before doing the MMR process, then first done the process of weighting. The weight value in this study is divided into two namely 1) the weight of the marginal variable and 2) the weight of the correlation variable. All weights will be calculated on an ordinal scale (bi = 1,2,3,4,5), where the highest weights are assigned to the GPA, the second highest is given to the highest achievement variable (PKM or Innovation), and the lowest weight is given on the correlation variable Lowest. After all variables are equipped with their respective weights, then MMR process is done by assigning variable X (GPA) as the main variable in accordance with MMR algorithm step. Next start entering the second, third, and so on until all marginal variables come

$$Y = \underbrace{5 X + 4 ? + 3 ?}_{\text{Var-}} + \underbrace{2 ? + 1 ?}_{\text{Var-}}$$

Figure 3: Forward Chaining MMR Algorithm

After preparing the forward chaining model of the MMR algorithm, the next step is how to formulate the placement of the marginal and correlation variables into the forward chaining model of the MMR algorithm in Figure 3. Therefore, in this research, the determination of forward model chaining algorithm MMR variable by doing iteration process and calculation of probability value to get maximum probability value of P (Max) from all variables calculated.

4. Results and Conclusions

4.1. MMR Weight Calculation

In the preliminary study, 175 students receiving the scholarship from the Faculty of Mathematics and Natural Sciences used as a sample in the calculation of the weight value of each feature used. The weighted value calculation is done by using the moderate multiple regression (MMR) method of six criteria used in the determination of scholarship at Faculty of Mathematics and Natural Sciences Udayana University are: GPA, PKM, Competition, Organization, Committee and Scientific Activities as performance benchmarks , creativity, and innovation from students.

In this study, of the six criteria, for students in the Faculty of Mathematics and Natural Sciences Udayana University, the criteria of IPK has a weight value (0.2285), PKM criteria has the highest marginal value (0.1333), Scientific Activity Criteria weight value (0.1667), Organization Criteria have weight value (0,0189) and Criteria of Committee have weight value (0,0163), as in table 1 s / d Table 5 below.

Table 1: Values of Creativity Weight and Student Organization

Activities	Prodi-Level	Fakulty-Level	University-Level	Regional	National
Creativity					
PKM					
Chairman	0.044444	0.088889	0.1333333	0.177778	0.22222
Members	0.022222	0.044444	0.0666666	0.088889	0.11111
Average					0.13333
Organisation					
Chairman	0.015106	0.018127	0.02114804	0.02417	0.03021
Vice Chairman	0.012085	0.015106	0.01812689	0.02115	0.02417
Secretary	0.009063	0.012085	0.01510574	0.01813	0.02115
Treasurer	0.009063	0.012085	0.01510574	0.01813	0.02115
Members	0.003021	0.006042	0.00906344	0.01209	0.01511
Average					0.01893
KepanitiaanThe committee					
Chairman	0.012085	0.015106	0.01812689	0.021148	0.024169
Vice Chairman	0.009063	0.012085	0.01510574	0.018127	0.021148

Secretary	0.006042	0.009063	0.01208459	0.015106	0.018127
Treasurer	0.006042	0.009063	0.01208459	0.015106	0.018127
Members	0.003021	0.006042	0.00906344	0.012085	0.015106

Source: Processed Data

Table 2: Score of Student Scientific Activities Score

Activities	Prodi-Level	Fakulty-Level	University-Level	Regional	National
Scientific Competition					
Olympiad	0.01905	0.03810	0.0571429	0.07619	0.09524
LKTI	0.01905	0.03810	0.0571428	0.07619	0.09524
Science Field Competition	0.01904	0.03809	0.0571428	0.07619	0.095238
Science Non-Field Competition	0.00952	0.01904	0.0285714	0.038095	0.047619
Average					0.066667

Source: Processed Data

While the value of criteria criteria multivariate between GPA with PKM has a weight value (0.21839), between the GPA with the Organization has a weight value (0.36782), between the GPA with the Committee has a weight value (0.402300), between GPA with Scientific competition has a

weight value (0.01149) as shown in Table 4.4. If organizational criteria, committees, Scientific competitions are multivariate to be weighted by innovation weight, then using Moderate Multiple Regression (MMR) we get the weight value (0.26035), as in table 4.5 below:

Table 3: Percentage of Student Activity Linkage with GPA

Activities	GPA				Sum
	3,0 -<3,25	3,25-<3,5	3,5-<3,75	3,75-4,0	
PKM	0.068966	0.114943	0.02298851	0.011494	0.218391
Scientific	0.002299	0.004598	0.0045977	0	0.011494
Organisation	0.16092	0.126437	0.06896552	0.011494	0.367816
Committee	0.195402	0.137931	0.05747126	0.011494	0.402299

Source: Processed Data

Table 4: Weight Value of Achievement Criteria, Creativity and Student Innovation

Criteria	Marginals	Multivariate	Information
GPA	0,2285711	-	
PKM	0.1333333	0.218391	Kreativities
Committee	0.0189325	0.011494	Inovation Mean(i)
Organisation	0.0163142	0.367816	
Scientific Competitions	0.0666667	0.402299	

Source: Processed From MMR Calculation

From the above criteria weighted data, a Moderate Multiple Regression (MMR) model can be used as a formulation in the ranking of the applicants for the following scholarships: $Y = 0.23 \text{ GPA} + 0.13 \text{ PKM} + 0.067 \text{ Innovation} + 0.22 (\text{GPA, PKM}) + 0.26 (\text{GPA, Innovation})$

Table 5: Correlation of Learning Assistance Scholarship Criteria

Criteria	N	db	Coefisien of Corelation	Coefisien of Determination (R ²)	Sig. (α)
GPA	312	311	0,23	0,0529	0,0201
PKM	27	26	0,22	0,0484	0,0417
Inovastion	312	311	0,26	0,0676	0,0374

Source: Processed From MMR Calculation

From table 5 it can be seen that the coefficient of correlation weight between GPA with Innovation (0.26) is the highest weight, so that between GPA and Innovation will have positive correlation with significance $\alpha = 0,0374$. Similarly, the weighted coefficient between GPA and PKM (0.22) is also positively correlated with significance $\alpha = 0.0417$

4.2. Conclusion

- 1) By using Moderate Multiple Regression (MMR) method, we can get the calculation of Creativity criterion (PKM) and Innovation from student marginally very meaningful included in learning aid scholarship model.
- 2) The correlation between student's GPA with PKM criterion and Innovation also significantly influence on model with 22% creativity factor and 26% innovation with significance less than 0.05.

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