



***Evaluating Students' Performance of Social Work
Department Using K-means and Two-step Cluster
"A Case Study of Mogadishu University"***

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Abstract

The study aims at evaluating the results of semester seven obtained by students of the Social work department at Mogadishu University to determine their academic performance. Descriptive statistics, K-means, and Two-step clusters in SPSS, as well as RATTLE in R-Studio, were used to examine 126 students' scores for the seven courses. The findings of the study revealed that the performance of the students is good. Finally, the study recommends the need to improve achievement test quality in particular and assessment modes in general.

Key words: Evaluating, Students' Performance, Social Work, K-Means, Two-step Cluster

Introduction

Academic achievement or performance is the accomplishment or acquired proficiency within the performance of an individual in a given skill or body of knowledge (Kaur, 2017). It is the measurement of student success across various academic subjects conducted by teachers and education officials using classroom performance, graduation rates and results from standardized tests https://ballotpedia.org/Academic_performance.

Higher education institutions are interested in student academic achievement and graduation rates. In addition, the academic success of university students has been a hot subject in the field of higher education. (Shahzadi & Ahmad, 2011).

An achievement test is a type of test that is restricted to specific content covered in a curriculum over a set period of time and is given after a course has been completed (Aisyah, 2018). As a result, the achievement test is an educational instrument for determining the level of a student's success against pre-determined goals in a given course.

The key problem in evaluating students' achievement in higher education is sorting students into separate groups based on their performance, which is a difficult challenge. Obtaining a holistic view of the state of the students' success while also discovering crucial information about their time-to-time performance is challenging for the traditional classification of students based on their average grades. (Oyelade, Oladipupo, & Obagbuwa, 2010). Built on that, the *k*-means algorithm by MacQueen, 1967 and Anderberg, 1973 is one of the mostly used clustering algorithms, is classified as a partitioned or

nonhierarchical clustering method(Rafi, Ramakrishna, Sabitha, Mohanty, & Rao, 2011). Clustering is a way that classifies the raw data(Singh & Singh, 2012). The k -means clustering algorithm is one of the widely used data clustering methods where the datasets having “ n ” data points are partitioned into “ k ” groups or clusters (Haraty, Dimishkieh, & Masud, 2015). Clustering provides insight on the nature and structure of data. The aim of clustering is organizing a set of data into clusters, the elements in each cluster are similar and different from those in other clusters (Pérez-ortega, Almanza-ortega, Zavala-díaz, & Martínez-rebollar, n.d.). As K-means cluster analysis, Two-step analysis is other method applied in data analysis. A two-step Cluster is an exploratory method for revealing normal groupings or clusters within a data set that would otherwise be invisible. This procedure's algorithm has some attractive characteristics that set it apart from traditional clustering techniques. (IBM, 2017). The SPSS Two Step Clustering Component is a scalable cluster analysis algorithm designed to handle very large datasets. It is capable of handling both continuous and categorical variables (SPSS, 2009).

Social work is an organized profession to extend the helping hands to an individual, group and community, for their betterment as well as sustaining them to help themselves by adopting varies professional strategies (Dhavaleshwar & Responsibility, 2017).

The purpose of social work is to promote or restore a mutually beneficial interaction between individuals and society in order to improve the quality of life for everyone(Revisited, 1981). Based on this

importance, Social work discipline is a new program for the tertiary education in Somalia supported by UNICEF. Three universities run in Mogadishu city are the first instructions provide this specialization namely, Somali National University, Mogadishu University, and City University with the same curriculum. The assessment modes adopted by the three universities are following the standardized assessment methods include: presentations, essays, course work, case study analysis, examinations, and field practicum (Social Work England, 2019). Based on that, the author thought it was necessary to conduct this study in order to determine the degree of the students' achievement in the third year of the Mogadishu University's social work department using three statistical analyses: descriptive statistics, K-means analysis, and Two-Step Clusters.

Methodology

The study is descriptive research designed to analyze students' test scores in the third year of semester seven for the social work department at Mogadishu University. Analysis of 126 students' scores was conducted in this study. Scores of seven courses were analyzed and coded, namely; Introduction to Management (IM), SWK Sustainable Social Development (SSSD). Economics for Social workers (EC), Social Work Research Methods (SRM), Principles of Statistics (PS), Communication Skills (CS), and SWK Project Planning & Management (SPPM). In this study, analysis of RATTLE Application in (R-Studio) was applied to limit the number of clusters, K-means cluster, Two-step cluster to examine the clusters, and Optimal Scaling to determine discrimination measures were applied in SPSS. Edraw Mind Master was used to visualize the steps of data analysis.



Figure 1. Steps of Data Analysis Using Edraw Mind Master

To determine the academic performance of the students through cluster analysis, the following Academic Performance Index was used:

Table 1. Academic Performance index of the Clusters Outputs

Interval Weighting Index	Decision
>90	Excellent
80-89	Very Good
70-79	Good
60-69	Average
50-59	Fair
< 50	Poor

Results and Discussion

In this part, the author presents the results of the study. The area to be analyzed and discussed include; reliability and convergent validity as the first step of the analysis. Descriptive statistics of the student's scores for the courses for the second analysis followed by K-means cluster for the third analysis and Two-step cluster analysis for the fourth analysis. The fifth analysis is discrimination analysis all in SPSS.

Reliability Analysis

To measure the internal consistency among the students' scores of the seven courses, The Cronbach's alpha in SPSS was calculated. The results showed ($\alpha=0.91$) for whole data. For the cluster one is ($\alpha=0.938$) and ($\alpha=0.856$) for the cluster (2). According to the general rule of thumb is that a Cronbach's alpha of 0.70 and above is good, 0.80 and above is better, and 0.90 and above is best. <https://www.statisticssolutions.com/cronbachs-alpha/>. Thus, the reliability of whole data ($\alpha=0.91$) and cluster 1 ($\alpha=0.938$) are best reliability and a better for the cluster 2 ($\alpha=0.856$). Thus, the reliability analysis suggests that students' scores for the seven courses examined in this study is internally consistent.

Convergent Validity

To determine the convergent validity, Pearson's coefficient of correlation in SPSS was calculated. The result presented in table (2) showed a positive significant correlation among the seven courses of the study. It is observed that all the Pearson Correlation Coefficients are strong (> 0.5) and ranges between (0.508- 0.784). Thus, the convergent validity of the data was confirmed.

Table (2) Inter-Item Correlation Matrix

Courses		IM	SSSD	EC	SRM	PS	CS	SPPM
IM		1						
SSSD	Pearson Correlation	.685**	1					
	Sig. (2-tailed)	.000						
EC	Pearson Correlation	.751**	.608**	1				
	Sig. (2-tailed)	.000	.000					
SRM	Pearson Correlation	.731**	.652**	.784**	1			
	Sig. (2-tailed)	.000	.000	.000				
PS	Pearson Correlation	.540**	.538**	.599**	.683**	1		
	Sig. (2-tailed)	.000	.000	.000	.000			
CS	Pearson Correlation	.569**	.568**	.652**	.589**	.508**	1	
	Sig. (2-tailed)	.000	.000	.000	.000	.000		
SPPM	Pearson Correlation	.731**	.689**	.770**	.752**	.570**	.629**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	

** Correlation is significant at the 0.01 level (2-tailed).

Descriptive Statistics Analysis**Table (3) Results on Analysis of the Students' Scores of the Courses**

Courses	Codes	N	Mean	Std. Deviation
Introduction to Management	IM	126	78.8	11.6
SWK Sustainable Social Development	SSSD	126	72.6	8.99
Economics for Social workers	EC	126	67.6	22.7
Social Work Research Methods	SRM	126	71.7	11.4
Principles of Statistics	PS	126	73.6	13.07
Communication Skills	CS	126	67.4	15.8
SWK Project Planning & Management	SPPM	126	62	14.38
Grand Mean			70.567	14

Results in table (3) and figure (2) illustrate descriptive statistics analysis of students' scores for seven courses of social work department

at Mogadishu University. The results show the course “Introduction to Management” scored up a mean of 79 with SD. 11.6. The second rank made up the course” Principles of Statistics” (M=73.6), and (SD.=13), while the course “SWK Sustainable Social Development” attained the third rank (M=72.6, SD=8.9). The fourth rank received by the course “Social Work Research Methods” a mean of 71.7 with SD.11.4. However, the fifth and sixth courses ranked as “Economics for Social workers” (M=67.6, SD.=22.7), and “Communication Skills” got (M=67.4, SD.=15.8), whereas, the course ” SWK Project Planning & Management” scored up the seventh rank (M=62), and (SD.=14.3). The grand mean of the scores for the courses indicated (70.5). Thus, these results show that the students of the social work department 3rd year at faculty of Arts and Humanities, Mogadishu University have a good performance.

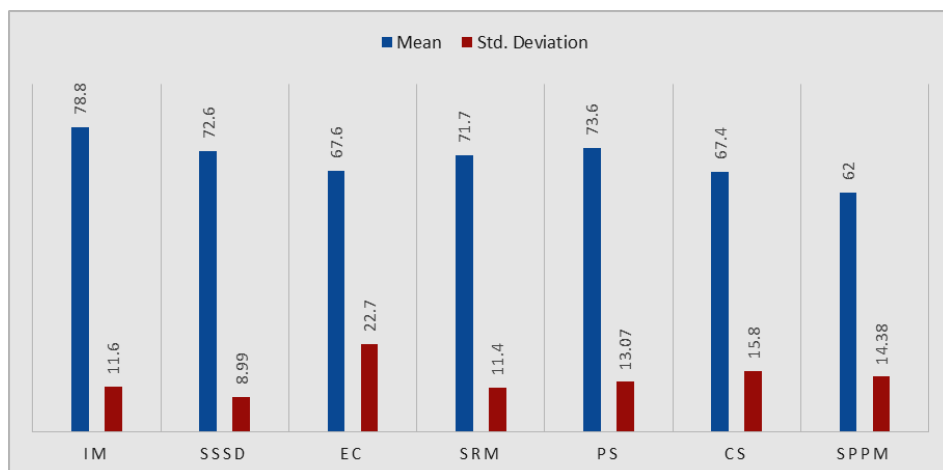


Figure (2)..Results of Analysis on the Scores of the Courses

K-means Cluster Analysis

Before applying K-mean cluster analysis. RATTLE in R-Studio was used to identify the number of clusters. The outcome was two clusters as shown in figure (3).

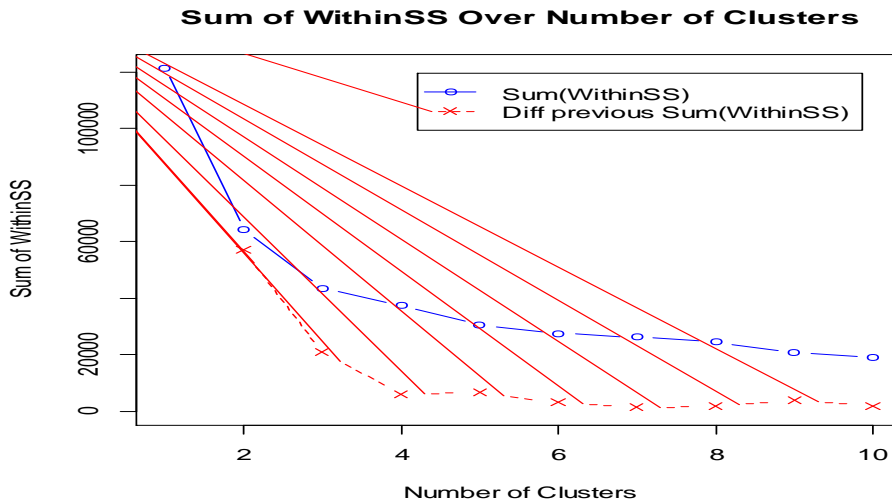


Figure (3) Number of Clusters

After the number of clusters was limited, K-means cluster analysis was applied in SPSS as shown in table (4).

Cluster one contains 58 students (46%) while cluster two consists of 68 (54%).

Table 4.Number of each cluster

Clusters	Frequency	%
Cluster 1	58	46%
Cluster 2	68	54%
Total	126	100%

Table 5. presents values of the final cluster centers for the two clusters so the values in cluster two are higher than cluster one. For the overall performance of the two clusters as illustrated in table (5), it is found that cluster (1) size 58 out of 126 is 61% as an “Average Performance” while cluster (2) size 68 out of 126 is 79% is “Good Performance” .Both decisions are depicted in the academic performance index of the table(1).

Table (5) Final Cluster Centers

Courses	Codes	Cluster	
		1	2
Introduction to Management	IM	71	86
SWK Sustainable Social Development	SSSD	67	77
Economics for Social workers	EC	49	84
Social Work Research Methods	SRM	63	79
Principles of Statistics	PS	65	81
Communication Skills	CS	57	76
SWK Project Planning & Management	SPPM	52	70
Grand Mean		61	79

Table (5) and figure (4) compare means between the two clusters where the course “Introduction to Management) has high value both cluster one and cluster two (M=71)and (M=86) whereas the course “Communication Skills” has the lowest value for the two clusters. However, cluster one extending (52-71) with a grand mean (61)while cluster two ranging between(70-86) with a grand mean(79).

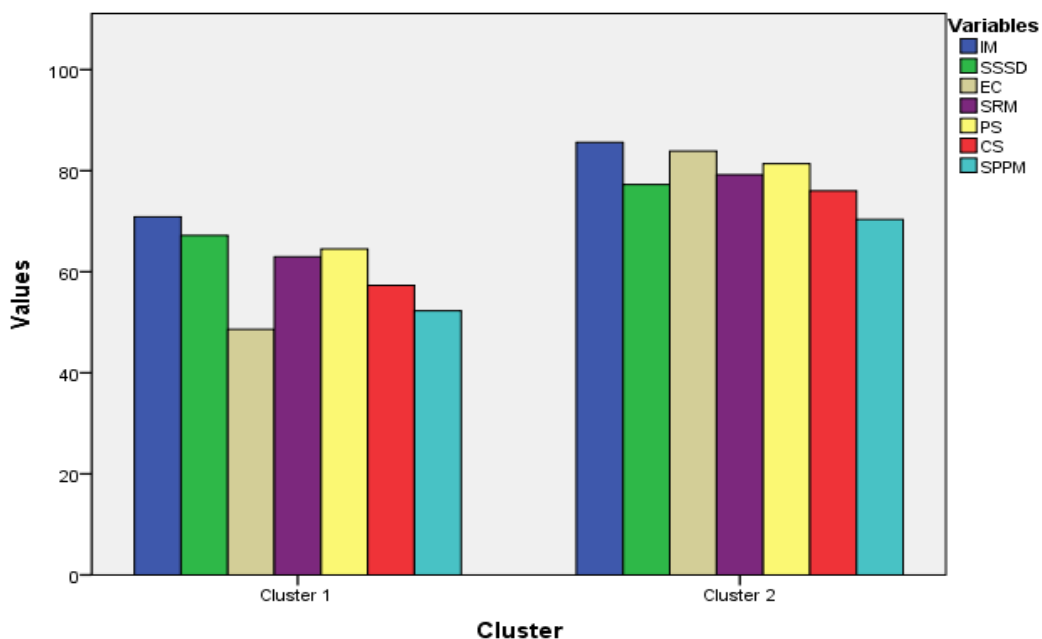


Figure (4) Final Cluster Center

Table (6) ANOVA Analysis

Course	Codes	Cluster		Error		F	Sig.
		Mean Square	df	Mean Square	df		
Introduction to Management	IM	6801.626	1	80.945	124	84.028	.000
SWK Sustainable Social Development	SSSD	3168.050	1	55.949	124	56.624	.000
Economics for Social workers	EC	38990.476	1	207.905	124	187.540	.000
Social Work Research Methods	SRM	8270.735	1	65.578	124	126.121	.000
Principles of Statistics	PS	8921.386	1	100.295	124	88.952	.000
Communication Skills	CS	10947.989	1	164.054	124	66.734	.000
SWK Project Planning & Management	SPPM	10209.255	1	126.319	124	80.821	.000

Table (6) above presents the differences among variables (courses scores) in the two clusters, the P-values of all courses $\leq (.000)$ less than (0.05). Thus, there are variances among the scores of the seven courses.

Results of Two-step Cluster Analysis

In this section, the Two-step cluster was another statistic method conducted by the author in an attempt to identify the similarity and differences between the outputs of the K-means cluster and the former cluster. Figure (5) visualizes the model summary produced by a Two-step analysis of seven inputs (data of courses) grouped into two clusters as well cluster quality where silhouette measure of cohesion and separation intervals (-1 to 0.2 Poor | 0.2 to 0.5 Fair | 0.5 to 1 Good). Based on that, the indicator passed to the green region (0.5). Thus, the cluster quality is "Good". Table (7) displays the cluster size and ratio of the largest cluster to the smallest cluster which is (2.15), this value is less than (3), therefore, is an acceptable ratio.

Table (7) Cluster Size and Ratio Sizes

Size of Smallest Cluster	40 (31.7%)
Size of Largest Cluster	86 (68.3%)
Ratio Of Sizes: Largest Cluster to Smallest Cluster	2.15

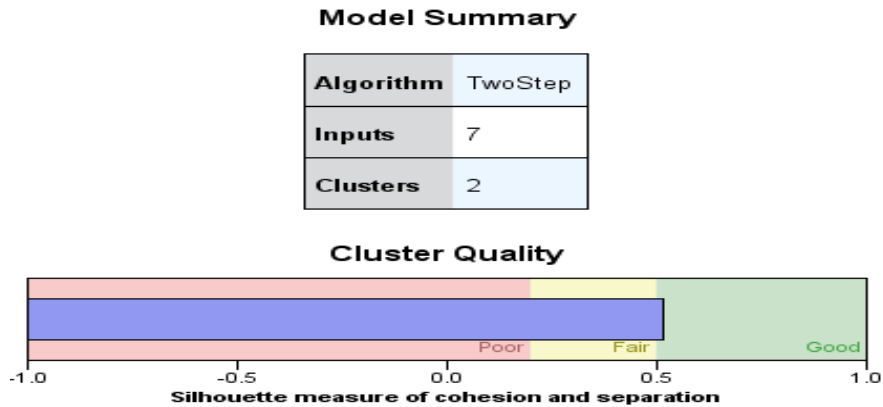


Figure (5) Model Summary and Cluster Quality

Figure (6) demonstrates the relative importance of each predictor in estimating the cluster model (IBM, 2017). The sum of the values for all predictors on the display is 1.0. The Importance measure of cluster cohesion is (0 to 0.2 Poor | 0.2 to 0.6 Fair | 0.6 to 1 Good). According to these interval values, the course “Social Work Research Methods SRM” scored up the optimal value of predictor importance while the courses ‘Economics for Social workers EC, “SWK Project Planning & Management SPPM” and “Principles of Statistics PS” are the region (0.6-0.8) as “Good” level of predictor importance. The courses “SWK Sustainable Social Development SSSD, “Introduction to Management IM, and “Communication Skills CS” are the region (0.2-0.6) which features a “Fair” level predictor importance. However, all variables (courses) contributed to establishing the cluster model with an acceptable level of predictor importance.

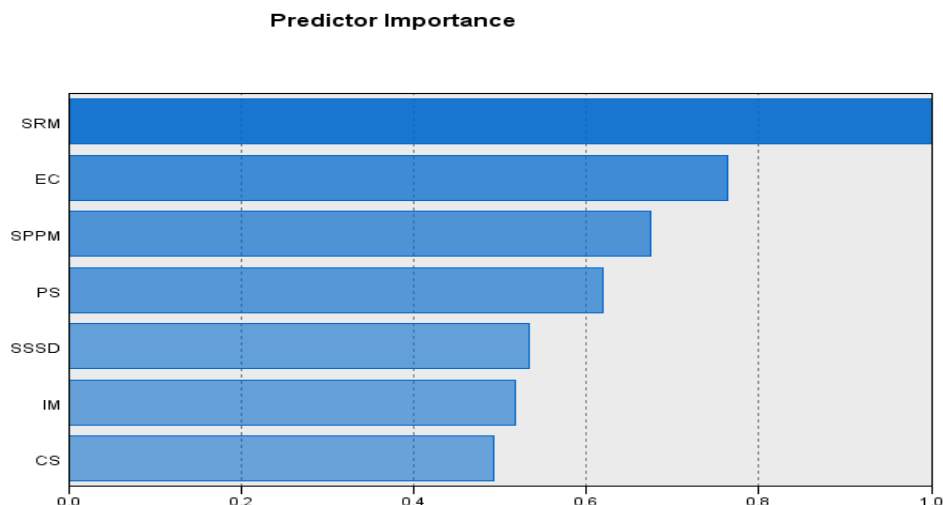


Figure (6) Predictor Importance for the Seven Courses in the Cluster

Table (8) and figure (7) illustrate comparing means of the two clusters made up by Two-steps cluster modular. The values of the cluster (2) are higher than those in cluster (1). The values in cluster two rankings (75-90), while values in the cluster one ranking (55-74). To determine the performance of the students in two clusters, the grand mean of each cluster was calculated. Therefore, the overall performance of the two clusters was judged. It is found that cluster (1) size 86 out of 126 is 65% as an “Average Performance” while cluster (2) size 40 out of 126 is 84% as “Very Good Performance”. Both decisions are described in the academic performance index of table (1).

Table (8) Input Means of Clusters

Cluster	1	2
Size	 68.3% (86)	 31.7% (40)
Inputs	IM 74.23	IM 88.68
	SSSD 69.02	SSSD 80.35
	EC 57.13	EC 90.28
	PS 68.05	PS 85.58
	CS 61.30	CS 80.58
	SPPM 55.70	SPPM 75.68

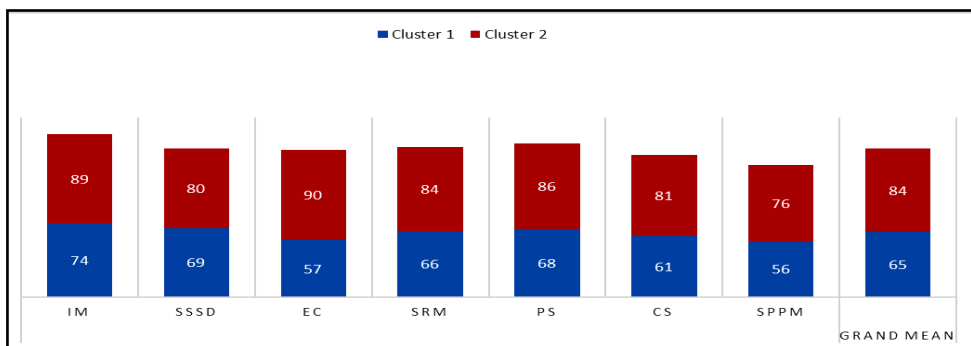


Figure (7) Comparing Means of Two Clusters

Table (9) shows a comparative analysis of the overall performance of the students in light of the three analysis methods applied in this study. K-mean cluster analysis explored (70%), Two-step cluster analysis showed (74.5%) and the descriptive analysis (70.5%). These results ranging (70-74.5) and indicate that the performance of the students of the social work department is a 'Good level'.

Table (9). A Comparison among The Results of the three Analyses

Analysis Methods	Overall Performance		Overall performance Average	Decision
	1	2		
K-Means Cluster	61	79	70	Good
TwoStep Cluster	65	84	74.5	Good
Descriptive Statistics	-		70.5	Good

Discrimination Analysis

To estimate the discrimination indicators of test scores for each variable (course), the Optimal Scaling in SPSS was used. Table (10) and figure (8) below show the discrimination measures. The most discriminant variables (courses) of two dimensions (clusters) is "Social Work Research Methods (SRM)" (M= 0.745) followed by "SWK Project Planning & Management (SPPM)" as second rank (M=0.708), while "Economics for Social workers (EC), Introduction to Management (IM), and Communication Skills (CS)" discriminated as third, fourth and fifth ranks (M= 0.698, 0.643 and 0.620). The courses "SWK Sustainable Social Development SSSD (M= 0.557)" and "Principles of Statistics (PS) with the mean (0.458) indicate sixth and seventh levels of discrimination.

The overall mean of discrimination for the cluster (1) shows high discriminant (72.941) than cluster (2) which made up (53.583). However, the grand mean of the seven courses revealed (63.262). Thus, the discrimination result of each course and their grand mean demonstrate the high level of discrimination.

Table (10) Discrimination Measures

Courses	Codes	Dimension		Mean
		1	2	
Introduction to Management	IM	0.725	0.562	0.643
SWK Sustainable Social Development	SSSD	0.627	0.487	0.557
Economics for Social Workers	EC	0.839	0.558	0.698
Social Work Research Methods	SRM	0.803	0.686	0.754
Principles of Statistics	PS	0.595	0.321	0.458
Communication Skills	CS	0.723	0.516	0.620
SWK Project Planning & Management	SPPM	0.794	0.621	0.708
Active Total		5.106	3.751	4.428
% Of Variance		72.941	53.853	63.262

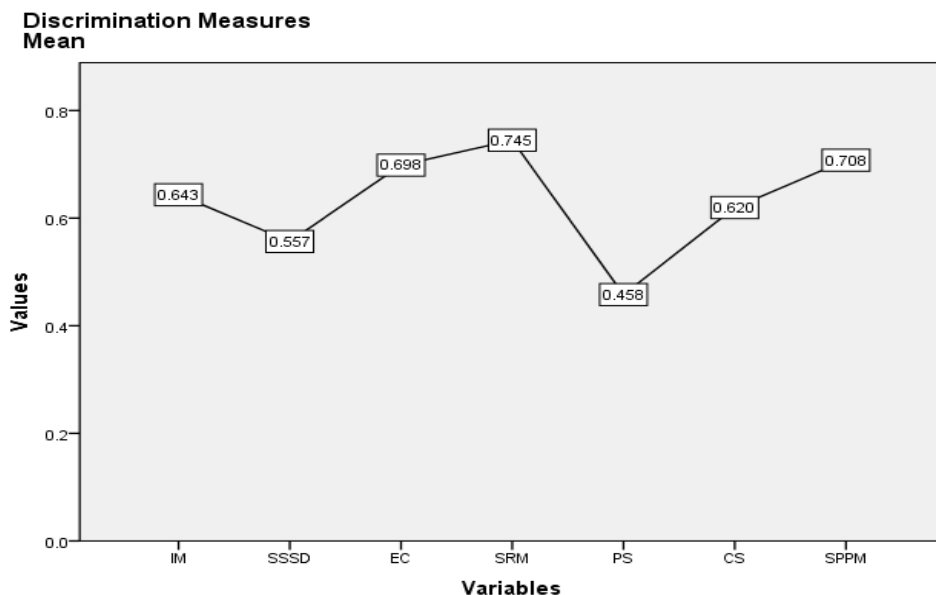


Figure (8) Grand Means of Discrimination for Variables (Courses)

Conclusion and Recommendations

Based on the results of the study, several statistical methods were employed to determine student performance. The reliability, convergent validity, cluster quality, and discrimination of the data were calculated. All indicators were accepted statistically. It was found that the level of students for the social work department in the third year at Mogadishu University was good where the descriptive statistic results showed the grand mean of scores for the seven courses (70,567) as well as the result of K-mean two clusters; the cluster one made up 61% as an 'Average performance' while the cluster two scored up 70% is a 'Good performance' while Two-step Cluster results revealed (65%) for the

cluster (1) is an ‘Average performance’ and (84%) for the cluster(2) as a ‘ Good performance’ according to the Academic Performance Index of the study. Based on these results, it is recommended to improve assessment modes in general and the achievement test in particular, to be aligned with teaching and learning methods to uphold the performance of the students. It is also highly recommended to conduct evaluation studies on students’ performance in the light of their exam scores for other departments at Mogadishu University.

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