Print ISSN: 2234-3040 / Online ISSN 2234-3059
doi:10.13106/eajbm.2017.vol7.no1.25

Assessment of Educational Conditions for 28 National Universities in South Korea

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Received: November 22, 2016. Revised: December 25, 2016. Accepted: January 15, 2017.

Abstract

Purpose - In this paper, we categorize and segment the 28 national universities in South Korea and measure the degree of dissimilarity (or similarity) between pairs of ones by using dissimilarity distance matrix and cluster analysis, respectively, based on the seven quantitative evaluation of educational conditions (percentage of small-scale courses, percentage of lecture by the faculty, collection of books per student, material purchase per student, percentage of building capacity, percentage of real estate capacity and rate of accommodation) in 2015. In addition, multidimensional scaling (MDS) techniques can obtain visual representation for exploring patterns of proximities among 28 national universities based on seven attributes of educational conditions.

Research design, data, and methodology - This work is carried out by the 2015 Announcement of University Information, which is provided by Ministry of Education in South Korea and utilized by multivariate analyses with CLUSTER, PROXIMITIES and ALSCAL modules in IBM SPSS 23.0.

Results - We make certain that 28 national universities can be categorized into five clusters which have similar traits by applying two-stage cluster analysis. MDS is utilized to perform positioning of grouped places of cluster and 28 national universities joining every cluster.

Conclusions - Both types and traits of each national university can be relatively assessed and practically utilized for each university competitiveness based on underlying results.

Keywords: Educational Conditions, Cluster Analysis, Multidimensional Scaling.

JEL Classifications: C18, M21.

1. Introduction

Over the last few decades, South Korea has achieved dramatic educational development, together with rapid economic growth. In particular, Korean post-secondary schools are greatly stratified, with a limited number of elite 4-year institutions at the top. Since academic credentials play an important role in securing a first-rate career at top-ranked company and national ministries, most Korean college applicants wish to attend these few selective 4-year universities. As a result, competition for these universities has been severe. Recently, in spite of these dramatic educational advances, the population of the school aged rapidly tended to decrease, so that the government authorities have pushed to restructure universities around the domestic nation in order to gain the competitiveness in education.

Jeong (2014) performed both cluster analysis and multidimensional scaling, based on the four principal criteria of research-performance in 28 national universities in Korea. The initially unknown groups can be classified and specialized into a cluster of relatively similar universities, and new groupings can be created without any prejudiced concept of what similar groups may arise. Furthermore, the location of similarity of each university may be represented

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on the multidimensional space, so that individual universities are then assigned coordinates in each of the two dimensions.

Park (2010) examined whether Project Strengthening Educational Competence (PSEC) contributes to educational condition and performances of university in South Korea empirically by using panel data. As a result, rate of employment of universities not taking part in the PSEC has decreased 5.28%, compared to ones taking part in the PSEC, while the rate of student recruits, the rate of faculty capacity, and the rate of scholarship payment have increased 1.27%, 1.32% and 1.36%, respectively.

Thirteen types of occupations and sixteen administrative areas in South Korea are classified and subdivided based on their dissimilarities and visually represented on two-dimensional space on Jeong (2015). The dissimilarities are decided by five traits of quantitative assessment (simplified procedure of trading, curtailed price, direct encounter with supplier, faster procedure of trading, etc.). Hence, domestic types of administrative districts and businesses can be categorized into certain clusters. And also, forms and traits of types of occupation and administrative areas can be assessed between and within the similar groups.

In this paper, 28 national universities in South Korea are categorized and segmented based on the seven characteristics of quantitative evaluation such as percent of small sized-course, collection of books per student, money for material per student and so forth, which stand for educational conditions of a college. In addition, both types and traits of every university can be relatively assessed and utilized for individual university's competitiveness based on the outlined results of MDS.

The remainder of this research is formed as follows: Section 2 describes sample collection and methods. Section 3 presents and discusses the empirical results. Finally, we summarize the findings in last section.

2. Data Collection

This research is performed by the 2015 Announcement of University Information jointly supported by Ministry of Education and Korean Council for University Education and has examined 28 national universities in South Korea (Ministry of Education, 2015).

This announcement provides useful information of universities in South Korea in order to make a reasonable judgement when conducting the underlying policy, so that it may ensure a consumer's right to know and enhance the efficiency and transparency of educational administration, together with promotion of learning and policy studies (Ministry of Education, 2013, 2014 and 2015).

In addition, the goal of this announcement is to accelerate improvement of quality through competition between universities and lasting restructuring by guaranteeing the consumer's right to choose.

3. Research Result

3.1. Dissimilarity distance matrix

Dissimilarity distance matrix (DDM) is exploited to analyze similarity and dissimilarity between each national university in South Korea by computing dissimilarity as a distance. Greater value signifies greater degree of dissimilarity between two universities.

Since all values corresponding to Mokpo National Maritime University, University of Seoul, and Korea National University of Education are very large, these three universities can be distinguishable from others from <Table 1>. Further, the values corresponding to these three universities are very big, so that they can be considered a group sharing relatively different traits.

<Table 1> Dissimilarity distance matrix between 28 national universities in South Korea

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0.00													
2	2.60	0.00												
3	4.11	2.31	0.00											
4	2.94	3.08	4.30	0.00										
5	1.66	3.10	4.52	3.68	0.00									
6	1.97	2.01	3.21	3.43	1.69	0.00								
7	2.69	2.69	3.26	4.39	2.38	1.92	0.00							
8	2.90	1.89	2.97	3.67	2.43	1.74	2.10	0.00						
9	1.89	2.28	3.38	3.72	1.46	0.67	1.82	1.71	0.00					
10	5.25	4.27	5.43	5.91	4.90	4.34	4.23	4.54	4.77	0.00				
11	3.71	2.16	1.25	4.31	4.16	3.16	2.58	2.80	3.21	4.97	0.00			
12	3.38	1.96	2.56	2.25	3.84	3.08	3.46	2.49	3.33	5.23	2.57	0.00		
13	4.15	2.06	1.66	3.59	4.57	3.45	3.82	2.67	3.62	5.66	2.17	1.62	0.00	
14	5.37	4.40	4.73	3.13	5.48	5.06	5.51	4.26	5.29	6.85	4.95	2.61	3.53	0.00
15	2.56	2.79	3.54	2.73	2.68	1.77	3.05	2.97	2.26	4.82	3.71	3.04	3.76	4.57
16	1.15	2.96	4.64	2.87	2.36	2.48	3.24	3.43	2.53	5.29	4.27	3.68	4.55	5.51
17	2.36	2.02	2.92	2.71	2.32	1.71	2.92	1.84	1.80	5.30	3.09	2.27	2.69	4.01
18	1.97	1.36	2.50	2.61	2.43	1.58	2.56	1.73	1.67	5.13	2.51	1.95	2.32	4.14
19	1.65	3.31	4.40	2.93	2.45	2.31	3.28	3.42	2.30	6.00	4.31	3.72	4.45	5.32
20	2.19	1.29	2.68	3.46	2.33	1.48	2.24	1.29	1.37	4.82	2.52	2.57	2.59	4.78
21	2.26	1.19	2.64	2.43	2.59	1.74	2.67	1.47	1.91	4.92	2.63	1.59	2.11	3.72
22	2.68	1.03	2.16	3.16	2.92	2.13	2.35	1.59	2.28	4.44	1.79	1.70	1.98	4.11
23	3.62	2.12	1.74	3.91	4.56	3.52	3.44	3.47	3.67	5.45	1.40	2.53	2.20	5.00
24	5.78	7.25	9.30	6.84	5.62	6.80	7.55	6.97	6.58	8.59	8.91	7.88	8.67	8.71
25	2.79	1.30	2.32	3.42	2.90	2.00	2.02	1.07	2.05	4.57	7.98	1.93	2.06	4.15
26	5.32	3.32	3.35	5.49	6.17	5.15	5.25	4.73	5.27	6.16	3.27	4.06	3.16	6.18
27	2.86	0.92	2.41	3.68	3.22	1.92	2.39	2.04	2.24	3.77	2.19	2.59	2.54	4.97
28	3.46	1.91	1.20	4.03	4.21	3.07	3.05	3.01	3.17	5.38	1.05	2.57	1.99	5.05

Note that the numerical values in the first row and column above show the following:

1: Gangneung-Wonju National Univ. 2: Kangwon National Univ. 3: Gyungnam National Univ. of Science & Technology 4: Kyungpook National Univ. 5: Gyungsang National Univ. 6: Kongju National

Univ. 7: Kunsan National Univ. 8: Kumho National Institute of Technology 9: Mokpo National Univ. 10: Mokpo National Maritime Univ. 11: Pukyong National Univ. 12: Pusan National Univ. 13: Seoul National Univ. of Science & Technology 14: Univ. of Seoul 15: Sunchon National Univ. 16: Andong National Univ. 17: Chonnam National Univ. 18: Chonbuk National Univ. 19: Jeju Mokpo National Univ. 20: Changwon National Univ. 21: Chungnam National Univ. 22: Chungbuk National Univ. 23: Hankyung National Univ. 24: Korea National Univ. of Education 25: Korea National Univ. of Transportation 26: Korea National Sport Univ. 27: Korea Maritime and Ocean University 28: Hanbat National Univ.

<Table 2> Dissimilarity distance matrix between 28 national universities in South Korea (continued)

	15	16	17	18	19	20	21	22	23	24	25	26	27	28
15	0.00													
16	2.78	0.00												
17	2.11	3.09	0.00											
18	2.20	2.60	0.95	0.00										
19	2.23	1.51	2.77	2.47	0.00									
20	2.83	2.82	1.57	1.06	2.92	0.00								
21	2.34	2.70	1.19	0.67	2.70	1.17	0.00							
22	2.90	3.30	1.77	1.31	2.54	1.35	1.24	0.00						
23	3.85	3.99	3.34	2.58	4.17	2.81	2.72	2.19	0.00					
24	7.53	5.63	6.91	6.93	6.35	6.71	6.85	7.41	8.77	0.00				
25	3.01	3.23	2.07	1.50	3.34	1.22	1.24	1.07	2.51	7.36	0.00			
26	5.81	5.58	4.92	4.24	6.06	4.07	4.20	3.67	2.54	9.32	3.92	0.00		
27	2.84	3.10	2.56	1.94	3.45	1.61	1.81	1.60	2.35	7.57	1.50	3.52	0.00	
28	3.58	3.96	2.93	2.22	3.97	2.34	2.44	1.92	0.79	8.67	2.15	2.78	2.08	0.00

On the other hand, Gangneung-Wonju National University, Gyungsang National University and Jeju National University can be regarded as having similar characteristics. The trait of Pusan National University in Pusan is similar to that of Seoul National University of Science & Technology and Chungnam National University; whereas, it is different from that of Mokpo National University and Korea National University of Education. Pukyong National University in Pusan tends to be similar to Gyungnam National University of Science & Technology and Hanbat National University, while having dissimilarity to Korea University of Education.

3.2. Cluster Analysis (Aldenderfer & Blashfield, 1985; Kaufman & Rousseeuw, 2005; Savaresi & Boley, 2004; Shepard, 1962; Yang, 2013)

Cluster analysis is an exploratory multivariate method which helps understanding of whole data's structure and which satisfies the principle that individuals within clusters are analogous (or related) to one another and heterogeneous (or unrelated) to individuals in other groups. Thus, the higher the homogeneity within a similar group and the higher the difference (or heterogeneity) between a cluster, the better or more distinct the clustering.

<Table 3> Agglomeration schedule

stage	cluster combined		coefficients	stage cluster first appears		next stage
	cluster 1	cluster 2		cluster 1	cluster 2	
1	6	9	.438	0	0	13
2	18	21	.446	0	0	6
3	23	28	.622	0	0	8
4	2	27	.837	0	0	10
5	8	25	1.133	0	0	9
6	17	18	1.160	0	2	16
7	1	16	1.319	0	0	14
8	11	23	1.527	0	3	11
9	8	20	1.578	5	0	12
10	2	22	1.820	4	0	12
11	3	11	2.002	0	8	20
12	2	8	2.383	10	9	16
13	5	6	2.495	0	1	17
14	1	19	2.498	7	0	19
15	12	13	2.635	0	0	18
16	2	17	2.715	12	6	18
17	5	7	4.212	13	0	19
18	2	12	5.066	16	15	20
19	1	5	6.119	14	17	21
20	2	3	6.169	18	11	22
21	1	15	6.279	19	0	22
22	1	2	9.657	21	20	24
23	4	14	9.806	0	0	24
24	1	4	16.810	22	23	25
25	1	26	21.268	24	0	26
26	1	10	26.379	25	0	27
27	1	24	56.813	26	0	0

First of all, we can find that since there are five points wherein coefficients in merging process increase dramatically in <Table 3>, individuals can be grouped into five clusters.

Korea National University of Education (which belongs to Cluster 4) among 28 national universities is superior to other universities in most of the attributes of educational conditions. In terms of percentage of lectures by the faculty, Mokpo National Maritime University (which belongs to Cluster 2) is situated superior to others. On the other hand, Cluster 1, which consists of Kyungpook National University, Pusan National University and University of Seoul, is dominant over others in terms of material purchase per student (see <Table 4>).

<Table 4> Final clustering centers

variables to be evaluated	cluster				
	1	2	3	4	5
percentage of small-scale courses	0.044	-1.492	-1.171	1.867	0.383
percentage of lecture by the faculty	-0.771	2.210	-1.064	0.060	0.378
collection of books per student	0.784	0.062	-0.984	1.986	0.089
material purchase per student	2.192	0.151	-0.525	0.275	-0.227
percentage of building capacity	-0.586	-0.662	-0.933	3.856	0.224
percentage of real estate capacity	0.017	-1.621	-0.573	4.175	0.049
rate of accommodation	-0.737	3.190	-0.673	2.868	0.011

Cluster 3, which is composed of six universities

(Gyungnam National University of Science & Technology, Pukyong National University, Seoul National University of Science & Technology, Hankyung National University, Korea National Sport University and Hanbat National University), is inferior to the rest of other clusters in terms of most of the attributes, and it needs active and resolute support and investment (see <Table 4>).

Seventeen among 28 universities (such as Gangneung-Wonju National University, Kangwon National University, Gyungsang National University, Konju National University and so on), which belong to Cluster 5, are in the 2nd rank of clusters in terms of most of thee valuation attributes.

<Table 4> Distances between final cluster centers

cluster	1	2	3	4	5
1		5.834	3.541	7.691	3.003
2			5.335	8.586	4.553
3				8.830	2.825
4					6.662
5					

By examining the difference in mean between groups, it is noticeable that there is a marked difference between Cluster 3 and Cluster 4; whereas, it relatively makes little difference between Cluster 3 and Cluster 5 (see <Table 4>).

<Table 5> Variance of analysis

variables to be evaluated	cluster		error		F	sig
	MS	df	MS	df		
percentage of small-scale courses	4.111	4	0.459	23	8.958	< 0.001
percentage of lecture by the faculty	3.973	4	0.483	23	0.226	< 0.001
collection of books per student	2.934	4	0.664	23	4.420	0.009
material purchase per student	4.260	4	0.433	23	9.835	< 0.001
percentage of building capacity	5.646	4	0.192	23	29.416	< 0.001
percentage of real estate capacity	5.519	4	0.214	23	25.779	< 0.001
rate of accommodation	5.686	4	0.185	23	30.734	< 0.001

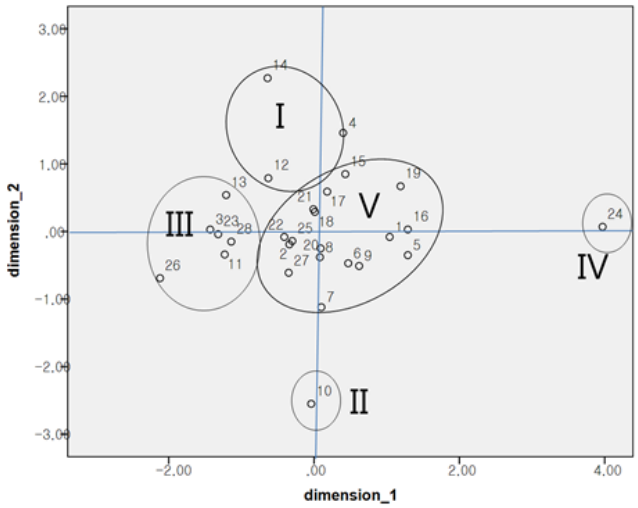
From <Table 5>, we can check that seven variables are all significant for classifying five different groups, which tests mean differences by groups.

3.3. Multidimensional scaling (Torgerson, 1952; Kruskal, 1964; Kruskal & Wish, 1978; Borg & Groenen, 2005; Takane et al, 1977)

Points (or 28 universities) are arranged within two dimensions so that points that are close together represents similar objects, while dissimilar objects are denoted by points that are far apart from <Figure 1>. This map is a two dimensional scatter plot expressing calculated coordinate of 28 national universities in two dimensional scaling. Each object shows strong tendency as it is far away from the origin.

Faculty-lecturing percentage, among seven attributes, has the strong and positive propensity as points go down from the origin; whereas, material purchase per student does as points go above the origin.

Further, the rest of five attributes (percentage of small-scale course, collection of books per student, percentage of building capacity, percentage of real estate capacity and rate of accommodation) show the strong and positive tendency as points are located on the right of the origin. Korea National University of Education (which belongs to Cluster 4) shows comprehensively strong superiority, while Korea National Sport University, in particular, shows inferiority to most of the attributes. Both Mokpo National Maritime University and University of Seoul show strong superiority in terms of faculty-lecturing percentage and material purchase per student, respectively.



<Figure 1> Derived stimulus configuration

4. Concluding Remarks

This paper applies two types of cluster analysis on seven educational conditions based on an Announcement of University Information, provided by Ministry of Education in South Korea.

As a result, it is affirmed that clustering is available by

categorizing 28 national universities into five clusters which share similar characteristics.

In addition, multidimensional scaling is used to perform positioning of both grouped levels of cluster with 28 national universities belonging to each cluster. Dissimilarity distance matrix is utilized to analyze similarity and dissimilarity between each national university.

This study suggests that we can relatively evaluate types and traits of each national university, obtain useful information in understanding and exploring the recent situation of educational conditions of national universities in Korea and practically utilized for each university competitiveness based on underlying results. It will be valuable to consider other evaluation areas such as research, teaching, industry income, finance, and so forth, for the purpose of assessing a variety of university competitiveness for the future study.

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