THE RANKING OF TURKISH UNIVERSITIES WITH COCOSO AND MARCOS

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Abstract

The ranking of universities according to their academic performance is important for both the reputation of the university and the region and country where the university is located. Additionally, universities can have the opportunity to observe their weaknesses and strengths through these rankings and draw a roadmap to improve their performance. Some organizations evaluate the performance of universities. URAP is one of the organizations assessing the performance of universities according to various criteria. The aim of this study is to rank Turkish universities according to their performances based on the 2019-year report published by URAP assessing the performance of 166 universities according to 5 criteria. For this evaluation, CoCoSo and MARCOS methods, which are newly introduced to literature, are used in this study.

Keywords: *CoCoSo, MARCOS, Ranking of Universities.*

1. INTRODUCTION

Universities are institutions where scientific knowledge is produced, education and training activities are carried out, and social and cultural activities are proceeded. The quality of these activities carried out in universities is extremely significant for the success and performance of universities. The performance and success of universities are effective in the progress, development, and level of development of the region and country in which they operate. Activities of universities, articles published according to the number of academicians, citations they have received, projects that have been accepted, etc. are effective factors in the performance of universities.

There are some organizations that assess the performance of universities in terms of various criteria and rank them according to these performances. Universities can check their situation and performance according to the assessments of these institutions, have an idea about their strengths, weaknesses, and deficiencies, and find the opportunity to draw a road map for themselves. URAP (University Ranking by Academic Performance) is one of the organizations that evaluate universities according to various criteria. The aim of this study is to rank Turkish universities according to their performances based on the 2019 year (2019-2020 Rankings) report published by URAP evaluating the performance of 166 universities according to 5 criteria (Article Scores, Citation Scores, Scientific Document Scores, PhD Scores, and The Number of Lecturer/The Number of Student Scores). In this study, CoCoSo (Combined Compromise Solution) and MARCOS (Measurement of Alternatives and Ranking according to Compromise Solution) methods are used to rank universities. These methods are newly introduced to the literature, and they were preferred in this study due to the limited number of studies on these methods.

2. LITERATURE REVIEW

Since the CoCoSo (Yazdani *et al.*, 2019a) and MARCOS (Stevic *et al.*, 2020) methods have been newly developed, the number of publications using these methods is few, and Table 1 summarizes the studies using these methods

Table 1. - Literature Review

Authors	Problem	Methods
CoCoSo Method		
Yazdani *et al.* (2019b)	Determination of supplier performances for a construction business in Madrid	CoCoSo-G

Barua *et al.* (2019)	Selecting logistics and transportation companies for a supply chain in France	Taguchi and CoCoSo
Zolfani *et al.* (2019)	Sustainable supplier selection	BWM and CoCoSo
Peng *et al.* (2020)	5G industry evaluation	Fuzzy MCDM method based on CoCoSo and CRITIC with score function
Ulutaş *et al.* (2020)	Location selection for logistics center	CoCoSo and Fuzzy SWARA
MARCOS Method		
Stevic *et al.* (2020)	Supplier selection in healthcare industries	MARCOS
Stanković *et al.* (2020)	Road traffic risk analysis	Fuzzy MARCOS
Ulutaş *et al.* (2020)	Stackers selection in a logistics system	CCSD-ITARA-MARCOS
Puska *et al.* (2020)	Project management software evaluation	MARCOS
Stević and Brković (2020)	Evaluation of human resources in a transport company	FUCOM and MARCOS

3. METHODOLOGY

In this study, CoCoSo and MARCOS methods are used to rank universities. In the methodology section, first, the CoCoSo method will be explained, and then the MARCOS method will be elaborated.

3.1. CoCoSo Method

CoCoSo procedure is as follows (Yazdani et al., 2019a).

Initial decision matrix has been formed as in Equation 1.

$$i: alternative; i = 1,2,3, \dots, m$$

$$j: criterion; j = 1,2,3, \dots, n$$

$$x_{ij}: value\ of\ alternative\ i\ for\ criterion\ j$$

$$X: initial\ decision\ matrix$$

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \tag{1}$$

Normalization has been made for benefit criteria as in Equation 2.

$$r_{ij}: normalized\ value\ of\ alternative\ i\ for\ criterion\ j$$

$$r_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \tag{2}$$

Normalization has been made for cost criteria as in Equation 3.

$$r_{ij} = \frac{\max_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \tag{3}$$

The total of the weighted comparability sequence has been calculated by using Equation 4.

$$S_i: total\ weighted\ comparability\ sequence\ for\ alternative\ i$$
$$w_j: weight\ of\ criterion\ j$$
$$S_i = \sum_{j=1}^{n}(w_j r_{ij}) \tag{4}$$

The whole of the power weight of comparability sequences for each alternative has been calculated by using Equation 5.

$$P_i: total\ power\ weight\ of\ comparability\ sequence\ for\ alternative\ i$$
$$P_i = \sum_{j=1}^{n}(r_{ij})^{w_j} \tag{5}$$

The values have been integrated with three aggregation strategy. Aggregation strategies have been shown in Equation 6, 7 and 8 respectively.

$$k_{ia}: aggregation\ strategy\ a\ for\ alterntive\ i$$
$$k_{ia} = \frac{P_i + S_i}{\sum_{i=1}^{m}(P_i + S_i)} \tag{6}$$

$$k_{ib}: aggregation\ strategy\ b\ for\ alterntive\ i$$
$$k_{ib} = \frac{S_i}{\min_i S_i} + \frac{P_i}{\min_i P_i} \tag{7}$$

$$k_{ic}: aggregation\ strategy\ c\ for\ alterntive\ i$$
$$\lambda: balance\ value; 0 \leq \lambda \leq 1$$
$$k_{ic} = \frac{\lambda S_i + (1-\lambda)P_i}{\lambda \max_i S_i + (1-\lambda) \max_i P_i} \tag{8}$$

Balance value is chosen by decision makers. 0.5 is preferable value.

The final ranking of the alternatives has been calculated by using Equation 9.

$$k_i: final\ value\ for\ alternative\ i$$
$$k_i = \sqrt[3]{k_{ia} k_{ib} k_{ic}} + \frac{k_{ia} + k_{ib} + k_{ic}}{3} \tag{9}$$

The highest final value shows the best alternative in the multi criteria decision making problem according to CoCoSo method.

3.2. Marcos Method

MARCOS procedure is as follows (Stević and Brković, 2020).

Initial decision matrix has been formed. This matrix format is same as in Equation 1.

Extended initial decision matrix has been prepared by defining the ideal and anti-ideal solution. Anti-ideal solution values have been found by Equation 10.

$$x_{agj}: anti-ideal\ solution\ value\ for\ criterion\ j$$

$$x_{agj} = \begin{cases} j \in benefit \Longrightarrow \min_{j} x_{ij} \\ j \in cost \Longrightarrow \max_{j} x_{ij} \end{cases} \tag{10}$$

Ideal solution values have been found by Equation 11.

$$x_{gj}: ideal\ solution\ value\ for\ criterion\ j$$

$$x_{gj} = \begin{cases} j \in benefit \Longrightarrow \max_{j} x_{ij} \\ j \in cost \Longrightarrow \min_{j} x_{ij} \end{cases} \tag{11}$$

Extended initial decision matrix can be seen in Equation 12.

$$EX: extended\ initial\ decision\ matrix$$

$$EX = \begin{bmatrix} x_{ag1} & x_{ag2} & \cdots & x_{agn} \\ x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \\ x_{g1} & x_{g2} & \cdots & x_{gn} \end{bmatrix} \tag{12}$$

Extended initial decision matrix has been normalized by using Equation 13.

$$n_{ij}: normalized\ value\ of\ alternative\ i\ for\ criterion\ j$$

$$n_{ij} = \begin{cases} j \in benefit \Longrightarrow \dfrac{x_{ij}}{x_{gj}} \\ j \in cost \Longrightarrow \dfrac{x_{gj}}{x_{ij}} \end{cases} \tag{13}$$

The weighted normalized values have been calculated by using Equation 14.

$$v_{ij}: weighted\ normalized\ value\ of\ alternative\ i\ for\ criterion\ j$$

$$v_{ij} = w_j n_{ij} \tag{14}$$

Sum of the weighted normalized values have been calculated by using Equation 15.

$$S_i: total\ weighted\ normalized\ value\ of\ alternative\ i\ for\ criterion\ j$$

$$S_i = \sum_{j=1}^{n} v_{ij} \tag{15}$$

Process has been repeated for ideal solution and anti-ideal solution. Sum of the weighted normalized values for ideal solution can be seen in Equation 16. Sum of the weighted normalized values for anti-ideal solution can be seen in Equation 17.

$$S_g: total\ weighted\ normalized\ value\ for\ ideal\ solution$$

$$S_g = \sum_{j=1}^{n} v_{gj} \tag{16}$$

$$S_{ag}: total\ weighted\ normalized\ value\ for\ anti-ideal\ solution$$

$$S_{ag} = \sum_{j=1}^{n} v_{agj} \tag{17}$$

Utility degree of an alternative in relation to anti-ideal solution has been found by using Equation 18.

$$K_i^-: utility\ degree\ of\ alternative\ i\ in\ relation\ to\ anti-ideal\ solution$$

$$K_i^- = \frac{S_i}{S_{ag}} \qquad (18)$$

Utility degree of an alternative in relation to ideal solution has been found by using Equation 19.

$$K_i^+: utility\ degree\ of\ alternative\ i\ in\ relation\ to\ ideal\ solution$$

$$K_i^+ = \frac{S_i}{S_g} \qquad (19)$$

Utility function of an alternative in relation to anti-ideal solution has been found by using Equation 20.

$$f(K_i^-): utility\ function\ of\ alternative\ i\ in\ relation\ to\ anti-ideal\ solution$$

$$f(K_i^-) = \frac{K_i^+}{K_i^+ + K_i^-} \qquad (20)$$

Utility function of an alternative in relation to ideal solution has been found by using Equation 21.

$$f(K_i^+): utility\ function\ of\ alternative\ i\ in\ relation\ to\ ideal\ solution$$

$$f(K_i^+) = \frac{K_i^-}{K_i^+ + K_i^-} \qquad (21)$$

In the last step, utility function of an alternative has been calculated by using Equation 22.

$$f(K_i): utility\ function\ of\ alternative\ i$$

$$f(K_i) = \frac{K_i^+ + K_i^-}{1 + \frac{1 - f(K_i^+)}{f(K_i^+)} + \frac{1 - f(K_i^-)}{f(K_i^-)}} \qquad (22)$$

According to MARCOS method, the highest utility function shows the best alternative.

4. ANALYSIS

The Decision Matrix showing the Turkish universities, evaluation criteria, and the scores of the universities under these criteria is presented in Table 2. The performance values of Turkish Universities have been collected from 2019-2020 report released by URAP (Available at: https://newtr.urapcenter.org/Rankings/2019-2020).

Table 2. - Initial Decision Matrix

Turkish Universities	Article Scores	Citation Scores	Scientific Document Scores	PhD Scores	The Number of Lecturer/The Number of Student Scores
Hacettepe University	181.16	200.00	182.96	180.47	58.33
Middle East Technical University	193.66	185.57	186.04	173.29	44.19
İstanbul Technical University	194.86	183.10	180.08	161.94	43.70
İstanbul University	161.56	162.54	167.98	174.94	50.15
Koç University	179.11	175.23	170.73	123.53	68.36
Ankara University	155.41	154.42	157.67	190.61	50.33
Boğaziçi University	172.78	175.62	166.74	123.53	44.59
Ege University	151.35	152.70	157.36	155.43	61.36
İhsan Doğramacı Bilkent University	176.45	182.51	171.74	101.11	44.22
Gebze Technical University	160.93	165.07	158.38	132.49	56.05
Gazi University	148.01	143.48	155.80	163.74	47.43
Yıldız Technical University	166.32	147.49	151.00	142.87	42.94
Sabancı University	164.52	167.91	160.26	100.00	57.01
İzmir Institute of Technology University	154.34	157.96	144.59	112.61	54.81
Atatürk University	133.03	138.96	135.04	156.50	59.87
Bezm-i Alem Vakıf University	149.99	163.08	162.61	60.36	85.47
Erciyes University	132.23	157.85	147.15	125.91	46.13
Marmara University	129.75	132.24	137.80	153.42	42.33
Dokuz Eylül University	133.39	139.64	140.19	126.39	50.55
Selçuk University	134.01	133.75	140.26	131.15	45.90
Çukurova University	137.94	129.14	138.37	131.82	45.83
Fırat University	142.17	137.56	133.45	111.35	58.17
Karadeniz Technical University	134.24	140.79	135.37	119.47	48.55
Eskişehir Osmangazi University	133.79	130.88	135.94	111.19	57.66
Akdeniz University	129.69	128.80	136.46	111.89	55.02
Abdullah Gül University	132.27	149.53	120.47	74.07	75.60
Bursa Uludağ University	125.09	128.49	130.92	119.84	41.27
Ondokuz Mayıs University	120.50	124.28	134.05	115.11	46.81
İnönü University	123.64	114.31	127.16	125.73	49.10
Anadolu University	122.91	119.85	115.51	132.79	47.10
Süleyman Demirel University	114.57	123.29	126.86	123.35	45.87
Gaziantep University	124.25	125.01	131.33	103.67	41.68
İstanbul Medeniyet University	124.21	134.18	120.79	72.97	73.38
Sakarya University	112.47	121.98	128.35	119.52	42.94
Çankaya University	159.15	162.98	127.49	32.51	35.36
Kocaeli University	122.74	120.38	128.70	101.51	42.86
Van Yüzüncü Yıl University	115.36	115.26	116.90	94.52	66.13
İzmir Katip Çelebi University	114.40	117.83	138.96	75.15	58.73
Ankara Yıldırım Beyazıt University	105.34	99.96	114.60	116.54	62.89
Başkent University	99.46	105.40	136.51	75.91	76.28
Atılım University	149.13	126.07	118.80	58.67	37.87

Dicle University	91.92	122.90	127.34	94.64	52.46
Manisa Celal Bayar University	103.56	130.54	117.01	84.29	48.86
Pamukkale University	102.34	122.54	118.23	89.28	50.00
TOBB University of Economics and Technology	112.67	114.67	126.99	71.83	52.98
Acıbadem Mehmet Ali Aydınlar University	103.98	104.13	111.47	59.37	99.00
Mersin University	112.65	108.80	110.94	93.83	48.44
Yeditepe University	100.19	111.85	113.77	116.81	30.47
Özyeğin University	123.05	131.47	113.29	62.42	38.65
Çanakkale Onsekiz Mart University	93.01	114.41	112.04	90.38	54.05
Düzce University	105.15	110.23	109.90	81.06	52.14
Tokat Gaziosmanpaşa University	103.93	116.31	112.19	76.14	49.32
Muğla Sıtkı Koçman University	105.28	101.45	111.77	86.15	51.82
Bolu İzzet Baysal University	103.47	112.49	112.30	73.38	54.27
Sivas Cumhuriyet University	110.68	111.77	111.78	67.05	48.72
Hitit University	109.13	104.72	105.94	64.57	63.84
Recep Tayip Erdoğan University	98.54	112.51	110.59	58.90	62.68
Kırıkkale University	100.26	100.00	107.45	87.27	46.40
Bursa Technical University	137.62	104.08	87.43	54.16	57.52
Necmettin Erbakan University	90.57	94.42	106.68	94.45	52.89
Kahramanmaraş Sütçü İmam University	86.51	99.86	100.91	97.40	52.14
Tekirdağ Namık Kemal University	102.33	109.49	103.51	60.22	59.43
Hatay Mustafa Kemal University	84.97	113.22	112.43	59.86	56.77
Niğde Ömer Halisdemir University	97.21	107.89	99.81	72.58	49.57
İstanbul Medipol University	96.97	98.19	109.34	73.60	48.34
Zonguldak Bülent Ecevit University	100.40	112.95	110.59	52.31	48.90
Balıkesir University	94.06	106.89	105.05	71.94	47.21
Aydın Adnan Menderes University	97.61	91.92	103.86	79.95	50.55
Harran University	94.42	97.28	104.62	68.81	54.95
Munzur University	132.62	106.59	87.94	11.90	80.88
Erzurum Technical University	103.41	112.60	86.37	53.52	60.34
Karabük University	101.27	105.20	88.07	86.43	29.69
Sinop University	97.95	137.99	95.03	14.79	63.76
Trakya University	80.39	87.77	104.36	86.44	47.36
Kütahya Dumlupınar University	84.84	123.13	105.12	62.34	29.61
Çankırı Karatekin University	102.70	102.43	88.51	40.95	66.75
Aksaray University	105.22	109.67	93.81	41.12	51.51
Afyon Kocatepe University	74.47	106.48	109.57	67.37	43.31
Adana Alparslan Türkeş Science and Technology University	115.33	96.65	82.14	26.55	80.08
Yozgat Bozok University	106.48	113.19	103.51	12.57	62.79
Galatasaray University	53.28	96.57	79.98	111.07	56.82

Adıyaman University	98.35	102.65	105.50	30.38	60.76
Yalova University	93.32	98.22	72.47	75.47	54.02
Ordu University	102.12	82.04	98.98	49.49	58.08
Bahçeşehir University	82.52	103.31	101.80	72.19	26.46
Bingöl University	99.09	101.54	88.82	35.86	57.75
Kastamonu University	97.40	86.82	77.08	81.91	39.33
Doğuş University	86.44	123.23	92.35	35.84	37.29
İskenderun Technical University	109.02	87.57	66.77	56.94	49.51
Nevşehir Hacı Bektaşi Veli University	75.58	93.20	80.98	74.55	42.78
Kadir Has University	86.18	73.63	91.48	73.87	40.89
Yaşar University	83.44	100.68	86.74	64.20	30.04
İzmir University of Economics	102.93	93.80	97.62	28.54	41.80
Demiroğlu Bilim University	64.20	93.85	102.77	9.66	91.99
Kırşehir Ahi Evran University	99.71	85.32	91.27	19.85	65.96
Bartın University	100.16	92.70	78.86	38.10	47.81
Kafkas University	70.54	84.86	97.19	48.47	55.66
Giresun University	92.28	88.84	84.52	33.23	56.83
Erzincan Binali Yıldırım University	85.37	89.79	87.29	33.62	58.28
Osmaniye Korkut Ata University	93.19	92.40	80.59	39.46	46.75
İstanbul Arel University	82.16	84.29	68.04	73.75	43.10
Işık University	86.68	92.25	94.35	42.72	30.36
Gümüşhane University	81.78	99.22	83.43	25.83	51.33
Karamanoğlu Mehmetbey University	90.45	86.43	75.89	18.60	59.26
Altınbaş University	80.11	70.22	72.17	59.91	42.58
İstanbul Bilgi University	91.63	84.73	86.92	48.56	12.31
Türk Hava Kurumu University	79.91	71.55	60.14	72.31	38.72
Bilecik Şeyh Edebali University	75.98	85.39	73.44	32.46	54.19
Bayburt University	89.73	96.37	76.81	10.19	46.91
Batman University	75.48	95.14	75.66	17.73	46.58
Bitlis Eren University	68.47	78.76	81.52	10.68	69.64
Amasya University	83.78	72.94	77.55	6.51	66.80
Piri Reis University	87.20	79.41	59.91	35.69	43.46
Burdur Mehmet Akif Ersoy University	68.68	71.80	76.65	40.99	46.29
Hasan Kalyoncu University	75.33	57.60	60.36	73.79	36.97
Hakkari University	83.61	70.12	54.47	0.20	92.57
Siirt University	86.72	82.07	77.35	4.49	46.84
Uşak University	77.81	67.98	66.22	43.91	41.08
Iğdır University	86.16	61.04	51.27	15.47	74.84
KTO Karatay University	51.91	128.64	53.84	14.30	36.84
Antalya Bilim University	84.80	86.18	75.08	0.20	39.10
Ted University	92.16	66.48	67.45	0.20	53.96
İstanbul Okan University	42.27	56.63	56.50	72.20	49.45
Artvin Çoruh University	63.55	66.39	65.32	15.59	65.64
İstanbul Commerce University	39.71	46.87	74.41	91.68	23.60
Ağrı İbrahim Çeçen University	70.17	95.81	67.69	0.91	39.12
İstanbul Aydın University	46.84	62.68	58.23	62.43	35.63

Konya Food and Agricultural University	77.05	58.29	33.51	0.20	95.88
Kilis 7 Aralık University	58.44	86.98	69.07	0.69	45.50
Mimar Sinan Fine Arts University	32.20	32.04	28.95	110.15	57.16
Maltepe University	27.88	45.46	48.98	84.53	52.84
Üsküdar University	65.19	71.93	67.55	20.99	31.00
İstanbul Kültür University	64.74	60.27	60.55	48.81	20.13
İstanbul Şehir University	37.74	89.50	61.15	19.13	42.30
Muş Alparslan University	75.35	59.85	50.70	1.18	62.27
Çağ University	35.45	144.92	49.84	11.11	0.10
Ardahan University	62.38	35.12	42.82	36.78	61.55
Ufuk University	37.25	55.79	73.59	5.33	65.72
University of Health Sciences	20.88	12.13	18.45	79.08	100.00
Biruni University	39.30	48.61	38.25	24.46	72.87
MEF University	63.83	43.57	64.59	0.20	43.96
Kırklareli University	57.59	49.67	51.09	6.55	42.40
İbn Haldun University	18.52	6.40	8.84	89.71	87.45
Beykent University	43.47	45.27	45.39	44.81	25.82
İstinye University	55.69	25.32	26.92	0.20	93.90
İstanbul Gelişim University	43.99	48.04	40.66	34.01	35.19
Higher Specialization University	37.07	48.27	28.54	0.20	87.14
Şırnak University	40.27	40.51	29.83	10.94	79.58
SANKO University	33.33	30.26	47.32	2.43	83.08
Social Sciences University of Ankara	19.09	8.10	12.84	61.66	94.45
İstanbul Yeni Yüzyıl University	27.19	39.59	43.46	17.16	60.17
İstanbul Sabahattin Zaim University	24.91	33.33	24.74	77.57	23.51
Fatih Sultan Mehmet Vakıf University	20.69	35.33	21.05	62.74	36.49
Toros University	41.80	48.05	35.57	6.00	44.19
Alanya Alaaddin Keykubat University	54.95	24.93	24.74	11.24	59.66
Alanya Hamdullah Emin University	54.95	24.24	24.74	11.24	59.66
Mardin Artuklu University	29.65	29.18	28.12	26.53	59.32
İstanbul Gedik University	16.14	18.29	23.45	49.82	62.08
Haliç University	9.50	32.68	42.48	68.43	14.51
Bandırma Onyedi Eylül University	46.52	25.04	21.45	18.79	41.48
Avrasya University	26.06	32.31	15.61	14.58	41.71
İstanbul 29 Mayıs University	0.80	1.12	9.25	58.65	55.25
Turkish-German University	8.83	35.37	9.29	17.17	53.96
Nuh Naci Yazgan University	27.92	34.55	33.32	0.20	27.69
Nişantaşı University	15.16	25.43	19.69	3.28	47.00
İstanbul Esenyurt University	15.52	19.74	14.21	0.20	48.74

The CoCoSo method was applied to the Decision Matrix shown in Table 2. The results of the CoCoSo method and the rankings of the universities according to these results are shown in Table 3.

Table 3. - CoCoSo Results

Turkish Universities	k_i	Rank
Hacettepe University	3.7224	1
Middle East Technical University	3.6170	2
İstanbul Technical University	3.5552	3
İstanbul University	3.4337	5
Koç University	3.4850	4
Ankara University	3.4055	6
Boğaziçi University	3.3062	9
Ege University	3.3461	7
İhsan Doğramacı Bilkent University	3.2796	10
Gebze Technical University	3.3111	8
Gazi University	3.2419	11
Yıldız Technical University	3.2002	14
Sabancı University	3.2381	12
İzmir Institute of Technology University	3.1516	16
Atatürk University	3.1663	15
Bezm-i Alem Vakıf University	3.2249	13
Erciyes University	3.0795	17
Marmara University	3.0252	20
Dokuz Eylül University	3.0340	18
Selçuk University	3.0040	21
Çukurova University	2.9974	22
Fırat University	3.0311	19
Karadeniz Technical University	2.9889	24
Eskişehir Osmangazi University	2.9894	23
Akdeniz University	2.9578	26
Abdullah Gül University	2.9745	25
Bursa Uludağ University	2.8622	30
Ondokuz Mayıs University	2.8656	29
İnönü University	2.8697	28
Anadolu University	2.8543	31
Süleyman Demirel University	2.8397	32
Gaziantep University	2.8005	36
İstanbul Medeniyet University	2.8865	27
Sakarya University	2.8031	34
Çankaya University	2.7200	41
Kocaeli University	2.7729	40
Van Yüzüncü Yıl University	2.8152	33
İzmir Katip Çelebi University	2.7854	38
Ankara Yıldırım Beyazıt University	2.7792	39
Başkent University	2.7998	37
Atılım University	2.6612	46

Dicle University	2.7154	42
Manisa Celal Bayar University	2.6839	43
Pamukkale University	2.6834	44
TOBB University of Economics and Technology	2.6821	45
Acıbadem Mehmet Ali Aydınlar University	2.8018	35
Mersin University	2.6537	47
Yeditepe University	2.5910	55
Özyeğin University	2.5955	54
Çanakkale Onsekiz Mart University	2.6355	48
Düzce University	2.6111	49
Tokat Gaziosmanpaşa University	2.5997	53
Muğla Sıtkı Koçman University	2.6055	52
Bolu İzzet Baysal University	2.6083	51
Sivas Cumhuriyet University	2.5707	57
Hitit University	2.6086	50
Recep Tayip Erdoğan University	2.5881	56
Kırıkkale University	2.5392	62
Bursa Technical University	2.5549	58
Necmettin Erbakan University	2.5520	59
Kahramanmaraş Sütçü İmam University	2.5407	61
Tekirdağ Namık Kemal University	2.5508	60
Hatay Mustafa Kemal University	2.5193	63
Niğde Ömer Halisdemir University	2.4976	65
İstanbul Medipol University	2.4955	66
Zonguldak Bülent Ecevit University	2.4861	69
Balıkesir University	2.4856	70
Aydın Adnan Menderes University	2.4939	67
Harran University	2.4927	68
Munzur University	2.5157	64
Erzurum Technical University	2.4845	71
Karabük University	2.3776	83
Sinop University	2.4396	74
Trakya University	2.4274	75
Kütahya Dumlupınar University	2.3575	86
Çankırı Karatekin University	2.4508	73
Aksaray University	2.4071	78
Afyon Kocatepe University	2.3946	81
Adana Alparslan Türkeş Science and Technology University	2.4731	72
Yozgat Bozok University	2.4031	79
Galatasaray University	2.4156	77
Adıyaman University	2.4197	76
Yalova University	2.3932	82
Ordu University	2.3996	80
Bahçeşehir University	2.2887	90
Bingöl University	2.3625	84
Kastamonu University	2.3153	87
Doğuş University	2.2714	93
İskenderun Technical University	2.2956	89
Nevşehir Hacı Bektaşi Veli University	2.2754	92
Kadir Has University	2.2706	94

Yaşar University	2.2265	100
İzmir University of Economics	2.2515	97
Demiroğlu Bilim University	2.3586	85
Kırşehir Ahi Evran University	2.3047	88
Bartın University	2.2480	98
Kafkas University	2.2793	91
Giresun University	2.2681	96
Erzincan Binali Yıldırım University	2.2690	95
Osmaniye Korkut Ata University	2.2292	99
İstanbul Arel University	2.2200	101
Işık University	2.1621	104
Gümüşhane University	2.1979	102
Karamanoğlu Mehmetbey University	2.1751	103
Altınbaş University	2.1309	106
İstanbul Bilgi University	2.0162	117
Türk Hava Kurumu University	2.1072	108
Bilecik Şeyh Edebali University	2.1427	105
Bayburt University	2.0870	110
Batman University	2.0688	111
Bitlis Eren University	2.1202	107
Amasya University	2.0939	109
Piri Reis University	2.0542	114
Burdur Mehmet Akif Ersoy University	2.0687	112
Hasan Kalyoncu University	2.0390	115
Hakkari University	1.9922	120
Siirt University	1.9925	119
Uşak University	2.0253	116
Iğdır University	2.0627	113
KTO Karatay University	1.9289	122
Antalya Bilim University	1.7985	139
Ted University	1.8241	136
İstanbul Okan University	1.9792	121
Artvin Çoruh University	2.0037	118
İstanbul Commerce University	1.8975	126
Ağrı İbrahim Çeçen University	1.8460	130
İstanbul Aydın University	1.9002	125
Konya Food and Agricultural University	1.8623	129
Kilis 7 Aralık University	1.8164	137
Mimar Sinan Fine Arts University	1.9086	124
Maltepe University	1.9168	123
Üsküdar University	1.8409	133
İstanbul Kültür University	1.8079	138
İstanbul Şehir University	1.8409	132
Muş Alparslan University	1.8323	134
Çağ University	1.4597	159
Ardahan University	1.8652	128
Ufuk University	1.8417	131
University of Health Sciences	1.8705	127
Biruni University	1.8310	135
MEF University	1.5748	154

Kırklareli University	1.6710	143
İbn Haldun University	1.5996	149
Beykent University	1.6446	146
İstinye University	1.6233	147
İstanbul Gelişim University	1.6589	145
Higher Specialization University	1.6103	148
Şırnak University	1.7420	140
SANKO University	1.7069	141
Social Sciences University of Ankara	1.7029	142
İstanbul Yeni Yüzyıl University	1.6610	144
İstanbul Sabahattin Zaim University	1.5328	157
Fatih Sultan Mehmet Vakıf University	1.5395	156
Toros University	1.5501	155
Alanya Alaaddin Keykubat University	1.5892	151
Alanya Hamdullah Emin University	1.5863	152
Mardin Artuklu University	1.5991	150
İstanbul Gedik University	1.5766	153
Haliç University	1.4362	160
Bandırma Onyedi Eylül University	1.4647	158
Avrasya University	1.3583	161
İstanbul 29 Mayıs University	1.0104	166
Turkish-German University	1.2962	162
Nuh Naci Yazgan University	1.1710	164
Nişantaşı University	1.2654	163
İstanbul Esenyurt University	1.0858	165

The MARCOS method was applied to the Decision Matrix shown in Table 2. The results of the MARCOS method and the rankings of the universities according to these results are shown in Table 4.

Table 4. - MARCOS Results

Turkish Universities	$f(K_i)$	Rank
Hacettepe University	0.8885	1
Middle East Technical University	0.8544	2
İstanbul Technical University	0.8339	3
İstanbul University	0.7927	5
Koç University	0.8088	4
Ankara University	0.7840	6
Boğaziçi University	0.7509	9
Ege University	0.7629	7
İhsan Doğramacı Bilkent University	0.7427	10
Gebze Technical University	0.7515	8
Gazi University	0.7295	11
Yıldız Technical University	0.7162	14
Sabancı University	0.7279	12
İzmir Institute of Technology University	0.6995	16
Atatürk University	0.7045	15
Bezm-i Alem Vakıf University	0.7260	13

Erciyes University	0.6760	17
Marmara University	0.6591	20
Dokuz Eylül University	0.6609	18
Selçuk University	0.6514	21
Çukurova University	0.6494	22
Fırat University	0.6600	19
Karadeniz Technical University	0.6465	23
Eskişehir Osmangazi University	0.6462	24
Akdeniz University	0.6360	26
Abdullah Gül University	0.6436	25
Bursa Uludağ University	0.6058	30
Ondokuz Mayıs University	0.6064	29
İnönü University	0.6080	28
Anadolu University	0.6036	31
Süleyman Demirel University	0.5983	32
Gaziantep University	0.5858	37
İstanbul Medeniyet University	0.6148	27
Sakarya University	0.5866	35
Çankaya University	0.5681	41
Kocaeli University	0.5769	40
Van Yüzüncü Yıl University	0.5907	34
İzmir Katip Çelebi University	0.5809	38
Ankara Yıldırım Beyazıt University	0.5793	39
Başkent University	0.5864	36
Atılım University	0.5441	46
Dicle University	0.5583	42
Manisa Celal Bayar University	0.5487	43
Pamukkale University	0.5483	44
TOBB University of Economics and Technology	0.5481	45
Acıbadem Mehmet Ali Aydınlar University	0.5909	33
Mersin University	0.5389	47
Yeditepe University	0.5204	55
Özyeğin University	0.5223	53
Çanakkale Onsekiz Mart University	0.5332	48
Düzce University	0.5256	50
Tokat Gaziosmanpaşa University	0.5220	54
Muğla Sıtkı Koçman University	0.5236	52
Bolu İzzet Baysal University	0.5249	51
Sivas Cumhuriyet University	0.5133	57
Hitit University	0.5260	49
Recep Tayip Erdoğan University	0.5196	56
Kırıkkale University	0.5027	63
Bursa Technical University	0.5111	59
Necmettin Erbakan University	0.5069	61
Kahramanmaraş Sütçü İmam University	0.5035	62
Tekirdağ Namık Kemal University	0.5078	60
Hatay Mustafa Kemal University	0.4976	64
Niğde Ömer Halisdemir University	0.4902	66
İstanbul Medipol University	0.4891	67
Zonguldak Bülent Ecevit University	0.4875	71

Balıkesir University	0.4862	72
Aydın Adnan Menderes University	0.4887	69
Harran University	0.4887	68
Munzur University	0.5114	58
Erzurum Technical University	0.4884	70
Karabük University	0.4538	84
Sinop University	0.4837	73
Trakya University	0.4678	77
Kütahya Dumlupınar University	0.4478	86
Çankırı Karatekin University	0.4794	74
Aksaray University	0.4646	79
Afyon Kocatepe University	0.4580	83
Adana Alparslan Türkeş Science and Technology University	0.4913	65
Yozgat Bozok University	0.4725	75
Galatasaray University	0.4674	78
Adıyaman University	0.4703	76
Yalova University	0.4591	82
Ordu University	0.4613	81
Bahçeşehir University	0.4261	90
Bingöl University	0.4518	85
Kastamonu University	0.4342	88
Doğuş University	0.4234	92
İskenderun Technical University	0.4300	89
Nevşehir Hacı Bektaşi Veli University	0.4216	95
Kadir Has University	0.4197	96
Yaşar University	0.4070	100
İzmir University of Economics	0.4179	97
Demiroğlu Bilim University	0.4643	80
Kırşehir Ahi Evran University	0.4385	87
Bartın University	0.4158	98
Kafkas University	0.4239	91
Giresun University	0.4229	94
Erzincan Binali Yıldırım University	0.4230	93
Osmaniye Korkut Ata University	0.4095	99
İstanbul Arel University	0.4053	101
Işık University	0.3881	105
Gümüşhane University	0.4026	102
Karamanoğlu Mehmetbey University	0.3988	104
Altınbaş University	0.3780	109
İstanbul Bilgi University	0.3477	120
Türk Hava Kurumu University	0.3715	111
Bilecik Şeyh Edebali University	0.3847	107
Bayburt University	0.3755	110
Batman University	0.3657	113
Bitlis Eren University	0.3871	106
Amasya University	0.3827	108
Piri Reis University	0.3576	116
Burdur Mehmet Akif Ersoy University	0.3602	115
Hasan Kalyoncu University	0.3511	118
Hakkari University	0.3998	103

Siirt University	0.3526	117
Uşak University	0.3472	121
Iğdır University	0.3705	112
KTO Karatay University	0.3284	126
Antalya Bilim University	0.3323	125
Ted University	0.3417	122
İstanbul Okan University	0.3354	124
Artvin Çoruh University	0.3494	119
İstanbul Commerce University	0.3110	132
Ağrı İbrahim Çeçen University	0.3198	129
İstanbul Aydın University	0.3101	134
Konya Food and Agricultural University	0.3653	114
Kilis 7 Aralık University	0.3129	131
Mimar Sinan Fine Arts University	0.3261	127
Maltepe University	0.3211	128
Üsküdar University	0.2954	140
İstanbul Kültür University	0.2832	145
İstanbul Şehir University	0.2986	139
Muş Alparslan University	0.3174	130
Çağ University	0.2467	149
Ardahan University	0.3068	135
Ufuk University	0.3101	133
University of Health Sciences	0.3363	123
Biruni University	0.3014	137
MEF University	0.2666	146
Kırklareli University	0.2553	147
İbn Haldun University	0.3039	136
Beykent University	0.2373	153
İstinye University	0.2994	138
İstanbul Gelişim University	0.2429	150
Higher Specialization University	0.2914	142
Şırnak University	0.2845	143
SANKO University	0.2840	144
Social Sciences University of Ankara	0.2951	141
İstanbul Yeni Yüzyıl University	0.2525	148
İstanbul Sabahattin Zaim University	0.2139	158
Fatih Sultan Mehmet Vakıf University	0.2180	157
Toros University	0.2238	156
Alanya Alaaddin Keykubat University	0.2390	151
Alanya Hamdullah Emin University	0.2383	152
Mardin Artuklu University	0.2363	155
İstanbul Gedik University	0.2365	154
Haliç University	0.1889	160
Bandırma Onyedi Eylül University	0.1985	159
Avrasya University	0.1745	163
İstanbul 29 Mayıs University	0.1839	161
Turkish-German University	0.1803	162
Nuh Naci Yazgan University	0.1546	165
Nişantaşı University	0.1596	164
İstanbul Esenyurt University	0.1486	166

5. CONCLUSION

It has been observed that there is a great similarity in both the ranking results in the report of the URAP and the ranking results made with the methods used in the study. According to the results of the proposed methods, Hacettepe University, Middle East Technical University, and Istanbul Technical University took the first three places. It is thought that this study will contribute to the literature since CoCoSo and MARCOS methods have been used in a few studies in the literature. In addition, this study is expected to provide informational benefits to university administrations, lecturers, and students on the basis of seeing the performance of universities.

References

Barua, A., Jeet, S., Bagal, D. K., Satapathy, P. & Agrawal, P. K. (2019). 'Evaluation of Mechanical Behavior of Hybrid Natural Fiber Reinforced Nano SiC Particles Composite Using Hybrid Taguchi-COCOSO Method', *International Journal of Innovative Technology and Exploring Engineering*, 8(10), pp. 3341-3345.

https://newtr.urapcenter.org/Rankings/2019-2020 (Accessed: 10 September 2020).

Peng, X., Zhang, X. & Luo, Z. (2019). 'Pythagorean fuzzy MCDM method based on CoCoSo and CRITIC with score function for 5G industry evaluation', *Artificial Intelligence Review*, 53, pp. 3813-3847.

Puška, A., Stojanović, I., Maksimović, A. & Osmanović, N. (2020). 'Evaluation software of project management used measurement of alternatives and ranking according to compromise solution (MARCOS) method', *Operational Research in Engineering Sciences: Theory and Applications*, 3(1), pp. 89-102.

Stanković, M., Stević, Ž., Das, D. K., Subotić, M. & Pamučar, D. (2020). 'A new fuzzy MARCOS method for road traffic risk analysis', *Mathematics*, 8(3), 457.

Stević, Ž. & Brković, N. (2020). 'A Novel Integrated FUCOM-MARCOS Model for Evaluation of Human Resources in a Transport Company', *Logistics*, 4(1), 4.

Stević, Ž., Pamučar, D., Puška, A. & Chatterjee, P. (2020). 'Sustainable supplier selection in healthcare industries using a new MCDM method: Measurement of alternatives and ranking according to COmpromise solution (MARCOS)', *Computers & Industrial Engineering*, 140, 106231.

Ulutaş, A., Karabasevic, D., Popovic, G., Stanujkic, D., Nguyen, P. T. & Karaköy, Ç. (2020). 'Development of a Novel Integrated CCSD-ITARA-MARCOS Decision-Making Approach for Stackers Selection in a Logistics System', *Mathematics*, 8(10), 1672.

Ulutaş, A., Karakuş, C. B. & Topal, A. (2020). 'Location selection for logistics center with fuzzy SWARA and cocoso methods', *Journal of Intelligent & Fuzzy Systems*, 38(4), pp. 4693-4709.

Yazdani, M., Zarate, P., Zavadskas, E. K. & Turskis, Z. (2019a). 'A combined compromise solution (CoCoSo) method for multi-criteria decision-making problems', *Management Decision*, 57(9), pp. 2501-2519.

Yazdani, M., Wen, Z., Liao, H., Banaitis, A. & Turskis, Z. (2019b). 'A grey combined compromise solution (CoCoSo-G) method for supplier selection in construction management', *Journal of Civil Engineering and Management*, 25(8), pp. 858-874.

Zolfani, S. H., Chatterjee, P., & Yazdani, M. (2019, May). A structured framework for sustainable supplier selection using a combined BWM-CoCoSo model. In *International scientific conference in business, management and economics engineering. Vilnius, Lithuania* (pp. 797-804).