

Investigation of the Turkish university rankings using InterCriteria Analysis

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Abstract: In the current investigation Turkish university rankings are analyzed. The dataset for overall ranking of universities for 2021-2022 is used. The information is downloaded from the University Ranking by Academic Performance website. Dependencies and independencies between Turkish universities are analyzed. The relationship between university rankings indicators are investigated.

Keywords: InterCriteria Analysis, Index matrix, Intuitionistic fuzzy sets, University rankings.

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1 Introduction to InterCriteria Analysis

InterCriteria Analysis is a decision making method based on the two fundamental concepts: intuitionistic fuzzy sets [2, 5] and index matrices [1]. Intuitionistic fuzzy set are introduced in



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1983 by Krassimir Atanassov as an extension of fuzzy sets. The intuitionistic fuzzy pairs are calculated on the base of the comparison of different values for criteria and objects. Index matrices are used as a tool for representing the values and degrees of dependencies and independencies between the criteria and objects. ICA determines the correlations by pairwise comparison to achieve possible relationships between different objects or criteria [3, 6]. Different extensions of ICA are developed in the years [4, 7, 8, 13]. ICA is successfully applied to analyze different correlations and opposite behaviors between the objects/criteria of the datasets in the area of genetic algorithms, medicine, crude oils, university rankings of different countries and etc., [9, 12].

2 InterCriteria Analysis applied to Turkish university rankings

The dataset for Turkish university ranking for 2021-2022 is downloaded from the University Ranking by Academic Performance website. The methodology of indicators selection is described in the Methodology section of the website. The input dataset contains information for 179 Turkish universities estimated by 5 indicators: paper score, total citation score, total scientific document score, number of graduated doctoral students and scientist/student score. The universities are numbered from C001 to C179 [14].

2.1 Application of ICA to Turkish University Rankings for identification the relationships between the indicators

Firstly, ICA is applied to investigate the relationships between the indicators. The analysis is performed using IcrADa software [11]. The investigation is a continuation of the applications of the ICA for years 2019-2020 and 2020-2021 [10]. The result of ICA application for 2021-2022 are presented in Table 1.

Table 1. Results of ICA application for the indicators correlations estimation

$\langle \mu, \nu \rangle$	paper score	total citation score	total scientific document score	number of graduated doctoral students	scientist/student score
paper score	$\langle 1.00, 0.00 \rangle$	$\langle 0.86, 0.14 \rangle$	$\langle 0.85, 0.15 \rangle$	$\langle 0.71, 0.28 \rangle$	$\langle 0.49, 0.51 \rangle$
total citation score	$\langle 0.86, 0.14 \rangle$	$\langle 1.00, 0.00 \rangle$	$\langle 0.87, 0.13 \rangle$	$\langle 0.71, 0.29 \rangle$	$\langle 0.48, 0.52 \rangle$
total scientific document score	$\langle 0.85, 0.15 \rangle$	$\langle 0.87, 0.13 \rangle$	$\langle 1.00, 0.00 \rangle$	$\langle 0.73, 0.26 \rangle$	$\langle 0.47, 0.53 \rangle$
number of graduated doctoral students	$\langle 0.71, 0.28 \rangle$	$\langle 0.71, 0.29 \rangle$	$\langle 0.73, 0.26 \rangle$	$\langle 1.00, 0.00 \rangle$	$\langle 0.44, 0.55 \rangle$
scientisc/student score	$\langle 0.49, 0.51 \rangle$	$\langle 0.48, 0.52 \rangle$	$\langle 0.47, 0.53 \rangle$	$\langle 0.44, 0.55 \rangle$	$\langle 1.00, 0.00 \rangle$

Description of the pairs of indicators is presented in Table 2. ICA determines 3 pairs of indicators in positive consonance, 3 pairs of indicators in weak dissonance and 4 pairs of

indicators in strong dissonance. The pairs of indicators in the area of dissonance are independent. The pairs of indicators in positive consonance have weak dependencies.

The received results are presented in the intuitionistic fuzzy triangle (Figure 1). They are compared with the results from previous investigation, published in [10]. The behavior of the indicators is constant in time with small exceptions. The pairs of indicators “*Total scientific document score – Number of graduated doctoral students*” varies from 1 year in weak dissonance to 3 years in weak positive consonance. Thereafter, despite of the indicators in the area of positive consonance, the selected indicators of Turkish university rankings are correct. They are constant in time. The weak variation is observed only in single event. The indicators that are in dissonance field are constant in time.

Table 2. Pairs of indicators

Type of correlations	Pairs of indicators	Number of pairs of criteria
positive consonance [0,85; 0,95)	Paper score – Total citation score, Paper score – Total scientific document score, Total citation score – Total scientific document score	3
weak dissonance [0,67; 0,75)	Paper score – Number of graduated doctoral students, Total citation score – Number of graduated doctoral students, Total scientific document score – Number of graduated doctoral students	3
strong dissonance [0,43; 0,57)	Paper score – Scientist/Student score, Total citation score – Scientist/Student score, Total scientific document score – Scientist/Student score, Number of graduated doctoral students – Scientist/Student score	4

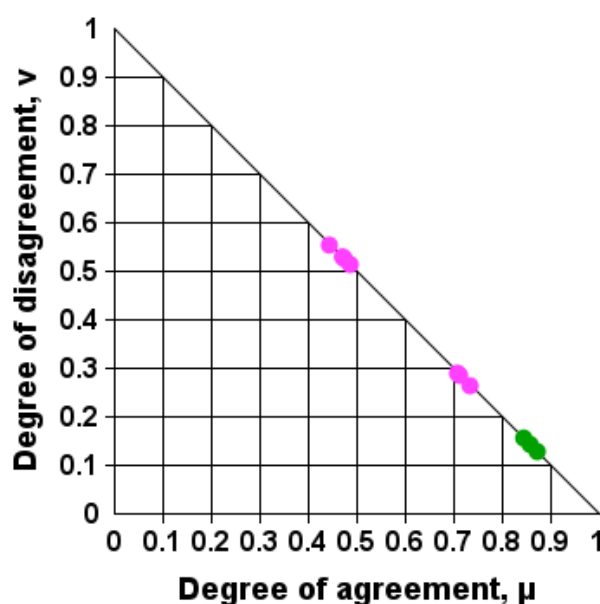


Figure 1. Pairs of indicators represented in the intuitionistic fuzzy triangle

2.2 Application of ICA to Turkish university rankings for identification the relationships between the universities

The ICA is applied to identify the relationships between the 179 universities. The distribution of the pairs of the universities according to their dependencies or independencies is written in Table 3. The received outcomes from ICA application are the following: 736 pairs of universities in strong positive consonance, 1802 pairs of universities in positive consonance, 2425 pairs of universities in weak positive consonance, 3732 pairs of universities in weak dissonance, 4197 pairs of universities in dissonance, 2050 pairs of universities in strong dissonance, 636 pairs of universities in weak negative consonance, 323 pairs of universities in negative consonance and 119 pairs of universities in strong negative consonance.

Table 3. Pairs of universities

Type of correlations	Number of pairs of universities
strong positive consonance [0,95; 1,00]	736
positive consonance [0,85; 0,95)	1802
weak positive consonance [0,75; 0,85)	2425
weak dissonance [0,67; 0,75)	2600
dissonance [0,57; 0,67)	2521
strong dissonance [0,43; 0,57)	2050
dissonance [0,33; 0,43)	1676
weak dissonance [0,25; 0,33)	1132
weak negative consonance [0,15;0,25)	636
negative consonance [0,05;0,15)	323
strong negative consonance [0,00;0,05)	119

The pairs of universities of strong positive consonance $\langle 1.00, 0.00 \rangle$ have very strong relationships while the pairs of universities in strong negative consonance $\langle 0.00, 1.00 \rangle$ have very strong opposite properties. The universities in strong positive consonance are the following:

- ICA application determines strong correlation between the following universities: Hacettepe Üniversitesi (Ankara), İstanbul Üniversitesi (İstanbul), Gazi Üniversitesi (Ankara), Ege Üniversitesi (İzmir), İstanbul Üniversitesi-Cerrahpaşa (İstanbul), Marmara Üniversitesi (İstanbul), Selçuk Üniversitesi (Konya), Bursa Uludağ Üniversitesi (Bursa), İnönü Üniversitesi (Malatya), Necmettin Erbakan Üniversitesi (Konya), Yeditepe Üniversitesi (İstanbul), İstanbul Ticaret Üniversitesi (İstanbul). Obviously, there are 5 universities in İstanbul, 2 universities in Konya, 2 universities in Ankara, 1 university in İzmir, 1 university in Bursa and 1 university in Malatya. These universities have similar tendencies in education according to the 2021-2022 Turkish university rankings.
- The universities Orta Doğu Teknik Üniversitesi (Ankara), İstanbul Teknik Üniversitesi (İstanbul), Ondokuz Mayıs Üniversitesi (Samsun), Beykent Üniversitesi (İstanbul) have

strong dependencies in education procedures. Their location is Istanbul, Ankara and Samsun.

- The universities Ankara Üniversitesi (Ankara), Ankara Yıldırım Beyazıt Üniversitesi (Ankara) are dependent. The two universities are in Ankara and they have strong correlations each other.
- The group of universities Sabancı Üniversitesi (Istanbul), Boğaziçi Üniversitesi (Istanbul), İzmir Yüksek Teknoloji Enstitüsü (İzmir), Akdeniz Üniversitesi (Antalya), Kocaeli Üniversitesi (Kocaeli), Gaziantep Üniversitesi (Gaziantep), Tobb Ekonomi Ve Teknoloji Üniversitesi (Ankara), İstanbul Medipol Üniversitesi (Istanbul), Hatay Mustafa Kemal Üniversitesi (Hatay), Kafkas Üniversitesi (Kars), İstanbul Bilgi Üniversitesi (Istanbul), Altınbaş Üniversitesi (Istanbul), Işık Üniversitesi (Istanbul) have similar education tendencies. These universities are dependent.
- The universities İhsan Doğramacı Bilkent Üniversitesi (Ankara), Van Yüzüncü Yıl Üniversitesi (Van), Pamukkale Üniversitesi (Denizli), Manisa Celâl Bayar Üniversitesi (Manisa), İstanbul Medeniyet Üniversitesi (Istanbul), Kirikkale Üniversitesi (Kirikkale), Hitit Üniversitesi (Çorum), Recep Tayyip Erdoğan Üniversitesi (Rize), Tokat Gaziosmanpaşa Üniversitesi (Tocat), Bingöl Üniversitesi (Bingöl), Afyon Kocatepe Üniversitesi (Afyon), Zonguldak Bülent Ecevit Üniversitesi (Zonguldak), Kütahya Dumlupınar Üniversitesi (Kütahya), Çağ Üniversitesi (Mersin), Doğuş Üniversitesi (Istanbul) and İstanbul Kültür Üniversitesi (Istanbul) are also dependent. There are close relationships each other.
- Dependencies are also found between the universities Gebze Teknik Üniversitesi (Kocaeli), Atilim Üniversitesi (Ankara), Kastamonu Üniversitesi (Kastamonu), Uşak Üniversitesi (Uşak).
- Dokuz Eylül Üniversitesi (İzmir), Süleyman Demirel Üniversitesi (Isparta), Anadolu Üniversitesi (Eskişehir), Sakarya Üniversitesi (Sakarya), Hasan Kalyoncu Üniversitesi (Gaziantep), Erciyes Üniversitesi (Kayseri) are group of universities with similar behavior in the education processes.
- Çukurova Üniversitesi (Adana) and Aydın Adnan Menderes Üniversitesi (Aydın) are two universities with strong correlation between their education activities.
- Karadeniz Teknik Üniversitesi (Trabzon), Eskişehir Osmangazi Üniversitesi (Eskişehir), Tekirdağ Namık Kemal Üniversitesi (Tekirdağ), Burdur Mehmet Akif Ersoy Üniversitesi (Burdur) are universities with close relationships.
- The group of universities Fırat Üniversitesi (Elazığ), Çankaya Üniversitesi (Ankara), Abdullah Gül Üniversitesi (Kayseri), Sivas Cumhuriyet Üniversitesi (Sivas), Düzce Üniversitesi (Düzce), Bolu Abant İzzet Baysal Üniversitesi (Bolu), Harran Üniversitesi (Şanlıurfa), Niğde Ömer Halisdemir Üniversitesi (Niğde), Çanakkale Onsekiz Mart Üniversitesi (Çanakkale), Balıkesir Üniversitesi (Balıkesir), Bursa Teknik Üniversitesi (Bursa), İskenderun Teknik Üniversitesi (İskenderun), Yaşar Üniversitesi (İzmir), Çankiri Karatekin Üniversitesi (Çankiri), Nevşehir Hacı Bektaş Veli Üniversitesi (Nevşehir), İstanbul Gelişim Üniversitesi (Istanbul) have similar tendencies in the education processes.

- Universities Bezm-İ Âlem Vakıf Üniversitesi (İstanbul), Erzincan Binali Yıldırım Üniversitesi (Erzincan), Ordu Üniversitesi (Ordu), Adıyaman Üniversitesi (Adıyaman), Giresun Üniversitesi (Giresun) are dependent according to their education processes.
- The universities Acıbadem Mehmet Ali Aydınlar Üniversitesi (İstanbul) And Piri Reis Üniversitesi (İstanbul) have strong relationships between their education activities.
- İzmir Katip Çelebi Üniversitesi (İzmir), Özyeğin Üniversitesi (İstanbul), Bahçeşehir Üniversitesi (İstanbul), Kadir Has Üniversitesi (İstanbul) are dependent.
- Sağlık Bilimleri Üniversitesi (İstanbul) And Kırıkkale Üniversitesi (Kırıkkale) have similar education processes.
- The universities Mersin Üniversitesi (Mersin), Muğla Sıtkı Koçman Üniversitesi (Muğla), Dicle Üniversitesi (Şanlıurfa), Kahramanmaraş Sütçü İmam Üniversitesi (Kahramanmaraş), Trakya Üniversitesi (Trakya), İstanbul Aydın Üniversitesi (İstanbul), Başkent Üniversitesi (Ankara) are similar and dependent.
- The behavior of the universities Gebze Teknik Üniversitesi (Kocaeli), Atilim Üniversitesi (Ankara), Kastamonu Üniversitesi (Kastamonu) And Uşak Üniversitesi (Uşak) is similar according to the education processes.
- Karabük Üniversitesi (Karabük) and Yalova Üniversitesi (Yalova) are dependent.
- The group Adana Alparslan Türkeş Bilim Ve Teknoloji Üniversitesi (Adana), Yozgat Bozok Üniversitesi (Yozgat), Aksaray Üniversitesi (Aksaray), Munzur Üniversitesi (Tunceli), Karamanoğlu Mehmetbey Üniversitesi (Karaman), Erzurum Teknik Üniversitesi (Erzurum), Kirşehir Ahi Evran Üniversitesi (Kirşehir), Siirt Üniversitesi (Siirt), Gümüşhane Üniversitesi (Gümüşhane), Iğdır Üniversitesi (Iğdır), Bayburt Üniversitesi (Bayburt), Osmaniye Korkut Ata Üniversitesi (Osmaniye), Türk Hava Kurumu Üniversitesi (Ankara), Batman Üniversitesi (Batman), Ağrı İbrahim Çeçen Üniversitesi (Ağrı), Antalya Bilim Üniversitesi (Antalya), Kilis 7 Aralık Üniversitesi (Kilis) represents strong relationships between universities.
- Universities Gebze Teknik Üniversitesi (Kocaeli), Atilim Üniversitesi (Ankara), Kastamonu Üniversitesi (Kastamonu), Uşak Üniversitesi (Uşak) have similar tendencies in the education.
- The next group of universities with similar behavior is Atatürk Üniversitesi (Erzurum), İstanbul Arel Üniversitesi (İstanbul), İstanbul Okan Üniversitesi (İstanbul), İstanbul Sabahattin Zaim Üniversitesi (İstanbul).
- The universities Bartın Üniversitesi (Bartın), Ardahan Üniversitesi (Ardahan), Bilecik Şeyh Edebali Üniversitesi (Bilecik), Muş Alparslan Üniversitesi (Muş), Ted Üniversitesi (Ankara), Kırklareli Üniversitesi (Kırklareli) are also similar.
- The following universities are also with similar education processes: Sinop Üniversitesi (Sinop), İzmir Ekonomi Üniversitesi (İzmir), Bitlis Eren Üniversitesi (Bitlis), Kto Karatay Üniversitesi (Konya).
- The group: Karadeniz Teknik Üniversitesi (Trabzon), Eskişehir Osmangazi Üniversitesi (Eskişehir), Tekirdağ Namık Kemal Üniversitesi (Tekirdağ), Burdur Mehmet Akif Ersoy Üniversitesi (Burdur) contains universities with strong correlation in their functioning.

- The İzmir Katip Çelebi Üniversitesi (İzmir), Özyeğin Üniversitesi (İstanbul), Bahçeşehir Üniversitesi (İstanbul), Kadir Has Üniversitesi (İstanbul) are correlated according their education indicators.
- The next part of correlated universities is Üsküdar Üniversitesi (İstanbul), Yüksek İhtisas Üniversitesi (Ankara), Toros Üniversitesi (Mersin).
- The pair of universities Demiroğlu Bilim Üniversitesi (İstanbul) and Artvin Çoruh Üniversitesi have strong relationships.
- Other universities with dependent education processes are Dokuz Eylül Üniversitesi (İzmir), Erciyes Üniversitesi (Kayseri), Süleyman Demirel Üniversitesi (İsparta), Anadolu Üniversitesi (Eskişehir), Sakarya Üniversitesi (Sakarya), Hasan Kalyoncu Üniversitesi (Gaziantep).
- Amasya Üniversitesi (Amasya), İstinye Üniversitesi (İstinye), Mef Üniversitesi (İstanbul) are also similar universities.
- Muş Alparslan Üniversitesi (Muş), Ted Üniversitesi (Ankara), Türk-Alman Üniversitesi (İstanbul), Kırklareli Üniversitesi (Kırklareli) are dependent.
- The following pairs are also correlated: Yüksek İhtisas Üniversitesi (Ankara) - Toros Üniversitesi (Mersin), Hakkari Üniversitesi (Hakkari) - Alanya Hamdullah Emin Paşa Üniversitesi (Alanya), İstinye Üniversitesi (İstanbul) - Mef Üniversitesi (İstanbul), İbn Haldun Üniversitesi (İstanbul) - Toros Üniversitesi (Mersin), Türk-Alman Üniversitesi (İstanbul) - Kırklareli Üniversitesi (Kırklareli), Sanko Üniversitesi (Gaziantep) - Kütahya Sağlık Bilimleri Üniversitesi (Kütahya), İstanbul Yeni Yüzyıl Üniversitesi (İstanbul) - İstanbul Esenyurt Üniversitesi (İstanbul), Alanya Alaaddin Keykubat Üniversitesi (Alanya) - Afyonkarahisar Sağlık Bilimleri Üniversitesi (Afyon), Afyonkarahisar Sağlık Bilimleri Üniversitesi (Afyon) - Alanya Hamdullah Emin Paşa Üniversitesi (Alanya), Bandırma Onyedil Eylül Üniversitesi (Balıkesir) - Mardin Artuklu Üniversitesi (Mardin), Samsun Üniversitesi (Samsun) - Beykoz Üniversitesi (İstanbul), Doğu Üniversitesi (İstanbul) - İstanbul Kültür Üniversitesi (İstanbul), Maltepe Üniversitesi (İstanbul) - Ankara Hacı Bayram Veli Üniversitesi (Ankara), Bitlis Eren Üniversitesi (İstanbul) - Kto Karatay Üniversitesi (Konya), Altınbaş Üniversitesi (İstanbul) - Işık Üniversitesi.
- The triple of universities İstanbul Rumeli Üniversitesi (İstanbul), Samsun Üniversitesi (Samsun) and Beykoz Üniversitesi (İstanbul) have similar relationships.

Obviously, there are group of universities that have more strong relationships each other. These universities have similar education processes. On the other hand, there are universities that are have not close relationships. For example, the universities Hacettepe Üniversitesi (Ankara) - Orta Doğu Teknik Üniversitesi (Ankara) are in the same positions in the ranking, but they have different education tendencies. The universities in strong positive consonance have strong correlations each other. These universities have similar functioning.

The universities in strong negative consonance have the following form:

- The universities Hacettepe Üniversitesi (Ankara), Hakkari Üniversitesi (Hakkari), Alanya Hamdullah Emin Paşa Üniversitesi (Alanya) have opposite behavior. The universities İstanbul Üniversitesi (İstanbul), Hakkari Üniversitesi (Hakkari), Alanya Hamdullah Emin Paşa Üniversitesi (Alanya) are independent. Ege Üniversitesi (İzmir), Hakkari Üniversitesi

(Hakkari), Alanya Hamdullah Emin Paşa Üniversitesi (Alanya) have opposite education processes. İstanbul Üniversitesi-Cerrahpaşa (İstanbul), Hakkari Üniversitesi (Hakkari), Alanya Hamdullah Emin Paşa Üniversitesi (Alanya) are independent. Marmara Üniversitesi (İstanbul), Hakkari Üniversitesi (Hakkari), Alanya Hamdullah Emin Paşa Üniversitesi (Alanya) are not correlated. Selçuk Üniversitesi (Konya), Hakkari Üniversitesi (Hakkari), Alanya Hamdullah Emin Paşa Üniversitesi (Alanya) have opposite education processes. İnönü Üniversitesi (Malatya), Hakkari Üniversitesi (Hakkari), Alanya Hamdullah Emin Paşa Üniversitesi (Alanya) are independent. Bursa Uludağ Üniversitesi (Bursa), Hakkari Üniversitesi (Hakkari), Alanya Hamdullah Emin Paşa Üniversitesi (Alanya) have opposite behavior. Necmettin Erbakan Üniversitesi (Konya), Hakkari Üniversitesi (Hakkari), Alanya Hamdullah Emin Paşa Üniversitesi (Alanya) have not dependencies. Yeditepe Üniversitesi (İstanbul), Hakkari Üniversitesi (Hakkari), Alanya Hamdullah Emin Paşa Üniversitesi (Alanya) have opposite characteristics. The universities Yeditepe Üniversitesi (İstanbul), Necmettin Erbakan Üniversitesi (Konya), Bursa Uludağ Üniversitesi (Bursa), Selçuk Üniversitesi (Konya), Marmara Üniversitesi (İstanbul), İstanbul Üniversitesi-Cerrahpaşa (İstanbul), Hacettepe Üniversitesi (Ankara), Ege Üniversitesi (İzmir) and İstanbul Üniversitesi (İstanbul), İnönü Üniversitesi (Malatya) are correlated but have not dependencies with the presented universities.

- Other group of universities with opposite characteristics is: Ankara Üniversitesi (Ankara), İstanbul Rumeli Üniversitesi (İstanbul), Samsun Üniversitesi (Samsun), Beykoz Üniversitesi (İstanbul).
- The next set of independent universities is: Gazi Üniversitesi (Ankara), Hakkari Üniversitesi (Hakkari), Afyonkarahisar Sağlık Bilimleri Üniversitesi (Afyon), Alanya Hamdullah Emin Paşa Üniversitesi (Alanya).
- İstanbul 29 Mayıs Üniversitesi (İstanbul) has different education activities according to the universities: Kırklareli Üniversitesi (Kırklareli), Türk-Alman Üniversitesi (İstanbul), Kilis 7 Aralık Üniversitesi (Kilis), Ted Üniversitesi (Ankara), Antalya Bilim Üniversitesi (Antalya), Muş Alparslan Üniversitesi (Muş), Ağrı İbrahim Çeçen Üniversitesi (Ağrı), Batman Üniversitesi (Batman), Türk Hava Kurumu Üniversitesi (Ankara), Osmaniye Korkut Ata Üniversitesi (Osmaniye), Bayburt Üniversitesi (Bayburt), Bilecik Şeyh Edebali Üniversitesi (Bilecik), Iğdır Üniversitesi (Iğdır), Gümüşhane Üniversitesi (Gümüşhane), Ardahan Üniversitesi (Ardahan), Siirt Üniversitesi (Siirt), Kırşehir Ahi Evran Üniversitesi (Kırşehir), Erzurum Teknik Üniversitesi (Erzurum), Bartın Üniversitesi (Bartın), Karamanoğlu Mehmetbey Üniversitesi (Karaman), Munzur Üniversitesi (Tunceli), Aksaray Üniversitesi (Aksaray), Yozgat Bozok Üniversitesi (Yozgat) and Adana Alparslan Türkeş Bilim Ve Teknoloji Üniversitesi (Adana).
- Ankara Sosyal Bilimler Üniversitesi (Ankara) has opposite education procedures according to the following universities: Boğaziçi Üniversitesi (İstanbul) Işık Üniversitesi (İstanbul), Altınbaş Üniversitesi (İstanbul), İstanbul Bilgi Üniversitesi (İstanbul), Kafkas Üniversitesi (Kars), Hatay Mustafa Kemal Üniversitesi (Hatay), İstanbul Medipol Üniversitesi (İstanbul), Tobb Ekonomi Ve Teknoloji Üniversitesi (Ankara), Gaziantep Üniversitesi (Gaziantep), Kocaeli Üniversitesi (Kocaeli), Akdeniz Üniversitesi (Antalya), İzmir Yüksek Teknoloji Enstitüsü (İzmir) and Sabancı Üniversitesi (İstanbul).

- Trabzon Üniversitesi (Trabzon) has opposite characteristics according to the universities: Giresun Üniversitesi (Giresun), Adıyaman Üniversitesi (Adıyaman), Ordu Üniversitesi (Ordu) and Erzincan Binali Yildirim Üniversitesi (Erzincan).
- Sanko Üniversitesi (Gaziantep) and Kütahya Sağlık Bilimleri Üniversitesi (Kütahya) are different according to the education processes in Sakarya Üniversitesi (Sakarya), Anadolu Üniversitesi (Eskişehir), Süleyman Demirel Üniversitesi (Isparta), Erciyes Üniversitesi (Kayseri), Hasan Kalyoncu Üniversitesi (Gaziantep) and Dokuz Eylül Üniversitesi (İzmir).
- The group of universities Ankara Yıldırım Beyazıt Üniversitesi (Ankara), İstanbul Rumeli Üniversitesi (İstanbul), Samsun Üniversitesi (Samsun) and Beykoz Üniversitesi (İstanbul) have difference in education.
- The universities Piri Reis Üniversitesi (İstanbul), Maltepe Üniversitesi (İstanbul), İbn Haldun Üniversitesi (İstanbul) and Ankara Hacı Bayram Veli Üniversitesi (Ankara) are different.
- The triples of universities with opposite behavior are: “İstanbul Ticaret Üniversitesi (İstanbul), Afyonkarahisar Sağlık Bilimleri Üniversitesi (Afyon), Alanya Hamdullah Emin Paşa Üniversitesi (Alanya)”, “Acıbadem Mehmet Ali Aydınlar Üniversitesi (İstanbul), İbn Haldun Üniversitesi (İstanbul), Ankara Hacı Bayram Veli Üniversitesi (Ankara)” and “Yıldız Teknik Üniversitesi (İstanbul), Recep Tayyip Erdoğan Üniversitesi (Rize) and İstanbul Esenyurt Üniversitesi (İstanbul)”.
- The pairs of universities with differences in educational management are Orta Doğu Teknik Üniversitesi (Ankara) - Avrasya Üniversitesi (Trabzon), İstanbul Teknik Üniversitesi (İstanbul) - Avrasya Üniversitesi (Trabzon), Çukurova Üniversitesi (Adana) - Malatya Turgut Özal Üniversitesi (Malatya), Ondokuz Mayıs Üniversitesi (Samsun) - Avrasya Üniversitesi (Trabzon), Bezm-i Âlem Vakıf Üniversitesi (İstanbul) - Trabzon Üniversitesi (İstanbul), Atatürk Üniversitesi (Erzurum) - Şırnak Üniversitesi (Şırnak), Aydın Adnan Menderes Üniversitesi (Aydın) - Malatya Turgut Özal Üniversitesi (Malatya), İstanbul Arel Üniversitesi (İstanbul) - Şırnak Üniversitesi (Şırnak), Galatasaray Üniversitesi (İstanbul) - Nuh Naci Yazgan Üniversitesi (Kayseri), Demiroğlu Bilim Üniversitesi (İstanbul) - İstanbul Gedik Üniversitesi (İstanbul), Mimar Sinan Güzel Sanatlar Üniversitesi (İstanbul) - Kilis 7 Aralık Üniversitesi (Kilis), İstanbul Okan Üniversitesi (İstanbul) - Şırnak Üniversitesi (Şırnak), Artvin Çoruh Üniversitesi (Artvin) - İstanbul Gedik Üniversitesi (İstanbul), Hakkari Üniversitesi (Hakkari) - İstanbul Ticaret Üniversitesi (İstanbul), Beykent Üniversitesi (İstanbul) - Avrasya Üniversitesi (Trabzon), İstanbul Sabahattin Zaim Üniversitesi (İstanbul) - Şırnak Üniversitesi (Şırnak), Alanya Alaaddin Keykubat Üniversitesi (Antalya) - Fatih Sultan Mehmet Vakıf Üniversitesi (İstanbul).

The universities in strong negative consonance have different functioning. These universities work differently to achieve their goals. The universities have opposite characteristics in their educational procedures. The universities in strong negative consonance have strong opposite relations between them.

Obviously, the received pairs of universities in strong positive consonance have strong dependencies each other. These universities have very close relationships. The pairs of universities in weak positive consonance and positive consonance have weak similarities. These universities have similar functionalities with small differences. The pairs of universities in

dissonance, weak dissonance and strong dissonance are independent. These universities have not relationships. The pairs of universities strong negative consonance have strong opposite behavior. The pairs of universities in weak negative consonance and negative consonance have opposite properties. The results are presented into the intuitionistic fuzzy triangle (Figure 2).

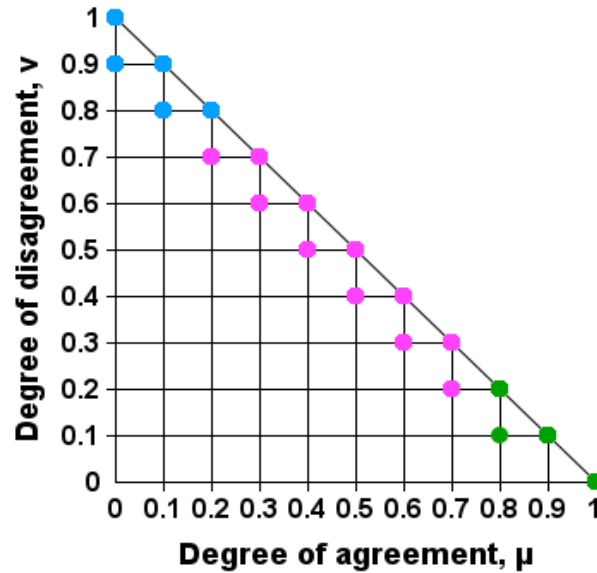


Figure 2. Pairs of universities represented in the intuitionistic fuzzy triangle

3 Conclusion

In the presented investigation the Turkish University Rankings are analyzed. ICA analysis is applied to the datasets for the year 2021-2022. The correlations between the pairs of indicators and pairs of universities are determined. The universities are segmented in different areas of similarities and differences. The pairs of indicators are mainly independent excluding 3 pairs of indicators in positive consonance. The received outcomes present good choice for the most indicators. The university segmentation according their similarities is made. In the future research work the tendency of university distribution in the time will be observed.

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