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Methodology for Comparative Analysis of University Rankings, with the Mediterranean and Black Sea Region Countries Taken as an Example

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Abstract: The article develops quantitative methodology of comparative analysis of global university rankings for the Mediterranean and Black Sea region. In its frameworks three analytical procedures are proposed. They are used to build university and country matrices showing entries of universities ranked TOP-N by the selected ranking into TOP-Ñ in some or all global university rankings as well as to calculate proximity of the number of entries of universities ranked TOP-N by the selected ranking into TOP-Ñ of all global university rankings to maximum possible number of entries that equals N. Matrices built on the basis of the first analytical procedure show academic superiority of Italian, Spanish and French universities of the region in question, with 6 Italian, 5 Spanish and 2 French universities found in all eight world university rankings. Country matrix built on the basis of the second analytical procedure identifies three clusters of countries: those that have high (Italy, Spain, France), middle (Israel, Greece, Turkey, Russia) and low (Slovenia, Croatia, Egypt, Serbia, Lebanon) level of university entries into world university rankings. The rest 17 countries do not have universities that are among TOP-500 in at least one world university ranking. The third analytical procedure is used to calculate indicator showing proximity of the number of entries of universities ranked TOP-20 by Webometrics ranking into TOP-500 of eight world university rankings to maximum possible number of entries that equals 20. This indicator correlates well with the total number of entries of universities ranked TOP-20 by Webometrics ranking into TOP-500 of world university rankings (TOTAL), which was calculated on the basis of the second analytical procedure.

Key words: Comparative analysis · Global university ranking · The Mediterranean and Black Sea region · Times Higher Education Ranking · THES-QS Ranking · ARWU Ranking · HEEACT Ranking · Leiden Ranking · URAP Ranking · SCImago Institution Ranking · Webometrics Ranking

INTRODUCTION

Nowadays there are a lot of different methodologies for university rankings. Empirical base for them is hard data, survey data, self-reports and request responses of the Internet search engines.

Methodological basis of these rankings is formed by different methods for selecting certain indicators, their normalization, weighing and aggregating.

Nowadays there are eight global university rankings, which rank from 400 (Times Higher Education Ranking) to more than 20000 universities (World Webometrics Ranking). They are Times Higher Education Ranking, THES-QS Ranking, THE-QS Ranking, ARWU Ranking, HEEACT Ranking, Leiden Ranking, URAP Ranking, SCImago Institutions Ranking, Webometrics Ranking. For each world university ranking we will consider two works in which they were studied and used for ranking universities. The most relevant works for the first ranking are [1, 2], for the second - [3, 4], for the third - [5, 6], for the fourth - [7, 8], for the fifth - [9, 10], for the sixth - [11, 12], for the seventh - [13], for the eighth - [14, 15], for the ninth - [16, 17]. These works and some others compare different methodologies of university rankings. Among them it is worth noting the work [9], which describes qualitative comparative analysis of three ranking methodologies (ARWU, THES-QS,HEEACT).

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Quantitative comparative analysis of methodologies for ARWU and the Times Higher Education Ranking is performed in the works of J.P.A. Ioannidis *et al* [18] and M. Saisana *et al*. [19]. The first work shows that the number of universities shared in TOP-200 lists by both rankings for 2006 is 133. It also presents other simple quantitative comparative procedures to assess these rankings. In the second work more complex statistical analysis with the use of Pearson correlation coefficients is carried out. It also describes uncertainty and sensitivity analysis for ARWU and the Times Higher Education Rankings.

In their earlier work M. Saisana and B. D'Hombres [20] through a sensitivity analysis and simulating using different weighting showed that 67% of universities in THE Ranking and 60% in the ARWU Ranking were highly sensitive to the composition of the overall score. It mainly concerns the universities at the top of the rankings.

Statistical and mathematical analysis of ARWU Ranking in the work by N.C. Liu and Y. Cheng [21] shows distribution of TOP-20, TOP-100, TOP-200, TOP-300, TOP-400 and TOP-500 universities among countries and presents matrix showing correlation between indicator scores of this ranking.

Analyzing SCImago Institution ranking L. Bornman *et al*. [22] use test statistics to evaluate statistical significance of the difference between publication activity of two institutions.

Analyzing Leiden Ranking L. Waltman, N.J. Van Eck *et al*. [23] present theoretical comparison between two normalization mechanisms for bibliometric indicators of research performance. In the work by L. Waltman, R.J.W. Tijssen and N.J. Van Eck [24] spatial mapping of 21.4 mln. publications (article and review) for the period from 1980 to 2009 included into Leiden Ranking shows that average distance of international co-authorship increased from 334 km in 1980 to 1553 km in 2009.

For comparative analysis of random objects rankings in multidimensional analysis the following methods of rank correlation are developed: Kendall's rank correlation coefficient, Spearman's rank correlation coefficient, Spearman's footrule.

They are developed for quantitative study of distance between two rankings of the same number of objects. This condition is not always met in the study of different university rankings. For comparing citation databases J. Bar-Ilan, M. Levene and A. Lin [25] introduce three measures: size of the overlap, Spearman's footrule and M measure. The first two measures are true for comparing rankings with identical lists of objects. The third measure extends Spearman's footrule to comprise rankings with non-identical lists of objects.

This methodology is used in the work [6] for quantitative comparative analysis of ARWU, THE-QS, HEEACT, Leiden and Webometrics Ranking.

In our research there is an attempt to develop quantitative methodology for comparative analysis of global university rankings in the frameworks of spatial analysis, with a big region of the world taken as an example.

The selected region is the Mediterranean and Black Sea Region that consists of 29 countries with direct access to the Mediterranean Sea and the Black Sea except Jordan that is on the coast of the Red Sea but has access to the Mediterranean Sea only through Israeli ports. These countries include European countries on the north Mediterranean Sea coast and the Black Sea coast and countries of North Africa and Western Asia within the Mediterranean basin.

MATERIALS AND METHODS

When formulating any scientific problem, it is necessary to understand to what degree and at what level it is studied. To do this, it is necessary to choose adequate English terms that are to be included in the conceptual apparatus of the given problem. To solve the problem under discussion in this article we selected the following terms: Times Higher Education Ranking, THES-QS Ranking, THE-QS Ranking, ARWU Ranking, HEEACT Ranking, Leiden Ranking, URAP Ranking, SCImago Institutions Ranking, Webometrics Ranking. Such terms will be tested with the help of Google Scholar advanced search in the line "with the exact phrase" for two cases: "anywhere in the article" (two options: include citations; at least summaries) and "in the title of the article" (same options). Such experiments show how popular different methods of university rankings. Data for eight university rankings will be used in analytical procedures.

We will consider three analytical procedures for comparative analysis of university networks. The idea of the first tool is the following.

Let us assume that there is a large region that consists of M countries and that we aim to select the most prestigious universities in it. To solve this task we suggest comparing university ranks in all global university rankings (n=8) and selecting those universities that are found in no fewer than k ($1 \le k \le n$) global university rankings.

Obviously, the closer k is to n, the smaller number of universities is found in no fewer than k rankings. To perform this procedure for each country TOP-N universities in one of the global rankings should be used as a basis and then matrix of the universities shared by no fewer than k global university rankings should be compiled.

Conditions of the procedure can be stricter if we compile matrix of the universities (based on TOP-N in one of the rankings) which are included in TOP-Ñ universities found in no fewer than k ($1 \le k \le n$) global university rankings (Ñ>>N); Ñ is the minimum number of universities shared by all global university rankings. In the studied case this number is 400 (for the Times Higher Education Ranking) but taking into consideration that the other seven rankings comprise at least 500 universities we assumed that Ñ=500.

The procedure of analyzing university entries into TOP-Ñ in all global university rankings (k=n) brings us to mathematical operation of intersection of all n lists that include TOP-Ñ universities. Using L_i to stand for these lists the final list L can be written as $L= \bigcap_{i=1}^{n} L_i$, where $\cap$ is a standard intersection operation in the set theory, L_i is a list of universities from i's TOP-Ñ global university ranking, $1 \le i \le n$. In this case there is no need to analyze TOP-N in one of the rankings.

Now we will proceed to the second tool. Let us assume that our aim is to rank countries of the region in question on the quality of their universities' systems. Agreeing to select some quantity N of the first universities (TOP-N) for each country according to one of the rankings we can build a country matrix showing the number of entries of universities ranked TOP-N by the selected ranking into TOP-Ñ of all global university rankings.

As a result we get a matrix of size M~ × n, where M~ is the number of countries with non-zero lines ($M \sim \le M$), n is the number of world university rankings. Summing array elements in lines results in total number of entries of universities ranked TOP-N by the selected ranking into TOP-Ñ of all world university rankings. This total number of entries (indicator TOTAL) demonstrates quality of the countries university systems. It is convenient to use Webometrics ranking as a selected one since it ranks all the universities in the world that have autonomous web-domains (around 20 thousand universities).

The procedure of building country matrix showing the number of entries of the certain group of universities (TOP-N) into TOP-Ñ of the global university rankings makes a good methodological tool for summary country university rankings.

The matrix built on the basis of this procedure allows to compile matrix showing crosscorrelation between all global university rankings.

Procedure that was proposed in the article (Moskovkin, Fraser, Moskovkina, 2013) can be used as the third analytical tool for comparative analysis of universities networks based on proximity indicator. There is considered a set of university networks of different countries in the quantity M of the same dimension N, where N is the amount of network nodes. For such networks, we introduce n-dimensional vector of indicators (features): $\vec{V} = (V_1, V_2, V_3, \ldots V_i \ldots, V_n)$, as well as normalized vector of these indicators $\vec{V} = (\bar{V}_1, \bar{V}_2, \bar{V}_3, \ldots \bar{V}_i \ldots, \bar{V}_n)$, where $\bar{V}_i = V_i/N$. We assume that V_i satisfies the inequality $0 \le V_i \le N$, which implies the inequality $0 \le \bar{V}_i \le 1$. The proximity of an arbitrary vector $\vec{V}$ to the standard unit vector is calculated with the aid of the normalized Euclidean distance:

$$d = \sqrt{\sum_{i=1}^{n} (1 - \bar{V}_i)^2} / \sqrt{n} \qquad (1)$$

where $0 \le d \le 1$.

It is worth noticing that Euclidean distance has been widely used for solving psychometric and econometric tasks of multidimensional analysis since 1950-s - 1960-s.

The smaller indicator d is, the closer the $\vec{V}$ is to the standard unit vector. Thus we can rank all M networks with the same dimensions depending on their proximity to the standard unit vector in n - dimensional feature space.

RESULTS AND DISCUSSION

Above mentioned names of global university rankings were tested at different dates with the help of Google Scholar ("with the exact phrase") and the results are presented in Table 1.

In the table THES-QS and THE-QS Ranking refer to the same ranking that Quacquarelli Symonds Limited has compiled since 2005 for the Times Higher Education Supplement.

Table 1: Google Scholar search results for the names of the world university rankings.

	Anywhere in the article						In the title of the article					
	Include citations			At least summaries			Include citations			At least summaries		
Ranking	23.05.12	16.10.12	27.06.13	23.05.12	16.10.12	27.06.13	23.05.12	16.10.12	27.06.13	23.05.12	16.10.12	27.06.13
Times Higher Education Ranking	106	129	161	103	124	154	0	0	0	0	0	0
THES-QS Ranking	15	17	21	15	17	21	1	1	1	1	1	1
THE-QS Ranking	43	40	65	43	40	64	0	0	0	0	0	0
ARWU Ranking	77	96	137	77	96	136	2	3	3	2	3	3
HEEACT Ranking	19	19	26	19	19	25	0	0	0	0	0	0
Leiden Ranking	157	181	265	149	170	255	4	5	9	2	2	5
URAP Ranking	0	0	3	0	0	3	0	0	0	0	0	0
SCImago Institutions Ranking	39	45	76	37	42	71	0	0	1	0	0	1
Webometrics Ranking	451	526	661	429	498	628	9	12	19	8	9	17

It can be seen that most search results are shown for Webometrics Ranking and Leiden Ranking. At the same time the number of search results has grown for five months period mostly for the Times Higher Education Ranking and ARWU Ranking. Evidently this test does not embrace all the search requests relevant to the terms in question. Indeed relevant search results could be received for requests "Times Higher Education", "THES-QS", "ARWU", etc. Besides, a lot of responses are received for search requests with "Ranking" being replaced by "Rankings" in the names of the world university rankings given in Table 1.

Out of search results the most relevant works for the first ranking are [1, 2], for the second - [3, 4], for the third - [5, 6], for the fourth - [7, 8], for the fifth - [9, 10], for the sixth - [11, 12], for the seventh - [13], for the eighth - [14, 15], for the ninth - [16, 17].

Virtually no search results for the sixth ranking can be compensated by testing abbreviation "URAP" in the line "with the exact phrase" and adding the term "Ranking" in the line "with at least one of the words". In this case we receive rather many references to the Turkish works, with the second response representing thorough Master research on this ranking by [26].

During the experiments with Google Scholar (Table 1) we noticed a lot of works that compare different methodologies of university rankings. Among them it is worth noting the work [9], which describes qualitative comparative analysis of three ranking methodologies (ARWU, THES-QS, HEEACT).

It is worth noting that the review of literature in Introduction section was made on the basis of the experiments with Google Scholar. We will now proceed to the discussion of the main results of our research.

According to the first analytical tool described in the previous section for each country of the Mediterranean and Black Sea region the first twenty universities of the Webometrics ranking (TOP-20, N=20) for July 2011 were selected and compared with seven other global university rankings. After that universities included in no fewer than five global university rankings (k=5) were selected. Table 2 shows these elite universities.

Table 2 shows that universities of Italy, France and Spain lead in the number of entries into global university rankings. Among the universities of these countries there are six universities of Italy found in TOP-500 of all global university rankings under consideration. They are universities of Bologna, Pisa, Rome, Milan and Padua. In France there are only two such highly ranked universities, with University Paris Pierre and Marie Curie among TOP-200 universities in all eight rankings. In Spain there are four universities (universities of Valencia, Barcelona, Madrid and Zaragoza), with all of them among TOP-600 in all eight rankings.

Then according to quality and academic performance come universities of Israel. Three of them are among TOP-400 in seven world university rankings. Two out of five Greek universities are among TOP-600 in seven world university rankings and one university of Turkey (Middle East Technical University) is in TOP-500 of six world university rankings (Table 2). Good result is shown by Moscow State University which is among TOP-500 in all world university rankings. We believe this table is useful for world university rankings' compilers as it helps to identify universities which are not present in several rankings whereas they are found in most rankings. For example, University Claude Bernard de Lyon 1 is among TOP-300 in seven world university rankings but it

Table 2: Universities (among TOP-20 of Webometrics ranking) of the Mediterranean and Black Sea region countries included in no fewer than five global university rankings

	World university rankings							
Name of the University	WR [July 2011]	THE [2011]	QS [2011]	ARWU [2011]	HEEACT [2011]	Leiden [2011/12]	URAP [2011]	SIR [2011]
France								
1. University Paris Pierre and Marie Curie	189	84	119	41	42	125	37	60
2. University Claude Bernard Lyon 1	282	-	350	201-300	212	211	169	235
3. Ecole Normale Superieure Paris	306	59	-	69	305	141	447	628
4. University de Nice Sophia Antipolis	355	-	-	401-500	488	147	651	712
5. University de Rennes 1	426	-	-	301-400	360	313	346	499
6 University Paris XI Sud	436	-	-	40	75	118	69	148
7. University Joseph Fourier Grenoble 1	439	-	254	151-200	185	218	216	370
8 University Rene Descartes Paris 5	453	-	319	151-200	139	167	140	320
9. Ecole Polytechnique France	459	63	-	301-400	277	-	349	463
10. Ecole Normale Superieure de Lyon	555	141	133	401-500	392	-	825	701
11. University Paris 1 Panthuion Sorbonne	560	351-400	206	-	-	-	1471	1440
12. University de Nantes	605	-	-	-	457	326	525	848
13. University Montpellier II Sciences et Techniques du Languedoc	717	276-300	329	201-300	237	193	245	295
14. University de Versailles Saint Quentin en Yvelines	744	-	-	401-500	370	-	1147	796
Greece								
1. National Technical University of Athens	344	-	551-600	-	250	400	503	383
2. Aristotle University of Thessaloniki	379	-	451-500	301-400	388	405	271	210
3. National and Kapodistrian University of Athens	409	-	-	201-300	-	453	168	152
4 University of Crete	596	276-300	451-500	-	429	324	456	579
5. University of Patras	631	-	551-600	-	-	415	428	381
Italy								
1. Università di Bologna	88	226-250	183	201-300	112	332	100	85
2. Università di Pisa	175	301-350	322	102-150	219	409	191	174
3. Università degli Studi di Roma La Sapienza	184	301-350	210	102-150	116	422	78	51
4. Università degli Studi di Milano	205	226-250	275	151-200	99	271	84	89
5. Università degli Studi di Padova	220	226-250	263	151-200	104	340	86	98
6. Università degli Studi di Firenze	249	-	360	201-300	189	365	170	185
7. Università degli Studi di Torino	256	-	451-500	401-500	168	321	151	205
8. Università degli Studi di Roma Tor Vergata	350	301-350	380	301-400	226	391	246	263
9. Politecnico di Milano	360	301-350	277	201-300	-	323	387	288
10. Università degli Studi di Napoli Federico II	367	-	401-450	301-400	196	417	107	150
11. Università degli Studi di Genova	391	-	501-550	301-400	301	414	287	282
12. Università degli Studi di Trento	394	276-300	401-500	-	-	-	547	567
13. Politecnico di Torino	405	351-400	-	201-300	-	350	526	386
14. Università degli Studi di Palermo	416	-	-	301-400	397	451	394	382
15. Università degli Studi di Pavia	431	-	-	401-500	308	348	307	353
16. Università degli Studi di Siena	436	-	451-500	401-500	348	431	362	411
17. Università degli Studi di Milano Bicocca	479	226-250	-	401-500	334	-	421	440
18. Università degli Studi di Catania	502	-	601	-	433	455	417	383
19. Università degli Studi di Parma	519	-	-	401-500	397	331	411	465
20. Università degli Studi di Bari Aldo Moro	536	351-400	-	-	-	411	318	1018
Russian Federation								
1. Lomonosov Moscow State University	304	276-300	112	77	241	499	138	70
2. Saint Petersburg State University	1002	351-400	251	301-400	-	500	479	455
Serbia								
1. University of Belgrade	995	-	601	-	-	495	357	338
Slovenia								
1. University of Ljubljana	207	-	551-600	401-500	442	462	289	260

Table 2: Continued

Name of the University	World university rankings							
	WR [July 2011]	THE [2011]	QS [2011]	ARWU [2011]	HEEACT [2011]	Leiden [2011/12]	URAP [2011]	SIR [2011]
Spain								
1. Universidad de Sevilla	116	-	501-550	-	464	360	341	360
2. Universidad Complutense de Madrid	127	-	253	201-300	286	390	182	181
3. Universidad Politicnica de Catalunya	145	351-400	373	-	-	351	430	225
4. Universidad de Granada	158	-	501-550	401-500	367	393	286	304
5. Universidad de Valencia	172	301-350	451-500	201-300	234	329	187	351
6. Universidad Politicnica de Valencia	223	351-400	451-500	301-400	470	272	396	227
7. Universidad de Barcelona	227	201-225	176	201-300	110	245	88	133
8. Universidad Autonoma de Barcelona	238	201-225	194	301-400	227	274	154	188
9. Universidad Autonoma de Madrid	270	276-300	222	201-300	238	309	210	243
10. Universidad de Salamanca	287	-		-	492	460	513	649
11. Universidad de Zaragoza	292	351-400	551-600	401-500	401	361	338	368
12. Universidad de Santiago de Compostela	374	-	401-450	401-500	352	303	336	369
[Egypt]								
1. Cairo University	1,219	301-350	501 - 550	401-500	-	-	498	474
[Israel]								
1. Hebrew University of Jerusalem	169	121	120	57	-	282	166	193
2. Tel Aviv University	189	166	-	102-150	105	336	87	91
3. Technion Israel Institute of Technology	253	201-225	-	102-150	278	339	205	195
4. Weizmann Institute of Science	257	-	-	102-150	135	25	224	374
5. Ben Gurion University of the Negev	504	-	-	301-400	382	440	282	268
6. Bar Ilan University	564	301-350	-	301-400	-	403	446	525
[Turkey]								
1. Middle East Technical University	493	276-300	501-550	-	-	381	495	483
2. Bilkent University Ihsan Dogramaci	658	201-225	401-450	-	-	-	856	916
3. Istanbul Technical University	683	276-300	501-550	-	-	-	633	556
4. Hacettepe University	782	-	501-550	-	-	492	400	340
5. Istanbul University	1083	-	501-550	-	-	497	383	337

Table 3: Universities out of TOP-20 in Webometrics ranking included in TOP-500 by all eight global university rankings

Name of the University	World university rankings							
	WR [July 2011]	THE [2011]	QS [2011]	ARWU [2011]	HEEACT [2011]	Leiden [2011/12]	URAP [2011]	SIR [2011]
France								
1. University Paris Pierre and Marie Curie	189	84	119	41	42	125	37	60
2. University Montpellier II Sciences et Techniques du Languedoc	717	276-300	329	201-300	237	193	245	295
Italy								
1. Università di Bologna	88	226-250	183	201-300	112	332	100	85
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3. Università degli Studi di Roma La Sapienza	184	301-350	210	102-150	116	422	78	51
4. Università degli Studi di Milano	205	226-250	275	151-200	99	271	84	89
5. Università degli Studi di Padova	220	226-250	263	151-200	104	340	86	98
6. Università degli Studi di Roma Tor Vergata	350	301-350	380	301-400	226	391	246	263
Russian Federation								
1. Lomonosov Moscow State University	304	276-300	112	77	241	499	138	70
Spain								
1. Universidad de Valencia	172	301-350	451-500	201-300	234	329	187	351
2. Universidad Politicnica de Valencia	223	351-400	451-500	301-400	470	272	396	227
3. Universidad de Barcelona	227	201-225	176	201-300	110	245	88	133
4. Universidad Autonoma de Barcelona	238	201-225	194	301-400	227	274	154	188
5. Universidad Autonoma de Madrid	270	276-300	222	201-300	238	309	210	243

Table 4: A range of ranks showing changes in global university rankings for the leading countries of the Mediterranean and Black Sea region calculated on the basis of data from Table 2

		A range of ranks showing changes in ranks							
Country	Number of universities	WR [July 2011]	THE [2011]	QS [2011]	ARWU [2011]	HEEACT [2011]	Leiden [2011/12]	URAP [2011]	SIR [2011]
Italy	20	88-536	226-400	183-601	102-500	99-433	271-455	78-547	51-1018
France	14	189-744	59-400	119-350	41-500	42-488	118-326	37-1471	60-1440
Spain	12	116-374	201-400	176-600	201-500	110-492	245-460	88-513	133-649
Israel	6	169-564	121-350	120	57-400	105-382	25-440	87-446	91-525
Greece	5	344-631	276-300	451-600	201-400	250-429	324-453	168-503	152-579
Turkey	5	493-1083	201-300	401-550	-	-	381-497	383-856	337-916
Russia	2	304-1002	276-400	112-251	77-400	241	499-500	138-479	70-455
Slovenia	1	207	-	551-600	401-500	442	462	289	260
Serbia	1	995	-	601	-	-	495	357	338
Egypt	1	1219	301-350	501-550	401-500	-	-	498	474

Table 5: Country matrix showing number of entries of universities ranked as TOP-20 by Webometrics ranking into TOP-500 in global university rankings for the Mediterranean and Black Sea region countries

Country	WR [July 2011]	THE [2011]	QS [2011]	ARWU [2011]	HEEACT [20 11]	Leiden [2011/12]	URAP [2011]	SIR [2011]	TOTAL	d
1. Italy	17	11	12	17	16	18	18	18	127	0.24
2. Spain	20	7	8	10	11	14	12	13	95	0.45
3. France	9	6	8	13	13	14	9	8	80	0.52
4. Israel	4	4	1	7	4	6	6	5	37	0.77
5. Greece	3	1	2	2	4	6	4	4	26	0.84
6. Turkey	1	4	2	0	0	6	5	6	24	0.86
7. Russian Federation	1	2	7	2	1	2	2	2	19	0.89
8. Slovenia	1	0	0	1	1	1	1	1	6	0.96
9. Croatia	0	0	0	1	0	1	1	1	4	0.98
10. Egypt	0	1	0	1	0	0	1	1	4	0.98
11. Serbia	0	0	0	0	0	1	1	1	3	0.98
12.Lebanon	0	0	1	0	0	0	0	0	1	0.99
TOTAL	56	36	41	54	50	69	60	60	426	

is not found in THE. The fact should draw attention of compilers of this ranking. Table 2 shows that Chinese rankings do not work well for universities of Turkey, QS does not show most universities of Israel, THE and QS fail for French universities.

Taking into account data in Table 2, matrix of universities ranked among TOP-500 by all eight world university rankings was built. It allows to shortlist universities to the most elite in the region in question (Table 3).

The number of universities in Table 3 is 14 out of 67 shown in table 2. The lead is taken by Italian, Spanish and French universities.

Using data of Table 2 a range of ranks showing changes in global university rankings was assigned (Table 4).

Table 4 shows that top positions in Webometrics ranking belong to Italy and Spain, THE assigns top ranks to France, Israel and Turkey, the best result in QS is for France, Israel (one university) and Russia (one university), leaders of ARWU, HEEACT and Leiden are France and Israel, top positions in URAP are taken by Italy and Israel, SIR gives top places to Spain, Israel and Russia. This comparison is rather approximate as the compared countries have different number of universities. However, data in table 4 presents good quantitative view of the centers of superior universities in the Mediterranean and Black Sea region.

Analysis of all eight university rankings allows to build a matrix of number of entries (TOP-20, N=20) according to Webometrics ranking of universities from the Mediterranean and Black Sea region countries into TOP-500 (Ñ=500) of global university rankings in 2011 (Table 5). It is worth noting that only THE ranks fewer than 500 universities (TOP-400).

Table 5 shows that in the number of entries in TOP-500 in eight global university rankings Italy, Spain and France are much ahead followed by a group of four countries - Israel, Greece, Turkey and Russia. At the end of the list there is a group of five European and Arab countries.

Table 6: Matrix of intercorrelation between world university rankings

	WR	THE	QS	ARWU	HEEACT	Leiden	URAP	SIR
WR	1	0.88	0.82	0.87	0.91	0.91	0.92	0.93
THE		1	0.88	0.92	0.90	0.95	0.98	0.97
QS			1	0.85	0.87	0.86	0.86	0.85
ARWU				1	0.98	0.94	0.93	0.89
HEEACT					1	0.96	0.94	0.91
Leiden						1	0.97	0.96
URAP							1	0.99
SIR								1

So there are three clearly identified clusters of countries:

- Those that have high level of university entries into global university rankings (80-127);
- Those that have middle level of university entries into global university rankings (19-37);
- Those that have low level of university entries into global university rankings (1-6).

For all the countries the smallest number of entries into TOP-500 was found in THE ranking (36) which is attributed to the fact that it ranks 400 universities. Maximum entries are in Leiden ranking (69). For the leading countries of the Mediterranean and Black Sea region disparity in the number of entries of TOP-20 universities of Webometrics ranking into TOP-500 of eight global university rankings is 13 (20-7=13) for Spain, 8 for France and 7 for Italy.

Additionally Table 5 demonstrates indicator calculated according to formula (1) which shows proximity of the number of entries of universities ranked TOP-20 by Webometrics ranking into TOP-500 of eight global global university rankings to maximum possible number of entries that equals 20. In this case M=12, N=20, n=8.

Table 5 shows that indicator d correlates well with the total number of entries of universities ranked TOP-20 by Webometrics ranking into TOP-500 of global university rankings. Pair correlation coefficient between TOTAL and d is almost 1.

To make analysis easier matrix of crosscorrelation between eight global university rankings was compiled on the basis of data in Table 5 which is shown in Table 6.

Table 6 shows that the pair correlation coefficient is not lower than 0.82 (WR and QS) reaching its maximum of 0.99 for pairs URAP and SIR.

CONCLUSION

In the context of research described by (Bar-Ilan, Levene, Lin, 2007; Aquilo, Bar-Ilan, Levene, Ortega, 2010) and spatial analysis this research develops quantitative methodology of comparative analysis of global university rankings. The Mediterranean and Black Sea region is taken as an example. In the frameworks of this methodology this article proposes three analytical procedures.

- Building matrix of universities (on the basis of TOP-N in one of the rankings) included into no fewer than k ($1 \le k \le n$) global university rankings and matrix of universities included into TOP-Ñ of no fewer than k global university rankings; n is a total number of global university rankings, Ñ is a minimum number of ranked universities among all global rankings (Ñ>>N).
- Building country matrix showing the number of entries of universities ranked as TOP-N by the selected ranking into TOP-Ñ of all global university rankings.
- Calculating indicator showing proximity of the number of entries of universities ranked TOP-N by the selected ranking into TOP-Ñ of all global university rankings to maximum possible number of entries that equals N (it was proposed by [27].

All three procedures are tested on the universities ranked TOP-20 by Webometrics ranking and TOP-500 by eight global university rankings for countries of the Mediterranean and Black Sea region. Matrices built on the basis of the first analytical procedure show academic superiority of Italian, Spanish and French universities of the region in question, with 6 Italian, 5 Spanish and 2 French universities found in all eight global university rankings.

Country matrix built on the basis of the second analytical procedure identifies three clusters of countries: those that have high (Italy, Spain, France), middle (Israel, Greece, Turkey, Russia) and low (Slovenia, Croatia, Egypt, Serbia, Lebanon) level of university entries into global university rankings. The rest 17 countries do not have universities that are among TOP-500 in at least one global university ranking.

The third analytical procedure is used to calculate indicator showing proximity of the number of entries of universities ranked TOP-20 by Webometrics ranking into TOP-500 of eight global university rankings to maximum possible number of entries that equals 20. This indicator correlates well with the total number of entries of universities ranked TOP-20 by Webometrics ranking into TOP-500 of global university rankings (TOTAL), which was calculated on the basis of the second analytical procedure.

REFERENCES

1. Proulx, R., 2007. Higher Education Ranking and Leagues Tables: Lessons Learned from Benchmarking. Higher Education in Europe, 32(1): 71-82.
2. Bookstein, F.L., H. Seidler, M. Fieder and G. Winckler, 2010. Too Much Noise In The Times Higher Education Rankings. Scientometrics, 85(1): 295-299.
3. Sowter, B., 2008. The Times Higher Education Supplement and Quacquarelli Symonds (THES - QS) World University Rankings: New Developments in Ranking Methodology. Higher Education in Europe, 33(2-3): 345-347.
4. Leydesdorff, L. and C. Shin Jung, 2011. How to evaluate universities in terms of their relative citation impacts: Fractional counting of citations and the normalization of differences among disciplines. Journal of the American Society for Information Science and Technology, 62(6): 1146-1155.
5. Holmes, R., 2010. The THE-QS World University Rankings, 2004-2009. Asian Journal of University Education, 6(1): 91-113.
6. Aguillo, I.F., J. Bar-Ilan, M. Levene and J.L. Ortega, 2010. Comparing university rankings. Scientometrics, 85(1): 243-256.
7. Docampo, D., 2012. Adjusted sum of institutional scores as an indicator of the presence of university systems in the ARWU ranking. Scientometrics, 90(2): 701-713.
8. Jovanovic, M., V. Jeremic, G. Savic, M. Bulajic and M. Martic, 2012. How does the normalization of data affect the ARWU ranking? Scientometrics, 93(2): 319-327.
9. Huang, M.H., 2011. A comparison of three major academic rankings for world universities: From a research evaluation perspective. Journal of Library and Information Studies, 9(1): 1-25.
10. Hou, A. Yung-Chi, M. Ince and C.L. Chiang, 2012. A reassessment of Asian pacific excellence programs in higher education: the Taiwan experience. Scientometrics, 92(1): 23-42.
11. Waltman, L., C. Calero-Medina, J. Kosten, C.M. Noyons, Ed Tijssen, J.W. Robert, N.J. Van Eck, Van T.N. Leeuwen, Van Raan, F.J. Anthony, M.S. Visser and P. Wouters, 2012. The Leiden ranking 2011/2012: Data collection, indicators and interpretation. Journal of the American Society for Information Science and Technology, 63(12): 2419-2432.
12. Leydesdorff, L. and L. Bornmann, 2012. Testing differences statistically with the Leiden ranking. Scientometrics, 92(3): 781-783.
13. Konur, Ö.G.Ö., 2011. Şırnak Üniversitesi ve "URAP Türk Üniversiteleri 2011 Yılı Akademik Performansa dayalı BaŞarı Sıralaması" Bilgi Notu. Temmuz, Şırnak. 20. (Working report). Retrieved from http://www.okonur.info.
14. Rodríguez-Navarro, A., 2011. A Simple Index for the High-Citation Tail of Citation Distribution to Quantify Research Performance in Countries and Institutions. PLoS ONE, 6(5):e20510. doi:10.1371/ journal. pone. 0020510.
15. De Mesnard, L., 2012. On some flaws of university rankings: The example of the SCImago report. The Journal of Socio-Economics, 41(5): 495-499.
16. Aguillo, I.F., J.L. Ortega and M. Fernández, 2008. Webometric Ranking of World Universities: Introduction, Methodology and Future Developments. Higher Education in Europe, 33(2-3): 233-244.
17. Ortega, J.L. and I.F. Aguillo, 2009. Mapping world-class universities on the web. Information Processing and Management, 45(2): 272-279.
18. Ioannidis John, P.A., N.A. Patsopoulos, F.K. Kavvoura, A. Tatsioni, E. Evangelou, I. Kouri, D.G. Contopoulos-Ioannidis and G. Liberopoulos, 2007. International ranking systems for universities and institutions: a critical appraisal. BMC Medicine, 5:30. Retrieved from http:// www.biomedcentral.com/ 1741-7015/5/30.
19. Saisana, M., B. d'Hombres and A. Saltelli, 2011. Rickety numbers: Volatility of university rankings and policy implications. Research Policy, 40(1): 165-177.

20. Saisana, M. and B. D'Hombres, 2008. Higher Education Rankings: Robustness Issues and Critical Assessment. How much confidence can we have in Higher Education Rankings? Scientific and Technical Research series. Luxembourg: Office for Official Publications of the European Communities, pp: 106.
21. Liu, N.C. and Y. Cheng, 2005. The Academic Ranking of World Universities. Higher Education in Europe, 30(2): 127-136.
22. Bornmann, L., F. De Moya Anegón and L. Leydesdorff, 2012. The new Excellence Indicator in the World Report of the SCImago Institutions Rankings 2011. Journal of Informetrics, 6(2): 333-335.
23. Waltman, L., N.J. Van Eck, T.N. Van Leeuwen, M.S. Visser and F.J. Van Raan Anthony, 2011. Towards a new crown indicator: Some theoretical considerations. Journal of Informetrics, 5(1): 37-47.
24. Waltman, L., Tijssen, J.W. Robert Van and N.J. Eck, 2011. Globalisation of science in kilometers. Journal of Informetrics, 5(4): 574-582.
25. Bar-Ilan, J., M. Levene and A. Lin, 2007. Some measures for comparing citation databases. Journal of Informetrics, 1(1): 26-34.
26. Oğuzhan, A., 2010. University ranking by academic performance: a scientometrics study for ranking world universities. A thesis submitted to the Graduate School of Informatics of the Middle East Technical University, pp: 174.
27. Moskovkin, V.M., J.K. Fraser and M.V. Moskovkina, 2013. University networks in the context of their academic excellence and openness: A comparative study of leading Czech and German universities. Webology, 10(1).