

# Rankings of countries based on rankings of universities

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## Abstract

Although many methods have been designed for ranking universities, there is no suitable system that focuses on the ranking of countries based on the performance of their universities. The overall ranking of the universities in a region can indicate the growth of interests in science among the people of that land. This paper introduces a novel ranking mechanism based on the rankings of universities. Firstly, we introduce and discuss two new rankings of countries, based on the rank of their universities. Secondly, we create rankings of countries according to the selected method, based on the top 12000 universities in webometrics.info (January 2012) and compare rankings of countries in 4 editions (January 2012 to July 2013). Firstly, we introduce two new methods of ranking countries based on their university rankings, Weighted Ranking (WR) and Average Ranking (AR). Secondly, we discuss how the introduced ranking systems, perform in ranking countries based on the two years of data. Thirdly, we choose QS (<http://www.topuniversities.com>) and webometrics.info as two different classification systems for comparing rankings of countries, based on the top 500 universities in these rankings. Results indicate that the methodology can be used to show the quality of the whole universities of each country used to compare rankings of countries in practice compare to other countries in the world.

## Introduction

Unlike rankings of universities, rankings of countries have not yet been the focus of considerable study in the web rankings research. There are many countries in which most of their universities belong to the government. In these countries, universities must follow their country policies, especially on the internet. Finding rankings of countries based on rankings of universities help researchers for comparing the performance of government decisions in the educational institutes and universities.

Higher education institutions are using rankings as a promotion tool that shows their educational and research excellence. Universities use these rankings for increasing their research performance (Isidro F. Aguillo, Judit Bar-lan, Mark Levene, Jose Luis Ortega, 2010). Local and international rankings have been focused by higher education policymakers (Ghane, Khosrowjerdi & Azizkhani, 2013). Rankings of the Times Higher Education (THE-QS, <http://www.topuniversities.com/home>), rankings of the Shanghai Jiao Tong University (ARWU, <http://www.arwu.org>), rankings of the Higher Education and Accreditation Council of Taiwan

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(HEEACT, <http://ranking.heeact.edu.tw>), web rankings of World Universities by the Cybermetrics Lab at CSIC (WR, <http://www.webometrics.info>), web rankings of Iranian Universities (RICEST, <http://websanji.ricest.ac.ir>), rankings of the Centre for Science and Technology Studies at Leiden University (CWTS, <http://ranking.heeact.edu.tw>), rankings of the SCImago Research Group (SJR, <http://www.scimagoir.com>) and 4 International Colleges & Universities (<http://www.4icu.org>) are the famous rankings of universities.

The concept of using rankings of universities for calculating countries' educational rankings is the central focus of this article. We used the data from the 4 data set updates, in two years, on university rankings of Webometrics. We produce country rankings from the January 2012 list and compare their rankings to the July 2012, January 2013, and July 2013. WR is a web-based ranking (21451 universities, January 2014) which is published every six months. We use a list of 12000 universities from each edition. We study and discuss changes in countries' ranks in one ranking of universities (WR) among the time. We also compare the rankings of countries in two different classification systems. We compare the rank of countries in the top 500 WR (January 2012) with the countries' rank in the top 500 THE-QS (2012).

## **Methodology**

For quantitative purposes, data of universities and research centers have been extracted from [webometrics.info](http://webometrics.info) and QS. Although [webometrics.info](http://webometrics.info) only provides the latest rankings of universities, in the last three years we have saved a full list of rankings of universities from [Webometrics.info](http://webometrics.info). [Webometrics.info](http://webometrics.info) collects data for all the universities of the world. The latest main list [webometrics.info](http://webometrics.info) contains the top 12000 domains (<http://webometrics.info/en/world?page=119>). [Webometrics'](http://webometrics.info) previous editions have only the top 500 universities from July 2009 ([http://webometrics.info/en/Previous\\_editions](http://webometrics.info/en/Previous_editions)). Many countries don't have any university in the top 500 (<http://webometrics.info/en/node/54>) thus in the last three years we have saved a full list of rankings of universities (top 12000 domains) from [Webometrics.info](http://webometrics.info) in our database. In this article, we use this database for calculating rankings of countries. In this study, we also produce QS countries' rank based on the top 500 QS World University Rankings (2012, <http://www.topuniversities.com/university-rankings/world-university-rankings/2012>) and compare with WR countries' rank ([webometrics.info](http://webometrics.info)) based on top 500 WR universities (January 2012). To compare the rankings of countries in each edition top 50 world countries with the highest number of universities in the WR (January 2012) were selected (Table 1). In this list United States of America with 2883 universities (January 2012) is at the top and Egypt with 34 universities is at the bottom of the list. Selected top 50 countries list contains 10927 universities (Table 1).

In the end, we used the top 500 QS universities (QS, 2012) for comparing to the top 500 WR (WR, January 2012) universities. Although [Webometrics.info](http://webometrics.info) provides 12000 universities in each edition and QS provides 750 universities, we used the top 500 universities. The simplest way of calculating the rank of one country is by calculating average rank. We define the average rank for

one country as the sum of the universities rank belongs to that country divide to count of universities.

$$AR = \frac{\sum_{i=1}^n R_i}{n}$$

Where AR is the Average Rank of the country and n is the total number of universities that belong to the country. Country average rank (AR), has two major problems drawback. The first problem is that items of each edition are not identical and comparing overlapping universities is not recommended. In this case, exiting one university at the bottom of the rankings list makes better AR for the country. The Second problem issue is the huge differences between the number of universities in each country. One country with a lower number of universities maybe takes a better position in the ranking table rather than a country like the United States of America which occupied the most position of top 100 universities (Table 4). To address the drawbacks of the AR problems system, we defined W as a new indicator that allows us to detect the weight of countries.

$$W = \sum_{i=1}^n (M - R_i + 1)$$

Where the W is the weight of the country, n is the total number of universities number of each country, M is the total number of universities number in the world's list (12000 in this study) and i is the ranking of each university in the Webometrics.info. W has the value zero when the country does not have any university at the world's list, its maximum value is  $M*(M+1)/2$ . Table 6 shows the calculated W according to the universities ranking for the top 50 countries in WR for 4 editions of different data sets. The Maximum W in July 2012 belongs to the United State of America with 18943854 and the lowest W belongs to Morocco with 103988.

M=12000

Min W=0

Max W=  $M*(M+1)/2 = 7200600$

$1+2+3+4+\dots + M = M*(M+1)/2$

Both problems of AR are solved by using W.

## Results

Weighted ranking (W) provides a new way to compare countries. We can compare changes of countries' rankings in this new ranking's list to other official rankings' list. Also, we can compare two separate rankings' lists. In the top 50 QS, there are 50 countries (Table 2) and in the top 50 WR, there are 48 countries (Table 3).

## Comparing four editions of WR

Table (6) shows the ranks of 50 countries in four WR editions. Selected countries are the countries with the highest universities number in January 2012, ranks have been produced based on country weight (table 5). The United State of America, china, and japan are at the top of the list. The highest drop from January 2012 to July 2013 belongs to Romania with 9 levels and the highest increase belongs to Pakistan with 5 levels.

Table 1: Top 50 countries with highest number of universities in top 12000 WR list

Rank	Country Name	January 2012	July 2012	January 2013	July 2013	Rank	Country Name	January 2012	July 2012	January 2013	July 2013
1	United States of America	2883	2750	2829	3031	26	Vietnam	85	82	83	77
2	China	1114	1073	1117	1102	27	Romania	85	76	78	67
3	Japan	679	645	758	773	28	Switzerland	84	73	70	81
4	Brazil	576	490	514	366	29	Australia	72	63	70	78
5	Russian Federation	447	418	640	577	30	Philippines	72	68	64	61
6	India	378	305	382	478	31	Portugal	70	66	69	64
7	France	372	337	397	394	32	Austria	66	64	64	64
8	Germany	337	317	324	341	33	Belgium	64	56	61	58
9	Republic Of Korea	286	284	272	245	34	Chile	64	60	56	57
10	Poland	265	236	273	270	35	Malaysia	64	62	60	64
11	United Kingdom	218	203	243	257	36	Peru	63	64	64	54
12	Mexico	201	182	153	140	37	Czech Republic	61	56	51	54
13	Iran (Islamic Republic of Iran)	178	163	161	172	38	Hungary	57	51	52	48
14	Indonesia	162	161	188	160	39	Denmark	56	49	47	45
15	Taiwan	154	153	151	154	40	Greece	51	47	49	52
16	Canada	154	148	171	231	41	Norway	51	48	49	47
17	Spain	154	139	137	131	42	Finland	48	47	47	45
18	Italy	141	123	126	132	43	Ecuador	44	40	37	30
19	Thailand	140	135	135	130	44	Kazakistan	44	37	40	41
20	Colombia	139	134	133	95	45	Sweden	43	42	43	42
21	Turkey	131	129	140	140	46	Ireland	41	34	31	36

Rank	Country Name	January 2012	July 2012	January 2013	July 2013	Rank	Country Name	January 2012	July 2012	January 2013	July 2013
22	Ukraine	112	106	184	126	47	Bulgaria	40	41	40	40
23	Argentina	98	92	96	98	48	Venezuela	37	35	32	29
24	Netherlands	90	76	78	71	49	Morocco	36	28	29	36
25	Pakistan	86	72	74	85	50	Egypt	34	34	37	34

Table 2: Top countries with highest number of universities at the top 500 QS (2012)

Rank	Country Name	University	Rank	Country Name	University
1	United States of America	99	26	Austria	5
2	United Kingdom	51	27	Brazil	5
3	Germany	39	28	Colombia	4
4	Australia	24	29	Saudi Arabia	4
5	France	22	30	Palestine	4
6	Canada	20	31	Norway	4
7	Japan	20	32	Chile	3
8	China	18	33	Portugal	3
9	Spain	14	34	Indonesia	3
10	Italy	14	35	South Africa	3
11	Netherlands	13	36	Greece	2
12	Republic Of Korea	13	37	Kazakstan	2
13	Taiwan	11	38	Mexico	2
14	Finland	8	39	Philippines	2
15	Switzerland	8	40	Poland	2
16	Sweden	8	41	Singapore	2
17	India	7	42	Thailand	2
18	Ireland	7	43	Turkey	2
19	Belgium	7	44	United Arab Emirates	2
20	New Zealand	7	45	Uruguay	1
21	Malaysia	6	46	Egypt	1
22	Russian Federation	6	47	Czech Republic	1
23	Hong Kong	6	48	Oman	1
24	Denmark	5	49	Pakistan	1
25	Argentina	5	50	Lebanon	1

Table 3: Top countries with highest number of universities at the top 500 WR (January 2012)

Rank	Country Name	University	Rank	Country Name	University
1	United States of America	155	25	Greece	4
2	Germany	44	26	Ireland	4
3	United Kingdom	30	27	Palestine	4
4	Spain	24	28	Turkey	4
5	Canada	23	29	Norway	4
6	Australia	17	30	Czech Republic	3
7	Italy	16	31	Indonesia	3
8	Taiwan	14	32	South Africa	3
9	China	14	33	Hungary	3
10	Japan	12	34	New Zealand	3
11	Brazil	12	35	Malaysia	3
12	Netherlands	11	36	Argentina	2
13	Sweden	9	37	Slovakia	2
14	Switzerland	7	38	Singapore	2
15	Belgium	7	39	Saudi Arabia	2
16	Portugal	6	40	Russian Federation	2
17	Hong Kong	6	41	Mexico	2
18	Thailand	6	42	Costa Rica	1
19	Poland	5	43	Colombia	1
20	France	5	44	Chile	1
21	Republic Of Korea	5	45	Slovenia	1
22	Denmark	5	46	Iceland	1
23	Austria	5	47	India	1
24	Finland	5	48	Croatia (local name: Hrvatska)	1

Table 4: Average rank of countries in four editions in WR (12000 universities)

AR (WR,12000)											
Rank	Country Name	January 2012	July 2012	January 2013	July 2013	Rank	Country Name	January 2012	July 2012	January 2013	July 2013
1	Sweden	3487.88	3549	3400.60	3777.52	26	Belgium	6012.53	6861.61	6137.20	6830.57
2	Taiwan	3543.68	3863.19	3668.77	4229.68	27	Russian Federation	6087.01	6039.20	6584.17	7496.95
3	United Kingdom	3954.39	4178.92	4632.36	4808.39	28	Ireland	6126.20	7253.33	5610.87	5563.92
4	Finland	4375.17	4721.65	4368.21	5734.67	29	Venezuela	6128.08	6457.65	6335.03	7240.48
5	Turkey	4402.29	4604.19	4891.14	5438.31	30	Bulgaria	6145.48	6277.72	5966.25	7265.13
6	Australia	4626.54	5116.29	4472.39	4634.24	31	Japan	6221.98	6681.09	6722.61	6865.12
7	Greece	4757.35	4840.66	4466.47	4829.35	32	Indonesia	6368.83	6228.70	6030.03	6415.21
8	Italy	4840.81	5463.68	4910.41	4902.27	33	Netherlands	6393.04	6768.57	5718.88	5881.94
9	Norway	4900.67	5030.90	4839.61	5138.66	34	Ecuador	6402.30	6648.16	5075.73	7041.13
10	Thailand	4938.87	5214.03	5594.10	5126.14	35	Colombia	6442.94	6753.41	6437.93	6822.69
11	Germany	5127.90	5448.34	5275.80	5460.31	36	Switzerland	6560.88	6946.32	6219.60	7058.88
12	Canada	5143.56	5067.65	4795.67	5817.54	37	Vietnam	6680.28	6816.17	7153.72	7100.75
13	China	5265.69	5482.91	5015.54	3973.40	38	Peru	6991.29	7236.08	6891.98	7948.81
14	Spain	5422.91	5581.17	4931.34	4494.01	39	Denmark	7156.16	7948.31	7370.40	7319.73
15	Austria	5427.41	5581.36	5481.92	5979.34	40	Brazil	7167.46	7487.41	6682.19	6465.13
16	United States of America	5429.12	5787.21	5687.48	5437.92	41	Iran (Islamic Republic of Iran)	7258.99	7651.30	6551.68	6976.69
17	Malaysia	5534.20	5111.09	4757.03	5593.72	42	Poland	7298.72	7322.05	6815.13	6995.31
18	Chile	5588.94	5551.67	4987.02	5194.88	43	Mexico	7328.01	7613.70	6499.49	6584.10
19	Portugal	5611.13	5746.15	5183.54	5418.44	44	Republic Of Korea	7349.12	6911.81	7183.57	6932.26
20	Romania	5804.34	6290.84	5799.40	6442.63	45	Ukraine	7381.49	6709.87	7249.29	7984.90
21	Argentina	5851.56	5686.82	5477.96	6267.42	46	Philippines	7863.76	7940.08	8369.33	7946.90
22	France	5857.22	6066.24	6192.60	6272.95	47	India	7964.18	8577.83	7746.40	7443.64
23	Czech Republic	5902.52	6177.15	5190	6556.94	48	Pakistan	8025.65	8549.49	7765.70	8021.74
24	Hungary	5993.70	6469.11	5949.71	6388.10	49	Kazakistan	8205.52	8323.27	7266.70	8489.78
25	Egypt	5998.91	6458.78	6697.35	5695.26	50	Morocco	9111.64	9365.50	8265.86	8413.03

Table 5: Weight of 50 countries in four editions in WR (12000 universities)

Rank	Country Name	January 2012	July 2012	January 2013	July 2013	Rank	Country Name	January 2012	July 2012	January 2013	July 2013
1	United States of America	18943854	17873913	17858132	19889656	26	Netherlands	504626	463593	489927	434382
2	China	7502026	7137381	7801639	8845309	27	Switzerland	456886	421019	404628	400231
3	Japan	3923274	3659314	4000265	3969265	28	Vietnam	452176	430748	402241	377242
4	Brazil	2783541	2702780	2733355	2025762	29	Portugal	447221	454617	470336	421220
5	Russian Federation	2643107	2635135	3466130	2598259	30	Austria	433791	425087	417157	385322
6	Germany	2315898	2212635	2178642	2230034	31	Malaysia	413811	441737	434578	410002
7	France	2285116	2229886	2305538	2256456	32	Chile	410308	408536	392727	387892
8	United Kingdom	1753944	1648411	1790337	1848245	33	Belgium	383198	335192	357631	299827
9	India	1525541	1401649	1624877	2177938	34	Czech Republic	371946	367462	347310	293925
10	Republic Of Korea	1330151	1469614	1310069	1241596	35	Greece	369375	359370	369143	372874
11	Taiwan	1302273	1253383	1258016	1196629	36	Sweden	366021	364288	369774	345344
12	Poland	1245839	1256980	1415469	1351266	37	Finland	365992	350003	358694	281940
13	Canada	1055891	1078127	1231940	1428148	38	Norway	362066	357531	350859	322483
14	Spain	1012872	978637	968406	983285	39	Hungary	342359	313578	314615	269371
15	Italy	1009446	938083	893288	936900	40	Pakistan	341794	329826	313338	338152
16	Turkey	995300	984947	995241	918637	41	Peru	315549	310029	326913	218764
17	Thailand	988558	960506	864796	893602	42	Philippines	297809	303569	232363	247239
18	Mexico	939070	923687	841578	758226	43	Denmark	271255	241579	217591	210612
19	Indonesia	912249	979807	1122355	893567	44	Ecuador	246299	231512	256198	148766
20	Iran (Islamic Republic of Iran)	843900	828029	877180	864010	45	Ireland	240826	206648	198063	231699
21	Colombia	772432	763760	739755	491844	46	Bulgaria	234181	246661	241350	189395
22	Argentina	602547	630319	626116	561793	47	Venezuela	217261	208483	181279	138026
23	Australia	530889	503528	526933	574529	48	Egypt	204037	199981	196198	214361
24	Romania	526631	494599	483647	372344	49	Kazakstan	166957	166902	189332	143919
25	Ukraine	517273	600858	874130	505902	50	Morocco	103981	105541	108290	129131

Table 6: Rank of 50 countries in four editions in WR (12000 universities)

Country Name	January 2012	July 2012	January 2013	July 2013	Country Name	January 2012	July 2012	January 2013	July 2013
United States of America	1	1	1	1	Netherlands	26	26	25	25
China	2	2	2	2	Switzerland	27	31	30	28
Japan	3	3	3	3	Vietnam	28	29	31	31
Brazil	4	4	5	8	Portugal	29	27	27	26
Russian Federation	5	5	4	4	Austria	30	30	29	30
Germany	6	7	7	6	Malaysia	31	28	28	27
France	7	6	6	5	Chile	32	32	32	29
United Kingdom	8	8	8	9	Belgium	33	38	36	37
India	9	10	9	7	Czech Republic	34	33	38	38
Republic Of Korea	10	9	11	12	Greece	35	35	34	32
Taiwan	11	12	12	13	Sweden	36	34	33	34
Poland	12	11	10	11	inland	37	37	35	39
Canada	13	13	13	10	Norway	38	36	37	36
Spain	14	16	16	14	Hungary	39	40	40	40
Italy	15	18	17	15	Pakistan	40	39	41	35
Turkey	16	14	15	16	Peru	41	41	39	43
Thailand	17	17	20	17	Philippines	42	42	44	41
Mexico	18	19	21	20	Denmark	43	44	45	45
Indonesia	19	15	14	18	Ecuador	44	45	42	47
Iran (Islamic Republic of Iran)	20	20	18	19	Ireland	45	47	46	42
Colombia	21	21	22	24	Bulgaria	46	43	43	46
Argentina	22	22	23	22	Venezuela	47	46	49	49
Australia	23	24	24	21	Egypt	48	48	47	44
Romania	24	25	26	33	Kazakstan	49	49	48	48
Ukraine	25	23	19	23	Morocco	50	50	50	50

## Comparing ranks of countries in top 500 WR and top 500 QS

Most of the researchers who analyze rankings of universities, use the data from the top 500 universities (<http://webometrics.info/en/node/54>, 2014). For the two rankings, WR and QS, we calculated the ranks rankings of countries based on the top 500 universities list. Table (7) shows the ranks rankings of countries in QS (2012) and table (8) shows the ranks rankings of countries in WR (January 2012).

$M=500$

$\text{Max } W = M*(M-1)/2 = 124750$

Tables (7) and (8) show count the number of universities, weight of countries and total country's ranking in the top 500 WR and top 500 QS lists. The result shows that the rankings of two universities' rankings are highly similar.

Table 7: Rank of 50 countries (Top 500 universities of QS, 2012)

Rank	Country Name	University	weight	Rank	Country Name	University	weight
1	United States of America	99	28147	26	Palestine	4	1054
2	United Kingdom	51	15817	27	Austria	5	942
3	Germany	39	9417	28	Singapore	2	928
4	Australia	24	6193	29	Brazil	5	900
5	Japan	20	5385	30	Saudi Arabia	4	836
6	Canada	20	5307	31	Argentina	5	739
7	France	22	5001	32	Chile	3	605
8	Netherlands	13	4579	33	South Africa	3	558
9	China	18	3431	34	Mexico	2	548
10	Republic Of Korea	13	3370	35	Thailand	2	544
11	Switzerland	8	3016	36	Colombia	4	383
12	Sweden	8	2482	37	Indonesia	3	327
13	Hong Kong	6	2379	38	Portugal	3	265
14	Belgium	7	2347	39	Lebanon	1	250
15	Spain	14	2087	40	Kazakstan	2	241
16	Italy	14	2017	41	Czech Republic	1	214
17	Taiwan	11	1864	42	United Arab Emirates	2	205
18	Finland	8	1796	43	Philippines	2	177
19	New Zealand	7	1669	44	Poland	2	177
20	Denmark	5	1557	45	Egypt	1	108
21	Ireland	7	1549	46	Turkey	2	100

Rank	Country Name	University	weight	Rank	Country Name	University	weight
22	India	7	1272	47	Oman	1	75
23	Norway	4	1151	48	Pakistan	1	75
24	Malaysia	6	1114	49	Greece	2	50
25	Russian Federation	6	1066	50	Uruguay	1	25

Table 8: Rank of 48 countries (Top 500 universities of WR, January 2012)

Rank	Country Name	University	weight	Rank	Country Name	University	weight
1	United States of America	155	47285	25	Finland	5	974
2	Germany	44	9874	26	Poland	5	824
3	United Kingdom	30	6906	27	Greece	4	795
4	Canada	23	6852	28	Indonesia	3	609
5	Spain	24	5135	29	Singapore	2	522
6	Australia	17	3837	30	New Zealand	3	512
7	Taiwan	14	3643	31	Mexico	2	469
8	Italy	16	3425	32	Ireland	4	461
9	Brazil	12	3403	33	Hungary	3	426
10	Netherlands	11	3113	34	Slovenia	1	420
11	China	14	2740	35	France	5	390
12	Japan	12	2690	36	Russian Federation	2	388
13	Sweden	9	2425	37	Chile	1	347
14	Switzerland	7	1805	38	Saudi Arabia	2	328
15	Thailand	6	1788	39	Turkey	4	265
16	Belgium	7	1659	40	Argentina	2	250
17	Hong Kong	6	1444	41	South Africa	3	185
18	Portugal	6	1371	42	Malaysia	3	171
19	Austria	5	1348	43	Colombia	1	143
20	Denmark	5	1155	44	Costa Rica	1	97
21	Norway	4	1144	45	Croatia (local name: Hrvatska)	1	54
22	Czech Republic	3	1065	46	India	1	46

Rank	Country Name	University	weight	Rank	Country Name	University	weight
23	Palestine	4	1029	47	Slovakia	2	42
24	Republic Of Korea	5	984	48	Iceland	1	19

## Limitations and Discussion

Changing methodology of the rankings of universities are the study's main limitations. Results which have been calculated based on each edition are not comparable. For comparing rankings of universities in different editions we should re-rank previous data with the new methodology. Characteristics of the Web are second limitation. We know search engines' results are not stable and changing continuously. Also, data sources' policies change among the time and providers lead to use new data sources for attracting web statistics. Rankings of universities which are based on web data sources only valid for the time span which they are collected and result calculated.

## Conclusion

In this paper, we introduced the new rankings of countries methods. Average rank of universities (AR) and weighting countries (W) based on their university ranks. The average rank is simple but not suitable to show a good view of countries rank. Using W in one ranking of universities in different editions shows us the result of the activities of countries to take better rank. The current study covered two universities' rankings which are very different methodologies. We compared different world universities' rankings (QS & WR) using W. The results show that the rankings of two rankings lists (WR and QS) are highly similar. On the other hand, deposit each ranking used different methods. This gives some confidence that to W is a robust algorithm to rank all countries around the world.

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