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A Simulation of the University League Table: Are you really what you are said you are?

บทคัดย่อ

ในปัจจุบันนี้การจัดอันดับของมหาวิทยาลัยได้รับความนิยมเป็นอย่างมากสำหรับผู้มีส่วนได้ส่วนเสีย อย่างไรก็ตามก็ยังมีข้อโต้แย้งจำนวนมากในเรื่องของค่าน้ำหนักของตัววัดผลที่ใช้ในตารางการจัดอันดับ การปรับเปลี่ยนค่าน้ำหนักในการจัดอันดับบ่อยครั้งทำให้ไม่สามารถที่จะเปรียบเทียบอันดับของมหาวิทยาลัยได้ในแต่ละปีและเป็นการสร้างความสับสนให้กับผู้ใช้ข้อมูลการจัดอันดับเนื่องจากจะเห็นปรากฏการณ์ในการเพิ่มขึ้นหรือลดลงอย่างมากของมหาวิทยาลัยใดมหาวิทยาลัยหนึ่งทั้งที่มหาวิทยาลัยนั้นไม่ได้มีการเปลี่ยนแปลงมากมายนัก ด้วยเหตุนี้เองผู้บริหารระดับสูงของมหาวิทยาลัยหลายแห่งเริ่มที่จะไม่ให้ความสนใจในการจัดอันดับนี้ ด้วยเหตุผลที่ว่าอันดับของมหาวิทยาลัยสามารถปรับเปลี่ยนไปได้อย่างง่ายดาย

จากปัญหาดังกล่าว การศึกษานี้ได้ใช้เทคนิคการจำลองสถานการณ์เพื่อช่วยให้ผู้ใช้ข้อมูลการจัดอันดับได้รับข้อมูลที่มีประโยชน์มากที่สุด ในการศึกษานี้ได้เลือกการจัดอันดับมหาวิทยาลัยของ The Times ในปี 2553 เป็นกรณีศึกษา ค่าน้ำหนักของตัววัดผลทุกตัวในตารางการจัดอันดับได้ถูกเปลี่ยนแปลงพร้อมๆ กัน โดยผลที่ได้รับค่าอันดับที่ดีที่สุดและแย่ที่สุดของแต่ละมหาวิทยาลัย นอกจากนี้การศึกษานี้ยังได้แสดงค่าความน่าจะเป็นที่มหาวิทยาลัยแห่งหนึ่งสามารถจะอยู่ในอันดับที่กำหนด นอกจากนี้การศึกษานี้ยังได้นำเสนอแนวทางในการวิเคราะห์จุดแข็งและจุดอ่อนของมหาวิทยาลัยซึ่งจะเป็นข้อมูลที่สำคัญสำหรับผู้กำหนดนโยบายของมหาวิทยาลัย

คำสำคัญ: การจัดอันดับ การจำลองสถานการณ์ การจัดอันดับมหาวิทยาลัย ค่าน้ำหนัก

ABSTRACT

The university league tables are increasingly popular among university stakeholders. Despite their widespread use, a number of criticisms of the tables are made, including the justification of the weighting of the measures in the table. Frequent changes in the weightings in the table make a year-on-year comparison impossible and confuse league table users by the dramatic increase or decrease in rankings of a particular university for no real reason. Because of this, senior management in many universities has decided to ignore the league tables, arguing that the league table can be easily manipulated.

Because of this problem, in this study, a simulation technique is used to aid league table users in making the best use of the information in the table. League tables published in the Times Good University Guide 2010 is selected for the case study. The weighting of every measure appearing in the table is varied simultaneously. The outcome of the simulation includes the best possible ranking and the worst possible ranking of each university. It also shows the probability that a particular university can reach a certain position in the ranking. This information can be further analysed in more detail to ascertain the relative strengths and weaknesses of a particular university, a useful tool for the university's policy makers.

Key words: Ranking, Simulation, University League Table, Weighting

INTRODUCTION

The university league tables are increasingly popular among university stakeholders. Though they are widely used, a number of criticisms of the tables arise, as being 'unreliable, that they do not measure what they claim to measure' (Bowden, 2000). The methodology of the tables are also challenged, such as the appropriateness of the variables used, the scaling of those variables, manipulation of data (Bowden, 2000), distortion of institutional purpose, quality of the variables, metrics of the variables (Yorke, 1997), data errors (Yorke, 1998), and different methodologies from different publishers (Berry, 1999).

One of the most important criticisms of the league table is the justification of the weighting of the measures in the table. In many league tables, there are changes in variables and also their weightings from year to year. Although it can be argued that changing criteria weights every year is acceptable because people's preferences are dynamic in nature, this changing makes comparison on a year-on-year basis impossible and also confuses users, as the ranking of a particular university can be made to increase or decrease dramatically simply by changing the weighting of a particular measure. It has also been found that the difference in university rankings can be explained mostly by the research variable (Yorke, 1998). This makes the league table unidimensional and suggests that the other measures are not important as far as the ordering of the university is concerned (Yorke, 1998). On the other hand, in some league tables, research and teaching, which are the main objectives of any university, are given a weighting of only 25%, which Oswald (2001) writes is 'strange at best and absurd at worst'.

Because of these reasons, senior management in many universities has made the decision to ignore the league tables, arguing that the league tables can be easily manipulated. By changing the weighting of some measures, the rank of their institutions can be increased or decreased materially. It is also argued that the league tables do not compare 'like with like' as the missions of all universities are not the same (NCIHE, 1997). Not only university policy makers but also students are struggling to obtain the correct information from the table. This is confirmed by a study by Sarrico, et al. (1997), which proposes that 'although the ... league table may be appropriate for the most able students, it is not useful in terms of assisting in the choice of university for other categories of applicants' (Sarrico et al. 1997, p. 1167).

For of all reasons stated above, in this study, the simulation technique is used to help league table users make the best use of the information from the table. Although the issues raised above about how the education philosophy is defined, the appropriateness of the variables used, manipulation of data, and the unreliability of measures are not directly addressed by the proposed simulation modeling, the modeling will at least provide more useful information for decision makers to better understand the situation of their universities.

The data is obtained from the latest university league table published in the Times Good University Guide 2010 (O' Leary, 2009). In this study, the weighting of every measure appearing in the table is varied simultaneously and a distribution of the ranking of each university is produced. The outcome of the study provides additional statistical data for each university ranking, including the mean of the ranking, the best ranking and the worst ranking of each university, as well as other statistical data that can be obtained from the ranking distribution.

The outcome of this study provides useful information to league table users. Policy makers in

the university will know how their universities actually perform by looking at the ranking distribution. Students will know how university ranking can vary. However this study cannot judge whether any particular university is really a good or bad since ”good” or “bad” is a relative measurement and it depends on the scale used. This research only proposes another way to measure the goodness and still could not address the properties inherited in multiple criteria decision making model, e.g. the appropriateness of the variables used. Nevertheless, the methodology used in this study can be applied to any university league table and will help producers of the league table provide more useful information to their readers in the future.

RANKING METHODOLOGY IN THE UNIVERSITY LEAGUE TABLE

As stated above, there are many university league tables published around the world, with The Times Good University Guide 2010 (O’ Leary, 2009) among the most popular; for these years, it is selected as the case study for this study. Based on information from the league table in the Times Good University Guide 2010, each university is judged based on eight measures: student satisfaction, research quality, entry standards, student-staff ratio, services and facilities spend per student, completion, good honours, and graduate prospects. The definition of each measure and the source of information are shown in Table 1. More details of how each indicator is calculated can be found from the Time Good University Guide 2010 (O’ Leary, 2009, pp. 38-41)

Table 1: Performance measures in the university league table
(data obtained from the Times Good University Guide 2010 (O' Leary, 2009))

Measure	Definition	Data Obtained From
Student satisfaction	A measure of students' views of the quality of their courses.	The National Student Survey (NSS).
Research quality	A measure of the quality of the research undertaken in each university.	The 2008 Research Assessment Exercise (RAE).
Entry standards	The average score, using the UCAS tariff, of new students under the age of 21 who took A and AS Levels, Highers and Advanced Highers.	HESA[1] data for 2007-2008.
Student-staff ratio	A measure of the average number of students to each member of the academic staff, apart from those purely engaged in research.	HESA data for 2007-2008.
Services and facilities spend per student	The expenditure per student on staff and student facilities, including library and computing facilities.	HESA data for 2005-2006 and 2006-2007.
Completion	The percentage of students expected to complete their studies (or transfer to another institution) for each university.	HESA performance indicators, based on data for 2006-2007 and earlier years.
Good honours	The percentage of graduates achieving a first or upper second class degree.	HESA data for 2007-2008.
Graduate prospects	The percentage of the total number of graduates who take up graduate-level employment or further study.	HESA data for 2007 graduates.

When the data is obtained for each measure, it is transformed into a Z-score by use of the following formula.

$$\text{Z-score} = (X - \mu)/\sigma$$

Where X is raw data, μ is the average of the data from every university, and σ is the standard deviation of the data. This process is to 'ensure that no indicator has a disproportionate effect on the overall total for each university' (O' Leary, 2009, pp. 38).

After conversion into a Z-score, each score is assigned a different weight. Based on the current league table, the Times assigns a weight and maximum score for each measure as shown in Table 2.

[1]HESA is the Higher Education Statistics Agency, which is the official agency for the collection, analysis and dissemination of quantitative information about higher education in the United Kingdom.

Table 2: Performance measures in the university league table and their weights and maximum score (data obtained from the Times Good University Guide 2010 (O' Leary, 2009))

Measure	Weight	Relative Weight Percentage	Maximum Score
Student satisfaction	1.5	16.67%	100.0
Research quality	1.5	16.67%	7.0
Entry standards	1.0	11.11%	N/A
Student-staff ratio	1.0	11.11%	N/A
Services and facilities spend per student	1.0	11.11%	N/A
Completion	1.0	11.11%	100.0
Good honours	1.0	11.11%	100.0
Graduate prospects	1.0	11.11%	100.0

After the weight is assigned into each measure, the overall score is then computed by adding all weighted scores and then becomes the total raw score that were transformed to a scale with 1000 for the top score (O' Leary, 2009, pp. 38).

DETERMINING THE WEIGHTS OF PERFORMANCE MEASURES IN THE LEAGUE TABLE

As previously described, this study does not aim to criticise the advantages or limitations of each measure. Its main concern is on the weights of each measure, which is the area that is of current interest. League table users often question the rationale behind the allocation of the weight of each measure. Some researchers criticise that the research assessment is heavily weighted, and therefore the difference in ranking of each university can be explained mostly by the research variable (Yorke, 1998). The others explain the rise and fall of a particular university based on the different weighting method in different years. This study therefore attempts to investigate the effect on ranking of a change in the weight, thereby providing additional useful information for league table users. Having said that, it is understandable that the simulation model cannot solve all the weighting problems and cannot be used to identify the absolutely appropriate weighting as this is subjective to the view of decision makers.

Based on the Simple-Attribute Rating Technique (SMART) developed by Edwards (1971) and SMART Exploiting Ranks (SMARTER) developed by Edwards and Barron (1994), weights can be determined by:

1. Intuitively chosen based on the judgment of the decision maker (Goodwin and Wright, 2004, p. 40).

2. Considering the range between the least- and most-preferred options for each attribute (Goodwin and Wright, 2004, p. 41). In this method, assignment of weight will depend on the importance of the change (or swing) from the least preferred to

the most preferred, based on the decision maker's judgment.

3. Ranking swing weights and use of the rank order centroid (ROC) to specify the weight (Goodwin and Wright, 2004, p. 55). This method is similar to the second method except that decision maker makes a judgment only on the ranking of swing weights and uses the ROC to specify the weight (see Edwards and Barron (1994) for more detail). The formulation used to identify the weight is as follows

$$W_i = (1/M)\sum_{n=i}^{M}\frac{1}{n}$$

Where M is the number of items and W^i is the weight for i^{th} item.

For example, if there are 4 items, the weight of the second rank item can be calculated as follows

$$W_i = (1/4)\sum_{n=2}^{4}\frac{1}{n} = (1/4)(\frac{1}{2}+\frac{1}{3}+\frac{1}{4}) = 0.2708$$

In the case of the Times Good University Guide, it is not clear how the weight for each measure is assigned. Nevertheless, for all the methods stated above, the decision makers need to justify the importance of the attribute at some point. As a result, the resulting weight is always criticised against that judgment. It is interesting to see how the weight would be different if different methods are applied, but this is beyond the scope of this study.

RESEARCH METHODOLOGY

The main research question of this paper is not to ascertain the effect of a change in weight on the university's ranking in the league table as it is a nature of multiple criteria decision making using the weighted average score, i.e. by changing weight, the ranking of university will be absolutely affected. It is also understandable that the result of multiple criteria decision making is always subjective depending upon how the decision makers perceive the importance of each criterion. However the research question of this study is simply to identify the magnitude of the effect of changing weights on university ranking, The data used in this study is the secondary data of performance measures and their associated weights obtained from The Times Good University Guide 2010 (O' Leary, 2009). After the data is obtained, it is then simulated by using the Monte Carlo simulation technique, a 'technique for selecting numbers randomly from a probability distribution (i.e. "sampling") for the use in trial (computer) run of simulation' (Taylor III, 207, pp. 566) in order to identify the magnitude of the effect of changing weight on the ranking as stated above. The variable in this study is therefore the weight for each measure in the league table. The spreadsheet add-in, @Risk, is used as a simulation tool. The number of trials used in this simulation is 10,000. For each trial, weight of each indicator is simulated according to uniform distribution with the minimum value of 0 and the maximum value of 1. It is noted that the sum of weights are not equal to one but this is not a problem as the main focus is the relative weight not the absolute value. The reason of using uniform distribution for each weight is that each weight should have the equal chance to be selected. Thus in each trial, eight different weights are assigned by the same probabilities in uniform distribution and the total score is automatically calculated and the ranking of each university is then obtained. After the simulation, the data is then analysed based on the descriptive statistics, which include the maximum, the minimum, and the average of the ranking of every university appearing in the league table. Linear programming is also performed to identify the best or worst solution. In this study, the linear programming is used to identify the weight of each indicator to yield the best and worst university ranking. It thus helps university

knows the situation (i.e. the weight of each indicator) that provides the best and worst possible results. More details of the linear programming method can be found in Ragsdale (2008).

RESULTS OF THE SIMULATION

The results of the simulation of the university ranking are reported in Table 3.

Table 3: The results of the simulation of the university ranking

University	Existing Ranking	Ranking from Simulation				Difference from Actual Ranking
		Best Ranking	Worst Ranking	Average Ranking	Ranking Based on Average Ranking	
Oxford	1	1	7	1.1	1	0
Cambridge	2	1	6	2.0	2	0
Imperial College	3	1	54	3.2	3	0
St Andrews	4	3	25	5.2	5	-1
University College London	5	1	28	5.0	4	1
Warwick	6	4	28	6.0	6	0
London School of Economics	7	1	78	6.8	7	0
Durham	8	4	33	8.8	8	0
Exeter	9	2	60	13.3	13	-4
Bristol	10	5	67	9.1	9	1
York	11	6	52	12.5	11	0
King's College London	12	5	40	11.1	10	2
Bath	13	7	37	13.4	14	-1
Edinburgh	14	3	67	12.8	12	2
Leicester	15	5	35	15.7	16	-1
Southampton	15	12	24	15.4	15	0
Loughborough	17	2	54	21.1	22	-5
Shefeld	18	11	44	17.6	17	1
Glasgow	19	12	41	20.3	20	-1
Nottingham	20	8	40	18.0	18	2
Newcastle	21	12	34	19.5	19	2
Birmingham	22	13	39	20.8	21	1
Lancaster	23	12	74	24.2	24	-1
Manchester	24	12	78	24.0	23	1
Aston	25	13	49	30.0	29	-4

Table 3: The results of the simulation of the university ranking (Cont.)

University	Existing Ranking	Ranking from Simulation				Difference from Actual Ranking
		Best Ranking	Worst Ranking	Average Ranking	Ranking Based on Average Ranking	
Cardiff	26	17	47	27.6	26	0
Leeds	27	19	54	28.3	28	-1
Liverpool	28	7	40	27.3	25	3
East Anglia	28	7	56	31.1	32	-4
Royal Holloway	30	16	54	30.8	30	0
Reading	31	12	69	32.8	35	-4
Queen's Belfast	32	15	51	30.9	31	1
Aberdeen	33	8	89	34.7	36	-3
School of Oriental and African Studies	33	3	90	27.7	27	6
Sussex	35	4	67	31.2	33	2
Queen Mary London	36	11	49	32.7	34	2
Surrey	37	11	53	36.1	37	0
Strathclyde	37	17	80	36.6	38	-1
Kent	39	8	56	40.5	39	0
Heriot-Watt	40	25	75	41.7	42	-2
Dundee	41	20	107	41.7	42	-1
Keele	42	26	51	40.8	40	2
Essex	43	18	82	42.6	43	0
Hull	44	8	75	46.5	46	-2
Goldsmiths College	45	10	104	45.3	44	1
Aberystwyth	46	8	113	50.2	50	-4
Brunel	47	14	90	46.5	46	1
Stirling	48	24	85	48.3	48	0
City	49	10	90	47.9	47	2
Swansea	50	20	97	49.6	49	1
Robert Gordon	51	4	80	50.4	51	0
Oxford Brookes	52	28	77	51.1	53	-1
Bradford	53	37	68	50.5	52	1
Ulster	54	17	88	54.0	54	0
Bangor	55	28	77	55.4	55	0

Table 3: The results of the simulation of the university ranking (Cont.)

University	Existing Ranking	Ranking from Simulation				Difference from Actual Ranking
		Best Ranking	Worst Ranking	Average Ranking	Ranking Based on Average Ranking	
Portsmouth	56	14	85	59.4	57	-1
Nottingham Trent	57	32	72	56.1	56	1
Bournemouth	58	29	102	60.7	58	0
Chichester	59	8	100	65.8	64	-5
Glasgow Caledonian	60	38	103	67.2	66	-6
Queen Margaret Edinburgh	61	42	93	61.9	59	2
West of England	62	40	83	65.1	62	0
Plymouth	63	44	103	62.2	60	3
Northumbria	64	36	93	65.4	63	1
Edinburgh Napier	65	38	104	65.9	65	0
Hertfordshire	66	12	106	63.6	61	5
De Montfort	66	28	93	68.7	68	-2
Gloucestershire	68	45	94	68.1	67	1
Shefeld Hallam	69	56	89	69.9	69	0
Brighton	70	53	105	71.0	71	-1
Coventry	71	54	97	70.6	70	1
Bedfordshire	71	24	105	74.7	76	-5
Winchester	73	28	109	72.6	73	0
Staffordshire	74	40	108	73.7	74	0
Bath Spa	74	28	109	72.5	72	2
UWIC Cardiff	76	41	95	79.4	79	-3
Birmingham City	77	40	97	76.1	77	0
Central Lancashire	78	40	103	83.7	83	-5
Lampeter	79	29	114	74.6	75	4
York St John	80	54	100	80.5	80	0
Worcester	81	40	108	83.5	82	-1
Teesside	81	28	109	86.9	88	-7
Cumbria	83	34	112	79.1	78	5
Salford	84	56	94	82.1	81	3
Sunderland	84	28	109	86.4	87	-3

Table 3: The results of the simulation of the university ranking (Cont.)

University	Existing Ranking	Ranking from Simulation				Difference from Actual Ranking
		Best Ranking	Worst Ranking	Average Ranking	Ranking Based on Average Ranking	
Lincoln	86	51	111	87.6	89	-3
Hudderseld	87	46	104	84.3	84	3
Edge Hill	88	20	111	90.9	94	-6
Kingston	89	61	96	84.6	85	4
Manchester Metropolitan	90	63	96	84.8	86	4
Chester	91	68	109	88.0	90	1
Roehampton	92	38	105	88.8	91	1
Northampton	92	54	106	93.4	96	-4
Glamorgan	94	60	111	92.2	95	-1
Abertay	95	11	112	89.6	93	2
University of the Arts London	96	44	114	89.5	92	4
Glyndwr	97	53	111	98.3	97	0
Canterbury Christ Church	98	68	114	98.5	98	0
Liverpool John Moores	99	71	110	99.3	99	0
Westminster	100	48	113	99.8	100	0
Leeds Metropolitan	101	68	111	100.1	101	0
Wolverhampton	102	67	113	102.6	103	-1
Anglia Ruskin	103	65	114	100.4	102	1
Derby	104	64	112	103.9	105	-1
Middlesex	105	10	114	103.5	104	1
Greenwich	106	78	114	108.1	109	-3
UWCN Newport	107	74	114	109.3	110	-3
Bolton	108	54	114	108.1	109	-1
East London	108	37	114	106.9	107	1
Thames Valley	110	78	114	110.2	112	-2
Southampton Solent	111	71	114	110.4	113	-2
Buckinghamshire New	112	59	114	110.1	111	1
London South Bank	113	77	114	112.0	114	-1
University for the Creative Arts	114	63	114	105.2	106	8

Based on the results shown in Table 3, the league table users now can see a more active picture of each university's ranking. For example, the University of Edinburgh, the 14th ranked university in the Times league table, can have a ranking as high as 3rd and as low as 67th. This information answers the criticism of the league table regarding the change of weight in each measure. The high-ranked universities are now aware of the potential downside, while the low-ranked universities can estimate their potential upside in the league table when the weights are changed. Weight is no longer the issue since it can be varied. Universities then cannot simply put the blame on the difference of weighting when their rankings are low, as it now becomes clear how good or poor these universities can be.

The output of the simulation is not limited to the best or the worst ranking. The results can also provide information about the probability of each university's achievement of a certain ranking. This becomes possible because the output of the simulation also includes the distribution of each university's ranking. Based on that distribution, it now becomes possible to estimate the probability of a university's reaching a certain ranking in the league table. However the results presented here do not mean that the university should try to get higher ranking by changing weights on particular measures. It is also understandable that to get a higher position, universities should focus on improving their performance with respect to the highly regarded criteria, regardless of how each criterion weight is generated and the ultimate goal is to do the best on important criteria, as far as the weights can be explicitly elicited. The results only suggest that some good universities such as Oxford and Cambridge perform well in almost every criteria, thus weighting is not issues for their ranking. On the other hand, some universities such as Exeter is included in top ten ranking because it performs well in few criteria thus its ranking will be significantly affected if the weights of those measures are changed.

Table 4 shows the probabilities that existing top-ten universities are likely to be included in the top-ten ranking based on results from the simulation.

Table 4: The probabilities that existing top-ten universities are likely to be in the top-ten ranking based on the simulation

University	Probabilities to be Included in Top-Ten Ranking
Oxford	100%
Cambridge	100%
Imperial College	99.76%
St Andrews	99.96%
University College London	99.81%
Warwick	99.75%
London School of Economics	91.92%
Durham	90.79%
Exeter	30.28%
Bristol	82.57%

By performing linear programming, each university can also further investigate situations that are most favourable or least favourable to its ranking. For example, based on the results of the simulation, the University of Edinburgh can be in the 3rd rank (its highest possible ranking) or in the 67th rank (the lowest possible ranking) when relative weights are assigned to each measure as shown in Table 5.

Table 5: Relative weights of the best and worst rankings of the University of Edinburgh.

Measure	Weight Percentage for the Best Ranking	Weight Percentage for the Worst Ranking
Student satisfaction	0%	100%
Research quality	100%	0%
Entry standards	0%	0%
Student-staff ratio	0%	0%
Services and facilities spend per student	0%	0%
Completion	0%	0%
Good honours	0%	0%
Graduate prospects	0%	0%

Table 5 can be interpreted as showing that the University of Edinburgh is relatively very strong in research quality and relatively less strong in student satisfaction. This information is useful for policy makers in the University, as it can be used to implement further development in areas that need work. Nevertheless, please note that this multiple criteria decision making model is always subject to two elements: 1) criterion weights and 2) performance on each criterion. Thus, if the weight (importance level) of each criterion can be derived, university's task is to do their best on the highly weighted criteria regardless. Furthermore it can be broken down for detailed analysis of the relative strengths and weaknesses of a particular university, a useful tool for policy makers. However what the policy makers should do is to do the best on the highly regarded criteria not by hoping that the weight will be changed according to their preference. Finally, it is expected that the results of this study will provide useful information to league table users and also assist league table providers to further develop their league tables to become more interesting and informative.

CONCLUSION

The simulation of the league table can provide additional perspectives for users by showing the best possible ranking and the worst possible ranking. It also shows the probability that a particular university can reach a certain position in the ranking.

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