Impact factor versus Q1 class of journals in world university rankings

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University ranking has become an important subject in recent years, to the extent that it has changed the landscape for tertiary education in many countries, particularly in the Orient. The appointment of a university head may hinge on its results, which are published every year. Students looking for a place to study invariably will refer to the rankings as their guide for choosing a particular university. The latter is probably more evident in the East as recent political events and upheavals, over the last decade or so, and the 9/11 attacks on the twin towers of the World Trade Center in the United States of America, have resulted in many foreign students looking to the East for continuing their university education. It offers a golden opportunity for a number of Asian universities to attract these students to study in their country, as North America and Europe tighten their intake of foreign students, particularly from the Middle East and Asia. Furthermore, the economics of higher education has led to many governments and their students to study in Asian universities where the cost of education is much lower. As a result of these global changes the world university rankings, of which there are several now in place, have become more significant and play an important part in guiding foreign students to the universities of their chosen subject or field. It helps the students to make decisions about joining a particular university for their higher education and training. Although there are several agencies involved in university rankings, we will confine our discussion to the arguably more popular world university rankings conducted by QS Quacquarelli Symonds Limited.

One of the six criteria used in the QS ranking is based on the number of citations per faculty member. Ideally the number of citations a journal obtains reflects the quality of its papers, namely higher citations for journals in which new discoveries and findings are reported and published. Thus these journals command high respect in a particular field and therefore are highly cited. *Journal Citation Reports*[1] or *JCR* categorizes these journals with the help of an indicator, known as the 'impact factor' (IF), which describes the quality and popularity of a journal based on the number of citations it receives and accumulates in a year. It indicates how many times the papers in a particular journal are cited by other journals. It is increasingly being regarded as the key indicator of the quality of science being published in the journals. As a result, the IF of a journal has been taken as an indicator of the quality of scholarship that is being produced and features importantly as a selection criterion in several exercises either for students aiming for a postdoctoral fellowship or a lecturer applying for promotion to a higher position in academic and research institutions.

Based on the *JCR* database, journals are further categorized into four different tiers, namely Q1, Q2, Q3 and Q4, which apparently is supposed to indicate their quality or tier in ranking. This is done based on the number of citations and the IF of the journal concerned. It has led to many anomalies and inconsistencies which are discussed and presented below.

Classification into categories

All the journals included in the *JCR* database have been classified into 176 categories (see Table S1 – Supplementary material). Table S1 shows these categories along with the total number of journals in each category. The information about the highest IF achieved in a category with the name of the journal is included in the last two columns of the table. As can be seen from Table S1, there is a lack of consistency in the number of journals distributed in the different categories. For example, some categories may have a large number of journals under them, e.g. 290 journals are grouped under the 'Biochemistry and Molecular Biology' category and 289 under the 'Mathematics' category, whereas the smallest collection of journals, as low as 6, belongs to the 'Andrology' category and 10 under 'Microscopy'.

We have analysed this distribution by making groups of journals in a demarcation of 10 or 20 falling in different categories. Figure 1 shows the distribution of categories based on the number of journals in a denominator of 10 or 20 in these categories. As is shown in the figure, the number of categories decreases with increasing number of journals in a category. There are a large number of categories with a small number of journals in them. For example, there are 32 categories comprising 21–30 journals. On the other hand, the number of categories comprising 161 and more journals is equal or less than five. This shows that there is unequal distribution of journals in the different categories.

Impact factor of journals in categories

Figure 2 shows a plot between the highest IF of a journal in a category and number of journals in that category.

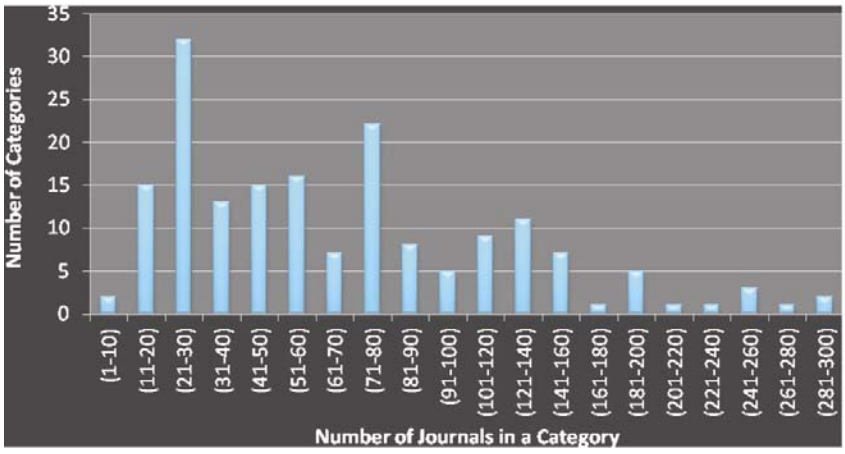

Figure 1. Distribution of categories based on the number of journals in a category.

Table 1. Journals categorized as Q1 but with low IFs

Category	No. of journals	Journal	Impact factor
Acoustics	30	*Phonetica*	1.600
Agricultural Economics and Policy	15	*Journal of Agricultural Economics*	1.551
Agriculture, Dairy and Animal Science	55	*Journal of Reproduction and Development*	1.459
Agriculture, Multidisciplinary	57	*Irish Journal of Agricultural and Food Research*	1.000
Agronomy	80	*Weed Science*	1.733
Computer Science, Cybernetics	20	*Biological Cybernetics*	1.586
Computer Science, Theory and Methods	99	*Journal of Heuristics*	1.262
Emergency Medicine	24	*American Journal of Emergency Medicine*	1.976
Engineering, Aerospace	27	*Aerospace Science and Technology*	0.983
Engineering, Civil	118	*Smart Structures and Systems*	1.231
Engineering, Geological	30	*Engineering Geology*	1.242
Engineering, Marine	14	*Journal of Navigation*	0.613
Engineering, Mechanical	122	*Probabilistic Engineering*	1.245
Engineering, Multidisciplinary	90	*Precision Engineering*	1.167
Engineering, Ocean	15	*Ocean Engineering*	1.178
Engineering, Petroleum	24	*SPE Reservoir Evaluation and Engineering*	0.944
Horticulture	32	*Euphytica*	1.554
Imaging Science and Photographic Technology	21	*IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*	1.489
Limnology	19	*Journal of Paleolimnology*	1.898
Logic	19	*Journal of Logic and Computation*	0.611
Materials Science, Ceramics	25	*International Journal of Applied Ceramic Technology*	1.384
Materials Science, Characterization and Testing	32	*Mechanics of Time-Dependent Materials*	1.109
Materials Science, Coatings and Films	18	*Thin Solid Films*	1.890
Materials Science, Composites	24	*Composites, Part B – Engineering*	1.731
Materials Science, Paper and Wood	21	*Journal of Wood Chemistry and Technology*	1.260
Materials Science, Textiles	21	*Journal of Engineered Fibers and Fabrics*	0.889
Medical Ethics	17	*Bioethics*	1.598
Mining and Mineral Processing	23	*Minerals Engineering*	1.352
Multidisciplinary Sciences	56	*Journal of the Royal Society of New Zealand*	1.933
Nuclear Science and Technology	35	*IEEE Transactions on Nuclear Science*	1.447
Operations Research and Management Science	77	*Safety Science*	1.402
Ornithology	21	*Journal of Ornithology*	1.636
Otorhinolaryngology	41	*Current Opinion in Otolaryngology & Head and Neck Surgery*	1.826
Remote Sensing	24	*International Journal of Applied Earth Observation and Geoinformation*	1.744
Soil Science	33	*Soil Science Society of America Journal*	1.979
Statistics and Probability	116	*Statistics and Computing*	1.429
Telecommunications	79	*IEEE Transactions on Broadcasting*	1.703
Transportation Science and Technology	28	*IEEE Transactions on Vehicular Technology*	1.921
Zoology	146	*Journal of Experimental Zoology Part A: Ecological Genetics and Physiology*	1.642

Source: 2011 Journal Citation Reports ® Science Edition (Thomson Reuters, 2011).

Although the distribution seems to be scattered, an average line shows a positive correlation between these variables. In other words, the IF of a journal increases with increasing number of journals in a category. Categories with lesser number of journals (< 100) show a mixed response, more oriented towards a lower IF. On the contrary, categories with a high number of journals (> 100) show relatively higher IFs.

Journal classification

As mentioned above, one of the important features in the *JCR* database is the characterization of journals into different tiers namely, Q1, Q2, Q3 and Q4. Table 1 lists the names of journals categorized as Q1, under the different categories, with low IFs (< 2.00). Of particular mention in the list is the *Journal of Logic and Computation*, which has an IF of 0.611 and is characterized as a Q1 journal in the 'Logic' category which has a total of 19 journals. Similarly, the *Journal of Navigation* (IF = 0.613), *Journal of Engineered Fibers and Fabrics* (IF = 0.889), *SPE Reservoir Evaluation and Engineering* (IF = 0.944) and *Aerospace Science and Technology* (IF = 0.983) are Q1 journals with an IF less than one. Interestingly, 27 out of a total of 39 journals shown in Table 1 belong to categories with less than 50 journals. On the other hand, in the category for 'Biochemistry and Molecular Biology', only journals with an IF of 4.405 and above, for example, *Biochimica et Biophysica Acta* (category Gene Regulatory Mechanisms), are placed in the Q1 tier (or rank).

Multiple classifications of journals

Another difficulty encountered is the classification of the same journal under different categories, whereby it may

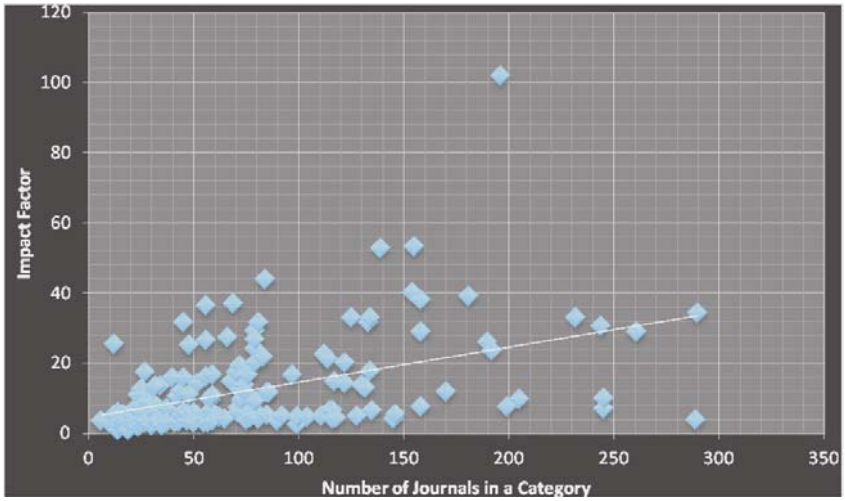

Figure 2. Plot showing correlation between the highest impact factor of a journal and number of journals in a category.

acquire a high rank in a particular category but a lower rank in another category. For example, *Statistical Applications in Genetics and Molecular Biology*, with an IF of 1.517 has been recognized as Q1 in the 'Statistics and Probability' category, but is ranked Q4 in the category, 'Biochemistry and Molecular Biology'.

These anomalies can become an obstacle for improving the quality of science, as scientists seeking to get Q1 publications, will invariably publish their research findings in journals with low IF that are categorized as Q1. In world university rankings, a journal that has been characterized as Q1 in a particular category and Q4 in a different category will be recognized as a Q1 journal. As more research scientists and academic staff in the different academic and research organizations worldwide come under increasing pressure to publish in high-tier journals, they will more often than not opt for the easier option of publishing their research in low IF journals that are characterized as Q1. There will be a shift in scientific publications moving towards low IF journals and this does not augur well for the future of scientific research. In view of the above facts, there is a need to revisit the classification of journals into the different tiers to ensure it gives a true reflection of the quality of the journals to safeguard the standard of science throughout the world.

1. 2011 Journal Citation Reports ® Science Edition, Thomson Reuters, 2011.

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