Top mathematicians of the world!

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Introduction

Essential Science Indicators (ESI) as a product of Thomson Reuters measures scientific performance in a 10-year period. It has published a list of Highly Cited Researchers 2014 in 21 various discipline. These persons have been selected as "well-established scientists" since they are in the top one percent by total citations in a given field. It is claimed that it identifies significant trends in the sciences and social sciences. Among 3216 scientists there are 99 mathematicians; cf. http://highlycited.com/.

We should notify that our investigation does not criticize the researchers but rather we challenge the criterions and the ways of ranking.

World distribution of highly cited mathematicians

Distribution of mathematicians (counted as first or second affiliations) around the world wide is presented in Table (1).

Country	Number	Country	Number
USA	42	Italy	2
Saudi Arabia	26	Spain	2
China	18	Serbia	2
UK	5	South Korea	2
France	4	Norway	1
Switzerland	4	Ireland	1
Iran	4	Malaysia	1
Germany	3	Jordan	1
Australia	3	Austria	1

Table (1)

The strange point is the situation of Saudi Arabia including the affiliations of 26 of 99 mathematicians!

Subject distribution of highly cited mathematicians

The main mathematics subject classifications of these mathematicians are recognized as in Table (2).

MSC number	Mathematics Subject	Number of Mathematicians
17	**Nonassociative rings and algebras**	**2**
18	**Category theory; homological algebra**	**1**
22	**Topological groups, Lie groups**	**1**
34	**Ordinary differential equations**	**12**
35	**Partial differential equations**	**14**
37	**Dynamical systems and ergodic theory**	**1**

39	**Difference and functional equations**	**1**
41	**Approximations and expansions**	**1**
42	**Fourier analysis**	**1**
47	**Operator theory**	**12**
48	**Calculus of variations and optimal control; optimization**	**1**
57	**Manifolds and cell complexes**	**2**
60	**Probability theory and stochastic processes**	**3**
62	**Statistics**	**28**
65	**Numerical analysis**	**7**
68	**Computer science**	**1**
76	**Fluid mechanics**	**2**
86	**Miscellaneous**	**1**
90	**Operations research, mathematical programming**	**1**
92	**Biology and other natural sciences**	**6**
94	**Information and communication, circuits**	**1**

Table (2)

As one can observe, the mathematicians are not uniformly distributed among 62 main subjects of mathematics (MSC2010). This is not to be expected, since ESI uses total citation and there are more papers in Differential Equations than in, e.g., Category Theory. In more pure subjects, there are a few selected mathematicians. Moreover, about 28% of 99 mathematicians are working in Statistics and about 26% in Differential Equations (Partial or Ordinary). Even in a certain subject one may see that most of mathematicians are working in a special filed. For instance, 12 of 99 mathematicians are working in “Operator Theory” (MSC47) and 10 of them indeed are do researches in the filed “Fixed Point Theory”. Probably there are similar situations in other subjects. Are these special fields, like fixed point theory, really “significant trends “ or “research fronts” in mathematics?

A fair way may be that ESI makes a partition of all mathematics subject classifications to about 6 categories and then select top 1% mathematicians in each category.

Citation

There has been ever a struggle between quantity and quality of research papers. Absolutely, both quality and quantity are important but in an ultimate judgment quality is preferred.

Nowadays several essential tools for assessing quality are based on academic citations. Unfortunately, whenever a measure is put in place, some people find ways to circumvent it. Among highly cited scientists, one can find persons who are selected due to a lot of self-citations (i.e. citations done by the author himself/herself). For example, ten top cited papers in MathSciNet of one of these 99 mathematicians have been received a total of 217 citations among which there are 118 self-citations. This means that 54% of citations are self-citations, in other words, more than half of the references to these ten top papers come from the author's own papers. Was it possible that he had been still selected as an influential researcher without considering the self-citations?! Even one of these 99 top mathematicians had about 30 papers in one year in an ISI- journal. It is worthy to note that there are highly cited mathematicians being in the list because of existence of non-self-citations (i.e. citations of their papers by other researchers). To have a fair judgment, we propose ESI to use non-self-citations instead of total citations for introducing highly cited researchers.

In the developing countries, there are many mathematicians who cannot do “hard mathematics” due to existence of a lot of serious problems in their countries as well as poor scientific training. They have to publish many papers either to obtain rewards or to avoid of academic perish! On the other hand, there are fields in which writing and publishing of papers is rather easy. To write papers in such “easily-producing-paper” fields highly increases the citations to such papers. Hence persons working in such subjects have more chances to be selected as top mathematicians.

Although among highly cited mathematicians there is a Fields medalist (Terence Tao) who has played key roles in creation of significant ideas, some of the highly cited authors have no paper in the prestigious list of top 50 journals of MathSciNet. If we assume that publications in top journals of MathSciNet determine the main stream of mathematics, one can discuss how these top mathematicians influence mathematics.

We should note that any attempt to correct the system may quickly lead to "adjustment" of people whose main goal is to have high citation index and not real scientific quality of their research.

Impact factor

In some countries, the administrators often classify journals into a few classes based merely on the impact factors of journals, when they want to evaluate researchers for hiring or promoting, or give them some fund. They then assign certain points to papers according to their classifications and simply count points but have no enough attention on the contents of papers! There are some journals, in particular business-open-access journals, which their impact factors have been greatly increased in the recent years by self-citations. Such journals seek rich customers and rich governments which pay for publications in order to show that they are promoting and developing!

To show the situation, we use the so-called Mathematics Citation Quotient (MCQ) computed by MathSciNet in 2013, which is the average number of times that the papers of the issues from 2008 to 2012 of a journal have been cited in 2013. Let us choose one of open-access journals in mathematics. The number of items published in the journal from 2008 to 2012 is 624. The number of citations to journal is 472, so its MCQ is 472/624=0.62. Among 472 items there are at least 325 self-citations! A large ratio: 68% self-citation!

Conclusion

We should separate quantity and quality of papers when we evaluate researchers or researches. Each of them has its worthiness for scientific assessment. Choosing one of them without having a deep look at the other is incomplete and may pervert us. A combination of both seems to be defensible.

For quantity, introducing a selected list of papers (e.g. 5 or 10 items) is examined to be good (this is also what NSF implicitly does). This would help diminishing the publication of many easy papers as they would not be counted.

For quality, we can really base our assessment on our knowledge of the whole body of mathematical literature. More precisely, we can rely on a combination of the following items:

1. Originality of works of the mathematician together with their depth and extent.

2. The prestige of journals (and their impact factors) in which the mathematician published his/her papers.
3. The number of citations as well as the reputation of persons and journals citing the works of the mathematician.
4. The global view of community of famous mathematicians about works of the mathematician.
5. Interaction in editorial board of prestigious journals.
6. Applications of the works of the mathematician in mathematics and other disciplines.

Although some of above factors are subjective but the assessment of several well-established mathematicians in a committee together with a use of bibliometrics as objective tools can reduce the deficiency of subjectivity and provide a favorable scholarly judgment.

The first world countries often act as above but the developing countries seldom. As evidence, one can observe that awarded mathematicians or plenary speakers of the International Congress of Mathematicians (ICM) and the European Congress of Mathematics (ECM) are not necessarily people having a lot of papers or having huge citations. In developing countries, the situation is rather complicated due to there is neither established evaluation system (original scientific traditions) nor enough well-known experts for assessment.

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