Measuring hot topics in sciences

Since the *h*-index[1] was introduced in 2005, it has been mainly applied to evaluate scientists[2,3]. However, this application does not in itself lead to improvements or progress in academic research. A search in *Web of Science* (*WoS*) reveals that there are different *h*-indices on different topics, which provide meaningful metrics in scientific studies for measuring hot topics[4,5].

Following the definition of original *h*-index, we can define a hot-degree for measuring the hot topics (including titles, subjects, keywords and so on) in sciences, as follows: 'The hot-degree of a topic is equal to *H*, if *H* is the largest number of publications each with citations at least equal to *H* on the study of the topic'.

Simply, *H* of a topic means that there are *H* publications at most, each with *H* citations at least, on the topic. Some values of *H* for various topics are: Cosmos, 62; Dark energy, 222; Dark matter, 292; Higgs, 204; Quantum gravity, 172; Human brain, 516 and Human genome, 457 (data from 3 November 2012, *WoS*).

Also, *H* can be searched on titles. In *WoS*, title *H* will be smaller than corresponding topic *H*, because topic indexing covers title in the database.

Obviously, each topic (including title, subject, etc.) has its unique *H* and is database-related. Different databases will give different results as there are differences in their data indexing, so that there are different numbers of *H* values in databases *WoS* and *Scopus*. However, as the *h*-index is robust, the differences of *H* will be small when we search by similar paths. For example, when we search same words on 'title' in *WoS* and on 'article title' in *Scopus*, the results of their *H* values, separately as *H-WoS* and *H*-Scopus, are shown in Figure 1 (*WoS* contains *SCI*, *SSCI* and *AHCI*; *Scopus* includes all subject areas; both cover all years).

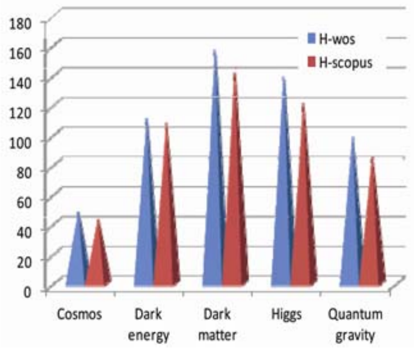

Figure 1. Different databases give different *H* values.

Although different databases give different results, their highly cited papers get most coherence. (We list the top 1 papers in the physical sciences searched by titles in Appendix 1, in which most records are in coherence, with one exception.)

The *H* is also time-related. Let *P* be total publications and *C* total citations, then we have similar dynamic formula[6] of *h*-index as follows, in the Lotkaian informetric system[7]. If there exists a power law relation between *P* and *C* (Heaps law or Herdan law), it is generally correct[8].

$$H = ((1 - a^t)^{\alpha - 1})P^{1/\alpha}, \qquad (1)$$

where *a* is the ageing rate and α is the exponent of Lotka's law. According to eq. (1) for definite *a* and α, *H* will increase quickly in the beginning and become almost stable in the end.

Concluding, the hot-degree *H* could become an effective indicator for measuring hot topics. Higher the *H* value of a topic, more will be the studies on the topic and more will be its impact. With *H* values, we may investigate the hot topic distribution of research in the academic field, which would benefit topic selection and could stimulate truly scientific studies and academic progress.

Appendix 1. Top 1 papers in the physical sciences

Title 1: Cosmos
Scoville, N. *et al.*, The Cosmic Evolution Survey (COSMOS): Overview. *Astrophys. J., Suppl. Ser.*, 2007, **172**(1), 1–8; *WoS* citations: 357; *Scopus* citations: 326.

Title 2: Dark energy
Riess, A. G. *et al.*, Type Ia supernova discoveries at $z > 1$ from the hubble space telescope: Evidence for past deceleration and constraints on dark energy evolution. *Astrophys. J. Lett.*, 2004, **607**(2I): 665–687; *WoS* citations: 2004; *Scopus* citations: 1868.

Title 3: Dark matter
Navarro, J. F., Frenk, C. S. and White, S. D. M., The structure of cold dark matter halos. *Astrophys. J. Lett.*, 1996, **462**(2 Part I), 563–575; *WoS* citations: 2565; *Scopus* citations: 2348.

Title 4: Higgs
WoS record top 1: Lee, B. W., Quigg, C. and Thacker, H. B., Weak interactions at very high-energies – role of Higgs-boson mass. *Phys. Rev. D*, 1977, **16**, 1519–1531; *WoS* citations: 936.

Scopus record top 1: Peskin, M. E. and Takeuchi, T., New constraint on a strongly interacting Higgs sector. *Phys. Rev. Lett.*, 1990, **65**(8), 964–967; *WoS* citations: 856; *Scopus* citations: 586.

Title 5: Quantum gravity
Arkani-Hamed, N., Dimopoulos, S. and Dvali, G., Phenomenology, astrophysics, and cosmology of theories with submillimeter dimensions and TeV scale quantum gravity. *Phys. Rev. D*, 1999, **59**, 1–21; *WoS* citations: 1541; *Scopus* citations: 1220.

1. Hirsch, J. E., *Proc. Natl. Acad. Sci. USA*, 2005, **102**, 16569–16572.
2. Ball, P., *Nature*, 2005, **436**, 900.
3. Acuna, D. E. *et al.*, *Nature*, 2012, **489**, 201–202.
4. van Raan, A. R. J., *Measurement*, 2005, **3**, 50–62.
5. Banks, M. G., *Scientometrics*, 2006, **69**, 161–168.
6. Egghe, L., *J. Am. Soc. Inf. Sci. Technol.*, 2007, **58**, 452–454.
7. Egghe, L., *Power Laws in the Information Production Process: Lotkaian Informetrics*, Elsevier, Amsterdam, 2005.
8. Ye, F. Y., *J. Am. Soc. Inf. Sci. Technol.*, 2011, **62**, 205–207.

FRED Y. YE

School of Information Management,
Nanjing University,
Nanjing 210 093, China
e-mail: yye@nju.edu.cn