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A bibliometric index based on the complete list of cited Publications

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Abstract

We propose a new index, the *j*-index, which is defined for an author as the sum of the square roots of the numbers of citations to each of the author's publications. The idea behind the *j*-index it to remedy a drawback of the *h*-index - that the *h*-index does not take into account the full citation record of a researcher. The square root function is motivated by our desire to avoid the possible bias that may occur with a simple sum when an author has several very highly cited papers. We compare the *j*-index to the *h*-index, the *g*-index and the total citation count for three subject areas using several association measures. Our results indicate that that the association between the *j*-index and the other indices varies according to the subject area. One explanation of this variation may be due to the proportion of citations to publications of the researcher that are in the *h*-core. The *j*-index is not an *h*-index variant, and as such is intended to complement rather than necessarily replace the *h*-index and other bibliometric indicators, thus providing a more complete picture of a researcher's achievements

Keywords

h-index, *g*-index, *j*-index

Introduction

In a broad sense, the number of publications of a researcher is a measure of quantity and the total number of citations to these publications is often perceived as a measure of quality. Although these metrics each take into account only one facet of a researcher's impact, several other bibliometric indices, such as the *h*-index and the *g*-index, combine citation and publication counts. However, the *h*-index and its derivatives (Bornmann, Mutz, Hug, & Daniel, 2011) have the drawback that they do not take into account the full citation list of a researcher, but, on the other hand, the total citation count has the drawback of biasing the index in favour of researchers with very highly cited top papers or very many papers with a relatively small number of citations. We first briefly review the *h*-index and some of its variants, and then introduce the *j*-index, a new index that addresses some of the drawbacks mentioned.

The *h*-index of a researcher is the maximum number *h* of the researcher's publications that each have at least *h* citations (Hirsch, 2005). As an equivalent definition, rank a researcher's publication list in descending order of the number of citations, with paper *i* receiving *C(i)* citations. The *h*-index is then the largest rank *h* for which $C(h) \geq h$. The *h*-index is completely insensitive to the fact that a researcher's top few papers are very highly cited, and conversely also to a researcher having many papers with very few citations (Bornmann & Daniel, 2007). A suggested improvement over the *h*-index, which gives more weight to highly cited papers, is the *g*-index. The *g*-index of a researcher is the largest rank *g* for which $\sum_{i=1}^{g} C(i) \geq g^2$ (Egghe, 2006); it is easily shown that $g \geq h$. A problem with the *g*-index is that it may still be biased since, if a researcher has a few papers that are very highly cited and the rest have very few citations, the *g*-index will still be high. This is because the *g*-index is equal to the largest rank *g* such that the average number of citations up until that rank is at least *g*. (Note that we consider the variant of the *g*-index that is not limited by the actual number of publications, i.e. fictitious papers with zero citations may be added to satisfy the definition of the *g*-index (Egghe, 2006).) If the *h*-index of a researcher is *h*, the *h*-core is the set of her/his *h* most highly cited publications. (It is irrelevant which of the publications with exactly *h* citations are chosen.) Another attempt to try and address the fact that the *h*-index does not take into account the total number of citations to papers in the *h*-core is via the *A*-index, which is the average number of citations to papers in the *h*-core, i.e. $A = {}^{1}/_{h} \sum_{i=1}^{h} C(i)$ (BiHui, LiMing, Rousseau, & Egghe, 2007). However, the *A*-index suffers from the fact that taking an average will, all other things being equal, often favour authors with fewer publications when they are highly cited. To remedy this, the *R*-index has been proposed, where $R = \sqrt{\sum_{i=1}^{h} C(i)} = \sqrt{Ah}$ (BiHui et al., 2007). It is easy to see that $h \leq R \leq A$. However, the *A* and *R* indices, and to a lesser extent the *g*-index, ignore the effect of papers outside the *h*-core, which are also part of a researcher's output.

In this paper we take a step towards defining an index that takes into account both the quantity and the quality of a researcher's output as reflected by the citation data, but that does not suffer from the drawbacks of simply counting the number of citations. On the one hand, the issue of quantity is addressed by an index which considers all of a researcher's cited papers, so that each cited output contributes towards the index. On the other hand, the issue of quality is addressed by applying a function to the numbers of citations that has the effect of reducing the impact of very highly cited papers, which tends to bias the values of many bibliometric indices. As an example, consider a researcher α who published a single paper with 100 citations compared to a researcher β who published 10 papers, each having 10 citations. The total number of citations of α and β are the same, but the average number of citations strongly favours α, who has far fewer publications. The *h*-index resolves this particular issue by strongly favouring β. However, if researcher α publishes another 9 papers each having 10 citations, their *h* indices will be same, although it is now obvious that researcher α has had more impact on the field. The *R*-index addresses this problem but ignores publications outside the *h*-core: if researcher β also has a long string of publications each with fewer than 10 citations, these will have no effect on *R*, *A* or any other index that only takes into account publications in the *h*-core.

Here we propose a new index, called the *j*-index, that takes into account all cited publications. By doing so, it is fairer to researchers who have a long tail of publications outside the *h*-core (see Section 5). Moreover, the *j*-index also reduces the bias that some indices tend to introduce in favour of researchers having a small number of very highly cited papers.

The function we use for defining the *j*-index is the sum of the square roots of the numbers of citations. This function arises in the study of social welfare functions (Segal, 2006). In that context, maximising the sum of the utilities (in our case, the total number of citations) is the utilitarian solution, where a "good" is allocated to the individual with the highest utility, while maximising the sum of the square roots is the optimal solution when randomisation, with probabilities proportional to individual utilities, is used to decide to which individual the "good" is allocated.

In our context of a bibliometric indicator, the sum of square roots serves to dampen the effect of highly cited papers, yet take into account the full citation list. Thus we propose the *j*-index of the researcher, defined as $j = \sum_{i=1}^{n} \sqrt{C(i)}$ where *n* is the number of cited publications. Although we do not claim the *j*-index is optimal in the sense that it is for welfare functions, we will demonstrate that it addresses some of the problems associated with the *h*-index and its variants.

We note that we do not address variants of indices that may arise from taking into account self-citations, multi-author publications, field dependence, and the age of publications (Bornmann et al., 2011). Although such refinements to indices are obviously worth pursuing, it would bias our comparison the total citation count and the *h* and *g* indices, which, in their original forms, do no not take such potential improvements into account.

The rest of the paper is organised as follows. In Section 2 we introduce the *j*-index and also an appropriate smoothing operator, and in Section 3 we compare the *j*-index with the *h*-index and other bibliometric indicators in the context of data sets from three subject areas taken from ISI's Highly Cited Database. In Section 4 we demonstrate that the *j*-index cannot be easily manipulated by adding publications with single citations, which may actually turn out to be self-citations, and in Section 5 we analyse the *h*-index in terms of the proportion of citations to publications inside and outside the *h*-core. Finally, in Section 6 we give our concluding remarks.

2. The *j*-index

We assume that a researcher's publication list is ranked in descending order of the number of citations, with paper *i* receiving C(*i*) citations, and that *n* is the number of cited publications.

We define *j*-index as

$$j = \sum_{i=1}^{n} \sqrt{C(i)} \quad (1)$$

We observe that the *j*-index is a sum of square roots, whereas the *R*-index is the square root of a sum, so clearly $R \le j$. Moreover, the *j*-index always takes into account the full range of cited publications, unlike the previously mentioned indices that are restricted to the *h*-core, or the *g*-index. We thus stress that the *j*-index is not an *h*-index variant.

In addition, we define a smoothing operator *S* for a monotonically decreasing sequence *u(i)*, defined such that

$$Su(i) = \frac{1}{i} \sum_{k=1}^{i} u(k) \quad (2)$$

Clearly the *S* operator maintains monotonicity, i.e. $Su(p) \ge Su(q)$ if $p \le q$.

We now define the *jS*-index as in (1) but using the smoothed values *SC(i)* rather than the raw values *C(i)*. Using the smoothed values is similar to the computation of a moving average for a time series (Chatfield, 1996). We note that *SC(1)* is the maximum number of citations and *SC(n)* is the average number.

3. Comparing the *j*-index with the *h*-index

We compare the j-index with the *h*-index and, in order to get a more comprehensive picture, we also include the *g*-index and the total citation count *T* in the comparison. According to (BiHui et al., 2007), the *h*, *g*, *A* and *R* indices are highly correlated, which is why we did not also include the *A* and *R* indices in the comparison.

Our comparison is based on comparing two lists of rankings of researchers using three well understood association measures: the Spearman correlation coefficient (Motulsky, 1995), the Spearman footrule (Diaconis & Graham, 1977) and the *M*-measure (Bar-Ilan, Levene, & Lin, 2007).

Suppose that we are ranking *n* researchers, labelled 1, 2, …, n, according to two criteria, and that *σ_1(i)* and *σ_2(i)* are the rankings of the i^{th} researcher according to the first and second criteria, respectively. The Spearman rank correlation coefficient is given by

$$1 - \frac{6\sum_{i=1}^{n}(\sigma_1(i) - \sigma_2(i))^2}{n(n^2-1)}$$

Spearman's footrule is a useful alternative measure for comparing the orderings of two permutations; it is given by

$$1 - \frac{\sum_{i=1}^{n}|\sigma_1(i) - \sigma_2(i)|}{\max F}$$

where maxF, the normalisation factor, is chosen so that the minimum value of the measure is zero, and is given by

$$\max F = \left\lfloor \frac{n^2}{2} \right\rfloor$$

The M-measure is a weighted variation of Spearman's footrule, giving more weight to identical or near identical rankings among the researchers in the top positions. It attempts to capture the intuition that identical or near identical rankings among the top researchers indicates greater similarity between the rankings. It is given by

$$1 - \frac{\sum_{i=1}^{n} \left| \frac{1}{\sigma_1(i)} - \frac{1}{\sigma_2(i)} \right|}{\max M}$$

where maxM, the normalisation factor, is chosen so that the minimum value of the measure is zero, and is given by

$$\max M = \sum_{i=1}^{n} \left| \frac{1}{i} - \frac{1}{n-i+1} \right|$$

In the tables below we make use of the following notation to indicate the level of significance of the Spearman rank correlation coefficient:

(**) indicates that a 2-tailed correlation test is significant at the 0.01 level.
(*) indicates that a 2-tailed correlation test is significant at the 0.05 level.
(n) indicate that a 2-tailed correlation test is not significant at the 0.05 level.

For the empirical comparison, we chose three subject areas: Immunology, Economics and Physics, from the medical, social and physical sciences, respectively. For each of these areas, ISI's Highly Cited Database (**www.isihighlycited.com**) was consulted, and 20 names were selected. The names were selected in such a way that the researchers were still active and their publications could be easily disambiguated when there were multiple authors with the same name. The publication lists with the citation counts for these subject areas were downloaded from Thomson-Reuters (ISI) Web of Science at the end of September 2010. (See the Appendix for a summary of the researchers' data sets that we used, together with the various indices we computed. These are sorted in descending order of the *h*-index.)

In Tables 1, 2 and 3, we show the correlation analyses for the Immunology, Economics and Physics researchers, respectively. We compared *T*, *h* and *g* with both the *j* and *jS* indices. The general patterns for Immunology and Economics exhibit high similarity between these three indices and both *j* indices. The similarities for Immunology are noticeably lower than for Economics when using the *M*-measure. So, for both Immunology and Economics, there is strong agreement when ranking the researchers using *T*, *h* and *g*, on the one hand, and *j* and *jS*, on the other. However, the ordering of the top Economics researchers is generally agreed upon, while for Immunology this is not the case (see the *M*-measure values in Tables 1 and 2). We further note that total number of citations *T* has a high correlation with *j* and *jS*, implying that for the group of Immunology and Economics researchers *T* is also a reasonable metric. (We note that using the average citation count would be unsatisfactory, as it tends to favour researchers who have published fewer papers but whose papers are highly cited vis-a-vis those who have in addition published a number of less frequently cited papers.)

Table 1: Correlation analysis for Immunology researchers

	j-index			*jS*-index		
	Spearman	**Footrule**	***M***	**Spearman**	**Footrule**	***M***
T	0.847(**)	0.770	0.674	0.884(**)	0.820	0.705
h	0.953(**)	0.870	0.605	0.919(**)	0.840	0.619
g	0.765(**)	0.700	0.533	0.806(**)	0.740	0.561
j	-	-	-	0.973(**)	0.930	0.962
jS	0.973(**)	0.930	0.962	-	-	-

The Physics group appears to be an outlier as the correlations are all lower and less significant. The highest association in this case is between *T* and *jS*. To get a better picture, we consider the associations between *T*, *h* and *g*. For Immunology and Economics, these are all high and significant at the 0.01 level. Table 4 shows these associations for the Physics researchers. We observe that *g* is more correlated with *T* than *h* is, which is not surprising since *g* takes into account citations to some publications outside the *h*-core. We note that there is a stronger association between *g* and *jS* than between *h* and *jS*. However, surprisingly, this is the other way around for the *j*-index. This, together with the fact that most of the correlations are higher with *jS* than with *j* is an indication that it may be preferable to use the smoothed rather than the raw data.

Table 2: Correlation analysis for Economics researchers

	j-index			*jS*-index		
	Spearman	**Footrule**	***M***	**Spearman**	**Footrule**	***M***
T	0.874(**)	0.770	0.899	0.943(**)	0.830	0.888
h	0.910(**)	0.800	0.852	0.850(**)	0.750	0.821
g	0.886(**)	0.770	0.889	0.941(**)	0.830	0.877
j	-	-	-	0.962(**)	0.900	0.921
jS	0.962(**)	0.900	0.921	-	-	-

Table 3: Correlation analysis for Physics researchers

	j-index			*jS*-index		
	Spearman	**Footrule**	***M***	**Spearman**	**Footrule**	***M***
T	**0.441(n)**	0.470	0.286	0.764(**)	0.670	0.457
h	**0.332(n)**	0.400	0.184	**0.371(n)**	0.460	0.231
g	**0.023(n)**	0.280	0.164	**0.468(*)**	0.500	0.338
j	-	-	-	0.836(**)	0.750	0.603
jS	0.836(**)	0.750	0.603	-	-	-

Table 4: Full correlation analysis for Physics researchers

	T			h			g		
	Spearman	Footrule	M	Spearman	Footrule	M	Spearman	Footrule	M
T	-	-	-	0.585(**)	0.630	0.658	0.890(**)	0.790	0.874
h	0.585(**)	0.630	0.658	-	-	-	**0.499(*)**	0.570	0.665
g	0.890(**)	0.790	0.874	**0.499(*)**	0.570	0.665	-	-	-
j	**0.441(n)**	0.470	0.286	**0.332(n)**	0.400	0.184	**0.023(n)**	0.280	0.164
jS	0.764(**)	0.670	0.457	**0.371(n)**	0.460	0.231	**0.468(*)**	0.500	0.338

One conclusion from the above analysis is that the total citation count is an important index that should be taken into account, since it significantly correlates with the other measures. Still, a word of caution is appropriate here: *T* is biased by the highly cited papers, which is one of the issues addressed by the *h*-index and its variants. Our justification for the *j*-index is that it tries to resolve this issue with T, while at the same time addressing some of the problems with the *h* and *g* indices, which are, respectively, unaffected and less affected, by the lower-cited publications.

4. Manipulating the *j*-index

One possible argument against *j*-index may be that it can be manipulated by an author with many publications each having a single citation. Taking this argument further, one may even hypothesise that these single citations are self-citations. In order to investigate this possibility, we carried out a further analysis on our data set by first removing all publications with a single citation, and in a second analysis by decreasing the numbers of citations to all publications by one. In all three disciplines the new data sets show very little relative change in the rankings according to the *j*-index. More specifically, in the rankings according to the *j*-index, for Immunology there was a single change, between Aarden and Goodnow in positions 14 and 15, in Economics there was a single change (only for the case when publications with single citations were removed) between Reinganum and Galor in positions 18 and 19, and for Physics there was a single change between Alivisatos and Foxon in positions 7 and 8.

As the correlations were computed on the relative rankings of researchers, we can conclude that the *j*-index is not very sensitive to small changes in the citation patterns, and thus cannot be easily manipulated by adding papers with single self-citations. If we relax the constraint of only a single self-citation, then the problem will be exacerbated, and we note that for the *j*-index self citing lower-ranked papers will have a greater proportional effect. Therefore, to tackle this problem, it may be useful to completely ignore the citations in the tail when computing the *j*-index. However, further research has to be carried out to investigate this and to determine how much of the tail should be ignored.

In comparison, the h-index will only change by at most one in these cases. However, as was shown in (Bartneck & Kokkelmans, 2011), in the more general case, authors could strategically (rather than randomly) self-cite their papers and thereby considerably inflate their *h*-indices.

5. Analysis of the *h*-index

We now analyse the *h*-index by partitioning the publications according to whether or not they are present in the *h*-core. Our contention is that the *h*-index is less satisfactory when there are a significant number of citations to publications outside the *h*-core.

Recall that *T* is the total number of citations for a researcher. We define H_1 to be the number of citations to publications in the *h*-core, i.e. $H_1 = Ah = R^2$ (recalling the definitions of the *A* and *R* indices from the introduction), H_2 to be the minimum possible number of citations to publications in the *h*-core, i.e. $H_2 = h^2$, H_3 to be the number of "excess citations" to publications in the *h*-core, i.e. $H_3 = H_1 - H_2$, and H_4 to be the number of citations to publications outside the *h*-core, i.e. $H_4 = T - H_1$. Note that $H_1 + H_4 = H_2 + H_3 + H_4 = T$. We now define $G_i = H_i/T$, i.e. the proportion of citations corresponding to H_i. In Table 5 we show the averages of these numbers for the three data sets.

Table 5: Average proportions of citations inside and outside the *h*-core

Discipline	H_1	H_2	H_3	H_4	G_1	G_2	G_3	G_4
Immunology	15860.05	4888.45	10971.60	4010.65	0.798	0.246	0.552	0.202
Economics	5100.85	929.605	4171.25	431.25	0.922	0.168	0.754	0.078
Physics	14947.50	4205.30	10742.20	5983.80	0.714	0.201	0.513	0.286

For all three data sets, a significant majority of the citations are to publications in the *h*-core, which is due to the long-tailed distribution of citations (cf. (Redner, 1998)). In this respect Economics stands out, with $G_4 = 0.078$ indicating that there are very few citations to publications outside the *h*-core. Moreover, looking at the G_3 values, we see that around three quarters of the citations to the *h*-core are "excess citations", which is essentially the main motivation for the *g*-index. Now, looking at G_4, i.e. the citations to publications outside the *h*-core, we observe that for Physics and Immunology, with $G_4 = 0.286$ and $G_4 = 0.202$, respectively, these represent a significant proportion of the citations. This is a clear indication that it is not sufficient to consider only the *h*-core, rather the complete citation and publication patterns of the researchers should be taken into account. The suggested *j*-index is a step towards achieving this goal. We stress that we do not suggest simply replacing the existing indices with the new index, but rather that it should be used to supplement them in order to provide a more complete picture of the scientists' achievements.

6. Concluding Remarks

We propose a new bibliometric measure, the *j*-index, that takes all of the citations to a researcher's publications into account. The *j*-index thus complements the *h*-index rather than being a variant of it. We used data sets of researchers from three areas, Immunology, Economics and Physics, and we have compared the difference in the rankings by the *j*-index with those by the *h*-index, *g*-index and total citation count. The association between the rankings is highest for the Economics group. It is not quite so high for the Immunology group, and is much lower for the Physics group. The varying association can be partly explained by the differing average proportions of citations to publications outside the *h*-core for the three groups. We suggest that the *j*-index may be particularly useful for subject areas where this proportion is significant.

The smoothing of the *j*-index by using the *jS*-index was also proposed, and this generally has the effect of increasing the associations with the other bibliometric indices. However, more research needs to be done on the effect of using smoothed values rather than raw ones in computing the *j*-index, and whether there may also be advantages in computing the other indices using smoothed values.

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7. Appendix: Researchers Datasets

Table 6: Immunology researchers data

Name	#publ	#cited publ	*T*	*h*	*g*	*j*-index	*jS*-index	G_1
Marrack, Philippa C.	445	326	45130	103	208	3048.871	5865.09	0.812
Nadler, Lee Marshall	468	312	32422	101	174	2569.53	4743.111	0.792
Gleich, Gerald J.	891	659	35065	96	164	3745.305	7388.135	0.619
Janossy, George	490	384	26430	93	148	2610.041	4694.46	0.688
Shevach, Ethan M.	472	341	33000	93	175	2638.21	5138.475	0.781
Ravetch, Jeffrey V.	186	165	22743	78	150	1614.011	2843.829	0.874
Krieg, Arthur M.	308	232	21413	72	143	1756.287	3430.861	0.810
Figdor, Carl Gustav	328	262	17665	69	126	1698.458	3328.844	0.769
Takeuchi, Osamu	185	166	24307	68	157	1462.607	3194.669	0.926
Hamaoka, Toshiyuki	498	424	15717	64	106	2096.03	3947.291	0.590
Goodnow, Christopher C.	199	152	13723	60	116	1154.837	2172.927	0.874
Kehrl, John H.	238	156	14897	59	121	1180.942	2379.839	0.850
Adorini, Luciano	289	238	11966	58	100	1390.148	2516.689	0.698
Aarden, Lucien A.	215	169	12854	57	111	1157.63	2259.28	0.840
Delespesse, Guy	294	207	9132	57	87	1154.157	1972.919	0.701
Bendelac, Albert	139	115	11983	52	109	951.7284	1720.823	0.890
Malefyt, Rene DeWaal	129	97	18561	50	136	1013.11	2086.274	0.943
Bjorkman, Pamela J.	174	141	15969	46	126	984.4421	2496.326	0.908
Parronchi, Paola	100	86	8159	36	90	621.8114	1305.763	0.918
Samraoui, Boudjema	28	19	6278	8	80	179.0477	549.3732	0.994

Table 7: Economics researchers data

Name	#publ	#cited publ	*T*	*h*	*g*	*j*-index	*jS*-index	G_1
Kahneman, Daniel	122	110	35162	58	188	1373.0213	3196.9825	0.155
Stiglitz, Joseph E.	214	188	14654	55	118	1235.8946	2650.8991	0.164
Diebold, Francis X.	87	76	4075	36	63	439.10071	834.97539	0.501
Milgrom, Paul Robert	48	47	9168	35	95	553.78487	922.30837	0.163
Maskin, Eric	72	63	4163	33	64	422.8165	748.03374	0.436
Zajac, Edward J.	49	44	3964	31	62	354.51678	601.78888	0.936
Lakonishok, Josef	57	51	3229	29	57	345.2689	576.34889	0.924
Besley, Timothy J.	89	67	2388	28	48	335.99404	572.29756	0.809
Hendry, David F.	129	112	4282	28	64	503.30275	1106.6833	0.846

Oswald, Andrew J.	79	67	3063	27	55	362.1094	671.10293	11.046
Akerlof, George A.	56	49	5670	26	75	373.57651	842.58434	0.523
Rodrik, Dani	84	67	2963	25	53	357.43071	673.65668	1.286
Caballero, Ricardo J.	63	59	1848	23	42	286.62383	458.42537	4.865
Rotemberg, Julio J.	59	49	2259	23	47	272.13715	489.60906	1.181
Bernanke, Ben S.	45	38	2525	20	50	237.817	463.0346	0.559
Constantinides, George M.	40	31	1895	20	43	204.24526	343.35389	1.328
Gali, Jordi	37	35	3110	19	55	248.82705	500.32536	0.644
Galor, Oded	39	38	2067	19	45	221.22758	418.54049	1.164
Reinganum, Jennifer F.	46	44	1624	18	40	221.30271	379.44138	7.510
Schoemaker, Paul J.H.	43	35	2533	17	50	215.89497	463.55556	1.492

Table 8: Physics researchers data

Name	**#publ**	**#cited publ**	***T***	***h***	***g***	***j*-index**	***jS*-index**	**G_1**
Alivisatos, A. Paul	306	226	43734	93	209	2323.435	5009.9179	0.904
Wilczek, Frank	341	269	27394	82	162	2028.4432	4231.8072	0.390
Sawatzky, George Albert	327	307	21973	77	139	2106.3496	3921.6089	1.141
Jackiw, Roman W.	210	197	26478	74	162	1743.8724	3549.7719	0.191
Bradley, Donal D. C.	426	398	32292	73	172	2495.4759	6004.2169	0.373
Patel, Popat M.	894	823	25560	71	120	3806.8148	6929.7421	0.408
Honscheid, Klaus	734	682	31020	66	157	3182.9438	7751.0023	0.743
Nazarewicz, Witold	335	306	13969	66	106	1711.9946	3042.935	1.487
Huse, David A.	172	165	14096	63	117	1230.6361	2314.4369	0.830
Foxon, C. Thomas	622	540	17282	62	114	2337.714	4833.0766	1.357
Fleming, Robert M.	181	170	14600	61	119	1297.3082	2309.9494	0.357
Mättig, Peter	675	650	16750	60	87	2897.9914	4693.1178	0.368
Mikenberg, Giora	505	493	14815	59	84	2421.7701	3750.5015	0.396
Minard, Marie-Noelle	329	314	13769	59	98	1809.2844	3015.3897	0.572
Steinhardt, Paul J.	185	174	20160	58	141	1358.8204	2983.0345	0.454
Duchovni, Ehud	444	436	13006	56	79	2162.1897	3251.0548	0.886
Loebinger, Fred K.	470	466	13493	53	81	2252.5334	3495.3743	1.032
Bastard, Gerald	222	194	12926	51	110	1166.8017	2515.9791	1.251
Procaccia, Itamar	303	281	17248	48	127	1449.6354	3735.0348	1.045
Gurtu, Atul	373	351	28061	44	163	1887.6882	5445.5491	0.830