

**“QUANTITATIVE EVALUATION OF ALTERNATIVE FIELD NORMALIZATION PROCEDURES”**Yunrong Li<sup>1</sup>, Filippo Radicchi<sup>2</sup>, Claudio Castellano<sup>3</sup> and Javier Ruiz-Castillo<sup>1</sup><sup>1</sup> Universidad Carlos III de Madrid, Departamento de Economía, Spain<sup>2</sup> Universitat Rovira i Virgili, Department d'Enginyeria Química, Spain<sup>3</sup> Istituto dei Sistemi Complessi (ISC-CNR), and Dipartimento di Fisica, "Sapienza" Università di Roma, Italy**Abstract**

Wide differences in publication and citation practices makes impossible the direct comparison of raw citation counts across scientific disciplines. Recent research has studied new and traditional normalization procedures aimed at suppressing as much as possible these disproportions in citation numbers among scientific domains. Using the recently introduced *IDCP* (*Inequality due to Differences in Citation Practices*) method, this paper rigorously tests the performance of six cited-side normalization procedures based on the Thomson Reuters classification system consisting of 172 sub-fields. We use six yearly datasets from 1980 to 2004, with widely varying citation windows from the publication year to May 2011. The main findings are the following three. Firstly, as observed in previous research, within each year the shapes of sub-field citation distributions are strikingly similar. This paves the way for several normalization procedures to perform reasonably well in reducing the effect on citation inequality of differences in citation practices. Secondly, independently of the year of publication and the length of the citation window, the effect of such differences represents about 13% of total citation inequality. Thirdly, a recently introduced two-parameter normalization scheme outperforms the other normalization procedures over the entire period, reducing citation disproportions to a level very close to the minimum achievable given the data and the classification system. However, the traditional procedure of using sub-field mean citations as normalization factors yields also good results.

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## I. INTRODUCTION

The number of citations that a scientific paper has accumulated is often interpreted as a proxy of its influence within the scientific community. Although the relation between citations and effective scientific influence is still under active debate (MacRoberts and MacRoberts, 1986, 1989, Adler *et al.*, 2009), citation numbers are often used in assessment exercises, and their practical role in modern science is becoming more and more central. However, because the significance of citations is content- and discipline-dependent (Bornmann and Daniel 2008), the direct comparison of raw citation numbers received by articles belonging to different fields is plagued with difficulties. A paper in Biochemistry typically accumulates more citations than a paper in Mathematics but this does not necessarily imply that the former is more influential than the latter. Different scientific disciplines strongly differ in citation practices, and as a consequence the typical number of citations that a paper in a given field receives may strongly differ from the number of citations typical of another field.

Naturally, this poses a challenge when articles belonging to a number of closely related but heterogeneous sub-fields need to be aggregated into a single intermediate category, such as the aggregation of Cardiac & Cardiovascular Systems, Hematology, Oncology, and other sub-fields into the discipline “Internal Clinical Medicine” (for a recent example of the difficulties raised even at the sub-field level, see Van Eck *et al.*, 2012). On the other hand, many bibliometric indicators have been developed with the aim of assessing the relevance of scientific research activities at different levels: journals (Garfield, 2006), scientists (Hirsch, 2005; Egghe, 2006), departments (Davis and Papanek, 2004), institutions (Kinney, 2007), etc. These indicators, however, are often based on raw citation numbers, and thus have several limitations when used to perform comparisons across different fields of research.

To overcome this inherent disproportion in citation numbers among scientific fields, several approaches have been proposed to normalize citation counts at the level of the single publication. The proposed schemes can be classified in two conceptually different classes:

1. Target (or cited-side) procedures, in which citation weights or normalization factors are functions of the cited papers. This class includes many different types of normalization techniques such as: (i) field averages (see *inter alia* Moed *et al.*, 1985, 1988, 1995, Braun *et al.*, 1985, Schubert *et al.*, 1983, 1987, 1988, Schubert and Braun, 1986, 1996, and Vinkler 1986, 2003, as well as Radicchi *et al.*, 2008); (ii) average-based scalar difference from the mean (Glänzel, 2011); (iii) two-parameter reverse engineering (Radicchi and Castellano, 2012a), and (iv) exchange rates (Crespo *et al.*, 2013a, b).

2. Source (or citing-side) procedures, in which citation weights are functions of the citing papers, studied by, *inter alia*, Zitt and Small, 2008, Moed, 2010, Leydesdorff and Opthof, 2010, Glänzel *et al.*, 2011, and Waltman *et al.*, 2012.

While the development of cross-disciplinary citation indicators dates back to the 1980s, only recently have scholars started to apply them to large sets of empirical data, and test their performances statistically. Three methods have been proposed to assess the performance of a generic normalization procedure quantitatively: (i) between-group variance (Leydesdorff and Bormann, 2011); (ii) a fairness test based on ranking (Radicchi and Castellano, 2012a, b), and (iii) the Inequality due to Differences in Citation Practices method (*IDCP* hereafter) (Crespo *et al.*, 2013a, b).

Between-group variance is the simplest of the three tests, but, by construction, it vanishes for indicators normalized by field averages. This makes its applicability very limited. Although based on different principles, both the fairness and the *IDCP* tests leverage on strict statistical formalisms that do not require any strong assumption (i.e., they are distribution free statistical tests). The fairness test has already been applied in three instances: to test the performance of indicators based on the two-parameter reverse engineering (Radicchi and Castellano, 2012a); to compare field averages and one version of “fractional citation counting”, which is part of source normalization procedures (Radicchi and Castellano, 2012b), and to test the performances of normalized Impact Factors of journals (Leydesdorff *et al.*, 2012). The *IDCP* method has been used for field averages, exchange rates, and Glänzel type normalizations (Crespo *et al.*, 2013a, b).

In this paper, we perform an extensive analysis of six normalized indicators of the target or cited-side variety, and assess their performance in the citation distribution for all articles in all fields –the *all-fields* case– using the *IDCP* method. The dataset consists of publications in 172 sub-fields (or Web of Science subject-categories) indexed by Thomson Reuters. The publications appeared in six different years, spanning a period of more than two decades from 1980 to 2004. This feature allows us to analyze temporal trends in citation practices, as well as the sensitivity of our results to a large range of citation windows.

Among the main results, we find that, relative to overall citation inequality, the effect of differences in citation practices across sub-fields has a similar importance independently of the year of publication and the length of the common citation window. Similarly, the ranking of normalization procedures in terms of their ability to reduce such an effect is essentially the same over the entire period. Our findings in this last respect are in line with previous results. Firstly, the similarity of citation distributions within the 172 sub-fields classification system explains why several normalization procedures work reasonably well in diminishing the impact on citation inequality of differences in citation practices across sub-fields. Secondly, the reverse engineering procedure out-performs other normalization methods (see Radicchi and Castellano, 2012a, b). Thirdly, normalization by field averages yields also good results (see Radicchi *et al.*, 2008, Radicchi and Castellano, 2012a, b, and Crespo *et al.*, 2013a, b).

The rest of the paper is organized into four Sections. Section II briefly discusses the evaluation methods, and introduces the six normalization procedures to be evaluated. Section III presents the data, and some descriptive statistics. Section IV contains the empirical results, while Section V offers some concluding comments.

## II. METHODS

### II.1. The Measuring Framework

Given a classification system into a number of scientific fields, Crespo *et al.* (2013a) introduces a simple model in which the number of citations received by an article is a function of two variables: the

article's underlying scientific influence, and the field to which it belongs to. Consequently, the citation inequality in the all-fields case is the result of two factors: differences in scientific influence within homogeneous fields, and differences in citation practices across fields.

Let  $c_l$  be the number of citations received by the  $l$ -th paper ( $l = 1, \dots, N$ ) in citation distribution  $\mathbf{C} = (c_1, \dots, c_N)$ , and assume that we are given a classification system –denoted by  $K$ – assigning the publications in  $\mathbf{C}$  into  $S$  sub-fields, indexed by  $s = 1, \dots, S$ . Partition each citation distribution  $c_s$  into  $\Pi$  quantiles of equal size,  $c_s^\pi$ , and citation mean  $\mu_s^\pi$ , for  $\pi = 1, \dots, \Pi$ . Under the assumptions of the model, the citation means  $\mu_s^\pi$  holding  $\pi$  constant are directly comparable across sub-fields. For each  $\pi$ , let  $\mathbf{m}^\pi = (\mu_1^\pi, \dots, \mu_s^\pi, \dots, \mu_S^\pi)$  be the distribution in which each publication in quantile  $c_s^\pi$  is assigned the mean citation in that quantile,  $\mu_s^\pi$ . The key concept of the model is the following. For each  $\pi$ , the citation inequality of  $\mathbf{m}^\pi$ , abbreviated as  $I(\pi)$ ,

$$I(\pi) = I(\mathbf{m}^\pi) = I(\mu_1^\pi, \dots, \mu_s^\pi, \dots, \mu_S^\pi), \quad (1)$$

captures the citation inequality attributable to differences in citation practices across sub-fields at quantile  $\pi$  (see Crespo *et al.*, 2013a, for details).

Given a citation distribution  $\mathbf{C}$ , in the implementation of this model one uses an additively decomposable citation inequality index,  $I$ , defined as

$$I(\mathbf{C}) = (1/N) \sum_l (c_l/\mu) \log (c_l/\mu) \quad (2)$$

where  $\mu$  is the mean of distribution  $\mathbf{C}$ . It can be shown that the total citation inequality in the all-sciences case,  $I(\mathbf{C})$ , can be decomposed into the sum of three terms, one of them being the *IDCP* (Inequality due to *D*ifferent *C*itation *P*ractices) term under classification system  $K$ :

$$IDCP(K) = \sum_\pi v^\pi I(\pi) \quad (3)$$

where  $v_s^\pi$  is the share of total citations in quantile  $\pi$  of sub-field  $s$ , and  $v^\pi = \sum_s v_s^\pi$ . Therefore,  $IDCP(K)$  is a weighted average of the key expressions in (1), with weights  $v^\pi$  so that  $\sum_\pi v^\pi = 1$ . Note that, due to the skewness of science, the weights  $v^\pi$  will rapidly increase with  $\pi$ .<sup>1</sup>

The impact of any normalization procedure can be evaluated by the reduction in the  $IDCP(K)$  term after normalization. However, in order to assess the soundness of this methodology we first ask: what is the lowest possible value for the  $IDCP$  term? In the case of infinite, real valued and identically distributed data, the  $IDCP$  term would be equal to zero. However, real citation numbers do not satisfy the former requirement. Consequently, we search for lowest value of the  $IDCP$  term that is achievable given the data and the classification system  $K$ , and use it as a reference for assessing the ability of the different normalization procedures to effectively remove the effect on total citation inequality of differences in citation practices across sub-fields in  $K$ .

In order to reach this goal, we use a very simple procedure. Given a sub-field  $s$ , we assign to each paper with  $c_{s,i}$  citations a score  $r_{s,i}$  equal to the fraction of papers within the same sub-field that have accumulated a number of citations lower than or equal to  $c_{s,i}$ . According to this rule, scores have values in the range 0 to 1, preserve the natural order (including ties) of the original citation sequence, and in each sub-field have exactly the same distribution: the uniform one. Therefore, given a classification system, this way of assigning scores to papers represents a sort of “perfect normalization” scheme for which the  $IDCP$  term provides the best performance that can be achieved for a given data set.

## II.2. Normalization Procedures

The following six normalization procedures will be empirically investigated in Section IV.

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<sup>1</sup> As far as the two remaining terms in the decomposition are concerned, one refers to the citation inequality that takes place within the  $c_s^\pi$  quantiles, while the other measures the citation inequality in the distribution where each article in any field is assigned the mean citation of the quantile to which it belongs. For high  $\Pi$ , the first term is expected to be small, while the second –capturing the skewness of science in the all-sciences case– is expected to be large. For details, see Crespo *et al.* (2013a).

1. *Normalization by sub-field average.* Each paper  $i$  in sub-field  $s$  receiving  $c_{si}$  citations, is assigned a score equal to  $c'_{si} = c_{si}/\mu_{s1}$ , where  $\mu_{s1}$  is the average number of citations received by papers in sub-field  $s$ . Thus,  $c'_{si}$  represents the relative impact, in terms of citations, of paper  $i$  within sub-field  $s$ .

2. We additionally consider a slight variation of the former normalization scheme, where  $\mu_{s1}$  is calculated excluding uncited publications. This different approach has been used by Radicchi *et al.* (2008), and has been also suggested by Waltman *et al.* (2011) and Abramo *et al.* (2012), because it is supposed to lead to higher levels of reduction of citation disproportions among scientific fields.

3. *Normalization by median value.* This represents a simple modification of the previous indicator, where the only difference is that the number of citations  $c_{si}$  received by a paper is divided by the sub-field  $s$ 's median value,  $m_s$  (instead of by the average value  $\mu_{s1}$ ). Since in practice there are several sub-fields for which  $m_s = 0$ , we calculate the median citation number of each category by excluding uncited publications.

4. *Normalization by two-parameter reverse engineering.* Radicchi and Castellano (2012a) introduce a normalization scheme based on the use of two parameters empirically estimated from the data. For each  $s$ , these parameters are the best estimates of the prefactor  $a_s$  and the exponent  $\alpha_s$  of a power-law transformation able to make different citation distributions collapse on top of each other. This means that if the score of a paper is computed as  $c'_{si} = (c_{si}/a_s)^{1/\alpha_s}$ , then the distribution of  $c'_{si}$  values is no longer dependent on the specific sub-field considered. In particular, when two distributions have the same exponent, the transformation necessary for their collapse is linear, and the method reduces to normalization by field average. Radicchi and Castellano (2012a) demonstrate that, for the vast majority of sub-fields, the values of  $\alpha_s$  are very similar, and the citation distributions are nearly the same when plotted as a function of the normalized values  $c'_{si}$ . However, a limited number of sub-fields are characterized by widely changing values of the transformation parameters, so that the distribution of their  $c'_{si}$  values does not follow a universal law.

5. *Glanzel's normalization.* This normalization involves the transformation of the raw data of any sub-field citation distribution with  $N$  papers,  $\mathbf{c}_s = (c'_{s1}, \dots, c'_{sN})$ , by the formula  $c'_{si} = c_{si} / (\mu_{s2} - \mu_{s1})$ , where  $\mu_{s1}$  is the average citation of sub-field  $s$ , and  $\mu_{s2}$  is the average citation defined over the publications receiving a number of citations equal to or greater than  $\mu_{s1}$ .

6. *Exchange rates normalization.* Crespo *et al.* (2011a, b) find that the similarity of the shape of citation distributions over 22 broad fields or 219 sub-fields allows the effect of idiosyncratic citation practices to be rather well estimated over a wide range of intermediate quantiles where citation distributions seem to differ by a scale factor. Consequently, a set of average-based measures, called exchange rates, can be estimated profitably over that interval.

### III. DATA

#### III.1. The Dataset

We use the dataset already analyzed in Radicchi and Castellano (2012a). It consists of six subsets, each including all publications in 8,304 scientific journals in the following years: 1980, 1985, 1990, 1995, 1999, and 2004. Journal titles are collected from the Journal of Citation Reports database (<http://science.thomsonreuters.com/cgi-bin/jrnlst/jlsubcatg.cgi?PC=D>). We restrict our attention only to documents written in “English”, and classified as “Article”, “Letter”, “Note” or “Proceedings Paper” for a total of 2,906,615 publications. We retrieve from the Web of Science database (WoS, [isiknowledge.com](http://isiknowledge.com), field “times cited”) the number of citations each document has accumulated from its publication year up to the week of May 23-31, 2011. Note that the citation windows vary across the yearly subsets, ranging from seven years (and five months) for the papers published in 2004, to 31 years (and five months) for the 1980 subset.

In what follows, the  $S$  sub-fields in the classification system  $K$  introduced in Section II.1 are identified with 172 subject-categories distinguished in the Web of Science by Thomson Reuters. As already emphasized by the inventors themselves (Pudovkin and Garfield 2002), this classification is known to have several weak points. One of them is that publications in the periodical literature are



assigned to sub-fields via the journal in which they have been published. Many journals are assigned to a single sub-field, but many others are assigned to two, three, or even more sub-fields. For example, the percentage of single-category papers in the datasets used in this paper tends to diminish with time: it is 67% in 1980, but only 56% in 2004. Therefore, between one third and 44% of all papers in our dataset are assigned to several sub-fields.

To tackle this problem, two paths can be followed. The first is a fractional strategy, according to which each publication is fractioned into as many equal pieces as necessary, with each piece assigned to its corresponding sub-field. The second follows a multiplicative strategy in which each paper is counted as many times as necessary in the several sub-fields to which it is assigned. In this paper we adopt the multiplicative approach. This leads to a substantial increase in the total number of “papers”: 42% in 1980, 45% in 1985, 48% in 1990, 56% in 1995, 58% in 1999 and 61% in 2004. However, judging from the findings obtained by Crespo *et al.* (2013b) using a similar dataset, we expect the results presented in this paper to be comparable to those that could have been obtained with a fractional strategy.

### **III.2. Descriptive Statistics within Each Year**

For each year, Table A in the Appendix presents the number of documents by size, while Table B includes sub-field mean citations and standard deviations.<sup>2</sup> Within each year, it comes as no surprise that sub-fields are very different in two key respects: Firstly, they are of very different sizes. In 1980 and 1995, for example, mean sub-field sizes are 2,103 and 2,753, with standard deviations 2,341 and 2,930. The range of variation in 1995, for example, is illustrated by Andrology and Engineering, Marine with 201 and 306 documents, and Engineering, Electrical & Electromagnetic and Biochemistry & Molecular Biology with 19,938 and 34,475 documents. Secondly, reflecting the wide differences in citation practices that motivate this paper, sub-fields have very different mean citations. In 1989 and 2004, for example, mean sub-field citations are 8.4 and 8.6, while standard deviations are 7.9 and 4.4. The range of variation in 2004 is illustrated, for example, by Cell Biology and Engineering, Marine with 17.8 and 0.6 mean citations, respectively.

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<sup>2</sup> Nanoscience & Technology and Robotics are missing in 1980, and Cell & Tissue Engineering in the 1980-1990 period.

However, once we use scale- and size-invariant statistical techniques that allow us to focus on the shape of citation distributions, we discover that –within each year– citation distributions are extremely similar. To show this, we use the Characteristic Scores and Scales (CSS hereafter) technique, introduced by Schubert *et al.* (1987) in the analysis of citation distributions. For each sub-field  $s$  in a given year, we compute the characteristic scores  $\mu_{s1}$  and  $\mu_{s2}$  already introduced in Section II.2. Consider the partition of sub-field citation distributions into three broad classes: documents with none or few citations below  $\mu_{s1}$ ; fairly cited articles, with citations above  $\mu_{s1}$  and below  $\mu_{s2}$ ; and articles with a remarkable or outstanding number of citations above  $\mu_{s2}$ . Table 1 presents the average and standard deviation over the 172 sub-fields of the percentage of articles in the three classes in every year, as well as the corresponding statistics for the percentages of the total number of citations accounted by each class.

**Table 1 around here**

Two points should be emphasized, one referring to the situation within each year, and another to the evolution over time. Firstly, within each year, the small standard deviations in Table 1 indicate that sub-field citation distributions are very similar. Specifically, they are highly skewed in the sense that a large proportion of articles get none or few citations while a small percentage of them account for a disproportionate amount of all citations. The evidence for more than two decades can be summarized with a single picture illustrating the partition of documents into the three classes, as well as the percentages of total citations accounted by each class (Figure 1). As can be seen in Table 1, the situation closely resembles the one described in Albarrán *et al.* (2011) for articles with a common, five-year citation window published in 1998-2003 in a wide array of 219 sub-fields. It is important to note that, as has been emphasized in the recent literature on normalization (Radicchi *et al.*, 2008, 2012a, b, and Crespo *et al.*, 2013a, b), and as we will presently see in the next Section, this similarity between citation distributions within each year paves the way for meaningful comparisons of citation counts across our 172 sub-fields.

**Figure 1 around here**

Secondly, in spite of the summary illustrated in Figure 1, it should be noted that the publication and citation percentages presented in Table 1 evolve smoothly during the 1980-2004 period. Perhaps not surprisingly, as the citation window increases from seven years in 2004 up to 31 years in 1980, sub-field citation distributions become somewhat more skewed. Specifically, for the two polar years in question, on average between 69% and 73% of all articles receive citations below the mean and only account for, approximately, between 24% and 21% of all citations, while articles with a remarkable or outstanding number of citations represent about 10% or 8% of the total, and account for, approximately, between 42% and 47% of all citations. As we will presently see in the next Section, these small differences over time play a crucial role in the robustness of our results to differences in publication dates and citation window lengths.

## IV. EMPIRICAL RESULTS

### IV. 1. The Importance of the *IDCP* Term over the 1980-2004 Period

With the exceptions cited in note 1, the six yearly datasets are characterized by the same classification system into 172 sub-fields. However, apart from publication dates and lengths of citation windows, many features of science change over the 1980-2004 period. Specifically, the distribution of documents by sub-field and sub-field citation means vary considerably over the six years we study (see Tables A and B in the Appendix, where for reasons explained below sub-fields are grouped into 19 broad fields). Therefore, the first question that should be analyzed is how total citation inequality  $I(\mathcal{C})$  and the *IDCP* term for the raw citations depend on time.

We have just seen in Table 1 that, on average, sub-field citation distributions become less skewed as we consider closer publication dates and smaller citation windows. Correspondingly, as can be seen in column 1 in Table 2, except for a slight increase between 1980 and 1985,  $I(\mathcal{C})$  decreases when we move in that direction.

**Table 2 around here**

The evolution of the *IDCP* term is more complex. To begin with, Figure 2 illustrates what happens to the expression  $I(\pi)$  as a function of  $\pi$  (Eq. 1 in Section II.1) for different yearly datasets when the number of quantiles is equal to 100 (since  $I(\pi)$  is too high for low percentiles, for clarity only the curves for  $\pi > 50$  are included in Figure 2).<sup>3</sup> It is convenient to distinguish between two regimes. Firstly, as we move from 1999 to 2004, the change in publication dates and the shortening of citation windows have a systematic effect: yearly curves move downward, and present a U shape with an intermediate percentile interval in which  $I(\pi)$  remains essentially constant. Since the *IDCP* term for each year is simply a weighted average of  $I(\pi)$  expressions (see Eq. 3 in Section II.1), we expect *IDCP* terms to decline as we move from 1999 to 2004, a fact observed in column 2 in Table 2. Secondly, changes in publication dates and/or changes in citation window lengths at the beginning of the period generate a change of regime: the curves  $I(\pi)$  as a function of  $\pi$  for 1985 and 1980 have a negative slope and intersect some of the other curves. However, as shown in column 2 in Table 2, the *IDCP* term keeps increasing from 1999 to 1985, but slightly decreases in 1980.

**Figure 2 around here**

Interestingly enough, the net result of these changes is that the ratio  $IDCP/I(\mathcal{C})$  remains approximately constant (see column 3 in Table 2). This means that, in spite of the many differences between the six yearly datasets, the relative importance of the differences in citation practices across sub-fields is of a similar order of magnitude over the entire period, representing about 13% of total citation inequality.

This percentage might be compared with what has been previously observed for other classification systems. Firstly, for the 219 Web of Science categories in the period 1998-2003 with a common five-year citation window, Crespo *et al.* (2013b) find that the *IDCP* term represents about 18% of total citation inequality. It should be noted that among the 219 sub-fields 184 correspond to the natural sciences, and 35 to the social sciences, while among the 172 sub-fields these two classes consist

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<sup>3</sup> As in Crespo *et al.* (2013a), all results in this paper are robust to the number of quantiles.

of 170 and 2 sub-fields. Secondly, following Albarrán *et al.* (2011), it is possible to aggregate the 219 sub-fields into 19 broad fields (see Tables A and B in the Appendix). In this case, Li and Ruiz-Castillo (2013) find that the importance of the *IDCP* term is reduced from 18% to 12.5%. Similarly, when we aggregate the 172 sub-fields of this study into 18 comparable fields (full results are available on request), the importance of the *IDCP* term is reduced from, approximately, 13% for the entire period (see Table 2 above) to, approximately, 7.9%. Therefore, as expected, in both nested classification systems the effect on total citation inequality of differences in citation practices at the field level is smaller than at the sub-field level. Finally, it might be noted that Crespo *et al.* (2013a) found that the *IDCP* term represented about 14% of total citation inequality for a third classification system into the 22 broad fields distinguished by Thomson Reuters (consisting of 20 natural sciences and two social sciences). The problem for comparability purposes is that this classification system is not nested in any of the previous ones: the connection between the 219 or 172 Web of Science categories and the 22 fields is unknown.

#### **IV. 2. The Relative Performance of Alternative Normalization Procedures**

Before presenting the results for the six regular normalization procedures, it is convenient to assess how well the “perfect normalization” scheme does. The results of the reduction of the absolute value of the *IDCP* term are in column 7 in Table 3. On average, the best normalization procedure achievable with our data generates a 95% reduction of the *IDCP* term. Not surprisingly in view of the two regimes found in the previous Sub-section, the ability to reduce the *IDCP* term is lower in 1985, and above all, in 1980, is lower than in 1990-2004.

#### **Table 3 around here**

Recall that the evidence in Table 1 indicates that, within each year, sub-field citation distribution shapes are very similar. This should translate into generally good results for reasonable normalization procedures. In particular, it is instructive to begin with the  $I(\pi)$  curves in Figure 2. As pointed out already, these curves are relatively constant over a certain percentile interval during the 1990-2004 period. This is exactly what was found in Crespo *et al.* (2013a, b, Figure 1), indicating that sub-field

citation distributions essentially differ by a scale factor over that interval. Therefore, we expect that a set of average-based exchange rates can be estimated with some precision over that interval.<sup>4</sup> On the other hand, using exchange rates and sub-field means as normalization factors should capture reasonably well these scale factors separating sub-field citation distributions. This is what we find in columns 3 and 5 in Table 3. Naturally, the reduction in the *IDCP* term in 1985, and above all, in 1980, is smaller than in 1990-204.

Interestingly enough, using sub-field means without zeros as normalization factors (column 4 in Table 3) performs better than using exchange factors but worse than using sub-field means computed over all documents. Finally, the median and the Glänzel normalization procedures (columns 1 and 2 in Table 3) do worse than the exchange rates, while the two-parameter scheme (column 6 in Table 3) performs extremely well, achieving reductions in the *IDCP* terms which are very close to the “perfect normalization” system, particularly in the 1999-204 period with citation windows of 17, 12, and eight years. As in the former cases, the performance is much worse in 1980 than for the rest of the period.

The results of the contest are clearly illustrated in Figure 3: the ranking of the six procedures is essentially the same over the entire period. Finally, Table 4 contains the results concerning the relative importance of the *IDCP* term after applying the different normalization schemes (excluding the “perfect normalization” that, understandably, does not perform well in relative terms because the total citation inequality in this case is extremely low). On average over the six years, the best two procedures –namely, the sub-field mean normalization and the two-parameter scheme– decrease the relative importance the *IDCP* term after normalization from, approximately, 13% to 2.9% and 1.3% –a remarkable improvement.

### **Figure 3, and Table 4 around here**

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<sup>4</sup> Results for exchange rates, standard deviations, and coefficients of variation are in columns 1, 2, and 3 in Table C in the Appendix (to facilitate the interpretation, exchange rates have been multiplied by ten). The last two rows in Table C inform about the intervals that have been used in the estimation of the exchange rates, as well as the percentage of total citations accounted by the different intervals in each yearly dataset. It is found that coefficients of variation are lower than or equal to 0.10 in the four years 1990, 1995, 1999, and 2004 in 143, 141, 141, and 163 out of 172 sub-fields. These numbers for 1985 and 1980 are 112, and 111. On the other hand, for comparison purposes column 4 in Table C provide how many citations in each sub-field are equivalent to ten citations in the all-sciences case when sub-field mean citations are used as normalization factors.

Further insight into the performance of the best normalization procedures is provided by Figure 4, where  $I(\pi)$  is plotted as a function of  $\pi$  both for the raw data and for the key normalization procedures for papers published in 1990 (to save space, similar results for other publication years are available on request). Note that since this quantity for the perfect normalization procedure is practically indistinguishable from the horizontal axis, it has not been included in Figure 4. Also, because  $I(\pi)$  is too large for many low percentiles, Figure 4 only reports results for the interval (50, 100]. The reduction of the  $I(\pi)$  curve achieved by the best normalization procedures over the entire percentile range is clearly illustrated. At the very upper tail of citation distributions –namely, when it most matters– the performance of mean normalization clearly worsens (this is also the case with the alternative procedures not included in Figure 4), while the two-parameter scheme keeps doing better than the rest in that interval. However, it should be emphasized that even after normalization differences in citation practices in the last percentile are very large indeed. At this level, the comparability of sub-field citation distributions becomes a much harder task.

**Figure 4 around here**

## V. DISCUSSION AND CONCLUSIONS

While the use of citation numbers in research assessment exercises is becoming more and more relevant, there is still much room for the improvement of bibliometric indicators devoted to the quantification of research impact. In particular, there is a strong necessity to find proper ways of suppressing disproportions in raw bibliometric measures that are merely due to different citation practices in different fields. In this paper we have used a recently introduced measurement framework – the *IDCP* method– with two purposes: (i) to estimate the effect on citation inequality of differences in citation practices across sub-fields when using raw citation numbers, and (ii) to assess the effectiveness of six normalization procedures for reducing this effect.

We have used a dataset consisting of 2.9 million papers published in different years ranging from 1980 to 2004, and assigned to 172 distinct sub-fields according to the same classification system. Many

aspects of scientific activity, including the citation process within this classification system, have changed considerably over this period. Nevertheless, this paper has unraveled a number of regularities that can be summarized as follows.

1. As observed in the past in other large datasets organized according to other classification systems, we find that, within each year, citation distribution shapes in our 172 sub-fields system are very similar to each other. Consequently, as also observed in the past, different normalization systems work reasonably well in the sense that the *IDCP* term –capturing the effect on citation inequality of differences in citation practices across sub-fields– is considerably reduced after normalization. In particular, on average over the entire period the three worst procedures reduce the *IDCP* term by 62%-69%, while the three best reduce it by 77%-89%. This is a remarkable result taking into account that the maximum reduction achievable with the data in the “perfect normalization” case is, on average, of 95% of the *IDCP* term.

2. As we go back in time and, consequently, citation windows become larger, two phenomena should be noted. Firstly, on average citation distributions become more skewed, and hence yearly overall citation inequality increases. Secondly, we must distinguish between two sub-periods: 2004-1990, in which the phenomena studied in this paper seem to evolve smoothly in time in a comparable fashion, and the 1985 and, above all, the 1980 datasets, in which the citation process seem to work quite differently. In the midst of a period of more than two decades with these features, the main results of the paper are the following two.

a) As we move towards earlier publication dates and greater citation windows, differences in citation practices within our classification system increase, causing the *IDCP* term to increase in absolute value in such a way that it represents, approximately, the same 13% of overall citation inequality over the entire period.

b) As we move back in time, normalization factors adjust to changes in overall citation inequality and to changes in the differences across sub-fields, with the following two consequences. Firstly, except for 1980, each of the six normalization procedures (as well as the “perfect” one) performs similarly



over the 1985-2004 period. Secondly, the same ranking of procedures according to their ability to reduce the *IDCP* term is essentially maintained over the entire period.

3. The best normalization procedure, namely, the two-parameter reverse engineering scheme, performs very close to the “perfect normalization” over the entire support of citation distributions, except for the last 1% in which this –and, of course, the other five procedures– experience a dramatic worsening. Nevertheless, for example, in 1995-2004 when citation windows vary between seven and sixteen years, this procedure reduces the size of the *IDCP* term by 92.5%-94%, and the importance of the problem of idiosyncratic differences in citation practices from 13% to less than 1% of overall citation inequality.

As far as extensions are concerned, the following three important issues could be cited: (i) the study of normalization procedures using better classification schemes; (ii) the comparison of normalization schemes based on different classification systems, or on no classification scheme at all, as in source or citing-side procedures; and (iii) the estimation of confidence intervals, so as to establish which of the differences found in this paper are statistically significant.

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## APPENDIX

**Table A. Number of documents by sub-field in the different yearly datasets**

	Subfields	1980		1985		1990		1995		1999		2004	
		No. of papers	%	No. of papers	%	No. of papers	%	No. of papers	%	No. of papers	%	No. of papers	%
<b>I. BIOSCIENCES</b>													
1	GENETICS & HEREDITY	2,515	0.71	3,136	0.67	5,260	0.85	9,477	1.11	11,085	1.12	12,947	
2	DEVELOPMENTAL BIOLOGY	546	0.15	665	0.14	1,355	0.22	2,265	0.26	2,744	0.28	3,289	
3	BIOCHEMISTRY & MOLECULAR BIOLOGY	14,673	4.13	18,570	3.95	25,535	4.12	34,475	4.02	37,591	3.81	43,556	
4	EVOLUTIONARY BIOLOGY	898	0.25	1,138	0.24	1,419	0.23	1,789	0.21	2,425	0.25	3,170	
5	BIOLOGY	2,834	0.80	2,868	0.61	3,933	0.63	4,420	0.52	4,782	0.48	5,302	
6	BIOPHYSICS	4,364	1.23	4,662	0.99	5,508	0.89	7,617	0.89	8,133	0.82	9,609	
7	BIOCHEMICAL RESEARCH METHODS	1,589	0.45	2,078	0.44	2,820	0.46	4,985	0.58	6,189	0.63	9,674	
8	CELL BIOLOGY	5,255	1.48	7,420	1.58	10,030	1.62	14,729	1.72	16,484	1.67	17,610	
9	CELL & TISSUE ENGINEERING		0.00		0.00		0.00	185	0.02	144	0.01	322	
<b>II. BIOMEDICAL RESEARCH</b>													
10	ANATOMY & MORPHOLOGY	305	0.09	351	0.07	427	0.07	675	0.08	826	0.08	1,022	
11	PHYSIOLOGY	3,330	0.94	4,505	0.96	5,969	0.96	6,698	0.78	7,333	0.74	7,846	
12	BIOTECHNOLOGY & APPLIED MICROBIOLOGY	2,159	0.61	2,917	0.62	4,788	0.77	9,366	1.09	11,328	1.15	13,899	
13	MEDICAL LABORATORY TECHNOLOGY	1,379	0.39	1,657	0.35	1,786	0.29	1,524	0.18	1,849	0.19	2,210	
14	MICROSCOPY	334	0.09	286	0.06	275	0.04	607	0.07	772	0.08	674	
15	ENGINEERING, BIOMEDICAL	1,018	0.29	1,128	0.24	1,759	0.28	2,711	0.32	3,010	0.30	4,717	
16	MEDICINE, RESEARCH & EXPERIMENTAL	4,480	1.26	4,958	1.05	5,578	0.90	7,096	0.83	7,902	0.80	8,861	
17	TOXICOLOGY	1,804	0.51	2,618	0.56	3,532	0.57	4,475	0.52	5,205	0.53	6,214	
18	PATHOLOGY	2,557	0.72	3,345	0.71	4,187	0.68	5,140	0.60	5,664	0.57	5,694	
19	PHARMACOLOGY & PHARMACY	10,063	2.83	13,427	2.85	15,634	2.52	17,962	2.10	18,956	1.92	20,991	
<b>III. CLINICAL MEDICINE I (INTERNAL)</b>													
20	MEDICINE, GENERAL & INTERNAL	14,744	4.15	15,623	3.32	15,069	2.43	15,177	1.77	15,478	1.57	14,814	
21	RESPIRATORY SYSTEM	1,497	0.42	1,844	0.39	3,254	0.53	5,483	0.64	6,073	0.61	6,259	
22	CARDIAC & CARDIOVASCULAR SYSTEMS	3,144	0.88	4,995	1.06	6,922	1.12	9,760	1.14	11,097	1.12	12,472	
23	GASTROENTEROLOGY & HEPATOLOGY	1,708	0.48	2,602	0.55	4,356	0.70	6,025	0.70	7,319	0.74	7,518	
24	INFECTIOUS DISEASES	1,561	0.44	2,547	0.54	3,629	0.59	5,173	0.60	6,365	0.64	7,727	
25	HEMATOLOGY	2,725	0.77	3,406	0.72	4,716	0.76	7,651	0.89	8,188	0.83	9,875	
26	ANESTHESIOLOGY	1,375	0.39	1,911	0.41	2,459	0.40	3,454	0.40	3,799	0.38	4,122	
27	ALLERGY	461	0.13	636	0.14	831	0.13	1,625	0.19	1,918	0.19	1,617	
28	ENDOCRINOLOGY & METABOLISM	3,617	1.02	4,871	1.03	6,836	1.10	8,898	1.04	9,803	0.99	11,259	
29	CRITICAL CARE MEDICINE	609	0.17	891	0.19	1,346	0.22	2,641	0.31	2,659	0.27	3,116	
30	EMERGENCY MEDICINE	306	0.09	560	0.12	602	0.10	1,107	0.13	1,290	0.13	1,661	
31	IMMUNOLOGY	6,467	1.82	8,667	1.84	11,079	1.79	15,607	1.82	16,919	1.71	17,048	
32	TROPICAL MEDICINE	698	0.20	790	0.17	1,072	0.17	1,075	0.13	1,429	0.14	1,298	
33	ONCOLOGY	4,938	1.39	6,156	1.31	9,443	1.52	13,851	1.62	16,269	1.65	19,647	
<b>IV. CLINICAL MEDICINE II (NON-INTERNAL)</b>													
34	PERIPHERAL VASCULAR DISEASE	1,929	0.54	2,446	0.52	3,608	0.58	6,683	0.78	7,303	0.74	8,353	
35	REPRODUCTIVE BIOLOGY	780	0.22	1,085	0.23	1,917	0.31	3,055	0.36	3,054	0.31	3,710	
36	PEDIATRICS	2,936	0.83	3,886	0.83	5,337	0.86	7,744	0.90	8,609	0.87	9,553	
37	DENTISTRY, ORAL SURGERY & MEDICINE	2,077	0.58	2,833	0.60	3,248	0.52	3,608	0.42	4,196	0.42	5,040	
38	ORTHOPEDECS	1,383	0.39	2,167	0.46	2,732	0.44	3,826	0.45	4,309	0.44	5,607	
39	OTORHINOLARYNGOLOGY	1,413	0.40	1,689	0.36	2,259	0.36	2,863	0.33	2,855	0.29	3,235	
40	RADIOLOGY, NUCLEAR MEDICINE & MEDICAL IMAGING	4,132	1.16	5,504	1.17	7,596	1.23	9,628	1.12	10,455	1.06	12,165	
41	PSYCHIATRY	2,919	0.82	4,330	0.92	5,029	0.81	6,617	0.77	7,804	0.79	9,108	
42	OBSTETRICS & GYNECOLOGY	2,060	0.58	3,074	0.65	4,618	0.75	5,886	0.69	5,909	0.60	7,384	
43	CLINICAL NEUROLOGY	3,736	1.05	5,375	1.14	7,212	1.16	11,622	1.36	13,281	1.34	15,563	
44	OPHTHALMOLOGY	2,123	0.60	2,914	0.62	3,787	0.61	4,086	0.48	5,093	0.52	6,359	
45	UROLOGY & NEPHROLOGY	1,656	0.47	2,238	0.48	3,403	0.55	5,086	0.59	6,490	0.66	7,784	
46	SPORT SCIENCES	1,008	0.28	1,517	0.32	2,036	0.33	2,589	0.30	3,737	0.38	4,701	
47	GERIATRICS & GERONTOLOGY	599	0.17	663	0.14	948	0.15	1,730	0.20	1,742	0.18	2,387	
48	INTEGRATIVE & COMPLEMENTARY MEDICINE	194	0.05	108	0.02	213	0.03	282	0.03	599	0.06	885	
49	DERMATOLOGY	1,866	0.53	2,651	0.56	3,136	0.51	4,152	0.48	4,720	0.48	4,808	
50	SURGERY	6,954	1.96	9,570	2.03	12,412	2.00	18,445	2.15	19,737	2.00	22,687	
51	TRANSPLANTATION	680	0.19	1,375	0.29	2,401	0.39	4,038	0.47	4,108	0.42	4,665	
52	RHEUMATOLOGY	720	0.20	1,126	0.24	1,462	0.24	1,832	0.21	2,381	0.24	3,058	
53	ANDROLOGY	161	0.05	174	0.04	215	0.03	201	0.02	195	0.02	248	
<b>V. CLINICAL MEDICINE III</b>													
54	HEALTH CARE SCIENCES & SERVICES	629	0.18	762	0.16	1,301	0.21	2,122	0.25	3,066	0.31	3,577	
55	MEDICINE, LEGAL	326	0.09	403	0.09	573	0.09	806	0.09	928	0.09	993	
56	MEDICAL INFORMATICS	162	0.05	283	0.06	474	0.08	835	0.10	1,159	0.12	1,196	
57	PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH	2,876	0.81	4,024	0.85	5,378	0.87	6,847	0.80	8,439	0.85	10,171	
58	NURSING	660	0.19	877	0.19	1,007	0.16	1,694	0.20	1,804	0.18	2,365	
59	SUBSTANCE ABUSE	175	0.05	410	0.09	454	0.07	778	0.09	952	0.10	1,049	
60	REHABILITATION	247	0.07	392	0.08	498	0.08	986	0.12	1,444	0.15	1,863	
61	EDUCATION, SCIENTIFIC DISCIPLINES	1,234	0.35	1,310	0.28	1,543	0.25	1,635	0.19	1,823	0.18	1,930	
62	PRIMARY HEALTH CARE	595	0.17	690	0.15	1,113	0.18	1,196	0.14	1,341	0.14	1,140	
<b>VI. NEUROSCIENCES &amp; BEHAVIORAL</b>													
63	NEUROIMAGING	203	0.06	292	0.06	487	0.08	786	0.09	968	0.10	1,430	
64	BEHAVIORAL SCIENCES	1,908	0.54	2,331	0.50	2,977	0.48	2,950	0.34	2,792	0.28	3,426	

65	NEUROSCIENCES	7,751	2.18	10,403	2.21	13,815	2.23	18,196	2.12	21,227	2.15	23,796
66	PSYCHOLOGY	1,186	0.33	1,442	0.31	1,600	0.26	2,246	0.26	2,604	0.26	2,942
<b>VII. CHEMISTRY</b>												
67	CHEMISTRY, MULTIDISCIPLINARY	8,653	2.43	9,962	2.12	11,327	1.83	13,790	1.61	17,292	1.75	23,501
68	CHEMISTRY, ANALYTICAL	3,174	0.89	5,321	1.13	6,050	0.98	9,948	1.16	11,698	1.18	14,446
69	ENGINEERING, CHEMICAL	3,802	1.07	5,088	1.08	6,807	1.10	9,116	1.06	10,693	1.08	13,612
70	CHEMISTRY, ORGANIC	5,772	1.62	7,231	1.54	8,867	1.43	11,480	1.34	13,773	1.39	16,878
71	CHEMISTRY, APPLIED	1,569	0.44	1,628	0.35	2,267	0.37	4,284	0.50	5,485	0.56	7,542
72	CHEMISTRY, PHYSICAL	6,711	1.89	8,988	1.91	11,078	1.79	17,819	2.08	22,527	2.28	29,735
73	CHEMISTRY, INORGANIC & NUCLEAR	2,552	0.72	3,977	0.84	5,132	0.83	5,946	0.69	8,348	0.85	10,219
74	ELECTROCHEMISTRY	1,302	0.37	1,616	0.34	2,351	0.38	3,399	0.40	4,052	0.41	5,539
75	CHEMISTRY, MEDICINAL	2,185	0.61	2,840	0.60	3,137	0.51	4,043	0.47	4,742	0.48	6,444
76	POLYMER SCIENCE	2,573	0.72	3,010	0.64	4,380	0.71	7,586	0.89	9,425	0.95	11,170
<b>VIII. PHYSICS</b>												
77	SPECTROSCOPY	1,367	0.38	2,549	0.54	3,760	0.61	4,871	0.57	5,804	0.59	6,648
78	PHYSICS, CONDENSED MATTER	5,820	1.64	6,787	1.44	10,973	1.77	15,933	1.86	19,149	1.94	22,654
79	OPTICS	3,226	0.91	4,696	1.00	6,966	1.12	9,713	1.13	10,311	1.04	12,693
80	PHYSICS, PARTICLES & SUB-FIELDS	1,480	0.42	2,596	0.55	4,037	0.65	5,655	0.66	6,450	0.65	8,759
81	PHYSICS, MATHEMATICAL	1,048	0.29	1,394	0.30	1,994	0.32	4,618	0.54	5,471	0.55	6,624
82	CRYSTALLOGRAPHY	1,551	0.44	2,672	0.57	3,867	0.62	3,909	0.46	4,796	0.49	7,032
83	PHYSICS, APPLIED	6,240	1.76	7,536	1.60	12,359	2.00	17,273	2.02	22,306	2.26	28,999
84	PHYSICS, FLUIDS & PLASMAS	1,042	0.29	1,383	0.29	1,175	0.19	3,972	0.46	4,626	0.47	5,648
85	PHYSICS, NUCLEAR	1,719	0.48	2,516	0.53	3,315	0.54	4,457	0.52	4,333	0.44	4,987
86	PHYSICS, MULTIDISCIPLINARY	6,870	1.93	7,853	1.67	9,178	1.48	10,727	1.25	12,198	1.23	15,438
87	THERMODYNAMICS	1,160	0.33	1,500	0.32	2,175	0.35	2,860	0.33	2,956	0.30	3,809
88	ACOUSTICS	1,232	0.35	1,468	0.31	1,789	0.29	2,719	0.32	2,670	0.27	3,361
89	PHYSICS, ATOMIC, MOLECULAR & CHEMICAL	5,959	1.68	6,966	1.48	8,269	1.33	8,798	1.03	11,829	1.20	12,973
<b>IX. SPACE SCIENCES</b>												
90	ASTRONOMY & ASTROPHYSICS	4,146	1.17	5,153	1.09	6,250	1.01	8,825	1.03	9,644	0.98	13,392
<b>X. MATHEMATICS</b>												
91	MATHEMATICS	5,421	1.53	7,895	1.68	9,160	1.48	10,070	1.18	11,458	1.16	13,390
92	MATHEMATICS, INTERDISCIPLINARY APPLICATIONS	1,323	0.37	1,332	0.28	1,688	0.27	2,751	0.32	3,195	0.32	4,370
93	MATHEMATICS, APPLIED	2,480	0.70	3,619	0.77	5,492	0.89	7,404	0.86	8,708	0.88	11,863
94	STATISTICS & PROBABILITY	1,524	0.43	2,295	0.49	2,916	0.47	3,710	0.43	4,519	0.46	4,922
<b>XI. COMPUTER SCIENCE</b>												
COMPUTER SCIENCE, INFORMATION SYSTEMS												
95	COMPUTER SCIENCE, INFORMATION SYSTEMS	816	0.23	876	0.19	1,159	0.19	2,271	0.27	3,185	0.32	4,633
96	COMPUTER SCIENCE, THEORY & METHODS	722	0.20	1,180	0.25	1,901	0.31	3,085	0.36	3,399	0.34	3,918
97	COMPUTER SCIENCE, INTERDISCIPLINARY APPLICATIONS	845	0.24	1,529	0.32	2,886	0.47	3,913	0.46	4,712	0.48	5,761
98	COMPUTER SCIENCE, CYBERNETICS	197	0.06	195	0.04	276	0.04	606	0.07	855	0.09	1,068
99	MATHEMATICAL & COMPUTATIONAL BIOLOGY	834	0.23	931	0.20	954	0.15	1,129	0.13	1,436	0.15	2,304
100	COMPUTER SCIENCE, HARDWARE & ARCHITECTURE	848	0.24	1,134	0.24	1,265	0.20	2,148	0.25	2,388	0.24	2,890
101	COMPUTER SCIENCE, SOFTWARE ENGINEERING	831	0.23	1,502	0.32	1,947	0.31	2,709	0.32	3,251	0.33	4,718
102	COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE	152	0.04	243	0.05	715	0.12	3,022	0.35	3,680	0.37	4,690
<b>XII. ENGINEERING</b>												
103	ENGINEERING, ENVIRONMENTAL	647	0.18	964	0.20	1,409	0.23	2,516	0.29	3,449	0.35	4,850
104	ENGINEERING, MARINE	205	0.06	200	0.04	228	0.04	396	0.05	367	0.04	489
105	ENGINEERING, ELECTRICAL & ELECTRONIC	5,755	1.62	9,114	1.94	12,081	1.95	19,938	2.33	22,985	2.33	26,432
106	ENERGY & FUELS	2,294	0.65	2,698	0.57	3,018	0.49	4,235	0.49	4,706	0.48	5,977
107	ENGINEERING, MANUFACTURING CONSTRUCTION & BUILDING TECHNOLOGY	198	0.06	282	0.06	599	0.10	1,505	0.18	2,368	0.24	3,385
108	AUTOMATION & CONTROL SYSTEMS	146	0.04	433	0.09	708	0.11	1,170	0.14	1,603	0.16	2,302
109	INSTRUMENTS & INSTRUMENTATION	1,082	0.30	1,257	0.27	1,600	0.26	2,485	0.29	2,886	0.29	3,449
110	OPERATIONS RESEARCH & MANAGEMENT SCIENCE	2,197	0.62	3,692	0.78	5,576	0.90	7,175	0.84	7,105	0.72	8,599
111	MECHANICS	1,297	0.36	1,712	0.36	2,047	0.33	3,257	0.38	3,542	0.36	3,902
112	ENGINEERING, INDUSTRIAL	2,893	0.81	3,640	0.77	4,460	0.72	6,810	0.80	7,338	0.74	10,165
113	ENGINEERING, MULTIDISCIPLINARY	274	0.08	705	0.15	1,274	0.21	2,347	0.27	2,491	0.25	3,109
114	IMAGING SCIENCE & PHOTOGRAPHIC TECHNOLOGY	2,211	0.62	2,129	0.45	2,603	0.42	3,267	0.38	3,627	0.37	4,443
115	NUCLEAR SCIENCE & TECHNOLOGY	128	0.04	342	0.07	438	0.07	726	0.08	799	0.08	1,136
116	ROBOTICS	2,477	0.70	5,203	1.11	5,555	0.90	7,094	0.83	6,942	0.70	7,589
117	TRANSPORTATION SCIENCE & TECHNOLOGY	43	0.00	43	0.01	149	0.02	282	0.03	460	0.05	497
118	TELECOMMUNICATIONS	250	0.07	386	0.08	379	0.06	520	0.06	736	0.07	1,562
119	ENGINEERING, CIVIL	967	0.27	1,319	0.28	1,739	0.28	2,788	0.33	3,927	0.40	5,196
120	ENGINEERING, PETROLEUM	1,232	0.35	2,239	0.48	2,998	0.48	3,780	0.44	3,847	0.39	5,972
121	ENGINEERING, MECHANICAL	1,092	0.31	961	0.20	854	0.14	932	0.11	1,314	0.13	1,613
122	MATERIALS SCIENCE, PAPER & WOOD	1,583	0.45	2,334	0.50	3,390	0.55	5,749	0.67	6,959	0.70	8,503
<b>XIII. MATERIALS SCIENCE</b>												
123	MATERIALS SCIENCE, MULTIDISCIPLINARY	349	0.10	817	0.17	1,071	0.17	1,059	0.12	1,064	0.11	1,048
124	MATERIALS SCIENCE, COATINGS & FILMS	5,489	1.54	5,919	1.26	11,074	1.79	18,071	2.11	23,804	2.41	34,391
125	MATERIALS SCIENCE, BIOMATERIALS	1,152	0.32	1,315	0.28	1,605	0.26	2,600	0.30	3,808	0.39	4,993
126	MATERIALS SCIENCE, TEXTILES	108	0.03	70	0.01	267	0.04	574	0.07	784	0.08	2,082
127	NANOSCIENCE & NANOTECHNOLOGY	235	0.07	322	0.07	348	0.06	561	0.07	760	0.08	949
128	MATERIALS SCIENCE, CERAMICS	0.00	0.00	316	0.07	689	0.11	1,921	0.22	3,219	0.33	7,183
129	MATERIALS SCIENCE, CERAMICS	1,076	0.30	1,250	0.27	1,420	0.23	2,171	0.25	2,790	0.28	3,443

130	MATERIALS SCIENCE, COMPOSITES	112	0.03	158	0.03	419	0.07	770	0.09	1,305	0.13	1,539
131	MATERIALS SCIENCE, CHARACTERIZATION & TESTING	442	0.12	737	0.16	429	0.07	920	0.11	1,254	0.13	1,293
132	METALLURGY & METALLURGICAL ENGINEERING	1,076	0.30	1,198	0.25	1,652	0.27	3,460	0.40	4,936	0.50	8,077
<b>XIV. GEOSCIENCES</b>												
133	ENGINEERING, GEOLOGICAL	220	0.06	307	0.07	347	0.06	494	0.06	848	0.09	1,406
134	GEOSCIENCES, MULTIDISCIPLINARY	2,026	0.57	2,968	0.63	4,037	0.65	6,210	0.72	7,569	0.77	10,683
135	ENGINEERING, OCEAN	188	0.05	329	0.07	263	0.04	549	0.06	676	0.07	874
136	MINERALOGY	634	0.18	708	0.15	924	0.15	1,201	0.14	1,294	0.13	1,724
137	ENGINEERING, AEROSPACE	918	0.26	1,395	0.30	1,522	0.25	2,276	0.27	1,949	0.20	1,902
138	GEOLOGY	413	0.12	595	0.13	729	0.12	1,015	0.12	1,483	0.15	1,604
139	GEOGRAPHY, PHYSICAL	428	0.12	718	0.15	911	0.15	1,281	0.15	1,768	0.18	2,230
140	METEOROLOGY & ATMOSPHERIC SCIENCES	1,123	0.32	1,880	0.40	2,618	0.42	5,137	0.60	5,099	0.52	6,720
141	GEOCHEMISTRY & GEOPHYSICS	2,177	0.61	2,507	0.53	3,314	0.54	3,829	0.45	4,212	0.43	5,777
142	REMOTE SENSING	329	0.09	611	0.13	649	0.10	797	0.09	934	0.09	1,301
143	PALEONTOLOGY	330	0.09	406	0.09	589	0.10	964	0.11	1,103	0.11	1,559
144	MINING & MINERAL PROCESSING	736	0.21	740	0.16	751	0.12	901	0.11	1,145	0.12	1,553
145	OCEANOGRAPHY	979	0.28	1,746	0.37	1,969	0.32	3,058	0.36	3,383	0.34	4,159
<b>XV. AGRICULTURAL &amp; ENVIRONMENT</b>												
146	AGRICULTURE, DAIRY & ANIMAL SCIENCE	1,763	0.50	2,034	0.43	2,656	0.43	2,610	0.30	3,202	0.32	3,868
147	BIODIVERSITY CONSERVATION	504	0.14	716	0.15	780	0.13	1,053	0.12	1,227	0.12	2,117
148	LIMNOLOGY	277	0.08	444	0.09	563	0.09	911	0.11	948	0.10	1,208
149	NUTRITION & DIETETICS	1,677	0.47	2,159	0.46	2,929	0.47	3,582	0.42	3,938	0.40	4,767
150	AGRICULTURE, MULTIDISCIPLINARY	1,518	0.43	1,529	0.32	1,918	0.31	1,818	0.21	2,142	0.22	2,803
151	ENVIRONMENTAL SCIENCES	3,048	0.86	4,750	1.01	6,779	1.09	10,689	1.25	12,049	1.22	16,938
152	AGRONOMY	1,858	0.52	2,384	0.51	3,094	0.50	3,888	0.45	3,634	0.37	4,767
153	FOOD SCIENCE & TECHNOLOGY	2,548	0.72	3,196	0.68	4,094	0.66	5,851	0.68	7,002	0.71	9,457
154	SOIL SCIENCE	1,207	0.34	1,603	0.34	1,939	0.31	2,286	0.27	2,551	0.26	2,766
<b>XVI. BIOLOGY (ORGANISMIC AND SUPRAORGONISMIC LEVEL)</b>												
155	ORNITHOLOGY	443	0.12	475	0.10	526	0.08	696	0.08	776	0.08	928
156	ZOOLOGY	3,147	0.89	4,233	0.90	4,615	0.75	4,986	0.58	5,246	0.53	6,684
157	MARINE & FRESHWATER BIOLOGY	2,297	0.65	3,267	0.69	3,728	0.60	5,200	0.61	5,977	0.61	6,939
158	WATER RESOURCES	1,046	0.29	1,944	0.41	2,366	0.38	3,904	0.46	4,265	0.43	5,490
159	PARASITOLOGY	858	0.24	958	0.20	1,417	0.23	1,798	0.21	2,020	0.20	2,239
160	VETERINARY SCIENCES	3,318	0.93	4,175	0.89	5,079	0.82	5,685	0.66	6,331	0.64	7,967
161	PLANT SCIENCES	6,050	1.70	7,989	1.70	10,016	1.62	11,670	1.36	11,714	1.19	12,844
162	FISHERIES	893	0.25	1,058	0.22	1,599	0.26	2,229	0.26	2,740	0.28	3,495
163	MICROBIOLOGY	4,039	1.14	5,452	1.16	7,428	1.20	9,711	1.13	11,077	1.12	13,224
164	ENTOMOLOGY	1,985	0.56	2,664	0.57	3,128	0.50	3,338	0.39	3,478	0.35	4,371
165	ECOLOGY	2,667	0.75	3,726	0.79	4,718	0.76	6,127	0.72	7,441	0.75	9,860
166	MYCOLOGY	329	0.09	401	0.09	500	0.08	740	0.09	950	0.10	1,019
167	VIROLOGY	1,648	0.46	1,862	0.40	2,836	0.46	3,743	0.44	4,158	0.42	4,713
168	FORESTRY	576	0.16	1,030	0.22	1,388	0.22	1,643	0.19	2,093	0.21	2,811
<b>XVII. MULTIDISCIPLINARY</b>												
169	MULTIDISCIPLINARY SCIENCES	4,879	1.37	7,785	1.65	11,404	1.84	10,747	1.25	10,958	1.11	10,909
<b>XVIII. SOCIAL SCIENCES, GENERAL</b>												
170	MEDICAL ETHICS	143	0.04	158	0.03	175	0.03	305	0.04	285	0.03	443
171	HISTORY & PHILOSOPHY OF SCIENCE	386	0.11	540	0.11	533	0.09	647	0.08	724	0.07	919
<b>XIX. ECONOMICS &amp; BUSINESS</b>												
172	AGRICULTURAL ECONOMICS & POLICY	444	0.12	450	0.10	460	0.07	576	0.07	750	0.08	592
<b>TOTAL</b>		<b>355,393</b>	<b>100</b>	<b>470,680</b>	<b>100</b>	<b>619,430</b>	<b>100</b>	<b>856,556</b>	<b>100</b>	<b>987,830</b>	<b>100</b>	<b>1,205,646</b>
<b>Mean Sub-field Size</b>		<b>2,103</b>		<b>2,753</b>		<b>3,622</b>		<b>4,980</b>		<b>5,743</b>		<b>7,010</b>
<b>Standard Deviation</b>		<b>2,341</b>		<b>2,930</b>		<b>3,756</b>		<b>5,014</b>		<b>5,728</b>		<b>6,887</b>

**Table B. Sub-field mean citations and standard deviations (SD) in the different yearly datasets**

		1980		1985		1990		1995		1999		2004	S
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	
<b>I. BIOSCIENCES</b>													
1	GENETICS & HEREDITY	34.3	194.9	39.7	391.1	37.1	62.8	41.6	86.9	38.9	73.3	25.6	43
2	DEVELOPMENTAL BIOLOGY	38.9	55.6	33.8	45.5	60.3	80.2	62.7	107.8	52.4	70.2	31.0	41
3	BIOCHEMISTRY & MOLECULAR BIOLOGY	43.0	149.4	45.6	189.5	47.5	213.1	44.0	95.1	40.2	71.2	26.2	52
4	EVOLUTIONARY BIOLOGY	44.9	301.6	54.2	508.3	30.9	52.2	36.4	70.2	34.6	66.1	22.9	25
5	BIOLOGY	15.6	31.2	16.4	37.8	16.7	43.7	15.9	36.2	17.2	30.6	16.1	28
6	BIOPHYSICS	28.3	47.6	30.1	47.4	32.4	58.9	30.0	45.5	28.2	56.2	19.5	67
7	BIOCHEMICAL RESEARCH METHODS	47.4	306.3	35.7	332.3	23.5	51.1	20.9	45.5	23.2	70.7	20.5	10
8	CELL BIOLOGY	42.4	90.5	49.9	96.3	58.1	112.6	54.3	107.7	49.8	86.7	32.7	45
9	CELL & TISSUE ENGINEERING							17.0	26.7	14.4	19.6	31.4	42
<b>II. BIOMEDICAL RESEARCH</b>													
10	ANATOMY & MORPHOLOGY	21.0	24.5	16.1	15.3	13.1	15.7	22.8	107.0	16.1	22.6	11.8	15
11	PHYSIOLOGY	43.3	77.3	38.3	61.1	33.8	47.7	29.2	35.1	27.1	29.7	18.7	15
12	BIOTECHNOLOGY & APPLIED MICROBIOLOGY	21.6	35.6	24.6	41.1	26.2	46.1	21.2	33.1	24.4	55.6	19.6	77
13	MEDICAL LABORATORY TECHNOLOGY	18.0	26.9	16.1	27.3	13.8	25.6	16.7	35.4	14.2	23.3	11.1	17
14	MICROSCOPY	10.3	19.4	17.2	24.6	12.8	18.5	15.3	20.9	12.2	20.1	9.9	13
15	ENGINEERING, BIOMEDICAL MEDICINE, RESEARCH &	19.0	56.2	17.7	39.3	19.5	37.1	19.2	34.7	21.7	41.3	18.8	25
16	EXPERIMENTAL	30.7	63.2	31.2	71.7	31.4	74.2	37.4	86.5	32.6	74.7	20.3	44
17	TOXICOLOGY	18.5	23.5	17.5	27.7	17.8	26.3	17.8	23.4	19.5	27.8	13.8	18
18	PATHOLOGY	23.8	37.3	25.2	44.7	24.8	51.1	22.2	38.1	21.3	46.7	14.4	15
19	PHARMACOLOGY & PHARMACY	24.7	37.9	21.7	39.0	21.3	37.0	19.5	31.5	19.9	28.9	14.7	17
<b>III. CLINICAL MEDICINE I (INTERNAL)</b>													
20	MEDICINE, GENERAL & INTERNAL	17.1	56.1	19.3	77.7	23.4	89.4	25.1	106.1	25.4	97.7	20.0	84
21	RESPIRATORY SYSTEM	21.3	35.0	19.1	33.6	18.6	30.2	25.1	43.5	23.4	38.5	16.3	24
22	CARDIAC & CARDIOVASCULAR SYSTEMS	34.2	107.2	30.7	57.6	28.4	61.6	28.2	54.8	26.4	52.8	20.2	40
23	GASTROENTEROLOGY & HEPATOLOGY	30.5	54.9	29.2	45.7	25.1	44.2	25.9	42.9	24.3	43.7	19.0	30
24	INFECTIOUS DISEASES	29.5	48.9	25.5	44.3	27.1	40.8	26.4	36.7	25.4	36.4	18.5	20
25	HEMATOLOGY	39.1	117.2	37.7	71.3	41.5	79.7	39.1	67.3	36.7	64.1	25.9	45
26	ANESTHESIOLOGY	18.5	32.4	17.2	37.3	18.0	36.7	15.9	31.0	15.0	26.1	10.1	10
27	ALLERGY	21.0	29.5	20.7	31.5	22.9	43.1	18.9	29.1	20.1	28.9	19.0	20
28	ENDOCRINOLOGY & METABOLISM	36.5	49.9	34.1	126.3	33.5	48.7	30.5	45.3	31.0	50.2	21.7	37
29	CRITICAL CARE MEDICINE	14.8	20.6	21.7	211.6	17.1	31.2	28.3	56.2	28.1	45.8	18.2	30
30	EMERGENCY MEDICINE	6.4	11.7	10.5	19.0	12.0	24.8	11.2	17.7	10.6	17.2	7.6	12
31	IMMUNOLOGY	35.6	71.6	33.0	64.3	34.4	57.4	33.1	64.6	30.9	53.2	22.2	34
32	TROPICAL MEDICINE	15.7	19.7	14.7	23.1	12.8	17.3	14.0	19.5	14.3	18.3	11.4	13
33	ONCOLOGY	32.9	49.5	32.2	51.7	33.1	65.5	33.2	56.3	32.1	57.9	23.4	35
<b>IV. CLINICAL MEDICINE II (NON-INTERNAL)</b>													
34	PERIPHERAL VASCULAR DISEASE	45.3	136.4	38.9	67.6	39.8	74.0	38.6	67.9	36.9	69.6	25.4	45
35	REPRODUCTIVE BIOLOGY	27.4	36.1	22.8	32.2	22.1	29.3	23.9	35.2	23.4	28.0	15.3	23
36	PEDIATRICS	21.4	36.6	19.6	33.2	17.7	29.4	16.3	29.6	14.9	24.3	10.7	10
37	DENTISTRY, ORAL SURGERY & MEDICINE	13.7	24.1	13.7	22.7	15.2	25.8	14.9	23.6	14.5	20.5	11.1	10
38	ORTHOPEDICS	23.9	47.0	20.7	39.2	24.5	44.5	22.1	36.2	18.8	26.5	13.0	18
39	OTORHINOLARYNGOLOGY	18.4	28.1	15.5	23.7	16.8	29.8	13.4	18.5	13.0	16.6	9.0	10
40	RADIOLOGY, NUCLEAR MEDICINE & MEDICAL IMAGING	21.1	37.9	20.6	38.0	21.1	42.6	20.4	43.9	19.9	42.6	15.8	23
41	PSYCHIATRY	31.4	63.6	29.3	62.1	31.1	53.1	27.9	56.4	29.6	48.6	20.9	27
42	OBSTETRICS & GYNECOLOGY	23.7	37.0	19.4	32.8	18.5	28.6	18.5	29.3	16.5	22.4	11.8	15
43	CLINICAL NEUROLOGY	31.6	57.7	28.5	51.4	30.9	52.0	24.9	44.2	25.0	43.5	17.0	24
44	OPHTHALMOLOGY	21.8	40.4	20.4	31.6	18.3	27.7	20.0	35.9	18.0	28.5	12.0	15
45	UROLOGY & NEPHROLOGY	19.9	29.8	17.7	36.6	20.1	40.2	22.6	34.7	21.3	39.3	15.6	24
46	SPORT SCIENCES	26.7	44.7	27.9	44.3	24.0	34.4	21.9	30.5	19.2	26.2	13.4	10
47	GERIATRICS & GERONTOLOGY	17.7	29.0	19.9	39.9	20.4	37.3	19.7	34.0	20.1	28.7	15.1	15
48	INTEGRATIVE & COMPLEMENTARY MEDICINE	6.2	9.4	8.0	10.7	9.4	12.2	13.3	16.0	13.0	18.0	10.5	11
49	DERMATOLOGY	17.3	27.2	15.6	23.8	17.3	26.0	15.5	23.8	13.6	20.4	10.1	13
50	SURGERY	24.0	45.4	21.3	37.9	21.6	38.2	18.0	32.5	16.7	28.4	12.2	15
51	TRANSPLANTATION	15.8	29.2	14.5	27.9	15.4	24.5	15.7	29.5	14.2	25.9	13.2	15
52	RHEUMATOLOGY	28.8	97.6	22.4	39.1	28.8	100.5	25.9	61.8	23.4	43.0	18.3	25
53	ANDROLOGY	12.8	15.3	17.0	16.9	17.1	25.3	13.1	17.3	15.2	17.1	11.5	12
<b>V. CLINICAL MEDICINE III</b>													
54	HEALTH CARE SCIENCES & SERVICES	7.5	18.7	13.3	24.4	13.1	29.8	15.2	30.2	14.3	25.3	11.8	18
55	MEDICINE, LEGAL	5.7	8.3	8.7	13.1	8.8	17.9	10.8	14.2	8.4	11.3	7.0	10
56	MEDICAL INFORMATICS	10.4	19.5	13.1	38.2	17.2	39.8	16.3	42.4	13.5	36.2	11.7	15
57	PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH	18.6	34.9	21.0	54.7	21.5	38.4	22.4	40.0	20.0	32.7	15.3	22
58	NURSING	2.8	6.3	5.8	16.9	9.5	16.5	9.7	15.6	8.8	11.4	7.9	10
59	SUBSTANCE ABUSE	24.4	39.6	20.2	25.4	28.5	39.4	25.9	34.2	23.5	28.6	17.0	21
60	REHABILITATION	11.6	21.1	14.1	34.9	15.5	25.1	15.5	22.4	16.1	25.4	11.5	13
61	EDUCATION, SCIENTIFIC DISCIPLINES	3.7	10.9	5.5	16.0	7.1	36.9	5.4	11.9	7.0	13.9	6.3	12
62	PRIMARY HEALTH CARE	3.5	7.9	3.9	17.5	5.0	12.7	6.1	12.6	7.4	14.3	6.9	11
<b>VI. NEUROSCIENCES &amp; BEHAVIORAL</b>													

63	NEUROIMAGING	18.2	23.3	19.2	24.7	25.5	43.5	27.7	68.3	34.1	71.1	26.0	34
64	BEHAVIORAL SCIENCES	24.9	45.1	24.7	38.5	25.8	35.8	26.6	33.9	24.9	27.1	17.0	17
65	NEUROSCIENCES	40.0	64.6	39.9	72.0	39.7	65.1	36.5	58.9	35.1	51.9	23.5	31
66	PSYCHOLOGY	44.1	209.8	35.5	88.0	41.5	133.0	33.6	53.4	27.4	35.8	17.9	21
<b>VII. CHEMISTRY</b>													
67	CHEMISTRY, MULTIDISCIPLINARY	24.7	66.8	22.9	142.0	23.6	79.0	20.5	48.7	23.4	43.0	21.4	40
68	CHEMISTRY, ANALYTICAL	30.1	215.9	21.3	197.9	19.7	42.4	19.9	32.3	19.1	41.0	15.0	20
69	ENGINEERING, CHEMICAL	14.3	30.0	11.4	23.3	13.0	29.9	12.7	23.5	13.7	26.1	10.8	16
70	CHEMISTRY, ORGANIC	21.3	47.8	22.3	33.1	20.9	28.9	19.0	23.8	18.3	29.1	14.6	17
71	CHEMISTRY, APPLIED	16.8	35.9	16.9	29.0	16.6	26.4	14.4	24.9	16.9	28.1	11.8	15
72	CHEMISTRY, PHYSICAL	24.6	54.0	22.2	46.3	21.3	51.0	21.6	35.8	22.2	37.3	18.5	30
73	CHEMISTRY, INORGANIC & NUCLEAR	23.0	30.2	21.6	28.8	19.8	27.2	18.9	23.9	15.4	22.0	12.3	15
74	ELECTROCHEMISTRY	28.3	54.0	21.9	34.8	22.5	44.9	20.5	34.1	20.7	30.0	17.3	22
75	CHEMISTRY, MEDICINAL	16.4	31.3	15.6	35.0	17.5	27.8	17.2	28.4	18.5	25.3	14.6	15
76	POLYMER SCIENCE	24.1	62.1	23.7	49.2	22.2	36.5	19.7	41.9	18.0	30.8	14.2	18
<b>VIII. PHYSICS</b>													
77	SPECTROSCOPY	22.5	43.1	18.6	92.2	15.3	33.6	14.7	80.8	13.4	32.6	9.6	13
78	PHYSICS, CONDENSED MATTER	23.7	55.6	26.3	62.7	21.9	91.6	17.7	37.7	16.1	59.5	13.4	27
79	OPTICS	23.7	47.6	24.7	77.4	19.0	46.3	15.8	36.0	15.6	28.0	12.2	15
80	PHYSICS, PARTICLES & SUB-FIELDS	36.3	93.8	29.5	92.1	21.2	47.9	17.7	46.1	21.2	51.4	14.3	26
81	PHYSICS, MATHEMATICAL	23.1	68.8	19.1	61.4	17.4	48.7	18.6	52.9	15.6	32.9	11.4	20
82	CRYSTALLOGRAPHY	19.5	33.3	15.5	101.5	17.2	263.1	11.7	84.2	12.6	92.5	8.1	75
83	PHYSICS, APPLIED	19.3	44.8	19.3	39.6	17.5	67.7	15.8	31.4	16.5	34.5	14.2	27
84	PHYSICS, FLUIDS & PLASMAS	23.1	40.6	22.5	39.1	21.8	35.1	22.3	42.7	18.8	28.2	12.3	18
85	PHYSICS, NUCLEAR	21.3	57.3	20.4	76.1	15.4	28.0	13.6	43.0	12.4	22.4	10.2	17
86	PHYSICS, MULTIDISCIPLINARY	26.9	164.3	27.9	95.2	27.1	86.3	26.1	76.2	23.0	73.3	16.2	33
87	THERMODYNAMICS	12.0	22.0	13.2	53.3	11.4	20.3	11.1	16.3	11.5	18.9	9.8	13
88	ACOUSTICS	17.6	41.2	15.0	26.0	17.7	34.3	13.8	23.1	12.8	18.8	8.8	12
89	PHYSICS, ATOMIC, MOLECULAR & CHEMICAL	33.8	111.1	33.2	151.5	26.4	56.3	22.9	59.2	21.4	35.2	14.3	20
<b>IX. SPACE SCIENCES</b>													
90	ASTRONOMY & ASTROPHYSICS	35.7	76.1	33.0	68.3	27.8	50.6	27.2	58.1	29.1	56.3	21.4	38
<b>X. MATHEMATICS</b>													
91	MATHEMATICS	10.4	24.1	8.9	23.0	7.6	16.7	7.2	15.7	6.4	12.2	4.6	8
92	MATHEMATICS, INTERDISCIPLINARY APPLICATIONS	22.2	171.0	23.4	74.1	20.3	56.4	14.9	38.4	13.8	33.6	10.4	15
93	MATHEMATICS, APPLIED	14.1	38.7	12.6	32.4	10.9	27.4	10.0	24.4	9.5	22.3	6.7	12
94	STATISTICS & PROBABILITY	25.8	160.2	19.4	59.7	18.0	71.1	16.6	51.5	13.0	33.9	9.0	21
<b>XI. COMPUTER SCIENCE</b>													
95	COMPUTER SCIENCE, INFORMATION SYSTEMS	14.9	46.1	17.8	67.7	13.9	62.0	12.1	60.8	14.9	72.6	11.6	44
96	COMPUTER SCIENCE, THEORY & METHODS	21.8	50.3	20.2	57.9	12.8	33.4	14.7	46.0	15.3	49.7	9.6	20
97	COMPUTER SCIENCE, INTERDISCIPLINARY APPLICATIONS	15.3	56.4	11.5	34.6	12.4	57.6	12.6	50.9	12.9	35.8	10.2	17
98	COMPUTER SCIENCE, CYBERNETICS MATHEMATICAL & COMPUTATIONAL BIOLOGY	12.0	35.6	27.9	178.0	13.5	28.1	10.6	36.0	11.5	20.5	10.4	17
99	COMPUTER SCIENCE, HARDWARE & ARCHITECTURE	20.3	33.7	17.5	37.4	23.8	68.5	21.3	53.3	23.0	66.1	20.0	43
100	COMPUTER SCIENCE, SOFTWARE ENGINEERING	19.8	54.2	17.7	51.8	13.9	40.0	15.4	51.4	15.3	51.7	9.8	22
101	COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE	17.3	42.4	15.6	51.4	12.5	34.9	12.1	35.1	11.6	36.5	8.9	18
102	INTELLIGENCE	58.0	129.3	29.4	59.6	40.8	137.7	22.8	94.5	21.8	56.8	16.8	67
<b>XII. ENGINEERING</b>													
103	ENGINEERING, ENVIRONMENTAL	21.5	39.3	20.0	43.0	20.4	36.6	22.7	33.9	21.2	28.8	16.4	23
104	ENGINEERING, MARINE ENGINEERING, ELECTRICAL & ELECTRONIC	0.6	2.4	1.0	3.6	0.5	2.6	0.6	2.1	0.6	2.5	1.1	3
105	ENERGY & FUELS	14.9	53.7	12.4	32.7	14.9	56.5	13.8	40.7	14.5	44.6	11.3	25
106	ENGINEERING, MANUFACTURING CONSTRUCTION & BUILDING TECHNOLOGY	5.3	15.8	5.2	12.3	7.0	15.8	9.1	16.4	11.1	26.1	11.9	15
107	CONSTRUCTION & BUILDING TECHNOLOGY	4.7	25.4	5.7	12.0	9.7	19.8	8.2	11.5	9.7	14.6	8.3	11
108	AUTOMATION & CONTROL SYSTEMS	8.4	10.3	9.5	20.0	9.2	14.0	10.3	14.8	10.1	14.9	7.4	9
109	INSTRUMENTATION OPERATIONS RESEARCH & MANAGEMENT SCIENCE	12.1	31.9	13.8	34.7	14.7	47.8	14.8	37.3	14.8	33.4	12.9	25
110	MECHANICS	5.0	14.7	10.8	42.7	10.5	28.8	10.9	24.1	10.5	17.7	8.3	13
111	ENGINEERING, INDUSTRIAL ENGINEERING, MULTIDISCIPLINARY IMAGING SCIENCE & PHOTOGRAPHIC TECHNOLOGY	13.4	32.3	14.0	32.3	17.0	36.3	12.8	24.0	14.2	30.8	10.7	15
112	NUCLEAR SCIENCE & TECHNOLOGY	17.0	36.6	16.9	34.9	15.1	29.6	13.6	28.6	13.0	24.2	9.5	13
113	ROBOTICS	15.2	47.6	8.8	17.9	8.3	18.7	8.9	15.2	9.5	14.5	8.3	10
114	TRANSPORTATION SCIENCE & TECHNOLOGY	5.7	21.2	7.9	29.9	8.5	24.6	8.9	20.6	9.2	24.2	7.3	12
115	TELECOMMUNICATIONS	18.0	32.7	20.2	58.9	25.7	54.0	20.5	32.8	25.7	57.1	16.3	23
116	ENGINEERING, CIVIL	9.1	16.4	8.2	32.7	8.9	18.1	7.8	17.3	8.1	13.4	6.0	10
117	ENGINEERING, PETROLEUM	40.0	89.3	17.2	68.6	11.9	68.6	11.9	20.2	11.8	19.1	11.2	17
118	ENGINEERING, MECHANICAL	9.6	36.6	5.5	14.9	9.5	22.7	12.3	33.3	12.5	22.6	5.4	11
119	ENGINEERING, MECHANICAL	15.3	93.9	10.9	34.3	14.1	46.6	12.8	49.5	13.3	47.4	10.0	26
120	ENGINEERING, CIVIL	6.9	16.5	7.3	16.6	8.4	17.1	8.7	16.3	9.5	14.9	7.0	11
121	ENGINEERING, PETROLEUM	0.3	1.7	1.4	7.4	1.6	5.0	1.4	4.4	2.6	6.2	2.1	4
122	ENGINEERING, MECHANICAL	8.9	20.2	10.5	22.6	10.9	19.5	9.6	15.0	9.6	17.2	7.5	11
<b>XIII. MATERIALS SCIENCE</b>													
123	MATERIALS SCIENCE, PAPER & WOOD	6.3	14.7	5.5	11.6	6.0	13.6	6.6	11.1	6.2	8.8	4.7	6
124	MATERIALS SCIENCE,	13.8	30.6	14.2	32.2	13.3	28.0	14.3	27.1	16.1	33.4	13.7	25



	MULTIDISCIPLINARY												
125	MATERIALS SCIENCE, COATINGS & FILMS	24.0	37.6	20.5	33.4	20.1	40.6	19.4	32.8	16.9	25.4	11.0	13
126	MATERIALS SCIENCE, BIOMATERIALS	31.1	57.3	25.7	43.1	29.2	46.1	26.4	38.9	31.3	49.5	23.0	28
127	MATERIALS SCIENCE, TEXTILES NANOSCIENCE & NANOTECHNOLOGY	4.8	7.1	5.0	7.5	6.5	9.1	6.2	10.1	5.6	9.9	5.7	11
128	MATERIALS SCIENCE, CERAMICS	19.7	44.6	17.3	39.2	25.5	50.4	13.9	25.4	12.0	24.0	7.9	11
130	MATERIALS SCIENCE, COMPOSITES	21.3	25.0	24.8	32.5	12.1	20.6	9.6	12.0	10.2	14.8	9.4	15
131	MATERIALS SCIENCE, CHARACTERIZATION & TESTING	4.7	12.6	3.0	15.3	4.4	8.7	3.7	8.0	3.1	7.4	4.6	8
132	MATERIALS SCIENCE, METALLURGY & METALLURGICAL ENGINEERING	5.6	12.7	6.7	13.4	7.8	16.1	9.9	16.1	11.5	23.4	8.1	13
	<b>XIV. GEOSCIENCES</b>												
133	ENGINEERING, GEOLOGICAL	17.5	33.7	15.7	32.0	17.1	41.9	11.7	19.1	11.5	15.6	7.1	9
134	GEOSCIENCES, MULTIDISCIPLINARY	23.0	38.2	19.6	37.5	19.4	31.7	17.7	27.4	18.5	26.1	11.7	10
135	ENGINEERING, OCEAN	5.2	13.9	7.0	17.8	12.1	20.4	10.3	22.3	9.6	14.3	7.5	13
136	MINERALOGY	32.1	53.3	27.1	38.8	25.7	40.1	17.9	24.7	20.6	46.4	11.0	13
137	ENGINEERING, AEROSPACE	6.3	17.2	6.7	26.2	8.0	18.7	5.9	11.7	5.2	10.4	4.7	8
138	GEOLOGY	23.7	35.7	24.6	39.4	25.7	31.2	23.0	31.4	18.5	23.6	12.4	10
139	GEOGRAPHY, PHYSICAL METEOROLOGY & ATMOSPHERIC SCIENCES	22.2	32.2	17.0	35.4	18.3	25.6	22.4	32.0	21.1	26.4	14.6	21
140	GEOCHEMISTRY & GEOPHYSICS	34.4	78.1	26.5	44.2	24.8	45.8	21.2	40.1	24.0	37.2	15.9	21
141	REMOTE SENSING	33.2	57.5	30.5	52.7	28.5	47.5	29.8	52.0	26.4	34.7	15.8	31
142	PALEONTOLOGY	17.5	32.4	21.1	55.2	23.6	45.7	21.8	34.2	22.3	32.8	14.9	22
143	MINING & MINERAL PROCESSING	22.8	43.0	19.0	27.4	17.8	25.0	17.1	26.9	16.3	20.3	9.7	11
144	OCEANOGRAPHY	9.4	20.9	7.8	16.2	8.0	13.2	8.9	14.4	8.5	14.7	6.0	9
145		33.0	113.1	31.7	45.4	29.9	43.7	29.0	39.9	23.4	25.7	13.7	15
	<b>XV. AGRICULTURAL &amp; ENVIRONMENT</b>												
146	AGRICULTURE, DAIRY & ANIMAL SCIENCE	14.7	29.0	14.1	21.5	15.0	22.4	15.9	25.3	12.7	17.8	9.0	11
147	BIODIVERSITY CONSERVATION	11.2	23.1	10.2	17.4	13.8	35.5	20.2	32.6	20.3	31.2	14.0	15
148	LIMNOLOGY	65.9	216.9	41.3	57.5	42.9	52.6	32.5	40.4	25.3	31.0	13.3	15
149	NUTRITION & DIETETICS	24.4	42.7	20.8	41.2	20.8	37.3	21.8	33.5	22.4	32.8	18.4	25
150	AGRICULTURE, MULTIDISCIPLINARY	12.5	36.2	12.1	25.0	11.5	21.6	14.5	28.3	17.3	29.8	12.1	10
151	ENVIRONMENTAL SCIENCES	17.7	42.9	18.4	34.7	17.9	32.4	21.1	35.1	21.4	30.6	14.9	15
152	AGRONOMY	13.3	21.9	13.7	20.0	14.1	21.6	15.4	23.9	15.6	21.0	10.0	13
153	FOOD SCIENCE & TECHNOLOGY	16.6	35.2	16.7	26.0	17.5	27.0	17.3	25.5	17.7	24.8	12.0	14
154	SOIL SCIENCE	26.6	146.7	20.5	43.8	20.3	31.7	19.4	29.4	18.4	22.5	11.1	12
	<b>XVI. BIOLOGY (ORGANISMIC AND SUPRAORGONISMIC LEVEL)</b>												
155	ORNITHOLOGY	21.9	65.9	16.3	20.6	17.1	21.4	14.6	17.0	15.6	65.9	8.4	11
156	ZOOLOGY	25.1	49.0	23.9	46.6	22.6	41.8	19.2	27.7	17.3	23.5	10.1	13
157	MARINE & FRESHWATER BIOLOGY	26.7	65.4	25.8	34.2	25.1	29.7	21.8	25.2	18.7	22.0	12.3	11
158	WATER RESOURCES	19.8	63.2	15.6	29.7	18.2	31.7	17.6	25.3	17.6	24.0	10.9	13
159	PARASITOLOGY	16.6	20.2	17.3	23.2	16.2	18.6	16.6	20.0	15.5	21.1	11.1	13
160	VETERINARY SCIENCES	11.7	17.8	11.1	16.7	11.8	16.5	11.9	18.6	11.2	16.4	7.6	10
161	PLANT SCIENCES	20.4	49.5	19.0	29.8	20.4	34.3	21.7	34.0	19.9	28.3	15.4	23
162	FISHERIES	30.6	97.5	24.9	29.1	21.5	31.7	19.0	21.8	17.5	20.3	10.8	10
163	MICROBIOLOGY	29.0	49.9	28.2	45.5	30.4	60.6	29.3	60.9	28.1	39.1	19.8	23
164	ENTOMOLOGY	11.9	17.1	11.5	15.5	11.9	16.7	11.7	15.3	10.6	13.2	7.8	8
165	ECOLOGY	34.6	57.3	37.8	277.6	30.7	46.8	29.4	44.4	27.5	36.6	18.0	21
166	MYCOLOGY	10.0	15.0	9.0	12.4	13.2	26.6	13.7	42.0	14.8	28.9	10.5	15
167	VIROLOGY	27.9	38.6	34.1	49.3	40.2	48.3	36.1	46.2	32.7	39.6	21.7	23
168	FORESTRY	11.7	22.2	12.5	20.7	16.3	26.0	16.4	23.6	16.8	21.5	11.4	13
	<b>XVII. MULTIDISCIPLINARY</b>												
169	MULTIDISCIPLINARY SCIENCES	55.3	184.7	76.1	213.0	67.2	200.7	78.2	203.6	70.7	174.5	48.9	110
	<b>XVIII. SOCIAL SCIENCES, GENERAL</b>												
170	MEDICAL ETHICS	2.3	4.6	4.3	9.6	4.0	10.0	7.5	11.3	7.6	14.0	6.3	9
171	HISTORY & PHILOSOPHY OF SCIENCE	7.9	14.2	7.6	12.7	6.3	9.9	5.7	10.6	4.6	8.3	4.2	7
	<b>XIX. ECONOMICS &amp; BUSINESS</b>												
172	AGRICULTURAL ECONOMICS & POLICY	7.0	19.0	7.3	10.4	10.2	17.3	10.4	15.6	8.7	11.8	7.9	8
	<b>TOTAL</b>												
	<b>Overall Mean Citation</b>	<b>20.9</b>	<b>52.3</b>	<b>20.1</b>	<b>52.6</b>	<b>20.0</b>	<b>42.2</b>	<b>19.2</b>	<b>37.4</b>	<b>18.6</b>	<b>33.9</b>	<b>13.6</b>	<b>22</b>
	<b>Standard Deviation</b>	<b>11.5</b>	<b>49.9</b>	<b>10.6</b>	<b>63.2</b>	<b>10.4</b>	<b>33.0</b>	<b>10.2</b>	<b>24.4</b>	<b>9.2</b>	<b>21.0</b>	<b>6.3</b>	<b>16</b>

**Table C. Exchange Rates (ER), Standard Deviations (SD), and Coefficient of Variations (CV), As Well As Exchange Rates Based On the Mean (ER( $\mu$ )) In the Different Yearly Datasets**

Subfields	1980				1985				1990			
	ER	SD	CV	ER( $\mu$ )	ER	SD	CV	ER( $\mu$ )	ER	SD	CV	ER( $\mu$ )
<b>I. BIOSCIENCES</b>												
1 GENETICS & HEREDITY	11.9	0.4	0.029	14.0	11.8	0.55	0.047	16.4	15.5	0.5	0.034	15
2 DEVELOPMENTAL BIOLOGY	16.3	0.9	0.055	15.9	14.8	1.20	0.081	14.0	27.5	1.1	0.039	25
3 BIOCHEMISTRY & MOLECULAR BIOLOGY	16.4	0.5	0.031	17.5	18.5	0.58	0.031	18.9	18.8	0.6	0.033	19
4 EVOLUTIONARY BIOLOGY	14.9	0.5	0.036	18.3	14.3	0.71	0.050	22.5	13.5	0.4	0.033	12
5 BIOLOGY	7.0	0.3	0.046	6.4	6.9	0.23	0.034	6.8	6.6	0.3	0.051	6
6 BIOPHYSICS	11.7	0.9	0.080	11.5	12.8	0.96	0.075	12.5	13.7	1.0	0.070	13
7 BIOCHEMICAL RESEARCH METHODS	12.5	2.5	0.200	19.3	9.9	0.52	0.053	14.8	8.9	0.3	0.031	9
8 CELL BIOLOGY	16.8	0.8	0.047	17.3	20.8	0.74	0.036	20.7	23.0	1.1	0.046	24
9 CELL & TISSUE ENGINEERING												
<b>II. BIOMEDICAL RESEARCH</b>												
10 ANATOMY & MORPHOLOGY	8.8	1.4	0.163	8.6	7.3	1.49	0.204	6.7	5.9	0.9	0.146	5
11 PHYSIOLOGY	18.3	2.1	0.114	17.6	16.7	1.48	0.089	15.9	15.3	1.2	0.080	14
12 BIOTECHNOLOGY & APPLIED MICROBIOLOGY	9.3	0.9	0.096	8.8	10.6	1.12	0.106	10.2	11.7	0.7	0.057	10
13 MEDICAL LABORATORY TECHNOLOGY	7.7	0.7	0.087	7.3	7.0	0.49	0.069	6.7	6.0	0.4	0.068	5
14 MICROSCOPY	4.5	0.5	0.104	4.2	8.0	0.83	0.103	7.1	5.7	0.3	0.053	5
15 ENGINEERING, BIOMEDICAL	7.1	0.8	0.108	7.7	7.1	0.52	0.074	7.3	7.9	0.4	0.045	8
16 MEDICINE, RESEARCH & EXPERIMENTAL	13.5	1.4	0.105	12.5	13.2	1.92	0.145	12.9	11.6	2.2	0.187	13
17 TOXICOLOGY	8.0	0.8	0.106	7.5	7.7	0.82	0.106	7.3	8.1	0.6	0.071	7
18 PATHOLOGY	10.3	0.9	0.085	9.7	10.8	0.29	0.026	10.4	10.5	0.3	0.031	10
19 PHARMACOLOGY & PHARMACY	10.7	0.7	0.066	10.1	9.3	0.56	0.060	9.0	9.2	0.5	0.049	8
<b>III. CLINICAL MEDICINE I (INTERNAL)</b>												
20 MEDICINE, GENERAL & INTERNAL	6.2	2.2	0.349	7.0	6.3	2.60	0.415	8.0	5.8	2.0	0.344	9
21 RESPIRATORY SYSTEM	9.5	0.5	0.052	8.7	8.8	0.60	0.068	7.9	8.4	0.1	0.011	7
22 CARDIAC & CARDIOVASCULAR SYSTEMS	14.9	0.5	0.036	14.0	13.2	0.19	0.015	12.7	11.5	0.5	0.040	11
23 GASTROENTEROLOGY & HEPATOLOGY	12.9	0.3	0.021	12.4	13.0	0.37	0.028	12.1	11.2	0.2	0.014	10
24 INFECTIOUS DISEASES	12.9	0.5	0.037	12.0	11.4	0.39	0.035	10.6	12.9	0.7	0.058	11
25 HEMATOLOGY	16.3	0.4	0.025	15.9	16.1	0.38	0.024	15.6	17.3	0.3	0.017	17
26 ANESTHESIOLOGY	8.5	0.4	0.048	7.5	7.7	0.47	0.061	7.1	7.9	0.3	0.037	7
27 ALLERGY	9.6	0.6	0.067	8.6	9.6	0.48	0.050	8.6	9.9	0.3	0.026	9
28 ENDOCRINOLOGY & METABOLISM	15.6	1.9	0.124	14.9	14.0	1.17	0.084	14.1	15.1	0.7	0.049	13
29 CRITICAL CARE MEDICINE	7.0	0.6	0.080	6.1	6.5	0.18	0.027	9.0	7.4	0.1	0.019	7
30 EMERGENCY MEDICINE	3.1	0.2	0.071	2.6	4.7	0.36	0.077	4.4	5.4	0.3	0.053	5
31 IMMUNOLOGY	14.4	0.2	0.017	14.5	13.9	0.12	0.009	13.7	14.9	0.6	0.037	14
32 TROPICAL MEDICINE	7.2	1.2	0.161	6.4	6.8	0.41	0.061	6.1	6.3	0.2	0.031	5
33 ONCOLOGY	14.4	1.0	0.070	13.4	14.2	1.04	0.074	13.4	14.6	0.6	0.044	13
<b>IV. CLINICAL MEDICINE II (NON-INTERNAL)</b>												
34 PERIPHERAL VASCULAR DISEASE	18.9	0.5	0.024	18.5	17.1	0.31	0.018	16.1	16.7	0.3	0.017	16
35 REPRODUCTIVE BIOLOGY	11.6	1.1	0.091	11.1	10.2	0.98	0.096	9.4	10.3	0.7	0.070	9
36 PEDIATRICS	9.7	0.7	0.069	8.7	8.8	0.43	0.049	8.1	7.9	0.3	0.037	7
37 DENTISTRY, ORAL SURGERY & MEDICINE	6.2	0.1	0.019	5.6	6.3	0.22	0.034	5.7	7.0	0.2	0.035	6
38 ORTHOPEDICS	10.0	0.6	0.057	9.7	9.0	0.20	0.023	8.6	10.6	0.2	0.016	10
39 OTORHINOLARYNGOLOGY	7.9	0.6	0.080	7.5	6.9	0.76	0.111	6.4	7.4	0.5	0.070	7
40 RADIOLOGY, NUCLEAR MEDICINE & MEDICAL IMAGING	9.1	0.4	0.049	8.6	8.9	0.12	0.014	8.5	9.0	0.2	0.018	8
41 PSYCHIATRY	13.2	0.2	0.018	12.8	12.1	0.40	0.033	12.1	13.7	0.2	0.012	12
42 OBSTETRICS & GYNECOLOGY	10.3	0.6	0.056	9.6	8.7	0.41	0.048	8.0	8.5	0.3	0.031	7
43 CLINICAL NEUROLOGY	13.1	0.7	0.052	12.9	12.4	0.61	0.049	11.8	13.5	0.4	0.029	12
44 OPHTHALMOLOGY	9.4	0.9	0.091	8.9	9.2	0.53	0.058	8.5	8.4	0.4	0.045	7
45 UROLOGY & NEPHROLOGY	9.1	0.6	0.069	8.1	7.7	0.31	0.040	7.3	8.5	0.1	0.016	8
46 SPORT SCIENCES	11.9	0.6	0.052	10.9	12.5	0.65	0.052	11.6	11.2	0.7	0.065	9
47 GERIATRICS & GERONTOLOGY	7.8	0.3	0.038	7.2	8.0	0.37	0.046	8.2	8.6	0.4	0.047	8
48 INTEGRATIVE & COMPLEMENTARY MEDICINE	2.9	0.3	0.091	2.5	3.8	0.34	0.090	3.3	4.8	0.3	0.054	3
49 DERMATOLOGY	7.6	0.6	0.081	7.0	7.1	0.47	0.066	6.5	7.9	0.5	0.061	7
50 SURGERY	10.3	0.4	0.035	9.8	9.4	0.23	0.024	8.8	9.5	0.2	0.021	9
51 TRANSPLANTATION	6.7	0.5	0.082	6.4	6.1	0.51	0.084	6.0	6.9	0.1	0.016	6
52 RHEUMATOLOGY	11.1	1.0	0.087	11.7	9.7	0.27	0.028	9.3	11.0	0.2	0.016	11
53 ANDROLOGY	5.7	0.6	0.102	5.2	7.8	1.45	0.185	7.1	7.8	0.9	0.117	7
<b>V. CLINICAL MEDICINE III</b>												
54 HEALTH CARE SCIENCES & SERVICES	3.0	0.3	0.091	3.0	5.9	0.51	0.088	5.5	5.4	0.1	0.019	5
55 MEDICINE, LEGAL	2.7	0.2	0.088	2.3	4.0	0.49	0.120	3.6	4.0	0.4	0.088	3
56 MEDICAL INFORMATICS	4.7	0.5	0.099	4.2	4.9	0.72	0.147	5.4	6.4	0.4	0.066	7
57 PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH	8.1	0.2	0.030	7.6	8.7	0.21	0.024	8.7	9.4	0.1	0.009	8
58 NURSING	1.2	0.3	0.205	1.1	2.3	0.45	0.193	2.4	4.5	0.2	0.051	3
59 SUBSTANCE ABUSE	10.7	0.7	0.063	9.9	9.2	1.17	0.127	8.4	12.5	1.4	0.109	11
60 REHABILITATION	5.2	0.5	0.094	4.7	6.1	0.31	0.051	5.9	7.8	0.3	0.044	6
61 EDUCATION, SCIENTIFIC DISCIPLINES	1.4	0.1	0.100	1.5	2.0	0.35	0.174	2.3	2.3	0.1	0.054	3
62 PRIMARY HEALTH CARE	1.6	0.3	0.213	1.4	1.5	0.28	0.191	1.6	1.9	0.5	0.262	2
<b>VI. NEUROSCIENCES &amp; BEHAVIORAL</b>												
63 NEUROIMAGING	8.2	0.7	0.086	7.4	8.7	1.04	0.120	8.0	11.3	0.8	0.068	10
64 BEHAVIORAL SCIENCES	10.5	0.4	0.034	10.1	11.0	0.56	0.051	10.2	12.4	1.1	0.085	10
65 NEUROSCIENCES	17.0	1.0	0.058	16.3	17.1	0.87	0.051	16.5	17.2	0.7	0.040	16
66 PSYCHOLOGY	13.6	1.2	0.087	18.0	13.8	0.75	0.055	14.7	16.0	0.4	0.028	17
<b>VII. CHEMISTRY</b>												
67 CHEMISTRY, MULTIDISCIPLINARY	10.1	0.2	0.022	10.0	9.0	0.47	0.052	9.5	9.0	0.4	0.048	9

68	CHEMISTRY, ANALYTICAL	9.1	0.4	0.046	12.3	7.7	0.12	0.016	8.8	8.1	0.3	0.043	8.
69	ENGINEERING, CHEMICAL	6.4	0.6	0.093	5.8	5.2	0.53	0.102	4.7	5.6	0.2	0.042	5.
70	CHEMISTRY, ORGANIC	8.6	0.9	0.100	8.7	9.6	1.17	0.122	9.2	9.4	0.9	0.096	8.
71	CHEMISTRY, APPLIED	7.2	0.5	0.064	6.9	7.5	0.43	0.057	7.0	7.4	0.2	0.023	6.
72	CHEMISTRY, PHYSICAL	10.1	0.3	0.034	10.0	9.7	0.40	0.041	9.2	8.9	0.2	0.027	8.
73	CHEMISTRY, INORGANIC & NUCLEAR	10.0	1.3	0.127	9.4	9.8	1.22	0.124	8.9	9.2	0.9	0.095	8.
74	ELECTROCHEMISTRY	11.6	0.7	0.065	11.5	9.4	0.71	0.075	9.1	9.7	0.7	0.070	9.
75	CHEMISTRY, MEDICINAL	6.6	0.4	0.068	6.7	6.7	0.54	0.081	6.5	7.7	0.4	0.052	7.
76	POLYMER SCIENCE	9.7	0.2	0.023	9.8	10.1	0.46	0.045	9.8	9.6	0.5	0.055	9.
<b>VIII. PHYSICS</b>													
77	SPECTROSCOPY	9.0	0.5	0.061	9.2	7.0	0.46	0.066	7.7	6.2	0.2	0.026	6.
78	PHYSICS, CONDENSED MATTER	9.7	0.2	0.022	9.7	10.7	0.31	0.029	10.9	8.5	0.1	0.014	9.
79	OPTICS	9.9	0.4	0.036	9.7	9.8	0.31	0.031	10.2	8.0	0.1	0.015	7.
80	PHYSICS, PARTICLES & SUB-FIELDS	14.2	2.0	0.139	14.8	10.3	2.31	0.225	12.2	7.9	0.8	0.101	8.
81	PHYSICS, MATHEMATICAL	8.9	1.5	0.174	9.4	7.2	0.84	0.117	7.9	6.5	0.4	0.068	7.
82	CRYSTALLOGRAPHY	7.8	0.6	0.076	8.0	5.6	0.39	0.070	6.4	5.3	0.3	0.051	7.
83	PHYSICS, APPLIED	8.0	0.1	0.015	7.9	8.2	0.16	0.020	8.0	6.9	0.1	0.015	7.
84	PHYSICS, FLUIDS & PLASMAS	9.9	0.4	0.042	9.4	9.8	0.40	0.040	9.3	9.5	0.1	0.015	9.
85	PHYSICS, NUCLEAR	8.5	0.2	0.020	8.7	7.5	0.27	0.036	8.4	6.4	0.2	0.035	6.
86	PHYSICS, MULTIDISCIPLINARY	9.5	1.4	0.146	11.0	10.6	1.61	0.151	11.6	9.4	1.5	0.157	11.
87	THERMODYNAMICS	5.3	0.2	0.031	4.9	5.5	0.25	0.045	5.5	5.0	0.1	0.015	4.
88	ACOUSTICS	7.2	0.7	0.104	7.2	6.7	0.39	0.058	6.2	7.5	0.1	0.019	7.
89	PHYSICS, ATOMIC, MOLECULAR & CHEMICAL	12.8	0.9	0.069	13.8	11.8	0.62	0.052	13.7	11.0	0.4	0.037	10.
<b>IX. SPACE SCIENCES</b>													
90	ASTRONOMY & ASTROPHYSICS	14.4	0.4	0.028	14.6	13.7	0.23	0.017	13.7	12.1	0.2	0.015	11.
<b>X. MATHEMATICS</b>													
91	MATHEMATICS	4.3	0.5	0.126	4.3	3.6	0.37	0.103	3.7	3.1	0.1	0.048	3.
92	MATHEMATICS, INTERDISCIPLINARY APPLICATIONS	6.7	1.1	0.167	9.1	8.3	2.08	0.252	9.7	7.0	0.4	0.055	8.
93	MATHEMATICS, APPLIED	5.5	0.7	0.126	5.7	5.0	0.62	0.125	5.2	4.2	0.2	0.048	4.
94	STATISTICS & PROBABILITY	9.1	1.1	0.117	10.5	6.9	1.73	0.249	8.0	5.7	0.6	0.107	7.
<b>XI. COMPUTER SCIENCE</b>													
95	COMPUTER SCIENCE, INFORMATION SYSTEMS	5.4	1.0	0.180	6.1	6.0	1.71	0.286	7.4	4.9	0.3	0.059	5.
96	COMPUTER SCIENCE, THEORY & METHODS	9.0	1.5	0.171	8.9	7.3	2.15	0.295	8.4	4.8	0.5	0.103	5.
97	COMPUTER SCIENCE, INTERDISCIPLINARY APPLICATIONS	5.5	1.1	0.200	6.2	4.6	0.42	0.091	4.8	3.7	0.4	0.102	5.
98	COMPUTER SCIENCE, CYBERNETICS	4.7	1.8	0.376	4.9	5.9	5.13	0.871	11.6	5.4	0.4	0.074	5.
99	MATHEMATICAL & COMPUTATIONAL BIOLOGY	8.9	0.6	0.069	8.3	7.2	0.47	0.065	7.3	8.6	0.4	0.045	9.
100	COMPUTER SCIENCE, HARDWARE & ARCHITECTURE	7.8	1.8	0.235	8.1	6.6	1.58	0.240	7.3	5.2	0.6	0.118	5.
101	COMPUTER SCIENCE, SOFTWARE ENGINEERING	7.1	1.0	0.140	7.1	5.5	1.50	0.273	6.5	4.5	0.7	0.164	5.
102	COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE	23.2	5.2	0.225	23.6	11.9	2.80	0.235	12.2	13.2	1.8	0.139	16.
<b>XII. ENGINEERING</b>													
103	ENGINEERING, ENVIRONMENTAL	9.6	0.4	0.047	8.8	8.4	0.98	0.117	8.3	8.5	0.9	0.103	8.
104	ENGINEERING, MARINE	0.2	0.2	1.203	0.2	0.2	0.33	1.404	0.4	0.1	0.1	1.555	0.
105	ENGINEERING, ELECTRICAL & ELECTRONIC	5.5	0.8	0.149	6.1	5.1	0.56	0.110	5.1	5.3	0.3	0.050	6.
106	ENERGY & FUELS	2.1	0.9	0.409	2.2	2.2	0.48	0.213	2.2	3.0	0.3	0.090	2.
107	ENGINEERING, MANUFACTURING	1.1	1.3	1.126	1.9	2.7	0.54	0.203	2.4	4.3	0.5	0.105	4.
108	CONSTRUCTION & BUILDING TECHNOLOGY	4.3	0.6	0.131	3.4	4.4	0.59	0.135	3.9	4.2	0.1	0.034	3.
109	AUTOMATION & CONTROL SYSTEMS	4.8	0.9	0.181	4.9	5.5	1.21	0.220	5.7	5.1	0.5	0.107	6.
110	INSTRUMENTS & INSTRUMENTATION	2.0	0.7	0.362	2.0	4.2	0.34	0.081	4.5	4.4	0.1	0.024	4.
111	OPERATIONS RESEARCH & MANAGEMENT SCIENCE	5.5	0.4	0.074	5.5	5.8	0.53	0.092	5.8	6.7	0.5	0.072	7.
112	MECHANICS	7.2	0.5	0.073	6.9	7.2	0.49	0.068	7.0	6.3	0.1	0.014	6.
113	ENGINEERING, INDUSTRIAL	5.8	1.3	0.232	6.2	4.0	0.23	0.057	3.6	3.3	0.3	0.083	3.
114	ENGINEERING, MULTIDISCIPLINARY	1.9	1.0	0.490	2.3	2.6	0.98	0.377	3.3	3.0	0.6	0.193	3.
115	IMAGING SCIENCE & PHOTOGRAPHIC TECHNOLOGY	7.7	1.9	0.244	7.3	7.4	1.42	0.191	8.4	9.7	0.7	0.069	10.
116	NUCLEAR SCIENCE & TECHNOLOGY	4.0	0.1	0.022	3.7	3.3	0.12	0.037	3.4	3.9	0.1	0.027	3.
117	ROBOTICS					16.4	8.78	0.536	16.6	4.9	0.8	0.163	7.
118	TRANSPORTATION SCIENCE & TECHNOLOGY	3.2	0.9	0.265	3.9	2.2	0.70	0.316	2.3	3.4	0.8	0.248	3.
119	TELECOMMUNICATIONS	4.7	0.9	0.196	6.2	4.3	0.69	0.161	4.5	4.5	0.7	0.155	5.
120	ENGINEERING, CIVIL	3.0	0.7	0.225	2.8	3.2	0.32	0.100	3.0	3.6	0.3	0.079	3.
121	ENGINEERING, PETROLEUM	0.1	0.1	1.374	0.1	0.3	0.31	1.131	0.6	0.3	0.3	1.010	0.
122	ENGINEERING, MECHANICAL	3.9	0.2	0.054	3.6	4.6	0.14	0.030	4.4	4.9	0.1	0.030	4.
<b>XIII. MATERIALS SCIENCE</b>													
123	MATERIALS SCIENCE, PAPER & WOOD	2.6	0.6	0.228	2.6	2.4	0.28	0.116	2.3	2.6	0.3	0.106	2.
124	MATERIALS SCIENCE, MULTIDISCIPLINARY	5.9	0.1	0.016	5.6	5.9	0.07	0.012	5.9	5.6	0.1	0.018	5.
125	MATERIALS SCIENCE, COATINGS & FILMS	10.6	0.8	0.075	9.8	8.9	0.49	0.055	8.5	8.3	0.3	0.039	8.
126	MATERIALS SCIENCE, BIOMATERIALS	14.4	2.6	0.181	12.7	11.2	1.81	0.161	10.6	12.8	0.4	0.030	12.
127	MATERIALS SCIENCE, TEXTILES	2.4	0.3	0.120	2.0	2.3	0.13	0.059	2.1	3.2	0.2	0.073	2.
128	NANOSCIENCE & NANOTECHNOLOGY					10.7	1.10	0.103	9.4	7.9	0.6	0.077	7.
129	MATERIALS SCIENCE, CERAMICS	8.6	0.2	0.021	8.0	6.9	0.57	0.083	7.2	10.8	0.2	0.022	10.
130	MATERIALS SCIENCE, COMPOSITES	10.7	1.7	0.162	8.7	11.8	1.01	0.086	10.3	5.9	0.3	0.058	5.
131	MATERIALS SCIENCE, CHARACTERIZATION & TESTING	2.0	0.3	0.136	1.9	1.0	0.43	0.425	1.3	2.0	0.1	0.054	1.
132	METALLURGY & METALLURGICAL ENGINEERING	2.6	0.6	0.230	2.3	3.2	0.36	0.112	2.8	3.4	0.2	0.060	3.
<b>XIV. GEOSCIENCES</b>													
133	ENGINEERING, GEOLOGICAL	7.2	0.5	0.065	7.1	6.9	0.28	0.041	6.5	6.6	0.3	0.039	7.
134	GEOSCIENCES, MULTIDISCIPLINARY	9.9	0.7	0.068	9.4	8.4	0.39	0.046	8.1	8.7	0.5	0.053	8.
135	ENGINEERING, OCEAN	2.2	1.2	0.560	2.1	2.8	0.85	0.305	2.9	5.7	0.5	0.088	5.
136	MINERALOGY	13.3	1.2	0.092	13.1	11.9	0.60	0.050	11.2	11.4	1.0	0.091	10.
137	ENGINEERING, AEROSPACE	2.5	0.4	0.173	2.6	2.5	0.39	0.156	2.8	3.1	0.3	0.090	3.
138	GEOLOGY	10.4	0.6	0.055	9.7	11.1	0.49	0.044	10.2	12.7	1.0	0.077	10.
139	GEOGRAPHY, PHYSICAL	9.8	0.5	0.054	9.1	7.3	0.51	0.069	7.0	8.6	0.3	0.030	7.
140	METEOROLOGY & ATMOSPHERIC SCIENCES	14.0	1.0	0.072	14.0	11.7	0.40	0.034	11.0	10.7	0.2	0.017	10.
141	GEOCHEMISTRY & GEOPHYSICS	14.4	0.3	0.022	13.5	13.5	0.39	0.029	12.6	12.6	0.7	0.056	11.
142	REMOTE SENSING	7.6	0.4	0.056	7.1	7.9	0.96	0.121	8.7	9.6	0.4	0.047	9.
143	PALEONTOLOGY	9.6	0.9	0.089	9.3	8.6	0.57	0.067	7.9	8.0	0.4	0.051	7.
144	MINING & MINERAL PROCESSING	4.4	0.2	0.051	3.8	3.6	0.19	0.052	3.2	4.0	0.2	0.040	3.

145	OCEANOGRAPHY	13.3	0.6	0.047	13.4	14.7	1.17	0.080	13.1	14.3	1.2	0.084	12
<b>XV. AGRICULTURAL &amp; ENVIRONMENT</b>													
146	AGRICULTURE, DAIRY & ANIMAL SCIENCE	6.2	0.3	0.041	6.0	6.4	0.52	0.082	5.8	7.1	0.4	0.055	6.0
147	BIODIVERSITY CONSERVATION	4.8	0.4	0.092	4.6	4.7	0.14	0.029	4.2	5.8	0.2	0.036	5.0
148	LIMNOLOGY	24.5	2.7	0.109	26.8	18.8	1.62	0.086	17.1	20.7	1.6	0.078	17
149	NUTRITION & DIETETICS	10.7	0.7	0.067	10.0	9.0	0.59	0.065	8.6	9.2	0.3	0.033	8.0
150	AGRICULTURE, MULTIDISCIPLINARY	5.2	0.1	0.023	5.1	5.4	0.27	0.051	5.0	5.1	0.3	0.054	4.0
151	ENVIRONMENTAL SCIENCES	7.4	0.1	0.016	7.2	7.9	0.14	0.018	7.6	7.6	0.1	0.016	7.0
152	AGRONOMY	5.8	0.3	0.058	5.4	6.2	0.44	0.071	5.7	6.5	0.3	0.049	5.0
153	FOOD SCIENCE & TECHNOLOGY	7.0	0.5	0.074	6.7	7.6	0.51	0.067	6.9	8.0	0.3	0.035	7.0
154	SOIL SCIENCE	9.5	0.1	0.012	10.8	8.6	0.56	0.065	8.5	9.3	0.7	0.071	8.0
<b>XVI. BIOLOGY (ORGANISMIC AND SUPRAORGONISMIC LEVEL)</b>													
155	ORNITHOLOGY	8.6	0.6	0.066	8.9	7.9	0.99	0.125	6.8	8.1	0.6	0.071	7.0
156	ZOOLOGY	10.3	0.4	0.040	10.2	10.3	0.19	0.018	9.9	9.8	0.5	0.050	9.0
157	MARINE & FRESHWATER BIOLOGY	11.3	1.2	0.103	10.9	11.6	1.55	0.133	10.7	11.6	1.2	0.105	10
158	WATER RESOURCES	7.8	0.4	0.047	8.1	6.8	0.30	0.045	6.5	7.9	0.1	0.015	7.0
159	PARASITOLOGY	7.2	1.1	0.153	6.8	7.8	0.92	0.118	7.1	8.0	0.7	0.089	6.0
160	VETERINARY SCIENCES	5.3	0.4	0.083	4.8	5.3	0.56	0.106	4.6	5.7	0.3	0.060	4.0
161	PLANT SCIENCES	8.5	0.6	0.075	8.3	8.4	0.69	0.082	7.9	9.0	0.6	0.064	8.0
162	FISHERIES	12.7	1.1	0.090	12.5	11.7	1.69	0.145	10.3	9.8	0.9	0.094	8.0
163	MICROBIOLOGY	12.3	0.8	0.065	11.8	12.2	1.03	0.084	11.7	13.4	1.0	0.074	12
164	ENTOMOLOGY	5.4	0.4	0.079	4.8	5.4	0.53	0.100	4.8	5.7	0.5	0.083	4.0
165	ECOLOGY	15.0	0.9	0.059	14.1	14.6	1.03	0.071	15.7	14.2	0.7	0.052	12
166	MYCOLOGY	4.4	0.2	0.046	4.1	4.2	0.33	0.080	3.7	5.3	0.3	0.062	5.0
167	VIROLOGY	11.8	1.2	0.105	11.4	15.1	1.31	0.086	14.1	18.8	2.2	0.116	16
168	FORESTRY	5.4	0.3	0.056	4.8	5.9	0.18	0.031	5.2	7.6	0.4	0.056	6.0
<b>XVII. MULTIDISCIPLINARY</b>													
169	MULTIDISCIPLINARY SCIENCES	23.0	2.8	0.122	22.5	32.4	2.93	0.091	31.5	24.1	6.5	0.270	27
<b>XVIII. SOCIAL SCIENCES, GENERAL</b>													
170	MEDICAL ETHICS	1.1	0.2	0.183	1.0	2.1	0.28	0.136	1.8	1.5	0.1	0.067	1.0
171	HISTORY & PHILOSOPHY OF SCIENCE	3.3	0.3	0.079	3.2	3.3	0.12	0.035	3.1	2.8	0.1	0.052	2.0
<b>XIX. ECONOMICS &amp; BUSINESS</b>													
172	AGRICULTURAL ECONOMICS & POLICY	2.6	0.4	0.164	2.8	3.5	0.37	0.106	3.0	4.4	0.5	0.109	4.0

Subfields	1995				1999				2004				
	ER	SD	CV	ER( $\mu$ )	ER	SD	CV	ER( $\mu$ )	ER	SD	CV	ER( $\mu$ )	
<b>I. BIOSCIENCES</b>													
1	GENETICS & HEREDITY	17.3	0.2	0.011	18.1	17.0	0.4	0.021	17.7	15.8	0.3	0.022	16.2
2	DEVELOPMENTAL BIOLOGY	28.1	0.4	0.016	27.3	25.0	0.6	0.025	23.9	19.6	0.3	0.014	19.6
3	BIOCHEMISTRY & MOLECULAR BIOLOGY	19.0	0.6	0.034	19.1	18.3	0.7	0.041	18.3	16.3	0.7	0.042	16.6
4	EVOLUTIONARY BIOLOGY	16.2	1.0	0.061	15.8	16.5	1.9	0.118	15.7	15.0	1.4	0.090	14.5
5	BIOLOGY	6.7	0.4	0.058	6.9	7.9	0.3	0.044	7.8	9.8	0.7	0.067	10.2
6	BIOPHYSICS	13.8	1.0	0.073	13.1	13.1	1.0	0.078	12.8	12.2	0.5	0.045	12.3
7	BIOCHEMICAL RESEARCH METHODS	9.5	0.7	0.069	9.1	9.9	0.6	0.064	10.6	11.8	0.4	0.038	13.0
8	CELL BIOLOGY	22.5	1.1	0.050	23.6	22.2	0.9	0.042	22.7	20.5	0.1	0.007	20.7
9	CELL & TISSUE ENGINEERING	8.0	0.7	0.092	7.4	7.1	0.4	0.060	6.6	20.2	2.4	0.117	19.9
<b>II. BIOMEDICAL RESEARCH</b>													
10	ANATOMY & MORPHOLOGY	8.2	0.2	0.028	9.9	7.7	0.2	0.028	7.3	7.7	0.4	0.049	7.5
11	PHYSIOLOGY	14.3	1.5	0.105	12.7	13.9	1.6	0.113	12.3	12.7	1.0	0.078	11.9
12	BIOTECHNOLOGY & APPLIED MICROBIOLOGY	9.9	0.6	0.059	9.2	10.9	0.5	0.041	11.1	11.4	0.2	0.022	12.4
13	MEDICAL LABORATORY TECHNOLOGY	6.7	0.2	0.031	7.3	6.8	0.2	0.032	6.4	7.0	0.1	0.017	7.0
14	MICROSCOPY	7.1	0.6	0.080	6.6	5.7	0.3	0.048	5.6	6.9	0.3	0.046	6.3
15	ENGINEERING, BIOMEDICAL	8.6	0.1	0.013	8.4	10.0	0.2	0.024	9.9	12.4	0.1	0.008	11.9
16	MEDICINE, RESEARCH & EXPERIMENTAL	13.9	3.0	0.218	16.3	12.3	1.9	0.156	14.9	10.9	0.6	0.058	12.8
17	TOXICOLOGY	8.6	0.8	0.094	7.7	9.4	0.8	0.086	8.9	9.2	0.6	0.063	8.8
18	PATHOLOGY	9.9	0.1	0.012	9.7	9.6	0.1	0.015	9.7	9.6	0.1	0.015	9.1
19	PHARMACOLOGY & PHARMACY	9.1	0.5	0.055	8.5	9.6	0.5	0.050	9.1	9.9	0.4	0.044	9.3
<b>III. CLINICAL MEDICINE I (INTERNAL)</b>													
20	MEDICINE, GENERAL & INTERNAL	5.1	2.3	0.450	10.9	6.2	3.1	0.501	11.6	6.7	1.9	0.283	12.6
21	RESPIRATORY SYSTEM	11.8	0.3	0.027	10.9	11.3	0.2	0.019	10.7	11.0	0.1	0.012	10.3
22	CARDIAC & CARDIOVASCULAR SYSTEMS	12.1	0.4	0.030	12.3	11.5	0.9	0.078	12.0	12.4	0.8	0.067	12.8
23	GASTROENTEROLOGY & HEPATOLOGY	11.9	0.1	0.012	11.3	11.2	0.2	0.018	11.1	11.9	0.3	0.024	12.1
24	INFECTIOUS DISEASES	12.8	0.6	0.051	11.5	12.5	0.6	0.048	11.5	12.2	0.5	0.041	11.7
25	HEMATOLOGY	17.6	0.3	0.015	17.0	16.8	0.5	0.027	16.7	16.5	0.6	0.037	16.4
26	ANESTHESIOLOGY	6.8	0.5	0.074	6.9	7.2	0.5	0.063	6.8	6.8	0.4	0.052	6.4
27	ALLERGY	8.8	0.5	0.059	8.2	9.9	0.2	0.023	9.2	12.1	0.4	0.030	12.0
28	ENDOCRINOLOGY & METABOLISM	14.4	1.0	0.070	13.3	15.0	1.1	0.075	14.1	14.0	0.4	0.030	13.7
29	CRITICAL CARE MEDICINE	12.8	0.5	0.037	12.3	13.2	0.2	0.012	12.8	11.9	0.4	0.031	11.5
30	EMERGENCY MEDICINE	5.4	0.1	0.027	4.9	5.1	0.2	0.037	4.8	5.1	0.1	0.025	4.8
31	IMMUNOLOGY	14.4	0.2	0.013	14.4	14.3	0.4	0.025	14.1	13.9	0.2	0.013	14.0
32	TROPICAL MEDICINE	6.8	0.4	0.062	6.1	7.3	0.5	0.070	6.5	8.2	0.4	0.045	7.2
33	ONCOLOGY	15.1	0.3	0.019	14.4	15.0	0.4	0.028	14.6	15.1	0.4	0.027	14.8
<b>IV. CLINICAL MEDICINE II (NON-INTERNAL)</b>													
34	PERIPHERAL VASCULAR DISEASE	17.5	0.2	0.011	16.8	17.0	0.2	0.014	16.8	16.2	0.1	0.009	16.1
35	REPRODUCTIVE BIOLOGY	11.3	0.7	0.065	10.4	12.1	1.3	0.104	10.6	10.1	0.5	0.048	9.7
36	PEDIATRICS	7.5	0.1	0.018	7.1	7.1	0.1	0.017	6.8	7.0	0.2	0.022	6.8
37	DENTISTRY, ORAL SURGERY & MEDICINE	7.3	0.4	0.051	6.5	7.3	0.4	0.049	6.6	7.5	0.2	0.032	7.0

38	ORTHOPEDICS	10.3	0.1	0.012	9.6	9.5	0.4	0.041	8.5	8.7	0.2	0.018	8.2
39	OTORHINOLARYNGOLOGY	6.7	0.4	0.061	5.8	6.5	0.6	0.091	5.9	6.2	0.3	0.044	5.7
40	RADIOLOGY, NUCLEAR MEDICINE & MEDICAL IMAGING	8.6	0.2	0.028	8.9	8.8	0.2	0.023	9.1	10.3	0.3	0.025	10.0
41	PSYCHIATRY	12.7	0.2	0.019	12.2	14.0	0.2	0.015	13.5	14.0	0.3	0.021	13.2
42	OBSTETRICS & GYNECOLOGY	8.6	0.3	0.038	8.0	8.3	0.3	0.036	7.5	7.9	0.2	0.020	7.5
43	CLINICAL NEUROLOGY	11.4	0.3	0.027	10.9	11.8	0.1	0.007	11.4	11.2	0.1	0.010	10.7
44	OPHTHALMOLOGY	9.2	0.3	0.038	8.7	8.8	0.1	0.015	8.2	8.0	0.1	0.016	7.6
45	UROLOGY & NEPHROLOGY	10.7	0.3	0.031	9.8	10.2	0.1	0.013	9.7	10.2	0.2	0.017	9.9
46	SPORT SCIENCES	10.8	0.7	0.065	9.5	9.7	0.4	0.043	8.7	9.2	0.5	0.051	8.5
47	GERIATRICS & GERONTOLOGY	9.2	0.2	0.026	8.6	10.0	0.6	0.059	9.1	10.3	0.3	0.027	9.6
48	INTEGRATIVE & COMPLEMENTARY MEDICINE	7.0	1.0	0.146	5.8	7.1	0.6	0.090	5.9	7.5	0.5	0.072	6.6
49	DERMATOLOGY	7.2	0.2	0.022	6.7	6.6	0.2	0.030	6.2	7.0	0.1	0.018	6.4
50	SURGERY	8.2	0.1	0.016	7.8	8.0	0.1	0.014	7.6	8.0	0.1	0.014	7.8
51	TRANSPLANTATION	7.0	0.1	0.021	6.9	6.4	0.2	0.032	6.5	8.5	0.1	0.012	8.4
52	RHEUMATOLOGY	10.9	0.3	0.024	11.3	11.4	0.2	0.021	10.7	12.1	0.4	0.030	11.6
53	ANDROLOGY	6.5	0.6	0.095	5.7	7.9	0.6	0.072	6.9	7.9	0.6	0.070	7.3
<b>V. CLINICAL MEDICINE III</b>													
54	HEALTH CARE SCIENCES & SERVICES	6.5	0.2	0.038	6.6	6.8	0.2	0.028	6.5	7.7	0.2	0.024	7.5
55	MEDICINE, LEGAL	5.4	0.4	0.065	4.7	4.4	0.4	0.085	3.8	4.9	0.3	0.052	4.4
56	MEDICAL INFORMATICS	6.5	0.2	0.037	7.1	5.7	0.2	0.031	6.1	7.1	0.2	0.032	7.4
57	PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH	10.2	0.2	0.017	9.8	9.5	0.1	0.013	9.1	10.2	0.2	0.023	9.7
58	NURSING	4.6	0.1	0.024	4.2	4.6	0.2	0.037	4.0	5.4	0.2	0.029	5.0
59	SUBSTANCE ABUSE	12.5	0.8	0.065	11.3	11.9	1.3	0.112	10.7	11.5	0.7	0.064	10.8
60	REHABILITATION	7.8	0.3	0.038	6.8	7.9	0.3	0.044	7.3	8.0	0.5	0.058	7.3
61	EDUCATION, SCIENTIFIC DISCIPLINES	2.2	0.2	0.103	2.4	3.0	0.4	0.127	3.2	3.7	0.2	0.063	4.0
62	PRIMARY HEALTH CARE	2.6	0.6	0.251	2.6	3.4	0.6	0.187	3.4	4.9	0.4	0.084	4.4
<b>VI. NEUROSCIENCES &amp; BEHAVIORAL</b>													
63	NEUROIMAGING	10.3	0.5	0.053	12.1	13.8	0.7	0.050	15.5	17.7	0.3	0.019	16.4
64	BEHAVIORAL SCIENCES	13.1	1.6	0.118	11.6	12.6	1.7	0.133	11.3	11.4	1.1	0.094	10.7
65	NEUROSCIENCES	16.6	1.0	0.058	15.9	16.5	0.8	0.049	16.0	15.3	0.5	0.031	14.9
66	PSYCHOLOGY	15.5	1.1	0.074	14.6	13.2	0.8	0.060	12.5	12.0	0.7	0.055	11.4
<b>VII. CHEMISTRY</b>													
67	CHEMISTRY, MULTIDISCIPLINARY	8.4	0.8	0.098	8.9	10.4	1.0	0.098	10.6	13.4	0.9	0.070	13.5
68	CHEMISTRY, ANALYTICAL	9.1	0.4	0.048	8.7	9.1	0.5	0.051	8.7	10.0	0.4	0.035	9.5
69	ENGINEERING, CHEMICAL	5.8	0.2	0.040	5.5	6.6	0.1	0.020	6.2	7.2	0.1	0.016	6.8
70	CHEMISTRY, ORGANIC	9.2	1.1	0.121	8.3	9.1	0.9	0.105	8.3	9.7	0.6	0.059	9.2
71	CHEMISTRY, APPLIED	6.8	0.2	0.027	6.2	8.3	0.3	0.037	7.7	8.1	0.2	0.028	7.5
72	CHEMISTRY, PHYSICAL	9.9	0.5	0.055	9.4	10.2	0.5	0.047	10.1	11.3	0.1	0.011	11.7
73	CHEMISTRY, INORGANIC & NUCLEAR	9.3	1.0	0.109	8.2	7.8	0.5	0.065	7.0	8.3	0.2	0.030	7.8
74	ELECTROCHEMISTRY	9.5	0.5	0.053	8.9	9.9	0.2	0.022	9.4	11.7	0.3	0.023	11.0
75	CHEMISTRY, MEDICINAL	7.8	0.6	0.071	7.5	9.1	0.9	0.094	8.4	9.7	0.8	0.081	9.3
76	POLYMER SCIENCE	8.6	0.3	0.040	8.6	8.5	0.3	0.038	8.2	9.4	0.2	0.020	9.0
<b>VIII. PHYSICS</b>													
77	SPECTROSCOPY	5.8	0.2	0.041	6.4	6.2	0.1	0.024	6.1	6.4	0.1	0.019	6.1
78	PHYSICS, CONDENSED MATTER	7.5	0.1	0.012	7.7	6.7	0.4	0.054	7.3	7.7	0.4	0.049	8.5
79	OPTICS	6.7	0.1	0.015	6.9	7.1	0.2	0.022	7.1	7.9	0.1	0.017	7.7
80	PHYSICS, PARTICLES & SUB-FIELDS	6.5	0.8	0.117	7.7	8.6	0.8	0.090	9.6	8.7	0.6	0.074	9.1
81	PHYSICS, MATHEMATICAL	7.3	0.2	0.023	8.1	6.9	0.2	0.033	7.1	7.2	0.1	0.019	7.2
82	CRYSTALLOGRAPHY	4.6	0.2	0.047	5.1	4.6	0.1	0.029	5.7	4.3	0.2	0.051	5.1
83	PHYSICS, APPLIED	6.7	0.1	0.012	6.9	7.0	0.3	0.045	7.5	8.4	0.3	0.039	9.0
84	PHYSICS, FLUIDS & PLASMAS	9.8	0.4	0.042	9.7	9.1	0.4	0.048	8.6	8.1	0.3	0.034	7.8
85	PHYSICS, NUCLEAR	5.6	0.2	0.028	5.9	5.6	0.2	0.028	5.7	6.5	0.2	0.033	6.5
86	PHYSICS, MULTIDISCIPLINARY	9.6	1.5	0.151	11.4	8.7	1.8	0.205	10.5	9.5	1.2	0.131	10.2
87	THERMODYNAMICS	5.3	0.3	0.053	4.9	5.6	0.4	0.073	5.2	6.5	0.2	0.032	6.2
88	ACOUSTICS	6.3	0.1	0.021	6.0	6.3	0.3	0.044	5.8	5.9	0.2	0.039	5.6
89	PHYSICS, ATOMIC, MOLECULAR & CHEMICAL	9.8	0.5	0.055	10.0	10.0	0.8	0.080	9.7	9.2	0.3	0.038	9.1
<b>IX. SPACE SCIENCES</b>													
90	ASTRONOMY & ASTROPHYSICS	11.7	0.1	0.010	11.8	13.0	0.2	0.015	13.2	13.6	0.1	0.005	13.6
<b>X. MATHEMATICS</b>													
91	MATHEMATICS	3.1	0.2	0.058	3.1	2.9	0.2	0.056	2.9	3.0	0.1	0.047	2.9
92	MATHEMATICS, INTERDISCIPLINARY APPLICATIONS	5.9	0.2	0.033	6.5	6.0	0.1	0.021	6.3	6.4	0.2	0.027	6.6
93	MATHEMATICS, APPLIED	4.1	0.3	0.064	4.4	4.2	0.2	0.051	4.3	4.2	0.2	0.042	4.2
94	STATISTICS & PROBABILITY	5.8	0.5	0.087	7.2	5.3	0.3	0.056	5.9	5.3	0.2	0.040	5.7
<b>XI. COMPUTER SCIENCE</b>													
95	COMPUTER SCIENCE, INFORMATION SYSTEMS	3.6	0.4	0.124	5.3	4.7	0.8	0.177	6.8	6.4	0.7	0.107	7.3
96	COMPUTER SCIENCE, THEORY & METHODS	5.3	0.5	0.102	6.4	5.7	0.7	0.131	7.0	5.6	0.4	0.066	6.1
97	COMPUTER SCIENCE, INTERDISCIPLINARY APPLICATIONS	4.1	0.3	0.074	5.5	5.2	0.4	0.079	5.9	6.5	0.2	0.038	6.5
98	COMPUTER SCIENCE, CYBERNETICS	3.7	0.9	0.235	4.6	5.3	0.6	0.117	5.2	6.9	0.6	0.088	6.6
99	MATHEMATICAL & COMPUTATIONAL BIOLOGY	9.0	0.2	0.027	9.3	8.8	0.2	0.027	10.5	11.2	0.2	0.018	12.7
100	COMPUTER SCIENCE, HARDWARE & ARCHITECTURE	5.1	0.9	0.174	6.7	5.3	1.1	0.202	7.0	5.7	0.5	0.096	6.2
101	COMPUTER SCIENCE, SOFTWARE ENGINEERING	4.2	0.8	0.199	5.3	4.4	0.7	0.170	5.3	5.3	0.5	0.095	5.6
102	COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE	7.5	0.9	0.120	9.9	8.5	0.8	0.100	9.9	9.1	0.4	0.045	10.6
<b>XII. ENGINEERING</b>													
103	ENGINEERING, ENVIRONMENTAL	10.5	0.1	0.011	9.9	10.5	0.4	0.035	9.6	10.6	0.2	0.016	10.4
104	ENGINEERING, MARINE	0.1	0.1	1.812	0.2	0.1	0.1	2.011	0.3	0.3	0.3	1.240	0.7
105	ENGINEERING, ELECTRICAL & ELECTRONIC	5.2	0.4	0.069	6.0	5.7	0.6	0.105	6.6	6.7	0.4	0.059	7.2
106	ENERGY & FUELS	4.2	0.3	0.076	4.0	5.1	0.3	0.065	5.0	7.9	0.2	0.023	7.5
107	ENGINEERING, MANUFACTURING	4.2	0.2	0.055	3.6	4.8	0.1	0.029	4.4	5.5	0.2	0.028	5.2
108	CONSTRUCTION & BUILDING TECHNOLOGY	5.1	0.3	0.050	4.5	5.1	0.2	0.042	4.6	5.2	0.2	0.036	4.7
109	AUTOMATION & CONTROL SYSTEMS	5.6	0.6	0.104	6.5	6.5	0.2	0.030	6.7	7.6	0.3	0.045	8.2
110	INSTRUMENTS & INSTRUMENTATION	4.7	0.1	0.021	4.7	5.0	0.2	0.032	4.8	5.4	0.1	0.023	5.2
111	OPERATIONS RESEARCH & MANAGEMENT SCIENCE	5.5	0.2	0.038	5.6	6.4	0.1	0.014	6.5	7.0	0.1	0.015	6.8
112	MECHANICS	6.0	0.1	0.017	5.9	6.0	0.1	0.022	5.9	6.3	0.1	0.022	6.0

113	ENGINEERING, INDUSTRIAL	4.2	0.1	0.035	3.9	4.6	0.2	0.046	4.3	5.7	0.2	0.031	5.2
114	ENGINEERING, MULTIDISCIPLINARY	3.6	0.5	0.147	3.9	4.0	0.5	0.121	4.2	4.8	0.3	0.058	4.6
115	IMAGING SCIENCE & PHOTOGRAPHIC TECHNOLOGY	9.2	0.5	0.053	8.9	11.1	0.7	0.065	11.7	10.6	0.8	0.079	10.3
116	NUCLEAR SCIENCE & TECHNOLOGY	3.5	0.1	0.027	3.4	3.8	0.1	0.030	3.7	4.0	0.1	0.033	3.8
117	ROBOTICS	5.2	0.2	0.037	5.2	5.6	0.3	0.046	5.4	7.2	0.5	0.063	7.1
118	TRANSPORTATION SCIENCE & TECHNOLOGY	4.6	0.9	0.197	5.4	6.0	0.3	0.051	5.7	3.2	0.7	0.221	3.4
119	TELECOMMUNICATIONS	3.7	0.8	0.202	5.6	4.2	1.4	0.323	6.1	5.4	0.7	0.135	6.3
120	ENGINEERING, CIVIL	3.9	0.3	0.072	3.8	4.7	0.3	0.058	4.3	4.8	0.2	0.047	4.4
121	ENGINEERING, PETROLEUM	0.3	0.3	0.816	0.6	0.9	0.5	0.602	1.2	1.3	0.4	0.337	1.4
122	ENGINEERING, MECHANICAL	4.6	0.1	0.028	4.2	4.6	0.1	0.029	4.4	5.2	0.1	0.024	4.8
<b>XIII. MATERIALS SCIENCE</b>													
123	MATERIALS SCIENCE, PAPER & WOOD	3.2	0.1	0.047	2.9	3.3	0.2	0.053	2.8	3.2	0.1	0.039	3.0
124	MATERIALS SCIENCE, MULTIDISCIPLINARY	6.4	0.1	0.014	6.2	7.0	0.2	0.026	7.3	8.3	0.3	0.036	8.7
125	MATERIALS SCIENCE, COATINGS & FILMS	8.8	0.4	0.042	8.5	8.0	0.4	0.044	7.7	7.5	0.3	0.044	7.0
126	MATERIALS SCIENCE, BIOMATERIALS	11.9	0.6	0.050	11.5	14.7	0.6	0.040	14.2	15.2	0.4	0.024	14.6
127	MATERIALS SCIENCE, TEXTILES	3.0	0.1	0.048	2.7	2.7	0.3	0.100	2.6	3.7	0.3	0.069	3.6
128	NANOSCIENCE & NANOTECHNOLOGY	7.8	0.1	0.017	8.0	8.7	0.6	0.068	9.7	12.4	0.5	0.042	13.1
129	MATERIALS SCIENCE, CERAMICS	6.4	0.2	0.035	6.0	5.9	0.2	0.036	5.5	5.4	0.1	0.027	5.0
130	MATERIALS SCIENCE, COMPOSITES	4.9	0.2	0.050	4.2	5.1	0.3	0.050	4.7	6.1	0.2	0.041	6.0
131	MATERIALS SCIENCE, CHARACTERIZATION & TESTING	1.5	0.3	0.176	1.6	1.2	0.4	0.369	1.4	3.0	0.3	0.096	2.9
132	METALLURGY & METALLURGICAL ENGINEERING	4.8	0.2	0.037	4.3	5.1	0.4	0.072	5.2	5.2	0.3	0.057	5.1
<b>XIV. GEOSCIENCES</b>													
133	ENGINEERING, GEOLOGICAL	5.5	0.3	0.048	5.1	5.6	0.2	0.040	5.3	4.7	0.1	0.030	4.5
134	GEOSCIENCES, MULTIDISCIPLINARY	8.7	0.3	0.036	7.7	9.3	0.6	0.065	8.4	7.8	0.3	0.044	7.4
135	ENGINEERING, OCEAN	4.0	0.7	0.177	4.5	4.8	0.4	0.079	4.4	4.9	0.4	0.073	4.8
136	MINERALOGY	8.6	0.7	0.083	7.8	8.8	0.3	0.038	9.4	7.3	0.4	0.050	6.9
137	ENGINEERING, AEROSPACE	2.6	0.3	0.098	2.6	2.3	0.4	0.189	2.4	3.1	0.2	0.080	3.0
138	GEOLOGY	11.3	0.7	0.059	10.0	9.6	0.5	0.056	8.4	8.5	0.4	0.046	7.9
139	GEOGRAPHY, PHYSICAL	10.7	0.9	0.083	9.7	10.6	1.2	0.118	9.6	9.4	0.7	0.072	9.2
140	METEOROLOGY & ATMOSPHERIC SCIENCES	9.7	0.3	0.027	9.2	11.3	0.2	0.016	10.9	10.4	0.3	0.024	10.0
141	GEOCHEMISTRY & GEOPHYSICS	13.9	1.0	0.070	13.0	12.9	0.9	0.073	12.0	10.5	0.4	0.040	10.0
142	REMOTE SENSING	9.8	0.4	0.043	9.5	10.6	0.3	0.026	10.2	9.4	0.4	0.044	9.5
143	PALEONTOLOGY	8.0	0.4	0.051	7.4	8.2	0.4	0.051	7.4	6.8	0.4	0.058	6.1
144	MINING & MINERAL PROCESSING	4.5	0.2	0.041	3.9	4.1	0.2	0.047	3.9	4.2	0.2	0.039	3.8
145	OCEANOGRAPHY	14.4	1.5	0.104	12.6	12.2	1.4	0.115	10.7	9.5	0.7	0.079	8.7
<b>XV. AGRICULTURAL &amp; ENVIRONMENT</b>													
146	AGRICULTURE, DAIRY & ANIMAL SCIENCE	7.6	0.2	0.027	6.9	6.4	0.2	0.035	5.8	6.3	0.1	0.021	5.7
147	BIODIVERSITY CONSERVATION	9.5	0.3	0.037	8.8	9.9	0.2	0.017	9.2	9.8	0.2	0.019	8.9
148	LIMNOLOGY	15.7	1.1	0.072	14.1	13.1	1.4	0.103	11.5	9.2	0.3	0.030	8.4
149	NUTRITION & DIETETICS	10.2	0.2	0.021	9.5	10.7	0.1	0.013	10.2	12.3	0.3	0.028	11.7
150	AGRICULTURE, MULTIDISCIPLINARY	6.6	0.2	0.023	6.3	8.3	0.2	0.023	7.9	8.4	0.2	0.025	7.6
151	ENVIRONMENTAL SCIENCES	9.8	0.3	0.035	9.2	10.4	0.5	0.046	9.7	9.9	0.3	0.027	9.4
152	AGRONOMY	7.1	0.3	0.043	6.7	7.7	0.5	0.062	7.1	6.8	0.3	0.045	6.3
153	FOOD SCIENCE & TECHNOLOGY	8.4	0.6	0.068	7.5	8.8	0.6	0.073	8.1	8.3	0.4	0.045	7.6
154	SOIL SCIENCE	9.2	0.4	0.048	8.4	9.5	0.8	0.084	8.4	7.7	0.4	0.046	7.0
<b>XVI. BIOLOGY (ORGANISMIC AND SUPRAORGONISMIC LEVEL)</b>													
155	ORNITHOLOGY	7.4	0.8	0.111	6.4	6.8	0.8	0.116	7.1	5.6	0.3	0.052	5.3
156	ZOOLOGY	9.3	0.6	0.068	8.4	8.6	0.6	0.074	7.9	6.9	0.3	0.039	6.4
157	MARINE & FRESHWATER BIOLOGY	10.9	1.4	0.128	9.5	9.6	1.2	0.124	8.5	8.5	0.8	0.097	7.8
158	WATER RESOURCES	8.4	0.3	0.032	7.7	8.8	0.5	0.060	8.0	7.3	0.2	0.026	6.9
159	PARASITOLOGY	8.2	0.6	0.073	7.2	7.7	0.5	0.070	7.1	7.4	0.4	0.056	7.0
160	VETERINARY SCIENCES	5.7	0.3	0.056	5.2	5.6	0.2	0.037	5.1	5.3	0.1	0.025	4.8
161	PLANT SCIENCES	9.8	0.4	0.040	9.4	9.5	0.5	0.051	9.1	9.9	0.2	0.018	9.8
162	FISHERIES	9.6	1.2	0.127	8.3	8.8	1.0	0.109	8.0	7.5	0.7	0.089	6.8
163	MICROBIOLOGY	14.0	1.0	0.071	12.8	13.8	1.0	0.073	12.8	13.3	0.9	0.071	12.6
164	ENTOMOLOGY	5.9	0.4	0.070	5.1	5.6	0.5	0.083	4.8	5.5	0.3	0.051	4.9
165	ECOLOGY	14.4	1.1	0.079	12.8	13.5	1.3	0.099	12.5	12.2	0.8	0.063	11.4
166	MYCOLOGY	5.6	0.4	0.063	6.0	7.0	0.4	0.052	6.7	6.8	0.2	0.037	6.6
167	VIROLOGY	17.4	1.8	0.103	15.7	16.3	1.5	0.093	14.9	14.5	0.9	0.063	13.7
168	FORESTRY	8.0	0.7	0.085	7.1	8.6	0.7	0.076	7.7	7.8	0.4	0.048	7.2
<b>XVII. MULTIDISCIPLINARY</b>													
169	MULTIDISCIPLINARY SCIENCES	28.3	8.2	0.288	34.1	29.0	7.9	0.273	32.2	30.0	4.1	0.137	30.9
<b>XVIII. SOCIAL SCIENCES, GENERAL</b>													
170	MEDICAL ETHICS	3.8	0.2	0.050	3.3	3.8	0.2	0.052	3.5	4.2	0.4	0.085	4.0
171	HISTORY & PHILOSOPHY OF SCIENCE	2.3	0.1	0.062	2.5	2.1	0.2	0.105	2.1	2.6	0.2	0.068	2.6
<b>XIX. ECONOMICS &amp; BUSINESS</b>													
172	AGRICULTURAL ECONOMICS & POLICY	4.9	0.2	0.047	4.5	4.3	0.2	0.042	4.0	5.4	0.4	0.081	5.0

Exchange Rates have been estimated over the following intervals:

1980: [70, 99]      1985: [66, 99]      1990: [65, 93]      1995: [50, 93]      1999: [56, 95]      6304: [70, 92]

The average percentage (and standard deviation) of total citations accounted by these intervals are the following:

1980: 66.4 (5.9)      1985: 68.8 (5.7)      1990: 42.1 (4.4)      1995: 47.5 (4.8)      1999: 56.0 (4.6)      6304: 43.1 (3.0)

**Table 1. The skewness of science. Averages (and standard deviations) over 172 sub-field citation distributions in 1980 and 2004 *versus* previous results for articles published in 1998-2002 with a five-year citation window classified in 219 sub-fields**

	Percentage of Articles In Category			Percentage of Total Citations Accounted For By Category		
	1	2	3	1	2	3
<b>Results from our dataset, selected years:</b>						
<b>1980</b>	73.2 (4.3)	19.0 (2.6)	7.7 (2.1)	21.1 (4.6)	32.1 (2.3)	46.9 (5.5)
<b>1985</b>	73.1 (4.3)	19.1 (2.5)	7.8 (2.2)	21.7 (5.0)	31.9 (2.4)	46.4 (5.6)
<b>1990</b>	72.0 (3.7)	19.8 (2.2)	8.2 (1.8)	21.8 (4.3)	32.4 (1.7)	45.8 (5.0)
<b>1995</b>	71.1 (3.6)	20.3 (2.1)	8.6 (1.6)	22.5 (4.0)	32.7 (1.4)	44.8 (4.5)
<b>1999</b>	70.2 (3.6)	20.8 (2.1)	9.0 (1.8)	23.3 (4.0)	33.0 (1.5)	43.7 (4.1)
<b>2004</b>	68.6 (3.5)	21.7 (2.0)	9.7 (1.7)	24.3 (3.6)	33.4 (1.4)	42.3 (3.5)

**Previous results over 219 sub-fields for articles published in 1998-2002 with a five-year citation window. Table 1, p. 391 in Albarrán *et al.* (2011, Table 1, p. 391):**

	68.6 (3.7)	-	10.0 (1.7)	29.1 (1.6)	-	44.9 (4.6)
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**Category 1** = articles with a low number of citations, below  $\mu_1$

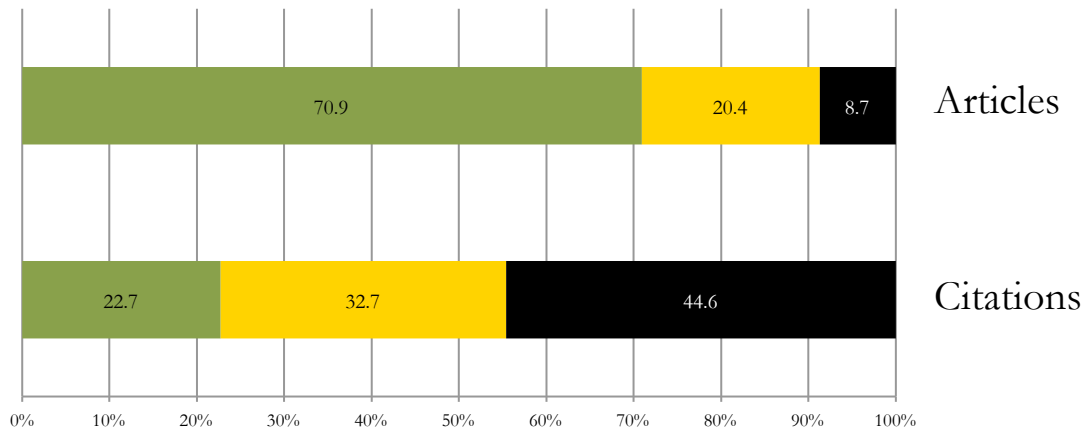
**Category 2** = articles with a fair number of citations, above  $\mu_1$  and below  $\mu_2$

**Category 3** = articles with a remarkable or outstanding number of citations, above  $\mu_2$

where:  $\mu_1$  = mean citation of each citation distribution

$\mu_2$  = mean citation of articles with a number of citations above  $\mu_1$

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**Figure 1. Percentage of articles in three broad classes, and percentage of citations accounted for by each class (Characteristic Scores and Scales technique)**



Table 2. The evolution of total citation inequality and the *IDCP* term

Year	(1) Total Citation Inequality	(2) <i>IDCP</i>	(3) = (2)/(1), In %
1980	1.058	0.124	11.7
1985	1.088	0.143	13.1
1990	1.030	0.139	13.5
1995	0.966	0.137	14.2
1999	0.890	0.120	13.4
2004	0.790	0.099	12.5
<b>Average</b>			<b>13.1</b>
<b>Std. Dev.</b>			<b>0.9</b>

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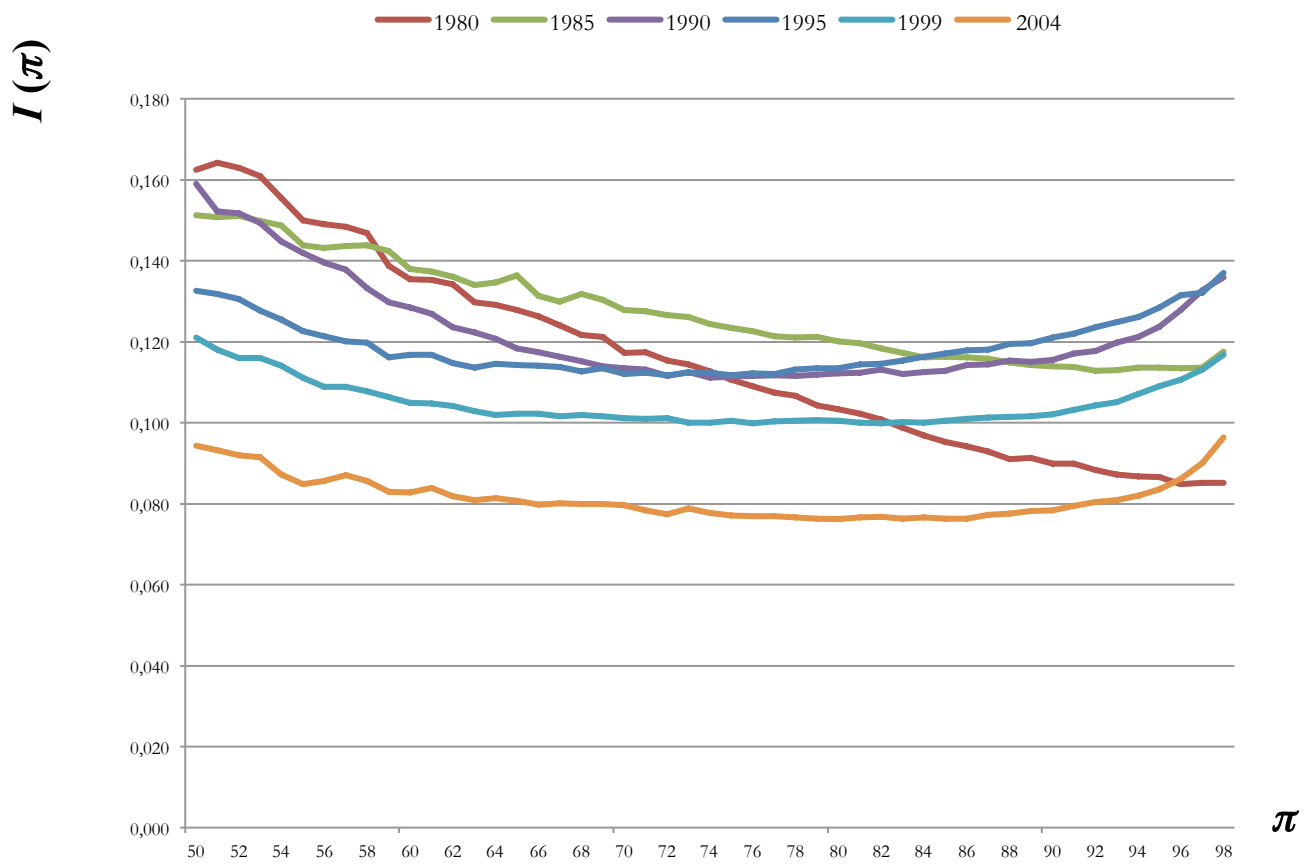


Figure 2. Citation inequality attributable to differences in citation practices across sub-fields,  $I(\pi)$ , as a function of the percentile  $\pi$  with raw data. All yearly datasets

**Table 3. The reduction of the *IDCP* term in % as a consequence of applying the different normalization procedures**

	<b>Median Without 0s (1)</b>	<b>Glänzel (2)</b>	<b>Exchange Rates (3)</b>	<b>Mean Without 0s (4)</b>	<b>Mean (5)</b>	<b>Two Parameters (6)</b>	<b>“Perfect Normalization” (7)</b>
<b>1980</b>	52.8	52.6	63.6	66.8	71.3	84.4	90.8
<b>1985</b>	64.3	63.3	70.9	75.0	78.0	82.4	95.1
<b>1990</b>	64.6	66.1	69.9	78.4	80.7	89.4	96.4
<b>1995</b>	62.2	70.7	67.8	81.7	83.3	94.0	96.4
<b>1999</b>	64.8	67.9	70.3	80.9	82.2	93.3	96.4
<b>2004</b>	63.9	63.5	71.5	79.4	80.8	92.5	96.5
<b>Average</b>	<b>62.1</b>	<b>64.0</b>	<b>69.0</b>	<b>77.0</b>	<b>79.4</b>	<b>89.3</b>	<b>94.9</b>
<b>Std. dev.</b>	<b>4.6</b>	<b>6.2</b>	<b>2.9</b>	<b>5.5</b>	<b>4.3</b>	<b>5.0</b>	<b>2.2</b>

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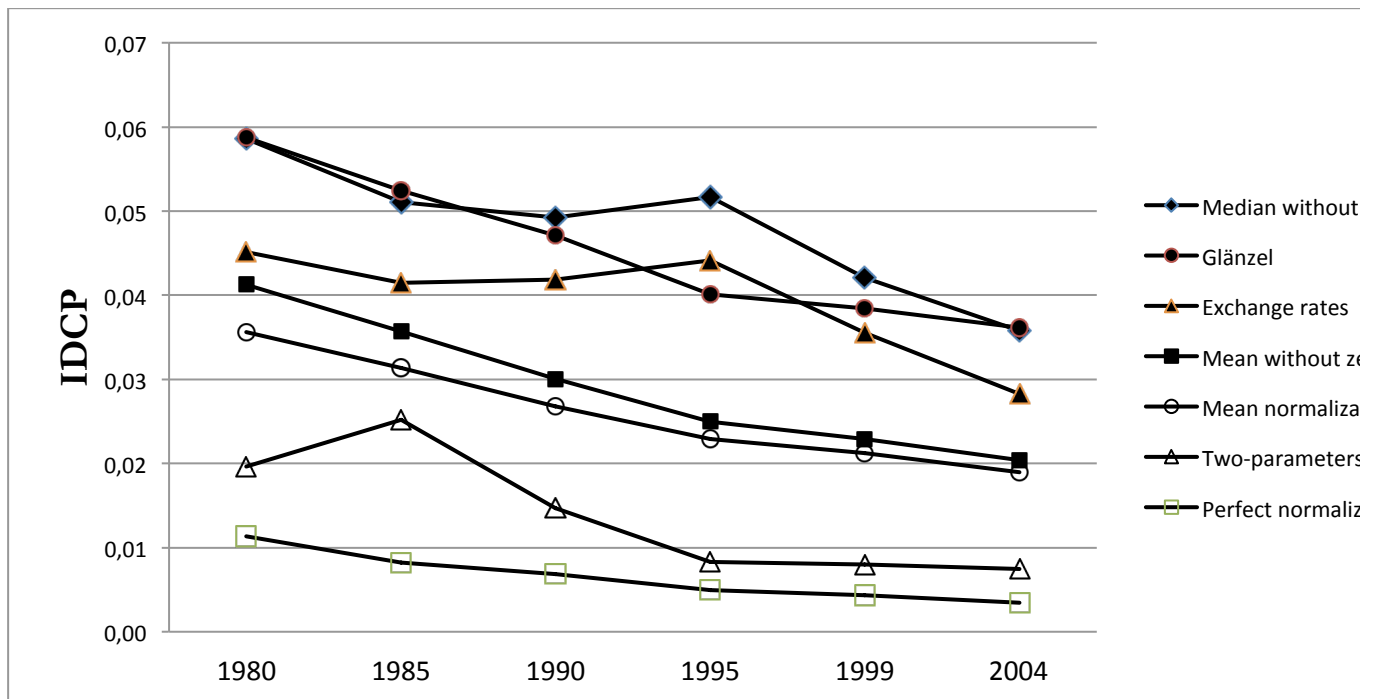


Figure 3. A comparison of the *IDCP* term in absolute value after applying the different normalization procedures in the six yearly datasets

Table 4. A comparison of the percentage that the *IDCP* term represents in % relative to total citation inequality after applying the different normalization procedures

	Median Without 0s (1)	Glänzel (2)	Exchange Rates (3)	Mean Without 0s (4)	Mean (5)	Two Parameters (6)
1980	5.6	6.2	4.4	4.3	3.6	1.7
1985	4.9	5.5	4.0	3.7	3.2	2.1
1990	5.0	5.3	4.3	3.3	2.9	1.3
1995	5.6	4.8	4.8	3.0	2.7	0.8
1999	4.9	4.9	4.2	2.9	2.7	0.8
2004	4.8	5.2	3.8	2.9	2.7	0.9
Average	5.1	5.3	4.3	3.3	2.9	1.3
Std. dev.	0.4	0.5	0.3	0.5	0.4	0.5

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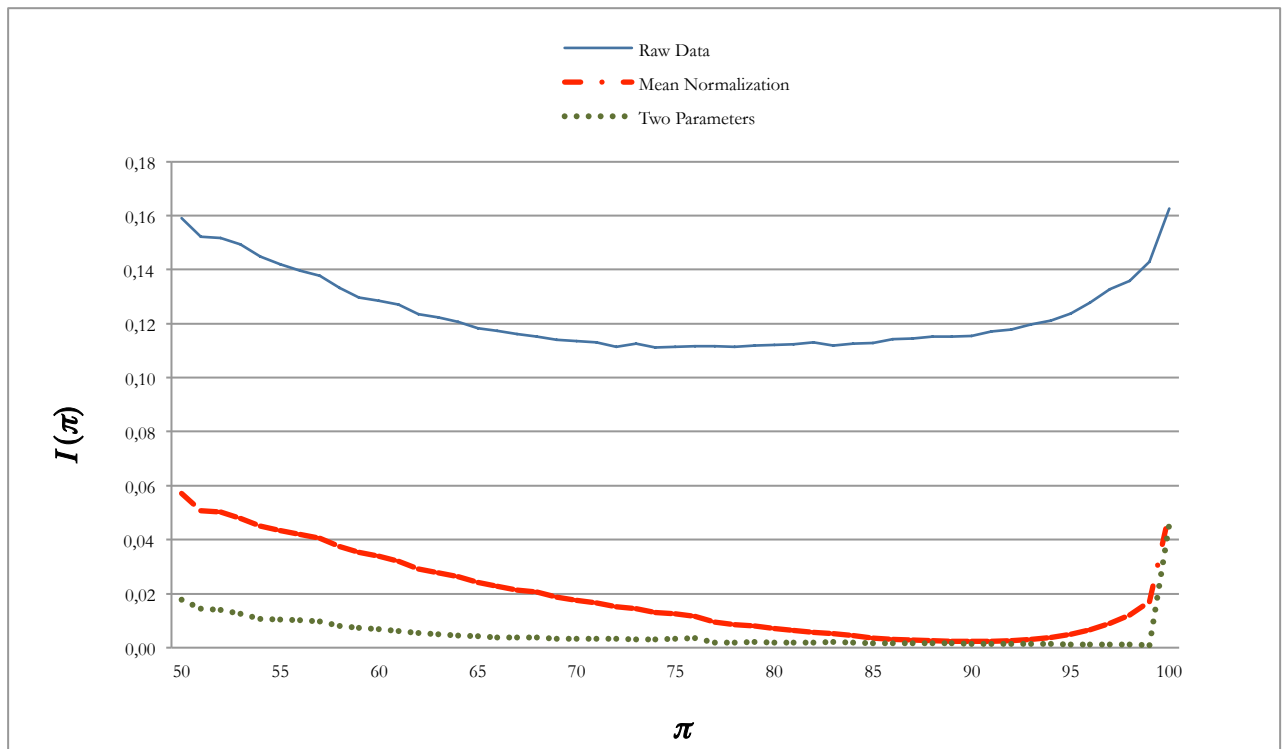


Figure 4. Citation inequality attributable to differences in citation practices across sub-fields,  $I(\pi)$ , as a function of the percentile  $\pi$ , before (Raw Data) and after applying the best normalization procedures to the 1990 Dataset.