Book Z-index and Its Application in Impact Evaluation Research (Postprint)

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Abstract

[Purpose/Significance] Based on the concept of academic credit, this paper proposes an indicator capable of measuring the academic impact of books—the Book Z-index. [Method/Process] Based on a list of high-impact scholars (h-index $\geq$ 5) in the field of Library and Information Science, this study collects book citation information of these scholars from CSSCI, calculates the Z-index of all relevant books using a batch statistical method, and conducts empirical research from the perspectives of authors, publishers, institutions, etc., to demonstrate the validity and application value of the Book Z-index. [Results/Conclusion] Applying the Z-index to book evaluation can describe the number and academic status of high-impact citers, providing a relatively fine-grained measurement tool for assessing the academic impact of different books, and also holds certain application value in the evaluation of scholars and institutions.

Full Text

Preamble

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The Z-index of Books and Its Application in Influence Evaluation Research

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Abstract: [Purpose/Significance] Based on the concept of academic credit, this paper proposes an indicator—the Book Z-index—that can measure the academic influence of books. [Method/Process] According to a list of high-influence scholars (h-index $\geq$ 5) in the library and information science field, we collected book citation information for these scholars from the CSSCI database, calculated the Z-index for all relevant books using batch statistical methods, and conducted empirical research from the perspectives of authors, publishers, and institutions to demonstrate the validity and application value of the Book Z-index. [Result/Conclusion] Applying the Z-index to book evaluation can describe both the number and academic status of high-influence citers, providing a more refined measurement tool for assessing the academic influence of different books. It also has certain application value in evaluating the influence of scholars and institutions.

Keywords: library and information science; academic credit; Book Z-index; high-influence books; book influence evaluation

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Books represent the crystallization of human wisdom, embodying the intellectual achievements of successive generations of scholars and playing a vital role in cultural heritage. Research on book influence evaluation helps identify methods for screening high-value books, promotes and publicizes high-level academic achievements, enhances the academic reputation of high-level book authors and their affiliated institutions, and facilitates the rational evaluation and utilization of books by academia, libraries, and research management departments. Current domestic research on book influence evaluation mainly includes:

(1) Research on book evaluation methods. First, employing feasible evaluation methods to assess the influence of books from specific institutions, publishers, and disciplines. For example, Su Xinning [1] used the CSSCI database to analyze citation patterns of humanities and social science books in China, screening the top five most influential books in each discipline. Yang Siluo et al. [2] took the library and information science field as an example and used citation analysis to evaluate the influence of relevant books, publishers, and author institutions from 1979 to 2008. Zhuge Weidong et al. [3] used OCLC to analyze the effectiveness of algorithms for book evaluation. Zhang Rong et al. [6] constructed an h-type index model to evaluate ten Chinese psychology books from perspectives including author academic influence, publisher academic influence, book awards, and peer review, exploring the feasibility and applicability of h-type in-

dex methods for evaluating book academic influence. Zhang Yu et al. [7] constructed a multi-dimensional evaluation system for Chinese scientific books from perspectives including book review analysis, citation analysis, and expert survey methods, and verified the evaluation system using three medical disciplines as examples. Qin Menghe et al. [4] took the energy and power engineering collection of Xihua University as an example, constructed an evaluation model from the perspective of book academic influence, and formulated an optimization strategy for that discipline's collection. Second, improving and constructing evaluation methods for book academic influence to perfect the disciplinary influence evaluation system. For instance, Song Jingjing et al. [5] used the PageRank algorithm to quantitatively evaluate 100 books in basic medicine and verified the algorithm's effectiveness for book evaluation.

(2) Research on book evaluation tools and databases. Xiong Xia et al. [8] introduced and compared three foreign electronic book academic influence evaluation tools—BKCI, Scopus Article Metrics, and Bookmetrix—and recommended that university libraries adopt multi-dimensional evaluation methods for electronic books. Nanjing University [9] proposed and constructed the "Chinese Academic Book Citation Index" database, while CNKI [10] published the "Chinese Highly Cited Books Annual Report," filling the gap in domestic book citation tools and promoting quantitative book evaluation research in China. However, these studies are basically still in the initial exploration stage and have not been widely applied.

Through the above review, we can see that the improvement of book influence evaluation methods and the perfection of evaluation systems are important contents of current book influence research. Simple quantitative indicators such as citation frequency and collection quantity only reveal the popularity of books and cannot comprehensively and accurately reflect their academic quality. Although improved methods such as h-type index models and multi-dimensional influence evaluation systems can measure book quality and influence to some extent, their practical effects need more verification due to subjective weight coefficient division and ambiguous evaluation subjects. This paper attempts to combine the concept of academic credit with h-index calculation methods from the perspective of citation data, proposes the Book Z-index, and then explores important citation behaviors and academic evaluation opinions to evaluate the quality of high-influence books and discover scholars' representative works.

2. Introduction to the Book Z-index

2.1 Concept and Calculation Method of the Book Z-index

Academic credit [11] is an academic evaluation concept oriented toward academic reputation under an open environment with mutual supervision. It emphasizes the qualifications and credibility of evaluators, attempts to organize the mutual credit situation of evaluation objects from the perspective of the

academic community, and uses the influence of evaluation objects among high-influence groups to simulate their community reputation, with the aim of discovering valuable information and guiding evaluation objects to pursue excellence through the academic appreciation of experts and information-marking behaviors such as citations, recommendations, and reviews. According to academic credit evaluation theory, applying Z-transformation to all members of a specific academic community can obtain each member's community reputation value and the credit they receive from other members. Organizing the community reputation credit sequence that a certain evaluation object receives and applying h-transformation can yield the Z-index of the evaluation object in a specific context. The Z-index is an indicator containing complex information that can reveal the endorsement credibility of the credit-granting group. It has the function of revealing information about the quality, prestige, status, influence, energy level, and grade of evaluation objects, and can reflect the comprehensive influence of evaluation objects among community members. Many occasions that can extract academic credit information are suitable for using the Z-index for evaluation, which can help us gain a deeper understanding of the scope and academic status of groups influenced by scholars, journals, individual documents, and blog posts [12].

Similarly, analyzing the citation situation of scholars that a book receives within a certain period can evaluate its academic reputation among professional groups of different statuses—that is, the academic status of a book can be assessed based on the expert academic credit it receives. This paper applies the Z-index to book evaluation and proposes the Book Z-index to indicate that a book has received academic credit expressed through citation behavior from Z scholars whose academic status is no less than Z, where the academic status of citers can be identified by indicators such as h-index and g-index. The calculation process of the Book Z-index is as follows: first, collect the citation information of a book; then mark each citation according to the citer's academic status; arrange the sequence in descending order of academic status values to obtain a sequence set; finally, extract the h-index of this sequence according to the h-index algorithm, and the obtained value is the Z-index of the book.

This paper uses the h-index to represent scholars' academic status. To avoid interference from multiple citations by the same scholar on the evaluation of a book's academic status, citations from the same scholar are regarded as one academic credit vote for marking purposes. For example, if a scholar published a book in 2000 and received 20 citations from 10 scholars by 2016, with some scholars citing the book multiple times, replace the names with the scholars' h-index values and arrange the resulting sequence in descending order to obtain a sequence that can represent the academic reputation and rank information obtained by the book: 10, 10, 9, 7, 7, 6, 4, 3, 2, 2. Applying h-transformation [11] to this sequence yields the value 6, which is the Z-index of the book. Obviously, from this example, we can see that the Book Z-index takes into account both citation quantity and quality, reflects the clarity of evaluation subjects and the objectivity of evaluation opinions, and can even be traced back to a specific

scholar's complete citation process. The Book Z-index can be batch-calculated with specialized software [11] to objectively and accurately evaluate the academic status and influence of books, and has high application value. This paper defines high-influence books as those with a Book Z-index ≥ 6, meaning that relevant books have at least 6 high-influence citers, and these citers have an academic status of h-index ≥ 6.

2.2 Analysis of Book Z-index Characteristics

To further explore the characteristics of the Book Z-index, this paper takes two books by a certain scholar as an example for explanation. Book A, *Knowledge Management in Organizations*, was published in 2004 with a total of 52 citations, while Book B, *Report on the Academic Influence of Chinese Humanities and Social Sciences (2000-2004)*, was published in 2007 with a total of 145 citations. The main citers and their academic status are shown in Table 1 . Citation data were collected in April 2017.

According to the Book Z-index calculation method, the Book Z-index values for Book A and Book B are 6 and 5, respectively. This means that although Book A has lower total citations, the number of experts who recognize its academic value is slightly higher than that of Book B. The professional value of Book A should seemingly be greater than that of Book B. It can be seen that compared with citation indicators that can only simply describe the popularity of academic achievements in academia, the Book Z-index indicator is more profound and can measure the influence and value of academic achievements according to the academic credit situation of expert groups.

3. Data Sources and Research Methods

3.1 Data Sources

In April 2017, using a self-compiled list of high-influence scholars (h-index ≥ 5) in the library and information science field [13]—totaling 498 individuals—we collected book citation information for these scholars from the CSSCI database for the period 1998-2016, with the cited literature type set to "book."

(1) Data Collection. We determined the list of high-influence scholars, summarized citation information from all core journals in the domestic library and information science field, and then batch-calculated the h-index of all scholars in this field to screen out those with h-index ≥ 5. This method of using an "expert scholar list" as a clue supplemented by manual restriction of professional fields to find high-influence books eliminates drawbacks such as small coverage and heavy workload caused by collecting books by discipline or specialty, and improves retrieval efficiency and data accuracy. During the export of txt data files, we identified books by authors with duplicate names according to research themes, and then used self-compiled programs to extract relevant content from txt files and save it in Excel format.

(2) Data Cleaning. We merged citation data for books that are essentially the same but appear different—that is, different versions or citation forms of the same book, except those with the same name but substantive content changes. For example, Zhu Qiang's *Overview of Chinese Core Journals* has four editions (2004, 2008, 2011, and 2014), introducing different versions of the Peking University core journal list, which according to the rules set in this paper cannot be merged. After collection, organization, and cleaning, we obtained 19,329 valid book citation entries involving 1,329 books by 279 authors.

3.2 Research Methods

First, we used batch statistical methods to mark the academic status of scholars in the library and information science field to obtain a list of high-influence scholars, and then collected their book citation information. Second, we adopted the academic credit evaluation method to construct the Book Z-index, and conducted statistics on the citation counts, citation years, and active years of books to measure their academic reputation and influence, screening out 94 high-influence books (Z-index ≥ 6). Finally, we explored the application of the Book Z-index in influence evaluation research from perspectives such as authors, publishers, and institutions to reveal its application value.

4. Empirical Research

4.1 Overall Situation of Books in China's Library and Information Science Field

This study collected a total of 1,329 books with 19,329 citation entries, with an average citation count of 14.5. Among them, 1,045 books (78.6% of the total) had citation counts below the average, indicating that the influence distribution of books in China's library and information science field conforms to the 80/20 rule, where only a minority of books receive widespread attention. To accurately measure the academic influence of these books, we used a self-compiled program [11] to batch-calculate their Book Z-index values. Figure 1 [Figure 1: see original paper] shows the Z-index distribution of these 1,329 books.

The Book Z-index can reflect the academic status and reputation of relevant books in the eyes of domain experts; the larger the value, the greater the influence among expert groups. Figure 1 shows that the Book Z-index of domestic library and information science books ranges from 0 to 11. The number of high Z-index books (taking the median and above, i.e., $6 \leq Z \leq 11$) is small, with only 94 books, accounting for 7.1% of the total. Books with Z-index < 6 number 1,235, which is 13.14 times the number of high Z-index books. From the perspective of the Book Z-index, although China's library and information science field has a considerable number of books, most have relatively small professional influence, while books with high influence and academic value are relatively few. Figure 1 shows that as the Book Z-index increases, the num-

ber of books with corresponding values declines sharply, indicating that the Book Z-index has good discriminative power for books with higher academic quality. Books with lower Z-index values are mainly due to citers having lower academic status and influence in the library and information science field, or being scholars from outside the field.

Table 2 shows the citation situation of high-influence books (Z-index ≥ 6) in China's library and information science field, where "citation years" refers to the number of years between 1998 and 2016 with citation counts > 0, and "active years" refers to the number of years with citation counts ≥ 6.

The books shown in Table 2 are mostly core works or textbooks in library science and information science, with strong diffusion effects, and their influence has spread beyond the library and information science field to other disciplines such as medicine and economics. For example, books like *Bibliometrics* and *Metadata Research and Application* have received citations and attention from scholars in the medical field. Among them, introductory books (including theories, introductions, guides, and new theories) are numerous, indicating that China's library and information science field has a preference for theoretical and introductory content and lacks original research results with greater innovation. Although the research paradigm in the library and information science community has shifted toward practical applications in recent years, practical application books with far-reaching influence are also scarce. From the perspective of citation years and active years, introductory books have had a more profound impact on China's library and information science community. Both well-known scholars with high academic status and ordinary newcomers frequently consult and cite these classic books, whose academic value remains timeless and continues to nourish generations of scholars during their slow release process. As stated in literature [14], short-term high citations reflect the fashionability of research frontiers, while long-term citations can reflect the contribution of cited literature in the process of transforming knowledge claims into conceptual symbols. Statistics on citation years and active years can finely reveal the characteristics of different books' influence from perspectives such as temporal distribution and citation intensity. For example, Wu Weici's *Introduction to Library Science* (Z-index of 11), Qiu Junping's *Bibliometrics* (Z-index of 9), and Huang Zongzhong's *Introduction to Library Science* (Z-index of 11) all have citation years of 19, showing profound and lasting academic influence. The active years of these three books are 19, 18, and 17 respectively, indicating that they have remained active, with many scholars citing them almost every year. It is worth noting that among the 1,329 books involved in this study, 35 had citation counts greater than 100, of which 32 appear in Table 2, while *Report on the Academic Influence of Chinese Humanities and Social Sciences (2000-2004)* (Book B in Table 1), *Research on Digital Reference Services in Libraries*, and *Overview of Chinese Core Journals (2008 Edition)* have Z-index values of 5 due to the lower academic status of their citing groups and thus do not appear in Table 2. This fully demonstrates the similarities and differences between the Book Z-index and citation count indicators in revealing book aca-

demic influence. Thus, the Book Z-index and related active indices are helpful for discovering academic achievements with significant innovation or high visibility, can optimally select scholars' representative works, and provide some inspiration for exploring "representative work" evaluation methods.

4.2 Practical Application of the Book Z-index

4.2.1 Author Influence Evaluation From the perspective of authors of the 94 high-influence books, combined with the number of high-influence books and citation counts (including self-citations) of each author in Table 2, and obtaining authors' birth dates and total citation counts of all documents from the CNKI and CSSCI databases to comprehensively measure authors' academic influence, Table 3 shows information on authors with two or more high-influence books, where Book Contribution Rate = Book Citation Count / Total Citation Count.

Table 3 shows that 11 scholars have published three or more high-influence books, among whom Qiu Junping, Ma Feicheng, Wu Jianzhong, Hu Changping, and Lu Taihong have published more books. The scholars listed in Table 3 are all academic authorities and leaders in the library and information science field, with strong research capabilities who can transform research achievements into monographs and play exemplary roles in the development of the field. Additionally, by studying the contribution rate of high-influence books, we found that most high-influence books play an important role in establishing the academic status of well-known scholars. Taking the first two high Z-index books in Table 2 as examples, *Introduction to Library Science* (1985) was cited 429 times, accounting for 25.3% of Wu Weici's total citations of 1,693; *Modern Library Science Theory* (1999) was cited 293 times, accounting for 67.2% of Xu Yichi's total citations of 436. This shows that high-influence books are of great significance in scholars' academic careers and often lay a solid foundation for scholars' subsequent research and personal academic branding.

From the age perspective, authors of high-influence books are mostly senior scholars, among whom Wang Chongde, Huang Zongzhong, and Zhang Qiyu have passed away, while only a few are middle-aged and young scholars. This may be related to the current tendency of library and information science scholars to focus on publishing journal articles. The reasons include: professional books have long production cycles, require substantial time, manpower, and energy, but the benefits authors can obtain are very limited, whereas publishing journal articles is not only faster but also requires relatively less investment, and can quickly generate academic influence in a short time to meet practical needs such as awards, project applications, and professional title evaluations. In such an academic environment, most scholars prioritize their own development and practical interests and choose to publish journal articles first. Therefore, for academic books, the lack of high-level authors seems to be an inevitable phenomenon in the current process of changing academic communication culture.

4.2.2 Publisher Influence Evaluation This paper extracted publisher information from the citation data of 94 high-influence books and standardized the names, obtaining 28 publishers. The National Library of Publishing House had former names including Bibliographic Literature Publishing House and Beijing Library Publishing House, which were unified. To comprehensively measure the influence of relevant publishers, this paper conducted statistics from the perspectives of category, number of high-influence books published, and citation counts. The results are shown in Table 4 .

Table 4 lists 28 publishers that have published high-influence books in the library and information science field. This list reflects the influence and appeal of various book publishing platforms in the library and information science field. According to Table 4, Wuhan University Press, National Library Publishing House, Scientific and Technical Documentation Press, Science Press, and other publishers are core publishers in the library and information science field.

4.2.3 Institution Influence Evaluation Evaluating and researching scientific research institutions helps understand their research competitiveness and influence, and improves research efficiency and quality. This paper collected author institution information for the 94 high-influence books from CNKI. Since some library and information science experts have worked at multiple academic institutions, to solve the attribution problem of research achievements, this paper regarded the institution where the author worked at the time of book publication as the book's affiliated institution. For example, Ke Ping has taught at Zhengzhou University and Nankai University, so his *Theoretical Research on Bibliographic Information Systems* (1996) and *Introduction to Information Management* (2002) were attributed to Zhengzhou University and Nankai University respectively. The results are shown in Table 5 .

Table 5 shows that these 94 high-influence books come from 21 units, including 13 universities, 4 research institutions, and 4 libraries, which basically reflects the distribution of major knowledge production forces in China's library and information science field. As shown in Table 5, universities are the main producers of professional books, such as Wuhan University, Peking University, Nankai University, and Sun Yat-sen University, while some research institutions and libraries also performed well, such as the National Science Library of the Chinese Academy of Sciences and Shanghai Library. Table 5 also shows that there are 54 well-known scholars who produced high-influence books, with top institutions such as Wuhan University and Peking University having more well-known scholars. According to the "Best Chinese Disciplines Ranking (2017)—1205 Library, Information and Archives Management" [15] released by Shanghai Ranking, the top 7 are Wuhan University, Nanjing University, Renmin University of China, Peking University, Nankai University, Central China Normal University, and Sun Yat-sen University, which is largely consistent with the results of this study, proving that evaluating institutional strength based on high-level books and the number of well-known scholars is feasible and effective. From the above anal-

ysis, it is not difficult to see that the situation of having high Z-index books and well-known scholars can well reflect the professional reputation of research institutions in academia and can serve as an effective indicator for institutional evaluation. In addition, combined with the birth dates of book authors in Table 3, many academic institutions, even former academic centers, face the dilemma of talent gaps, with aging well-known scholars and a shortage of middle-aged and young experts. The fact that the "Double First-Class" discipline of Library, Information and Archives Management was awarded to Wuhan University, Nanjing University, and Renmin University of China in 2017 confirms the rise and fall of academic reputation of different institutions to a certain extent, making how to cultivate and attract new academic leaders a key factor in maintaining and enhancing academic reputation.

4.2.4 Research Theme Analysis High-influence books mostly condense the author's research achievements at a specific stage, and readers can usually intuitively perceive the research content of books from titles and abstract information. Based on this and combined with the author's research scope, this paper used content analysis to mark keywords for books, and then used Gephi software to draw a knowledge structure map of the library and information science field to clearly display research hotspots and development directions in China, as shown in Figure 2 [Figure 2: see original paper].

Figure 2 reflects the complex relationships among various research themes in China's library and information science field from the book perspective. The central part consists of core knowledge of information science and library science, which are closely connected and continuously expanding outward. The library science field is more tightly concentrated than information science, mainly focusing on different development stages of library science and comparative studies between China and the West, such as electronic libraries, digital libraries, Chinese library science, and Western library science. In particular, research on derived library systems, services, and applications shows more humanistic care. In addition, the appearance of terms such as contemporary, modern, and 21st century reveals the temporal characteristics of disciplinary development. Relatively speaking, research themes in information science are more diverse, mainly including metrology, documentation, competitive intelligence, and retrieval. These sub-themes are diverse, adjacent, and closely related. At the same time, the development trend of "disciplinary intellectualization" is obvious, such as information management → knowledge management, data mining → knowledge mining, information service → knowledge service, which has even evolved into a new research direction—knowledge mapping. In addition, new fields surrounding the central part—various small "floating islands"—are related to the research content of library and information science, such as information measurement, information architecture, and information resource management. With the in-depth development of various research themes in information science and library science and their gradual transition to practical applications, basic theoretical development is relatively mature, and the main core research

and disciplinary structure have been formed, reflecting the continuity, stability, and systematicity of disciplinary development. It is worth noting that emerging hotspots such as big data, knowledge measurement, intellectual property, information ecology, and reading promotion are currently in the brewing stage. Although occasional monographs exist, compared with the flourishing scene of journal articles, the number of books and citation situations are not optimistic and have not appeared in the disciplinary knowledge structure map. This phenomenon reflects from the side that the development space of the library and information science field is relatively narrow, theoretical innovation is not easy, and current research achievements mostly appear in the form of short papers, with few thick original monographs, which is also a common phenomenon in the current process of changing academic communication models.

5. Summary and Discussion

This paper attempts to comprehensively measure the academic influence of books from the perspectives of citer quantity and academic status level, and batch-calculates the Z-index of books in the library and information science field. Compared with other evaluation methods (citation frequency, collection quantity, etc.), the Book Z-index measures the influence of different books from the perspective of experts and scholars, reflecting influence among high-end academic groups, and has the ability to identify classic high-value books. The high-influence books obtained have professional representativeness and authority. This study screened out 94 core books in the library and information science field and conducted empirical research and analysis from perspectives such as authors, institutions, and publishers. The study found that there are many low-influence books but few high-influence books in China's library and information science field, with many introductory works but few original works with distinctive features. Theoretical content research in the library and information science field is relatively mature, while practical application research achievements are lacking, and theoretical innovation is very difficult. With the rapid expansion of the research group and the lowering of publishing thresholds, the phenomenon of homogeneous knowledge production is becoming increasingly serious, and the role and academic status of professional books are no longer as prominent as before. Their knowledge contribution, interest group size, and reader experience are difficult to compare with works from the era of knowledge scarcity. However, setting aside the external environment where the focus of academic communication models is gradually shifting to journal articles, the main factors restricting book influence have always been the academic gold content of books and promotional efforts. Therefore, book authors should strive to produce high-level masterpieces, and publishers and academic institutions should also strengthen the promotion of high-quality books to expand the radiation of library and information science achievements in professional groups and social perception through joint efforts.

It is worth noting that research measuring the influence of scholars and institu-

tions from the perspective of journal articles has been common, while research from the perspective of books has been rare, mainly because professional book publishing information is relatively scattered and citation data are not easily accessible. This paper identifies the "hiding places" of highly cited books from the perspective of highly cited authors. Theoretically, it will not miss books cited more than 5 times in the library and information science field, which is quite valuable for researchers lacking prior book information. This method bridges the information gap and makes the evaluation of academic influence and various derived academic reputations based on high-influence books simple and feasible. This paper verifies the effectiveness of this judgment through empirical research and hopes to provide some inspiration for related research. Due to limitations of citation databases, this study could not cover all citation data of sample books and could not analyze citations from books and dissertations. In addition, this study did not make finer distinctions of book types (such as textbooks, monographs, etc.). If conditions permit, future research can further compare the influence differences of different types of achievements.

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Author Contributions

Zhou Chunlei: Proposed research ideas and framework, collected basic data, guided paper writing and revision, finalized the manuscript.

Chen Yanyun: Collected, cleaned, and organized data, wrote and revised the paper.

Cai Chengrui: Collected and cleaned basic data, revised the paper.

The Z-index of Books and Its Application in the Study of Influence Evaluation

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Abstract: [Purpose/significance] Based on the thought of academic credit, this paper puts forward Z-index of books, which can measure the academic influence of books accurately. [Method/process] According to the list of high influence (h-index $\geq$ 5) scholars in library and information science, the paper collects the citation information of these scholars' books from the CSSCI, calculates the Z-index of all books by using the batch statistical method, and certifies the validity and application value of the Z-index of book from the authors, publishers, institutions and other perspectives. [Result/conclusion] The results

show that the application of Z-index to evaluate books can describe the number and academic status of the citers, provide a precise measure tool to evaluate the academic influence of different books, and have a certain application value in evaluating academic influence of authors and institutions.

Keywords: library and information science; academic credit; Z-index of books; high influence books; evaluation of book influence

Note: Figure translations are in progress. See original paper for figures.