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# Ranking journals using social choice theory methods: A novel approach in bibliometrics

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ABSTRACT

We use data on economic, management and political science journals to produce quantitative estimates of (in)consistency of the evaluations based on six popular bibliometric indicators (impact factor, 5-year impact factor, immediacy index, article influence score, SNIP and SJR). We advocate a new approach to the aggregation of journal rankings. Since the rank aggregation is a multicriteria decision problem, ranking methods from social choice theory may solve it. We apply either a direct ranking method based on the majority rule (the Copeland rule, the Markovian method) or a sorting procedure based on a tournament solution, such as the uncovered set and the minimal externally stable set. We demonstrate that the aggregate rankings reduce the number of contradictions and represent the set of the single-indicator-based rankings better than any of the six rankings themselves.


## 1. Introduction

After almost a century since P. L. K. Gross and E. M. Gross published their pioneering work (Gross & Gross, 1927), ranking journals remains a problem. The introduction of the impact factor by Garfield and Sher (1963) ushered in the era of indicators. The emergence of the Scopus database and the invention of the h-index (Hirsch, 2005) reignited the interest in developing various bibliometric measures. However, their growing multiplicity generates two questions.

(a) How do the rankings based on different measures correlate with each other?
(b) What can a decision-maker do if there are several rankings but he/she needs just one?

Therefore, we start with the correlation analysis of the journal rankings. This has been done already in a number of comparative studies which were focused either on indicators from different databases (Archambault, Campbell, Gingras, & Larivière, 2009; Delgado & Repiso, 2013; Leydesdorff, 2009), or on citation, network and usage metrics (Bollen, Van de Sompel, Hagberg, & Chute, 2009). The reviews of Waltman (2016), Rousseau (2002) and Glänzel (2003) may serve as an

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**Table 1**
Indicators: sources and properties.

| | Database | Year | Publication window, years | Weighted |
|---|---|---|---|---|
| 2-year IF | WoS/JCR | 2011 | 2 | No |
| 5-year IF | WoS/JCR | 2011 | 5 | No |
| Immediacy index | WoS/JCR | 2011 | 1 | No |
| Article influence | WoS/JCR | 2011 | 5 | Yes |
| SNIP | Scopus | 2011 | 3 | No |
| SJR | Scopus | 2011 | 3 | Yes |

introduction to the vast literature on citation indicators. In agreement with the previous results, we find that all rankings correlate positively with each other. But our calculations also demonstrate that there is a non-negligible percentage of contradictions.

The multiplicity of contradicting evaluations is a problem for a decision-maker. To make decisions, there should be just one ranking. An obvious solution is to choose the best indicator. Unfortunately (for decision-makers), the academic discussion concerning relative advantages of various indicators has been inconclusive so far. Since there is no compelling reason to presume that one indicator is somehow inferior to the others, it is problematic to make the choice rationally.

The overarching goal of this paper is to relieve a prospective decision-maker from such a necessity. Instead of choosing the best indicator, a decision-maker may choose an appropriate aggregation procedure and use all rankings available. The theory of aggregation is a well-developed area, and, consequently, it allows one to make quite definite conclusions regarding the appropriateness of a choice.

To construct an aggregate ranking is to rank on a basis of multiple criteria. It is well known that there exists a formal analogy between the multicriteria decision-making and social choice (Arrow & Raynaud, 1986). Therefore, a decision-maker may consider the whole panoply of extensively studied and well-behaved social choice procedures. In this paper we propose to use *ordinal* aggregation methods based on the *majority rule*. To the best of our knowledge, none of them has ever been used to aggregate journal rankings.[1] The rank correlation analysis confirms that the aggregates thus obtained reduce the number of contradictions and represent the set of single-indicator-based rankings better than any member of the set.

## 2. Data

We consider three sets of journals representing three academic disciplines: economics, management, and political science. The rankings are calculated for each set separately. A journal is included if the following two criteria are both satisfied:

(a) both the Journal Citation Reports and the Scopus database classify the journal as either an economic, or management, or political science journal;
(b) values of all six bibliometric indicators are known.

After exclusion of journals with missing values, the sets contain 212 economic journals, 93 management science journals and 99 political science journals. Their lists are given in the extended preprint version of this paper (Aleskerov, Pislyakov, & Subochev, 2014).

Impact factor (IF), 5-year IF, immediacy index (II) and article influence score (AI) were taken from the Journal Citation Reports database (all for JCR-2011 edition). SNIP and SJR metrics for 2011 were taken from the Journal Metrics website powered by the Scopus database.

The main selection criteria for indicators were their popularity and diversity of data sources and methodologies. The latter is particularly important, since it is senseless to aggregate rankings if they are based on identical indicators. In order to capture the relatively vague concept of "journal influence/quality", it seems better to use measures which are as independent and dissimilar as it is possible.

The set of selected indicators contains all kinds of metrics. There are unweighted as well as weighted (AI, SJR) measures. The indicators use different publication windows from one (immediacy index) to five (5-year IF, AI) years. Moreover, they are taken from different databases, since a choice of a database may significantly change the values of indicators even when they are based on the same methodology (Pislyakov, 2009).

The selected indicators are well known and popular among the decision-makers and are calculated by the leaders of the citation database market, Clarivate Analytics (ex-Thomson Reuters IP) and Elsevier. They are easily available for large sets of journals, which is also important for decision-makers. The data sources and the properties of the indicators are summarized in Table 1.

[1] Cook, Raviv, and Richardson (2010) apply a non-majoritarian ordinal aggregation method called the Kemeny-Young rule. We make some comments concerning this rule in the Conclusion.