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A data-driven method for rating management information systems journals in the same scale of the Association of Business Schools Journal Guide

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Abstract

An appropriate measurement of journal quality is essential in accreditation, funding allocation, hiring, merit pay, tenure, and promotion decisions in academics. The current best practice to rate journal quality is to combine journal bibliometrics with expert assessment. For example, the Association of Business Schools (ABS) Journal Guide generated by this method is widely used by many business schools. However, different journal bibliometrics calculated in the citation network sometimes provide inconsistent ranking, and it is hard for domain experts to utilize the conflicting information. Therefore, given a journal, if the ABS Scientific Committee members are not familiar with it and different journal bibliometrics provide conflicting information, the given journal is hard to be rated and will not be included in the ABS journal list. In order to solve the above issue and maintain a comprehensive list of journals in the management information systems (MIS) field, this paper proposes a data-driven method to predict the ABS rating based on six popular bibliometrics for any given MIS journal. To the best of our knowledge, our method is the first work on this type to predict ABS ratings, which can serve as a more reliable rating reference and is much easier to be used to generate the rating for a comprehensive list of journals in the MIS field. In this paper, comprehensive experiments are conducted to evaluate the rating performance of our method from four different perspectives, including new journals, top journals, and interdisciplinary journals, and identifying overrated and underrated journals by ABS. Experiment results show our method can provide very reliable estimated ABS ratings for most MIS journals with few exceptions. Since our method is not perfect, expert knowledge is encouraged to be included to correct our estimated ABS ratings. However, such correction must be conducted under the following two constraints. First, domain experts must have sufficient evidences to do the correction. Second, correction can be adding or subtracting 1, but not beyond 1.

1 | INTRODUCTION AND RELATED WORK

High-quality publications can advance knowledge and have academic impacts. Therefore, they are evaluated and acknowledged in many scenarios, such as promotion and tenure for scholars and accreditation for academic institutes. However, it is relatively hard and time consuming to evaluate the quality and impact for each individual publication. In practice, it is more convenient to utilize the quality of the journal, where the related paper is published, to indicate the quality of the paper. Although not every paper in a high-quality journal is highly influential, it is a reliable indicator for the paper quality because most papers in it must be highly influential. Otherwise, the related journal cannot be a high-quality journal. Therefore, the problem of measuring paper quality can be considered as the problem of measuring journal quality. However, the measurement of journal quality is naturally contentious as it involves many different dimensions. For example, if Journal A focuses more on practical applications whereas Journal B focuses more on advancing theories, it is hard to conclude that Journal A is better than B or vice versa. In addition, due to the interdisciplinary nature of the management information systems (MIS) field, to create a measurement that is both accurate and comprehensive is even more challenging. Since more and more accreditation agencies, funding agencies, and universities realize the importance for interdisciplinary collaboration to solve more complex problems that cannot be addressed by single disciplines alone (Reich & Reich, 2006), an up-to-date, accurate, and comprehensive measurement system is critically important especially for the new and high-quality journals aiming at emerging and interdisciplinary topics. Otherwise, a problematic measurement system will force researchers submitting their high-quality papers to a relatively less-fitted journal and prevent them from doing interdisciplinary research.

Since an appropriate measurement of journal quality is critically important, there are many research efforts on measuring MIS journal quality in the past, and they can be classified into three categories: survey based, metric based, and hybrid.

1.1 | Survey-based methods

Survey-based methods typically involve researchers rating journals in their own field and compile a summarized ranking on the basis of majority opinion. For example, Lowry, Romans, and Curtis (2004) surveyed 8,714 faculty from 414 MIS departments worldwide with 32% response rate. Instead of using a predetermined journal list, the respondents could freely report their top-four research journals. They compiled the top MIS journals worldwide. Peffers and Ya (2003) conducted an online survey of 1,129 respondents and categorized MIS publication outlets into MIS journals, allied discipline journals, and professional and managerial magazines. Similar works include Templeton, Lewis, and Luo (2007), Mylonopoulos and Theoharakis (2001), and Walczak (1999).

Almost all the survey studies rank *MIS Quarterly* and *Information Systems Research* as the elite MIS journals, so survey-based methods are very reliable for identifying top MIS journals. However, they have several limitations. First, the ranking lists developed by survey-based methods become less and less reliable for the lower ranking journals. Among tenured MIS faculty, only 0.8% in the United States and 0.7% worldwide published in *MIS Quarterly* and *Information Systems Research* (Lowry et al., 2013). Hence, a reliable ranking system for nonelite MIS journals is also highly desired for the accreditation, funding allocation, hiring, merit pay, tenure, and promotion purposes in nonelite MIS programs. Second, the MIS field is highly dynamic, and its top journals and hot topics change over time (Lowry et al., 2013). Thus, survey-based results can only be used to reflect the journal quality around the time these studies are conducted.

1.2 | Metric-based methods

Metric-based methods typically use different graph analysis techniques (Straub & Anderson, 2010) of articles in a journal in the citation network to assess the related journal quality. The current popular metric-based methods include Institute for Scientific Information (ISI) Impact Factor, ISI 5-year Impact Factor, Eigenfactor, Article Influence, Source Normalized Impact per Paper (SNIP), and SCImago Journal Ranking (SJR). Among them, Springer journals will provide their ISI Impact Factor, ISI 5-year Impact Factor, SNIP, and SJR to indicate their quality, whereas Elsevier journals will provide their ISI Impact Factor, ISI 5-year Impact Factor, SNIP, SJR, Eigenfactor, and Article Influence.

The Thomson Reuters ISI Impact Factor, the most well-known metric, calculates the average number of citations received per paper published in that journal during the two preceding years (Fersht, 2009). However, a window of 2 years does not reflect long-term contribution. Allen, Jones, Dolby, Lynn, and Walport (2009) found that many highly cited articles are not cited in the first 3 years but become highly cited afterward. To solve this problem, ISI 5-year Impact Factor is used to assess a 5-year window instead of 2 years.

Although it solves the long-term contribution issue, it still can be manipulated by having bias towards review-oriented articles, which are more likely to be heavily cited than original research articles (Harvey, Kelly, Morris, & Rowlinson, 2010). In addition, Impact Factor can also be manipulated by promoting artificial self-citation or cross-citation among several journals. To alleviate the manipulation on Impact Factor, Eigenfactor is designed to give citations from highly ranked journals a larger weight than those from poorly ranked journals. Besides Eigenfactor, SJR is another metric to give more weights to citations from highly ranked journals. In addition, Article Influence is calculated by dividing the Eigenfactor by the percentage of all articles recorded in the Journal Citation Reports for the given journal to give a fair consideration to the journals that do not publish too many articles.

Another issue for ISI Impact Factor is that it is hard to be compared across disciplines (Harvey et al., 2010) as different fields have significantly different Impact Factors. For example, journals in Mathematics tend to have lower Impact Factors than journals in Life Sciences. To solve this problem, SNIP measures contextual citation impact by weighting citations on the basis of the total number of citations in a subject field, which enables direct comparison of sources in different subject fields.

Comparing with survey-based methods, metric-based methods are simple, objective, and up to date. But they have several limitations. First, different metric-based methods measure journal quality from different dimensions. Therefore, different metrics could potentially provide conflicting journal rankings. Second, they cannot reflect some important qualitative information including editorial practices, peer-review process, the credentials of editorial boards, and so on (Straub & Anderson, 2010). In addition, it does not directly provide a similar tiered structure by survey-based methods, which make rules based on it hard to follow.

1.3 | Hybrid methods

Whereas survey-based methods can consider qualitative information that is hard to quantify and provide a tiered structure, which is easier for policy makers to make rules, metric-based methods are simple, objective, and up to date. Many journal-ranking experts have increasingly recommended that the best overall approach is to combine journal bibliometrics with expert assessment of journal quality (Allen et al., 2009; Butler, 2008; CABS, 2015; Harnad, 2008 and Harzing, 2017).

Among different journal ranking lists generated by hybrid methods, the Association of Business Schools (ABS) Academic Journal Guide is widely used by business schools. To generate this journal guide (CABS, 2015), the members of the ABS Scientific Committee were provided with a variety of metrics, including Impact Factor, SNIP, and SJR, for each journal and asked to consult widely within their respective academic communities to assign it to one of the following five categories: 4* for elite journals, 4 for top journals, 3 for highly regarded journals, 2 for good standard journals, and 1 for modest journals. Other related work (Harzing, 2017) includes Centre National de la Recherche Scientifique (CNRS) Journal List (Zimmermann, 2015), Association of University Professors of Business in German Speaking Countries (VHB) Journals List (Betriebswirtschaft, 2015), Australian Business Deans Council (ABDC) Journal List (ABDC, 2016), ESSEC Business School (ESS) Journal List (ESSEC, 2016), and Foundation National pour l'Enseignement de la Gestion des Entreprises (FNEGE) Journal List (FNEGE, 2016).

The hybrid method combines the advantages of both survey-based and metric-based methods to provide a relatively objective journal list with useful qualitative information from domain experts in a tiered structure. However, this method is not perfect either. First, domain experts cannot have a comprehensive knowledge on all the journals in their field. Second, they may not be familiar with the new journals on emerging topics. Hence, the generated ranking list cannot be comprehensive. For example, in the ABS list, only 79 journals are included in the MIS field. Thomson Reuters ISI includes 146 journals in the MIS field, whereas Scopus includes 225 journals in the MIS field. In other words, with the ABS list, a significant number of journals in the MIS field are excluded and more likely to impact the entire MIS field for homogeneous research (Mingers & Willmott, 2013). To generate a comprehensive journal list is hard for ABS because it is too demanding for the members of the ABS Scientific Committee in the MIS field to do diversified research to evaluate MIS journals in more heterogeneous topics.

To alleviate the noncomprehensive issue with hybrid methods, in this paper, a data-driven method is proposed that allows for expanding the ABS Journal List in the MIS field and is consistent with the ABS journal ranking. The rest of the paper is organized as follows. Our data-driven method is introduced in Section 2, and experiments are conducted to verify the performance of our method in Section 3. Finally, a conclusion is drawn in Section 4.

2 | OUR METHODS

One important finding that inspired our research is that metric-based methods provide very similar results to expert-based methods in determining a tiered structure of MIS journals (Lowry et al., 2013). Therefore, it is reasonable to assume a strong correlation between different metrics and ABS ratings for the 79 MIS journals in the ABS Journal List. Then, with the values of different metrics and ABS ratings for the 79 MIS journals in the ABS Journal List, a prediction model can be constructed to reflect the relationship between different metrics and ABS ratings. With the constructed prediction model, any MIS journal not in the ABS Journal List can be assigned a predicted ABS rating on the basis of its values of different metrics.

In this research, six popular metrics, that is, ISI Impact Factor, ISI 5-year Impact Factor, Eigenfactor, Article Influence, SNIP, and SJR, are used as attributes for each MIS journal in the ABS Journal List. ISI Impact Factor, ISI 5-year Impact Factor, Eigenfactor, and Article Influence for a given journal are available in http://isiknowledge.com/jcr, whereas SJR and SNIP are available in https://journalmetrics.scopus.com/. In addition, the ABS rating 4* will be converted into 5 in order to make all the rating numbers into the same numeric type for our prediction models to process.

2.1 | Data preprocessing

To verify the linear relationship between different metrics and ABS ratings and to remove outliers, the scatterplots of different metrics versus ABS ratings are shown in Figure 1.

2.1.1 | Data transformation

According to Figure 1, all the metrics roughly have a linear relationship with ABS ratings except Eigenfactor. The Eigenfactors of the two elite journals with the ABS rating of 5 (i.e., 4*) is significantly lower than two journals with the ABS rating of 3 and one journal with the ABS rating of 2. In order to maintain a linear relationship between different metrics and ABS ratings, the Eigenfactor is transformed into a log scale and the related scatter plot is shown in Figure 2. When transforming Eigenfactor into a log scale, the journal with the zero value in Eigenfactor will be assigned with the negative infinity. In order to maintain the transformed log value within a smaller range, the transformed log of Eigenfactor is corrected by a small number ε as $\log(Eigenfactor + \varepsilon)$. As the provided Eigenfactor is rounded in the fourth decimal, ε is set to be 0.00005 in our research.

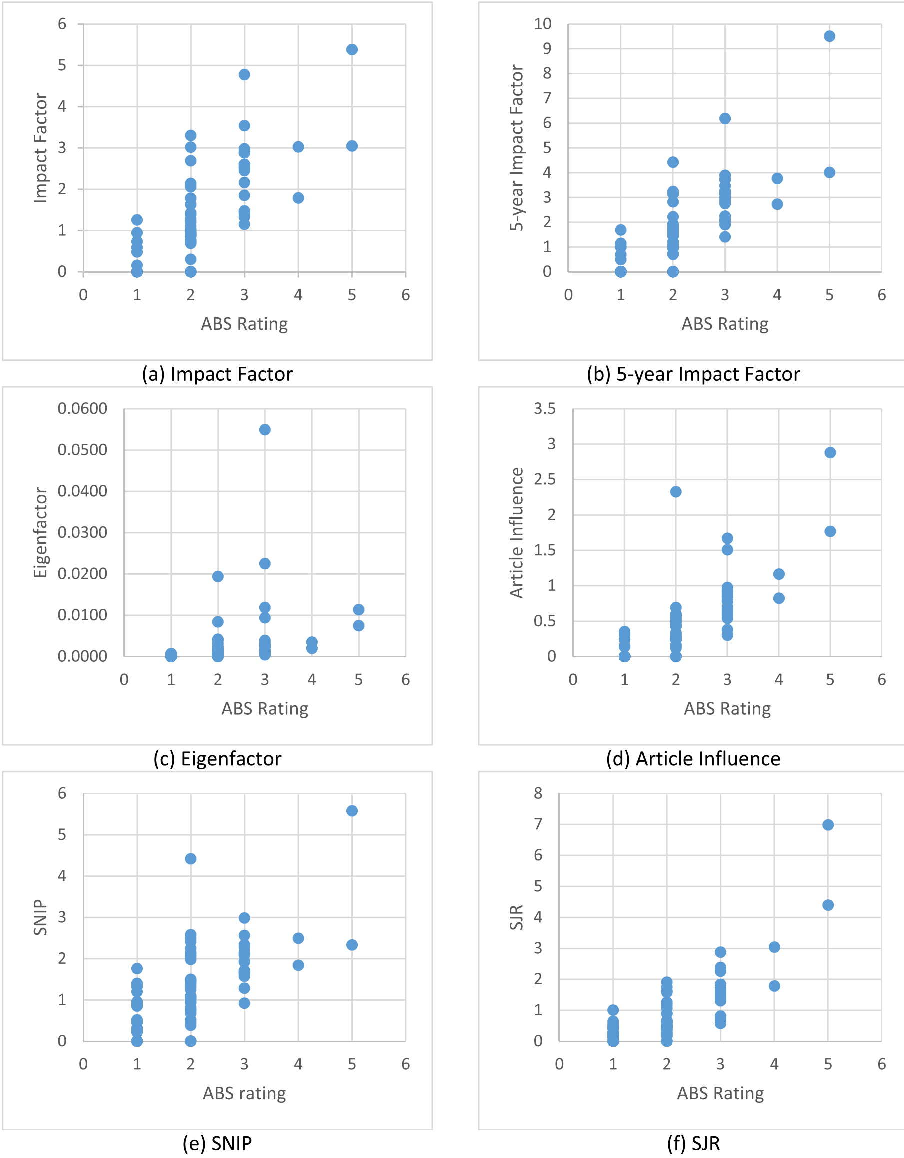

FIGURE 1 Different metrics versus ABS ratings

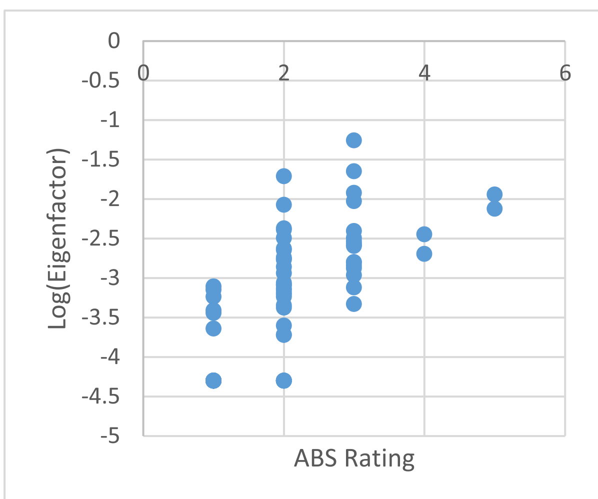

FIGURE 2 The log of Eigenfactor versus ABS ratings

2.1.2 | Outlier removal

Although all the above metric values will increase with the ABS ratings in most cases, there are several potential outliers subject to be removed to reveal a more genuine linear relationship between different metrics and ABS ratings. There are three types of potential outliers in our dataset.

The first type of potential outliers is related to the journals that have significantly higher values of a certain metric than other journals with the same ABS rating. Those potential outliers were intuitively selected according to their positions in Figure 1 and listed in Table 1. Among those outliers, *Communications of the ACM* is listed 5 times, followed by *Journal of Information Technology* 3 times, *Journal of Computer Mediated Communication* twice, and all the remaining journals once. Therefore, three journals, that is, *Communications of the ACM*, *Journal of Information Technology*, and *Journal of Computer Mediated Communication*, are considered as Type-1 outliers.

The second type of potential outliers is related to the journals that have missing values for some metrics. For the journals rated as 3 or above, their values in six different metrics are all available. However, among the journals rated as 2 or 1, some do not have the corresponding value for some metrics. If a journal has missing values for some metrics, the value of zero will be assigned to replace their missing values. Such a way of handling the missing values might be appropriate for the journals rated as 1 by ABS, but problematic for the journals rated as 2 by ABS since rating 2 is assigned for good standard journals. Therefore, if a journal is rated as 2 but has missing values for some metrics, it will also be treated as outliers. Therefore, six journals of *Annual Review of Information Science and Technology*, *Communications of the Association for Information Systems*, *Health Systems*, *Journal of Enterprise Information Management*, *Pacific Asia Journal of the Association for Information Systems*, and *Scandinavian Journal of Information Systems* are treated as Type-2 outliers according to the above rule.

The third type of potential outliers is related to the two elite journals, *MIS Quarterly* and *Information Systems Research*. They are rated as 4* by ABS, but it is hard to assign them an appropriate numeric ABS rating to reflect the linear increases of their metric values. For example, it might be more appropriate to rate *MIS Quarterly* as 6 and *Information Systems Research* as 5 to indicate the gap among the journals in the ABS list. However, it takes extra efforts to justify why the above numeric ABS rating assignment is reasonable. Therefore, *MIS Quarterly* and *Information Systems Research* are simply treated as Type-3 outliers instead of being assigned with numeric ABS ratings by us.

The entire ABS list has 79 MIS journals. After removing three Type-1 outliers, six Type-2 outliers, and two Type-3 outliers, the entire dataset has 68(=79–3–6-2) journals left for the next step of model construction.

2.2 | Model construction

In this paper, many prediction models are constructed to reflect the relationship between different metrics and ABS ratings. With the constructed prediction models, any MIS journal not in the ABS Journal List can be assigned a predicted ABS rating on the basis of its values of different metrics. To construct a prediction model to predict the numerical ABS ratings, three widely used models, that is, linear regression (Seal, 1968), neural network (Kohonen, 1988), and support vector machine (Cortes & Vapnik, 1995), are tested in our research. Different models constructed by us are all assessed by their prediction performance. In addition, the coefficients of linear regression models are discussed in detail because linear regression cannot only be used for the prediction purposes but also can be explained. However, the coefficients of neural network and support vector machine are not discussed as these two models are hard to interpret.

In this dataset with the 68 MIS journals after removing outliers, all the metrics are highly correlated with each other, indicated by their correlation matrix in Table 2. For the multiple linear regression model with all the metrics, shown in Table 3, it has a serious multicollinearity problem that impacts the interpretation of the model. Thus, Article Influence is the only useful metric for explaining the change of ABS ratings in our multiple regression model. Such data redundancy will also make the multiple linear regression model more likely to be overfitting.

TABLE 1 The list of potential Type-1 outliers by different metrics

Metric	ABS rating	Metric value	Journal title
Impact Factor	3	4.775	*Journal of Information Technology*
		3.541	*Journal of Computer Mediated Communication*
	2	3.301	*Communications of the ACM*
		3.017	*Internet Research: Electronic Networking Applications and Policy*
		2.692	*International Journal of Information Management*
5-year Impact Factor	3	6.189	*Journal of Information Technology*
	2	4.425	*Communications of the ACM*
Eigenfactor	3	0.0549	*Expert Systems with Applications*
		0.0225	*Computers in Human Behavior*
		0.0119	*Decision Support Systems*
		0.0094	*Journal of the American Society for Information Science and Technology*
	2	0.0194	*Communications of the ACM*
		0.0084	*Journal of Systems and Software*
Article Influence	3	1.671	*Journal of Information Technology*
		1.509	*Journal of Computer Mediated Communication*
	2	2.329	*Communications of the ACM*
SNIP	2	4.415	*Communications of the ACM*

Note. ABS: Association of Business Schools; SNIP: Source Normalized Impact per Paper.

TABLE 2 The correlation matrix

	ABS ratings	Impact Factor	5-year Impact Factor	Eigenfactor	Article Influence	SNIP	SJR
ABS ratings	1.000	0.823	0.862	0.782	0.883	0.721	0.802
Impact Factor	0.823	1.000	0.965	0.874	0.911	0.839	0.907
5-year Impact Factor	0.862	0.965	1.000	0.871	0.953	0.835	0.907
Eigenfactor	0.782	0.874	0.871	1.000	0.860	0.857	0.786
Article Influence	0.883	0.911	0.953	0.860	1.000	0.834	0.918
SNIP	0.721	0.839	0.835	0.857	0.834	1.000	0.814
SJR	0.802	0.907	0.907	0.786	0.918	0.814	1.000

Note. ABS: Association of Business Schools; SNIP: Source Normalized Impact per Paper; SJR: SCImago Journal Ranking.

TABLE 3 The multiple linear regression model with all the metrics

Parameter	Estimate	Std. error	*t* value	Pr(>|t|)
Intercept	1.550	0.672	2.308	0.024
Impact Factor	−0.124	0.131	−0.944	0.349
5-year Impact Factor	−0.076	0.218	−0.349	0.728
Eigenfactor	0.110	0.158	0.694	0.490
Article Influence	1.923	0.631	3.046	0.003
SNIP	−0.003	0.230	−0.013	0.990
SJR	0.176	0.219	0.802	0.426

Note. SNIP: Source Normalized Impact per Paper; SJR: SCImago Journal Ranking.

To solve the multicollinearity problem and alleviate the potential overfitting issue, six different simple linear regression models, shown in Table 4, are developed. Apparently, each metric alone is a strong indicator to explain the ABS rating changes. The result also verifies the finding that metric-based methods provide very similar results to expert-based methods in determining a tiered structure of MIS journals (Lowry et al., 2013). As discussed in Section 1.2, different metrics are illustrating journal quality from different perspectives. Therefore, an ensemble linear regression model is built by assigning equal weight to each of the six different simple linear regression models in Table 4, and the ensemble linear regression model is calculated as follows:

$$\begin{aligned}&\frac{1}{6}(1.124+0.72{*}\textit{Impact Factor})+\frac{1}{6}(1.054+0.608{*}5\text{–}\textit{year Impact Factor})+\ldots+\frac{1}{6}(1.154+0.995{*}\textit{SJR})\\&=1.68+0.12{*}\textit{Impact Factor}+0.1{*}5\text{–}\textit{year Impact Factor}+0.14{*}\log(\textit{Eigenfactor}+0.00005)\\&+0.39{*}\textit{Article Influence}+0.12{*}\textit{SNIP}+0.17{*}\textit{SJR}.\end{aligned}$$

3 | EXPERIMENTS

In this section, four different models built in the previous section are assessed by their rating performance from four different perspectives, including new journals, top journals, and interdisciplinary journals, and how to identify overrated and underrated journals by ABS. The four models built

TABLE 4 Six fitted simple linear regression models' summary

Model ID	Parameter	Estimate	Std. error	*t* value	Pr(>|t|)
1	Intercept Impact Factor	1.124 0.720	0.088 0.061	12.82 11.77	<2e-16 <2e-16
2	Intercept 5-year Impact Factor	1.054 0.608	0.080 0.044	13.18 13.82	<2e-16 <2e-16
3	Intercept Eigenfactor	4.655 0.839	0.280 0.082	16.65 10.20	<2e-16 3.42e-15
4	Intercept Article Influence	1.073 2.368	0.072 0.155	14.86 15.28	<2e-16 <2e-16
5	Intercept SNIP	1.033 0.740	0.124 0.088	8.338 8.445	6.59e-12 4.23e-12
6	Intercept SJR	1.154 0.995	0.091 0.091	12.64 10.92	<2e-16 <2e-16

Note. SNIP: Source Normalized Impact per Paper; SJR: SCImago Journal Ranking.

in the previous section are the multiple linear regression with the multicollinearity problem (denoted as MLR), the ensemble simple linear regression (denoted as ESLR), neural network (denoted as NN), and support vector machine (denoted as SVM).

3.1 | The rating performance of new journals

In this section, a test dataset is created to test the performance of rating new journals by referencing to the journal lists created by similar hybrid methods (Harzing, 2017) as the ABS list. Those journal lists include CNRS Journal List, VHB Journals List, ABDC Journal List, ESS Journal List, and FNEGE Journal List.

The test dataset consists of the MIS journals that are rated in some of the above lists, but not rated in the ABS list. Those MIS journals will be assigned with estimated ABS ratings in the following way. CNRS categories journals into 1*, 1, 2, 3, and 4 with 1* for highest quality rating, 1–3 for intermediate quality rating, and 4 for lowest quality ratings. VHB categories journals into A+ for world leading, A for leading, B for important and respected, C for recognized, and D for peer reviewed. ABDC categorizes journals into A* for best or leading journals, A for highly regarded journals, B for well-regarded journals, and C for recognized journals. ESS ABDC categorizes journals into 0+ for the best, 0 for excellence, 1 for high level, 2 for national circulation, and 3 for a very narrow circulation. FNEGE categorizes journals into 1* for prominent journals, 1 for notable journals, 2 for highly selective journals, 3 for very good journals, and 4 for good journals. Except ABDC, all the remaining four journal lists rate journals into five categories, which are the same as ABS. Therefore, converting the rating from CNRS, VHB, ESS, and FNEGE into the ABS rating is straightforward. In order to have a fair conversion between ABDC ratings and ABS ratings, their journal lists are compared. Through the journal list comparison, we found A* journals in ABDC are equivalent to the journals in ABS with rating of 4 or 4*, followed by A journals in ABDC equivalent to ABS rating of 3, B journals in ABDC equivalent to ABS rating of 2, and C journals in ABDC equivalent to ABS rating of 1.

Based on the five journal ranking lists, MIS journals that are not rated by ABS can now be assigned an estimated ABS rating in Table 5. For the CNRS column, the number outside the parenthesis is the rating assigned by CNRS for the related journal, and the number within the parenthesis is the converted rating in the ABS scale. The similar conversion is conducted for the VHB, ABDC, ESS, and FNEGE columns. In order to have a reliable estimation on ABS ratings, only the MIS journals that are rated by at least two journal lists are selected. In addition, when the journal is only rated by two lists, it is selected if having the same converted ABS rating, such as *ACM Transaction on Database Systems*, *Artificial Intelligence*, *Information Technology and Management*, and *Journal of Database Management*. When the journal is rated by more than two lists, it is selected if there is a majority on the converted ABS ratings and the difference between the minimal and maximal converted ABS ratings is equal to 1 or 0. According to the above rules, nine MIS journals that are not rated by ABS are selected and assigned with estimated ABS ratings, shown in Table 5.

With the nine selected MIS journal with estimated ABS ratings, all the four models, that is, MLR, ESLR, NN, and SVM, are tested on how well they predict estimated ABS ratings according to journals' six metrics, and the result is shown in Table 6. Based on the root mean square error between the predicted rating by each model and our estimated ABS ratings by five journal ranking lists, ESLR is the best model with 0.495 followed by SVM with 0.682, MLR with 0.726, and NN with 2.332. Generally speaking, NN and SVM are more advanced methods and outperform regression methods in many applications, especially for nonlinear relationships in voice and image recognition (Hinton et al., 2012). However, in some studies (Pugh & Ryman, 1991; Sargent, 2001), regression methods might have better or equivalent performance. For example, Pugh and Ryman (1991) found NN can be better when locating nonlinear effects and require sufficiently large data samples to avoid overfitting. In our application, we observe a linear relationship between ABS ratings and other journal metrics in Section 2.1, and the dataset in this application is very small with only 68 samples. Therefore, the regression methods outperform others in this application, which is consistent with the research finding of Pugh and Ryman (1991).

TABLE 5 Estimated ABS ratings for nine new MIS journals

Journal	CNRS	VHB	ABDC	ESS	FNEGE	Estimated ABS rating
ACM Transactions on Database Systems		B (3)		1 (3)		3
Artificial Intelligence		B (3)		1 (3)		3
Data and Knowledge Engineering		B (3)	A (3)	1 (3)		3
IEEE Transactions on Knowledge and Data Engineering	2 (3)			1 (3)	2 (3)	3
IEEE Transactions on Software Engineering	2 (3)	B (3)		1 (3)	2 (3)	3
Journal of Quality Technology	2 (3)		A (3)		3 (2)	3
Electronic Commerce Research		C (2)	A (3)	2 (2)		2
Information Technology and Management		C (2)	B (2)			2
Journal of Database Management			B (2)	2 (2)		2

Note. ABS: Association of Business Schools; MIS: management information systems; CNRS: Centre National de la Recherche Scientifique; VHB: Association of University Professors of Business in German Speaking Countries; ABDC: Australian Business Deans Council; ESS: ESSEC Business School; FNEGE: Foundation National pour l'Enseignement de la Gestion des Entreprises.

TABLE 6 Predicted ABS ratings for nine new journals

Journal	Estimated ABS rating	MLR	ESLR	NN	SVM
ACM Transactions on Database Systems	3	2.381	2.186	2.617	2.138
Artificial Intelligence	3	4.683	3.785	7.315	4.169
Data and Knowledge Engineering	3	2.299	2.403	2.271	2.273
IEEE Transactions on Knowledge and Data Engineering	3	3.237	3.217	5.695	3.370
IEEE Transactions on Software Engineering	3	3.408	3.097	5.788	3.304
Journal of Quality Technology	3	3.682	2.871	6.725	3.098
Electronic Commerce Research	2	1.868	2.091	1.845	1.741
Information Technology and Management	2	1.733	1.695	1.819	1.464
Journal of Database Management	2	1.485	1.368	1.186	1.026
Root mean square error		0.726	0.495	2.332	0.682

Note. ABS: Association of Business Schools; MLR: multicollinearity problem; ESLR: ensemble simple linear regression; NN: neural network; SVM: support vector machine.

3.2 | The rating performance on top journals

When building different models, the two elite journals, *MIS Quarterly* and *Information Systems Research*, are removed from our training set because ABS rates them as 4*, which means the rating is above 4 but is not provided with a specific number. In order to understand the rating performance on top journals, we use a basket of eight top MIS journals (AIS, 2011), identified by Association for Information Systems senior scholars. For the basket of 8 top MIS journals, their predicted ABS ratings by these journals' six metrics together with the original ABS ratings are shown in Table 7. In addition, in the study conducted by Lowry et al. (2013), although there is no agreement on which MIS journal is ranked in the fourth position, most MIS experts will rank *MIS Quarterly* first, *Information Systems Research* second, and *Journal of Management Information Systems* third. The expert knowledge on the Top-3 MIS journals are also used to assess different rating methods.

First, NN has the closest estimation of the original ABS rating comparing with MLR, ESLR, and SVM. However, it is overfitting to the training data and has the worst performance on rating new journals according to Table 6. In addition, it assigns a higher rating to *Information Systems Research* than *MIS Quarterly*, which contradicts to the fact that *MIS Quarterly* has a higher value than *Information Systems Research* in all the six metrics and the expert knowledge on the Top-3 MIS journals. Second, MLR, ESLR, and SVM have very similar ratings on top journals. However, both MLR and SVM will rank *Journal of Information Technology* higher than *Information Systems Research*, which contradicts to the fact that almost all the survey studies rank *MIS Quarterly* and *Information Systems Research* as the elite MIS journals, and *Journal of Information Technology* is ranked in a lower tier. Since each method can predict ABS ratings on the basis of different journal metrics, the best possible method should rank *MIS Quarterly* on the top, followed by *Information Systems Research*, journals with ABS rating 4, and journals with ABS rating 3. Similarly, the worst possible method will rank journals with ABS rating 3 on the top, followed by journals with ABS rating 4, *Information Systems Research*, and *MIS Quarterly*. However, all the four methods we tried do not generate the ideal ranking list. In order to evaluate the quality of the ranking lists generated by different methods, a widely used measure of ranking quality for web search engine algorithms known as discounted cumulative gain (DCG; Järvelin & Kekäläinen, 2002) is utilized in this paper. Given any ranking list, its related DCG is calculated as $2^{*}rating_1 + \sum_{i=2}^{n} \frac{rating_i}{\log_2(i)}$, where i is the ranking position of the current journal and $rating_i$ is the ABS rating score of the current journal. In DCG, if a journal with a high ABS rating is ranked low, it suffers more penalty than a journal with a low ABS rating in the same ranking position. Therefore, the ranking list with high ABS rating journals on top has a higher DCG score, and the ideal ranking list has the highest DCG score. According to Figure 3 with the DCG score for each ranking list, ESLR has the best performance on rating top journals among the four methods.

TABLE 7 Predicted ABS ratings for the basket of eight MIS journals

Journal	MLR	ESLR	NN	SVM	ABS Rating
MIS Quarterly	7.306	6.003	6.805	6.588	4*
Information Systems Research	4.787	3.873	7.115	4.196	4*
Journal of Management Information Systems	3.715	3.275	4.130	3.398	4
Journal of the Association of Information Systems	2.869	2.726	3.815	2.706	4
European Journal of Information Systems	2.995	2.942	3.035	2.846	3
Information Systems Journal	3.261	2.757	2.997	2.841	3
Journal of Information Technology	5.237	3.632	3.045	4.331	3
Journal of Strategic Information Systems	3.034	2.733	2.728	2.742	3

Note. ABS: Association of Business Schools; MIS: management information systems; MLR: multicollinearity problem; ESLR: ensemble simple linear regression; NN: neural network; SVM: support vector machine.

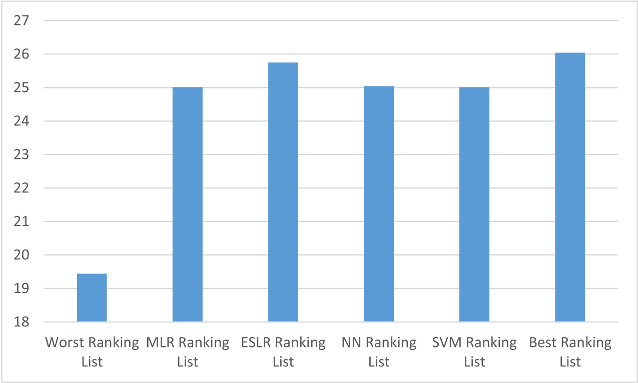

FIGURE 3 The discounted cumulative gain score for each ranking list

Based on the ESLR ratings, first, *MIS Quarterly* has a significantly higher value than all the other top journals. It suggests that a paper published on this journal should receive significantly more credits than other top MIS journals. Second, although *Information Systems Research* is rated as 4* by ABS, the same as *MIS Quarterly*, it does not have the same significant high value as *MIS Quarterly* across all the six journal metrics compared with the six top journals with the ABS rating of 4 or 3 according to Figure 1. In addition, the two top journals with the ABS rating of 4 also do not have a significant high value than some journals with the ABS rating of 3 according to Figure 1. In all, our ESLR method suggests assigning *MIS Quarterly* with a rating of 6, *Information Systems Research* and *Journal of Information Technology* with a rating of 4, and the remaining five top journals with a rating of 3 to reflect the journal quality difference.

Although our best method ESLR correctly predicts the ABS ratings for most journals, it is not always perfect. For example, the Top-3 MIS journal ranking based on our ESLR ratings is not consistent with the widely accepted Top-3 MIS journal ranking, due to the lack of expert knowledge on some important qualitative information about these journals. In other words, our ESLR ratings is consistent with the ABS ratings for most journals and can be treated equally as the ABS ratings. At the same time, expert knowledge is encouraged to adjust our ESLR ratings under the two following constraints. First, adjustments can be made to those journals that domain experts have sufficient evidences to believe they are overrated or underrated. Second, our ESLR rating can be corrected by 1, but not beyond 1. For example, the ESLR rating for *Information Systems Research* can be corrected to 5 from 4, but not 6 to be the same quality as *MIS Quarterly*. Similarly, the ESLR rating for *Journal of Information Technology* can be corrected to 3 from 4, and the ESLR rating for *Journal of Management Information Systems* can be corrected to 4 from 3. For other journals, our ESLR ratings is consistent with the ABS ratings.

3.3 | The rating performance of interdisciplinary journals

To understand how well the best rating model, ESLR, can be utilized to rate interdisciplinary journals related to MIS in the same scale of ABS, the journals in the health informatics category are tested. Health informatics is considered as the interdisciplinary research between medical and MIS fields. Generally speaking, medical journals have much higher values in terms of Impact Factor, 5-year Impact Factor, Eigenfactor, Article Influence, and SJR than journals in other fields. When our ESLR model is used to rate all of the 54 journals categorized as health informatics by https://journalmetrics.scopus.com/ and the ESLR ratings are rounded into integers, there are one journal rated by 6, two journals rated by 4, six journals rated by 3, twenty journals rated by 2, and twenty-five journals rated by 1. The percentage of journals in each rating category in the health informatics field is almost the same as the ABS journal list in the MIS field, shown in Table 8. In other words, the six metrics for interdisciplinary journals related to MIS changes in the same scale as pure MIS journals, and our ESLR model is also appropriate to rate the interdisciplinary journals related to MIS.

Another interesting finding is related to the highest rated journal *GigaScience* by our ESLR model in the health informatics field. *GigaScience* was launched by BGI, the world largest genomics institute, for big data studies, the recent extreme hot topic, across the entire spectrum of life and

TABLE 8 The percentage of journals in each rating category

Health informatics			MIS		
ESLR ratings	Number of journals	Percentage of journals	ABS ratings	Number of journals	Percentage of journals
4*	1	1.95	4*	2	2.53
4	2	3.70	4	2	2.53
3	6	11.11	3	17	21.52
2	20	37.04	2	31	39.24
1	25	46.30	1	27	34.18

Note. ESLR: ensemble simple linear regression; MIS: management information systems; ABS: Association of Business Schools.

TABLE 9 Underrated journals by ABS

Journal	ESLR	ABS	CNRS	VHB	ABDC	ESS	FNEGE
Communications of the ACM	4.068	2		B (3)	A (3)	2 (2)	
Journal of Electronic Commerce Research	2.055	1		C (2)	B (2)		
Ethics and Information Technology	1.851	1					
International Journal of Information Management	2.725	2	3 (2)	C (2)	A (3)	2 (2)	3 (2)
Internet Research	2.700	2					

Note. ESLR: ensemble simple linear regression; ABS: Association of Business Schools; CNRS: Centre National de la Recherche Scientifique; VHB: Association of University Professors of Business in German Speaking Countries; ABDC: Australian Business Deans Council; ESS: ESSEC Business School; FNEGE: Foundation National pour l'Enseignement de la Gestion des Entreprises.

TABLE 10 Overrated journals by ABS

Journal	ESLR	ABS	CNRS	VHB	ABDC	ESS	FNEGE
Journal of the Association of Information Systems	2.726	4	2 (3)	A (4)	A* (4)	1 (3)	2 (3)
Information Technology and People	1.826	3	3 (2)		A (3)	2 (2)	3 (2)
Annual Review of Information Science and Technology	1.081	2					
Health Systems	1.081	2					
Pacific Asia Journal of the Association for Information Systems	1.081	2					

Note. ESLR: ensemble simple linear regression; ABS: Association of Business Schools; CNRS: Centre National de la Recherche Scientifique; VHB: Association of University Professors of Business in German Speaking Countries; ABDC: Australian Business Deans Council; ESS: ESSEC Business School; FNEGE: Foundation National pour l'Enseignement de la Gestion des Entreprises.

biomedical sciences in 2012. This journal has been quickly gaining a wide recognition over the past 5 years for its focus on the recent hot topic. In other words, our ESLR model can highlight not only good interdisciplinary journals but also emerging journals promptly.

3.4 | Underrated and overrated journals by ABS

For all the 79 MIS journals rated by ABS, the Top 5 underrated journals according to the difference between ESLR ratings and ABS ratings are shown in Table 9. In order to understand which rating is more reasonable between ESLR and ABS in Table 9, the CNRS, VHB, ABDC, ESS, and FNEGE ratings (shown outside the parenthesis) together with their converted ABS ratings (shown within the parenthesis) are also used as a reference. First, only two out of 79 MIS journals, that is, *Communications of the ACM* and *Journal of Electronic Commerce Research*, are identified as underrated by ABS since their differences between ESLR and ABS are greater than 1. The *Communications of the ACM* is a significant outlier in Section 2.1 because it has significantly higher values in Impact Factor, 5-year Impact Factor, Eigenfactor, Article Influence, and SNIP than any other journal with ABS rating of 2. Besides, ABS, VHB, ABDC, and ESS also rated this journal. VHB and ABDC rated it as 3, whereas ESS rated it as 2. According to the majority vote, it might be more appropriate to rate it as 3. Both ESLR ratings and ABS ratings are not accurate for *Communications of the ACM*. ESLR overrates this journal due to the lack of expert knowledge on some important qualitative information. For *Journal of Electronic Commerce Research*, it might be more appropriate to rate it as 2 since both VHB and ABDC rated it as 2. In other words, if ABS rating is strictly followed, any reasonable scholar would avoid submission of his/her papers to *Communications of the ACM* and *Journal of Electronic Commerce Research* as they require higher quality of papers to be published but are not recognized properly by the ABS journal list. Therefore, our ESLR rating system is more appropriate than the ABS rating for not only interdisciplinary MIS journals out of the ABS list but also *Communications of the ACM* and *Journal of Electronic Commerce Research* in the ABS list.

Similarly, the Top-5 overrated journals are shown in Table 10. Only *Journal of the Association of Information Systems* and *Information Technology and People* are identified as overrated by ABS since their difference between ESLR and ABS are greater than 1. According to CNRS, VHB, ABCS, ESS, and FNEGE, it might be more appropriate to rate *Journal of the Association of Information Systems* as 3 and *Information Technology and People* as 2, which is consistent with our ESLR ratings. In addition, for *Annual Review of Information Science and Technology*, *Health Systems*, and *Pacific Asia Journal of the Association for Information Systems*, they do not have any value on Impact Factor, 5-year Impact Factor, Eigenfactor, Article Influence, SNIP, and SJR and are not rated by CNRS, VHB, ABDC, ESS, and FNEGE. Therefore, it might be more appropriate to be rated as 1 instead 2, which is also consistent with our ESLR ratings.

4 | CONCLUSION AND DISCUSSION

In this paper, a data-driven method is proposed for rating MIS-related journals that are not included in the ABS list. To the best of our knowledge, our method is the first work on this type, and it is very important because an up-to-date, accurate, and comprehensive measurement system is critically important especially for those who intend to publish in new and high-quality journals aiming at emerging and interdisciplinary topics.

There are three existing types of journal ranking efforts, survey-based, metric-based, and hybrid methods. Our work can be considered as a new type of hybrid method with more emphasis on data analytics compared with the existing hybrid methods with more focus on expert knowledge. In the existing hybrid methods, experts utilize the results from metric-based methods to expand the ranking list with more nonelite journals. In our method, we construct a prediction model between the tiered rating determined by expert knowledge and the journal metrics derived by graph analytics from the reference graph. Such a prediction model utilizes handy journal metrics to predict the tiered ratings determined by expert knowledge.

Survey-based methods are solely based on expert knowledge. They cannot provide reliable tiered ratings for the nonelite journals and only reflect the journal quality when surveys are conducted. To solve the above issue, metric-based methods analyse the citation network to derive reliable ratings for the nonelite journals and dynamically adjust the journal ratings over time with the dynamical change in the citation network. However, they cannot provide similar tiered ratings as survey-based methods. This make rules for accreditation, funding allocation, hiring, tenure, promotion, and others based on metric-based methods hard to follow. The existing hybrid methods then utilize the results from metric-based methods to expand the ranking list by experts and maintain tiered ratings at the same time. The expanded journal list can include more journals than survey-based methods but is still not comprehensive. In addition, the expanded journal list requires the periodic update by experts to reflect the recent changes in journal quality. Comparing with metric-based methods, our method can provide tiered ratings. Comparing with the existing hybrid methods, our method overcomes their noncomprehensive list issue (especially for the new journals focusing on emerging topics) and the requirement of periodic manual update.

Based on the CNRS, VHB, ABDC, ESS, and FNEGE lists, nine MIS journals not rated by ABS are selected and their estimated ABS ratings were derived to test the rating performance of different models. Among four different data-driven methods, the ESLR achieves the best performance and generates reasonable ratings for new journals, top journals, and interdisciplinary journals. Given any MIS journal, its rating can be calculated by 1.68 + 0.12 * *Impact Factor* + 0.1 * 5 − *year Impact Factor* + 0.14 * log (*Eigenfactor* + 0.00005) + 0.39 * *Article Influence* + 0.12 * *SNIP* + 0.17 * *SJR*. After rounding the ESLR rating into integers, 1 indicates low-quality journals, 2 indicates good-quality journals, 3 indicates high-quality journals, 4 indicates top journals, and 5 or above indicates elite journals.

However, it is better for our ESLR rating to serve as a complement instead of a replacement for either ABS ratings or expert knowledge. ESLR ratings, ABS ratings, and expert knowledge should be used altogether to generate a more accurate MIS journal ranking list.

On one hand, the ABS list is not comprehensive and requires ESLR rating as a complement to include more MIS journals. According to our experimental results, our ESLR ratings is consistent with the ABS ratings for most journals, but not all of them. Therefore, for the MIS journals not in the ABS list, our ESLR rating can be used as a reference, and expert knowledge is encouraged to be included to adjust our ESLR rating. When making corrections, it must be conducted with caution because our ESLR rating is still reliable for most MIS journals. In other words, any adjustment must follow the two following constraints. First, domain experts must have sufficient evidences to believe our ESLR ratings are overrated or underrated. Second, our ESLR ratings can be corrected by 1, but not beyond 1. For example, the ESLR rating for *Information Systems Research* is 4. It can be adjusted to 5, but not 6 to be the same quality as *MIS Quarterly*. The ESLR rating for *GigaScience* is 6. In order to be conservative for relatively new journals, reducing its rating to 5 can be considered as reasonable. The rating of 5 indicates that *GigaScience* has the same journal quality as *Information Systems Research*, but lower than *MIS Quarterly*. However, if further reducing its rating to 4 or even lower, it discourages MIS researchers to publish in *GigaScience*.

On the other hand, our ESLR rating can help to identify overrated and underrated journals by ABS if the difference between our ESLR rating and the ABS rating is greater than 1. Complemented by our ESLR ratings, the ABS Journal Guide is recommended to do the following changes: (a) It should clearly mention that *MIS Quarterly* is better than *Information Systems Research* although both are elite journals, (b) *Journal of the Association of Information Systems* should be rated as 3 instead of 4, (c) *Information Technology and People* should be rated as 2 instead of 3, (d) *Communications of the ACM* should be rated as 3 instead of 2, and (e) *Journal of Electronic Commerce Research* should be rated as 2 instead of 1.

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