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CROSS CORRELATION ANALYSIS BETWEEN SNIP, SJR AND IF FOR SELECTED JOURNALS
Vladimir M. Moskovkin, Alla A. Reznik, Marina V. Sadovski, Elena V. Kaluzhnaya, Svetlana I. Shatokhina
 Belgorod State University, 85, Pobedy St., Belgorod, 308015, Russia
Email: moskovkin@bsu.edu.ru

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Annotation:

The cross correlation analysis was presented in the given article and linear regression equations between various types of journal metrics (SNIP, SJR, IF) were obtained for Economics and Mathematics and Computer Science journals. It was showed that correlation coefficients for all the journal metrics of the first group of journals (Economics journals) were higher than the similar coefficients in the second group of journals (Mathematics and Computer Science journals). It was obtained that the mean observation of the journal metrics for the first group of journals come up to the inequalities $IF > SJR > SNIP$ with a small spread of the mean values, as for the second group of the journal metrics the following inequalities takes place: $SNIP > IF > SJR$

Key words: cross correlation analysis, journal metrics, SNIP, SJR, IF, Economics Journal, Mathematics and Computer Science Journals.

Introduction

As an alternative to the Journal Impact Factor (IF) developed by the Institute of Scientific Information (ISI) of Thomson-Renters (Sher, Garfield, 1965; Garfield, 1972), the SCImago Journal Rank (SJR) was developed in 2005 (Gonzalez-Pereire, Guerrero-Bote, Moya-Anegón, 2005), and in 2010 the Source Normalized Impact per Paper (SNIP) (Moed et al, 2010) was developed as well. In January 2010, Scopus endorsed last two journal metrics (Colledge et al, 2010). The first scientific articles were published in 2008, comparing SJR with IF (Falagas et al, 2008; Butler, 2008), and in 2010 the first scientific article was published, comparing SNIP with IF (Leydesdorff, Opthof, 2010). In the article (Falagas, 2008) the comparative ranking for the top 20 journals by IF and SJR was given and in the article (Butler, 2008) the similar comparison but for the top 10 journals was given as well.

In the last article, there is comparative analysis of SNIP, SJR and IF values for the four mathematical journals and one biological journal on 2007. Detailed analysis of SJR and SNIP advantages over IF was done in the work

Vladimir M. Moskovkin**et al.* /*International Journal of Pharmacy & Technology* (Lancho-Barrantes, Guerrero-Bote, Moya-Anegón, 2010). In terms of the correlation analysis between these journal metrics for a certain sample of journals, the conclusion in this article is important for us, which states that the range that SJR and SNIP cover (about 0 to 10) is smaller than the range of the IF (about 0 to 60).

Also, we should emphasize the work (Ahlgren, Waltman, 2014), in which the degree to which the values of the above mentioned journal metrics correlate with the quality levels in the Norwegian model is analyzed.

In our work the correlation analysis will be conducted between SNIP, SJR and IF values for two aggregated subject areas of journals by Elsevier publishing House.

Methodology

October 19, 2016 we chose four subject areas of journals on the Elsevier website, such as: 1. All journals within Economics and Finance; 2. All journals within Business, Management and Accounting; 3. All journals within Mathematics; 4.

All journals within Computer Science. We chose journals in each subject area of journals which had all data on SNIP, SJR and IF simultaneously, i.e. those journals which were included in the database of Scopus and Web of Science at the same time. Eventually in every subject area, there were 77; 51; 90 and 102 journals, consequently. After that, we have combined two first and two second subject areas due to their similarity in content, and we've got two aggregated subject areas (Table 1).

Under such aggregation, we have included the «Journal of Manufacturing Systems» additionally from the fourth subject area (All journals within Computer Science) to the first aggregated subject area; the journal «Computers & Industrial Engineering» from the first subject area to the second aggregated subject area, and the «Journal of Economic Dynamics and Control» and the «Review of Economic dynamics» from the first subject area to the second aggregated subject area.

As a result, we got 114 journals in the first aggregated subject area and 150 journals in the second aggregated subject area.

After that, we have done a correlation analysis between indicators of SNIP, SJR and IF, using the standard features of Excel, and also, we have calculated the mean values of these indicators by aggregated subject areas to compare them with literature data.

Results and Discussion

Table 1 and Table 2 show the initial data of journal metrics for the first and the second aggregated subject areas.

Table 1: Data of journal metrics for the aggregated subject area «Journals within Economics, Finance Business, Management and Accounting». October 19, 2016.

Journals within Economics, Finance Business, Management and Accounting	SNIP	SJR	IF	Journals within Economics, Finance Business, Management and Accounting	SNIP	SJR	IF
Accounting, Organizations & Society	2.813	2.515	2.464	International Journal of Information Management	2.495	1.173	2.692
Applied Ergonomics	1.882	1.212	1.713	International Journal of Industrial Organization	0.980	1.085	0.866
Business Horizons	1.671	0.726	1.008	International Journal of Project Management	2.569	1.497	2.885
China Economic Review	1.186	0.997	1.116	International Journal of Research in Marketing	1.573	3.004	1.833
Communist and Post-Communist Studies	1.232	0.666	0.308	International Review of Economics & Finance	1.362	0.890	1.846
Computers & Industrial Engineering	1.846	1.630	2.086	International Review of Law and Economics	0.978	0.369	0.543
Computers in Industry	1.978	0.930	1.685	Japan and the World Economy	1.066	0.477	0.603
Decision Support Systems	2.271	2.262	2.604	Journal of Accounting and Economics	3.507	6.834	3.535
Ecological	1.512	1.733	3.227	Journal of	1.478	1.030	1.317

Economics				Accounting and Public Policy			
Economic Modelling	1.024	0.815	0.997	Journal of Air Transport Management	1.103	0.845	1.084
Economic Systems	0.933	0.420	0.701	Journal of Banking and Finance (JBF)	1.588	1.264	1.485
Economics and Human Biology	0.942	1.272	1.639	Journal of Business Research	1.889	1.682	2.129
Emerging Markets Review	1.641	0.879	1.549	Journal of Business Venturing	3.270	4.923	4.204
Energy	1.898	2.350	4.292	Journal of Choice Modelling	0.648	0.549	1.056
Energy Economics	1.851	3.025	2.862	Journal of Comparative Economics	1.382	1.066	1.380
Energy Policy	1.653	2.436	3.045	Journal of Consumer Psychology	1.669	2.973	2.009
European Economic Review	1.405	1.712	1.095	Journal of Corporate Finance	1.356	1.446	1.286
European Management Journal	1.382	0.816	1.437	Journal of Destination Marketing & Management	1.519	1.003	1.034
Evaluation and Program Planning	0.914	0.470	1.000	Journal of Development Economics	2.508	2.840	1.837
Evolution and Human Behavior	1.395	1.942	3.223	Journal of Econometrics	2.002	3.781	1.611
Explorations in Economic History	1.540	1.306	1.000	Journal of Economic Behavior and	1.362	1.425	1.374

				Organization			
Finance Research Letters	0.663	0.405	0.480	Journal of Economic Dynamics and Control	1.029	0.937	0.879
Forest Policy and Economics	1.207	1.195	1.552	Journal of Economic Psychology	1.496	1.085	1.677
Futures	1.164	0.638	1.242	Journal of Economic Theory	1.489	2.587	1.097
Games and Economic Behavior	1.154	1.596	0.882	Journal of Empirical Finance	1.041	0.879	0.907
Human Resource Management Review	2.451	1.224	2.236	Journal of Engineering and Technology Management	1.706	1.079	1.474
Industrial Marketing Management	1.385	1.413	1.930	Journal of Environmental Economics and Management	1.795	2.915	2.197
Information and Management	1.919	1.381	2.163	Journal of Family Business Strategy	0.743	0.980	1.088
Information and Organization	1.640	1.306	1.419	Journal of Financial Economics	4.028	9.920	3.541
Information Economics and Policy	1.513	0.947	0.826	Journal of Financial Intermediation	1.734	1.861	2.145
International Business Review	1.441	1.100	1.669	Journal of Financial Markets	1.644	3.233	1.726
International Journal of Accounting Information Systems	1.669	0.657	1.128	Journal of Financial Stability	1.791	1.264	1.689
International	1.777	1.198	1.626	Journal of Forest	0.992	0.746	1.185

Journal of Forecasting				Economics			
International Journal of Hospitality Management	1.779	1.887	2.061	Journal of Health Economics	2.258	2.292	2.339
Journal of Hospitality, Leisure, Sport & Tourism Education - JoHLSTE	0.668	0.353	0.375	Long Range Planning	2.481	1.958	2.936
Journal of Housing Economics	1.101	0.883	1.035	Management Accounting Research	2.715	1.913	2.286
Journal of International Economics	2.635	3.723	2.017	Omega	2.846	3.771	3.962
Journal of International Financial Markets, Institutions & Money	1.266	0.872	1.051	Organizational Dynamics	0.456	0.670	0.522
Journal of International Management	1.427	1.829	1.982	Pacific-Basin Finance Journal	0.962	0.541	0.938
Journal of International Money and Finance	1.624	1.316	1.524	Regional Science and Urban Economics	1.335	1.328	1.024
Journal of Interactive Marketing	2.755	3.077	3.256	Research in Organizational Behavior	1.459	1.806	1.889
Journal of Macroeconomics	0.936	0.618	0.714	Research in Social Stratification and	1.193	1.126	1.379

				Mobility			
Journal of Manufacturing Systems	2.248	1.190	2.240	Research Policy	3.126	3.536	3.470
Journal of Mathematical Economics	0.605	0.579	0.434	Resource and Energy Economics	1.145	1.159	1.250
Journal of Monetary Economics	2.216	4.150	2.488	Resources Policy	1.560	1.083	2.489
Journal of Nutrition Education and Behavior (JNEB)	1.060	1.060	2.253	Review of Economic Dynamics	1.574	2.554	1.256
Journal of Operations Management	3.290	5.052	4.000	Scandinavian Journal of Management	1.001	0.504	1.076
Journal of Policy Modeling	1.068	0.935	0.986	Sport Management Review	1.561	0.805	1.193
Journal of Public Economics	1.707	2.267	1.440	Technological Forecasting and Social Change	1.752	1.348	2.678
Journal of Purchasing & Supply Management	1.661	2.359	2.562	Technovation	2.169	1.794	2.243
Journal of Retailing	2.180	2.056	2.014	Telecommunications Policy	1.004	0.658	0.982
Journal of Stored Products Research	1.069	0.786	1.533	The Journal of Strategic Information Systems	1.693	1.605	2.595
Journal of the Japanese and International Economies	0.809	0.409	0.508	The Leadership Quarterly	2.122	2.770	2.938

Journal of Urban Economics	2.225	2.434	2.121	The North-American Journal of Economics and Finance	0.785	0.578	1.360
Journal of Vocational Behavior	1.935	1.741	2.764	Tourism Management	2.876	2.450	3.140
Journal of World Business	1.899	1.656	2.811	Utilities Policy	0.972	0.547	1.110
Labour Economics	1.229	1.127	0.899	World Development	2.157	2.100	2.438

Table 2: Data of journal metrics for the aggregated subject area «Journals within Mathematics and Computer Science». October 19, 2016

Journals within Mathematics and Computer Science	SNIP	SJR	IF	Journals within Mathematics and Computer Science	SNIP	SJR	IF
Acta Mathematica Scientia	0.727	0.615	0.557	Computers & Industrial Engineering	1.846	1.630	2.086
Ad Hoc Networks	2.144	0.967	1.660	Computers & Fluids	1.585	1.171	1.891
Advances in Applied Mathematics	1.249	1.054	0.833	Computers & Graphics	1.299	0.514	1.120
Advances in Engineering Software	1.874	0.812	1.673	Computers & Mathematics with Applications	1.357	1.092	1.398
Advances in Mathematics	1.995	3.261	1.405	Computers & Security	2.563	1.020	1.640
Annals of Pure and Applied Logic	1.335	1.190	0.582	Computers & Structures	2.136	1.710	2.425
Annual Reviews in Control	4.985	2.443	2.042	Computers and Electronics in Agriculture	1.786	0.823	1.892

Applied and Computational Harmonic Analysis	1.776	1.589	2.094	Computers in Biology and Medicine	1.207	0.589	1.521
Applied Mathematical Modelling	1.612	1.318	2.291	Computers in Industry	1.978	0.930	1.685
Applied Mathematics and Computation	1.203	1.008	1.345	Control Engineering Practice	2.048	1.354	1.830
Applied Mathematics Letters	1.235	1.141	1.659	Cortex	1.417	2.469	4.314
Applied Numerical Mathematics	1.266	1.254	1.414	Data & Knowledge Engineering	2.412	1.258	1.500
Applied Soft Computing	2.143	1.763	2.857	Decision Support Systems	2.271	2.262	2.604
Artificial Intelligence	4.084	2.426	3.333	Design Studies	3.091	1.056	2.070
Artificial Intelligence in Medicine	1.721	0.884	2.142	Differential Geometry and its Applications	0.929	0.641	0.594
Automatica	2.991	4.315	3.635	Digital Investigation	1.766	0.674	1.211
Bulletin des Sciences Mathématiques	1.246	1.942	0.664	Digital Signal Processing	1.331	0.688	1.444
Chaos, Solitons & Fractals	1.090	0.679	1.611	Discrete Applied Mathematics	1.185	0.880	0.722
Cognition	1.676	2.770	3.411	Discrete Mathematics	1.040	1.000	0.600
Cognitive Systems Research	1.850	0.307	1.204	Discrete Optimization	1.248	0.924	0.889

Communications in Nonlinear Science and Numerical Simulation	1.776	1.575	2.834	Displays	1.419	0.481	1.903
Comptes Rendus Mathematique	0.775	1.154	0.446	Ecological Complexity	1.026	0.930	1.797
Computational Geometry	1.349	0.766	0.589	Electronic Commerce Research and Applications	2.053	1.582	2.139
Computational Statistics & Data Analysis	1.244	1.283	1.179	Engineering Analysis with Boundary Elements	1.320	1.251	1.862
Computer Aided Geometric Design	1.554	1.024	1.092	Engineering Applications of Artificial Intelligence	2.148	1.371	2.368
Computer Communications	2.002	0.889	2.099	European Journal of Combinatorics	1.089	1.233	0.650
Computer Languages, Systems and Structures	0.944	0.252	0.556	European Journal of Operational Research	2.295	2.595	2.679
Computer Methods in Applied Mechanics and Engineering	2.023	2.952	3.467	Expert Systems with Applications	2.561	1.839	2.981
Computer Networks	1.819	0.755	1.446	Expositiones Mathematicae	0.628	0.453	0.784
Computer Speech and Language	1.648	0.974	1.324	Finite Elements in Analysis and Design	1.516	1.278	2.175
Computer Standards &	1.907	0.888	1.268	Finite Fields and Their	1.344	1.096	1.292

Interfaces				Applications			
Computer Vision and Image Understanding	2.340	1.490	2.134	Future Generation Computer Systems	3.323	1.483	2.430
Computer-Aided Design	2.183	1.078	2.149	Fuzzy Sets and Systems	1.712	1.711	2.098
Computerized Medical Imaging and Graphics	1.311	0.630	1.385	Games and Economic Behavior	1.154	1.596	0.882
Computers & Electrical Engineering	1.164	0.565	1.084	Graphical Models	0.972	0.443	0.821
Historia Mathematica	0.597	0.233	0.464	Journal of Process Control	1.929	1.440	2.216
Image and Vision Computing	2.049	1.700	1.766	Journal of Pure and Applied Algebra	1.188	0.990	0.669
Information and Computation	1.354	0.698	0.873	Journal of Statistical Planning and Inference	0.987	1.090	0.727
Information and Management	1.919	1.381	2.163	Journal of Symbolic Computation	1.843	0.979	1.030
Information and Software Technology	3.163	0.920	1.569	Journal of Systems and Software	2.415	0.897	1.424
Information Fusion	3.537	1.941	4.353	Journal of Systems Architecture	1.084	0.399	0.683
Information Processing Letters	1.265	0.698	0.605	Journal of The Franklin Institute	1.411	1.454	2.327
Information Sciences	2.489	2.513	3.364	Journal of the Korean Statistical Society	0.756	0.392	0.353

Indagationes Mathematicae	0.861	0.476	0.407	Journal of Visual Communication and Image Representation	1.588	0.785	1.530
Integration, the VLSI Journal	1.156	0.283	0.703	Journal of Visual Languages and Computing	1.398	0.411	0.634
International Journal of Approximate Reasoning	2.091	2.304	2.696	Journal of Web Semantics	6.086	2.435	1.277
International Journal of Critical Infrastructure Protection	1.826	0.655	1.351	Knowledge-Based Systems	2.645	2.140	3.325
International Journal of Forecasting	1.777	1.198	1.626	Linear Algebra and its Applications	1.195	0.837	0.965
International Journal of Human-Computer Studies	2.158	0.815	1.476	Mathematical Biosciences	0.901	0.719	1.256
International Journal of Non-Linear Mechanics	1.400	1.211	1.920	Mathematical Social Sciences	0.567	0.493	0.344
Journal de Mathématiques Pures et Appliquées	1.746	3.180	1.818	Mathematics and Computers in Simulation	1.054	0.677	1.124
Journal of Algebra	1.230	1.165	0.660	Medical Image Analysis	3.083	2.048	4.565
Journal of Applied Mathematics and Mechanics	0.710	0.310	0.367	Neural Networks	2.236	1.629	3.216

Journal of Approximation Theory	1.265	0.923	0.921	Neurocomputing	1.757	1.202	2.392
Journal of Combinatorial Theory, Series A	1.634	2.350	0.979	Nonlinear Analysis: Hybrid Systems	1.520	1.994	3.192
Journal of Combinatorial Theory, Series B	2.054	2.411	1.094	Nonlinear Analysis: Real World Applications	1.784	1.792	2.238
Journal of Complexity	1.653	1.226	1.358	Ocean Modelling	1.558	2.141	3.337
Journal of Computational and Applied Mathematics	1.293	1.089	1.328	Operations Research Letters	0.744	0.727	0.627
Journal of Computational Science	1.161	0.587	1.078	Optical Switching and Networking	0.707	0.492	1.137
Journal of Computer and System Sciences	2.376	1.334	1.583	Parallel Computing	1.693	0.726	1.000
Journal of Differential Equations	1.876	2.809	1.821	Pattern Recognition	3.166	2.051	3.399
Journal of Econometrics	2.002	3.781	1.611	Pattern Recognition Letters	2.155	1.225	1.586
Journal of Economic Dynamics and Control	1.029	0.937	0.879	Performance Evaluation	1.581	0.527	0.944
Journal of Functional Analysis	1.518	2.526	1.273	Pervasive and Mobile Computing	2.051	0.872	1.719
Journal of	1.111	0.705	0.752	Review of	1.574	2.554	1.256

Geometry and Physics				Economic Dynamics			
Journal of Manufacturing Systems	2.248	1.190	2.240	Robotics and Autonomous Systems	2.265	1.377	1.618
Journal of Mathematical Analysis and Applications	1.262	1.161	1.014	Science of Computer Programming	1.380	0.570	0.828
Journal of Mathematical Economics	0.605	0.579	0.434	Signal Processing	1.931	1.119	2.063
Journal of Multivariate Analysis	1.165	1.458	0.857	Signal Processing: Image Communication	1.551	0.661	1.602
Journal of Network and Computer Applications	2.762	1.100	2.331	Statistics & Probability Letters	0.834	0.720	0.506
Journal of Number Theory	1.073	0.858	0.596	Simulation Modelling Practice and Theory	1.591	0.724	1.482
Journal of Parallel and Distributed Computing	1.727	0.851	1.320	Spatial Statistics	1.785	1.052	1.385
Journal of Pragmatics	1.387	1.153	1.118	Speech Communication	1.677	0.685	1.038
Stochastic Processes and their Applications	1.347	1.664	1.193	Theoretical Computer Science	1.345	0.720	0.643
Telematics and Informatics	1.665	0.737	2.261	Topology and its Applications	0.954	0.542	0.493

According these tables, we calculated the mean values of journal’s metrics for both aggregated subject areas (Table 3).

Table 3: The mean values of journal metrics for both aggregated subject areas. October 19, 2016.

Aggregated subject area	SNIP	SJR	IF
Journals within Economics, Finance Business, Management and Accounting (114)	1.643	1.685	1.781
Journals within Mathematics and Computer Science (150)	1.699	1.250	1.588

This Table illustrates that there is an inequality $IF > SJR > SNIP$ with a little scatter of their mean values for journals of first aggregated subject area. But there is another system of inequalities $SNIP > IF > SJR$ for journals of second aggregated subject area. For comparison, we present the same data on a wider journal's sample from the work (Colledge et al, 2010) (Table 4).

Table 4: Mean values of various journal metrics for both main subject areas. April 2010

Main subject fields	SNIP	SJR	RIP
Social Science (4,256)	0.84	0.045	0.74
Engineering Computer Science (2,175)	1.3	0.070	1.08

In the Table 4 there is RIP (Raw Impact per paper), which is very similar to the IF (Colledge et al, 2010). This Table shows that there are inequalities $SNIP > RIP > SJR$ in both cases. According to the Tables 3 and 4, the systems of inequalities are identical for similar aggregated subject areas, which include Computer Science.

Also, we can see that the mean values of journal metrics for similar aggregated subject areas have increased significantly with time (for 6 years).

Also, we can give an example of specific SNIP, SJR and IF values for the four mathematical journals in the work (Leydesdorff, Opthof, 2010) on 2007 (Table 5).

Table 5: Various journal metrics values for the four mathematical journals. 2007.

Journal	SNIP	SJR	IF
Invent Math	3.294	0.065	1.664
J Electron Mater	1.319	0.113	1.320
Math Res Lett	1.179	0.041	0.702

Ann Math	4.979	0.104	2.739
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Table 5 shows that values of journal metrics are included in comparative series SNIP>IF>SJR of Mathematical and Computer journal’s mean values (Table 3,4).

By comparison of SJR with IF in the work (Falagas et al, 2008), the authors have found out that of the 20 journals with the highest journal IFs, 13 retain a position in the top 20 journals with the use of the SJR indicator, and vice versa.t the same time, as it was mentioned in the introduction, we have not found the works in which the direct correlations between SNIP, SJR and IF have been obtained.

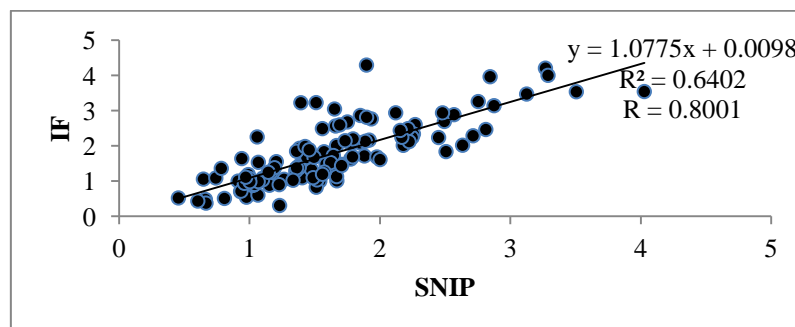
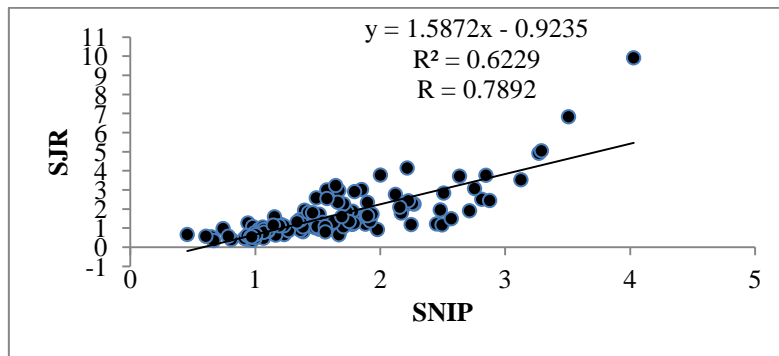
Table 6 shows a matrix of paired correlations of journal's metrics values for both aggregated subject areas, which have been obtained on the basis of the Tables 1 and 2.

Table 6: Matrix of paired correlations (R) of various journal's metrics values for both aggregated subject areas.

	Journals within Economics, Finance Business, Management and Accounting (114)			Journals within Mathematics and Computer Science (150)		
	SNIP	SJR	IF	SNIP	SJR	IF
SNIP	1			1		
SJR	0.7892	1		0.5069	1	
IF	0.8001	0.6794	1	0.5780	0.6749	1

As we can see, this table shows that Pearson's correlation coefficients for all journal metrics of Economics aggregated subject area are higher than similar correlation coefficients for Mathematics and Computer aggregated subject area.

The corresponding linear regression equations are illustrated in Figures 1 and 2.



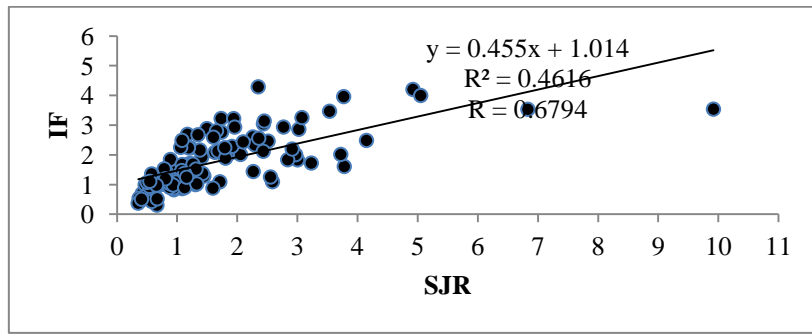


Figure 1. Linear regression equations between various journal metrics for the aggregated subject area «Journals within Economics, Finance Business, Management and Accounting»

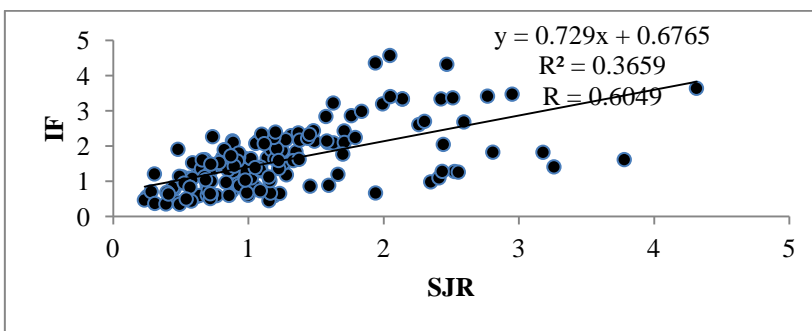
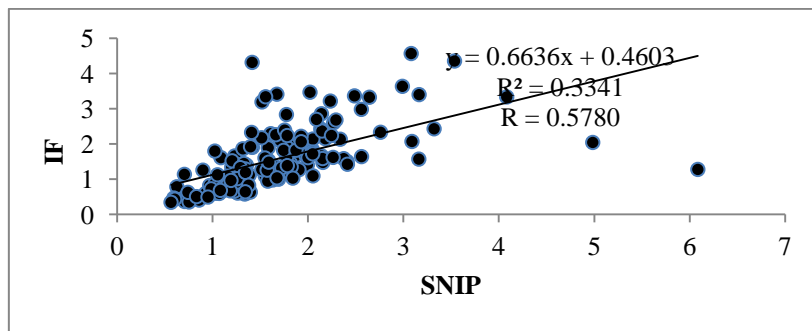
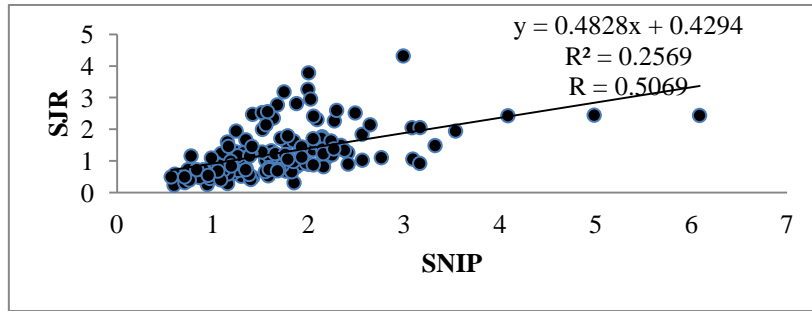


Figure 2. Linear regression equations between various journal metrics for the aggregated subject area «Journals within Mathematics and Computer Science»

Conclusion: In this piece of research work there is a matrix of paired correlations and linear regression equations between various types of journal metrics (SNIP, SJR, IF) in this work, which are based on two aggregated subject areas, which have been obtained by the Elsevier database (October 19, 2016). It is shown that Pearson's correlation coefficients for all journal metrics of Economics aggregated subject area were higher than similar correlation coefficients for Mathematics and Computer aggregated subject area. Additionally, the mean values of the above

mentioned journal metrics for aggregated subject areas under consideration were calculated, which were compared with the literature data. The main conclusion of this work suggests that there is an inequalities $IF > SJR > SNIP$ with a little scatter of mean values for journals of Economics aggregated subject area, and $SNIP > IF > SJR$ - for journals of Mathematics and Computer aggregated subject area.

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