Fifty years of the journal of optimization theory and applications: A bibliometric overview

Sigifredo Laengle[1*], Rajkumar Verma[1,2], José M. Merigó[1,3]

[1] Department of Management Control and Information Systems, University of Chile Av. Diagonal Paraguay 257, Santiago 8330015, Chile

[2] Department of Applied Sciences, Delhi Technical Campus, 28/1, Knowledge Park-III, Greater Noida-201306, Uttar Pradesh, India

[3] School of Information, Systems & Modelling, Faculty of Engineering and Information Technology, University of Technology Sydney, 81 Broadway, Ultimo 2007, NSW, Australia

Corresponding Author Email: slaengle@fen.uchile.cl

ABSTRACT

The Journal of Optimization Theory and Applications is a leading international journal in the field of mathematical optimization and its applications in science and engineering. In 2017, the journal becomes 50 years old. Motivated by this anniversary, this paper presents a bibliometric overview of the leading trends occurring in the journal during these years. The study uses the Scopus database and analyzes the leading authors, institutions, countries, papers, and keywords of the journal. In order to deepen into the results, the work also develops a graphical analysis of the bibliographic material by using the visualization of similarities (VOS) viewer software.

1. INTRODUCTION

Journal of Optimization Theory and Applications (JOTA) is a leading international journal in the field of mathematical optimization and its applications in science and engineering. Professor Angelo Miele, the Foyt Professor Emeritus of Mechanical Engineering and Materials Sciences, Rice University, USA, was the founding Editor-in-Chief of JOTA. Presently, Franco Giannessi from the University of Pisa, Italy, and David G. Hull from the University of Texas, Austin, are the Editors-in-Chief. The first volume of JOTA was published in 1967 which consisted of three issues published tri-annually and totaling 256 pages. In 1968, the journal increased to six issues and in 1969, to twelve issues divided into three volumes. In 1986, the journal started publishing four volumes per year and each volume contained three issues. Today, the journal is very well recognized in the scientific community. To deal with an increasing number of submissions on a variety of topics, the journal has a team of approximately 150 associate editors' form all over the world. JOTA is indexed in all the major databases including American Mathematical Society, Scopus, Science Citation Index and Journal Citation Reports (JCR) of the Web of Science, ACM Digital library, International Abstracts in Operations Research, Mathematical Reviews and Zentralblatt Math. Throughout its lifetime, JOTA has been published by Springer based in the USA.

Bibliometrics is the research field of library and information sciences that studies published scientific literature from a quantitative perspective [3, 9]. Over the years, bibliometrics has become very popular among researchers to study the research trends, citations analysis, the impact of publications, analysis of particular research topic [1-2], journal analysis [4, 6, 8] and countries contributions in a particular field [2].

In 2017, JOTA celebrates its 50th anniversary. This milestone motivates an interest in conducting a general bibliometric analysis of the major trends that have occurred in the journal during the last 50 years. By doing so, this work studies a wide range of bibliometric issues including publication and citation evolution of the journal, most cited papers in the journal, most-cited papers of JOTA, the most productive and influential authors, institutions and countries, and a keyword analysis. Additionally, the study also uses the visualization of similarities (VOS) viewer software [11] to develop the graphical visualization of the bibliometric material published in the journal. This mapping analysis is carried out with bibliographic coupling [5], co-occurrence and co-citation analysis [10].

2. RESULTS
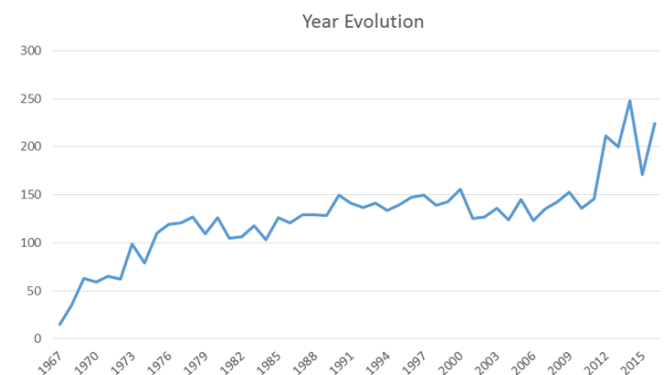
Figure 1. Annual number of papers published in JOTA

R	TC	Title	Author/s	Year	Citations per year
1	1688	Thermodynamical approach to the traveling salesman problem: An efficient simulation algorithm	Černý V.	1985	54,45
2	1090	Generalized Benders decomposition	Geoffrion A.M.	1972	24,77
3	927	Lipschitzian optimization without the Lipschitz constant	Jones D.R., Perttunen C.D., Stuckman B.E.	1993	40,30
4	888	Multiplier and gradient methods	Hestenes M.R.	1969	18,89
5	729	Shuffled complex evolution approach for effective and efficient global minimization	Duan Q.Y., Gupta V.K., Sorooshian S.	1993	31,70
6	626	Convergence of a block coordinate descent method for nondifferentiable minimization	Tseng P.	2001	41,73
7	608	A globally convergent method for nonlinear programming	Han S.P.	1977	15,59
8	480	Weak convergence theorems for nonexpansive mappings and monotone mappings	Takahashi W., Toyoda M.	2003	36,92
9	478	Active control of flexible systems	Balas M.J.	1978	12,58
10	448	An iterative approach to quadratic optimization	Xu H.K.	2003	34,46
11	440	Optimal infinite-horizon feedback laws for a general class of constrained discrete-time systems: Stability and moving-horizon approximations	Keerthi S.S., Gilbert E.G.	1988	15,71
12	432	Necessary and sufficient conditions for quadratic stabilizability of an uncertain system	Barmish B.R.	1985	13,94
13	420	Profit, directional distance functions, and Nerlovian efficiency	Chambers R.G., Chung Y., Färe R.	1998	23,33
14	374	Nonzero-sum differential games	Starr A.W., Ho Y.C.	1969	7,96
15	350	Cone convexity, cone extreme points, and nondominated solutions in decision problems with multiobjectives	Yu P.L.	1974	8,33
16	328	Unified approach to quadratically convergent algorithms for function minimization	Huang H.Y.	1970	7,13
17	318	On the Stackelberg strategy in nonzero-sum games	Simaan M., Cruz Jr. J.B.	1973	7,40
18	290	Application of interior-point methods to model predictive control	Rao C.V., Wright S.J., Rawlings J.B.	1998	16,11
19	269	Dc programming: Overview	Horst R., Thoai N.V.	1999	15,82
20	264	H∞-control for Markovian jumping linear systems with parametric uncertainty	Shi P., Boukas E.K.	1997	13,89
21	254	Weak convergence theorem by an extragradient method for nonexpansive mappings and monotone mappings	Nadezhkina N., Takahashi W.	2006	25,40
22	243	A comparison of two methods for determining the weights of belonging to fuzzy sets	Chu A.T.W., Kalaba R.E., Spingarn K.	1979	6,57
23	236	Weak and strong convergence theorems for a nonexpansive mapping and an equilibrium problem	Tada A., Takahashi W.	2007	26,22
24	226	Controlled and conditioned invariant subspaces in linear system theory	Basile G., Marro G.	1969	4,81
25	225	Convergence of hybrid steepest-descent methods for variational inequalities	Xu H.K., Kim T.H.	2003	17,31
26	222	An iterative row-action method for interval convex programming	Censor Y., Lent A.	1981	6,34
27	221	On the convergence of the coordinate descent method for convex differentiable minimization	Luo Z.Q., Tseng P.	1992	9,21
28	220	Control of the Burgers equation by a reduced-order approach using proper orthogonal decomposition	Kunisch K., Volkwein S.	1999	12,94
29	211	On the formulation and theory of the newton interior-point method for nonlinear programming	El-Bakry A.S., Tapia R.A., Tsuchiya T., Zhang Y.	1996	10,55
30	210	Complementarity problems over cones with monotone and pseudomonotone maps	Karamardian S.	1976	5,25

JOTA started publishing articles in 1967 and included 15 documents in the first volume. The journal is growing through time. Figure 1 presents the annual number of documents published in the journal. Note that the graph only includes articles, reviews, and notes.

During the first seven years, the number of articles increased significantly and reached 99. With a small fall in 1974, the journal started publishing more than one hundred papers in 1975 and this number reached 150 in 1990. With slightly up and down, the journal reached a top of 248 documents in 2014. The number of published documents was 224 in 2016.

Another interesting issue is to consider the most influential documents published in the journal. Table 1 presents a list of the thirty most cited papers of all-time appearing in the journal. Note that in the case of a tie in the number of total citations received by papers, the youngest paper appears first in the list.

The most cited paper was published by Černý in 1985 and has 1688 citations. It has also the highest number of cites per year. This paper proposed a thermodynamical approach based simulation algorithm to solve the travelling salesman problem. In Scopus database, it has the fourth position in all the papers published on the topic of travelling salesman problem till now. The second most cited paper is on the generalization of Benders decomposition written by Geoffrion. It has also received more than 1000 citations. The third and fourth most

cited papers were published in the year 1993 and 1969   respectively.

Table 2. Top 40 most cited documents in JOTA publications

Rank	Year	Reference	Type	TC	Co-citations
1	1970	Rockafellar RT, Convex Anal	B	375	299
2	1983	Clarke FH, Optimization Nonsmoo	B	255	220
3	1969	Mangasarian OL, Nonlinear Programmin	B	153	122
4	1970	Ortega JM, Iterative Solution N	B	111	96
5	1998	Rockafellar RT, Variational Anal	B	106	98
6	1976	Rockafellar RT, Siam J Control, V14, P877	A	97	84
7	1968	Fiacco A, Nonlinear Programmin	B	96	73
8	1990	Harker PT, Math Program, V48, P161	A	95	94
9	1990	Aubin JP, Set Valued Anal	B	94	80
10	1974	Yu PL, J Optimiz Theory App, V14, P319	A	94	86
11	1969	Luenberger DG, Optimization Vector	B	82	55
12	1965	Isaacs R, Differential Games	B	81	44
13	1968	Geoffrion AM, J Math Anal Appl, V22, P618	A	74	67
14	1980	Kinderlehrer D, Intro Variational In	B	74	67
15	1971	Polak E, Computational Method	B	72	60
16	1982	Bertsekas DP, Constrained Optimiza	B	71	67
17	1985	Sawaragi Y, Theory Multiobjectiv	B	71	71
18	1992	Cottle RW, Linear Complementari	B	67	52
19	1962	Pontryagin LS, Math Theory Optimal	B	65	44
20	1994	Blum E, Math Student, V63, P123	A	63	57
21	1980	Giannessi F, Variational Inequali, P151	A	63	61
22	1961	Fan K, Math Ann, V142, P305	A	59	57
23	1973	Luenberger DG, Intro Linear Nonline	B	59	46
24	1983	Dennis JE, Numerical Methods Un	B	58	45
25	1984	Aubin JP, Appl Nonlinear Anal	B	57	53
26	1983	Cesari L, Optimization Theory	B	57	39
27	1967	Lee EB, F Optimal Control Th	B	55	27
28	1975	Fleming W, Deterministic Stocha	B	54	23
29	1966	Hestenes MR, Calculus Variations	B	54	34
30	1975	Holmes RB, Geometric Functional	B	52	44

Table 3. Citing articles of JOTA (2007-2016): Authors, universities, countries, and journals

R	University	TP	Country	TP	Journal	TP
1	King Abdulaziz U	179	China	3.357	J Optim Theory Appl	645
2	CNRS	155	USA	1.476	J Global Optim	246
3	Sichuan U	144	Italy	634	Optimization	238
4	Shanghai Normal U	131	India	626	Fixed Point Theory Appl	219
5	Chongqing U	131	France	616	Abstract Applied Analysis	210
6	Kaohsiung Medical U	130	Iran	526	J Inequalities Appl	206
7	King Fahd U Pet Min	101	Germany	491	Appl Math Computation	195
8	Chongqing Normal U 4	101	Taiwan	489	Optimization Letters	164
9	Nat Sun Yat-Sen U	99	Australia	392	SIAM J Optimization	143
10	Hong Kong Polytech U	98	Viet Nam	354	Nonlinear Analysis	121
11	Dalian U Technology	86	Saudi Arabia	347	J Nonlinear Convex Anal	120
12	Chinese Acad Sciences	86	South Korea	334	Eur J Operational Res	112
13	Xidian U	85	Spain	308	J Appl Math	110
14	Gyeongsang National U	81	UK	278	Comput Optim Appl	102
15	Aligarh Muslim U	80	Romania	273	Taiwanese J Mathematics	91
16	U Polit Bucharest	79	Japan	257	J Comput Appl Math	85
17	Tianjin Polytechnic U	78	Canada	234	J Industrial Manag Optim	82
18	U Roma Sapienza	77	Russia	222	Math Problems Eng	82
19	Ministry Educ China	75	Thailand	219	Numeric Func Anal Optim	81
20	Technion	75	Hong Kong	201	J Math Analysis Appl	80
21	King Mongkuts U Tech	71	Brazil	193	Automatica	73
22	Georgia Inst Tech	70	Poland	158	Math Programming	73
23	MIT	69	Portugal	137	Optim Methods Software	73
24	Vietnam National U	67	Turkey	134	IEEE T Automatic Control	71
25	Federation U Australia	66	Israel	111	SIAM J Control Optim	71
26	Curtin U	66	Austria	110	Adv Difference Equations	62
27	Zhejiang U	64	Netherlands	108	Set Valued Variat Anal	57
28	Harbin Inst Tech	64	Belgium	88	Comput Math Appl	53
29	Chongqing Jiaotong U	63	Chile	88	IEEE T Signal Processing	49
30	Shanghai U	63	Pakistan	79	J Nonlinear Sci Appl	49

Abbreviations available in previous table.

A further important issue is to analyze the most cited documents by papers published in JOTA. In order to do so, the work uses the VOS viewer software and generates the results for the co-citation of documents to identifying those documents that are most cited in the journal. Table 2 presents the 30 most cited documents.

As we seen, the first five positions are occupied by the different books. In the ranking, the first book is written by R.T. Rockafellar on the topic Convex Analysis and the second one by F.H. Clarke on Optimization and Nonsmooth Analysis. It is interesting to note here first, fifth and sixth positions are filled by same author 'R.T. Rockafellar'.

Next, in order to identify the origin of the citations of JOTA, let us analyze the citing documents of the journal. Table 3 presents the Top 30 universities, countries, and journals that cite documents published in JOTA.

The King Abdulaziz University, Saudi Arabia, is the leading citing institution in the table and more than 40% of the institutions in Top 30 are from China. In terms of country, China obtains the first position over the USA. Additionally, Italy and India get the third and fourth position, respectively and France, Iran and Germany appear in Top 10. From the journal perspective, JOTA itself leads the table which is quite obvious because it is a very common phenomenon for most of the journals to cite itself. In the list, the majority of the journals are from Mathematics and Optimizations.

3. MAPPING JOTA WITH VOS VIEWER SOFTWARE

Figure 2. Co-citation of journals in JOTA

The previous section presents some general results on various leading variables in JOTA. However, it is interesting to develop a graphical analysis of bibliometric material from a general point of view in terms of bibliographic coupling, citation, co-citation, co-authorship, and co-occurrence of keywords. For doing so, the work uses the VOS viewer software [11]. First, let us look into co-citation of journals cited in JOTA. The co-citation occurs when two documents published in different journals receive a citation from a third document published in another journal. The graph visualizes the two journals that have received the citation and they have one co-citation link. Fig. 2 presents the results between 1987 to 2016 with a minimum threshold of one hundred citations and the one hundred most representative connections.

The Journal of Optimization Theory and Applications itself is the most cited journal, which is very common for most of the journals. Mathematical Programming, Journal of Mathematical Analysis and Applications and SIAM Journal on Control and Optimization are also highly cited. Note that

most of the journals are from optimization, mathematics and operation research.

Next, let us analyze the bibliographic coupling of institutions publishing in the journal. Fig. 3 presents the results with a threshold of ten documents and one hundred bibliographic coupling connections. Note that institutions have a strong connection with the authors because they represent the affiliation of the authors on the published document.

Currently, the institutions that publish more frequently in the journal are the University of California Berkeley, Hong Kong Polytechnic University, Chinese Academy of Sciences and Rice University. Most of the institutions from the list are from the USA and China. Moreover, note that institutions from the same country or region tend to connect more between each other.

Next, let us analyze the most common keywords used by authors in the journal to characterize their documents. In order to do so, the study develops a co-occurrence of author

keywords visualization. Fig. 4 presents the results considering a threshold of ten occurrences and the one hundred most frequent connections.

Optimal control, variational inequalities, nonlinear programming, duality, global optimization, optimality conditions, vector optimization, differential games, are the most common keywords in the journal.
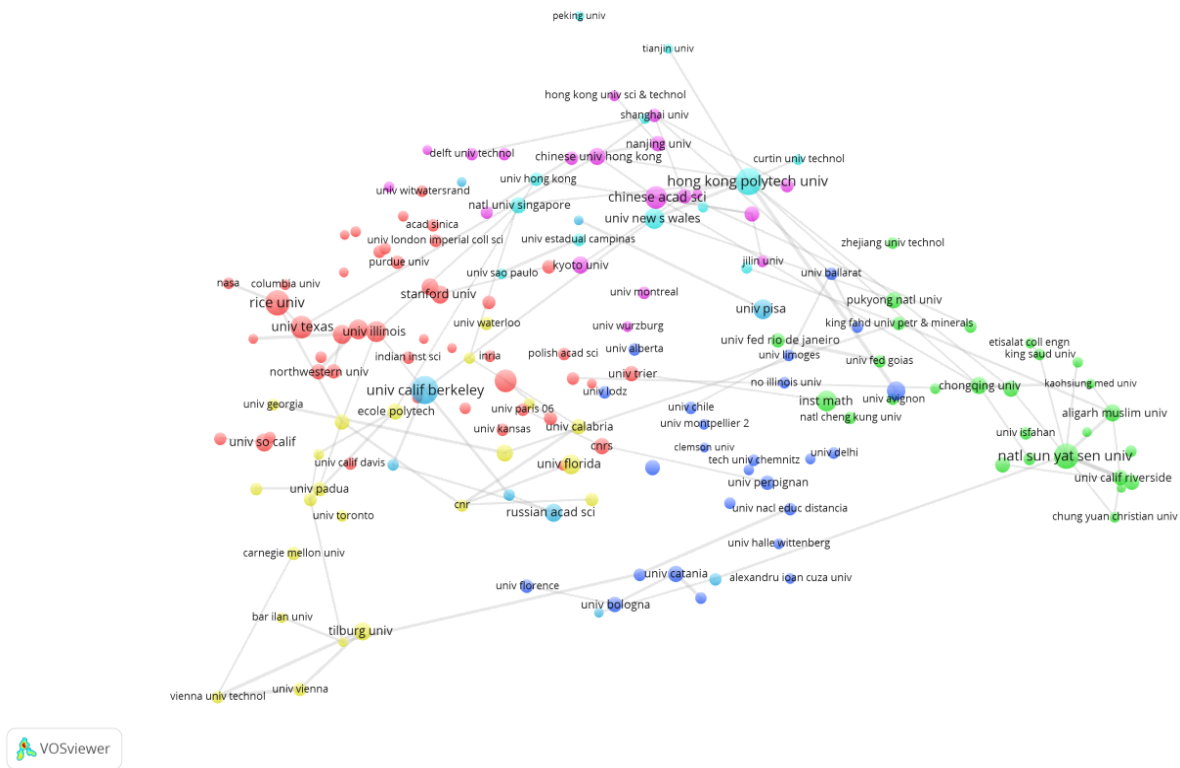

Figure 3. Bibliographic coupling of institutions publishing in JOTA
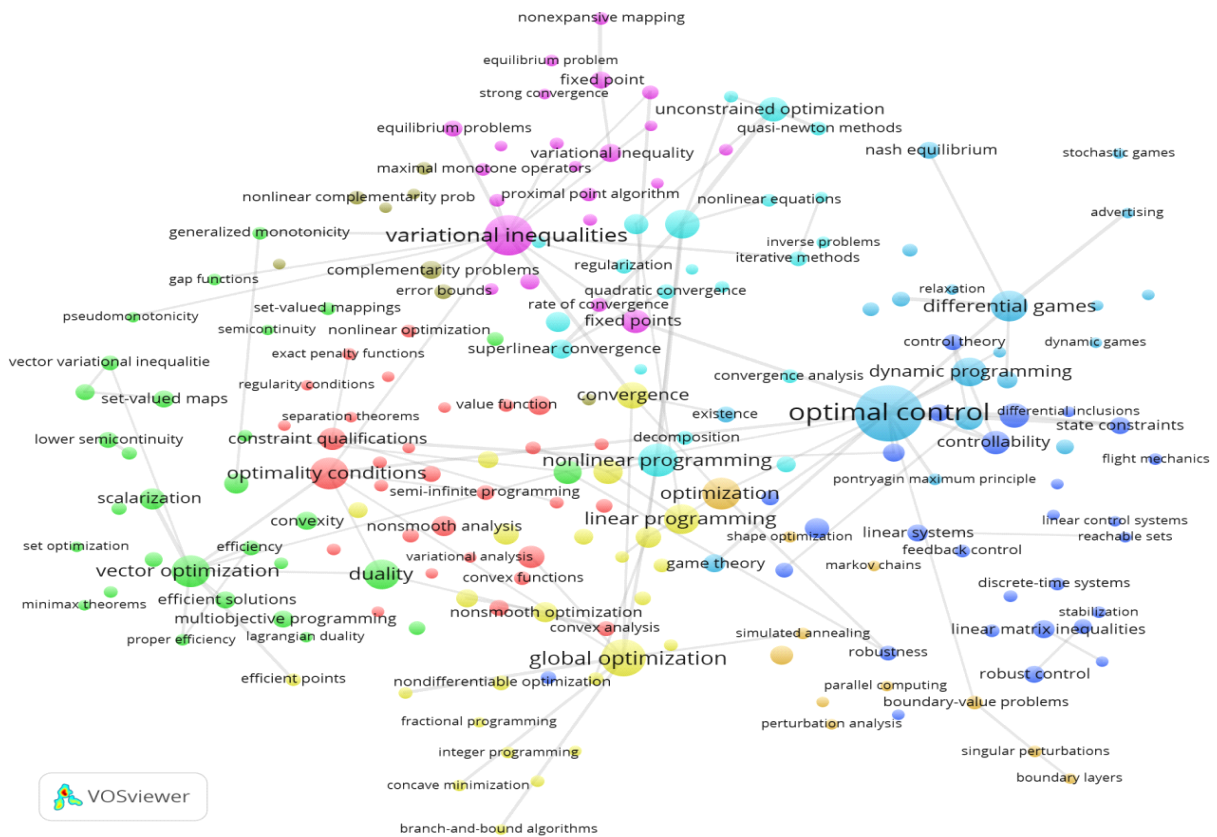

Figure 4. Co-occurrence of author keywords in JOTA

4. CONCLUSIONS

In 2017, JOTA has celebrated the 50th anniversary. Motivated by this event, this study presents a bibliometric analysis of the journal during this period to identify the leading trends and most significant results occurring in the journal. The study uses the Scopus database and analyses all the publications of JOTA between 1967 and December 2016. The results show the strong growth of JOTA through time and provide a general overview on various bibliometric indicators.

The work also develops a graphical analysis of the bibliometric material by using VOS viewer software. The study considers co-citation, bibliographic coupling and co-occurrence of author keywords. Most of the journals cited in JOTA are related to optimization, mathematics and operations research. The graphical results show that the leading topics of the journal are optimal control, global optimization, variational inequalities, nonlinear programming, optimality conditions and convex programming. The main advantage of the graphical analysis is the representation of the connections between different variables that indicates similar profile in the publications of JOTA.

REFERENCES

[1] Blanco-Mesa F, Merigó JM, Gil-Lafuente AM. (2017). Fuzzy decision making: A bibliometric-based review. Journal of Intelligent & Fuzzy Systems 32: 2033-2050. https://doi.org/10.1109/NAFIPS.2016.7851585

[2] Bonilla C, Merigó JM, Torres-Abad C. (2015). Economics in Latin America: A bibliometric analysis. Scientometrics 105(2): 1239-1252. https://doi.org/10.1007/s11192-015-1747-7

[3] Broadus RN. (1987). Toward a definition of bibliometrics. Scientometrics 12: 373-379. https://doi.org/10.1007/BF02016680

[4] Cancino C, Merigó JM, Coronado F, Dessouky Y, Dessouky M. (2017). Forty years of Computers & Industrial Engineering: A bibliometric analysis. Computers & Industrial Engineering 113: 614–629. https://doi.org/10.1016/j.cie.2017.08.033

[5] Kessler MM. (1963). Bibliographic coupling between scientific papers. American Documentation 14(1): 10-25. https://doi.org/10.1002/asi.5090140103

[6] Laengle S, Modak NM, Merigó JM, Zurita G. (2018). Twenty-five years of Group Decision and Negotiation: A bibliometric overview. Group Decision and Negotiation 27(4): 505-542. https://doi.org/10.1007/s10726-018-9582-x

[7] Merigó JM, Gil-Lafuente AM, Yager RR. (2015b). An overview of fuzzy research with bibliometrics indicators. Applied Soft Computing 27: 420-433. https://doi.org/10.1016/j.asoc.2014.10.035

[8] Mulet-Forteza C, Martorell-Cunill O, Merigó JM, Genovart-Balaguer J, Mauleon-Mendez E. (2018). Twenty five years of the Journal of Travel & Tourism Marketing: A bibliometric ranking. Journal of Travel & Tourism Marketing 35(9): 1201-1221. https://doi.org/10.1080/10548408.2018.1487368

[9] Pritchard A. (1969). Statistical bibliography or bibliometrics. Journal of Documentation 25(4): 348- 349.

[10] Small H. (1973). Co-citation in the scientific literature: A new measure of the relationship between two documents. Journal of the American Society for Information Science 24: 265–269. https://doi.org/10.1002/asi.4630240406

[11] Van Eck NJ, Waltman L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. Scientometrics 84(2): 523-538. https://doi.org/10.1007/s11192-009-0146-3