INTERNATIONAL JOURNAL OF REAL ESTATE AND LAND PLANNING

VOL.2 (2019)

eISSN 2623-4807

Available online at https://ejournals.lib.auth.gr/reland

An artificial intelligence algorithm analyzing 30 years of research in mass appraisals

Thomas Dimopoulos[1,2], Nikolaos Bakas[1]

[1]*Neapolis University Pafos, School of Architecture, Land & Environmental Sciences, 2 Danais Avenue, 8042 Paphos, Cyprus. {t.dimopoulos, n.bakas}@nup.ac.cy*

[2]*Cyprus University of Technology, School of Surveying Engineering and Geoinformatics, 30 Arch. Kyprianos Str., 3036 Limassol, Cyprus. thomas.dimopoulos@cut.ac.cy*

Abstract

The research papers issued in scientific journals, for a variety of thematic areas, are not only increasing, nonetheless exhibit an exponential growth over the last years. Accordingly, the researchers, struggle to retrieve information apropos of novel knowledge and get informed in their field, while the rigor and at the same time, the extensive composition of surveys, reviews, and overviews of research works, has become difficult or even impossible, as the number of the available research studies is enormous. However, such reviews, contain vital information regarding the evolution of a scientific subject, the trends of the literature, the most significant concepts, and the concealed associations among research papers, their references, as well as authors' clusters. In this work, a scientometric study of the relevant to Mass Appraisals literature is for a first time accomplished, regarding the numerical models, computational procedures, and automated methods, utilized in the Mass Appraisals and Property Valuations literature. The study is based on an adequate pool of papers, constituted in Scopus database, utilizing a machine learning algorithm developed from one of the authors, for multidimensional scaling and clustering of the keywords found in the papers' database, the authors and their cooperation and the co-occurrences of the references in the papers studied. The time-series of the most frequent keywords are also computed, demonstrating the evolution of the mass appraisals research and identifying future trends.

Keywords: Multidimensional Scaling; Bibliometric Mapping; Knowledge Management; Mass Appraisal; Property Valuation; Geographically Weighted Regression; Multiple Regression Analysis (MRA); Artificial Neural Networks;

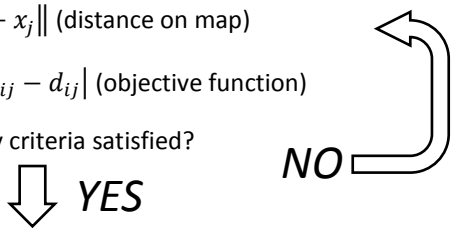
1. Introduction

This work aims to review the mass appraisals related literature, by revealing the major computational methods used, the inter-papers associations of the technical concepts, the most influential authors, the major journals as well as their associations and evolution over time. This task demands a vast and complicated work -as it will be clarified in the next paragraphs- since the research papers available in scientific journals has been exponentially increased during the last years. Bornmann and Mutz (2015) investigated the growth rates of the scientific publishing and found to be 1% up to the middle of the 18th century, to 2 to 3% up to the period between the two world wars, and 8 to 9% to 2010. Accordingly, the development of international scientific output, reach a doubling every nine years on average, as demonstrated by Van Noorden (2014). Hence, novel methods has been evolved in the field of

bibliometric analysis, called bibliometrics, scientometrics, scientific mapping etc., utilizing computer processes to analyze a massive amount of research papers. In this work, a relevant procedure developed by Plevris et. Al. (2017) has been used for the bibliometric mapping, as described in the following Table 1. The procedure is based in the contingency table which indicates he simultaneous appearances of pairs of keywords in a paper. This appearance indicates a thematic association of the two concepts, as expressed by the pair of keywords. By doing this for all the pairs of the keywords in the studied database, all the inter items associations are revealed. However, in order to accomplish a visual representation of these associations, the bibliometric map is constituted, where the distances of each two items correspond to their co-occurrence in the database. In particular, the lesser the distance (the closer the items on the map) the higher their simultaneous appearance in the database. Conclusively, the developed bibliometric map offers a generic image of the studied papers database, as well as their thematic relationship.

Table 1: Bibliometric Mapping Algorithm

1. $c_{ij} := contingency\ table$ (co-occurrence of objects)
2. s_{ij}:= similarity
3. $ds_{ij} := \frac{1}{s_{ij}}$ (dis-similarity)
4. $d_{ij} = \|x_i - x_j\|$ (distance on map)
5. $f_{ij} := |ds_{ij} - d_{ij}|$ (objective function)
6. Optimality criteria satisfied?



7. End => drawing of the bibliometric map

2. Constitution of the database

2.1 Papers obtained manually

There were approximately 50 papers and 23 authors that constituted the first database. Those papers and author names were also used to examine if the query and the algorithm were working.

2.1 Papers obtained by Scopus query

An initial search in Scopus [1] database was performed, utilizing the two basic keywords *Mass Appraisal* and *Property Valuation* with OR condition and at the same time the more specific, targeting secondary keywords (MSK): *CAMA, Neural Networks, Geographically Weighted Regression, Regression Analysis, Automated Valuation, Spatial Analysis, Computer Aided, Computer Assisted and Machine Learning*. The secondary keywords were identified manually in a literature examination by the authors and they were separated with OR condition as well.

Figure 1: Basic search and initial database

The resulting papers in Scopus were 123 relative documents that were manually checked by the authors and approved as relevant, but the number of the documents was not satisfactory enough for a proper bibliometric analysis. Accordingly, in order to expand the database, further research accomplished based on the main authors. Because in Scopus and in any scientific database, some authors appear with small differences in their names, this further investigation was crucial for the construction of a larger and more complete database. These searches were executed in the title, abstract and keywords in the Scopus fields (*TITLE-ABS-KEY*).

Hence, the second step was to use the keywords *CAMA, Geographically Weighted Regression, Automated Valuation, Spatial Analysis, Mass Appraisal, and Property Valuation,* together with each one of the authors' names. We excluded the generic keywords such as *neural networks* and *regression* because Scopus yielded irrelevant results from other thematic areas. Specifically, the authors' names were not used with their first name, but only the last name, which together with the keywords, should give correct results. The authors with the most document were: Lasota, Trawiński, Telec, Kauko, D'Amato, Davis (which results with this procedure were irrelevant and thus excluded), Haran (which results were selected manually), Dimopoulos (manually), Kempa (manually), McCluskey (with a lot of results which all were included), Borst (all relevant).

Consequently, a second search was performed in Scopus, utilizing the keyword *Real Estate* into the first part of the query, together with *Mass Appraisal* and *Property Valuation*, with OR statement among them. This way, Scopus yielded 935 research documents, with top ten keywords the *Regression Analysis, Real Estate, Spatial Analysis, Neural Networks, Housing, Costs, Investments, Commerce, Housing Market* and *Forecasting,* which seemed to be relevant to the studied field. However, a more careful investigation of the titles and abstracts of the most cited papers of the resulting database, exhibited an approximate 30% of irrelevant papers and another 10% in the general thematic area of Real Estate, however dealing with Economics, Commercial etc, which are not directly relevant to the mass appraisals literature. A variety of transformations of the query was scrutinized, in order to accomplish a formulation of the query with consistent papers. Accordingly, when the word *Hous** (with * indicating any other character, such as *ing, e,* etc) was incorporated into the *OR Real Estate* part of the query, then the resulting (402) documents were relevant to the studied topic. Finally, the keyword Female was also excluded from the database, as, obviously, was referring to medical or social sciences papers. The structure of the query is demonstrated in Fig. 2.

Mass Appraisal **OR** *Property Valuation* **OR** *(Real Estate* ***AND*** *Hous*)*

AND

CAMA, Neural Networks, Geographically Weighted Regression, Regression Analysis, Automated Valuation, Spatial Analysis, Computer Aided, Computer Assisted and Machine Learning

Figure 2: Refined search in Scopus database

Hence, the above-mentioned procedure produced a database with 486 research papers. The papers are relevant to the studied topic and at the same time adequate in terms of size, in order to produce generative conclusions. In Fig. 4, the frequencies of the top twenty keywords, occurred in the Scopus database are demonstrated. The most frequent, were the keywords *property valuation, real estate,* and *mass appraisal,* indicating the consistency of the database and the accurate selection of the papers. Accordingly, the top twenty keywords can be classified into two categories, the methodological ones (property valuation, real estate, mass appraisal, housing etc.) and some technical / data analysis keywords, such as *gis, spatial analysis, geographically weighted regression, bagging, artificial neural networks*, as classified in Fig. 3

property valuation, real estate, mass appraisal, housing, housing prices, real estate market, real estate appraisal, housing market, valuation

gis, spatial analysis, geographically weighted regression, bagging, artificial neural networks, neural networks, genetic fuzzy systems, data stream, trend functions, regression analysis, machine learning

Figure 3: Methodological and technical keywords

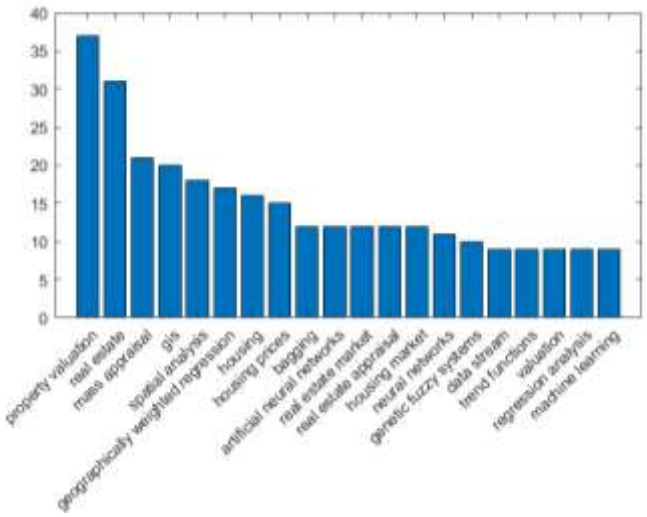


Figure 4: Frequencies of top twenty keywords in the Scopus database

3. Bibliometric results

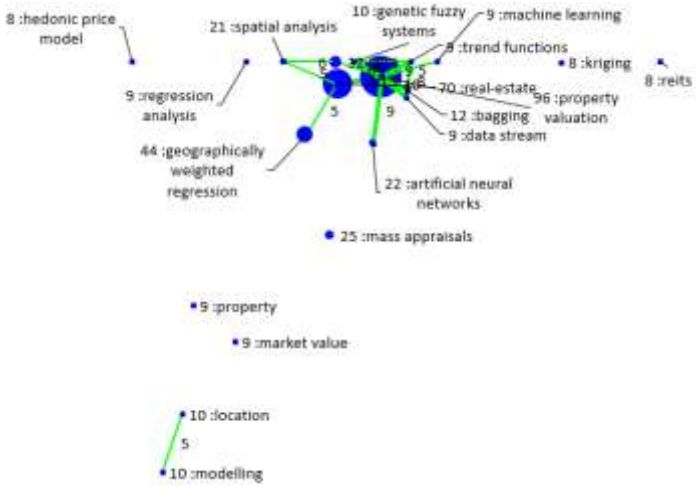


Figure 5: Bibliometric map of the top twenty keywords

In Figure 5, the twenty most frequent keywords are depicted. The distances on the keywords map represent their co-occurrences, that is to say the times they exist at the same time in a research paper. The size of the circle (representing a keyword) is proportional to the times this keyword exists in a research paper. From Fig. 5, it is derived that the most frequent keyword is "property valuation", with 96 occurrences (in the top right side of the map), followed by the keyword "real estate", with 70 occurrences. Accordingly, the closest (hence the more related keywords) are the "spatial analysis", "geographically weighted regression", "machine learning", "artificial neural networks", "trend functions", concerning mainly data analysis methods, numerical modelling, spatial analysis and predictions. The exact numbers of the keywords occurrences and co-occurrences are demonstrated in the following Table 2.

Table 2: Co-Occurrences of keywords

Contingency Table	property valuation	real-estate	geographically weighted regression	gis	mass appraisals	artificial neural networks	spatial analysis	bagging	location	modelling	genetic fuzzy systems	market value	property	machine learning	regression analysis	data stream	trend functions	reits	kriging	hedonic price model
property valuation	96	10	3	6	2	9	3	10	0	0	9	1	1	5	2	9	9	1	0	0
real-estate	10	70	5	2	1	1	5	0	0	1	0	0	2	0	3	0	0	1	0	2
geographically weighted regression	3	5	44	2	3	2	3	0	1	0	0	0	0	0	0	0	0	0	2	0
gis	6	2	2	32	1	0	6	0	1	1	0	0	1	0	0	0	0	0	0	1
mass appraisals	2	1	3	1	25	3	1	0	3	0	0	1	0	1	0	0	0	1	1	1
artificial neural networks	9	1	2	0	3	22	0	0	0	0	0	2	0	0	0	3	3	0	0	1
spatial analysis	3	5	3	6	1	0	21	0	0	0	0	0	0	0	0	0	0	0	1	0
bagging	10	0	0	0	0	0	0	12	0	0	4	0	0	0	0	0	0	0	0	0
location	0	0	1	1	3	0	0	0	10	5	0	0	2	0	0	0	0	0	0	0
modelling	0	1	0	1	0	0	0	0	5	10	0	2	2	0	0	0	0	0	0	0
genetic fuzzy systems	9	0	0	0	0	0	0	4	0	0	10	0	0	0	0	5	5	0	0	0
market value	1	0	0	0	1	2	0	0	0	2	0	9	0	0	0	0	0	0	0	1
property	1	2	0	1	0	0	0	0	2	2	0	0	9	0	0	0	0	0	0	0
machine learning	5	0	0	0	1	0	0	0	0	0	0	0	0	9	0	0	1	0	0	0
regression analysis	2	3	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0
data stream	9	0	0	0	0	3	0	0	0	0	5	0	0	0	0	9	8	0	0	0
trend functions	9	0	0	0	0	3	0	0	0	0	5	0	0	1	0	8	9	0	0	0
reits	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
kriging	0	0	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	8	0
hedonic price model	0	2	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	8

Accordingly, the timeseries of the keywords are demonstrated in the following Figure 6. In the vertical axis, the frequencies of the keywords per year are demonstrated, in the horizontal axis the years studied and in the legend the keywords with various colors. A high increase for the keywords “property valuation”, as well as “real estate” is exhibited after the year 2010. The final years (2015, 2016 and 2017) a strong decrease is appeared, however it cannot be considered as reliable, as the relevant articles might not included in Scopus yet.

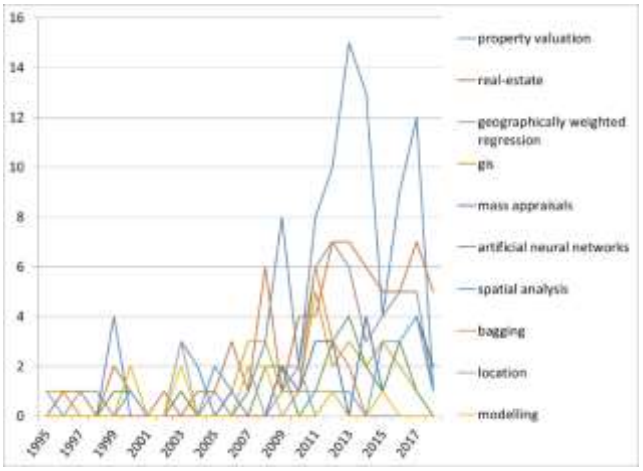


Figure 6: Keywords Occurrences Time-series

In Figure 7, the Bibliometric map of the twenty highest publishing authors is demonstrated. Each author is represented with a circle, while the radius of the circle is proportional to the articles published. The exact number of the published articles for each author is written with a numeric value before the name of the author. Some of the circles are linked with a green line, indicating that these authors have been cooperating in scientific papers. The number of common papers, is written with a number in the middle of the line. The closer two circles are, that means that these authors have written more common papers.

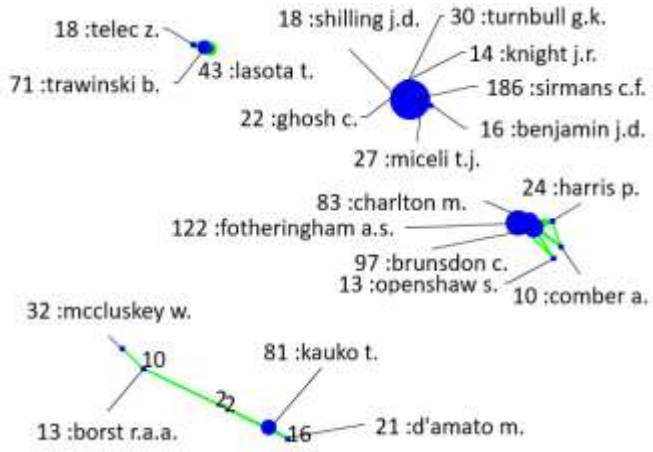


Figure 7: Bibliometric map of the top twenty authors in the Scopus database

Accordingly, in Fig. 7, four clusters are constructed, one with authors McCluskey, Borst, Kauko and D’ Amato, One with Fotherigham, Brunsdon, Charlton et. al., one with Trawinski, Lasota and Telec, and finally one with Sirmans,

Turnbull, Ghosh et. al. The exact number of each author's papers as well as the co-authorship papers, are demonstrated in the following Table 2.

Table 3: Co-Authorship Matrix

Co-Occurances	sirmans c.f.	fotheringham a.s.	brunsdon c.	charlton m.	kauko t.	trawinski b.	lasota t.	mccluskey w.	turnbull g.k.	miceli t.j.	harris p.	ghosh c.	d'amato m.	shilling j.d.	telec z.	benjamin j.d.	knight j.r.	borst r.a.a.	openshaw s.	comber a.
sirmans c.f.	186	0	0	0	0	0	0	0	30	27	0	22	0	18	0	16	14	0	0	0
fotheringham a.s.	0	122	19	28	0	0	0	0	0	0	9	0	0	0	0	0	0	0	2	0
brunsdon c.	0	19	97	33	0	0	0	0	0	0	17	0	0	0	0	0	0	0	2	10
charlton m.	0	28	33	83	0	0	0	0	0	0	18	0	0	0	0	0	0	0	9	1
kauko t.	0	0	0	0	31	0	0	0	0	0	0	0	16	0	0	0	0	2	0	0
trawinski b.	0	0	0	0	0	121	68	0	0	0	0	0	0	0	28	0	0	0	0	0
lasota t.	0	0	0	0	0	68	43	0	0	0	0	0	0	0	18	0	0	0	0	0
mccluskey w.	0	0	0	0	0	0	0	32	0	0	0	0	0	0	0	0	0	10	0	0
turnbull g.k.	30	0	0	0	0	0	0	0	30	7	0	0	0	2	0	4	1	0	0	0
miceli t.j.	27	0	0	0	0	0	0	0	7	27	0	0	0	0	0	0	0	0	0	0
harris p.	0	9	17	18	0	0	0	0	0	0	24	0	0	0	0	0	0	0	0	1
ghosh c.	22	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0
d'amato m.	0	0	0	0	16	0	0	0	0	0	0	0	21	0	0	0	0	2	0	0
shilling j.d.	18	0	0	0	0	0	0	0	2	0	0	0	0	18	0	6	0	0	0	0
telec z.	0	0	0	0	0	28	18	0	0	0	0	0	0	0	18	0	0	0	0	0
benjamin j.d.	16	0	0	0	0	0	0	0	4	0	0	0	0	6	0	16	0	0	0	0
knight j.r.	14	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	14	0	0	0
borst r.a.a.	0	0	0	0	2	0	0	10	0	0	0	0	2	0	0	0	0	13	0	0
openshaw s.	0	2	2	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0
comber a.	0	0	10	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	10

Finally, in Figure 8, the timeseries of the papers published by the highest publishing authors is demonstrated. Two peaks were found, Sirmans with twenty papers in 2010 and Trawinski with 18 in 2012 (?? To search)

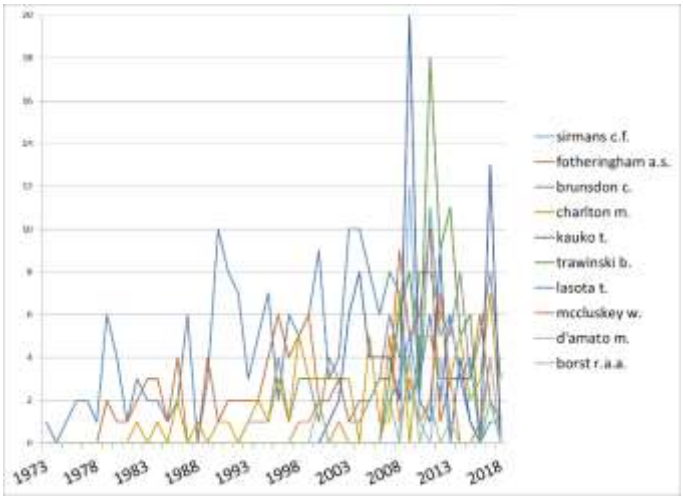


Figure 8: Authors Time-series

4. Conclusions

Significant effort was spent on the identification of a relevant to Property Valuations database, as a lot of Authors' names existed with a variety of formats, i.e. Charlton M.E. & Charlton M., Stewart Fotheringham A. & Fotheringham A.S. The same stands for the keywords, hence, the database cleaning was an important part of this work. The technical keywords, regard mainly two categories of research topics: The numerical methods (Regression Analysis, Neural Networks, etc.) and the geographical information (GIS, Spatial Analysis, Geographically Weighted Regression, etc). The keyword “property valuation”, although the most frequent, exhibits a degradation trend, especially in the normalized timeseries. Machine Learning revealed a variety of information in the literature, such as research collaboration groups, keywords association and evolution of the thematic areas through time.

References

Anderson, N.B. 2011, "No relief: Tax prices and property tax burdens", *Regional Science and Urban Economics,* vol. 41, no. 6, pp. 537-549.

Antipov, E.A. & Pokryshevskaya, E.B. 2012, "Mass appraisal of residential apartments: An application of Random forest for valuation and a CART-based approach for model diagnostics", *Expert Systems with Applications,* vol. 39, no. 2, pp. 1772-1778.

Benjamin, J.D., Guttery, R.S. & Sirmans, C.F. 2004, "Mass appraisal: An introduction to multiple regression analysis for real estate valuation", *Journal of Real Estate Practice and Education,* vol. 7, no. 1, pp. 65-77.

Bornmann, L. and Mutz, R., 2015. Growth rates of modern science: A bibliometric analysis based on the number of publications and cited references. *Journal of the Association for Information Science and Technology*, 66(11), pp.2215-2222.

García, N., Gámez, M. & Alfaro, E. 2008, "ANN+GIS: An automated system for property valuation", *Neurocomputing,* vol. 71, no. 4-6, pp. 733-742.

Geltner, D., MacGregor, B.D. & Schwann, G.M. 2003, "Appraisal smoothing and price discovery in real estate markets", *Urban Studies,* vol. 40, no. 5-6, pp. 1047-1064.

Greiner, M. & Thomas, M. 2012, "Mass appraisal of residential real estate portfolios with stratified sampling: A case study", *Journal of Real Estate Portfolio Management,* vol. 18, no. 3, pp. 305-321.

Gstach, D. 2009, "A property taxation mechanism with self-assessment", *Metroeconomica,* vol. 60, no. 3, pp. 400-408.

Hu, S., Cheng, Q., Wang, L. & Xie, S. 2012, "Multifractal characterization of urban residential land price in space and time", *Applied Geography,* vol. 34, pp. 161-170.

Hui, E.C.M., Chau, C.K., Pun, L. & Law, M.Y. 2007, "Measuring the neighboring and environmental effects on residential property value: Using spatial weighting matrix", *Building and Environment,* vol. 42, no. 6, pp. 2333-2343.

Ioannides, Y.M. 2002, "Residential neighborhood effects", *Regional Science and Urban Economics,* vol. 32, no. 2, pp. 145-165.

Jou, J.-. & Lee, T. 2008, "Neutral property taxation under uncertainty", *Journal of Real Estate Finance and Economics,* vol. 37, no. 3, pp. 211-231.

Kong, F., Yin, H. & Nakagoshi, N. 2007, "Using GIS and landscape metrics in the hedonic price modeling of the amenity value of urban green space: A case study in Jinan City, China", *Landscape and Urban Planning,* vol. 79, no. 3-4, pp. 240-252.

Kuburić, M., Tomić, H. & Mastelić Ivić, S. 2012, "Use of multicriteria valuation of spatial units in a system of mass real estate valuation", *Kartografija i Geoinformacije,* vol. 11, no. 17, pp. 58-74.

Lewis, D.J. & Plantinga, A.J. 2007, "Policies for habitat fragmentation: Combining econometrics with GIS-based landscape simulations", *Land Economics,* vol. 83, no. 2, pp. 109-127.

Liu, X.-., Deng, Z. & Wang, T.-. 2011, "Real estate appraisal system based on GIS and BP neural network", *Transactions of Nonferrous Metals Society of China (English Edition),* vol. 21, no. SUPPL. 3, pp. s626-s630.

Lughofer, E., Trawiński, B., Trawiński, K., Kempa, O. & Lasota, T. 2011, "On employing fuzzy modeling algorithms for the valuation of residential premises", *Information Sciences,* vol. 181, no. 23, pp. 5123-5142.

Noorden, V.R., 2014. Global scientific output doubles every nine years. *Nature News Blog*. (Accessed: 1st May 2018).

Plevris, V., Bakas, N., Markeset, G. and Bellos, J., 2017. Literature review of masonry structures under earthquake excitation utilizing machine learning algorithms. *COMPDYN 2017*

Schulz, R., Wersing, M. & Werwatz, A. 2014, "Automated valuation modelling: a specification exercise", *Journal of Property Research,* vol. 31, no. 2, pp. 131-153.

Scopus*, https://www.scopus.com/ (Accessed: 1st May 2018).*

Sipan, I., Ali, H.M., Ismail, S. & Abdullah, S. 2015, "GIS-based mass appraisal model for equity and uniformity of rating assessment", *Proceedings of the 26th International Business Information Management Association Conference - Innovation Management and Sustainable Economic Competitive Advantage: From Regional Development to Global Growth, IBIMA 2015*, pp. 3376.

Wheeler, D. and Tiefelsdorf, M., 2005. Multicollinearity and correlation among local regression coefficients in geographically weighted regression. *Journal of Geographical Systems*, 7(2), pp.161-187.

Appendix A.

Scopus Objects	**New Objects**
geographically weighted regression	geographically weighted regression
real estate	real estate
property valuation	property valuation
gis	gis
spatial analysis	spatial analysis
mass appraisal	mass appraisal
housing	real estate
gwr	geographically weighted regression
housing prices	property valuation
portfolio diversification	portfolio diversification
housing market	real estate
real estate appraisal	property valuation
real estate market	real estate
artificial neural networks	artificial neural networks
bagging	bagging
valuation	property valuation
neural networks	artificial neural networks
kriging	kriging
risk-adjusted returns	risk-adjusted returns
reits	reits

house prices	property valuation
gwr	geographically weighted regression
neural networks	artificial neural networks
real estate appraisal	property valuation
housing market	real-estate
housing prices	property valuation
housing	real-estate
mass appraisal	mass appraisals
real estate market	real-estate
house price	property valuation
valuation	property valuation
real estate	real-estate

The following record was deleted as irrelevant

Brunsdon C., McClatchey J., Unwin D.J. Influence of Synoptic Situations on the Precipitation in Kraków (Poland) 2001 International Journal of Climatology

mccluskey w.j.	mccluskey w.
mccluskey j.j.	mccluskey w.
mcclatchey j.	mccluskey w.
mccluskey d.	mccluskey w.
connell mccluskey c.	mccluskey w.
mccluskey w.i.	mccluskey w.
trawi ń ski b.	trawinski b.
trawiński b.	trawinski b.
trawiński b.	trawinski b.
trawiński k.	trawinski b.
trawiński g.	trawinski b.
trawinski p.r.	trawinski b.
trawinski g.	trawinski b.
trawiński g.	trawinski b.
charlton m.e.	charlton m.
borst d.	borst r.a.
borst r.	borst r.a.
fotheringham s.	fotheringham a.s.
stewart fotheringham a.	fotheringham a.s.

Authors co-occurrences Table

Contingency Table	sirmans c.f.	brunsdon c.	fotheringham a.s.	kauko t.	charlton m.	lasota t.	trawinski b.	turnbull g.k.	miceli t.j.	mccluskey w.	harris p.	ghosh c.	d'amato m.	charlton m.e.	shilling j.d.
sirmans c.f.	186	0	0	0	0	0	0	30	27	0	0	22	0	0	18
brunsdon c.	0	98	14	0	29	0	0	0	0	0	17	0	0	4	0
fotheringham a.s.	0	14	95	0	18	0	0	0	0	0	8	0	0	5	0
kauko t.	0	0	0	81	0	0	0	0	0	0	0	0	16	0	0
charlton m.	0	29	18	0	64	0	0	0	0	0	18	0	0	0	0
lasota t.	0	0	0	0	0	43	2	0	0	0	0	0	0	0	0
trawinski b.	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0
turnbull g.k.	30	0	0	0	0	0	0	30	7	0	0	0	0	0	2
miceli t.j.	27	0	0	0	0	0	0	7	27	0	0	0	0	0	0
mccluskey w.	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0
harris p.	0	17	8	0	18	0	0	0	0	0	24	0	0	0	0
ghosh c.	22	0	0	0	0	0	0	0	0	0	0	22	0	0	0
d'amato m.	0	0	0	16	0	0	0	0	0	0	0	0	21	0	0
charlton m.e.	0	4	5	0	0	0	0	0	0	0	0	0	0	19	0
shilling j.d.	18	0	0	0	0	0	0	2	0	0	0	0	0	0	18

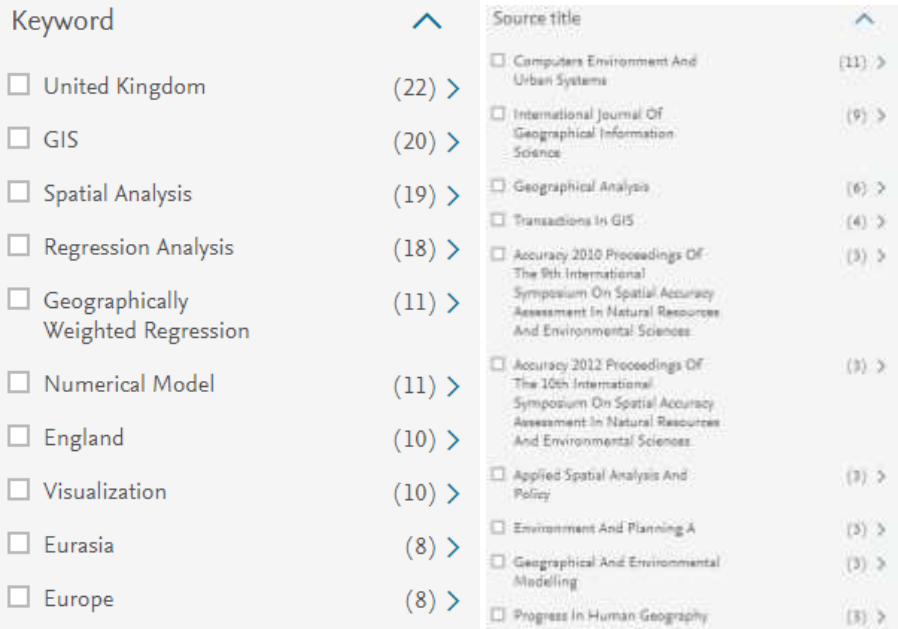
Appendix II: Selected Authors & Scopus Items

Brunsdon

In Scopus exists as Brunsdon, C. with 104 documents

https://www.scopus.com/authid/detail.uri?origin=resultslist&authorId=6701626868&zone=

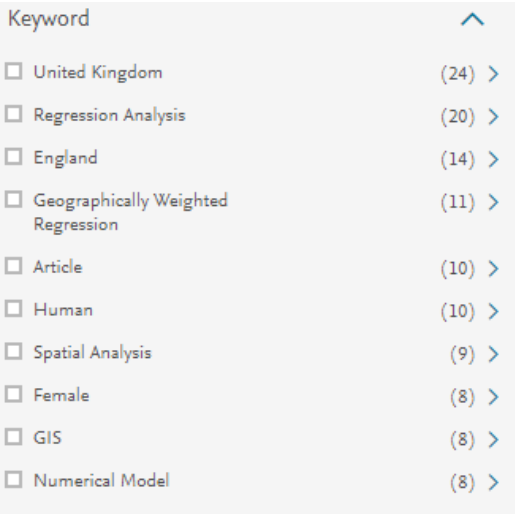
AU-ID ("Brunsdon, Chris F." 6701626868)



Charlton

AU-ID ("Charlton, Martin" 7102039728) , 78 documents

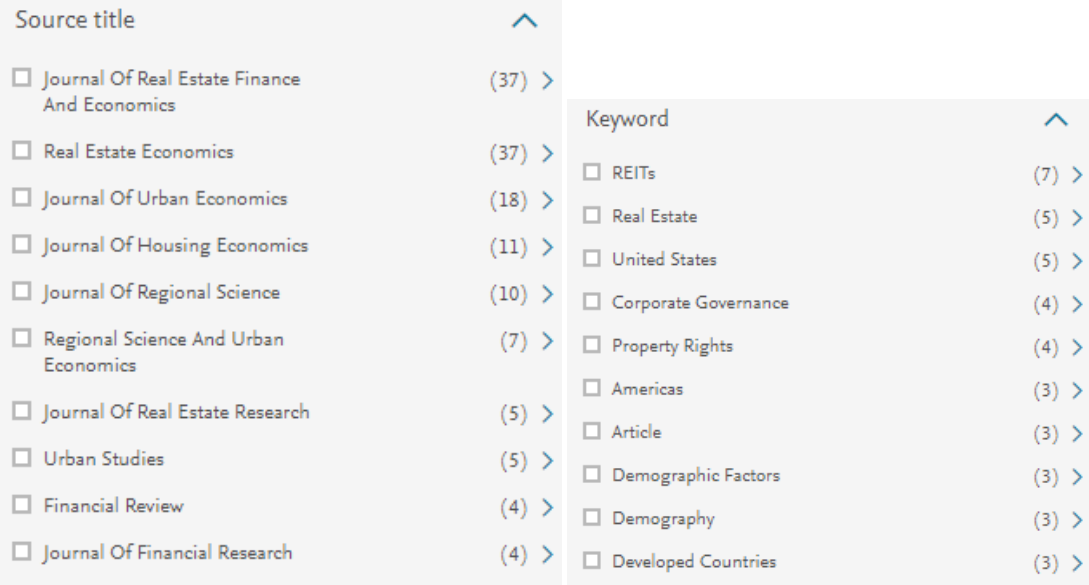
https://www.scopus.com/authid/detail.uri?origin=resultslist&authorId=7102039728&zone=



Sirmans

AU-ID ("Sirmans, C. F." 7004354026) , 185 results

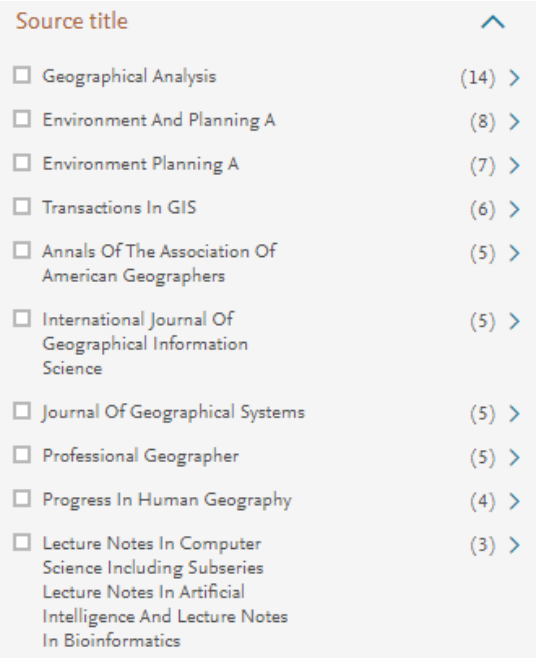
https://www.scopus.com/authid/detail.uri?origin=resultslist&authorId=7004354026&zone=

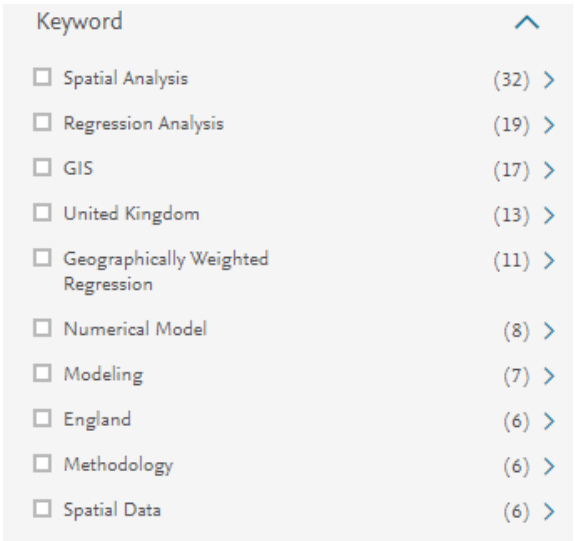


Fotheringham, A.S.

AU-ID ("Fotheringham, A. Stewart" 7005669439) , 121 results

https://www.scopus.com/authid/detail.uri?origin=resultslist&authorId=7005669439&zone=

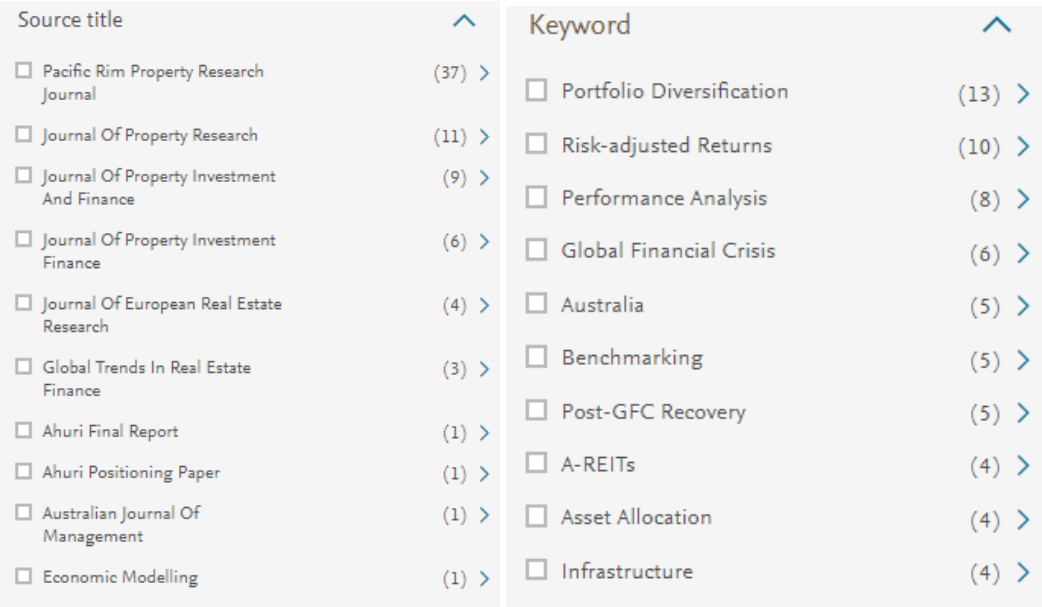




Newell, Graeme

AU-ID ("Newell, Graeme" 55952214900) , 81 documents

https://www.scopus.com/authid/detail.uri?origin=resultslist&authorId=55952214900&zone=



Kauko

AU-ID ("Kauko, Tom" 6602722279)

https://www.scopus.com/authid/detail.uri?origin=resultslist&authorId=6602722279&zone=

Borst

AU-ID ("Borst, Richard A." 18633590000)

https://www.scopus.com/authid/detail.uri?origin=resultslist&authorId=18633590000&zone=