sciendo

Editorial for the special issue:
"Novel Solutions or Novel Approaches in Operational Research"

co-published with the Slovenian Society INFORMATIKA – Section for Operational Research (SSI-SOR)

Samo Drobne
University of Ljubljana, Faculty of Civic and Geodetic Engineering, Ljubljana, Slovenia

Ksenija Dumičić
University of Zagreb, Faculty of Economics and Business, Zagreb, Croatia

Lidija Zadnik Stirn
University of Ljubljana, Biotechnical Faculty, Ljubljana, Slovenia

Abstract

This special issue of Business Systems Research (SI of BSR) is co-published by the Slovenian Society INFORMATIKA – Section for Operational Research (SSI-SOR) and highlights recent advances in operations research and management science (OR/MS), with a focus on linking OR/MS with other areas of quantitative and qualitative methods in a multidisciplinary framework. Nine papers that have been selected for this SI of BSR present improvements and new techniques (methodology) in operations research (OR) and their use in various fields of business, economics, spatial science and location.

Keywords: interdisciplinary research, operations research, risk and uncertainty, autoregressive models, machine learning, clustering comparison measure, multi-criteria decision making, big data, location-allocation, fuzzy logic, hidden economy

Editorial process

The term operations research (OR), or, often, management science (MS), means scientific approach to decision making, which seeks to determine how best to design or operate a system, usually under conditions requiring the allocation of resources in business word (Winston, 2003). OR is a decision support discipline and as such is concerned with developing systems aimed at helping decision makers solve problems and make decisions. Within decision support topics OR provides data analysis, simulation, modelling techniques and software tools (Mladenić et al., 2003; Rubio et al., 2014).

Applications of OR in real word problems are very numerous and in a very different fields such as in business engineering, management, economics, manufacturing, government, health care, transport, geographic information systems, scheduling, marketing, inventory, environment, and others (Cochran et al., 2011). The applications

of OR permit to structure complex problems in a realistic context in a transparent and flexible way, with introduction of both quantitative (for example, financial ratios) and in quantitative criteria in the evaluation process (Figueira et al., 2005).

OR has made an important impact on improving the efficiency of organizations and has made a contribution to increasing the productivity and social welfare. The International Federation of Operational Research Societies (IFORS) and the Association of European Operational Research Societies (EURO) are umbrella organizations for OR societies worldwide representing more than 50 national societies including also Slovenian Society INFORMATIKA - Section for Operational Research (SSI-SOR). The most important events organized by SSI-SOR are the international symposia. The 14th International Symposium on Operations Research, called SOR'17, was held in Bled, Slovenia, in September 27 - 29, 2017. SOR'17 was the scientific event in the area of operations research, another one in the traditional series of the biannual international OR conferences, organized in Slovenia by SSI-SOR. The main objective of SOR'17 was to advance knowledge, interest and education in OR in Slovenia, in Europe and worldwide in order to build the intellectual and social capital that are essential in maintaining the identity of OR, especially at a time when interdisciplinary collaboration is proclaimed as significantly important in resolving problems facing the current challenging times. Further, the SSI-SOR agreed to work together with diverse disciplines, i.e. to balance the depth of theoretical knowledge in OR and the understanding of theory, methods and problems in other areas within and beyond OR. Approximately 200 participants, coming from research institutes, universities, governmental institutions, private and public companies all over the world, attended SOR'17. Ninety-seven papers were presented, written by 184 authors and co-authors. The papers were accepted after a blindly review process of two independent reviewers selected from the SOR'17 Program Committee and reviewers appointed by SSI-SOR.

At the SOR'17, it was agreed that the special issue (SI) of BSR would be published, so the call for papers for this SI was launched already during that symposium in Bled in September 2017. The call was directed to the participants of SOR'17 as well as to other researchers from the field of OR. The submitted papers should present developments and new techniques in OR methods/models and their practical uses in business, economics, finance, organization, management, social sciences, environment, transport and other areas.

Several papers have been received. Some of them are extended journal version of short SOR'17 papers from proceedings (Zadnik Stirn et al., 2017). Each submission for the SI of BSR was reviewed by the guest editors firstly, and then it was reviewed by two independent experts blindly.

Nine papers were selected for this special issue of BSR. They owe practical orientation and consistent emphasis on model formulation and model building. Further, they move beyond a mere presentation of algorithms and reinforce the features and coverage of the most recent developments in optimization, simulation and decision analysis.

The selected papers consider developments and techniques in OR and their practical uses in fields of business, economics, spatial science and location. Topics covered by selected papers present interdisciplinary research and include from the methodological point of view multi-criteria decision making, fuzzy logic, neural networks, machine learning, prediction models, nonlinearity, autoregressive models, risk and uncertainty and big data, while from the application point of view business process modelling, organization performance, strategy planning, financial

applications, energy consumption elasticity, stock market, hierarchical functional regions, water management, land cadastre and bike-sharing stations.

The success of the SI of BSR should be seen because of joint effort. The guest editors would like to express the sincere thanks to the authors for their well-written contributions and to the reviewers for their careful evaluation of submissions and their thoughtful and constructive comments. Last, but not least the guest editors express deep appreciation and thanks to the Editor-in-Chief, Professor Mirjana Pejić Bach, PhD for her generosity, service and commitment to invite us as guest editors of the SI of BSR.

Contributions

According to the goals and editorial policy of BSR the papers published in BSR should present original theoretical and empirical advances of business and economic systems using a wide range of methodological approaches, above all those from the field of operations research/analytics/ management science and statistics. The nine papers accepted for this SI of BSR fulfill these objectives.

In the first paper, entitled "CVaR in Measuring Sector's Risk on the Croatian Stock Exchange", *Aljinović and Trgo* used risk measurement method Conditional Value-at-Risk (CVaR) to estimate the risk for Croatian stock market sectors. The application was carried out at the sample of 29 stocks grouped into 8 sectors for three periods: before economic crisis (2006-2007), during the crisis period (2008-2009) and after (2013-2014). The results reveal that the sectors that were risky during the crisis period are not the same sectors as those that were risky before and after the crisis. Further, the results also tell that the Construction sector is the most risky sector in all three periods, while Hotel-management, Tourism and Food Retailing are among the least risky sectors.

The second paper, entitled "Neural Network Approach in Forecasting Realized Variance Using High-Frequency Data", of authors *Arnerić, Poklepović and Wen Teai*, deals with measurement and forecasting of realized variance (RV) for high-frequency data. The authors assert that the use of the Heterogeneous AutoRegressive model (HAR-RV) does not consider data nonlinearity. Thus, they developed Feedforward Neural Networks model (FNN-HAR-type). Both models were compared regarding forecasting performances and predictive accuracy using several statistical tests, like Wald test and many others. The numerical results confirm that FINN-HAR-type models capture better nonlinear behavior of RV. Further, on sample data, where the out-of-sample predictive accuracy was almost equal, FINN-HAR-type models showed better accuracy compared to HAR-type models.

In the third paper, entitled "Number of Instances for Reliable Feature Ranking in a Given Problem", *Bohanec, Kljajić Borštnar and Robnik-Šikonja* conduct the machine learning models for the cases where the user adds new features to an existing classification model in order to increase classification accuracy of the model. The sample size was studied in order to estimate the impact of new features, and ReliefF and bootstrap-based estimation of confidence intervals for feature ranks were performed. In the application, real world business sales forecasting data and two sets of data from literature (one set with missing values) were used. The results reveal that the combination of both suggested methods are appropriate to estimate the impact of new feature in reliable manner. The numerical results also show that the new features with high or low rank can be detected already if a sample is small, while features that ranked near to the border of already existent features need larger samples to detect their impact.

In the next paper, entitled "The Influence of the Zonation Effect on a System of Hierarchical Functional Regions", *Drobne and Lakner* suggest a new concept of the clustering comparison measure. The suggested measure was applied in the analysis of

the influence of the zonation effect on a system of hierarchical functional regions. The zonation effect is described as the variation in results obtained from different ways of subdividing geographical space at the same scale. In the application, the authors compared two systems of hierarchical functional regions of Slovenia modelled by the Intramax aggregation procedure using the inter-municipal labor commuting flows for the same year, but for two different initial sets of municipalities. The results of the analysis show that the zonation effect has an influence on hierarchical functional regions. The authors concluded that the suggested clustering comparison measure, which was a metric measure, was appropriate for comparing hierarchical clusterings. The measure is easy to interpret, but it still should be adjusted for the number of clusterings, what is one of the future research directions, as suggested by the authors.

In the fifth paper, entitled "Risk-Based Decision Support Model for Offshore Installations", *Erdogan, Refsdal, Nygård, Petter Rosland and Kvam Randeberg* developed a risk-based multi-criteria decision support model using the DEXi methodology. The model was applied to the problem of maintaining an offshore installation where flotels are used to accommodate personnel. The operatives have to decide whether to disconnect/connect the gangway from/to the installation or not. Their actions are risky because an "unrestrained" disconnection may cause harm to personnel and equipment. The application of the model consisted of six scenarios, 16 attributes including the top attribute, which represents the advice to the decision maker, and 28 basic attributes, each with two or more possible values. The feedback to the model results was obtained in 12 meetings held with operatives who represented the target group and had not participated in developing the model. The results of the meetings show that the offshore operatives agreed with the advice produced by the presented model for five of the six scenarios. For the sixth scenario, they expressed doubt.

The sixth paper, entitled "Autonomous Sensor Data Cleaning in Stream Mining Setting", of authors *Kenda and Mladenić*, explores the data mining process, i.e., the data pre-processing. Data cleaning represents the first step in data pre-processing. It represents a permanent challenge in data analytics. If not done or badly performed it can result in inaccurate predictions and later in unreliable business decisions. The authors propose an own algorithm/method for data cleaning based on Kalman filter. This new method has been quantitatively tested on an artificial data set, and compared to the ARIMA state-of-the-art method. Better results were obtained on the datasets with lower noise ratio. The main advantage of the new method is that it can work with Big Data in a streaming scenario. Additionally, the proposed method was applied to a heterogeneous set of real-world time-series of groundwater levels in Ljubljana region. The efficiency of new proposed cleaning method with an indirect approach was tested. The authors also fitted an ARIMA model to raw and clean data in order to compare the respected error measures. The proposed data cleaning was shown to be beneficial on time-series that have properties like majority of sensor streams available in the Internet of Things domain. Finally, the authors developed the meta-classification method, which can predict the success of the data cleaning with 75%-85% precision.

The seventh paper, entitled "Location and Coverage Analysis of Bike-Sharing Stations in University Campus", of authors *Mete, Abidin Cil and Özceylan*, presents the study focused on site selection of bike stations with the aim to minimize the total walking distance of the users. To solve this allocation problem the decision support model is generated. First, set and covering models are proposed for usage of deciding on coverage capability on determined points and potential bike stations. Next, P-center and P-median models are used to allocate demand points to proposed

stations. Finally, undesirable facility location model determines the stations with maximum distance from demand points. These stations need to be removed in the final solution. The presented model is applied to the Gaziantep University Campus in Turkey with 20 demand points and 20 potential bike stations. The results reveal that potential bike stations cover all demand points.

In the eighth paper, entitled "Energy Consumption as an Indicator of Hidden Economy: Comparative Analysis", *Novkovska and Dumičić* show that methods using energy consumption data, the Lackó method and the Kaufmann and Kaliberda method, are an appropriate device for designing models for determining the magnitude of hidden economy in open economies of limited size. Therefore, they are adequate for the Western Balkan countries, as well. This approach is shown on empirical data with measurements of quantifiable physical parameters, with the known economic laws taken into account when connecting the variables. Using Kaufman and Kaliberda method, the authors offer an efficient description of variation of hidden economy in the times of crisis in the Western Balkan countries, which enables the cross-countries comparisons, as well. The progress of the hidden economy level in the Republic of Macedonia and Croatia in the period 1994-2015, using that method has been focused primarily. Quite alike changes in these two transition countries are recognized, with an increase dynamics in the beginning of the 90-ties for the Republic of Macedonia, which progressed faster as compared to Croatia. At the end of that decade, the hidden economy became higher in the Republic of Macedonia.

In the last paper, entitled "GNSS-Condition Impacts on Land Boundary Coordinates and Land Area Determination", *Pavlovčič Prešeren* estimated the influence of GNSS-acquired coordinates' quality on land area calculation. For this, several results based on different scenarios, i.e. with obstacles and shortening occupation duration, to describe the importance of optimal GNSS measurement conditions, were obtained. The goal of experiments was to gain knowledge of several factors that influence the quality of positioning and further use of fuzzy logic to tackle the optimal measurement conditions at the field. Fuzzy logic answers could be useful in every-day practice to make decisions, how to acquire best coordinates in specific conditions. The findings confirm that only good measurement conditions lead to high quality coordinates and well-defined areas of land properties, which are the fundamental factor on the issues of property valuation and assessing land taxes or rents.

It might be concluded that the high quality papers of the SI of BSR would be interesting to both, the scientific and the professional audience, since possible influence on theory and applications are visible.

Ljubljana, Zagreb, September 2018

Guest Editors of SI BSR

Samo Drobne
Ksenija Dumičić
Lidija Zadnik Stirn

References

1. Cochran, J.J., Cox, L.A., Keskinocak, P., Kharoufeh, J.P., Smith, C. (2011), "Wiley Encyclopedia of Operations Research and Management Science", Wiley, New Jersey.
2. Figueira, J., Greco, S., Ehrgott, M. (2005), " Multicriteri Decision Analysis", Springer, New York.
3. Mladenić, D., Lavrač, N., Bohanec. M., Moyle, S. (2003), "Data Mining and Decision Support", Kluwer, Boston.
4. Press, Belmont, California.
5. Rubio, S., & Jiménez-Parra, B. (2014), "Reverse logistics: Overview and challenges for supply chain management", International Journal of Engineering Business Management, 6, 12.
6. Winston, W. L. (2003),"Operations Research: Applications and Algorithms", Duxbury
7. Zadnik Stirn, L., Kljajić Borštnar, M., Žerovnik, J., Drobne, S. (2017), "Proceedings of the 14th International Symposium on Operational Research, SOR17", Bled, Slovenia, September 27-29, 2017, Slovenian Society INFORMATIKA (SSI), Section for Operational Research (SOR), Ljubljana.

About the editors

Samo Drobne
Member of Management Board of Slovenian Society INFORMATIKA – Section for Operational Research (SSI-SOR)
Secretary of Slovenian Society INFORMATIKA – Section for Operational Research (SSI-SOR)
Co-editor of several proceedings of the international symposia on operations research in Slovenia (Proceedings of SOR)
University of Ljubljana, Faculty of Civil and Geodetic Engineering, Ljubljana, Slovenia
Author can be contacted at **samo.drobne@fgg.uni-lj.si**

Ksenija Dumičić
President of Croatian Statistical Association
Editor-in-Chief of Croatian Review of Economic, Business and Social Statistics (CREBSS)
Member of Croatian Operational Research Society
Member of International Statistical Institute
Member of Royal Statistical Society
University of Zagreb, Faculty of Economics and Business, Zagreb, Croatia
Author can be contacted at **kdumicic@efzg.hr**

Lidija Zadnik Stirn
President of Slovenian Society INFORMATIKA – Section for Operational Research (SSI-SOR)
Vice-president of Slovenian Society INFORMATIKA (SSI)
Representative of SSI-SOR in International Federation of Operational Research Societies (IFORS) Representative of SSI-SOR in Association of European Operational Research Societies (EURO)
Co-editor of Central European Journal of Operations Research (CEJOR)
Co-editor of several proceedings of the international symposia on operations research in Slovenia (Proceedings of SOR)
University of Ljubljana, Biotechnical Faculty, Ljubljana, Slovenia
Author can be contacted at **lidija.zadnik@bf.uni-lj.si**