

This special issue of the International Journal of Approximate Reasoning (IJAR) grew out of the 9th International Conference on Soft Methods in Probability and Statistics (SMPS). The conference was organized at the University of Compiègne (France) in July 2018 (<https://smpsbelief2018.hds.utc.fr/>), jointly with the International Conference on Belief Functions (BELIEF). The biennial SMPS is a recognized conference among international meetings on generalized methods for uncertainty quantification and handling. The first SMPS took place in Warsaw (Poland) in 2002, followed by meetings in Oviedo, Bristol, Toulouse, Oviedo and Mieres, Konstanz, Warsaw, and Rome. This first joint edition of the SMPS and BELIEF conferences provided a unique opportunity to foster professional communication among researchers from both communities. Compiègne has proved to be a very nice location, offering wonderful chances for collaborations and discussions, as well as sightseeing places such as its Napoleonic palace.

Following a selective refereeing process, 34 papers were chosen for SMPS 2018 and presented mostly in plenary sessions. A number of invited talks about topics related to uncertainty management with statistical and probabilistic methods were also given: Thomas Augustin gave a talk entitled “On Statistical Modelling with Imprecise Probabilities”, Scott Ferson on the “Non-Laplacian uncertainty: practical consequences of an ugly paradigm shift about how we handle not knowing”, and Ryan Martin on “Belief functions and Valid Statistical inference”.

The IJAR Best Paper Award dedicated to young researchers, generously provided by Elsevier, was granted at the meeting. The Prize went to Jasper de Bock (Belgium), Alexander Erreygers (Belgium) and Beatriz Sinova (Spain), the two last papers being presented in this special issue.

This special issue contains the following contributions:

- ‘Nearly-Linear uncertainty measures’ [1] by Chiara Corsato, Renato Pelesoni and Paolo Vicig. This paper studies a set of imprecise probabilistic models that consist in applying a linear transformation to an initial probability measure, exploring in particular their mathematical properties and subjective, and connecting them to well-known simpler models such as linear-vacuous mixtures or Pari-Mutuel models.
- ‘Estimation of classification probabilities in small domains accounting for nonresponse relying on imprecise probability’ [2] by Aziz Omar and Thomas Augustin. This paper deals with missing data in the small area estimation problem, which refers to the estimation of parameters related to domains for which the sample size is very small (e.g., in surveys). As assumptions about the missing data process can have a huge impact on estimations in these situations, the paper proposes conservative ways to make inference, based on imprecise probabilistic approaches, while allowing to include existing knowledge about the missingness process.
- ‘Control charts based on fuzzy costs for monitoring short autocorrelated time series’ [3] by Olgierd Hryniewicz, Katarzyna Kaczmarek-Majer and Karol R. Opara. This paper introduces a new technique to predict time series, based on an ensemble approach where weights are fuzzy-valued and elicited from domain experts. The approach is applied to the self-detection of mood changes in bipolar patients.
- ‘A review and proposal of (fuzzy) clustering for nonlinearly separable data’ [4] by Maria Brigida Ferraro and Paolo Giordani. After reviewing clustering methods to deal with nonlinearly separable clusters, the paper proposes a new fuzzy clustering method to handle such cases, based on manifold learning and the geodesic

distance. The method performances are then assessed on different data sets, both synthetic and real.

- ‘Empirical analysis of the maximum asymptotic bias of location estimators for fuzzy number-valued data’ [5] by Beatriz Sinova and Stefan Van Aelst. This paper studies the robustness of location estimators for random fuzzy numbers, as in such cases there is no uniformly best location estimator (like it happens in the precise settings). It focuses on the asymptotic behaviour, thus complementing previous studies that mainly dealt with the finite sample case.
- ‘Cutting levels of the winning probability relation of random variables pairwise coupled by a same Frank copula’ [6] by Bernard De Baets and Hans De Meyer. This paper explores the probabilistic order relation between random variables that are linked together by copulas of the Frank family. In particular, it analyses the condition under which such a relation is acyclic.
- ‘Conditional submodular Choquet expected values and conditional coherent risk measures’ [7] by Davide Petturiti and Barbara Vantaggi. This paper provides an axiomatic definition of conditional submodular capacities, which constitute a general and tractable model of uncertainty. These results lead in turn to an axiomatization of conditional submodular Choquet expected values and to conditional coherent risk measures.
- ‘A min-max regret approach to maximum likelihood inference under incomplete data’ [8] by Romain Guillaume and Didier Dubois. This paper discusses a regret-based version of maximum likelihood estimation in case of partially observed data. It provides algorithmic procedures to perform it in the case of multinomial models. It also makes a comparison with other approaches based on the pessimistic and optimistic views of the likelihood under incomplete data.
- ‘Bounding inferences for large-scale continuous-time Markov chains: A new approach based on lumping and imprecise Markov chains’ [9] by Alexander Erreygers and Jasper De Bock. This paper investigates how tools issued from imprecise probabilities can be used to provide guaranteed inferences on large-scale Markov-chains. It gives a theoretical analysis of the problem, as well as efficient inference algorithms for lumped Markov Chains.

The papers presented in this special issue of the International Journal of Approximate Reasoning are closely related to papers presented at SMPS 2018. We selected nine conference papers from the many excellent contributions and invited the corresponding authors to submit a related full-length paper. All of them agreed to do so, and each paper was subsequently carefully reviewed again by two or three external referees and by us.

These papers reflect the wide range of topics covered at the conference and fit well with the focus of the journal. The papers in this special issue provide a glimpse of the success of SMPS 2018 and of the progress of research and applications involving uncertainty handling with statistical and probabilistic methods. We hope that they also motivate readers to participate in future SMPS conferences.

Acknowledgements

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research results at SMPS 2018 and for accepting our invitation to submit extended papers for this special issue.

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