June 21, 2021

Dr. Dianne Helen Cook
Editor-in-Chief
The R Journal

Dear Madam,

I am pleased to submit our original manuscript entitled "**fcaR**, Formal Concept Analysis with R" written by Pablo Cordero, Manuel Enciso, Domingo López-Rodríguez and Ángel Mora.

This manuscript contains original material that is not under consideration to be published elsewhere. We believe this manuscript is suitable for publication in your journal as the focus of the work reflects its aims and scope.

This work aims to present the first R package implementing the core methods in Formal Concept Analysis (FCA). FCA is a well-founded mathematical tool based on lattice theory and logic that constitutes a framework that complements and extends the study of exact and approximate association rules.

We are aware that there exist some libraries (e.g. **arules**, **frbs** or **RKEEL**) that implement algorithms to find rules from a dataset. However, in those packages, the variables must be binarized or categorized first, and the support for general knowledge discovery tasks is minimal. Notably, none of the existing approaches uses logic tools to infer knowledge from the extracted rules and implications or uses formal methods for generic fuzzy variables. Thus, we can say that **fcaR** is the first implementation of the formal methods that constitute the core of FCA.

In its implementation, we have considered three critical factors: *extensibility*, *integration* and *reproducible research*.

The use of an object-oriented programming paradigm in **fcaR** to define the basic object classes with their properties and methods allows to *extend* the functionality to other fields, and the incorporation of new methods can be done with ease.

Additionally, we have taken into account that **arules** is a *de facto* standard when working with transactional databases and association rules. We have implemented methods to import and export both datasets and sets of rules from/to the native object types in **arules**. This way, **fcaR** can be *integrated* into the usual knowledge discovery workflow, with the additional benefits of the use of FCA (e.g. logic tools and formal methods).

Furthermore, **fcaR** is designed to be used in *reproducible research*. Its classes have methods to export to several formats, particularly to LaTeX so results and plots can be easily incorporated into documents. In fact, the present work has been written entirely as an RMarkdown document, interleaving text with **fcaR** code, to produce the final proposal.

This work aims to provide a unified computational framework for the theoretically-oriented FCA users to develop, test, and compare new methods and knowledge extraction strategies. We also aim to present this tool for knowledge discovery accessible to other scientific communities, allowing for the development of new packages in other fields using FCA techniques, especially in the construction of recommendation systems.

We believe this work will be of interest to the readers of your journal.

All the authors have approved the manuscript and agree to its submission to *The R Journal*. We hope you find our manuscript suitable for publication and look forward to hearing from you in due course.

Yours faithfully,

Domingo López-Rodríguez
Universidad de Málaga
Dep. de Matemática Aplicada
ETSI Informática
Campus de Teatinos
Málaga, Spain