

Javier Tarrío Saavedra

Higher Polytechnic University College
Mendizábal s/n, 15403, Ferrol, SPAIN.

E-mail: javier.tarrio@udc.es

Prof. Michael Kane,
Editor-in-Chief,
R Journal

Estimated Prof. Michael Kane,

I would like to submit this manuscript, jointly written with Miguel Flores, Rubén Fernández-Casal, and Salvador Naya entitled *Statistical Quality Control with the qcr Package*, for possible publication in the *R journal*. This is a work performed by members of the Universidade da Coruña (UDC, Spain) and Escuela Politécnica Nacional (EPN, Quito, Ecuador), within the framework of the UDC – EPN agreement.

This interdisciplinary collaborative work between universities of Spain and Ecuador has led the developing of the *qcr* (quality control review) R package. This R library, included in CRAN (GPL-2|GPL-3 [expanded from: GPL (≥ 2)]), provides practitioners a comprehensive set of tools for statistical quality control of processes and services in industry and other domains such as environmental sciences and chemistry. This project intends to provide free and open source tools to develop statistical process control, a branch of statistics where the commercial software are mostly used. Consequently, the *qcr* library includes the main parametric and nonparametric statistical tools to perform the Analysis and Control steps of the DMAIC cycle of Six Sigma methodology. The implementation nonparametric techniques for process control and capability analysis is now crucial in the framework of Industry 4.0. In fact, with the new paradigms of data collection, data are usually not Gaussian. Concerning the Six Sigma Control step, *qcr* package, as the reference R library *qcc*, includes control charts for univariate and multivariate critical to quality (CTQ) variables. Namely, Shewhart, CUSUM and EWMA univariate control charts, and, on the other hand, T^2 Hotelling multivariate control charts are performed. In addition to these types of control charts, *qcr* provides, for first time in R software, multivariate nonparametric approaches such as *r*, *Q* and *S* control charts based on data depth and proposed by Regina Liu. Multivariate CUSUM and EWMA are also implemented.

It is very important to stress that two new Functional Data Analysis (FDA) approaches for control charts (also known as profile control charts) developed by the authors of the present manuscript are also included. These are based on functional data depth and bootstrap resampling procedures, providing graphical outputs such as curves charts, depth control charts and rank control charts. These two approaches account for one of the first contributions in R software of FDA for Statistical Process Control (SPC).

Regarding the Six Sigma Analysis step of DMAIC cycle, a comprehensive set of tools for capability analysis are implemented. Parametric capability indices, CTQ histograms and qq plots are included in *qcr*. In this case, the main contribution of *qcr* is the implementation of nonparametric capability indices in addition to the corresponding capability graphical tools (not available in other R packages). Moreover, a complete number of datasets based on real study cases (many of them retrieved from the authors' professional experience) are also included in the *qcr* package to illustrate the implemented techniques.

The authors hope that this version will meet the standards of the *R Journal*.

I look forward to hearing from you.

Yours sincerely,



Javier Tarrío Saavedra