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Coastal waters monitoring data: frequency distributions of the principal water quality variables

Franco GIOVANARDI*, Maria Grazia FINOIA, Simone RUSSO, Marina AMORI and Bianca DI LORENZO

ICRAM – Central Institute for Marine Research, via di Casalotti, 300, 00166 Roma, Italy
*e-mail corresponding author: f.giovanardi@icram.org

ABSTRACT

Examining the results of the Italian national programme of marine coastal monitoring, the old problem has arisen about the choice of the most appropriate procedures and methods to validate data and screen preliminary data. Therefore, statistical distributions of water quality parameters have been taken into consideration, in order to assign appropriate frequency distributions to all the routinely measured variables. Each sample distribution has been analysed and defined by a probability density function (p.d.f.), by means of a powerful method of data analysis (Johnson 1949) that allows for the computation of statistical parameters of a wide variety of non-normal distributions. The resulting Johnson distributions are then classified depending on four fundamental categories of frequency distributions: normal, log-normal, bounded and unbounded. Theoretical aspects of the method are explained and discussed in an adequate way, so as to allow for practical applications. The shape and nature of these curves require further consideration, in order to understand the behaviour of water quality variables and to make comparison among different coastal zones. To this end, two coastal systems were considered in this work: the Emilia-Romagna coastal area of the NW Adriatic Sea and the Tuscany littoral of the Northern Tyrrhenian Sea. There are notable advantages to the adopted approach. First it offers the possibility to overcome severe constraints requested by the normality assumption, and avoids the troublesome search for the most appropriate transformation function (i.e. for ensuring normality). Second, it avoids searching for other kinds of theoretical distributions that are appropriate for the data. In our approach, the density functions are opportunely integrated, in such a way that, for whatever value assumed by a given variable, the corresponding expected percentage point value under the respective frequency curve, can be calculated, and vice versa*. We believe that the Johnson method, although tested with coastal monitoring data, can be usefully adopted whenever we have to analyse environmental data and try to understand how an aquatic system works (e.g. large lakes). In the Appendix specific details about the Johnson classification criterion are reported and highlight the case of bimodal distributions. Finally, an example of data analysis is provided, by using the R (V. 2.11) software, with both graphical and numerical outputs.*

Key words: Coastal waters, monitoring data processing, frequency distributions, Johnson's distributions, normal law approximation, coastal eutrophication, TRIX Index.