II Joint Conference of the Belgian, Royal Spanish and Luxembourg Mathematical Societies
Logroño, June 6–8, 2016

Circular Isotonic Regression with Applications to cell-cycle Biology

Cristina Rueda[1], **Miguel Fernández**[2]

Constraints on parameters arise naturally in many applications. Statistical isotonic regression methods that honor the underlying constraints tend to be more powerful and result in better interpretation of the underlying scientific data.

While Euclidean space data are commonly encountered in applications, there are numerous instances where the underlying data and the parameters of interest reside on a unit circle that are often the result of an oscillatory system. One example of an oscillatory systems is the periodic expression of genes participating in cell division cycle. In this case, researchers are interested in correlating the phases of periodic genes across different experimental conditions or species or tissues etc. Thus the statistical problem of interest is to draw inferences regarding the relative order among parameters on a unit circle.

There exists a long history of statistical literature on isotonic regression in the context of Euclidean space data (cf. [3]), and also on methodology for analyzing angular data (cf. [2]). In comparison, isotonic inference for circular data is almost non-existent. Just as one cannot trivially extend standard statistical methods in the Euclidean space to the circle, isotonic statistical regression for Euclidean space cannot be extended to constraints on a unit circle (cf. [1]). The purpose of this talk is two-fold. First we describe recent theoretical and methodological advances in Circular Isotonic Regression and second we describe some applications of the methodology in cell biology.

References

[1] C. Rueda, M.A. Fernández, and S.Peddada, Estimation of Parameters Subject to Order Restrictions on a Circle with Application to Estimation of Phase Angles of Cell-Cycle Genes, *Journal of the American Statistical Association* **104, 485** (2009), 338–347.

[2] K. Mardia and P. Jupp, *Directional Statistics*. John Wiley & Sons, New York, 2000.

[3] M.J. Silvapulle and P.K. Sen, *Constrained Statistical Inference. Inequality, Order and Shape Restrictions*. John Wiley & Sons, New York, 2004.

[1]Department of Statistics and Operation Research, University of Valladolid, Paseo Belén 7, 47011
crueda@eio.iva.es

[2]Department of Statistics and Operation Research, University of Valladolid, Paseo Belén 7, 47011
miguelaf@eio.uva.es