Precipitation Modeling by Polyhedral RCMARS and Comparison with MARS and CMARS

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Nowadays, climate change is an important issue due to the possibility that it may result in extreme weather events such as floods or droughts. Therefore, precipitation forecasting has drawn attention since it is a useful tool in meeting the increasing necessity for the efficient management of water resources as well as in preventing disasters before they happen. Although, precipitation is a very complicated physical process in nature, which makes it difficult to forecast, recent positive developments in predictive data mining techniques used in early warning systems improve the accuracy of precipitation forecasts. In literature, there exist many statistical and computational methods used for this aim, including linear and nonlinear regression, kriging, time series models, neural networks and Multivariate Adaptive Regression Splines (MARS). Among these methods, MARS stands out as the better performing precipitation modeling method. In fact, MARS is very useful nonparametric technique to construct high-dimensional and nonlinear multivariate functions in many areas of engineering and science. In this study, we applied a recently developed method called Robust Conic MARS (RCMARS) to forecast precipitation. Here, in CMARS, which is developed as an alternative to MARS, the model complexity is penalized in the form of Tikhonov regularization and studied as a conic quadratic programming. In RCMARS, CMARS is refined further by including the existence of uncertainty in the future scenarios and robustifying it with a robust optimization technique. RCMARS is more model-based and employs continuous, well-structured convex optimization that enables us to use interior point methods and their codes, e.g., MOSEK. To evaluate the performance of the RCMARS method, it is applied to a precipitation model for the continental central Anatolia region of Turkey, where drought has been a recurrent phenomenon for the last few decades. Then, the performance of the RCMARS precipitation model is compared to that of MARS and CMARS. The results indicated that RCMARS constructs more precise and stable precipitation model compared to those of MARS and CMARS.

Keywords: Robust Conic Multivariate Adaptive Regression Splines, Robust Optimization, Conic Quadratic Programming, Continental Central Anatolia, Meteorological data, Early Warning System

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