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Modelling rainfall interarrival times and rainfall depths at daily scale

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Analysis of daily rainfall data, and subsequent modelling of some derived variables concerning rainfall, is fundamental in different areas such as agricultural, ecological, and engineering disciplines. A way of studying the alternance of consecutive rainy days (wet spells) and no-rainy days (dry spells) is through the interarrival time (*IT*), which is the time elapsed between two consecutives rainy days. If we suppose that *IT* observations are independent and identically distributed (i.i.d.), *ITs* are usually modelled through a renewal processes. The simplest renewal process is the Bernoulli process with *ITs* geometrically distributed. The need to suppose a non-constant probability of rain brings to more sophisticated models. Previous works [Agnese et al. (2014), Baiamonte et al. (2019)] have successfully proposed the three-parameter family of the *Hurwitz-Lerch-Zeta* distribution (HLZD), which represents a forward step with respect to other commonly used *IT* distributions. In [Agnese et al. (2022)], a second successfully reached goal was to show that the HLZD is also suitable to model the rainfall depth, h. In literature, rainfall depths are more frequently treated as continuous, despite sometimes these models fail to account for the time discreteness of the sampled process. Indeed, daily rainfall depth measurements are usually carried out by automatic-counting how many times a small bucket corresponding to 0.2 mm is filled. Due to the abundance of ties in the data, the variable depth h is well suited to be considered discrete. We present results involving data never considered in literature and consisting of measures sampled along 60-70 years at 7 different stations. These stations represent different climates from the rainfall characteristics point of view and let us to infer about the great handiness of the HLZD within rainfall modelling. Current research is addressed to modelling further rainfall variables related to *IT* and h, such as wet and dry spells, and the cumulative rainfall depth in a wet spell. Furthermore, given the remarkable performance of the HLZD family of distributions in the univariate modelling, we aim at modelling the dependence structure between *IT* and h, exploiting possibly new methodological advances in the subject, such as discrete copulas.

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