Semiparametric mixed beta regression for modelling disease severity in plants

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The Severity Index (SI) in plant diseases represents the proportion of plant material affected by the disease, and can be considered as a continuous variable in a (0, 1) interval. When modelling how the SI changes through time, mixed beta regression is a powerful alternative, since it incorporates many characteristic features of longitudinal data. Usually generalized linear mixed models or non-linear mixed model methods are used for modelling disease progress curves in plant epidemiology, and some of their parameters have meaningful interpretations in terms of the epidemics. When the average and/or the plant-specific curves do not follow a parametric form, semi-parametric methods are a very useful alternative. We propose a semiparametric mixed beta regression with smooth average and plant-specific curves to model the disease progress curves for Black Sigatoka (a fungal disease) in banana crops. The proposed semi-parametric method allows to model flexible shapes for disease progress curves, and can be used to compare treatments while taking into account the longitudinal and design structures of the data. Alternative spline combinations are explored and compared in real and simulated datasets.

Keywords: B-splines, plant disease epidemiology, generalized linear mixed models.