Modelling a response as a function of high frequency count data: the association between physical activity and fat mass

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We develop a new statistical modelling approach where the response is a function of high frequency count data. Our application is about investigating the relationship between the health outcome fat mass and physical activity (PA) measured by accelerometer. The accelerometer quantifies intensity of physical activity as counts per epoch over a given period of time. We use data from the Avon longitudinal study of parents and children (ALSPAC) where accelerometer data is available as a time series of accelerometer counts per minute over seven days for a subset of children. In order to compare accelerometer profiles between individuals and to reduce the high dimension a functional summary of the profiles is used. We use the histogram as a functional summary due to its simplicity, suitability and ease of interpretation. Our model is an extension of generalised regression of scalars on functions or signal regression. It allows also multi-dimensional functional predictors and additive non-linear predictors for metric covariates. The additive multidimensional functional predictors allow investigating specific questions about whether the effect of PA varies over its intensity, by gender, by time of day or by day of the week.