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Interval-censored regressors driven by limits of detection and quantification within a generalized linear model

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ABSTRACT

High-performance liquid chromatography is a laboratory technique used to quantify specific components in a mixture, such as in blood plasma. Measurements through this technique are only quantifiable if they surpass a limit of quantification LQ. To prevent information loss, the laboratory analysis also involves testing if the component is present in the mixture, yet its detection is only feasible when the concentration is above a limit LD. Hence, observations may take form [0, LD] when the presence of the component is uncertain, [LD, LQ] indicating their presence without precise quantification, or an exact value otherwise. It is common for certain components to be found in very small concentrations, making it necessary in the analysis stage to aggregate components from the same family in order to observe statistically significant effects. After computing the sum, the resulting variable is a mixture of exact and interval-censored observations. Carotenoids, antioxidant compounds obtained through dietary intake, serve as illustration of this topic, as described in Gómez, Marhuenda-Muñoz and Langohr (2022). Carotenoid intake has been reported to be associated with improved cardiovascular health, and so there is considerable interest in exploring the relationship between plasma carotenoid concentration and various cardiometabolic biomarkers. Generalized linear models stand as the most suitable tool for these analyses, motivating our current work.

We propose a likelihood-based approach that takes advantage of Turnbull's non-parametric estimator to express the likelihood function in terms of the innermost intervals. Maximization is achieved through an EM-type algorithm firstly introduced in Gómez, Espinal and Lagakos (2003). A challenge arises as the likelihood function includes a sequence of integrals that cannot be solved without imposing parametric assumptions on the Turnbull's estimator, which is usually undefined inside innermost intervals. To address this obstacle, we have developed an adaptative numerical integration method that requires minimal assumptions on the estimator, and that also allows us to monitor such assumptions.

REFERENCES

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