A NEW APPROACH TO MODELLING CASE-HISTORY DATA WITH MISSING INDIVIDUAL COVARIATES

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Regular censusing of populations of marked wild animals produces data for estimating their annual survival. This is important for assessing effects such as climate change. We want to regress survival probabilities on covariates; however time-varying covariates measured on individual animals often contain missing values. We propose a new approach for analyzing such data, based on a new way of calculating the likelihood. This approach does not exclude incompletely observed life histories, avoids imputation of missing values, and uses all the available data. Simulation demonstrates that the new method produces approximately unbiased estimators with better precision than that of alternative methods. An illustration is provided by mark-recapture-recovery data on Soay sheep (*Ovis aries*), studied on the Scottish island of Hirta in the St. Kilda archipelago. The annual survival probabilities for these sheep are modeled using age-classes; within these age-classes the annual survival probabilities are logistically regressed on both individual and environmental covariates. The new approach reduces the likelihood to a simple product of trinomial distributions. Using this approach, it is shown that for adult sheep the covariate *current weight* (with missing values) provides better inferences than using *birth weight* (with complete records). Furthermore, the multiple trinomial structure of the data provides new perspectives on a complex data set, and a new way of assessing goodness of fit.