

Post-mortem interval: a functional data analysis for criminology

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It is not unusual in cases where a body is discovered that it is necessary to determine a time of death or more formally a post mortem interval (PMI). Forensic entomology can be used to estimate this PMI by examining evidence obtained from the body from insect larvae growth. In this talk, we propose a method to estimate the hatching time of larvae (or maggots) based on their lengths, the temperature profile at the crime scene and experimental data on larval development. This requires the estimation of a time-dependent growth curve from experiments where larvae have been exposed to a relatively small number of constant temperature profiles. Since the temperature influences the developmental speed, a crucial step is the time alignment of the curves at different temperatures. We then propose a model for time varying temperature profiles based on the local growth rate estimated from the experimental data. This allows us to find out the most likely hatching time for a sample of larvae from the crime scene. We explore via simulations the robustness of the method to errors in the estimated temperature profile and apply it to the data from two criminal cases from the United Kingdom. Asymptotic properties are also provided for the estimators of the growth curves and the hatching time.

Reference: Davide Pigoli, Frédéric Ferraty, John A D Aston, Anjali Mazumder, Cameron Richards, Martin J R Hall (2023). Estimation of temperature-dependent growth profiles for the assessment of time of hatching in forensic entomology, *JRSS C*, 72, 231–253