Analysis of Forensic DNA Mixtures

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Abstract

DNA is now routinely used in criminal investigations and court cases, although DNA samples taken at crime scenes are of varying quality and therefore present challenging problems for their interpretation. We present a statistical model for the quantitative peak information obtained from an electropherogram (EPG) of a forensic DNA sample and illustrate its potential use for the analysis of criminal cases. In contrast to most previously used methods, we directly model the peak height information and incorporates important artefacts associated with the production of the EPG. Our model has a number of unknown parameters, and we show that these can be estimated by the method of maximum likelihood in the presence of multiple unknown contributors, and their approximate standard errors calculated; the computations exploit a Bayesian network representation of the model. A case example from a UK trial, as reported in the literature, is used to illustrate the efficacy and use of the model, both in finding likelihood ratios to quantify the strength of evidence, and in the deconvolution of mixtures for the purpose of finding likely profiles of one or more unknown contributors to a DNA sample. Our model is readily extended to simultaneous analysis of more than one mixture as illustrated in a case example. We show that combination of evidence from several samples may give an evidential strength close to that of a single source trace and thus modelling of peak height information provides for a potentially very efficient mixture analysis.

Joint work with Robert Cowell, Therese Graversen and Steffen Lauritzen.

*url: http://host.uniroma3.it/facolta/economia/economia.asp?contenuto=docenti&id=49