

Paternity testing and other inference about relationships from DNA mixtures

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We present methods for inference about relationships between contributors to a DNA mixture and other individuals of known genotype: a basic example would be testing whether a contributor to a mixture is the father of a child of known genotype. The evidence for such a relationship is evaluated as the likelihood ratio for the specified relationship versus the alternative that there is no relationship. We analyse real casework examples from a criminal case and a disputed paternity case; in both examples part of the evidence was from a DNA mixture. DNA samples are of varying quality and therefore present challenging problems in interpretation. Our methods are based on a recent statistical model for DNA mixtures, in which a Bayesian network (BN) is used as a computational device; the present work builds on that approach, but makes more explicit use of the BN in the modelling. The R code for the analyses presented is freely available as supplementary material.

We show how additional information of specific genotypes relevant to the relationship under analysis greatly strengthens the resulting inference. We find that taking full account of the uncertainty inherent in a DNA mixture can yield likelihood ratios very close to what one would obtain if we had a single source DNA profile. Furthermore, the methods can be readily extended to analyse different scenarios as our methods are not limited to the particular genotyping kits used in the examples, to the allele frequency databases used, to the numbers of contributors assumed, to the number of traces analysed simultaneously, nor to the specific hypotheses tested.