EDITORIAL

Scientific findings (i.e. DNA, finger marks, shoeprints, handwriting, fibres, paint and glass fragments, and else) examinations represent essential tools in modern criminal justice systems. Intended as a scientific contribution to legal investigations, these instances of forensic science theory and practice are widely perceived by the public as both well founded and reliable. Across legal systems, numerous courts have repeatedly highlighted that practicing forensic scientists are required to continually assess the ways that are pursued for evaluating and presenting scientific findings in context pointing out that there is a need for a paradigm shift towards the integration of sound probabilistic methods for evaluation under uncertainty.

Pioneer forensic scientists like Kirk and Kingston wrote:
"When we claim that criminalistics is a science, we must be embarrassed, for no science is without some mathematical background, however meager. This lack must be a matter of primary concern to the educator […]. Most, if not all, of the amateurish efforts of all of us to justify our own evidence interpretations have been deficient in mathematical exactness and philosophical understanding." (1964 at 435-436)

This quotation is still of primary relevance today, since interpretation and data evaluation have been stated as some of the most neglected areas in the entire field of forensic science. At the time of Kirk and Kingston, opinions based on scrutinised statistical or probabilistic studies were indeed rare, but they still are so in current days.

Forensic statistics is the name of a discipline that addresses questions of inference and decision-making in the judicial system and represents an important branch of modern statistics. Forensic statistics engages in the challenge of guiding people in reasoning under uncertainty, which is common to law and forensic science. Reasoning under uncertainty raises not only legal and scientific questions of technical difficulty and practical importance, but also fundamental questions in a wide variety of domains.

On the 8th September 2015, a scientific committee chaired by Professor Luigi Fabbris from the University of Padua (Italy) organised in Padua – on behalf of the Association for Applied Statistics (ASA), the Italian Statistical Society (SIS) and the Statistics Department of the University of Padua – a meeting session entitled *«Statistics for juridical, forensic and educational studies »*. Two thematic issues of the *Statistica Applicata - Italian Journal of Applied Statistics* would like to present this specialised statistical discipline throughout a series of invited papers coming

from interrelated scientific areas (statistics, forensic science, law and philosophy of science) approaching various aspects of the discipline. One of the purposes of the thematic issues is to make statisticians in Italy aware of the academic and societal importance of this field, not only for the administration of justice but also for its impact on societal civilization.

The flexibility of statisticians to publish in top ranking journals regularly consulted by forensic scientists, geneticists and lawyer should be encouraged. It is vital if those disciplines are to profit from statistical advances.

The two issues are structured into four general themes: the introduction to the domain, the management of complex patterns of evidence, the use of data to assess the value of the evidence, and the relationship between law and science and contains five papers each.

The volume 27 (issue 2) contains two papers, one by Frosini (statistician) and the other by Taroni and Biedermann (forensic scientists) that illustrate the basic concepts of the discipline and the logical way to reason under conditions of uncertainty. Some historical criminal cases are presented also referring to a great scientific mind as Henry Poincaré acting as expert in the Dreyfus case (1908). An introduction to modern method of managing multiple items of evidence through graphical probabilistic models, i.e. the Bayesian networks, is also presented.

The main focus of the paper written by Mortera and Dawid (statisticians) is the probabilistic environment known as Bayesian Network. This paper deals with identification problems linked to DNA evidence in criminal and civil cases. Situations involving mixtures of DNA profiles and paternity scenarios are developed pointing out the need to model the genetic quantitative data.

Kaye (jurist), by taking into account the abundance of statistical thinking on the problem on evaluating measurements of chemical and physical properties of transfer evidence, does examine standards adopted by some quarters of forensic scientists to clarify some sources of confusion in the statistical terminology.

Finally, Bozza (statistician), developed statistical methods for the evaluation of evidence in the form of likelihood ratios for multivariate continuous variables. She focuses on the correct direction of support offered by the likelihood ratios by re-sampling techniques to measure the robustness of the system throughout the analysis of handwriting characters in questioned documents.

The volume 27 (issue 3) of the *Statistica Applicata - Italian Journal of Applied Statistics* will propose a new collection of invited papers written by academics and practitioners involved in the measure and management of uncertainty in forensic and judicial related matters. This issue number 3 will start with a contribution of Aitken and Huang (statisticians) who focused on statistical methods for the

evaluation of data in the form of hierarchical longitudinal binary data, notably by using data coming from striation marks in tool expertise.

Taruffo (jurist) displays his wide competence and experience in civil and criminal trials. Among the many topics commented on by Taruffo we quote: "the weight of the naked statistical evidence in trials, the information and assumptions needed for the correct application of the Bayesian approach to inference, the kind of inductive inferential models used in trials, the meaning and use of epidemiological frequencies in a search for individual causation, and the establishment and assessment of accepted standards of proofs."

Forensic laboratories routinely performed comparative examinations in firearm and toolmarks; this aspect is presented by Rosati (forensic scientist) who puts forward the role played by statistical studies in firearm and toolmarks identification process. His contribution focuses on observational studies and controlled tests performed to guarantee the admissibility of forensic testimony in front of a court of justice.

The paper written by Garbolino (philosopher of science) puts forward probability theory as a system of rules for coherent behaviour in an uncertain environment. Bayes' theorem is presented as a tool of scientific reasoning to learn from experience: a fundamental tool in every domain where an individual should make inferences and decisions.

Finally, Corradi (statistician) approaches – using graphical probabilistic models – a current problem in mass disaster. Bayesian Networks are used to deal with identification of missing persons and the possibility to automatically searching an unknown person in a database.

In conclusion, let us reaffirm that Forensic Statistics is an important branch of modern Statistics and we encourage all the readers to properly acknowledge the academic and societal importance of forensic statistics for both the modern administration of justice and the fostering of scientific approaches to the law.

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Co-editors of the thematic issues

REFERENCE

Kirk, P.L. and Kingston, C.R. (1964). Evidence evaluation and problems in general criminalistics. In *Journal of Forensic Sciences.* 9: 434-444.