PREFACE

For the rational study of the law the black letter man may be the man of the present, but the man of the future is the man of statistics and the master of economics.

O. W. Holmes: *The path of the law,* 1897.

Probability is the standard measurement of uncertainty.

D. V. Lindley: *Probability,* [in:]
The use of statistics in forensic science, 1991.

The most striking similarity between legal and scientific practice lies in the uncertainty that pervades both and the near-certainty that hopefully emerges at the end, the jurors oscillating as the evidence is presented.

D. V. Lindley: *Statistics and the evaluation of evidence for forensic scientists,* 2004.

The above three quotes, spanning over 100 years, illustrate the importance of the topic of this seminar to the administration of justice.

Forensic science is concerned with comparisons. Characteristics of material found at a crime scene are compared with characteristics of material associated with a suspect. There are two aspects to the comparison: the similarity of the two sets of characteristics, with respect to the underlying natural variation and their rarity. Statistics is concerned with comparisons. Data on responses to a new medical treatment are compared with data on responses to a current medical treatment. The responses are compared with respect to the underlying natural variation in the data.

The variation inherent in biological and chemical phenomena, as in DNA profiles or elemental compositions of glass or chemical compositions of drugs leads to uncertainty in measurements of these phenomena.

Subjective assessment of the uncertainty leads to subjective assessments of similarity and rarity. Measurements on crime scene evidence and evidence from a suspect may be deemed to be "similar" or "very similar" and may be deemed to be "rare" or "common". The choice of adjective may well be a personal choice and lead to a debate amongst experts and confusion for the triers of fact.

Objective assessment which takes account of the underlying variation requires the use of appropriate models. The choice of the model is a subjective one. However, once the model is chosen, the results will be determined. Different people with the same data and same model will produce the same assessment of the evidence. There is a debate here also but this debate is about the assumptions underlying the choice of model. Are the striations in a bullet independent? If so, the number of consecutive matching striations observed may be able to be modelled with a Poisson distribution. If not, a different model will be needed. The debate is about science, not about a choice of adjective.

Correct assessment of variation, uncertainty and comparisons requires a proper understanding of probability and statistics. This understanding provides:

– clarification of the questions that need asked and answered of evidence;
– a coherent approach to the evaluation of evidence which enables the inclusion and combination of both subjective opinions and objective analyses;
– an effective method in which to analyse, criticise, and check for coherence of results and opinions and then to revise these in a coherent manner;
– an ability to structure, propagate and assess evidence.

It was the purpose of this seminar to discuss the role of statistics in the evaluation of evidence. The vision for the future of forensic scientists and statistics is one of increasing collaboration over the whole range of scientific endeavour, a collaboration in which forensic scientists provide data and problems of evidential evaluation and interpretation, statisticians provide probabilistic models developed to ensure mathematical rigour and both ensure practical value for the outcome. This collaboration will lead to an improvement in the administration of justice through statisticians ensuring their contribution to the science is relevant. There are several strands to aid this vision, e.g. research, networking, education. Research has four components, theoretical mathematical and statistical research in university departments of mathematics and statistics, applied statistical research, short-term visiting fellowships for forensic scientists to visit statisticians or *vice-versa*, and statistical input to the design and analysis of research of a forensic scientific nature conducted by scientists. Networking and travel grants will be very useful to enable a group of people to meet on a regular basis and collaborate on research and statistical interpretation related to case-work. Travel grants will enable individuals to meet for periods of two or three days at a time.

As discussed in the One-day-One-issue-Seminar in the Hague (16^{th} to 17^{th} April, 2004), two courses in statistics for forensic scientists are required. The first is a course which covers basic ideas of the laws of probability, variation, significance probabilities, interval estimation, regression and correlation, and analysis of variance. The second is a more advanced course which covers Bayesian inference, evidence evaluation and interpretation, multivariate analysis and Bayesian networks. The second course could only be attended by those who had attended the first course or a course equivalent to it (e.g. as an undergraduate).

There are also two factors relevant to support the vision. First, an infrastructure is needed to be a focus for research and education in this area with the provision of secretarial, computing and library facilities and the accompanying accommodation. Secondly, there is a need to provide suitable reference databases. Data of forensic relevance from criminal investigation are increasing. DNA databases exist. Glass databases exist. It is important that databases for other evidential types be developed as well.

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