Comments on AS5388.3-201X - draft Australian standard for interpretation (Part 3) of forensic analysis

Comments made by:

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I am Chairman of the Statistics and Law working group of the Royal Statistical Society. However, these comments are made in a personal capacity as time does not permit of a formal response by the group.

I compliment Standards Australia for attempting to set down standards for the interpretation of forensic analysis. I have been working in this area for many years and it is very difficult to determine how best to interpret data arising from investigations and forensic science. Standards Australia may wish to refer to two recent publications by the Royal Statistical Society (RSS):

Aitken,C.G.G., Roberts,P. and Jackson,G. (2010) Fundamentals of probability and statistical evidence in criminal proceedings.

Puch-Solis,R., Roberts,P., Pope,S. and Aitken,C.G.G. (2012) Assessing the probative value of DNA evidence.

These are both available as pdf files from the Royal Statistical Society's website:

http://www.rss.org.uk//statsandlaw

They are the first two of a series of reports to be published by the RSS under the general title of 'Communicating and interpreting statistical evidence in the administration of criminal justice', supported by the Nuffield Foundation. The other two reports, one on Bayesian networks and one on Case Assessment and Interpretation are due for publication in the next twelve months.

I presume Standards Australia are aware of the recent Law Commission of England and Wales report 'Expert evidence in criminal proceedings in England and Wales' to which I will make reference later.

There are two parts of the draft which I like. First, on page 7, section 5.2, it is noted that 'the processes by which such analyses are made shall be documented'. It is important that there is proper documentation of the analyses used, otherwise the perception of a black box becomes a reality. Second, on page 9 in section 8.1. it is noted that 'any identifiable and reasonable alternatives to the opinion should be documented as should the reasons for their rejection'. As you will read later, I believe it is important that at least two propositions for the occurrence of the evidence be considered. Thus, identifiable and reasonable alternatives have to be considered. However, in the spirit of considering the

likelihood of the evidence under at least two propositions, it is not clear that alternatives need to be rejected by the scientist. It should be the case that relative likelihoods for the propositions are quoted.

Recommendation 9.18(2)(c) on p. 142 of the report of The Law Commission of England and Wales on expert evidence, published in 2011 (LAW COM 325) is particularly pertinent here: it reads:

> 9.18: We recommend that Part 33 of the Criminal Procedure Rules be amended to include the following
>
> (2) a rule requiring an expert's report to include:
>
> (c) 'a rule that where an expert witness is called by a party to give a reasoned opinion on the likelihood of an item of evidence under a proposition advanced by that party, the expert's report must also include, where feasible, a reasoned opinion on the likelihood of the item of evidence under one or more alternative propositions (including any proposition advanced by the opposing party).'

Paragraphs 7.21 - 7.26 (pp. 112 - 114) provide further detail. it is clear that the Law Commission supports the idea of a comparison of the likelihood of the evidence under each of two propositions.

There are other various points in the draft where I have comments

- Page 5, Section 4.1 (b): There is a shift away from identification in forensic science, even with fingerprint evidence, towards an evaluation of evidence to suggest evidence supports a particular proposition over another proposition.
- Page 5: A two-stage process is not advisable in the evaluation of evidence as this may lead to a procedure which has been called 'falling off the cliff'. For example, a test of a null hypothesis of a common source may reject this hypothesis at the 5% level with a significance probability of 4.9% say. Alternatively, another test of a null hypothesis may not reject the hypothesis of a common source at the 5% level with a significance probability of 5.1% say. There is very little difference statistically between the outcomes of these two analyses but a large difference in legal terms.
- Page 8: Section 5.2, first paragraph on page: A question: the implication is that information derived from 'non-parametric statistical descriptors' is to be treated as opinion whereas if the information is derived from parametric descriptors it is to be treated differently. Is this so? If this is not the meaning of this piece of text then it needs to be rewritten.
- Page 8: Section 5.2 again: statistical analyses in the legal context are not used to estimate the likelihood of a hypothesis. Within the legal context, the scientist comments on the relative likelihood of the evidence under

each of two propositions. It is for the trier of fact (judge and / or jury) to determine the likelihood of the hypothesis.

- Page 10: Section 8.2: first paragraph: the implication is that a 'numerical probability' may be expressed as a 'likelihood ratio or as a frequency'. A likelihood ratio is not a probability. For discrete data it is a ratio of probabilities, for continuous data it is a ratio of probability density functions. A relative frequency, as an estimate of a probability, is used to estimate the probability of finding a characteristic on an innocent person in some relevant population. It makes no comment on the probability of finding the characteristic on a guilty person. This latter probability need not be equal to one (e.g., in a case involving DNA mixtures). Quotation of a relative frequency in isolation can be very misleading.

- Page 10: Section 8.2: fourth paragraph: The statement 'X (evidence) is more likely if Y rather than Z' is fine though better expressed as 'the evidence is so many times more likely if Y rather than Z', using a numerical value rather than the general phrase 'more likely'.

- Page 11: the expression of Bayes Theorem is presumably a misprint. It is also incomplete. The letters E and H need to be defined for clarity. I recommend:

  Let E denote evidence and H a proposition about the origin of the evidence. Then Bayes Theorem states that

  $$Pr(H \mid E) = \frac{Pr(E \mid H) \times Pr(H)}{Pr(E)}.$$

  It is better still to use the odds form of Bayes theorem. Let H_p and H_d denote the prosecution and defence propositions, respectively. Then

  $$\frac{Pr(H_p \mid E)}{Pr(H_d \mid E)} = \frac{Pr(E \mid H_p)}{Pr(E \mid H_d)} \times \frac{Pr(H_p)}{Pr(H_d)}.$$

- Page 13: In statistics, a parameter is a characteristic of a population, for example a population mean. A statistic is a function of data, for example, a sample mean and is used as an estimate of a parameter. It is not correct to say that a parameter is a statistic calculated from data.

- Page 14: Probability (a): you should emphasis that the relative frequency is measured when repeating the experiment *under identical conditions*. These conditions are impossible to create in realistic situations.

CGG Aitken

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