

## Dear Colleagues,

Probabilistic descriptions of uncertainty such as probability values and probability distributions can themselves be uncertain. To express this, terms and concepts like 2<sup>nd</sup>-order uncertainty, model uncertainty, epistemic uncertainty, and uncertainty quantification have been employed. A burst of activity in such topics includes a number of relevant special issues that have recently appeared or will soon appear. These include *Reliable Computing* 9 (6), *Reliability Engineering and System Safety* (forthcoming at this writing), *SIAM Journal on Scientific Computing* (forthcoming), and now this second special issue of *Reliable Computing*. This issue features three peer reviewed papers described briefly in the following paragraphs.

It is a fact that an  $n$ -digit number beginning with 9 tends to be less prevalent than the same number except with its leftmost digit changed from 9 to 8. Similarly, numbers starting with 8 tend to be less common than those starting with 7, and so on. This seemingly odd fact is easily checked by using a Web search engine to find out how many occurrences of various numbers are present on the Web. It was discovered as early as 1881 as a result of the observation that pages of logarithm tables containing numbers starting with lower-valued digits were dirtier (i.e. more heavily used). Applications include detecting faked data, generating pseudo-random numbers, and intelligent number rounding. In “Dirty pages of logarithm tables, lifetime of the universe, and (subjective) probabilities on finite and infinite intervals,” Nguyen, Kreinovich, and Longpré present an explanation for this phenomenon using interval computations.

Discrete, numerical approaches to representing probability distributions are flexible because a wide variety of distributions can be expressed. When these numerically expressed distributions are marginals of joint distributions, a corresponding numerical representation of the joint distributions is possible. Discretization tends to cause error, but this error can be bounded if the supports of distributions are partitioned into intervals instead of sampled by point values. However, the non-overlapping nature of a partition will likely not be present in the result if each element of one partition is combined (e.g. with +, −, \*, /) with each element of the other. This combining operation is a key step in bounding the distribution of a random variable whose samples are a function of samples of the marginals. In “On the use of Random Set Theory to bracket the results of Monte Carlo simulations,” Tonon grounds this phenomenon of overlapping intervals in the framework of the theory of random sets, and compares the results to those obtained through the Monte Carlo approach.

Use of intervals to partition the supports of marginal distributions, and applying the Cartesian product approach of combining each interval in one marginal with each interval in another is the foundation of other techniques for numerical manipulation of distributions as well. The Cartesian product of sets of intervals that partition marginals leads to extreme cumulative distribution functions (CDFs) that bound a space of plausible CDFs. The bounded space is sometimes called a probability box, a p-box, a bounded CDF family, or envelopes. The extreme CDFs are sometimes called envelopes or bounds, and distinguished by the terms left and right, northwest and southeast or, more ambiguously, upper and lower. Envelopes are relatively close together if the marginals are independent and farther apart if no dependency relationship is given. In “Using Pearson correlation to improve envelopes around the distributions of functions,” Berleant and Zhang show how using correlation to partially specify the dependency relationship can yield envelopes of intermediate separation.

*Reliable Computing* is pleased to take this opportunity be a part of the growing interest in these matters.

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