Journal of Intelligent & Fuzzy Systems 15 (2004) 135
IOS Press

Book review

Fuzzy statistics, James J. Buckley, Springer-Verlag, Berlin-Heidelberg, 2004, EUR 96.25, ISBN 3-540-21084-9

For every sample $x_1, \ldots, x_n$, traditional statistical methods provide us with estimates for different characteristics of the corresponding probability distribution. For example, for the mean μ, a natural estimate is the arithmetic average

$$\frac{x_1 + \ldots + x_n}{n}.$$

Statistics allows us to produce not only point estimates; it also allows us, given a confidence level α, to produce *confidence intervals* that contain the actual (unknown) value of the characteristic with the probability $1 - \alpha$. For different confidence levels, we get different intervals: the smaller the degree of confidence α, the wider the intervals. As a result, for each characteristic, we get a nested family of intervals corresponding to different values of α.

It is known that a fuzzy set can be uniquely determined by a nested family of intervals: namely, by the family of its α-cuts corresponding to different values of α. Thus, the nested confidence intervals can be viewed as α-cuts of the corresponding fuzzy set. This fuzzy set is called a *fuzzy estimator* for the corresponding statistical characteristic.

The advantage of this representation is that, instead of generating and processing a *single* confidence interval (or, as is sometimes done, *several* different confidence intervals), we can now handle *all* the confidence intervals at the same time when processing the corresponding fuzzy set. The author shows that this representation leads to useful and efficient algorithms for processing the corresponding fuzzy statistics. He shows this on the example of three types of statistical problems:

- estimating the sample's characteristics like mean and variance;
- estimating the differences between characteristics of different samples;
- testing statistical hypotheses (e.g., that two samples are from the same distribution); and
- problems about the relation between different samples representing related quantities:
  - estimating correlation;
  - estimating parameters of linear regression;
  - using the linear regression to predict the value of one of the quantities based on the known values of the other quantities.

All algorithms are illustrated by Maple codes.

This book is very unusual and unique: it describes an unexpected and interesting use of fuzzy techniques in the area that, at first glance, seems to have nothing to do with the fuzzy logic – the area of statistical processing of non-fuzzy data.

Vladik Kreinovich
Book review Editor
Journal of Intelligent & Fuzzy systems