Model Averaging in Quantitative Risk Assessment

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The relation between exposure and the associated risk can be studied using dose-response models. Traditionally a model selected according to a goodness-of-fit criterion is been used for making inferences. Here we propose fractional polynomials as competitive dose-response models in risk assessment. The set of candidate models is chosen based on biological plausibility and rationale and the risk at a dose common to all these models is estimated using the selected models and by averaging over all models using Akaike's weights. In addition to including parameter estimation inaccuracy, as in the case of a single selected model, model averaging accounts for the uncertainty arising from other competitive models.

We consider two settings in quantitative risk assessment: the determination of a safe level of exposure in the area of toxicology and teratology, and the estimation of risk at low levels of exposure in microbial risk assessment. More precisely the method is illustrated on the determination of a safe level of exposure for Ethylene glycol (EG), a high-volume industrial chemical with diverse applications, and on the estimation of risk at low dose levels of *Salmonella* and *Campylobacter* in humans.

The variance estimate of the model-averaged parameter is looked at in more detail. A bootstrap-based method is proposed to estimate the variance of the model-averaged parameter. The performance of this method as compared to the classical approach is studied through a simulation study.

References

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