On Cumulative Residual Opinion Pools

A.E. Abbas, E. Salimi
Daniel J. Epstein Department of Industrial and Systems Engineering
Price School of Public Policy
University of Southern California

Abstract
The problem of aggregating expert opinion can be summarized as follows: Given an uncertain quantity, $\theta$, each of $m$ experts provides a probability distribution $p_i(\theta)$, $i = 1, 2, ..., m$. The decision maker is interested in incorporating the expert distributions to obtain an aggregate probability distribution for $\theta$. A Bayesian approach tackles this problem using a prior distribution for $\theta$ and a likelihood for each of the expert distributions, and then determines a posterior distribution given the expert opinion. Linear and log-linear pools have also been used to combine expert distributions. Formally the linear pool is defined as:

$$p(\theta) = \sum_{i=1}^{m} w_i p_i(\theta)$$

and the log-linear pool is defined as

$$p(\theta) = \prod_{i=1}^{m} p_i(\theta)^{w_i}$$

where $p(\theta)$ represents the aggregated distribution and $w_i$ is the weight associated with expert $i$'s opinion.

One of the issues that arises with the log-linear pool is that when an expert assigns a probability of 0 to any event, the aggregate pool distribution also assigns a probability of zero to that event.

Abbas (Abbas 2009) provided an interpretation of linear and log-linear pools as the distributions that minimize the weighted sum of Kullback-Leibler divergence to and from the expert distributions (respectively). Recently Rao (Rao, et al. 2004) proposed a cumulative residual entropy measure and Baratpour and Rad (Baratpour and Rad 2012) proposed a cumulative residual divergence measure. In this paper we explore the properties of aggregate distributions using a weighted some of cumulative residual Kullback-Leibler divergences. We term these aggregate distributions, the cumulative residual opinion pools.

Key words: Cumulative residual entropy, opinion pools, maximum entropy

References