The Wisdom of the Crowd and Higher-Order Beliefs

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The classic wisdom-of-the-crowd problem asks how a principal can “aggregate” information about an unknown state of the world from agents without understanding the information structure among them. Such aggregation obviously has large social and private value, especially when it concerns important social or economic events. Therefore, it is important to understand the limits of such an exercise: without specific assumptions on the information agents have, how can we aggregate it? Classic results by Prelec et al. [2017] (henceforth PSM) and Arieli et al. [2017] show that even when agents’ signals are i.i.d. conditional on the state, knowing the first-order beliefs of even an infinite set of agents is generally not sufficient to learn the state. In the terminology of econometrics, there is an “identification problem.”

We propose a new simple procedure, Population-Mean-Based Aggregation, which only requires agents to communicate their beliefs about the state, and also some agents to communicate their expectations of the population average belief. The procedure can accommodate correlations in agents’ information, misspecified beliefs and any finite number of possible states of the world. This procedure can also be used for elicitation, i.e., to give agents strict incentives to truthfully report their beliefs about an unobserved state of the world.

The basic idea is intuitive. Consider the case of binary states and conditionally i.i.d. signals. By the law of large numbers, the population average belief must equal the expected belief in that state. If the principal knew the expected belief in each state, they could simply compare with the average among agents to learn the state. Suppose the principal asked two agents with different beliefs for their expectation of the population average belief. By the law of iterated expectations, each reports the weighted average of the expected belief conditional on the state, weighted by their (different) likelihood of the two states. This is a simple system of two linear equations in two unknowns; thus the expected beliefs in each state can be recovered. We show in what follows that this basic idea is much more applicable. With a view to using such procedures in practice, we construct a robust variant which accommodates agents being misinformed about the population distribution of beliefs. We show that aggregation remains possible as long as the average amount by which agents are misinformed about others’ beliefs is smaller than the true difference in state contingent averages.

The idea of eliciting and using higher-order beliefs is not new: In our context, we note the elegant “Surprisingly Popular” (herein, SP) procedure developed by PSM, who pioneered the use of second-order beliefs for the purpose of information aggregation. We discuss the relative advantages and disadvantages of our mechanism with respect to SP in the full paper. In particular, our mechanism can explicitly handle robust aggregation, as outlined above, and any finite number of possible states of the world. Finally, we provide evidence that this procedure performs well on the experimental data of Prelec et al. [2017], which they graciously provided us with. Despite their experiment not being optimized for our procedure, we show that our procedure performs comparably well to the SP procedure on the data.

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