Towards Optimal Effort Distribution in Process Design under Uncertainty, with Application to Education

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Abstract

In most application areas, we need to take care of several (reasonably independent) participants. For example, in controlling economics, we must make sure that all the economic regions prosper. In controlling environment, we want to guarantee that all the geographic regions have healthy environment. In education, we want to make sure that all the students learn all the needed knowledge and skills.

In real life, the amount of resources is limited, so we face the problem of "optimally" distributing these resources between different objects.

What is a reasonable way to formalize "optimally"? For each of the objects, preferences can be described by utility functions; see, e.g., Luce and Raiffa (1989): namely, an action is better if its expected utility is larger. It is natural to require that the resulting group preference has the following property: if two actions has the same quality for all participants, then they are equivalent for the group as well. It turns out that under this requirement, the utility function of a group is a linear combination of individual utility functions.

To solve the resulting optimization problem, we need to know, for each participant i, the utility resulting from investing effort e in this participant. In practice, we only know this value with (interval) uncertainty. So, for each distribution of efforts, instead of a single value of the group utility, we only have an interval of possible values. To compare such intervals, we use Hurwicz optimism-pessimism criterion well justified in decision making Hurwicz (1951); Luce and Raiffa (1989).

In the talk, we propose a solution to the resulting optimization problem.

References

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