

## **Title: Equal quantile rule in resource allocation with uncertain demand**

### **Abstract:**

Consider that agents have uncertain demands on a resource, and an allocation of the resource has to be made before the uncertainty resolves. A planner, on one hand, wants to satisfy the demands of agents, and on the other, wants to avoid potential waste generated when the realized demands fall short of the allocated amount. Imagine that for each single demand or each profile of demands, the planner selects the “optimal” allocation that minimizes the sum of the cost of unsatisfied demands and the cost of generated waste. When the two costs are linear, the optimal allocation rule is the one that ensures all agents to have equal probabilities of being satisfied, with the probabilities bounded by a ratio that depends on the unit costs of unsatisfied demands and waste. We call such a rule an equal quantile rule. We show that the class of equal quantile rules are the only allocation rules satisfying four familiar axioms --- Strict ranking, Continuity, Consistency, Lower composition --- and Ordinality which requires an allocation be invariant under any continuous and increasing transformation of the measuring unit of the demands.