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ESTIMATING THE RANDOM ARRIVAL RULE IN BANKRUPTCY: A CASE STUDY

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ABSTRACT

A bankruptcy problem (O'Neill, 1982) is an interactive situation in which several agents claim a portion of a good larger than the one available. These situations take the name from a very common problem in Economics as the bankruptcy of a company. In particular, the existence of several creditors that claim a fraction of a total estate is fundamental. Thomson (2015) provides a complete survey on this topic. A main goal in this class of problems consists of determining how we must divide the resource among all those agents who have claims on it. One of the most notable cases is the random arrival rule.

Although the random arrival rule has been analysed from a theoretical point of view in several papers (see Hwang (2015), for instance), its obtaining makes into a hard task when the number of involved agents enlarges. The main drawbacks concerning the random arrival rule for bankruptcy problems, similar to the ones described for obtaining the Shapley value of general TU-games, are computational. For large-scale problems, determining this rule substantially complicates since the complexity exponentially increases with the number of agents. In fact, Aziz (2013) provides an algorithm to determine it, but only for the special case of integer claims. Nevertheless, it does not solve the computational problem for the calculation in practice when considering large sets of real-valued claimants. Due to the wide applications of bankruptcy theory to real world, where exact solutions are often not possible in practice, sampling techniques (Cochran, 1977) become a useful alternative tool.

This work addresses a sampling methodology to estimate the random arrival rule in bankruptcy situations, based on simple random sampling with replacement. It is an adaptation of the procedure in Castro et al. (2009) for estimating the Shapley value of TU-games. It is especially useful when dealing with large-scale problems. This procedure is analysed by establishing the theoretical statistical properties and bounds for the incurred error. We evaluate this tool on examples for which this allocation rule can be exactly calculated. Finally, we apply this sampling method to provide a new system of quotas for the milk market in Galicia (Spain) after the suppression of the European regulation in 2015.

Key words and sentences: Bankruptcy, random arrival rule, sampling, game theory.

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