**The Impact of Familiarity Network on Equilibrium Bidding in Auctions**

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Auction theory has succeeded in converting abstract game theoretic insight into notable practical importance (List & Shogren, 1999). The simplified form of buyer-seller interaction they embody is closely related to more complex forms of economic interaction (Easley & Kleinberg, 2010), from Renewable Energy Procurement (Anatolitis, Azanbayev, & Fleck, 2022) to display ads on search engine (Varian, 2009). It helps to allocate resources efficiently and ensuring that they end up in the hands of those who value them the most.

At a typical summer weekend country auction in New England, over half those in attendance are likely to be tourists and another quarter nonprofessional locals (Smith, 2002). This intriguing context is shaped by the distinctive composition of the audience, where locals benefit from a sense of community cohesiveness and a familiarity network. The close-knit relationships among locals fostered by their shared geographic and social context contribute to know each other’s valuations more. In contrast, tourists, unfamiliar with the local community and each other, may lack the same degree of interconnection. The more closed to outside buyers a dealer-dominated auction is, the more it operates like an exchange auction; the more open it is, the more it resembles a sales auction.

What’s more, this context can be extended to the fashion online world, where it’s typically considered anonymous and symmetrical for bidders. In such a setting, bidders may not necessarily be human; we face rivals such as auto-bidding robots equipped with specific algorithms. For instance, in online ad auctions, robots strive to maximize their value, focusing on metrics like the number of clicks/conversions, while adhering to a minimum admissible ratio based on the return-on-investment constraint, using similar algorithms (Deng, Mao, Mirrokni, Zhang, & Zuo, 2022). Thus, despite humans being unfamiliar with each other, algorithms themselves may share some similarities in valuations and bidding strategy, akin to the earlier example of locals and tourists.

A bidder’s belief about the informational landscape of rival’s emerges as a crucial determinant of bidding strategy. While information acquisition in auctions has been an important issue in existing literature, few studies investigate the acquisition of information about other bidders (Kim & Koh, 2020). Knowing other bidder’s information proves pivotal for bidders, providing a dual advantage. First, bidder with more information can estimate the value of an auctioned object more precisely, gaining an informational advantage; second, they can better predict their rival’s bidding strategy (which depends on the latter’s information), gaining a strategic advantage.

To address the impact of familiarity network in auctions, this paper lies at the intersection of the literature on auction theory and familiarity network. To the best of our knowledge, there’s none milestone work that was specifically discussing this topic in previous literature, which makes our work interesting and groundbreaking.

Several recent studies have also emphasized the role of bidder asymmetries. A typical finding is that revenue is more sensitive to asymmetries (and is lower) in the second-price auction than in the first-price auction, providing an argument for the superiority of the first-price auction. For example, (Kim & Koh, 2020) studied costly learning rival’s information in the first-price or second-price auction, in which two bidders with each observes a binary signal. Only when the learning cost is low or values are sufficiently interdependent, there’s a efficiency/revenue trade-off, otherwise first-price auction is better. As an improvement, (McClellan, 2023) focuses on information disclosure, studied second-price common-value auctions in which one bidder may be an expert with access to more precise information about the value of the good. One can decrease revenue sensitivity via design of how much information bidders have about their opponents while keeping the second-price auction format.

These studies demonstrate the importance of information, as well as the potential benefits of gaining a deeper understanding of this setup’s mechanism. Our work different from the above in a sense that we consider free ”learning” process (it’s known for the locals by prior knowledge) and in the setting of private auction with heterogeneous n bidders.

Our work aims to characterize the asymmetry bidders by familiarity network, another settingup other than consider an ”expert” bidder, who knows exact the valuation of the good in common value auction, or costly learning your opponent as for firms. The research objectives are to theorize and compare the impact of familiarity network to bidding strategies on equilibrium in standard auctions. Provided with potential applications including efficient auction mechanism design when auctioneer e.g., government, entering a new market selling natural resources or financial assets. The scope of this research covers the analysis of the auctions with familiarity network with different settings. From n = 3 with a couple(perfect knows each other’s valuation) and a stranger to different level of familiarity with several clusters (unions).