# DISSERTATION PROPOSAL

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## "Essays on Contemporary Matching and Allocation Problems"

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In this thesis, I investigate the contemporary problems arising in various matching and allocation settings. In the first chapter, I provide remedies to overcome size-based disparities in liver allocation system. In the second chapter, I study the existence of popularity bias in the recommendation systems of online dating platforms. In the third chapter, I aim to investigate the implications of users' privacy concerns in two-sided matching platforms.

In the first chapter, we consider the problem of achieving a fairer liver allocation system where there are size-based disparities in organ access. Shorter patients in liver transplant waitlists have higher average waiting times and mortality rates while waiting for a transplant compared to taller patients because they can receive liver transplants from a narrower organ size range. We model the transplant waiting list as a multiclass fluid model of overcrowded queues. We focus on equalizing the likelihood of receiving a transplant objective for three different patient classes based on height. The optimal policy, Equity Adjusted Mortality Risk Policy, ranks patients according to their patient classes and dropout probabilities to allocate deceased-donor livers. Motivated by this optimal policy, we propose exception points to short patients' Model of End-Stage Liver Disease (MELD) scores to artificially move them to higher positions in the transplant waitlist to achieve equal likelihood of receiving an organ transplant for all patients. Our numerical results show that the short patients' average waiting time until receiving a transplant and number of dropouts while waiting for a transplant can decrease drastically (12.44% and 7.81%, respectively) with a modest increase in these measures for tall patients (4.29% and 6.76%) and a negligible increase for medium patients (1.14% and 1.78%) with the implementation of our proposed policy. We lay the groundwork for reducing the effect of other disparities in liver transplant waitlists including blood type, etymology and gender.

In the second chapter, we study whether online dating platforms have an incentive to have biased recommendations against unpopular users and if so, how such bias affects users' matching probabilities on the platform. We model the problem as a three-stage matching game. In the first stage, the platform recommends a fixed number of users to each user depending on its objective. In the second stage, users decide whether to send a proposal to each recommended user anticipating the probability of their proposals being reciprocated. Finally, in the third stage, users decide whether to accept incoming proposals from the second stage of the game. In our model, popular users are more selective in sending and accepting proposals (due to having better options on other dating scenes) and users' probability of rejecting proposals increases as they receive more proposals (due to the cost of evaluating each proposal). Our analysis shows that the platform's revenue-maximizing recommendations and the match-maximizing recommendations are not necessarily at odds even though the revenue-maximizing platform leads to higher bias against unpopular users resulting in suboptimal matching probabilities for them. Popular users drive a higher revenue for the platform and increase the number of successful matches on the platform as long as they are not highly selective in sending and accepting proposals. Finally, unbiased (random) recommendations result in significantly lower number of proposals and number of matches on the platform compared to the revenue-

maximizing and match-maximizing recommendations when users' probability of rejecting proposals stays unchanged. Therefore, online dating platforms should take users' behavior on sending and accepting proposals into account while making recommendations.

In the third chapter, I aim to investigate the implications of users' privacy concerns in two-sided matching platforms. Users share their identity-related information, credentials and personal preferences to find higher quality matches, e.g. better jobs in freelancer platforms or more compatible dating partners in matchmaking platforms. However, disclosing information comes at the expense of social privacy risk due to information being exposed to other users on the platform, and institutional privacy risk due to information being sold to third-party companies and leakage to unauthorized people. Using a search-theoretic model where ex-ante homogeneous users meet randomly, I plan to characterize users' behavior on how much information to share in the symmetric equilibrium where the search is costly. I deviate from the current literature on matching which commonly assumes that the users can observe the idiosyncratic utility from a potential match before it occurs. In reality, users receive noisy signals for the true value of a potential match and the magnitude of this noise depends on the information available to the user. Users can only observe the true value of a match after the match occurs. I conjecture that the users share no personal information on the platform in equilibrium when the idiosyncratic utilities that two users receive from a match are different and independent of each other. The reason is that the user who discloses information bears the privacy risks, and creates a positive externality for other users by enabling them to receive a less noisy signal from her profile. However, she does not benefit from this externality because her utility from the potential matches does not increase due to independence. Therefore, a positive correlation between the idiosyncratic utilities is necessary for users to disclose information so that the users who would show interest to match would be more likely to give a higher utility to the user who shares information. Next, I propose to extend the model where the platform uses a recommendation algorithm depending on their observable characteristics. Receiving only a few recommendations in every period, the platform restricts users' choices which decreases the social privacy risk on the platform. This might lead users to share more information which would potentially increase the social welfare. However, it might also lead users to reject 'good enough' matches knowing that they are more likely to find the 'best' when more information is available. This might result in a decrease in the social welfare due to search costs and privacy risks. My aim is to explore how the platform's design (unrestricted choice or restricted choice) and objective (maximizing revenue or maximizing social welfare) would shape users' behavior on disclosing their personal information.