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A stochastic dynamic programming approach to decision making in arranged marriages☆

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ABSTRACT

We employ a stochastic dynamic programming approach to study decision making by an individual wishing to have an arranged marriage. First, we show that this individual never opts out of a voluntarily agreed upon marriage. Second, we demonstrate that our marrying individual uses a reservation utility to determine which marriage proposal to accept. Third, we compute the expected length of time during which our marrying individual stays single. Finally, we focus on an arranged marriage market in which there are many identical marrying individuals and profit maximizing matchmaking firms. We show that profit maximization implies that all matchmaking firms offer marriage proposals whose utility equals the reservation utility of our marrying individuals.

1. Introduction

In "love marriages", men and women who wish to get married search for a bride/groom and this activity is generally conducted by the two individuals who are interested in getting married. In contrast, in "arranged marriages", the individuals who wish to get married typically do not conduct any search activities by themselves. Instead, the process of searching for a suitable bride or groom is conducted by parents, family, and, in recent times, increasingly by matchmaking firms. As noted by Batabyal [1], it is a routine in many contemporary arranged marriages for the well-wishers of a marrying individual to bring appropriate marriage proposals to this individual for his or her approval. If a specific marriage proposal is approved then the search process concludes. If the proposal is not approved, then the search process continues.

Arranged marriages have been studied by researchers in several disciplines. Examining arranged marriages within the Tamil Brahmin diaspora, Kalpagam [2] notes that the matrimonial strategies employed and accepted by all the pertinent parties still reflect deep gender asymmetries. Lu [3] analyzes the activities of matchmakers in arranged marriages in Taiwan and points out that these activities go beyond mere commercial activities and involve other types of social relations that are sustained throughout a marriage. Wolf and Gates [4] focus on Taipei, Taiwan and notice that the differential marriage rates of urban and rural women can be explained by the greater demand for female labor in the city and not by the increased freedom of women to refuse marriages arranged by their parents. Banerjee et al. [5] point out that because both sides to an arranged marriage have a strong preference for a "within caste" marriage and because these two sides are fairly homogeneous in terms of the distribution of other attributes, caste remains a persistent feature in the Indian arranged marriage market.

Although the papers discussed in the previous paragraph have advanced our understanding of arranged marriages, they have shed little light on the *theoretical* aspects of decision making in arranged marriages. Recently, a small literature

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has begun to formally analyze decision making in arranged marriages. Using the so called "one-stage-look-ahead-policy", Batabyal [6] shows that a marrying individual's optimal decision rule depends only on the nature of the current marriage proposal, independent of whether there is recall of previous proposals. Batabyal [7] analyzes decision making in arranged marriages with an age constraint and demonstrates that it is optimal to wait a while before saying yes to a particular marriage proposal. Vaillant and Harrant [8] have used the theoretical framework in Batabyal [7] to empirically study the functioning of a French matchmaking agency. Batabyal and DeAngelo [9] study arranged marriages from the perspective of a matchmaker and provide conditions under which it is optimal for this matchmaker to either accept or reject individual matching assignments. We continue this theoretical investigation of arranged marriages begun by the researchers mentioned above. Specifically, we use a stochastic dynamic programming approach adapted from [10] to analyze aspects of decision making in arranged marriages that have been insufficiently studied in the literature. Our approach can also be thought of as a "search-theoretic approach". First, we use our theoretical framework to show that *an individual* wishing to have an arranged marriage never opts out of a marriage that he has voluntarily entered into. Second, we demonstrate that our marrying individual uses the notion of a reservation utility to determine which marriage proposal to accept. Third, we compute the expected length of time during which our marrying individual stays single (unmarried). Finally, we focus on an arranged marriage *market* in which there are many identical marrying individuals on the demand side and profit maximizing matchmaking firms on the supply side. We show that profit maximization implies that all matchmaking firms offer marriage proposals whose utility equals the reservation utility of our marrying individuals.[1]

The rest of this paper is organized as follows. Section 2 delineates the theoretical framework. Section 3 studies the use of the concept of a reservation utility by our marrying individual to determine which marriage proposal he ought to accept. Section 4 calculates the mean length of time during which our marrying individual is single. Section 5 first focuses on an arranged marriage market and then demonstrates a logical implication of profit maximization by the matchmaking firms under study. Section 6 concludes and suggests ways in which the research in this paper might be extended.

2. The theoretical framework

Consider an individual who wishes to have an arranged marriage and who has a utility function defined over the *quality* of marriage proposals. This individual can be male or female. However, in most arranged marriage settings, males tend to have more bargaining power than females. As a result of the investigative activities of this individual's family, friends, and matchmakers, marriage proposals of uncertain quality are brought to our marrying individual. The qualities of these marriage proposals are *random* variables whose domain is a closed interval in the set of non-negative real numbers. Because our marrying individual's utility function maps stochastic proposal quality to utility, the utilities generated by the marriage proposals of uncertain quality are themselves *random* variables with domain $[0, \hat{u}]$. Denote the distribution function of these utilities by $H(u)$. Let β be the time invariant discount factor; this invariance is needed for the validity of our subsequent mathematical analysis. Time is discrete. From the standpoint of our marrying individual, $H(u)$ is an exogenously given stationary distribution of utilities. The reader may want to think of our marring individual as someone who "samples" utilities from the $H(u)$ distribution. This marrying individual's aim is to maximize the net present discounted value of his utility stream. Once our marrying individual accepts a specific utility, i.e., once he accepts a marriage proposal of a particular quality, he can stay married to the person behind this marriage proposal for an indefinitely long period of time.

Our task now is to formulate our marrying individual's intertemporal maximization problem. We do so recursively with the maintained assumption that once our marrying individual finds a marriage partner and gets married, he never leaves his partner. Using stochastic dynamic programming (see [13] and, for a more recent exposition, [14]), the recursive problem of our marrying individual who currently has utility u can be written as

$$V(u) = \max\left[u/(1-\beta),\ \beta\int_0^{\hat{u}} V(\tilde{u})\mathrm{d}H(\tilde{u})\right], \tag{1}$$

where $V(\cdot)$ is the value function. Eq. (1) is sometimes referred to as the optimality equation. We now show that our marrying individual never opts out of a marriage that he has voluntarily entered into.

3. Never leave an acceptable marriage partner

Mathematically, demonstrating the above involves showing that once our marrying individual accepts a proposal with a particular utility and gets married, he never leaves the person behind this particular utility. Notice that if our marrying individual accepts a marriage proposal with utility u at time t, then we must have

$$u/(1-\beta) \geq \beta\int_0^{\hat{u}} V(\tilde{u})\mathrm{d}H(\tilde{u}). \tag{2}$$

[1] There exists a small literature on stable matching and the marriage problem. See [11,12] for additional details on this literature.