

Mathematical modeling of dating market

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Abstract

Nowadays, it has become much easier to establish contact with any person, and as a consequence, one would like to think that the satisfaction with marriages (and as a consequence, their stability should have increased). Nevertheless, in the experience of most developed countries we can observe that this assumption is erroneous. Part of this can be explained by cultural change, but it is interesting to see to what extent the availability of dating itself affects the number of stable couples. This paper constructs a mathematical model describing the process of finding a partner, and presents the results of experiments conducted on networks of different structure, allowing us to formulate new hypotheses concerning the number of stable marriages in different social contexts and the influence of globalization on the problem of optimal partner choice

1 Extended abstract

Before the advent of the Internet, dating a guy and a woman presented significant difficulties for both men and women due to geographical limitations. First, it was often impossible to get connection in any way other than by meeting in person, and second, it was impossible to keep contact in any way other than by meeting in person. Moreover, the geographical location imposed some restrictions on the partners with whom there is a chance to meet: (say, a villager could not meet a girl from another country, but only with the inhabitants of neighboring villages). Now it has become much easier to get acquainted: with the help of social networks and dating apps it is possible to find the most attractive people and make connection without additional costs almost anywhere in the world. Nevertheless, addition knowledge does not make couples stronger and more stable, but rather the opposite: fewer marriages are formed and the number of divorces is increasing (both in the EU[1] and in Russia[2]). Thus, excessive knowledge, on the contrary, leads to fewer satisfied agents. In an attempt to explain this phenomenon, this paper examined two phenomena that may have an effect on the number of stable couples. The first phenomenon is selectivity. We will define selectivity as the proportion of acquaintances of an agent that shows what percentage of acquaintances it is permissible to be matched with. It has been experimentally shown that males and females have different selectivity: while in males it grows linearly with the number of females observed, in females the number of admissible partners grows slower than linearly with the number of partners observed[3]. The second important phenomenon is globalization. If earlier all dating with a high probability took place only within one community (and was limited by geographical location), now these restrictions are largely absent. Applying these two phenomena to my work leads to a description of the behavior of the size of stable matching.

1.1 Mathematical model and observation

Let us introduce the following mathematical model: Let there be a set of men M and a set of women W . Each man $m \in M$ has strict and equal preferences \bar{P}_m on the set of all women, and each woman in turn has strict and equal preferences \bar{P}_w on the set of all men. Then let us call the preference profile \bar{P} . The males are combined with females and females with males, thus forming a bipartite graph. This graph is random (similar models are common in the literature, e.g. [4,5,6,7]). For the selectivity of men we will consider a certain parameter q_m denoting a share of women known to a man, with whom he is ready to mate. The similar coefficient for women is q_w . According to some experimental results, the selectivity of women and men may be different, which will be discussed in this paper[3]. In this situation we will consider 4 models of dating graph formation:

- Erdős-Rényi -type model (each man generates k acquaintances that are equally and independently distributed on the set of women or each edge of a bipartite graph is formed with probability p).
- Preferred attachment-type model (the graph is constructed in iterative way: each new man forms connections with k women, but the probability of forming connection with a particular woman is proportional to the number of men who already know her)
- Small-villages model: the whole community is divided into several villages. Each male as in the Erdős-Rényi model generates k links, but with probability $q > 0.5$ a link is made within a village and with probability $1 - q$ an edge is formed equally likely with any from the population.
- Distance graph model: men and women are located on some geometric space with distance (plane). We consider the cases when a man knows k nearest women and when the edges is forming between agents close enough in distance terms.

Under such conditions we consider, at first, the size of a stable pairing, and at second, the probability of getting into this matching depending on overall ranking of agent. This work shows the dynamics of the size of a stable matching (according to the Gale-Shapley algorithm it's size will be the same for any stable partition in a particular graph), and also considers the negative and positive effects of the number of edges formed by one agent and the presence of a phase transition in the probability of being part of a stable matching depending on the place in the overall ranking.

References

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