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The Prisoner's Dilemma in Modern Dating: A Game-Theoretic Analysis of Distributed Online Dating Platforms

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ABSTRACT

Online dating has revolutionized how people meet potential partners, with approximately 38% of single American adults having experimented with it. While location-based services have enhanced these platforms' popularity, they often fail to promote genuine interactions, instead fostering a culture of superficiality. This paper examines the application of game theory, specifically the Prisoner's Dilemma and Nash Equilibria, to modern dating platforms. Through analysis of user behavior patterns and market dynamics, we demonstrate how current platform structures lead to asymmetric equilibria where men adopt indiscriminate matching strategies while women become increasingly selective. We examine existing solutions implemented by various dating platforms and propose a novel rating-based feedback mechanism to promote more genuine interactions. Our findings suggest that current dating platform dynamics often result in a "tragedy of the commons" scenario but can be improved through carefully designed mechanisms that align individual incentives with collective benefits.

Keywords: game theory, prisoner's dilemma, online dating, nash equilibrium

INTRODUCTION

Online dating has become immensely popular, with about 38% of American adults who are “single” having experimented with it. Location-based services have long been touted as a commercial revolution (e.g., hailing taxis), and hence these apps further gained popularity owing to the ability to discover and interact with nearby potential mates [1][2]. However, rather than promoting genuine interaction, it encourages more than anything a culture of superficiality and reduces the already difficult search for the desired companion to an anonymous slot machine generating so-called ‘matches’. These apps all together rarely seem to be able to live up to their self-proclaimed ambitions and virtues. These apps design their algorithms and caching systems [3-5] to optimize for engagement rather than meaningful connections - storing and recycling profiles that generate the most interactions, while potentially hiding equally compatible matches that don't fit their engagement metrics. While U.S. dating app users continue to increase, the rate of growth tends to be significantly less than that in past years.

The idea that a dating pool can be analyzed as a marketplace or an economy is both recently popular and very old: For generations, people have been describing newly single people as “back on the market” and analyzing dating in terms of supply and demand. Nash Equilibrium, a concept that is prominent in the realms of economics and Game Theory, fits well within the dating environment. Specifically, the dating market can be modelled in parallel to a famous application of Nash Equilibria called Prisoner’s Dilemma.

NASH EQUILIBRIA

Nash’s equilibrium is a simple concept that aids economists to predict how competing companies will set prices, how much to compensate an in-demand employee, and even how to design auctions in order to attain maximum profit from the bidders.

Nash Equilibria is a proposed solution of a non-cooperative game involving two or more players in which each player is assumed to know the equilibrium strategies of the other players, and no player has anything to gain by changing only his own strategy [3-5].

In other words, Nash equilibrium [6-8] is a configuration of strategies in a game in which no player has an immediate incentive to change his own initial strategy unilaterally. If two players Alice and Bob choose strategies A and B, (A, B) is a Nash equilibrium if Alice has no other strategy available that does better than A at maximizing her payoff in response to Bob choosing B, and Bob has no other strategy available that does better than B at maximizing his payoff in response to Alice choosing A.

Nash equilibria more often than not lead to collectively horrible outcomes:

- If two people can betray each other, without repercussions, they will - instead of trusting each other
- If two countries have access to nuclear weapons both will build up an arsenal instead of demilitarizing

All in all, it entails choosing a strategy keeping in mind the worst-case scenario i.e the other player might play an adverse move.

PRISONER'S DILEMMA

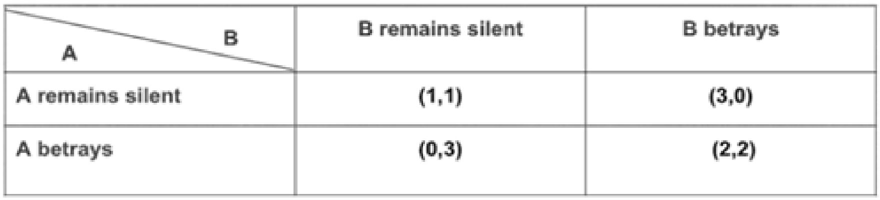
A famous example epitomizing Nash Equilibrium is the Prisoner’s Dilemma. Two members of a criminal gang are arrested and imprisoned. Each prisoner is in solitary confinement with no means of communicating with the other. The prosecutors lack sufficient evidence to convict the pair on the principal charge, but they have enough to convict both on a lesser charge.

Classical Scenario

Simultaneously, the prosecutors offer each prisoner a bar- gain. Each prisoner is given the opportunity either to betray the other by testifying that the other committed the crime, or

to cooperate with the other by remaining silent. The possible outcomes are (Fig. 1):

- If A and B each betray the other, each of them serves two years in prison.
- If A betrays B but B remains silent, A will be set free, and B will serve three years in prison.
- If A remains silent but B betrays A, A will serve three years in prison and B will be set free.
- If A and B both remain silent, both of them will serve only one year in prison (on the lesser charge).



B A	B remains silent	B betrays
A remains silent	(1,1)	(3,0)
A betrays	(0,3)	(2,2)

Figure 1: Prisoner's Dilemma Payoff Matrix

Collectively the wisest choice for both of them would be to not testify, with a total jail sentence of 1+1=2 months and both only being implicated for a minor offence. But unluckily this is not the Nash equilibrium of the prisoner’s dilemma. Irrespective of whether one expects to be betrayed by the other, betraying their partner is always more favorable for them. Hence unilaterally deviating from this strategy will provide no incentive to any player.

PRISONER'S DILEMMA IN DATING MARKET

These concepts of game theory [9-12] are applied to several scenarios of the dating market. Dating becomes a game, and certain strategies are developed throughout and equilibria are achieved.

The Tinder Case Study

Match group is the biggest player in the current dating market. It owns several dating apps like Hinge, OkCupid, Match.com along with Tinder. Tinder is the biggest revenue generator for this company as of 2024.

Tinder is a dating app that allows its users to find their potential ‘matches’ by swiping left or right on displayed user profiles. Swiping left signifies rejection whereas swiping right shows interest in the user profile. These profiles are preselected by a sophisticated algorithm which considers factors like user’s age preferences, location, appearance and some others.

Dating in Tinder is a game

Once a user signs in into this dating app he is prompted to complete his user profiles and preferences information. Then using this information certain user profiles are filtered and displayed from the user pool asking the signed in user to swipe left (reject) or right (accept) on a bunch of profiles displayed one after another. His choices are taken into account for further finding a potentially better ‘match’ for the user. After the user has shown his interest in a bunch of profiles, he is in the game. This game is now a matching problem:

When two users swipe right on each other, there is a ‘match’ and then they can start messaging each other. The user needs to swipe right on those profiles that have more chances of matching with him. So he needs a strategy.

Two major strategies of swiping left or right on the profiles are:

1) Strategy I: Honest Swiping: Based on genuine interest:
- Swipe right on people you like
- Swipe left on people you don’t like
- If you trigger a match, you will message them for further dialog

2) Strategy II: Dishonest Swiping: To game the system:
- Swipe right on everyone
- If you trigger a match, then you decide whether you like them or not

When both the players are honest swipers (Strategy I), neither will know the other’s opinion before making their own decision, and if a match results it will be genuine and should be activated as part of the intended play. Both win (mutual cooperation).

If both players play the dishonest strategy (Strategy II), a potentially meaningless match will be created. However, since both knew they were playing degenerate, they are aware that this match is likely meaningless. No one wins (mutual defection).

Once we closely look at this mutual defection scenario, we see that this doesn't really help the users individually as it doesn't give any beneficial information about the other since both are dishonest from the start. Even for the platform as a whole, this has a high chance of being a meaningless match and not resulting in any messaging or conversation between the players. If A plays as intended (honestly) and B plays dishonestly, B will get to make their decision with the pre-knowledge that A likes them, which is beneficial to them (temptation to defect). If B decides to reject A, he will get silence from someone who he believed did like him, which is a negative experience for them (sucker's payoff).

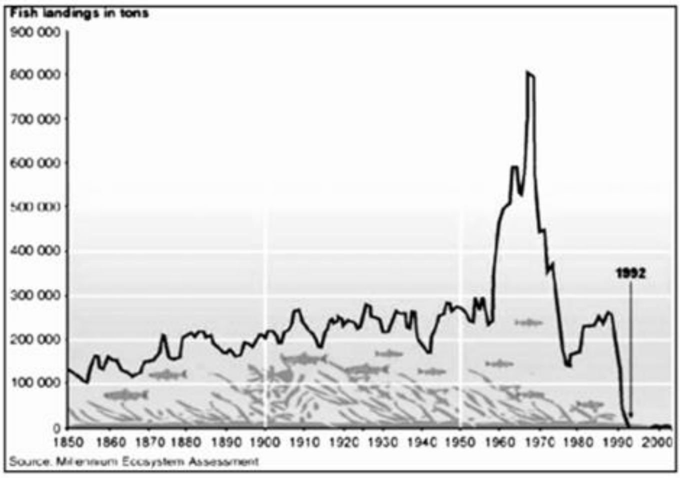
GENERALIZING TO N-PLAYER PRISONER'S DILEMMA

The n-player Prisoner's dilemma offers a straightforward way of thinking about the tension between the individual and in general people as a group. In the real-world the effects of cooperation or defection are often distributed diffusely to other users and not just with the person we are interacting with.

The Tragedy of Commons

It is a situation in a shared-resource system where individual users, acting independently according to their own self-interest, behave contrary to the common good of all users by depleting or spoiling the shared resource through their collective action.

An example of the tragedy of the commons [13-15] is overfishing. Each country that fishes international waters can increase its utility by taking more of the fish in this common resource, but as more and more countries overfish, the common stock is depleted beyond where it can quickly replenish and so in subsequent years all have less (Fig. 2).



Source: Millennium Ecosystem Assessment

Figure 2: Collapse of Atlantic cod stocks off the East coast of Newfoundland in 1992

In the case of dating markets, when a person defects, it doesn't affect only the person he betrayed but it also leads to an impact on the dating platform i.e Tinder which in turn affects other users as well. For an analogy, The platform Tinder is similar to International waters and it's users are the countries that overfish (defect - Strategy II).

OUR 'HIGHLY SKEWED' DATING MARKET

We know that the dating market is not balanced in terms of numbers of males or females, numbers of honest or casual swipers. This skewed nature affects the Nash equilibria for the system.

Analysis of User Activity on Tinder

Through data on almost half a million users, stark differences emerge between how men and women interact with the app. The curated male profiles like a large number of other users, but only match with a small minority (0.6%). The opposite can be seen for the female profiles, who attain a far higher matching rate (10.5%).

The Tinder Solution

To address these issues, Tinder has implemented several solutions:

- Introduction of Superlike feature (one per day)
- Algorithm rewards pickiness while de-incentivising excessive swiping
- Limiting the number of likes to 100
- Tracking whether matches initiate real conversation

EXISTING SOLUTIONS

Various dating platforms have implemented different mechanisms to address these issues:

Coffee Meets Bagel

Incorporates three different functionalities:

- Limited number of highly curated profiles
- Limited possible matches per day
- Paid “woo” button for signaling special interest

Bumble

Takes a different approach:

- Only female users can send the first text
- Men can match with only one woman per day
- Matches expire after 24 hours if no message is sent

Other Platforms

- Clover: Intention signaling and detailed search criteria
- Aisle: Limited invitation system
- DatingDNA: Pre-filtering criteria
- Fliqpic: Video-based matching
- TheCatch: Game-based selection system

PROPOSED SOLUTION - RATINGS VIA FEEDBACK MECHANISM

We propose a feedback system where users rate each other after dates or conversations.

The system includes:

- Objective feedback questions curated by experts
- Anonymous two-way feedback system
- Historical rating consideration
- Least Squares Regression Model for rating prediction

The two-way system ensures accountability for both users while maintaining anonymity. Higher ratings lead to prioritized matching, creating an incentive for honest behavior and deterring the use of Strategy II (betraying).

CONCLUSION

The application of game theory to online dating reveals fundamental issues in current platform designs. The Prisoner's Dilemma framework helps explain why users often adopt strategies that lead to collectively suboptimal outcomes. Our analysis shows how the current market structure creates asymmetric Nash equilibria where men tend toward indiscriminate swiping while women become increasingly selective.

The proposed rating-based feedback mechanism offers a promising approach to aligning individual incentives with collective benefits, potentially breaking the cycle of the N-player Prisoner's Dilemma that currently characterizes many dating platforms.

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