Rookie Dilemma and Seat Allocation: Applying the Deferred Acceptance Algorithm to F1 Driver Market Design

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Abstract. The research presented in this paper assumes the Formula One (F1) driver market as the research setting and focuses on the major problems that the current junior development system faces. The career development of the drivers is heavily reliant on team-based, Junior Driver Programmes in the current institutional structure. This means that young talents in the driver field can rarely get the best matches depending on their performance which consequently influences the level of competitiveness of the game as well as its market worth. In order to overcome these issues, the paper presents the Deferred Acceptance (DA) algorithm that was developed by Gale and Shapley, and on which the F1 driver market is based on. According to this scheme, the corresponding mechanism of the team and driver is restructured. In addition, the paper includes the problem of the economic incentive of the investment into junior development and suggests the methods of compensation, such as the transfer fee system and the revenue sharing system, to eliminate the risk of the inadequate investment towards teams. The results indicate that the suggested mechanism is capable of providing stable matching results, optimizing the efficiency of talent distribution, and increasing the competitive equilibrium. Simultaneously, it adds to the commercial value of F1 in general by raising its degree of uncertainty and creating the chances to see star drivers emerge.

Keywords: Formula one, Deferred Acceptance algorithm, stable matching, Sports Economics.

1 Introduction

One of the most commercially valuable sports in the world, Formula One (F1) finds the essence of its competitiveness not in the technological innovation and the organization of the event, but also in the effective distribution of driver talent. Nevertheless, as of now, Rookie drivers in this game are now grappling with two very significant issues.

To begin with, good results in junior categories are no longer a guarantee to their Formula One careers. The FIA Formula 2 Championship is currently considered the main and most well-known route to Formula One. However, according to the

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statistics of driverdb.com, nine seasons since the rebranding of GP2 to Formula 2 in 2017 have had 27 top three finishers, only 11 of which have received a full-time Formula One opportunity, which is only 40.74 per cent. What is even more interesting, this percentage has been decreasing over the last years. Of the three leading drivers in Formula 2, only 33.3% made the transition to Formula One between 2023 and 2025, with none making the transition in 2025. However, the recent rookie data of Formula One indicates otherwise. Of recent drivers joining the 2025 and 2026 seasons, Andrea Kimi Antonelli, Oliver Bearman and Arvid Lindblad all had a sixth-place highest showing in Formula 2. This difference means that no longer was performance in junior series the sole determinant of selecting drivers in Formula One. Second, the current junior development system is limiting drivers career paths more and more. One of the unique aspects of the Formula One driver market is that the majority of current drivers' employees are graduates of team-run Junior Driver Programmes. It is these programmes that identify, train and supply young talent, and assist drivers to join Formula One. Nevertheless, even though they seem mature, these systems have a number of structural challenges.

The use of the Deferred Acceptance (DA) algorithm in matching markets in the real world has remained a topic of study in recent studies. Doğan et al. present a systematic approach to applying the mechanisms of DA under the institutional constraints, which illustrates its applicability to the policy design [1]. Dreyfuss et al. add behavioral aspects to the DA model and demonstrate that the choice of individuals can be inconsistent with the theoretical predictions, but stable results can be strong [2]. More recent research by Cai focuses on the manipulability of the DA mechanism and concludes that its strategic features are conditioned by the market structure, and that under some conditions it is possible to preserve stability [3]. All in all, the literature testifies to the strength and broad applicability of DA mechanisms, in addition to the significance of real-world incentives and behavior. Their use in the sports markets, especially regarding the allocation of Formula One drivers, is, however, barely explored.

It is against this backdrop that, this paper will implement the Deferred Acceptance algorithm to redesign the current matching mechanism and also suggest two compensation schemes to counter the economic issues that may arise. The research is not only an expansion of the matching models into the realm of sports economics on a more abstract level, but also provides a feasible route to institutional change in the F1 driver market. Such contributions are very essential towards improving the long term competitiveness and commercial value of the sport.

2 Causes of Mismatch Analysis

The earlier part of this paper has described some of the issues that the F1 rookie market is experiencing at the moment. This section is devoted to the driver development system to discuss the reasons why the stable matching is a hard task to accomplish within the current framework.

The lock-in effect caused by team affiliations is one of the problems. Teams are competing on the track, but also build strategic alliances in the long run. Game-theoretically, this kind of alliance may appear as an equilibrium when repeated interactions among firms take place [4]. The engine manufacturers are the key players in these alliances in Formula One and form long-term collaborative relations with teams consuming the same power units. This has resulted in informal groupings. And to fill in the small number of available race seats, teams typically put their junior drivers with associated or customer teams. An example is George Russell who is currently a driver of Mercedes-AMG Petronas Formula One Team but who had three seasons with Williams Racing. Although these arrangements might not be the most competitive option that the drivers would have chosen, they offer short term career stability, and the drivers are guaranteed to remain in Formula One.

Nevertheless, the Red Bull system works in a stricter way. Being one of the oldest junior programmes, it has given birth to a significant number of high level drivers. The company is comprised of Oracle Red Bull Racing and Visa Cash App Racing Bulls Formula One Team, which is in a way a development team of young talent. The ones who play well in the affiliated team are rewarded with promotion to the main team and others are released. In the 2025 season, Liam Lawson switched between the two teams several times, and Yuki Tsunoda spent five years in the Red Bull system and then left the grid.

Notably, when someone gets out of such a system does not mean that one is not able to perform. Indeed, there are a number of drivers who were once a member of the Red Bull Junior Team who have since succeeded in other areas. Alexander Albon, at Williams Racing, and Pierre Gasly, at BWT Alpine Formula One Team, are examples of people who have come to be instrumental to their teams. This implies that they could have been even more successful, had they had opportunities outside the Red Bull system earlier in their careers.

The benefits of Red Bull development model are clear. It has contributed to the performances of Sebastian Vettel and Max Verstappen with spells of uninterrupted supremacy. Although this kind of dominance may make other drivers interested in some markets, including the United States, it tends to reduce opportunities of other drivers and may adversely impact the competitiveness of the sport in general [5]. Long durations during which the outcome of a championship is predictable could also decrease the involvement and attention of the people [6].

The other major concern is the skewed choice of talents. Because of the difference in the size and financial capabilities of major teams and minor teams, the effectiveness and quality of their junior programmes differ significantly. Financial capacity is one of the advantages of larger teams since being able to identify and develop high-potential drivers is more likely to occur in larger teams than smaller ones. On the contrary, despite smaller teams discovering highly talented drivers, they might not have an improved career opportunities compared to those with largest teams, mainly because of information asymmetry and inadequate financial assistance. Also, drivers who do not join any junior programme as independent drivers might miss the chances of promotion due to lack of exposure. This scenario is remarkably similar to the forecast of Akerlof in his market-lemons model: when buyers (teams)

do not have perfect information about the quality of sellers (drivers), the market structure is strongly biased to the poorer quality players, and the more talented is forced to exit the market [7].

3 Analysis of Matching Mechanism Based on DA Algorithm

To conclude, it is important to develop the system that will enable new drivers to be more flexible and leave the limiting team affiliation as well as find the opportunities in the other teams. In the meantime, they should have a more equal access to opportunities, irrespective of backgrounds. Already, there have been instances of drivers abandoning junior programmes to go and play with other teams. The loss of Oscar Piastri to the BWT Alpine Formula One Team development programme to the McLaren Formula One Team. Nonetheless, this shift caused contractual conflicts as well. Hence, it is especially important to develop a consistent and efficient solution that can help to turn these unique cases into more ordinary and sustainable practice within the sport.

To solve this case, the deferred acceptance (DA) algorithm is proposed. It is a solution of the two-sided matching problems in the conditions of decentralized preferences, given by David Gale and Lloyd Shapley. Through repeated rounds of proposals and rejections, the process converges to a stable matching, defined as a situation in which no pair of agents would both prefer to be matched with each other over their assigned partners[8].This framework is particularly relevant for analyzing the allocation of drivers to teams in Formula One, The Formula One driver market can be analogized to a college admissions system, where teams act as universities, drivers as applicants, and race seats as admission quotas.

Every driver can only be matched with 1 team and each driver has a preference ranking over all teams which have available seats. Furthermore, they also have the option of staying “single” (which means they are not matched to any teams). If a rookie prefers staying “single” to being matched to a team, then it means the course unacceptable to him. In the assumption, all rookie drivers who meet the age requirement and the Super License points requirement can participate in the project.

R: a finite set of rookies;

T: a finite set of team t has q seats

Rookie r has a ranking $\succsim r$ over $T \cup \{t\}$

Tean t has a ranking $\succsim t$ over $R \cup \{r\}$

Matching μ is a correspondence from $R \cup T$ to $R \cup T$ such that

$$\mu(r) \in T \cup \{r\} \tag{1}$$

$$\mu(t) \subseteq R \text{ such that } |\mu(t)| \leq q \tag{2}$$

$$\mu(r) = t \Longleftrightarrow r \in \mu(t), \text{ for every } r \in R \text{ and } t \in T \tag{3}$$

Step 1: Every driver applies to his favorite acceptable team

Each team places the highest ranked q applicants among the acceptable and qualified ones (all applicants if there are fewer than q) on its hold list and rejects

others. A team's ranking of drivers can be understood as a form of "scoring market", in which each driver is evaluated based on an overall performance score, which reflects their championship points, financial contribution, and other relevant indicators in a multi-dimensional evaluation process [9].

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Step k: Applicants who were rejected at step k−1 apply to their next best acceptable and qualified team.

Each team places the highest ranked q acceptable driver among the new applicants and those in the hold list on the new hold list reject the rest.

The algorithm terminates when every driver in the system is either on a hold list or has been rejected by every team that is available to him. At the end, teams are matched to drivers on their hold lists.

To illustrate the model more explicitly, the author provides a simplified example with number of variables.

Table 1. The teams' ranking.

≿A	≿B
1	2
3	4
5	6
2	1
4	3
6	5
7	7

Consider two teams, labeled A and B, each with a capacity of 2 seats, and seven rookies denote as 1, 2, 3, 4, 5, 6, and 7. Each student holds an individual preference ranking over the teams, and their priority ranking within each course is clearly specified.

In the initial step, as shown in Table 1, all drivers apply to their first-choice courses, and each team ranks the applicants based on the given priority weights. Under this procedure, Rookies 2, 4, and 5 are rejected by their first-choice teams.

In the next iterations, as shown in Table 2 the rejected rookie drivers apply to their second-choice course. Among these applicants, Rookies 2 and 4 meet the priority and capacity requirements of Team B. As a result, Team A is matched with Rookies 1 and 3, and Team B is matched with Drivers 2 and 4, forming the final stable matching.

Table 2. The drivers' preference.

≿1	≿2	≿3	≿4	≿5	≿6	≿7
a	a	a	a	a	b	b
1	b	3	b	b	a	a

4 Optimization and Utility Analysis of Matching Schemes

4.1 Mechanism Evaluation

After introducing the DA algorithm, an important issue arises. The proposed model not only involve the matching of preferences between drivers and teams, but also incorporates financial considerations. Junior driver programmes require substantial long-term investment, to secure access to drivers whose costs are predictable and whose loyalty is relatively high. If drivers are free to join other teams after completing their development, in response, teams would likely to reduce their investment in junior programmes, which could ultimately weaken the overall talent development system in Formula One. This concern is also recognized, that matching models with monetary transfers involve utility-based decision-making. In such settings, both sides evaluate outcomes not only based on preferences but also on expected returns [10].

4.2 Optimization Recommendations

To overcome this problem, two solutions complementary to each other are suggested to aid the matching mechanism and compensate teams in terms of their investment in developing drivers. The former is comparable to the transfer fee system in professional football. The team that developed the driver would have to receive a transfer fee by the receiving team. Yet, this mechanism can be in conflict with voluntary nature of the deferred acceptance process. The match might not be realized in case the team to which the shipment is to be made is not ready to pay a high price of transfer. The second method is more in line with the corresponding framework. A driver would be at liberty to work in any team after going through a junior programme, but a set percentage (say 5/10) of his future earnings would be paid to the training team over a specified duration. The specific percentage might go down to once the system is set up and market feedback is received. This is a good way of converting development investment into a claim on the human capital of the driver in future without raising the immediate financial load on the receiving team.

In case the suggested mechanism is possible to introduce into the Formula One driver market, it is likely to produce a number of positive impacts. To begin with, it would resolve the imbalance between the real results and the real preferences of drivers and teams. The DA algorithm is strategy-proof and stable according to the market design theory. This means that no driver and team will wish to be paired with each other more than they have been assigned their partners and drivers will have reasons to tell the truth about their preferences. Second, the returns on the investment in junior programmes would be more predictable. It develops a compensation system like venture capital wherein returns are not based simply on the availability of a race seat but rather on the success of the investment in the long term.

4.3 Economic Effect Analysis

The effects of this mechanism on the total commercial value of Formula One can be discussed in two ways as well. The former is the enhancement of the competitive balance. There is empirical evidence that the uncertainty surrounding the

championships decreases the number of people interested in the event and that the number of Google search results decreases on average by about 10 percentage points (or one third) [6]. This implies that a more equalized competition is able to maintain an increased degree of audience engagement.

The second view is related to the long-term appearance of superstar drivers. Schreyer and Torgler discover that the loss of Michael Schumacher resulted in a loss of about 1.58 million TV viewers in Germany, which underscores the high commercial externalities involved in star drivers [11]. With a revenue-sharing system, training teams can reap some of this external value and thus retain their motives to invest in the development of juniors and secure a steady stream of high-profile drivers in the future.

5 Conclusion

Using the F1 driver market as the context of the research, this paper critically examines the problem of talent mismatch and market distortion that the existing system creates. It subsequently builds a new driver-team corresponding mechanism according to the Deferred Acceptance algorithm. The findings show that this mechanism can produce stable matching, where pairing drivers and teams will be less biased by their actual preferences, and lead to a more efficient resource allocation in general. Simultaneously, the model offers long-term benefits on the investments in driver development by teams by offering them incentives like revenue-sharing scheme without compromising the stability of the matching process. This assists in solving the problem of lack of incentives to investment. Moreover, the suggested mechanism will be able to disrupt the current trend of lock-in of talent and lead to a higher driver mobility that will also lead to the increase in the competitive balance in the sport. Competitiveness breeds more uncertainty in the outcomes, greater involvement of the audience and eventually the media and commercial value of F1. Moreover, the mechanism helps in sustaining the occurrence of star drivers, creating a long-term commercial spillover.

Although this study suggests a theoretically viable mechanism design, there are several limitations to the study. To begin with, the analysis is mostly founded on a theoretical framework and is not empirically validated; further studies can use real-world data regarding driver transfers and performance. Second, the model is relatively simplified in its assumptions about the preferences of drivers and teams, and might not adequately reflect the complexity of decision-making in the real world. Lastly, since the framework does not emphasize anything on experienced drivers, the question of whether priority must be given to experienced or new drivers is an open question. The model can be further developed in future research by extending it to dynamic matching environments to increase its practical usefulness.

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