Do fantasy sports players' actions influence their performance in Dream11 contests? Adding data to the debate on skill vs chance

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Abstract

Daily fantasy sports platforms allow users to compete with one another by creating their own teams within some constraints, using their knowledge or intuition about the performance of players in real life. Since players' actual performance on the match day is uncertain, emerging as a winner in such contests combines skill and chance. Using data from Dream11, a fantasy sports platform in India, through participation in public contests on the platform during the ICC T20 cricket World Cup, we test whether skill or chance plays the dominant role for winners. When we proxy lack of skill by randomly selecting teams via computer simulation and comparing the performance of real teams with simulated teams, our findings suggest that chance and skill are evenly balanced. In our sample of 31 games, in almost 50% games, we see that teams picked randomly perform at par or better than the real teams constructed by real users. Furthermore, we observe that while real teams perform better in games where the skill gap between two teams is much higher, randomly simulated teams fare better in closely matched teams. However, when we do within players comparison across matches, we found that participants playing with multiple teams and participants playing more games outperform the rest.

Keywords: Dream11, daily fantasy sports, skill vs chance, cricket

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1 Introduction

Beginning with the Greek autotelic activity, when spectators gathered around large stadiums to witness the contests, the last few decades have witnessed an unprecedented rise in the phenomenon of spectatorship in sports (Guttmann (1981)). New media forms have enabled mediated sports consumption for the masses through home television, online streaming, social networking, and sports bars (Fairley and Tyler (2012)). The increasing use of handheld devices and technology in the consumption and engagement of sports fans has replaced the social phenomenon of watching sports with personalized experiences. Sports are no longer just about the play, but a significant aspect of the sports is in the consumption of the sport by spectators (Zillmann et al. (2012)). The most recent addition to the ever-increasing engagement of sports spectators is their direct participation in a real-world game through virtual fantasy sports platforms.

Fantasy sports is an online sports concept where the participants act as owners. Each participant assembles a fantasy team by choosing from a set of players participating in a real-world sport subject to certain conditions. At the start of the game, a marking scheme is set. Each player collects fantasy points throughout the sporting event based on the player's on-field performance. A fantasy team's total score is the sum of each selected player's fantasy points. By the end of the game, a leaderboard is constructed, which ranks the participants based on their final fantasy points.

There are two primary versions of fantasy sports: (1) Daily and (2) Season long. In daily fantasy sports (referred to as DFS in literature), participants play a single game, which usually runs for a couple of hours. In the season-long fantasy league, participants pick players and compete throughout the season. Season-long leagues are closer to real-life setups and usually try to imitate the decision-making process of real-life managers and team owners. This provides opportunities to restructure your fantasy team as the league progresses.

Cricket is an extremely popular sport in India, DFS platforms such as Dream11[1] have become extremely popular in India. Millions of people play DFS in India. The largest daily fantasy sports league in India, Dream11, has more than 110 million users with 1000+ daily contests, and it processes billions of rupees in entry fees every year. Dream11 is not the only one. MyTeam11, My11Circle, Howzat, Halaplay, 11Wicket, MyFab11, MPL Fantasy cricket, and Ballebaazi are other corporates in the crowded fantasy sports category in India. Although there are multiple sports one can play on these platforms, cricket is the most popular one. As per the report by the Federation of Indian Fantasy Sports (FIFS) in collaboration with Deloitte,[2] the current market size of fantasy sports in India is roughly Rs 34,600 crore for the financial year (FY) 2021 and is expected to reach Rs 1,65,000 crore by the FY 2025 (CAGR: 38%). The total direct revenue attributable to the

[1] www.dream11.com

[2] Fantasy Sports: Creating a virtuous cycle of sports development by the Federation of Indian Fantasy Sports (FIFS) and Deloitte, February 2022.

fantasy sports industry is Rs 10,700 crore, and the indirect revenue through its vendors and service providers is Rs 5,500 crore in FY 2021. As per KPMG, the Indian Premier League fantasy league alone is worth $1 billion.[3] In September 2021, the two biggest fantasy sports companies, Dream Sports and Mobile Premier League, raised $225 million and $90 million to reach the valuation of $5 billion and $945 million, respectively.[4]

However, the exponential growth witnessed by online fantasy Sports is not without controversies. The dominant amongst these has been the classification of online fantasy sports as a game of skill or chance. Regarding legal jurisprudence concerning fantasy sports, the anti-gambling laws (The Public Gambling Act 1867 and Prize Competition Act 1955) exempt games, predominantly games of skill, and the Supreme Court of India argues that such games which are predominantly skill-based are entitled to constitutional protection. While the States of Nagaland, Rajasthan, and Punjab have classified Daily fantasy sports as games of skill, it continues to be banned in the state of Tamil Nadu, wherein it is still classified as a game of chance.

In this paper, drawing on data from 31 fantasy games of an International cricket Tournament, we test whether DFS cricket is predominantly a game of skill or a game of chance. To this end, we first proxy lack of skill by randomly selecting teams via computer simulation and comparing the performance of real teams with simulated teams. Later, we compare real teams by classifying players as skilled vs. non-skilled. We use two different measures for this classification. First, we proxy skill by selecting players who participate with multiple teams (incentive matters), and second, we proxy skill by selecting participants playing more games (learning by doing or experience).

When we compare the performance of actual teams with the randomly simulated teams, our findings suggest that chance vs. skill is roughly evenly balanced on Dream11. In our sample of 31 games, in almost 50% games, we see that teams picked randomly perform at par or better than the real teams constructed by real users. Furthermore, we observe that while real teams perform better in games where the skill gap between two teams is much higher, randomly simulated teams fare better in closely matched teams. However, when we compare the relative performance comparison of real teams across matches, we found participants playing with multiple teams and participants playing more games outperforming the rest. We interpret this in favor of skill.

The rest of the article is structured as follows. Section 2 reviews the ongoing skill vs. chance debate worldwide and in India in the context of DFS. In Section 3, we review the literature around fantasy sports focusing predominantly on the methodologies employed

[3] There is a huge growth opportunity in India with fantasy gaming, says Varun Mahna on the launch of FantasyDangal, Firstpost, April 7, 2021.
Fantasy sports in India gaining fast popularity on the back of IPL, The Economic Times, October 17, 2020.

[4] Exclusive: Dream11 in talks to raise over $400 Mn at $8.5 Bn valuation, Entracker, August 30, 2021.
Gaming start-up Mobile Premier League valued at $2.3 bn, joins unicorn club, Business Standard, September 15, 2021.

to discern games of skill from games of chance. In Section 4, we explicate the methods and data used for analysis. We document our findings in Section 5. We discuss our main findings and their implications in Section 6 and conclude in Section 7.

2 Questions

Recently, the DFS has landed in a tense political climate, and some States in India have declared these activities gambling. The decision to classify this under gambling originated from the definitional challenge and lack of empirical evidence associated with classifying games as games of skill or chance. There are two contentious issues here that need immediate attention:

1. What is the extent of chance in the winnings of DFS participants?;
2. Since all games involves a certain degree of chance. If skill and chance can be quantified, above what threshold level can a game be classified as a game of skill?

When we look at the gambling literature (see Sanchez (2016) and the references therein), in order for a game to be classified as gambling, it must have at least three elements: (1) Consideration: it means that players must pay something of value to participate. It includes anything of value and not just money; (2) Prize: anything of value promised to the winner/s; and (3) Chance: defined as the unforeseen, inexplicable, and utterly uncontrollable aspect of the game.

DFS possesses all these elements. In DFS, the fee to participate falls within the widely accepted definition of consideration. The prize money is also easily identifiable and is usually in the form of cash. Since even the most-skilled centric game possesses some element of chance, the element of chance in DFS cannot be eliminated. If these are games of chance, then the State's laws concerning gambling become pivotal as various States' have laws to prevent the gambling behavior of the citizens.

However, only in highly conservative jurisdictions, if chance plays any role in influencing the game's outcome, the game is classified as gambling.[5] Given that almost all games involve an element of chance, under this strict definition, all games will qualify as gambling. To avoid this, various jurisdictions have taken different approaches to decide whether a game is a game of skill or chance. These approaches can are broadly classified into two categories:

1. **The predominance test or Dominant factor test or Deciding factor test**: Under this framework, we envision a continuum with pure skill on one end and pure chance on the other. Games like chess are considered a game of extreme skill, while bingo and slot machines are games of pure chance. Games in between are

[5]This is known as the "any chance test." In these jurisdictions, if chance plays any role in influencing the game's outcome, the game is classified as gambling.

called “Mixed games," and empirical evidence is used to decide the merit in each case. In most jurisdictions, an activity is a game of skill if players' ability control at least 51% of a contest's outcome. Courts have often employed the dominant factor test to determine whether a game is a game of skill or a game of chance (Holleman (2006); Meehan (2015); Sanchez (2016), p. 332). In most jurisdictions, DFS games are classified as a game of skill under the predominance test.

2. **The material evidence test**: In this framework, we judge whether chance is a material element affecting the game's outcome. This is a higher level of scrutiny than the predominance test because it evokes two phases of subjective analysis: (1) Determining the level of chance in a particular game; and (2) Determining if that chance level is high enough to be considered material in the outcome of a game. Limited studies classify DFS as a game of skill under the material evidence test.

Is DFS a game of pure chance? If we define chance as the unforeseen, inexplicable, and completely uncontrollable aspect of the game, then the chance element can also be classified into three broad categories:

1. **Systemic chance**: If the game itself has elements created by a random event, such as throwing dice or shuffling cards. Cricket as a game does not have an element of systemic chance. So DFS on cricket cannot be a game of systemic chance.

2. **Imperfect information**: Where the players have incomplete knowledge of the game's rules or the other players' actions. In DFS, the rules of the game are clear, but given the non-sequential decision-making, the game is one of imperfect information. This is essential here; otherwise, participants will imitate the winners' team composition.

3. **The lucky shot**: Games where the odds of success are very low. For example, golf is considered a game of skill, but "hole-in-one" is considered a chance game. DFS has a minimal element of the lucky shot.

The skill vs. chance debate suggests that DFS is neither a game of pure skill nor pure chance. Since it lies between the two extremes (Sanchez (2016)), it has been debated whether these are games of chance or skill. The decision to classify it as gambling rests purely on the empirical evidence to quantify skill components influencing the game's outcome. The Indian experience so far is also mixed. The Honourable Supreme Court of India upheld the ruling of the Rajasthan High Court, which classified DFS as a game of skill under the dominant factor test. The ruling suggests that ‘the element of skill' had a predominant influence on the outcome of the game, which follows the following format:

- Participants have to choose a team consisting of at least the same number of players as playing in a real-life sports team (e.g., 5 in basketball, 7 in kabaddi, and 11 in cricket and football);

- All contests run for at least the duration of one full sports match; and

- No team changes are allowed by the participants after the start of the sports match.

On this basis, the Court adjudged that playing on Dream11 constitutes a 'game of mere skill,' which makes the Dream11 game exempt from the provisions of the Public Gambling Act 1867 (PGA). The Court also opined that playing the Dream11 game involves considerable skill, judgment, and discretion and that success on Dream11 arises out of users' exercise, superior knowledge, judgment, and attention. Therefore, this is a legitimate business activity protected under Article 19(1)(g) of the Constitution of India.

However, some states are still looking for a better argument. Even when a game involves considerable skill, judgment, and discretion, if the performance of individual players is hugely unpredictable, then DFS cannot be classified as a game of skill. Just because an element of the game is within the players' control does not mean we can predict the joint performance of a subset of players. For them, selecting 11 out of 22 players before the game is a low bar. Also, limited empirical evidence was presented to substantiate the case of judgment and discretion used by the players or to quantify the share of skill in differentiating skilled and well-informed players from the non-skilled players in Dream11.[6]

Researchers have also suggested that the tactics of the advertisers of DFS to provide participants with an illusion of control over the game have an impact on winning more than the skills possessed by the participants (Kwak et al. (2013)). They argue that illusory control increases winning expectancy, and increased winning expectancy leads to a favorable attitude and decision toward the advertised product. Arguing in a similar vein and drawing on the motivations of the players' playing these fantasy sports, Dwyer et al. (2018) argue that many participants were victims of problem gambling (an urge to continue gambling despite facing a huge loss).

This paper uses data from the team composition of Dream11 participants in the ICC[7] T20 World Cup 2021 provides empirical evidence by asking the following questions:

1. Is considerable judgment involved in picking teams in DFS?;
2. Do real teams perform better than purely randomly selected teams?; and
3. Do skilled players consistently perform better?

3 Related literature

Several studies have empirically examined the question of skill vs. chance in the context of DFS. To determine whether a game involves skill or chance, researchers have proposed

[6] In a recent study, using personal experience and an auto-ethnographic account to evaluate the presence of the skill in DFS, Naha (2021) points out the importance of knowledge and that it unequivocally favors its predominance over a fortune for success.

[7] International Cricket Council (ICC) is the world governing body of cricket.

three different approaches: (a) an examination of different pay-offs amongst different players and to ascertain if there are pre-determined observable characteristics that help predict pay-offs; (b) an examination of how actions taken by the DFS players affect the pay-offs; and (c) return correlations across time, implying the persistence of skill.

Using the first approach, by employing differential returns amongst players as a proxy to identify a priori skilled pokers players, Levitt and Miles (2014) finds that highly skilled players achieved an average return on investment of over 30%, compared to a -15% for all other players, thus, suggesting that skill influences returns more than chance. However, concentrating on players may introduce survivor bias, where winners may play longer and, therefore, bias the data set. In their empirical investigation of skill vs. chance in the case of cricket and Basketball, Misra et al. (2020) provide a model that follows approach (a) above but corrects for survival bias and reports that there is evidence to show that the outcomes are not driven by pure chance.

The second approach to test if DSF is a game of skill is an examination of how the actions of DSF players affect their playoffs. It is suggested that winners utilize different strategies than losing participants. In their analysis of NBA fantasy sports from DraftKings, Evans et al. (2018) report that winning participants more frequently select NBA rookies and international players. Players paying for more lineups in a given contest earn profits far more often than those entering a few lineups, indicating that the number of lineups can serve as a proxy for skill. Alternatively, in the context of DFS, analyzing player actions as a measure of skill can also be tantamount to understanding if the team picked by the player (actions taken by the players) has a superior performance to a randomly picked team involving no thought. A comparison of teams picked by real users vs. those randomly picked using Monte Carlo Simulation, Getty et al. (2018) found that skill is a significant influencer of the outcomes of fantasy sports games.

The last approach focuses on measuring skill through player performances across time by assuming that the skill of a fantasy player remains mostly the same throughout the tournament. In such a scenario, the distribution of underlying skill across the playing population does not change, and the win fraction of each player in the first half of the season is correlated with that player's win fraction in the second half (Getty et al. (2018), p. 874). Table 1 summarizes these various measures of skills used in the literature.

From existing literature, we infer that skill has been a vital factor in deciding the outcome of fantasy sports. Due to the predominance of skill, courts in various countries have deemed fantasy sports legal and unrelated to gambling. While it can be inferred from prior literature that there is an element of skill present, the possibility of involvement of chance cannot be overruled, and different fantasy sports fall on various portions of the skill-chance spectrum because of the varying roles played by skill and chance (Getty et al. (2018)).

However, we see that most empirical studies examining skill vs. chance in the context of DFS have examined poker (Getty et al. (2018); Levitt and Miles (2014)) and Basketball

Table 1 Measures of skill

Measure of skill	Assertion	Papers
Pay-off Comparison of DFS players	In a game of skill, skilled (higher ranked) players will outperform lower ranked players. Alternatively put expected payoffs are same for all the players	Getty et al. (2018); Levitt and Miles (2014); Misra et al. (2020)
Actions taken by players significantly affect pay-offs	In a game of skill, actions of players are essential and therefore compared to no actions, actions should yield better pay-offs	Evans et al. (2018); Getty et al. (2018)
Persistence: Temporal analysis of DFS players	Skills of players do not change significantly over the contest, and therefore, the win fraction of each player in the first half of the season is correlated with that player's win fraction in the second half	Getty et al. (2018)

(Easton and Newell (2019); Evans et al. (2018); Getty et al. (2018)). Studies examining DFS in the context of cricket are somewhat rare (for an exception, see Misra et al. (2020)), and given that different sports have different skill-chance proportions (Getty et al. (2018); Mindell (2018)), implications and findings from other sporting contexts may not hold. It has often been argued that "Nothing is certain in cricket except its uncertainty" (Ryder, 1974) and has too many variables, making cricket's fantasy edition extremely challenging. Furthermore, the only study examining the question of skill or chance in cricket fantasy sport (Misra et al. (2020)) has explored pay-off comparison amongst players.

Given the nature of the data, we focus on effect-based analysis rather than the cause. We assume that in games with many opportunities to display one's skill, the more likely it is that a person possessing the skill will win. We test whether players possessing the requisite skill prevail a statistically relevant percentage of time over a person without the requisite skill (based on the law of large numbers). The results of a mathematical analysis of this nature do not need to result in the more skilled person winning virtually every time, but instead only a statistically relevant number of times in order to show that overall, in the particular game or format offered, skill is the predominant factor.

In this research, we examine the question of skill vs. chance in cricket by evaluating how the players' actions affect their pay-offs. While player-to-player heterogeneities in pay-offs do compare how the actions of players (in terms of selection of players) affect the pay-offs, in this study, we extend the analysis of Misra et al. (2020) by comparing the pay-offs of purely randomly simulated teams with real teams to differentiate how

the actions of the players affect the pay-offs. We hypothesize that if a game is purely a game of chance, every strategy will perform equally well. In particular, a random team will perform as well as a team selected by any other strategy (Getty et al. (2018); Levitt and Miles (2014)). We also compare the aggregate performance of real players with randomly simulated teams.

We also employ two different measures to proxy skill a priori and compare the performance of skilled vs. non-skilled players. First, we proxy skills by selecting players who participate with multiple teams. This is a commonly employed strategy of skilled players and is well documented. Secondly, we proxy skill by selecting participants playing more games. We assume that players applying analysis, skills, and awareness of the games will get better and are more likely to play more games (learning by doing).

4 Materials and method

Research context: Cricket Fantasy Sports

A game of cricket comprises 22 players, 11 players from each side. In a T20 match, each team gets 20 overs of 6 balls each to score as many runs as possible. A team can bat for a maximum of 20 overs or before all except one team member is declared out. The first team that bats sets the target score. The side batting second needs to chase the target in the given 20 overs. Which team would bat first is the captain's choice that calls the coin toss right. Winning the toss could be of strategic advantage as the winning captain can assess the pitch and weather forecast situations to decide whether to bat or field first.

Popular versions of DFS in cricket, such as Dream11, are adaptations to the basic game of cricket. Unlike a real game wherein one team competes against the other, in DFS, players need to pick the best-performing players based on a point system from both teams. There are constraints that a player must pick at least a pre-decided number of players for each team. While in an actual game, the number of runs scored and chased determines the winner, in a fantasy game, there are additional points that a player gets for scoring a boundary (4 runs/6 runs) or scoring more than a decided threshold. There are also points awarded for getting a member of the opposite team out (through a catch or run out). In addition, from the set of 11 players you choose from the set of 22 playings, the player also needs to pick a captain and a vice-captain. This selection is essential because the points earned by a captain are multiples by two, and those of the vice-captain are multiplied by 1.5 to get the final tally of points.

Unlike other tournaments studied in Fantasy Sports literature, Dream11 fantasy Sports are different. Dream11 DFS is one shot contest, unlike season-long tournaments studied in literature wherein "*Even tiny differences in skill manifest themselves in near certain victory if the time horizon is long enough*" (Levitt and Miles (2014)) and game designers can increase the number of games per player to increase the effect of skill in the sport. However, in Dream11, the winners are decided after each match, and there is no baggage

of poor performance or advantage of good performance. As a result, in this research, we wish to model an 'unskilled' player. We define an unskilled participant as someone who does not know the form of the players, cannot strategize which players to pick, or has no information on the prior meetings of the players to take any informed action in team selection. The unskilled player can only select a valid team wherein the likelihood of picking a player is unaffected by any of these parameters.

The comparison of simulated 'unskilled players' with the real players is also significant, given the arguments by Dream11 in Punjab and Haryana High Court to classify DFS as a 'game of skill.' The argument, amongst others, includes[8] (a) assessment of all the players available to make the team and evaluate the worth of a player against the other players keeping aside bias for an individual or a team; (b) use awareness about player's performance and performance statistics; and (c) analyze the conditions of the other factors about the game, pitch, form of players, etc. In our case, the simulated 'unskilled' player lies at the opposite end of using any such intelligence or skill. Neither does the player compare the performance statistics of players to select the best 11, nor does it consider other factors, such as information about the pitch to select players. Thus, the approach juxtaposes the arguments of a 'game of skill' with a 'dumb' selection to see if the arguments used to justify DFS as games of skill affect players' performance in DFS.

Simulation

Random teams were built using simulation. Given the starting line of 22 players,[9] we picked all possible combinations of valid teams. Valid teams are teams that obey constraints imposed by Dream11. A valid team must have the following:

1. A team must have 11 members
2. A maximum of 7 players can be selected from any one of the teams
3. A team must not breach the 100 credit cap (each player comes with some credits ranging from 7-10 typically)
4. A team must have a different combination of players as shown in Table 2 below:

Table 2 Composition of team in Dream11 DFS

Player type	Min	Max
Wicket Keeper	1	4
Batsman	3	6
Bowler	3	6
All-rounder	1	4

5. You must assign a captain and a vice-captain amongst your selected team members.

[8]https://fifs.in/wp-content/uploads/2020/07/Fantasy-Sports_Legality_India_Report.pdf
[9]In cricket, there are no substitutions.

A summary of the points table used by Dream11 to compute the points earned by each player during a match is shown in Table 3. More details on points are available at https://www.dream11.com/games/point-system.

Table 3 Point system

Batting points		**Bowling points**	
Activity	Points	Activity	Points
1 run	1	Wicket excluding run out	25
Boundary bonus (4 runs)	1	Bonus (LBW/Bowled)	8
Boundary bonus (6 runs)	2	3 wicket bonus	4
30 runs bonus	4	4 wicket bonus	8
Half-century bonus (50 runs)	8	5 wicket bonus	16
Century bonus (100 runs)	16	Maiden over	12
Dismissal for a duck (only for Batter, Wicket-Keeper & All-Rounder)	-2		

Unlike Getty et al. (2018), we could combinatorially find all possible valid compositions in two steps. First, we generated all possible combinations of ${}^{22}C_{11}$ players, giving each player a unique number in the index. This gives us a list of 7,05,432 teams. Second, we iterate over these 7,05,432 teams and remove all invalid teams, that is, teams that do not fall within the constraints imposed by points 2, 3, and 4. Depending on the number of players within each category (Wicket keeper, Batter, All-rounder, and Bowler), the number of valid teams would vary from match to match. To simulate a perfectly random team, we needed to ensure that each player in the team was equally likely to be picked as a captain and a vice-captain. This can be done in 110 ways (11 ways to pick a captain $\times$ ten ways to pick a vice-captain). Thus, each valid team produced above can have 110 different combinations after selecting the captain and vice-captain. Each player has almost an equal chance of getting picked in our simulation.

To compare the performance of the simulated with the real players in DFS, we participated in public contests on Dream11 during the ICC T20 World Cup 2021 tournament. Table 4 details the games we participated in. Due to certain constraints, we could not participate in two of the 33 matches.

5 Results

5.1 Is considerable judgment involved in picking teams?

Figure 1 shows the pattern of player selection between simulated and real teams for the Australia vs. South Africa match played on October 23, 2021. The percentage of times a particular player is selected varies drastically for real teams compared to simulated teams, where we find uniformity.[10] We also found that a statistically significant propor-

[10]This also confirms that the simulation is uniformly random.

Table 4 Participation details and performance of our own teams

	Date	Match	Participation Fee	Winnings
1	23-10-2021	Australia vs South Africa	49	0
2	23-10-2021	England vs West Indies	49	49
3	24-10-2021	Bangladesh vs Sri Lanka	49	0
4	24-10-2021	India vs Pakistan	59	0
5	25-10-2021	Afghanistan vs Scotland	49	49
6	26-10-2021	South Africa vs West Indies	49	49
7	26-10-2021	New Zealand vs Pakistan	49	0
8	27-10-2021	Bangladesh vs England	35	35
9	27-10-2021	Namibia vs Scotland	49	0
10	28-10-2021	Australia vs Sri Lanka	49	49
11	29-10-2021	Bangladesh vs West Indies	49	0
12	29-10-2021	Afghanistan vs Pakistan	49	49
13	30-10-2021	South Africa vs Sri Lanka	49	49
14	30-10-2021	Australia vs England	49	0
15	31-10-2021	Afghanistan vs Namibia	35	35
16	31-10-2021	India vs New Zealand	49	0
17	01-11-2021	England vs Sri Lanka	49	85
18	11-02-2021	Bangladesh vs South Africa	49	49
19	11-02-2021	Namibia vs Pakistan	35	0
20	11-03-2021	New Zealand vs Scotland	-	-
21	11-03-2021	Afghanistan vs India	49	0
22	11-04-2021	Australia vs Bangladesh	49	49
23	11-04-2021	Sri Lanka vs West Indies	-	-
24	11-05-2021	Namibia vs New Zealand	49	49
25	11-05-2021	India vs Scotland	49	49
26	11-06-2021	Australia vs West Indies	49	49
27	11-06-2021	England vs South Africa	49	0
28	11-07-2021	Afghanistan vs New Zealand	49	49
29	11-07-2021	Pakistan vs Scotland	49	0
30	11-08-2021	India vs Namibia	49	86
31	11-10-2021	England vs New Zealand	35	0
32	11-11-2021	Australia vs Pakistan	49	0
33	14-11-2021	Australia vs New Zealand	49	0

tion of participants have selected players who are not part of the playing 22 on the match day.[11] This is made by real players who were not able to change the team after the final lineup was announced and therefore had players who are not part of the playing 22.

Comparing the composition of real vs. simulated teams across all matches, we do find the selection of players in simulated teams to be uniformly distributed. The percentage of teams selecting a particular player in the team as captain and vice-captain is also uniform and is of equal magnitude.[12] However, when we compare this with the distribution of players in real teams, we do see considerable differences in the team composition. We

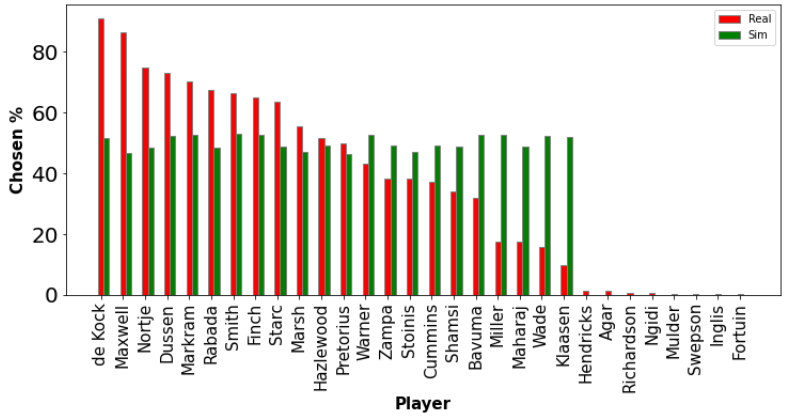
[11]For match-wise statistics, please refer to Table A.1 in Appendix A.

[12]For a few games where both teams have selected too few pure batsmen, bowlers or all-rounders, the simulated random teams composition will not be uniform.

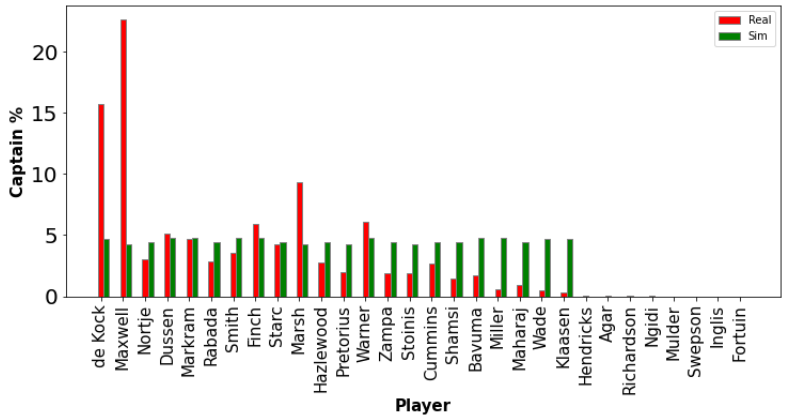
Figure 1 Composition of real vs simulated teams: Australia vs South Africa

Red and green bars represent the % of real and simulated teams selecting a particular player respectively.

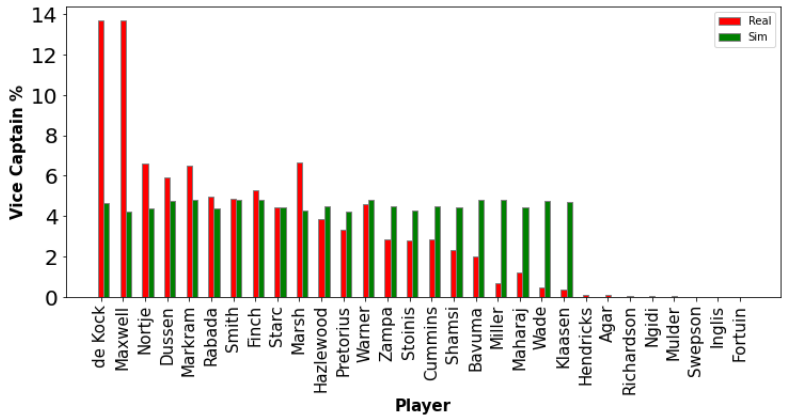
(a) Frequency of real and simulated teams selecting a particular player



(b) Frequency of real and simulated teams selecting a particular player as Captain



(c) Frequency of real and simulated teams selecting a particular player as Vice-Captain



do find less number of players picked more frequently and few players not picked at all. The selection is even more skewed when we look at the assignment of Captain and Vice-captain. In games that are heavily tilted towards a particular side (for example, India vs. Namibia), the real teams' composition is very biased in favor of a few players (since people don't expect the lower order to bat). These findings do suggest that DFS involves considerable judgment and discretion in team selection. Next, we test if this judgment and discretion give an edge or influence the outcome in a meaningful way.

5.2 Do real teams perform better than randomly simulated teams?

If DFS is a game of chance, a team picked by the unskilled player should perform equally well. In other words, there is no strategy or information to take advantage of. In particular, a random team should perform as well as a team selected by any other strategy. To examine the predominance of skill vs. chance from the contests we participated in, we ask if, on average, real teams perform better than those constructed through random simulation. We test this using three different measures.

5.2.1 One-to-one comparison

We compare every real team's performance with one simulated random team (with replacement). For all the matches, we compare the Dream11 points scored by real teams with those scored by the randomly simulated team. We measure the ratio R defined as:

$$R = \frac{\textit{Number of times the real team win}}{\textit{Number of times the simulated team win}}$$

If R is greater than 1, we interpret that, on average, the actual teams perform better than the simulated teams. In other words, R greater than one means picking teams requires skill and translates to better scores (points) on Dream11.

Table 5 documents R for all the 31 matches we participated in. From Table 5, we observe that in 15 out of the 31 matches, R is less than one, and for two matches, the R number is equal to 1 (2 places of significance). We do not see strong evidence for skill in Dream11 DFS contests.

To ensure that our findings are robust, we randomly pick a real team and compare its performance with a randomly picked simulated team. We do this comparison a million times and record the ratio of the number of winnings of the real teams compared to simulated teams. Again, an R number greater than 1 denotes the prevalence of skill in selecting teams. Table 6 presents the ratio R for 31 matches we participated in.

We find the numbers very similar to what we observed previously. For 15 out of 31 games, we found $R > 1$, for 14 games, we found $R < 1$ and for 2 games, we found $R = 1$. The findings do not overwhelmingly support the skill component.

Table 5 Do real teams perform better than simulated teams? One-to-one comparison

	Date	Match	Win Probability (for real team)	R
1	23-10-2021	Australia vs South Africa	0.46	0.84
2	23-10-2021	England vs West Indies	0.44	0.79
3	24-10-2021	Bangladesh vs Sri Lanka	0.29	0.40
4	24-10-2021	India vs Pakistan	0.46	0.84
5	25-10-2021	Afghanistan vs Scotland	0.65	1.88
6	26-10-2021	New Zealand vs Pakistan	0.21	0.27
7	26-10-2021	South Africa vs West Indies	0.68	2.09
8	27-10-2021	Bangladesh vs England	0.36	0.55
9	27-10-2021	Namibia vs Scotland	0.50	1.00
10	28-10-2021	Australia vs Sri Lanka	0.49	0.96
11	29-10-2021	Afghanistan vs Pakistan	0.51	1.06
12	29-10-2021	Bangladesh vs West Indies	0.24	0.31
13	30-10-2021	Australia vs England	0.41	0.69
14	30-10-2021	South Africa vs Sri Lanka	0.40	0.67
15	31-10-2021	Afghanistan vs Namibia	0.33	0.50
16	31-10-2021	India vs New Zealand	0.50	1.00
17	01-11-2021	England vs Sri Lanka	0.63	1.74
18	02-11-2021	Namibia vs Pakistan	0.83	4.92
19	02-11-2021	Bangladesh vs South Africa	0.58	1.37
20	03-11-2021	Afghanistan vs India	0.57	1.34
21	04-11-2021	Australia vs Bangladesh	0.69	2.21
22	05-11-2021	India vs Scotland	0.79	3.85
23	05-11-2021	Namibia vs New Zealand	0.40	0.66
24	06-11-2021	Australia vs West Indies	0.53	1.13
25	06-11-2021	England vs South Africa	0.55	1.25
26	07-11-2021	Afghanistan vs New Zealand	0.47	0.88
27	07-11-2021	Pakistan vs Scotland	0.47	0.88
28	08-11-2021	India vs Namibia	0.85	5.66
29	10-11-2021	England vs New Zealand	0.58	1.40
30	11-11-2021	Australia vs Pakistan	0.44	0.77
31	14-11-2021	Australia vs New Zealand	0.62	1.67

5.2.2 One-to-many comparison

To ensure that the simulated team is not from a particular end of the point's spectrum, we measure the performance of the actual team with ten randomly simulated teams. So for each real team, we make ten comparisons and record the ratio

$$R1 = \sum_{i=1}^{N} \frac{\textit{Number of times the real team } i \textit{ won}}{10}$$

Where N is the number of confirmed teams in each match. If R1 is greater than 5, the actual team scores more points than five simulated teams out of 10, then we interpret it as evidence of the skill involved in picking Dream11 teams. Table 7 shows the performance of the actual teams (average of R1 across all real teams) and the standard deviation with

Table 6 One-to-one comparison: Alternate approach

	Date	Match	Win Probability (for real teams)	R
1	23-10-2021	Australia vs South Africa	0.46	0.84
2	23-10-2021	England vs West Indies	0.44	0.78
3	24-10-2021	Bangladesh vs Sri Lanka	0.29	0.40
4	24-10-2021	India vs Pakistan	0.45	0.83
5	25-10-2021	Afghanistan vs Scotland	0.65	1.88
6	26-10-2021	New Zealand vs Pakistan	0.21	0.27
7	26-10-2021	South Africa vs West Indies	0.67	2.07
8	27-10-2021	Bangladesh vs England	0.35	0.55
9	27-10-2021	Namibia vs Scotland	0.50	0.99
10	28-10-2021	Australia vs Sri Lanka	0.49	0.95
11	29-10-2021	Afghanistan vs Pakistan	0.51	1.06
12	29-10-2021	Bangladesh vs West Indies	0.24	0.31
13	30-10-2021	Australia vs England	0.41	0.68
14	30-10-2021	South Africa vs Sri Lanka	0.40	0.67
15	31-10-2021	Afghanistan vs Namibia	0.33	0.50
16	31-10-2021	India vs New Zealand	0.50	1.00
17	01-11-2021	England vs Sri Lanka	0.63	1.73
18	02-11-2021	Namibia vs Pakistan	0.83	4.91
19	02-11-2021	Bangladesh vs South Africa	0.58	1.36
20	03-11-2021	Afghanistan vs India	0.57	1.34
21	04-11-2021	Australia vs Bangladesh	0.69	2.20
22	05-11-2021	India vs Scotland	0.79	3.83
23	05-11-2021	Namibia vs New Zealand	0.40	0.66
24	06-11-2021	Australia vs West Indies	0.53	1.13
25	06-11-2021	England vs South Africa	0.55	1.24
26	07-11-2021	Afghanistan vs New Zealand	0.47	0.88
27	07-11-2021	Pakistan vs Scotland	0.47	0.88
28	08-11-2021	India vs Namibia	0.85	5.65
29	10-11-2021	England vs New Zealand	0.58	1.39
30	11-11-2021	Australia vs Pakistan	0.44	0.77
31	14-11-2021	Australia vs New Zealand	0.62	1.66

ten simulated random teams for the 31 matches.

Again, we observe that, in 16 out of 31 matches, the average win is less than five; for one match, it is equal to 5. Thus, we do not find strong evidence for skill exhibited in team selection.

5.2.3 Aggregate performance comparison

We can also look at the aggregate performance of actual and simulated teams to address the question of skill vs. chance in Dream11 cricket contests. We hypothesize that if people playing in real life are skilled, they should perform better than the randomly selected teams on average. We do this analysis by picking up as many simulated teams (with replacement) as there are real teams, comparing the mean and median scores of actual and simulated teams, and performing a t-test to check if the difference in means

Table 7 One-to-ten comparison

	Date	Match	Average Wins	Standard Deviation
1	23-10-2021	Australia vs South Africa	4.58	3.14
2	23-10-2021	England vs West Indies	4.42	3.06
3	24-10-2021	Bangladesh vs Sri Lanka	2.86	2.68
4	24-10-2021	India vs Pakistan	4.56	3.17
5	25-10-2021	Afghanistan vs Scotland	6.53	3.17
6	26-10-2021	New Zealand vs Pakistan	2.15	2.55
7	26-10-2021	South Africa vs West Indies	6.77	2.84
8	27-10-2021	Bangladesh vs England	3.57	2.75
9	27-10-2021	Namibia vs Scotland	5.00	2.76
10	28-10-2021	Australia vs Sri Lanka	4.90	3.21
11	29-10-2021	Afghanistan vs Pakistan	5.16	3.07
12	29-10-2021	Bangladesh vs West Indies	2.40	2.71
13	30-10-2021	Australia vs England	4.08	3.09
14	30-10-2021	South Africa vs Sri Lanka	4.04	2.87
15	31-10-2021	Afghanistan vs Namibia	3.34	2.71
16	31-10-2021	India vs New Zealand	5.01	3.18
17	01-11-2021	England vs Sri Lanka	6.35	3.26
18	02-11-2021	Namibia vs Pakistan	8.32	2.20
19	02-11-2021	Bangladesh vs South Africa	5.78	2.96
20	03-11-2021	Afghanistan vs India	5.74	3.26
21	04-11-2021	Australia vs Bangladesh	6.89	2.97
22	05-11-2021	India vs Scotland	7.94	2.31
23	05-11-2021	Namibia vs New Zealand	3.98	2.80
24	06-11-2021	Australia vs West Indies	5.32	2.93
25	06-11-2021	England vs South Africa	5.56	2.97
26	07-11-2021	Afghanistan vs New Zealand	4.70	3.13
27	07-11-2021	Pakistan vs Scotland	4.69	2.72
28	08-11-2021	India vs Namibia	8.50	2.19
29	10-11-2021	England vs New Zealand	5.84	3.05
30	11-11-2021	Australia vs Pakistan	4.37	2.99
31	14-11-2021	Australia vs New Zealand	6.25	2.95

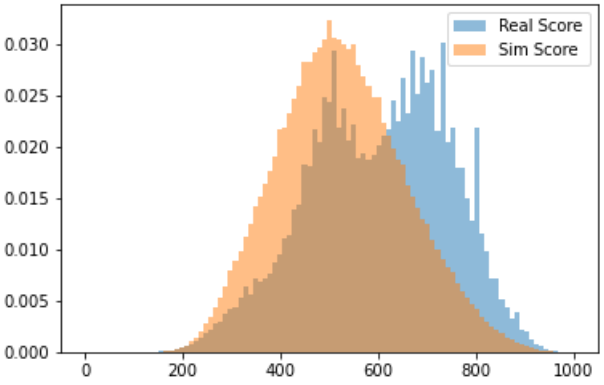
is statistically significant. If actual life participants have higher mean scores statistically than simulated teams, then we interpret team selection on Dream11 involves skill. We frame the null hypothesis as both teams would have equal means.

Visually the performance may be evaluated by looking at the score of histograms of actual and simulated teams (see Figure 2). If team selection involved skill, then the actual team's histogram should be to the right of the simulated team's histogram (see Figure 2 - Panel (a)). If skill and chance play an equal role, then the scores' histogram will overlap (Panel (b)). However, if chance dominates, then the histogram of scores of skill will be to the left of the histogram of randomly simulated teams.

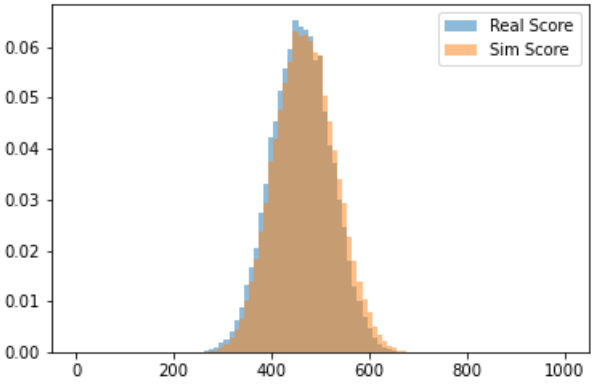
When we compare the means scores of real teams with the randomly simulated teams (Table 8), we found that in 17 out of the 31 matches, random teams outperform real teams. Thus, we do not find skill as a dominant factor in team selection across matches.

Figure 2 Comparing distribution of aggregate scores

(a) When skill dominates: Afghanistan vs Scotland (October 25, 2021)



(b) When skill balances chance: Australia vs South Africa (October 23,2021)



(c) When chance dominates: Bangladesh vs Sri Lanka (October 24, 2021)

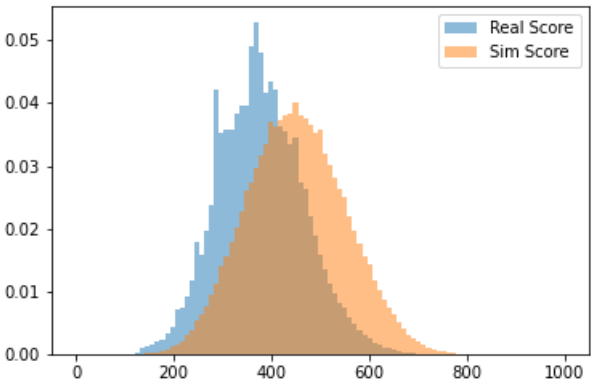


Table 8 Aggregate score comparison

	Date	Match	Mean (real)	Mean (simulated)	SD (real)	SD (simulated)	t-value	p-value	Null Hypothesis (equal mean)
1	23-10-2021	Australia vs South Africa	459.40	469.67	61.70	61.89	-212.33	0.00	Rejected
2	23-10-2021	England vs West Indies	380.03	400.00	79.54	84.76	-362.73	0.00	Rejected
3	24-10-2021	Bangladesh vs Sri Lanka	375.73	451.52	87.78	100.25	-967.13	0.00	Rejected
4	24-10-2021	India vs Pakistan	390.54	405.82	99.85	99.27	-202.53	0.00	Rejected
5	25-10-2021	Afghanistan vs Scotland	599.56	525.35	145.02	130.34	913.29	0.00	Rejected
6	26-10-2021	New Zealand vs Pakistan	411.91	491.52	68.34	71.01	-1697.19	0.00	Rejected
7	26-10-2021	South Africa vs West Indies	462.32	413.88	73.80	79.48	1080.81	0.00	Rejected
8	27-10-2021	Bangladesh vs England	374.72	413.20	67.17	81.43	-588.98	0.00	Rejected
9	27-10-2021	Namibia vs Scotland	402.90	405.05	72.26	94.69	-12.22	0.00	Rejected
10	28-10-2021	Australia vs Sri Lanka	432.94	436.71	81.28	78.75	-81.04	0.00	Rejected
11	29-10-2021	Afghanistan vs Pakistan	467.07	464.28	55.80	60.14	89.06	0.00	Rejected
12	29-10-2021	Bangladesh vs West Indies	392.56	453.26	61.72	58.58	-1554.49	0.00	Rejected
13	30-10-2021	Australia vs England	401.26	431.15	89.75	91.23	-601.30	0.00	Rejected
14	30-10-2021	South Africa vs Sri Lanka	477.23	511.50	85.96	100.86	-553.25	0.00	Rejected
15	31-10-2021	Afghanistan vs Namibia	439.46	491.95	75.70	91.71	-634.82	0.00	Rejected
16	31-10-2021	India vs New Zealand	373.49	372.77	76.44	75.30	59.14	0.00	Rejected
17	01-11-2021	England vs Sri Lanka	561.85	491.00	156.80	129.54	1039.41	0.00	Rejected
18	02-11-2021	Namibia vs Pakistan	476.58	451.73	83.22	87.05	401.95	0.00	Rejected
19	02-11-2021	Bangladesh vs South Africa	453.25	475.43	88.04	98.44	-463.02	0.00	Rejected
20	03-11-2021	Afghanistan vs India	438.18	394.89	95.64	102.58	927.45	0.00	Rejected
21	04-11-2021	Australia vs Bangladesh	533.81	416.67	80.26	91.30	1690.39	0.00	Rejected
22	05-11-2021	India vs Scotland	420.45	401.25	69.11	77.57	481.58	0.00	Rejected
23	05-11-2021	Namibia vs New Zealand	498.69	473.23	106.95	99.72	524.61	0.00	Rejected
24	06-11-2021	Australia vs West Indies	461.30	395.62	99.20	97.90	1138.27	0.00	Rejected
25	06-11-2021	England vs South Africa	621.36	458.43	132.33	144.21	2187.33	0.00	Rejected
26	07-11-2021	Afghanistan vs New Zealand	403.91	426.72	53.58	65.07	-533.33	0.00	Rejected
27	07-11-2021	Pakistan vs Scotland	454.67	446.72	87.83	101.58	146.88	0.00	Rejected
28	08-11-2021	India vs Namibia	507.45	491.61	80.52	89.83	305.91	0.00	Rejected
29	10-11-2021	England vs New Zealand	408.17	417.44	78.14	79.67	-197.25	0.00	Rejected
30	11-11-2021	Australia vs Pakistan	422.70	431.06	55.27	75.31	-184.64	0.00	Rejected
31	14-11-2021	Australia vs New Zealand	539.39	401.96	91.16	94.03	2797.41	0.00	Rejected

5.3 Do skilled DFS players win consistently?

A significant amount of literature available offering strategies and tips for improving performance in traditional fantasy sports supports the inference that it is a game of skill. For example, DraftKings presented aggregate data at the 2014 Sloan Sports Analytics Conference, showing that only 10% of its players were profitable in 2013. However, 80% of the profits were made by 5% of the profitable players on DraftKings.

Similarly, in an expert report prepared by Prof. Zvi Gilula, it was evident that in the fantasy sports games offered by Draft Kings and FanDuel, the win rates of "top scoring performers" were significantly higher than the "average scoring performers." His statistical analysis relies on two facts to conclude that fantasy sports games are games preponderantly based on skill:

1. statistically skilled and well-informed players do better than non-skilled players within a set period of games; and
2. over time, a player gets better and is more likely to win contests by applying analysis, skills, and awareness of the games he acquired.

He illustrates this point's importance by generating a simple simulation exercise where an "average performer" and a "top performer" participate in 10 guaranteed pool prize contests each week. He found the probability of success (win rate) of the hypothetical average performer to be 19% against the probability of success (win rate) of the hypothetical top performer to be 47%. The large gap between the win rates of "average" and top-performing users was found to be practically and statistically significant. The report argues that it is improbable that the difference in average win rates between the top and average performers can be explained solely by chance.

This is to say that if we consider a person who was consistently winning fantasy sports games and has a good understanding of the game and pit them against either a person with little knowledge of fantasy sports games or against a person who selects a random lineup, the skilled and consistent player will win most of the time. The ability to consistently find players who outperform their salary value is a critical element denoting the skill involved in fantasy sports games. In the previous section 5.2.2, we already compared the performance of real players with random simulated teams and did not find the skill component to be a dominant factor. In this section, we dig a little further and classify real players as skilled vs. non-skilled. Since we do not have player characteristics, we proxy skill a priori by comparing the performance of all participants. First, we proxy skills by selecting players who participate with multiple teams. This is a commonly employed strategy of skilled players and is well documented. Secondly, we proxy skill by selecting participants playing more games. We assume that players applying analysis, skills, and awareness of the games they acquired will get better and are more likely to play more games (learning by doing).

5.3.1 Participants playing with multiple teams

In this section, we compare the performance of participants playing with more teams to participants playing with one team. If skill plays a major role in determining the outcome, then we must observe people playing with multiple teams outperforming players playing with one team. Table 9 documents our findings, while Table B.1 shows the performance of individuals playing with multiple teams in one specific match.

Our findings suggest that in 18 out of 31 games, the average score of participants playing with one team is higher than for participants playing with multiple teams (≥ 2). These findings do not support the claim that participants playing with more teams outperform players playing with one team. To increase the skill gap and substantiate our findings further, we look at the share of winners - in the top 5,000 - for participants who have participated with one vs. 20 teams (see Table 10). Here, we find a lower share of participants playing with one team and a higher share of participants playing with 20 teams in the top 5,000. These findings align with the claim made by Prof. Zvi Gilula and DraftKings, though the share of participants playing with 20 teams and finishing in the top 5,000 is not disproportionately large as claimed by DraftKings. The choice of the top 5,000 here is random. We did a similar exercise by looking at various other cut-offs

Table 9 Do participants playing with more teams perform better?: Means comparison

			Mean				
	Date	Match	Players with 1 team	Players with ≥ 2 teams	t-stats	p-value	Null hypothesis
1	23-10-2021	Australia vs South Africa	459.54	459.32	2.79	0.01	Rejected
2	23-10-2021	England vs West Indies	381.50	379.25	23.31	0.00	Rejected
3	24-10-2021	Bangladesh vs Sri Lanka	369.02	379.99	-84.21	0.00	Rejected
4	24-10-2021	India vs Pakistan	383.97	393.61	-67.66	0.00	Rejected
5	25-10-2021	Afghanistan vs Scotland	607.80	595.58	65.15	0.00	Rejected
6	26-10-2021	New Zealand vs Pakistan	399.48	418.13	-213.99	0.00	Rejected
7	26-10-2021	South Africa vs West Indies	471.39	457.76	158.11	0.00	Rejected
8	27-10-2021	Bangladesh vs England	370.55	377.50	-70.06	0.00	Rejected
9	27-10-2021	Namibia vs Scotland	398.63	405.10	-69.98	0.00	Rejected
10	28-10-2021	Australia vs Sri Lanka	437.98	430.83	81.19	0.00	Rejected
11	29-10-2021	Afghanistan vs Pakistan	471.79	464.90	99.04	0.00	Rejected
12	29-10-2021	Bangladesh vs West Indies	381.07	398.41	-231.54	0.00	Rejected
13	30-10-2021	Australia vs England	392.74	405.04	-125.73	0.00	Rejected
14	30-10-2021	South Africa vs Sri Lanka	485.73	473.07	119.97	0.00	Rejected
15	31-10-2021	Afghanistan vs Namibia	432.05	443.37	-94.40	0.00	Rejected
16	31-10-2021	India vs New Zealand	369.80	374.94	-70.41	0.00	Rejected
17	01-11-2021	England vs Sri Lanka	611.38	542.99	414.75	0.00	Rejected
18	02-11-2021	Namibia vs Pakistan	542.76	528.35	120.71	0.00	Rejected
19	02-11-2021	Bangladesh vs South Africa	417.72	421.81	-48.22	0.00	Rejected
20	03-11-2021	Afghanistan vs India	511.62	492.97	163.05	0.00	Rejected
21	04-11-2021	Australia vs Bangladesh	458.25	462.75	-36.63	0.00	Rejected
22	05-11-2021	India vs Scotland	631.22	617.33	96.32	0.00	Rejected
23	05-11-2021	Namibia vs New Zealand	403.59	404.07	-6.87	0.00	Rejected
24	06-11-2021	Australia vs West Indies	450.00	456.76	-64.26	0.00	Rejected
25	06-11-2021	England vs South Africa	512.41	505.23	74.47	0.00	Rejected
26	07-11-2021	Afghanistan vs New Zealand	411.06	406.89	44.57	0.00	Rejected
27	07-11-2021	Pakistan vs Scotland	424.01	422.20	26.52	0.00	Rejected
28	08-11-2021	India vs Namibia	551.24	535.23	156.12	0.00	Rejected
29	10-11-2021	England vs New Zealand	480.85	474.13	53.73	0.00	Rejected
30	11-11-2021	Australia vs Pakistan	457.54	451.93	59.91	0.00	Rejected
31	14-11-2021	Australia vs New Zealand	451.58	435.22	153.94	0.00	Rejected

(top 500, top 50,000, and top 5,00,000), and our findings are robust to these alternate specifications.[13]

5.3.2 Participants playing more games

Here we proxy skills by participants who play more games. Since we do not have a record of players, we proxy a skilled player as a player who participated in more than 20 games in the ICC T20 World Cup 2021. We then compare the average score of skilled vs. non-skilled players for all games. We put 20 as an exogenous cut-off to ensure that the

[13]To save space, we have not shown the table here, but it is available from the author upon reasonable request.

Table 10 Do players participating with multiple teams perform better?

Sl no.	Date	Match	Participants with 1 team % of total	Participants with 1 team % in top 5k	Participants with 20 teams % of total	Participants with 20 teams % in top 5k
1	23-10-2021	Australia vs South Africa	35.76	20.26	6.57	7.98
2	23-10-2021	England vs West Indies	34.53	21.24	5.11	7.36
3	24-10-2021	Bangladesh vs Sri Lanka	38.80	25.06	6.31	9.42
4	24-10-2021	India vs Pakistan	31.86	15.28	11.19	21.42
5	25-10-2021	Afghanistan vs Scotland	32.56	24.06	7.99	11.92
6	26-10-2021	New Zealand vs Pakistan	33.32	18.58	5.60	12.84
7	26-10-2021	South Africa vs West Indies	33.49	32.56	6.41	7.24
8	27-10-2021	Bangladesh vs England	39.93	25.50	4.12	7.04
9	27-10-2021	Namibia vs Scotland	33.95	18.94	6.64	13.64
10	28-10-2021	Australia vs Sri Lanka	29.54	28.12	8.61	10.16
11	29-10-2021	Afghanistan vs Pakistan	31.03	42.72	7.30	5.98
12	29-10-2021	Bangladesh vs West Indies	33.62	18.04	6.51	10.16
13	30-10-2021	Australia vs England	30.74	18.40	6.38	11.14
14	30-10-2021	South Africa vs Sri Lanka	32.84	29.44	7.18	9.58
15	31-10-2021	Afghanistan vs Namibia	34.53	19.36	6.75	11.24
16	31-10-2021	India vs New Zealand	28.07	14.90	8.31	11.34
17	01-11-2021	England vs Sri Lanka	27.58	50.52	9.12	4.00
18	02-11-2021	Namibia vs Pakistan	37.88	32.10	4.95	5.76
19	02-11-2021	Bangladesh vs South Africa	33.30	26.6	6.93	8.32
20	03-11-2021	Afghanistan vs India	30.70	26.02	6.59	11.40
21	04-11-2021	Australia vs Bangladesh	32.16	21.02	7.49	12.44
22	05-11-2021	India vs Scotland	29.01	16.44	8.17	16.24
23	05-11-2021	Namibia vs New Zealand	32.07	24.06	7.36	8.56
24	06-11-2021	Australia vs West Indies	30.81	19.26	7.74	15.68
25	06-11-2021	England vs South Africa	30.88	23.90	5.95	7.64
26	07-11-2021	Afghanistan vs New Zealand	30.75	25.72	7.57	8.90
27	07-11-2021	Pakistan vs Scotland	27.79	19.04	8.31	12.42
28	08-11-2021	India vs Namibia	26.02	26.00	10.47	10.28
29	10-11-2021	England vs New Zealand	36.40	38.74	6.77	6.24
30	11-11-2021	Australia vs Pakistan	23.59	19.06	10.21	11.44
31	14-11-2021	Australia vs New Zealand	18.08	18.92	17.61	15.62

skill gap (if it exists) must be statistically pronounced for our statistical analysis. We are assuming that players playing more than 20 games here consistently play DFS and are better and more likely to win contests by applying analysis, skills, and awareness of the games they acquired.

Note that our selection also creates survival bias in our dataset in favor of skilled players assuming that loss-making players might drop out and not stick for the entire series. Also, note that we are not exploring the inter-temporal dimension here. We are just comparing the performance of players who have played equal or more than 20 games to those who have played less than 20 games in the tournament.

Table 11 shows our findings. We find that in 18 out of 31 games we participated in, participants who have played more than 20 games outperformed the rest. These findings

suggest that skills can be acquired by participating more frequently or playing consistently.

Table 11 Performance comparison: Learning by doing

Sl No.	Date	Match	<20 games	≥20 games	t-stats	p-value	Null hypothesis
1	23-10-2021	Australia vs South Africa	456.56	462.70	-81.91	0.00	Rejected
2	23-10-2021	England vs West Indies	379.80	380.30	-5.43	0.00	Rejected
3	24-10-2021	Bangladesh vs Sri Lanka	369.97	381.42	-90.27	0.00	Rejected
4	24-10-2021	India vs Pakistan	387.70	395.28	-55.25	0.00	Rejected
5	25-10-2021	Afghanistan vs Scotland	596.53	602.55	-34.22	0.00	Rejected
6	26-10-2021	New Zealand vs Pakistan	405.03	419.94	-180.57	0.00	Rejected
7	26-10-2021	South Africa vs West Indies	464.60	459.66	60.29	0.00	Rejected
8	27-10-2021	Bangladesh vs England	373.00	381.16	-68.51	0.00	Rejected
9	27-10-2021	Namibia vs Scotland	398.19	407.39	-105.16	0.00	Rejected
10	28-10-2021	Australia vs Sri Lanka	435.58	429.81	71.41	0.00	Rejected
11	29-10-2021	Afghanistan vs Pakistan	468.58	465.45	48.59	0.00	Rejected
12	29-10-2021	Bangladesh vs West Indies	386.30	399.05	-179.53	0.00	Rejected
13	30-10-2021	Australia vs England	397.99	405.45	-81.91	0.00	Rejected
14	30-10-2021	South Africa vs Sri Lanka	478.68	475.76	29.40	0.00	Rejected
15	31-10-2021	Afghanistan vs Namibia	437.04	442.08	-44.04	0.00	Rejected
16	31-10-2021	India vs New Zealand	371.23	377.32	-89.73	0.00	Rejected
17	01-11-2021	England vs Sri Lanka	574.18	546.51	183.74	0.00	Rejected
18	02-11-2021	Namibia vs Pakistan	536.25	525.69	76.71	0.00	Rejected
19	02-11-2021	Bangladesh vs South Africa	418.49	422.51	-50.35	0.00	Rejected
20	03-11-2021	Afghanistan vs India	498.11	499.50	-13.01	0.00	Rejected
21	04-11-2021	Australia vs Bangladesh	454.41	468.52	-123.36	0.00	Rejected
22	05-11-2021	India vs Scotland	619.96	623.21	-24.57	0.00	Rejected
23	05-11-2021	Namibia vs New Zealand	404.72	403.06	25.60	0.00	Rejected
24	06-11-2021	Australia vs West Indies	453.38	456.10	-27.95	0.00	Rejected
25	06-11-2021	England vs South Africa	509.79	504.87	55.21	0.00	Rejected
26	07-11-2021	Afghanistan vs New Zealand	409.08	407.14	22.44	0.00	Rejected
27	07-11-2021	Pakistan vs Scotland	422.07	423.40	-21.72	0.00	Rejected
28	08-11-2021	India vs Namibia	541.73	536.45	58.10	0.00	Rejected
29	10-11-2021	England vs New Zealand	477.37	474.18	22.96	0.00	Rejected
30	11-11-2021	Australia vs Pakistan	456.61	448.51	100.33	0.00	Rejected
31	14-11-2021	Australia vs New Zealand	438.41	437.84	6.81	0.00	Rejected

6 Discussion

In this research, we empirically examine the question of skill vs. chance in the context of DFS. Taking a departure from the dominant design of testing skill vs. chance question by comparing the performance (or returns) of more and less skilled participants (Levitt and Miles (2014); Misra et al. (2020)), we explore this question through the lens of actions of players, and test if the actions taken by participants lead to better outcomes. In other words, in our approach, we move away from the assertion that "chance will not repeat; the skill will likely repeat" (Levitt and Miles (2014), p. 42) and put more emphasis on disentangling the effect of DFS players' actions on the performance.

Using data from participating in the ICC T20 World Cup 2021 tournament, we compare the performance of real players' team selection with a random team, with each player equally likely to be picked. From our analysis, we do not find strong support for skill in DFS on Dream11. In about 50% of the games, we see that randomly picked teams do outperform teams picked by real users, suggesting that the skill involved in picking up teams is relatively low. Also, the real teams outperform the simulated teams only in heavily skewed matches. We also compare real teams by classifying players as skilled vs. non-skilled. We use two different measures for this classification. First, we proxy skill by selecting players who participate with multiple teams, and secondly, we proxy skill by selecting participants playing more games (learning by doing). We do not find skill as the dominant factor for participants playing with multiple teams by comparing the average score. However, when we look at the proportion of top scorers participating with 20 teams, we find their performance better. When we proxy skill as participants playing more games, we find the skill to be dominant though we cannot correct the survival bias in the dataset.

There are three possible ways to interpret this result. First, the uncertainty associated with cricket is high, making picking the right team combination of 11 players difficult. We do find some evidence in support of this argument. The uncertainty is likely to be higher in the case of teams that are closely matched compared to teams that are wide apart in their skills. For example, we expect the R number to be higher when the teams are unevenly matched. In this case, it is intuitive for a real player of DFS to pick most players from the strong team. This combination favors more top-order batsmen from the strong team compared to all-rounders' who are less likely to earn points as the weak team's bowlers are less likely to run through the top order of the stronger team. Similarly, when picking the bowlers, the users are likely to pick them from the stronger team because they are more likely to pick wickets from the lower-ranked team. Our statistical analysis supports this observation, and the R number is higher when the teams are unevenly matched. Using the ICC rankings for the teams, we postulate the difference between the two playing teams and split the sample of 31 matched into two groups (based on whether the difference between the competing teams was greater or lesser than the median). Based on Mann-Whitney U Test, we find a statistical difference between the R numbers for the two samples at a 5% significance level. This result is exciting because one of the arguments made for the DFS as games of skill is that you need to pick players from both teams rather than betting on the team more likely to win. However, the game skill component, defined as picking the right players, increases when one side is more likely to win the contest. Humans understand the higher likelihood of a team winning (in unevenly matched teams) better than a random selection of players from both teams.

Second, the point systems may be influencing skill vs. chance in the case of Dream11. Prior research has suggested that point systems and player prices affect the chance element in DFS (Getty et al. (2018)). It is suggested that to increase the role of skill in DFS, game designers should increase the points for less frequent events. The question of

the legality of DFS (Holleman (2006)) has largely debated whether skill or chance governs the outcome. In most cases, the consideration has primarily focused on the Fantasy Sport, ignoring the finer or micro aspects such as the number of players taking part in the context, matching of these "skills" in these contests, or the number of teams an individual enrolls in the competition. For example, on Dream11, there are three different types of contests (a) Regular, (b) Head-to-head, and (c) Winner take all. In addition, the type of contests is also moderated by low or high entry fees. Both of these factors would affect the probability of winning in DFS. Low entry fees for regular contests would increase participation and decrease the odds of winning.

Given that the probability of winning is affected by the nature of the contest a user participates in, the rules of DFS remaining the same, it is expected that the different types of contests mentioned above would exhibit different proportions of skill or chance. Therefore, we would like to suggest that the debate on the legality of DFS be more nuanced and take into consideration the nature of different contests taking place on these platforms at a time when research also indicates the prevalence of addiction behavior in players of DFS and demand for increased consumer protection (Dwyer et al. (2018)). Empirically, our results suggest that in a head-to-head contest wherein we match all real users with randomly picked teams, the performance of real participants varies with the skill difference of the playing countries.

The third possibility might be that the current format of DFS on the Dream11 platform is based on single matches, which is not enough for skill to play a considerable role in the outcome. Season-long games with more avenues to intervene might be more skill centric since they give participants more opportunities to use their skills. Another possibility is Dream11, as the platform is still in its initial stages. As users become more advanced and algorithms and technology get deployed more frequently, these algorithms' skills and strategies outperform randomly simulated teams.

Furthermore, prior research also suggests that participants entering only one lineup tend to be less sophisticated (Evans et al. (2018); Harwell (2015)), and it is argued that "...the vast majority of bettors who are small guys... are overmatched by an elite few who have the algorithms... to win the biggest money." [14] We interpret this as further evidence that even the most skilled need to hedge their chances by participating with more teams. Given the cap on the number of teams you can participate with, the current Dream11 even does not allow this skill to play out. Thus, our results suggest that a DFS in T20 cricket exhibits a vital element of chance, as chance consistently performs at par or better than most real participants.

[14] Welcome to the Big Time by Don Van Natta Jr., Outside the Lines and ESPN the Magazine, August 24, 2016.

7 Conclusion and public policy consideration

The widespread adoption of DFS has brought the regulatory and legal spotlight to focus on the nature of these sports. In this research, we seek to examine the question of whether such games are games of skill or games of chance. While every sport will have an element of chance, legal experts are interested in finding the predominance of skill or chance. Drawing on empirical data from one of the dominant fantasy sports platforms in India across a contest, we tested the skill quotient of these DFS. Defining a game of skill as one where the actions of players playing these fantasy sports have material effects on the consequence of the game, we find that it is not easy to neglect the element of chance in DFS.

Our findings suggest that players use considerable judgment and discretion in team selection. The choice of players of DFS participants looks very different from a simple rule-based random selection of teams. However, when we simulate a player without the requisite skill using a randomly simulated team and compare its total score with a real-life fantasy sports player, skill and chance play an equal role in one-to-one comparison, one-to-ten comparison, or aggregate comparison.

When we proxy skilled players as participants entering the DFS with multiple teams, the average score of skilled vs. non-skilled players does not support skill as a dominant factor. However, the consistently higher share of skilled players at the top of the league table does suggest diversification skills. In this light, any cap on the number of teams per participant suppresses the skill component. Overall, we do find a higher winning percentage for participants playing with multiple teams as evidence in favor of skill. Alternatively, when we proxy skilled players as players participating in more than 20 games, we also find skill as the dominant factor.

An alternate interpretation can be that cricket is a game of extreme uncertainty where skill and chance equally influence players' performance. Using certain skills, skilled participants can marginally outperform the rest. However, comparing this to the evidence provided by DraftKings at the 2014 Sloan Sports Analytics Conference, where they show that only 10% of its players were profitable in 2013 and 80% of the profits were made by 5% of the profitable players, we do not find such disproportionate gains.[15]

There are multiple dimensions associated with DFS. Based on our analysis, we do not find skill as the overwhelming factor determining the winnings in the Dream11 DFS contests. How we differentiate the skilled from the unskilled and the methodology adopted influences the skill share in the outcome. This also challenges all other formats of fantasy games based on cricket as a game of skill. Satisfying a particular format for the game ignores various other essential dimensions of the problem. It is a relatively low bar to

[15] Jason Robins, The Analytics Behind Winning at Daily Fantasy Sports, MIT SLOAN SPORTS ANALYTICS CONF., https://www.sloansportsconference.com/event/the-analytics-behind-winning-at-daily-fantasy-sports

be classified as a game of skill. Literature suggests that there is a consensus that fantasy sports should not be reviewed in isolation but in how it is offered. Different game formats must be analyzed differently, and findings based on one particular game or format must only be generalized for some contests.

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A Human error in team selection

Table A.1 Composition of real vs simulated teams: Magnitude of this error is significant

	Date	Match	Proportion of invalid teams
1	23-10-2021	Australia vs South Africa	3.48
2	23-10-2021	England vs West Indies	2.42
3	24-10-2021	Bangladesh vs Sri Lanka	5.15
4	24-10-2021	India vs Pakistan	2.52
5	25-10-2021	Afghanistan vs Scotland	1.74
6	26-10-2021	New Zealand vs Pakistan	3.45
7	26-10-2021	South Africa vs West Indies	8.00
8	27-10-2021	Bangladesh vs England	5.31
9	27-10-2021	Namibia vs Scotland	2.41
10	28-10-2021	Australia vs Sri Lanka	0.86
11	29-10-2021	Afghanistan vs Pakistan	0.79
12	29-10-2021	Bangladesh vs West Indies	6.92
13	30-10-2021	Australia vs England	0.80
14	30-10-2021	South Africa vs Sri Lanka	1.67
15	31-10-2021	Afghanistan vs Namibia	5.69
16	31-10-2021	India vs New Zealand	2.57
17	01-11-2021	England vs Sri Lanka	0.59
18	02-11-2021	Namibia vs Pakistan	2.91
19	02-11-2021	Bangladesh vs South Africa	7.10
20	03-11-2021	Afghanistan vs India	4.39
21	04-11-2021	Australia vs Bangladesh	3.92
22	05-11-2021	India vs Scotland	2.34
23	05-11-2021	Namibia vs New Zealand	3.08
24	06-11-2021	Australia vs West Indies	2.03
25	06-11-2021	England vs South Africa	0.63
26	07-11-2021	Afghanistan vs New Zealand	1.27
27	07-11-2021	Pakistan vs Scotland	1.86
28	08-11-2021	India vs Namibia	2.31
29	10-11-2021	England vs New Zealand	3.79
30	11-11-2021	Australia vs Pakistan	0.73
31	14-11-2021	Australia vs New Zealand	3.85

B Players playing with multiple teams

Table B.1 Performance comparison: Players playing with multiple teams (Australia vs South Africa - October 30, 2021)

User participating with ... team/s	All teams (% of total)	Top 50k teams (% of total)	Top 5k teams (% of total)	Top 500 teams (% of total)	Top 50 teams (% of total)
1	35.76	26.91	20.26	18.20	20.00
2	15.53	15.87	16.92	15.00	16.00
3	9.14	10.51	11.48	12.40	8.00
4	6.98	8.06	8.90	11.00	4.00
5	5.73	6.98	7.28	7.20	4.00
6	4.18	4.89	5.22	5.00	6.00
7	2.77	3.26	3.52	3.60	6.00
8	2.13	2.67	3.38	3.60	2.00
9	1.56	1.93	2.20	1.20	0.00
10	2.99	3.28	3.46	3.60	6.00
11	1.91	2.14	2.56	3.80	4.00
12	1.08	1.42	1.94	1.40	2.00
13	0.72	0.86	0.86	0.80	2.00
14	0.61	0.77	0.96	1.20	4.00
15	0.83	1.07	1.20	1.80	4.00
16	0.47	0.55	0.70	0.60	0.00
17	0.37	0.46	0.48	0.40	0.00
18	0.37	0.49	0.38	0.20	0.00
19	0.30	0.33	0.32	0.20	0.00
20	6.57	7.55	7.98	8.80	12.00