Valuing Recreation Opportunities Near Urban Areas: Evidence from Disc Golf

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Abstract

This paper applies a travel cost model combining revealed and stated preference data to estimate the recreational value of a disc golf course near New York City, where such facilities were limited at the time of the study. Using intercept survey data from Franklin D. Roosevelt and Heckscher State Parks, we estimate individual consumer surplus per trip with a fixed-effects Poisson regression. The survey collects travel costs and contingent behavior responses, capturing how trip frequency would change with reduced travel time. By combining revealed and stated preferences, we control for individual-specific factors influencing demand. Supplementary data from the UDisc scorekeeping app provides an estimate of total annual visits, allowing us to calculate aggregate consumer surplus. We estimate individual surplus at approximately $68 per trip and total annual surplus for the course at about $6 million. These results can inform policymakers considering the allocation of public land.

Keywords: disc golf, non-market valuation, recreation demand, travel cost, contingent behavior, stated preference **JEL Codes:** D40, H41, Q26, Q51, Q56, Z20

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1 Introduction

Disc golf is a recreational sport that combines elements of traditional golf with the use of specialized discs instead of clubs and balls. The game involves players throwing discs into baskets across a course, with the goal of completing each "hole" in as few throws as possible. Compared to traditional golf, disc golf is far more accessible, both financially and in terms of skill level (UDisc, 2024). The minimal equipment—typically just a few discs—and the use of existing terrain, such as forests, open fields, and trails, make it an environmentally friendly sport that integrates seamlessly into natural landscapes (PDGA, 2021). Most disc golf courses are free to play, inviting people of all ages and backgrounds to participate without the high costs associated with traditional golf.

Although disc golf has been around for decades, it has grown substantially in recent years, especially in the wake of the COVID-19 pandemic, which led many to seek safe, outdoor recreational activities (Taff et al., 2021). As of 2023, there are more than 10,000 disc golf courses across the United States, with the sport gaining popularity internationally as well (UDisc, 2024). This growth has brought disc golf into the mainstream, creating a demand for additional courses and establishing it as a popular option for public recreation. The widespread use of UDisc, a digital scorekeeping app utilized by disc golfers to track rounds and find courses, reflects this increase in participation. Several years after the pandemic, the sport still shows steady growth in the U.S. and internationally, with new courses being built and more rounds played each year (UDisc, 2022, 2023, 2024). Given the rising popularity of the sport, it is important to assess whether disc golf courses represent a valuable use of public land. A crucial element of this analysis is the recreational value of the disc golf course itself.

Establishing a new disc golf course is relatively low-cost and straightforward compared to traditional golf or other outdoor recreational sites such as mountain bike courses. Course construction typically involves minimal landscaping, with only a few permanent installations, such as baskets and tee pads. Many disc golf courses preserve the natural landscape as much as possible. All that is required is a walkable trail for the players and a reasonable target for each 'hole'. Maintenance costs are also lower than for traditional golf courses, as disc golf requires less manicured landscaping and fewer artificial features. For public parks, disc golf offers an affordable recreational option that requires little intervention to maintain, making it a potentially valuable addition to public land offerings.

In New York City, however, the popularity of disc golf has yet to translate into local access to courses. Despite a population of over 8 million, New York City had no disc golf courses within its city limits at the time of this study, requiring residents to travel to nearby locations in Westchester, New Jersey, or Long Island to play.

To evaluate whether a new course should be built, policymakers must compare the costs and benefits of constructing a disc golf course. The Professional Disc Golf Association (PDGA) estimates that installation costs for a new disc golf course in most places is under $25,000, reflecting the relatively low amount of labor and materials needed (PDGA, 2025). However, without an estimate of the benefits of disc golf, policymakers lack the necessary information to conduct a cost-benefit analysis that can be compared with other potential land uses. This study is the first to quantify the benefits of a disc golf course, which will inform efforts to build courses in NYC and other urban areas.

This paper applies tools from the non-market valuation literature to indirectly estimate recreational values. We conducted intercept surveys at two disc golf courses, Franklin D. Roosevelt (FDR) State Park in Westchester (north of NYC) and Heckscher State Park on Long Island, gathering data on travel costs and the number of trips taken by respondents annually. To supplement these revealed preferences, we included contingent behavior questions that asked respondents to estimate how their trip frequency would change under hypothetical reduced travel times. Using a pooled single-site travel cost model with fixed effects, we estimate a consumer surplus of approximately $68 per trip, with a total annual surplus for the course of $6.08 million. This study provides an important contribution to the literature by offering the first valuation estimate of a disc golf course, supplying valuable insights for policymakers and park administrators evaluating potential recreational uses for public land.

The remainder of the paper is organized as follows: Section 2 provides a background of disc golf's growth and significance, using data from UDisc to contextualize its rising popularity. Section

3 reviews relevant literature on sports economics and recreational valuation. Section 4 describes the survey design and implementation. Section 5 details our dataset, including key variables and sample characteristics. Section 6 outlines the econometric model used to estimate consumer surplus, while Section 7 presents our results. Finally, Section 8 discusses the implications of our findings for public land management and offers directions for future research.

2 Background

2.1 History and Growth of Disc Golf

Although the origins of disc golf are somewhat unclear, much of the credit goes to Ed Headrick, who invented both the Frisbee and the "disc golf pole hole" in the 1960s and 1970s while working for the toy company Wham-O (PDGA, 2024b). This target, now a staple of disc golf courses, laid the foundation for the sport as we know it today. The first organized disc golf tournaments took place in the late 1960s, and by the 1970s, disc golf had gained momentum. In 1976, Headrick formalized the sport by founding the Professional Disc Golf Association (PDGA), and in 1979, he organized a prominent tournament with a $50,000 prize, which significantly boosted the sport's visibility.

Since then, disc golf has established a strong following and competitive scene, with events like the annual World Disc Golf Championship, which began in 1982. Disc golf has experienced significant growth, with prize money for major tournaments soaring from $33,782 in 2010 to over $150,000 in 2021 (Gardner, 2021). In recent years, players have signed multi-year million-dollar endorsements, and tournament earnings have increased (Cleghorn, 2022; Weiner, 2021). Paul McBeth's $10 million endorsement deal with Discraft, along with other high-profile sponsorships, demonstrate the sport's increasing mainstream appeal and financial success (Gardner, 2021). PDGA membership, an indicator of professional and enthusiast interest, expanded from just 5,653 members in 1999 to 126,132 members by 2024 (PDGA, 2024a). Disc golf has grown into an internationally recognized sport, with over 15,000 courses worldwide and an average of 3.4

new courses being built daily in 2023 (UDisc, 2024). While the majority of courses are located in the United States, which boasts more than 10,000, other countries have shown significant growth as well, with some exceeding the U.S. in terms of course density and accessibility. For context, the U.S. has around 50,000 pickleball courts and 16,000 traditional golf courses, highlighting disc golf's expansion alongside other popular recreational activities. Lastly, the global disc golf market was valued at $248.69 billion in 2023 and is projected to reach $688.98 billion by 2030, indicating substantial growth (Verified Market Research, 2024).

2.2 Disc Golf in New York City and Surrounding Areas

While many major U.S. cities, including San Francisco, Los Angeles, Chicago, Houston, and Philadelphia, have disc golf courses within city limits, New York City (NYC) was an exception at the time of this study, with no courses in its five boroughs.[1] Figure 1 shows the disc golf course locations surrounding New York City as of 2023, with FDR and Heckscher State Parks among the closest and most popular courses accessible to NYC residents before the opening of a local course. The absence of local options restricts access for city dwellers, particularly given that 54 percent of NYC households do not own a car (Komanoff, 2023).

Disc golf's accessibility and affordability have driven the sport's expansion, with an estimated 89 percent of courses free to play (UDisc, 2024). Unlike many sports facilities, most disc golf courses operate on a first-come, first-served basis and do not require reservations or attendants. This makes it challenging to collect detailed attendance data directly from the courses themselves. However, UDisc, the most popular scorekeeping app (Soppe, 2024), offers an important data source since its inception in 2012. Its latest growth report states that the app recorded 20.1 million rounds among 1.26 million users in 2024 (UDisc, 2025). We used anonymized UDisc data to track course visits and popularity trends at FDR and Heckscher, as well as the New York, New Jersey, and Connecticut tri-state region.

[1] In June 2024, the first disc golf course opened at Highland Park in Queens.

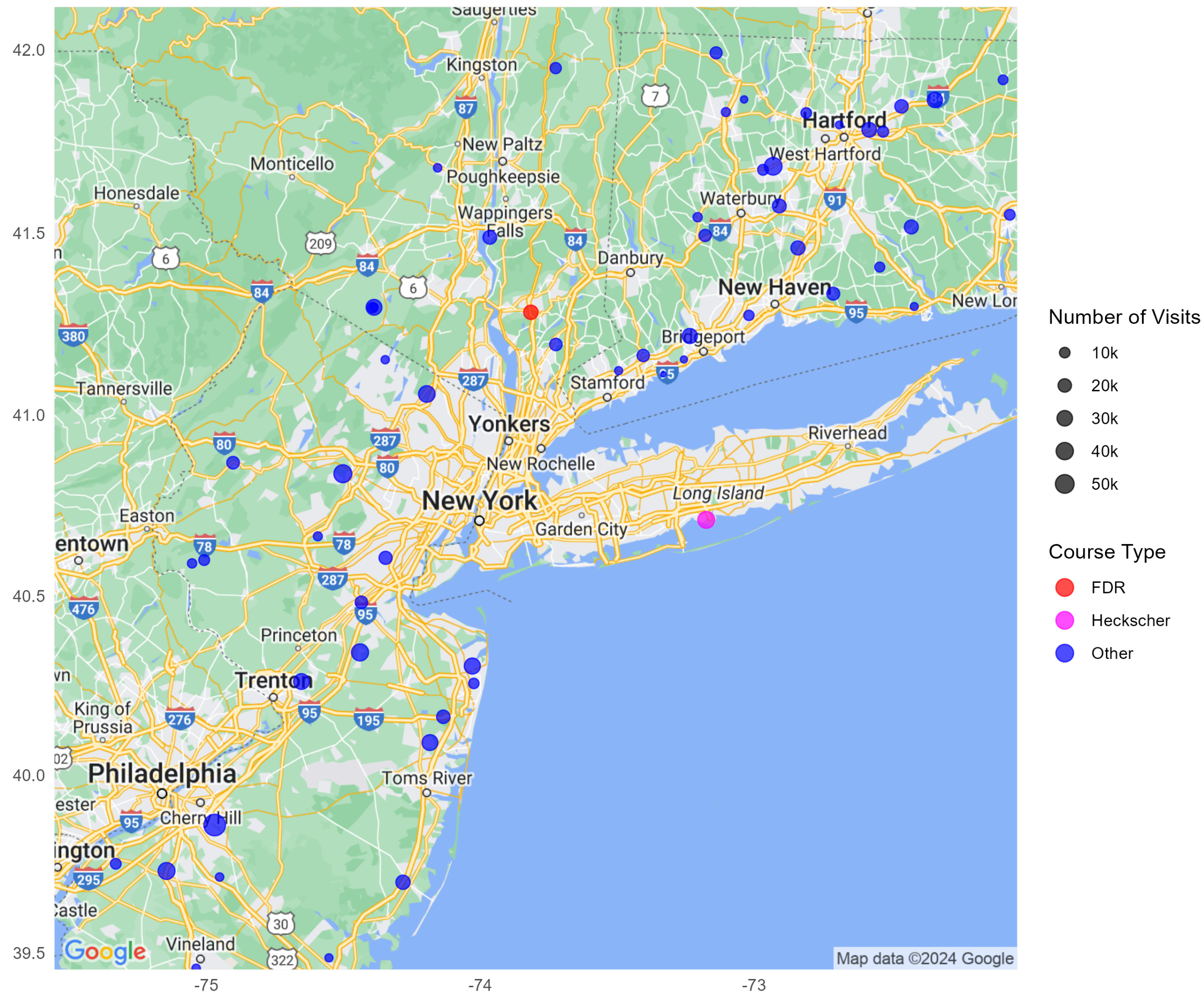

Figure 1: Locations of disc golf courses surrounding New York City. Dot sizes represent the total number of UDisc visits recorded from 2015 to 2023, with larger dots indicating higher visitation. Red and pink dots highlight FDR and Heckscher courses, two of the most accessible and popular options for NYC residents.

2.3 Regional Trends in Participation and the Impact of COVID-19

Data from UDisc highlights a marked increase in disc golf visits across the tri-state area over the past decade. Figure 2 shows the growth in average daily visits to FDR and Heckscher alongside normalized visit data from the broader region, which includes all recorded visits in Connecticut, New Jersey, and New York. This regional definition follows state boundaries rather than a specific distance measure, as it reflects the full geographic coverage of the dataset provided by UDisc.

Between 2015 and 2019, average daily visits at Heckscher ranged from 5 to 10, with slightly lower numbers at FDR. Visits surged from 2020 onwards, reaching averages of 15 to 25 daily visits at each course—a pattern mirrored in regional data. This uptick coincides with the COVID-19 pandemic, which spurred demand for safe outdoor activities and likely contributed to disc golf's newfound popularity. Notably, this increase in visits has remained steady even as the impact of the pandemic has receded, indicating a lasting interest in disc golfing.

To facilitate visual comparison, the regional data in Figure 2 is normalized by rescaling it to match the range of visit counts observed at Heckscher and FDR. Specifically, we linearly transform the regional visit data so that its minimum and maximum values align with the corresponding values at Heckscher and FDR. This normalization does not alter the underlying trends but allows the regional data to be displayed on the same axis as the site-specific data. As a result, while the precise magnitudes of regional visits are not directly comparable to the study sites, the visualization effectively highlights how trends at Heckscher and FDR track broader regional patterns over time.

The growth in recorded visits reflects both the rising popularity of the sport and the widespread adoption of the UDisc scorekeeping app, underscoring the relevance of understanding the benefits these courses provide to the community.

The regional trend, which reflects total visits to all other disc golf courses in the tri-state area, mirrors the patterns observed at the two study courses. While absolute visit numbers for the broader region are not directly comparable to individual courses, the normalized data allows for a clearer visual comparison of relative trends in disc golf participation across different scales. These patterns help contextualize disc golf's appeal, particularly in regions like New York City, where outdoor

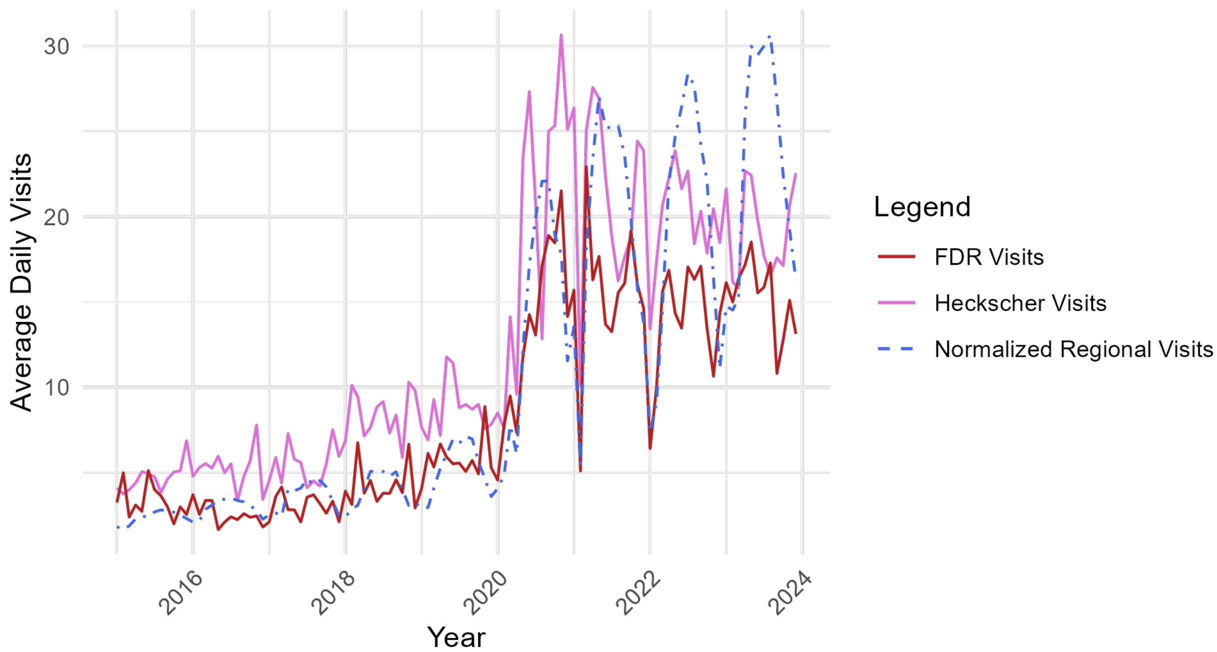

Figure 2: Average daily visits per month at FDR (red) and Heckscher (pink) disc golf courses, based on UDisc app data from 2015 to 2023. Each data point represents the average number of daily visits for a given month. The dashed blue line shows normalized regional visits, rescaled for visual comparison, highlighting seasonal patterns and the impact of the COVID-19 pandemic.

recreation options are in high demand.

Notably, after 2020, visits to Heckscher and FDR appear to level off or even decline slightly, whereas total regional visits continue to grow at a steady, moderate pace. This divergence does not suggest course substitution, as there were no significant new course openings in the NYC metro area during this period. In particular, Heckscher remains the only disc golf course on Long Island, meaning its visitors are unlikely to have shifted to other nearby courses. Instead, the continued regional growth likely reflects broader expansion of the sport and increased UDisc adoption in areas beyond the immediate NYC region. This includes disc golf communities throughout the entire tri-state area, spanning from northern New Jersey down to Philadelphia, across Connecticut toward Boston, and throughout upstate New York, including cities like Buffalo and Rochester. The divergence in trends suggests that while participation in the NYC metro area has stabilized, the sport's broader growth trajectory remains strong across the wider region.

2.4 Environmental and Economic Considerations

Disc golf's popularity is further supported by its low environmental impact compared to traditional golf. Disc golf courses generally integrate into existing landscapes with minimal alteration. Maintenance needs are low. Few, if any, staff members are required to operate the course, making it a cost-effective addition to public parks. In contrast, traditional golf courses are very water-intensive and often involve extensive landscaping and frequent application of fertilizers, which can pollute nearby water systems (Salgot and Tapias, 2006; Guzmán and Fernández, 2014). This makes disc golf a more sustainable choice for environmentally conscious players and communities.

When evaluating the potential construction of a disc golf course, policymakers must weigh both costs and benefits. According to the PDGA, installing a new course costs under $25,000, a relatively modest investment considering the low labor and material requirements (PDGA, 2025). In urban areas, however, the primary cost consideration is the opportunity cost of land, as public spaces are often in high demand for a variety of uses. Without a clear understanding of the benefits disc golf courses provide, it is difficult for policymakers to make well-informed decisions. This study fills that gap by providing an estimate of the recreational benefits of a disc golf course, offering valuable data for decision-makers considering such projects in New York City and other urban settings.

3 Literature Review

The economics literature on disc golf is limited to two studies that analyze the impact of entrance fees on disc golf participation (Liao et al., 2024, 2025). The rest of this section is focused on papers related to nonmarket valuation.

To capture the value of a disc golf course, we employ the travel cost model (TCM), a method first proposed by Harold Hotelling in a 1941 letter to the U.S. National Park Service. The TCM is one of the main techniques for valuing non-market goods, particularly recreational resources. The core premise of the TCM is that traveling to a recreational site incurs implicit costs, typically divided into travel expenses and the opportunity cost of time. Given these costs, recreation consumers make decisions about how many visits to make to a specific site or set of sites. Because travel costs inevitably vary among people who live at different distances from the site, these differences can be used to construct a demand curve and estimate individual consumer surplus. This can then be aggregated to estimate the total annual consumer surplus, based on the total number of annual trips to the course.

As with most studies that use the TCM, our study relies on survey data. One common approach in TCM literature is to implement an off-site, probability-based sampling design (such as a mailed survey), but this method can be costly per observation due to high non-response rates and the fact that the majority of residents in the New York City region never visit disc golf courses. Despite the growth of this recreational activity, disc golf is still a niche sport relative to other outdoor activities. In this study, we chose the alternative approach of an on-site intercept survey, which directly samples the target population (Parsons, 2017). In a paper describing best practices for implementing recreational models, Lupi et al. (2020) suggests using on-site surveys rather than off-site surveys when the focus is on the "aggregate scale of resource use", which aligns with the goals of this study. The downside of the on-site approach is that we only survey individuals who already visit disc golf courses, and we are more likely to encounter disc golfers who visit the courses more frequently, a problem known as endogenous stratification. Following Shaw (1988), we subtract one trip from each respondent to account for on-site sampling bias; this correction remains widely used in recreation demand studies (Haab and McConnell, 2002). There is evidence that this correction aligns the estimates from an on-site survey with those from an off-site household survey (Loomis, 2003). [2]

Combining revealed and stated preference methods has been shown to provide efficiency gains over the traditional TCM (Kling, 1997; Cameron, 1992; Whitehead et al., 2008b; Xie and Adamowicz, 2023) and to increase precision by expanding the range of observable prices or costs, using hypothetical prices beyond those observed in revealed preferences, as demonstrated in Pouliot et al. (2018). Augmenting the TCM with contingent behavior (CB) offers several important advan-

[2] While more recent work has developed alternative adjustments, Shaw's method is particularly appropriate given our relatively small sample size, and it yields consistent estimates in our setting.

tages. First, one of the primary concerns of the TCM is omitted-variable bias due to unobserved, individual-specific factors (Cameron, 1992). Many studies attempt to mitigate this bias by including demographic variables such as age and education in the regression, but even a large set of control variables will only reduce, rather than eliminate these effects. By observing repeated behavior from individuals, we can include individual fixed effects in the regression, which captures all unobserved, time-invariant factors for each person. In addition, a conceptual advantage of the CB method is that it may be easier for people to judge how their behavior would change under certain conditions, rather than a typical contingent valuation question which directly asks respondents about prices (Englin and Cameron, 1996). Finally, a practical advantage of including CB questions is the ability to gather multiple observations per individual in an intercept survey, reducing the cost of the survey. The combined TCM-CB model has been used recently to measure the impact of wind turbines (Kipperberg et al., 2019), water quality changes on recreational swimming (Lankia et al., 2019), and urban parks (Mäntymaa et al., 2021), among other studies.

In this paper, we combine respondents' revealed choices with a set of stated answers to CB questions. The CB questions ask respondents how their behavior would change when faced with different implicit prices that otherwise would not have been observed. Each respondent potentially generates four observations: the total trips they took to the courses over the previous year, plus three stated annual trip estimates conditional on a hypothetical time change.

4 Survey Design and Data Collection

Following best practices, we designed our survey with expert input and made refinements based on a pilot phase (Dillman, 2016). This pilot testing, conducted during the summer and fall of 2022, allowed us to refine both the questions and the survey interface. Feedback from leading experts in environmental economics and stated preference methodology further enhanced the survey's effectiveness and ensured alignment with our study's objectives. The full version of the survey, including all questions and response options, is available in Appendix A.

The survey was structured into four sections to gather comprehensive data for our analysis.

Section A focused on travel cost-related information and collected revealed preference data. Respondents were asked about the number of annual trips taken to the disc golf course, the number of trips to four substitute sites, the typical drive time required, the type of vehicle used, and their home address.[3] To address privacy concerns, respondents had the option to provide the nearest street intersection instead of their exact address.

Section B of the survey focused on the Contingent Behavior questions, designed to capture the potential variability in disc golfer behavior under hypothetical scenarios. In this section, we explored how hypothetical changes in travel time might affect the frequency of visits to the disc golf courses. This complements the travel cost data collected in Section A by combining actual expenses and behaviors with hypothetical ones (Whitehead et al., 2008a, 2000; Parsons, 2017). By asking participants how their visitation might change if their travel time were reduced, we gather additional data points that enhance our understanding of their preferences. The focus on travel time, rather than a decrease in prices, comes from the nature of this recreational activity. Because disc golfers typically do not pay to play, their primary cost is travel time, particularly near NYC, where driving distances and times are considerable. Respondents were presented with the following CB question:

> *Consider the typical one-way travel time to this disc golf course. Suppose this travel time* ***decreased by [X] minutes****. How would this change the number of trips you made to this course over the past year?*
>
> Choices: More trips, Fewer trips, The same number of trips

The hypothetical reductions in travel time, [X], were randomly assigned values of 10, 15, 20, or 25 minutes. For those who selected *More trips* or *Fewer trips*, a follow-up question was presented: *How many* ***additional (fewer) trips*** *to this disc golf course would you have taken in the past 365 days?* The ability to assess responses under these modified conditions provides a richer dataset for analysis, offering insights into how changes in travel costs could influence disc golfer behavior.

[3] Respondents were asked about their annual trips to courses at FDR State Park, Heckscher State Park, Leonard Park, Campgaw, and Beacon. The other sites were chosen based on popularity and proximity to New York City.

This question was followed by two additional CB questions with proposed travel times slightly higher and lower than [X]. Table 1 summarizes the combination of time scenarios.

Table 1: Contingent Behavior Scenarios

Baseline Time	Lower Time	Higher Time
10	5	15
15	10	20
20	15	25
25	20	35

The lower and higher time values were presented in random order following the baseline scenario. In addition, the survey was programmed to account for the respondent's actual travel time. For example, a disc golfer who typically takes 20 minutes to get to the course would not be shown scenarios with a time reduction of 25 or 35 minutes,[4] as these would be unrealistic. With the revealed travel costs combined with the three CB questions, we collected up to four observations per respondent. The final two sections of the survey, Sections C and D explored the impacts of the COVID-19 pandemic on disc golfing habits and gathered demographic data, respectively.

The primary data collection occurred through intercept surveys at the disc golf courses at FDR and Heckscher State Parks during Fall 2022 as well as Spring and Summer 2023. Our research team, consisting of the primary investigators and undergraduate research assistants, strategically timed visits to coincide with peak periods—weekends with favorable weather and weekday afternoons—when disc golfer traffic was highest. Because our intercept surveys were conducted primarily on weekends and during favorable weather conditions, the resulting sample likely represents periods of peak visitation. Consequently, the welfare estimates reported here should be interpreted as upper-bound estimates of recreational value, because visitation would likely be lower during unfavorable weather. To supplement our efforts, we posted flyers with a QR code linking to the survey at prominent locations, such as near the first hole, allowing players to participate even in our absence. However, this approach yielded few responses. As a result, in the spring and summer of 2023, we intensified our efforts with more direct intercept surveys. Equipped with mobile

[4]These times were tested and adjusted during the pilot of the survey and reflect that some disc golfers travel long distances. For reference, the average round-trip distance was about 40 miles.

devices running Qualtrics, we approached players as they arrived at the course. The survey was conducted interactively, with questions read aloud and responses recorded directly into the system. For sensitive demographic questions, such as age and income, we handed the device to participants to ensure privacy and comfort as they entered their information. To encourage participation, respondents were entered into a raffle to win one of five $50 Amazon gift cards upon completing the survey.

Through our distribution strategy, we collected a total of 190 surveys, with 102 from FDR State Park and 88 from Heckscher State Park. We removed 47 surveys from respondents who did not provide their home address, zip code, or nearest intersection. We also removed one survey from a person who lived over 250 miles away from the disc golf course, as this was not representative of the local population and could skew the results. The second highest report was 155 miles away, and we retained that survey in our final sample. After cleaning the data, our final sample is reduced to 142 surveys, 75 from FDR and 67 from Heckscher. Each respondent provided up to four observations through revealed and stated preference scenarios, resulting in a dataset of 520 observations. Some respondents generated less than four observations due to non-response to CB questions. For the remainder of the paper, all summary statistics and analyses will refer to this cleaned dataset.

5 Data Description

5.1 Demographics

Table 2 shows the summary statistics for the demographic variables used in this study. The average survey respondent was nearly 36 years old, with a household income of $121,056 per year. Disc golf welcomes players from all ages, as shown by the reported age range of 18 to 68 years old.[5] The courses are located in high-income areas, as depicted by the maximum household-income in our sample. A large majority of the surveyed disc golfers were White (86%) and identified as male

[5]We limited the sample to those at least 18 years old following our IRB protocol. Thus, our sample excludes underage disc golfers who also visited the course.

(94%). While this recreational activity is inexpensive and accessible, there is substantial room to increase its diversity. Given that New York City's demographics include about 36% White (World Population Review, 2025) and 48% male (Neilsberg Research, 2025), more efforts to promote this recreational activity among women and minorities could be productive. Most respondents had at least a Bachelor's degree (73%). Disc golfers have been playing for about 6 years on average, with a minimum experience of 0 years, a median of 3 years, and a maximum of 45. The demographics within each course are similar with no statistically significant differences across the means.

Table 2: Summary Statistics

	Min	Mean	Median	Max	SD	N
Age	18	35.52	35.14	68	11.01	142
White	0	0.86	1	1	0.35	142
Male	0	0.94	1	1	0.24	142
College Degree	0	0.73	1	1	0.45	142
Household Income	$10,000	$121,056	$125,000	$250,000	$71,751	142
Disc Golf Experience (Years)	0.00	5.90	3.00	45.00	7.70	142

Notes: College Degree equals 1 if the respondent had a Bachelor's degree, Professional degree, Master's degree, or PhD.

5.2 COVID-19 Pandemic

The COVID-19 pandemic significantly altered patterns in outdoor recreation, making activities that allowed for social distancing, like disc golf, particularly appealing. To explore these shifts, the survey included several questions related to pandemic-era participation in disc golf, summarized in Table 3.

The first question asked players when they began playing disc golf. Most respondents reported starting after March 2020; approximately 29 percent joining the sport during the peak of the pandemic. We define this peak period as spanning from March 2020 to June 2021; NYC fully reopened in July 2021 (NPR, 2021). For those who started after February 2020, the survey further asked whether pandemic-related restrictions, such as lockdowns and social distancing, influenced their interest in the sport. Among respondents who began during the pandemic's peak, 59 percent cited the pandemic as a motivating factor. In contrast, only 27 percent of those who took up the

Table 3: Disc Golf Participation Patterns During the COVID-19 Pandemic

		Time period when player started: Pre-Pandemic Before 03/20	Pandemic 03/20 - 06/21	Post-Pandemic 07/21 - 12/23
When a player started playing	N	64	41	35
	%	45.1%	28.9%	24.6%
Start playing due to the pandemic?	Yes		59.0%	26.9%
	No		41.0%	73.1%
Increase playing due to the pandemic?	Yes	65.6%	85.4%	42.9%
	No	34.4%	14.6%	57.1%

Notes: While the pandemic continued in 2021, NYC fully reopened on July 1, 2021 (NPR, 2021).

sport after this period indicated that the pandemic influenced their decision. These results suggest that the pandemic was a significant factor driving new players to the sport during its peak.

The survey also examined whether the pandemic led disc golfers to play more frequently. Among those already playing before the pandemic, approximately 66 percent reported an increase in their playing time due to the pandemic, indicating that the event significantly impacted experienced disc golfers as well. Of those who started during the pandemic's peak, around 85 percent reported playing more frequently due to COVID-19 and related restrictions. Finally, among those who began playing after the restrictions were eased, 43 percent indicated they played more because of the pandemic. These findings suggest that, even as restrictions were relaxed and concerns about the pandemic diminished, some disc golfers continued to view COVID-19 as a catalyst for increased engagement with the sport.

5.3 Disc Golf Course Visits

In our intercept survey, we began by asking respondents how many times they had visited the course over the past 365 days, as well as how many times they had visited each of four other nearby disc golf courses. To aid respondents in answering accurately, we presented a map with the five courses near the New York City area: Heckscher State Park, FDR State Park, Leonard Park, Beacon Glades, and Campgaw Reservation (see Appendix A).

The data presented in Table 4 provides a summary of annual visits to various disc golf courses reported by respondents in our intercept survey. On average, respondents reported 33.13 annual visits to the course where they were surveyed (either FDR or Heckscher), including the day of the survey itself. This high frequency of visits indicates a strong level of engagement among local disc golfers, especially considering that this is based solely on observed data, without adjustments for hypothetical increases due to reduced travel times, as explored in the contingent behavior questions.

Table 4: Summary Statistics of Annual Visits to Disc Golf Courses

Course	**Min**	**Mean**	**Max**	**SD**	**Total (Share %)**
Surveyed Site (FDR or Heckscher)	1	33.13	200	42.54	4704 (65.54%)
Other Surveyed Site (Heckscher or FDR)	0	4.44	150	16.21	630 (8.78%)
Leonard	0	6.54	120	15.76	929 (12.94%)
Beacon	0	3.82	100	11.35	542 (7.55%)
Campgaw	0	2.62	100	11.17	372 (5.18%)

Notes: Based on 142 surveys. These are actual number of trips only (not hypothetical contingent behavior) and include the trip taken on the survey day, which is why the minimum number of trips is 1. The "Surveyed Site" refers to the course where respondents were intercepted (either FDR or Heckscher), and the "Other Surveyed Site" refers to the alternative primary course (Heckscher or FDR).

A small but notable amount of cross-site visitation occurs between FDR and Heckscher, with respondents from each course reporting an average of 4.44 annual visits to the other surveyed site. This limited substitution pattern suggests that while some players are willing to travel to both locations, most respondents demonstrate a preference for their primary, or surveyed, site, likely due to convenience, familiarity, or specific course features.

Among the additional courses, Leonard Park emerges as the most frequently visited substitute course, with respondents reporting an average of 6.54 annual visits. Leonard's proximity to FDR may account for its popularity as a substitute. Beacon Glades and Campgaw Reservation follow, with mean visit frequencies of 3.82 and 2.62 annual visits, respectively. The variation in these substitution rates likely reflects both geographical proximity and the specific characteristics of each course that appeal to the disc golfing community.

It is worth noting that an average of 33 trips per year to a single course already reflects a high level of site loyalty and participation. When we incorporate the contingent behavior data—where respondents reported hypothetical trips if travel times were reduced—total projected annual visits per respondent rise even further, underscoring the potential for increased site demand if disc golf courses were more readily accessible. This highlights both the popularity of the sport and the value that additional local access might bring to players in the area.

All but one survey respondent considers disc golf to be their primary reason for visiting these parks. The survey further asked respondents to identify their main reasons for choosing specific courses. Table 5 presents these responses, highlighting a range of factors from practical concerns like travel time to more course-specific features.

Table 5: Reasons for Choosing a Disc Golf Course

Reason	**FDR (N = 75) Count (%)**	**Heckscher (N = 67) Count (%)**
Positive reviews / recommendations	36 (48%)	26 (39%)
Travel time from your residence	52 (69%)	57 (85%)
Quality of tee areas	40 (53%)	27 (40%)
Layout of course	49 (65%)	37 (55%)
Difficulty of course	36 (48%)	28 (42%)
Natural resources (trees, wildlife, views)	40 (53%)	26 (39%)
Not crowded / short wait time	22 (29%)	23 (34%)
Entry / parking cost	18 (24%)	12 (18%)
Other amenities (e.g., picnics, bathrooms)	15 (20%)	7 (10%)

Travel time is notably the most influential factor, selected by 69% of FDR respondents and 85% of Heckscher respondents. This high selection rate suggests that accessibility and proximity are crucial, especially for Heckscher, which is relatively isolated on Long Island with fewer alternative courses nearby. In contrast, FDR's closer proximity to other courses may allow for more flexibility in course selection, underscoring travel time as a competitive advantage for Heckscher.

Another interesting pattern emerges in respondents' consideration of entry or parking costs, which is more prominent among FDR disc golfers (24%) than Heckscher players (18%). The parking fee at these parks varies throughout the year. During low season, there is free entrance. Before the summer and at the beginning of the Fall, Heckscher charges $8 and FDR $10 during weekends and holidays. During the summer season, both charge $10 every day.[6] This may reflect the availability of free or low-cost substitute courses near FDR, making cost a distinguishing factor for players. Heckscher's geographic isolation, by comparison, makes travel time and convenience more pivotal than entry fees.

Regarding course-specific attributes, both groups rate the layout highly, with 65% of FDR respondents and 55% of Heckscher respondents citing it as important. This suggests that while both courses are valued for their design, FDR players may place slightly more emphasis on course features, likely because of the greater range of alternatives in the area. Additionally, the quality of tee areas and course difficulty were notable factors for both groups, though slightly less prioritized than layout.

Amenities such as natural resources and the absence of crowding received mixed responses. While 53% of FDR players value natural features like trees and views, only 39% of Heckscher players do, possibly reflecting FDR's more scenic setting or greater environmental diversity. The availability of other park amenities, such as picnicking areas or restrooms, was less critical overall, chosen by only 20% of FDR players and 10% of Heckscher players. This indicates that disc golfers are generally focused on the playing experience itself, rather than ancillary facilities.

Overall, these findings underscore the significance of travel time and course layout in disc golfers' choice of venue, with practical accessibility being particularly decisive for Heckscher players. These insights may guide future considerations for course development, especially in densely populated areas where proximity and course quality play crucial roles.

5.4 Travel Cost

Disc golf courses are often free to play, but players still face notable travel expenses each time they visit. Our travel cost measure combines vehicle expenses[7] with the opportunity cost of travel time, following standard practice in the recreation demand literature (Amoako-Tuffour and Martínez-Espiñeira, 2012; Haab and McConnell, 2002). Although respondents may perceive time costs

[6]The effect of parking fees on disc golfing behavior is explored in these papers: Liao et al. (2025) and Liao et al. (2024)

[7]About 99% of our sample arrived by personal / private vehicle to the course.

differently from monetary outlays, treating them jointly provides a consistent measure of total trip cost and is widely accepted in empirical travel cost models. The driving cost component depends on factors such as fuel price, travel distance (D_i), fuel efficiency, and vehicle wear, including maintenance, repairs, and depreciation. The second cost component, the opportunity cost of time, reflects the hours spent traveling (T_i), valued at a fraction of the player's hourly wage rate. Together, these two factors represent the primary travel costs, tc_i, associated with a disc golf trip:

$$tc_i = \alpha_i D_i + \frac{1}{3} \cdot T_i \left(\frac{m_i}{2080} \right). \tag{1}$$

In Equation (1), the term $\alpha_i D_i$ represents the driving cost, where α_i is the per-mile vehicle cost. This cost, based on 2021 AAA estimates (American Automobile Association, 2021), varies by vehicle type, ranging from \$0.48 per mile for a small sedan to \$0.77 per mile for a half-ton pickup truck. The second term, $\frac{1}{3} \cdot T_i \left(\frac{m_i}{2080} \right)$, in equation 1 reflects the opportunity cost of time, where we apply a standard convention of using one-third of the respondent's hourly wage rate to approximate leisure time (Amoako-Tuffour and Martínez-Espiñeira, 2012). We estimate the hourly wage rate by dividing the respondent's reported annual household income, m_i, by the standard 2080 annual working hours (40 hours per week over 52 weeks). Note that our primary travel cost measure assumes that the full vehicle cost is borne by the respondent. In practice, however, travel expenses may be shared among passengers. To assess the sensitivity of our results to this assumption, we also estimate an alternative specification in which vehicle-related costs are divided by the reported number of occupants.

To estimate T_i (travel time) and D_i (distance) for round-trip calculations, we used the Google Maps API to calculate the time and distance between each respondent's provided address (or nearest intersection, if an address was unavailable) and the disc golf course.[8] This baseline measurement allowed us to compute travel costs for the actual, revealed annual number of trips taken by each respondent.[9]

[8]Travel times from Google Maps API represent typical driving conditions and do not adjust for variation by time of day, day of the week, or temporary congestion. Because most survey responses were collected during weekend daytime hours, we expect this omission to introduce only limited noise rather than systematic bias.

[9]Times and distances were obtained using the `mapdist` function from the `ggmaps` package in R.

For the contingent behavior (CB) scenarios, respondents were asked hypothetical questions about how their trips might change if the travel time were reduced, for example, by 10 minutes on a one-way trip. In these cases, we adjusted the round-trip time and distance accordingly. Suppose a respondent's one-way travel time was initially estimated at 25 minutes, making the round-trip travel time 50 minutes. If the CB scenario reduced this one-way time by 10 minutes, the new round-trip time would be $50 - 2 \times 10 = 30$ minutes. To account for this change in time, we also scaled down the round-trip distance by the same percentage reduction in travel time. For instance, if the round-trip time decreased from 50 to 30 minutes (a 40% reduction), we reduced the initial round-trip distance by 40% to reflect the adjusted travel cost in these hypothetical scenarios. This method provided a consistent basis for estimating travel costs across both revealed and contingent scenarios.

Table 6 shows the summary statistics for the travel cost-related variables. On average, disc golfers in our sample take 46 trips per year, although this number is skewed by highly active users (the median is 24.5). The average distance to the disc golf course was 40 miles. The average round-trip time estimated from the Google Maps API was 52 minutes. The resulting average travel cost was $43.

Table 6: Travel Cost Summaries

	Min	Mean	Median	Max	SD	N
Annual Trips	0.00	46.11	24.50	414.00	59.68	520
Round Trip Distance (miles)	0.17	40.21	31.51	154.86	30.88	520
Round Trip Time (minutes)	0.20	52.23	42.72	177.83	37.25	520
Travel Cost ($)	0.22	42.69	32.93	213.93	34.28	520
Travel Cost to Substitute Course ($)	7.32	106.45	89.46	284.82	59.16	520

We also calculate the travel cost to a substitute disc golf course to include as a control variable in our regressions. Because our survey asked for the number of visits to five different courses, we identified each subject's substitute course as the one with the most visits, excluding FDR and Heckscher which are pooled into a single-site for the analysis. The average round-trip travel cost to a substitute course was $106, reflecting the lack of close alternatives to the FDR and Heckscher courses.

5.5 Contingent Behavior

Table 7: Direction of Change in Trips per Scenario

Decrease in Time	Change in Trips: More Trips N (%)	Same Trips N (%)	Fewer Trips N (%)
5	86 (34.26%)	165 (65.74%)	0 (0.00%)
10	219 (59.19%)	150 (40.54%)	1 (0.27%)
15	356 (76.89%)	104 (22.46%)	3 (0.65%)
20	224 (82.96%)	46 (17.04%)	0 (0.00%)
25	140 (92.72%)	11 (7.28%)	0 (0.00%)
35	54 (93.10%)	4 (6.90%)	0 (0.00%)

Table 7 summarizes the responses to the CB questions. The first column shows the reduction in travel time presented in each scenario, which ranged from 5 to 35 minutes. Respondents were given three possible choices, ”more trips”, ”same trips”, and ”fewer trips”. The CB questions were tailored to each respondent’s self-reported one-way travel time to the course, and whether that time was typical for them. Thus, fewer respondents were shown larger reductions in travel time, as fewer respondents lived far enough from the course for these scenarios to apply.

The remaining columns summarize the percentage of respondents who indicated they would take more, the same, or fewer trips. A 5-minute reduction in travel time led 34 percent of respondents to state they would take more trips, while 66 percent indicated they would take the same number of trips. None selected fewer trips. As the reduction in travel time increases, a higher percentage of respondents indicated they would take more trips. This is intuitive, as disc golfers are likely to visit nearby courses more frequently. We observed four unexpected responses where participants indicated they would take fewer trips. However, these represent a very small percentage of the overall sample. Overall, Table 7 shows that respondents generally answered as expected, with a greater willingness to take more trips as travel time decreases.

6 Econometric Model

Our analysis uses a pooled single-site travel cost model to uncover consumer preferences for disc golf. We assume that the number of trips taken by an individual to a disc golf course follows a Poisson process. The parameter λ_{ij} is the expected number of trips taken by individual i in travel cost scenario j and takes the log-linear form:

$$\ln(\lambda_{ij}) = \beta_0 + \beta_1 tc_{ij} + \beta_2 cb_{ij} + \beta_3 sub_i + \beta_4 fdr_i + \boldsymbol{\beta_5 x_i}, \tag{2}$$

The subscript i refers to the individual, and j represents the specific scenario. For our analysis, $j = 1$ corresponds to the individual's actual (revealed) trips and associated travel cost to the course where they were surveyed (either FDR or Heckscher). For $j = 2, 3, 4$, these represent hypothetical scenarios presented in the contingent behavior (CB) questions, where respondents are asked to consider alternative travel times and costs to the same course. The variable of primary interest is the travel cost, tc_{ij}, which is calculated using Equation 1. Because site visits are expected to follow the Law of Demand, we expect the sign of β_1 to be negative.

The variable cb_{ij} is a dummy variable that equals 1 if the observation is a contingent behavior response and 0 otherwise. This variable is included to capture potential differences between revealed preferences (actual trips) and stated preferences (hypothetical trips in CB questions). The parameter β_2 captures the different data generating process in the CB responses, which could result from the presence of hypothetical bias. Thus a statistically significant estimate of β_2 would suggest the presence of hypothetical bias, or the tendency to misstate preferences due to the hypothetical nature of a stated preference question (Whitehead et al., 2008b).

The variable sub_i represents the travel cost to the nearest substitute disc golf course and is included to control for the availability of alternative sites. Economic theory predicts the sign of β_3 will be positive, indicating that individuals are more likely to visit the primary site as the cost of traveling to a substitute increases. Because we have pooled observations from two nearby courses, we include a dummy variable for the FDR course (fdr_i) to control for unobserved differences between the two courses.

The vector $\boldsymbol{x_i}$ contains demographic information on the individuals, which remains constant across scenarios. This vector includes variables such as age, household income, year the individual started playing disc golf, and dummy variables for education level, race, and gender. These dummy variables equal 1 if the individual has at least a Bachelor's degree, is White, or is male, respectively. In addition, we include years of playing disc golf to control for experience. Including these variables helps control for potential differences in player experience and demographic factors that may influence disc golfing preferences.

As described by Parsons (2017), the probability of observing an individual i in scenario j choosing to take r_{ij} trips in a year is given by:

$$Pr(r_{ij} \mid r_{ij} > 0) = \frac{\exp(-\lambda_{ij}) \cdot \lambda_{ij}^{r_{ij}-1}}{(r_{ij} - 1)!} \tag{3}$$

where λ_{ij} represents the expected number of trips. We apply the on-site sampling correction specified by Shaw (1988), which involves subtracting one trip from the total observed trips. This correction addresses two key issues with on-site sampling: first, the sample is truncated at one trip, and second, it oversamples more frequent users. Without this adjustment, both factors could bias the parameter estimates.

Substituting Equation 2 into Equation 3 gives the probability of observing individual i in scenario j taking r_{ij} trips as a function of travel cost, whether the scenario is hypothetical, the cost of traveling to a substitute course, the course (FDR or Heckscher) where the respondent was surveyed, and individual characteristics such as income and the year they started playing. Based on these factors, we calculate the probability of observing the number of trips taken by each individual in each scenario. The parameters of Equation 2 are estimated using maximum likelihood estimation (MLE). The overall likelihood of observing the complete pattern of visits across all scenarios is then the product of these individual scenario-specific probabilities:

$$L = \prod_{i=1}^{I} \prod_{j=1}^{J} \frac{\exp(-\lambda_{ij}) \cdot \lambda_{ij}^{r_{ij}-1}}{(r_{ij} - 1)!} \tag{4}$$

We begin by estimating two model specifications. In the first version, referred to as Model 1, we estimate the model using all the key variables—travel cost, the CB dummy, substitute course travel cost, and the FDR course dummy—without including any demographic variables. In the second version, referred to as Model 2, we expand the model to include demographic variables such as age, gender, race, education level (whether the respondent has at least a Bachelor's degree), income, and the year the individual started playing disc golf.

While Model 2 incorporates some observable individual characteristics such as income and the year the individual started playing disc golf, there may still be unobserved factors that influence the relationship between the number of trips and travel costs. For instance, a person's enjoyment of disc golf or their aversion to long drives may not be directly observed but can still affect their decision-making. As long as these unobserved characteristics remain constant across the different scenarios presented (e.g., varying travel times of 10, 20, or 30 minutes), we can account for them using an individual fixed effect, η_i.

This brings us to our primary model specification, referred to as Model 3, which addresses potential omitted-variable bias by incorporating individual fixed effects:

$$\ln(\lambda_{ij}) = \beta_1 tc_{ij} + \beta_2 cb_{ij} + \eta_i, \tag{5}$$

In this specification, η_i represents a fixed effect for each individual, allowing us to account for all characteristics that remain constant across scenarios. This helps control for unobserved factors and reduces the possibility of omitted variable bias in our estimates.

Notice that Equation 5 excludes the variables sub_i, fdr_i, and the vector of demographic characteristics, $\boldsymbol{x_i}$ (which included the experience variable), because they are constant across scenarios. The fixed effects capture any unobserved individual-specific characteristics that do not change between scenarios.

With the parameter estimates from these models, we can estimate important economic metrics such as the elasticity of trips with respect to cost, the average individual consumer surplus per trip, and the annual consumer surplus per each individual disc golfer (Parsons, 2017). The formula for the price elasticity of trips to travel cost is:

$$e_p = \hat{\beta}_1 \bar{tc}, \tag{6}$$

where $\hat{\beta}_1$ is the estimated coefficient on travel cost from the model, and $\bar{tc}$ is the average estimated trip cost in the sample. This elasticity measures the percentage change in the number of trips in response to a one percent change in travel costs.

The formula for the estimated consumer surplus per trip, CS_0, which captures the economic benefit an individual receives from a visit to the disc golf course, is given by:

$$CS_0 = \frac{1}{-\hat{\beta}_1}. \tag{7}$$

To get the annual consumer surplus for each individual, we multiply the result from Equation 7 by the expected trips per year.

$$CS_{ij} = \frac{\bar{\lambda}_{ij}}{-\hat{\beta}_1}. \tag{8}$$

Our primary models all use travel times and distances derived from Google Maps, ensuring a standardized measure across respondents. Model 1 serves as the baseline, incorporating essential travel cost variables. Model 2 builds on this by including additional demographic controls, while Model 3 introduces a fixed effect to account for unobserved individual heterogeneity. These models allow us to systematically assess the economic value of a disc golf course while controlling for key individual-level variables that influence travel decisions.

7 Results

The regression results are presented in Table 8. Models 1, 2, and 3 evaluate the impact of travel costs on the number of disc golf trips, controlling for various individual characteristics. The Poisson models incorporate robust standard errors, with Model 3 clustering errors at the individual level to account for unobserved heterogeneity across respondents.[10]

[10] The Poisson models with fixed effects were estimated using the $fixest$ package in R (Berge et al., 2021).

Table 8: Main Regression Results

Model:	(1)	(2)	(3)
Variables			
Constant	3.637***	3.603***	
	(0.1814)	(0.3374)	
Travel Cost ($)	-0.0098***	-0.0117***	-0.0146***
	(0.0018)	(0.0019)	(0.0033)
Contingent Behavior (cb)	0.2968**	0.2641**	0.2050**
	(0.1183)	(0.1129)	(0.0929)
Travel Cost to Substitute Course	0.0039***	0.0030**	
	(0.0010)	(0.0012)	
FDR	-0.3025**	-0.3259**	
	(0.1503)	(0.1595)	
Age		-0.0041	
		(0.0044)	
Male		-0.1759	
		(0.1979)	
White		0.2598	
		(0.2030)	
College Degree		-0.0776	
		(0.1116)	
Household Income		0.0173**	
		(0.0073)	
Experience		0.0248***	
		(0.0070)	
Fixed-effects			
ResponseId			Yes
Fit statistics			
Observations	520	520	508
Squared Correlation	0.16080	0.22281	0.87450
Pseudo R^2	0.20030	0.24961	0.83863
BIC	25,832.3	24,279.0	5,898.0

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Regression results using the log of trips as the dependent variable. Household Income is divided by $10,000. The variables Contingent Behavior, FDR, Male, White, and College Degree are dummy variables. All regressions use robust standard errors. Model (3) clusters standard errors at the individual level.

Model 1 is a baseline Poisson model with robust standard errors, focusing on core variables without additional demographic controls. The coefficient for travel cost is negative and statistically significant ($p < .01$), with an estimated value of -0.0098, supporting the expectation that higher travel costs reduce the number of trips. The contingent behavior dummy cb is positive and statistically significant ($p < .05$), suggesting that contingent behavior (hypothetical trips) tends to be greater than actual trips. Additionally, the travel cost to a substitute course is positive and significant ($p < .01$), indicating that alternative sites are considered good substitutes.

Additionally, the FDR dummy is negative and statistically significant at the 0.05 level, with an estimated coefficient of -0.3025. This indicates that respondents surveyed at FDR take fewer trips compared to those surveyed at Heckscher, even after controlling for travel cost and the cost of substitute sites. This finding implies that Heckscher respondents may have a stronger preference for their course, showing a greater willingness to bear travel costs, potentially due to perceived quality differences between the sites or other unobserved amenities that make Heckscher a more attractive destination.

Model 2 builds on Model 1 by including demographic controls, such as age, gender, race, educational attainment, and income. The travel cost coefficient remains negative and statistically significant ($p < .01$), with a slightly higher value of -0.0117, reinforcing the inverse relationship between travel cost and trip frequency. The contingent behavior dummy continues to be positive and significant ($p < .05$), and the substitute's travel cost remains positive and statistically significant. Among the demographic variables, only household income and experience show statistical significance, with income positively associated with trip frequency, implying disc golfing is a normal good. The positive sign on experience indicates that more experienced players tend to take more trips.

Model 3 is our primary model, a Poisson panel data model with individual fixed effects, which controls for unobserved individual characteristics, helping to address potential omitted variable bias. In this model, the coefficient for travel cost remains negative and statistically significant at the 0.01 level, with an estimate of -0.0146, reinforcing the inverse relationship between travel cost and the frequency of disc golf trips. The contingent behavior dummy is also positive and statistically significant at the 0.05 level, with an estimate of 0.205, indicating that hypothetical trips are still reported at higher levels than revealed trips even after accounting for individual-specific factors. This persistence of significance for the contingent behavior dummy suggests that respondents tend to overstate their intended trips under hypothetical scenarios, an indication of hypothetical bias.[11]

The inclusion of fixed effects in Model 3 improves model fit relative to Model 2, as evidenced by a higher pseudo-R^2 value (0.84 compared to 0.22), suggesting that much of the variability in trip frequency is tied to individual-specific traits. Model fit can also be compared using the Bayesian Information Criterion (BIC), which penalizes model complexity. Between Models 2 and 3, the BIC for Model 3 is approximately four times smaller. Because a lower BIC indicates a better fit, this comparison further supports Model 3 as the preferred specification. Overall, the fit statistics show that by accounting for unobserved individual heterogeneity, Model 3 provides a more robust estimate of the effect of travel cost on trips. Accordingly, we retain Model 3 as our preferred model for discussion and welfare analysis.

We also estimated a variant of Model 3 where the vehicle costs in Equation 1, $\alpha_i D_i$, were divided among the number of passengers, n_i.[12] The overall results are very similar, both qualitatively and quantitatively, to the results for Model 3. Importantly, the coefficient remains negative and highly significant in the fixed-effects model, and overall fit statistics are nearly unchanged.

As a simple heterogeneity check, we estimated a model to allow the travel cost coefficient to vary by income group using an above-median income indicator. In the individual fixed-effects specification, the interaction between travel cost and high-income status is positive and statistically significant, indicating that high income groups are less sensitive to changes in travel cost. This is consistent with the idea that travel costs constitute a smaller share of disposable income for these individuals. Consequently, modest changes in travel expenses or time costs are less likely to affect their recreational participation decisions. Full estimates are reported in Appendix C.

[11] Hypothetical bias is a common finding in the recreation demand literature (Murphy et al., 2005), and has been consistently found in combined SP/RP studies, including Englin and Cameron (1996), Whitehead et al. (2008b), and Lankia et al. (2019). The bias is generally interpreted as a tendency for respondents to overstate intended participation under hypothetical conditions.

[12] The full results can be found in Appendix B.

Finally, we tested whether sensitivity to travel cost differed for individuals who began playing disc golf after the onset of COVID-19 by interacting travel cost with a post-COVID indicator (March 2020 onward). The interaction term is statistically insignificant, indicating no meaningful difference in travel cost responsiveness between pre- and post-COVID entrants.[13]

7.1 Welfare Estimates

We focus on the results from Model 3 for calculating our welfare estimates, because the Poisson model with fixed effects controls for unobserved differences across individuals. Table 9 presents these welfare estimates along with 95% confidence intervals. Standard errors for all welfare estimates are derived from 10,000 block-bootstrap samples.[14]

The individual per-trip consumer surplus is estimated at \$68.49, with a 95% confidence interval from \$47.29 to \$119.65. The price elasticity of trips is estimated at -0.686. This elasticity suggests that the demand for disc golf trips is somewhat responsive to changes in travel costs, though not highly elastic.

To place these values in context, our estimated consumer surplus per trip is comparable to estimates for a range of outdoor recreational activities. Travel cost studies frequently report per-trip surpluses of \$30-\$70 for beach recreation (Parsons et al., 1999; Blackwell, 2007), \$40-\$100 for hiking and trail use (Shrestha et al., 2002; Loomis, 2005), and similar magnitudes for general visits to urban parks (Chen et al., 2014).

To estimate the annual consumer surplus provided by the pooled disc golf site, we first calculate an average per-person consumer surplus based on individual trips and visits. The per-trip consumer surplus of \$68.49, combined with an average of 47.13 annual trips per person, results in an average annual consumer surplus of \$3,228 per disc golfer. To estimate the total annual consumer surplus for the disc golf site, we multiply this per-person surplus by the estimated number of unique visitors to the course.

We employ UDisc scorekeeing app data together with our survey results to aggregate the wel-

[13]These results are available upon request.
[14]Bootstrap samples were generated using the $BMisc$ package in R (Stewart, 2023).

fare estimates. While Hartman et al. (2021) found that about 20% of rounds were recorded using UDisc in 2020, disc golf participation has grown by 76% over the last five years (UDisc, 2025). Moreover, 2020 was a unique year due to the COVID-19 Pandemic restrictions. To have a more accurate percentage for the NYC region, our survey asked whether each respondent uses UDisc, Disc Golf Course Review, Disc Caddy, or Other to record scores. The survey shows that about 80% of our sample uses UDisc. Because this percentage is more recent and comes from our sample, it is employed to extrapolate our results.

Using UDisc scorekeeping logs, we first counted the total number of unique visitors to FDR in 2023 and separately counted the unique visitors to Heckscher. Taking the average of these two numbers, we found an average of 1,772 unique visitors per course. Because UDisc data are estimated to capture approximately 80% of disc golf activity among our sample, we adjust this figure to account for the remaining users, leading to an imputed estimate of 2,215 visitors to the site in 2023.[15] Combining this estimate of unique visitors with the per-person consumer surplus of $3,228 yields a total annual consumer surplus of approximately $7.15 million for the disc golf site. This calculation provides a comprehensive measure of the annual recreational value offered by the site, with a 95% confidence interval ranging from $4.94 million to $13.04 million.

Table 9 presents the welfare estimates with and without adjusting for hypothetical bias. The estimates are derived from Model 3 in Table 8. To account for hypothetical bias, we set the contingent behavior (CB) dummy variable to zero for all observations, which allows us to predict the average number of trips per person without hypothetical overstatement. The bottom part of Table 9 shows unadjusted welfare estimates (columns 2 and 3) and adjusted welfare estimates (columns 4 and 5). This adjustment corresponds to the estimated coefficient on the CB dummy in Table 8, which captures the average difference in trip frequency between stated- and revealed-preference observations. A positive and significant CB coefficient indicates that respondents report more trips under hypothetical scenarios—a pattern consistent with the presence of hypothetical bias. By setting CB = 0 for all individuals, we remove this upward shift and recover welfare estimates

[15] Relative to the 20% from Hartman et al. (2021), 80% offers a more conservative aggregation. Moreover, we do not use 100% as we know that UDisc is not used by all disc golfers.

Table 9: Main Welfare Estimates

	Estimate	95% Confidence Interval (CI)
Consumer surplus per trip	$68.49	[$47.29, $119.65]
Price elasticity of trips	-0.686	[-0.88, -0.35]

	Original		CB=0 (Adjusted)	
Annual Welfare Measures	Estimate	95% CI	Estimate	95% CI
Estimated trips per person	47.13	[38.63, 56.71]	40.06	[30.78,49.62]
Consumer surplus per person	$3,228	[$2,160, $5,801]	$2,744	[$1,890, 4,525]
Consumer surplus (millions)	$7.15	[$4.94, $13.04]	$6.08	[$4.36, $10.38]

Note: Welfare estimates are based on the fixed-effects Poisson model (Model 3 in Table 8). Because the survey shows that UDisc captures about 80% of disc golfing activity, we aggregated UDisc scorekeeping logs to extrapolate our results. Specifically, we found that 1,772 is the average number of disc golfers using the UDisc app at each course in 2023. Thus, we adjust the number of disc golfers to 2,215 to account for all disc golfers. Confidence intervals were derived from 10,000 block-bootstrap samples.

that reflect predicted behavior under actual, revealed conditions (see Englin and Cameron, 1996; Whitehead et al., 2008b).

The adjusted prediction yields an average of 40.06 trips per person annually, lower than the original estimate of 47.13 trips. Consequently, the estimated total annual consumer surplus for the course decreases to $6.08 million, compared to the original estimate of $7.15 million. Although this adjustment suggests a lower welfare estimate, the overlapping 95% confidence intervals indicate that the difference is not statistically significant. For advocacy purposes or policy recommendations, especially when proposing new courses in the New York City area, we recommend using the adjusted welfare estimate as it more conservatively accounts for potential hypothetical bias.

8 Conclusion

This study estimates the value of a disc golf course, an increasingly popular outdoor recreational activity, by using an on-site intercept survey to collect revealed and stated preference data on trip frequency under varying travel times. Using these data, we estimate a travel cost model for disc golf demand and derive welfare measures, including consumer surplus per trip, annual consumer surplus per individual, and total annual consumer surplus for the course as a whole. Our model also allows us to identify and account for differences between stated trips and revealed trips, which we characterize as the hypothetical bias in stated trips. Specifically, respondents tend to overstate the number of trips they would make in hypothetical scenarios with reduced travel times. Adjusting for this hypothetical bias refines our estimates of consumer surplus, though the differences between welfare estimates with and without this adjustment are not statistically significant.

Our preferred model, a fixed-effects Poisson regression controlling for unobserved individual characteristics, estimates an individual consumer surplus of \$68.49 per trip. Adjusting for hypothetical bias, this translates to an estimated total annual consumer surplus of \$6.08 million for the course. To express this annual welfare flow as a present value, we discount future benefits. Applying a 5% real discount rate, this annual surplus corresponds to a net present value of \$121.6 million for the course (assuming the annual surplus persists over time). Note that this welfare estimate bases itself on the current annual number of trips taken to the disc golf course. If the popularity of disc golf continues to increase, especially in densely populated areas, the recreational value these courses provide will likely grow as well.

Our findings offer valuable insights for parks and recreation departments and disc golf advocates considering new courses, particularly in urban areas such as New York City. The Professional Disc Golf Association (PDGA) estimates the cost of installing a new disc golf course falls below \$25,000. An important consideration in evaluating the cost-effectiveness of disc golf investments is the opportunity cost of land, particularly in dense urban settings. While the installation and maintenance costs of disc golf courses are relatively low, the land required for an 18-hole layout can be substantial, and the value of that land may be high in metropolitan areas. In such contexts, disc golf may compete with alternative uses such as playgrounds, athletic fields, nature trails, or other public amenities. Although land costs and opportunity costs are high in urban areas, our welfare estimates suggest that building a course in an existing park may provide considerable benefits, justifying the investment. The present value estimate supports this, particularly for low-cost public land already within the NYC park system. However, a full benefit–cost analysis would need to incorporate the opportunity cost of land, which varies considerably across locations within urban areas.

Our study has additional limitations that future research can address. First, logistical constraints in collecting observations at two specific disc golf courses limit our sample size. A larger sample across more courses would enable more precise estimates and a broader understanding of course demand. In addition, because surveys were conducted during weekends with good weather, our sample reflects peak participation days. This may overstate typical visitation rates but captures realistic conditions under which most disc golf play occurs.

Moreover, our study is based in a densely populated urban setting, while many disc golf courses sit farther from major population centers. Future research can examine how different surrounding demographic characteristics and course features affect welfare estimates, providing a more comprehensive understanding of the value of disc golf across diverse regions. A further limitation is that the travel times derived from Google Maps API do not account for time-of-day or weekday versus weekend variation in traffic conditions. While this could introduce small measurement errors, these are unlikely to materially affect our results, given that most surveys were conducted during comparable weekend daytime periods.

A related limitation concerns the app-based data used to benchmark overall visitation. Although UDisc provides the most comprehensive record of disc golf play, it probably does not capture all users equally. Our reliance on this source could introduce some uncertainty in scaling aggregate welfare estimates, although our sensitivity analysis mitigates this concern.

Finally, the sample is demographically homogeneous, composed largely of White male respondents. This composition mirrors current participation patterns in the sport but limits the generalizability of the welfare estimates, consistent with evidence that recreation values and access are often understated for minority populations in environmental valuation studies (Ando et al., 2024). Expanding access to disc golf facilities in more diverse and underserved areas could therefore broaden participation and provide new insights into recreational equity. In fact, our results point to an opportunity for greater inclusion within disc golf, suggesting potential for this recreational activity to expand among women and minorities. This is particularly important in the New York City area, which has a diverse population and an extensive public transportation infrastructure. Improved local access, especially through the strategic placement of courses that are accessible by public transportation and to diverse communities, may be a key factor in broadening participation and addressing existing imbalances in recreational access. These improvements can be complemented by outreach programs targeting women and minorities, including introductory training opportunities as well as efforts to disseminate the benefits and accessibility of this recreational activity. This lack of diversity is a critical consideration for parks and recreation efforts, suggesting the prioritization of resources that can foster equitable and inclusive access to disc golf in the New York City area.

Future studies can investigate barriers that may limit participation by women and minorities, especially in diverse areas like NYC. For example, if the lack of public transportation access constitutes a barrier, disc golf courses within NYC may enable greater access for individuals without cars, increasing the appeal of this low-cost and inclusive activity. Additionally, as disc golf courses increasingly integrate into cities with robust public transit, future research can explore how travel costs should adjust to account for non-automobile travel. This is particularly relevant in the context of the traditional travel cost method, which typically assumes car access. Furthermore, the valuation of such amenities in urban environments can consider potential frictions due to racial or socioeconomic barriers (Ando et al., 2024). A dedicated study on the value of courses within cities with transit options would provide valuable insight into how urban disc golf can enhance equitable access to outdoor recreation.

In sum, our findings suggest that disc golf can generate substantial recreational value, particularly in dense urban environments where low-cost, accessible outdoor amenities are in high demand. We have quantified the welfare benefits of an urban disc golf course and accounted for hypothetical bias in stated behavior. This study suggests that disc golf investments in existing public parks can yield meaningful returns relative to their installation costs.

Urban planners must balance competing demands for limited public space. We encourage them to incorporate valuation studies such as ours to inform their decisions about how recreational investments are allocated.

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9 Appendix A. Survey

Introduction

We invite you to participate in this survey that investigates disc golfing habits and opinions. Our research team is composed of economics professors and students. Below are details about the study:

Title of Research Study: Estimating benefits of and demand for a disc golf course near New York City
Principal Investigator(s): Jimena González-Ramírez, PhD; Kenneth Liao, PhD, and Kevin Meyer, PhD.
Student Investigator(s): Victoria Adams and Robert Mack
Supported By: Department of Economics and Finance, O'Malley School of Business, Manhattan College
Collaborating Institutions: Farmingdale State College and Saginaw State Valley University

Your participation in this survey is completely **voluntary**. You may decline altogether, or leave blank any questions you do not wish to answer. Your responses will remain strictly confidential and anonymous, as individual responses cannot be identified. Data from this research will only be reported in aggregate levels.

You must be 18 years or older to participate in the survey. It should take approximately **5-10 minutes** to complete. To show our appreciation for your time and effort, anyone who completes the survey has the opportunity to win a **$50 Amazon gift card** (one entry per person per course). A total of 5 cards will be raffled. Winners of the raffle drawing will be emailed about their gift cards after the survey closes.

There are no known risks to participate in this survey beyond those encountered in everyday life and no anticipated direct benefits to your participation in this survey. However, your participation will allow you to take part in research that may contribute to our understanding of the value of a disc golf course near New York City.

By clicking on the arrow below, you give your consent to participate in this survey.

If you have any questions, please contact the principal investigator, Dr. Jimena González (jimena.gonzalez@manhattan.edu) or the Manhattan College Institutional Review Board (irb@manhattan.edu)

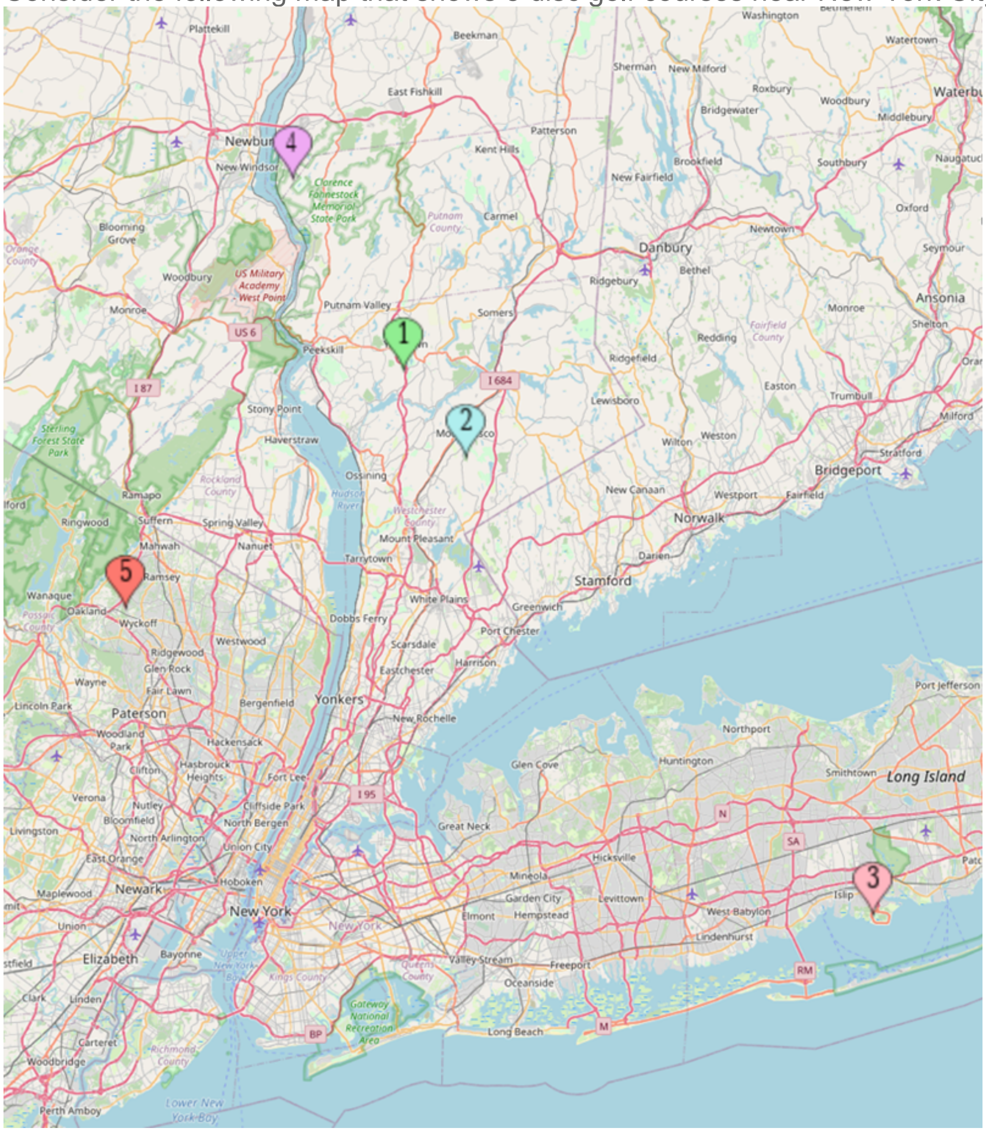
Age Check

Are you 18 years of age or older?

- ◯ Yes
- ◯ No

Trip to Courses

Consider the following map that shows 5 disc golf courses near New York City:



(1) FDR State Park, (2) Leonard Park, (3) Heckscher State Park, (4) Beacon Glades, (5) Campgaw Reservation

To the best of your knowledge, how many times have you played disc golf at each of the following courses? (If you didn't play, enter zero)

	Last 30 days	Last 365 days
(1) FDR State Park		
(2) Leonard Park		
(3) Heckscher Forest		
(4) Beacon Glades		
(5) Campgaw Reservation		

Was disc golf the primary reason to visit these parks?

◯ Yes

◯ No

Intro to CB Section

How long did it take for you to travel to this disc golf course today (one-way)? (Enter your answer in minutes)

Is this the typical amount of time it takes you to travel to this disc golf course (one-way)?

- ◯ Yes
- ◯ No

What is the typical amount of time it takes you to travel to this disc golf course (one-way)? (Enter your answer in minutes)

CB_10

Consider the time it typically takes to travel to this disc golf course (one-way). Now suppose this travel time **decreased by 10 minutes.**

Would you have taken more or fewer trips to this disc golf course in the past 365 days?

- ◯ More trips
- ◯ Fewer trips
- ◯ The same number of trips

How many **additional trips** to this disc golf course would you have taken in the past 365 days?

How many **fewer trips** to this disc golf course would you have taken in the past 365 days?

CB_15

Consider the time it typically takes to travel to this disc golf course (one-way). Now suppose this travel time **decreased by 15 minutes.**

Would you have taken more or fewer trips to this disc golf course in the past 365 days?

- More trips
- Fewer trips
- The same number of trips

How many **additional trips** to this disc golf course would you have taken in the past 365 days?

How many **fewer trips** to this disc golf course would you have taken in the past 365 days?

CB_20

Consider the time it typically takes to travel to this disc golf course (one-way). Now suppose this travel time **decreased by 20 minutes.**

Would you have taken more or fewer trips to this disc golf course in the past 365 days?

- More trips
- Fewer trips
- The same number of trips

How many **additional trips** to this disc golf course would you have taken in the past 365 days?

How many **fewer trips** to this disc golf course would you have taken in the past 365 days?

CB_25

Consider the time it typically takes to travel to this disc golf course (one-way). Now suppose this travel time **decreased by 25 minutes.**

Would you have taken more or fewer trips to this disc golf course in the past 365 days?

- More trips
- Fewer trips
- The same number of trips

How many **additional trips** to this disc golf course would you have taken in the past 365 days?

How many **fewer trips** to this disc golf course would you have taken in the past 365 days?

CB_5

Suppose instead that the typical travel time to this disc golf course **decreased by 5 minutes.**

Would you have taken more or fewer trips to this disc golf course in the past 365 days?

- More trips
- Fewer trips
- The same number of trips

How many **additional trips** to this disc golf course would you have taken in the past 365 days?

How many **fewer trips** to this disc golf course would you have taken in the past 365 days?

CB_10_15

Suppose instead that the typical travel time to this disc golf course **decreased by 15 minutes.**

Would you have taken more or fewer trips to this disc golf course in the past 365 days?

- More trips
- Fewer trips

◯ The same number of trips

How many **additional trips** to this disc golf course would you have taken in the past 365 days?

How many **fewer trips** to this disc golf course would you have taken in the past 365 days?

CB_15_10

Suppose instead that the typical travel time to this disc golf course **decreased by 10 minutes.**

Would you have taken more or fewer trips to this disc golf course in the past 365 days?

◯ More trips

◯ Fewer trips

◯ The same number of trips

How many **additional trips** to this disc golf course would you have taken in the past 365 days?

How many **fewer trips** to this disc golf course would you have taken in the past 365 days?

CB_15_20

Suppose instead that the typical travel time to this disc golf course **decreased by 20 minutes.**

Would you have taken more or fewer trips to this disc golf course in the past 365 days?

◯ More trips

◯ Fewer trips

◯ The same number of trips

How many **additional trips** to this disc golf course would you have taken in the past 365 days?

How many **fewer trips** to this disc golf course would you have taken in the past 365 days?

CB_20_15

Suppose instead that the typical travel time to this disc golf course **decreased by 15 minutes.**

Would you have taken more or fewer trips to this disc golf course in the past 365 days?

- More trips
- Fewer trips
- The same number of trips

How many **additional trips** to this disc golf course would you have taken in the past 365 days?

How many **fewer trips** to this disc golf course would you have taken in the past 365 days?

CB_20_25

Suppose instead that the typical travel time to this disc golf course **decreased by 25 minutes.**

Would you have taken more or fewer trips to this disc golf course in the past 365 days?

- More trips
- Fewer trips
- The same number of trips

How many **additional trips** to this disc golf course would you have taken in the past 365 days?

How many **fewer trips** to this disc golf course would you have taken in the past 365 days?

CB_25_20

Suppose instead that the typical travel time to this disc golf course **decreased by 20 minutes.**

Would you have taken more or fewer trips to this disc golf course in the past 365 days?

- More trips
- Fewer trips
- The same number of trips

How many **additional trips** to this disc golf course would you have taken in the past 365 days?

How many **fewer trips** to this disc golf course would you have taken in the past 365 days?

CB_35

Suppose instead that the typical travel time to this disc golf course **decreased by 35 minutes.**

Would you have taken more or fewer trips to this disc golf course in the past 365 days?

- More trips
- Fewer trips
- The same number of trips

How many **additional trips** to this disc golf course would you have taken in the past 365 days?

How many **fewer trips** to this disc golf course would you have taken in the past 365 days?

Travel Cost Questions

Have you participated in any disc golf tournaments in the previous 4 years?

- ◯ Yes
- ◯ No

How many discs did you bring with you to the course today?

What percentage of the time do you use a score keeping app when you play disc golf?

	0	10	20	30	40	50	60	70	80	90	100
Percentage											

Which app do you use?

- ◯ UDisc
- ◯ Disc Golf Course Review
- ◯ Disc Caddy
- ◯ Other

What is(are) the primary reason(s) that you chose to visit this particular disc golf course? (Check all that apply)

- ☐ Positive reviews / recommendations
- ☐ Travel time from your residence
- ☐ Quality of tee areas
- ☐ Layout of course
- ☐ Difficulty of course
- ☐ Natural resources (trees, wildlife, flowers, views, etc.)
- ☐ Not crowded / short wait time
- ☐ Entry / parking cost

- [ ] Other amenities at the park (e.g., picnics, bathrooms)

What form of transportation do you use to get to this disc golf course?

- ○ Personal / Private vehicle
- ○ Taxi / rideshare
- ○ Public transportation
- ○ Bike
- ○ Walk
- ○ Other ______

Which fuel type best describes the vehicle?

- ○ Regular gasoline
- ○ Premium gasoline
- ○ Flex fuel / E85
- ○ Hybrid gasoline / electric
- ○ Fully electric
- ○ Diesel
- ○ Other ______

Which type best describes the vehicle?

- ○ Compact / small sedan / coupe
- ○ Midsize / medium sedan
- ○ Large sedan / station wagon / crossover
- ○ Small / compact SUV
- ○ Medium / large SUV / minivan
- ○ Small pickup truck
- ○ Large pickup truck
- ○ Other ______

Do you typically use an Empire Pass (regional parking pass for NY State parks)?

- ○ Yes
- ○ No

How many people **(including yourself)** arrived in the same vehicle as you?

When you make the choice to visit a disc golf course, do you typically know when/whether the park has a vehicle/parking fee?

- Yes
- No

An important aspect of this study involves understanding the distance disc golfers travel to visit this course. In order to calculate this distance, we would like to record your address.

This information will remain **completely private** and will only be used for the purpose of this study (you will not be contacted as a result of providing your address).

If you are not comfortable providing your address, we would appreciate you sharing the road intersection that is nearest your house/building on the next page:

What is your address?

Address (Street Number and Street Name)

Zip Code

What is the road intersection nearest your house/building?

Road intersection (Street 1)

Road intersection (Street 2)

Zip Code

Covid-19 related questions

When did you start playing disc golf?

	Numeric Answer
Month (mm)	
Year (yyyy)	

Did you start playing disc golf because of COVID-19/lockdowns/social distancing?

- Yes
-

No

Do you think COVID-19/lockdowns/social distancing caused you to play more disc golf?

- ◯ Yes
- ◯ No

Demographics

Information about your household will help us better understand how household characteristics affect disc golf choices. It will also help us to determine how representative our sample is of the state of New York.

All of your answers are **strictly confidential**. The information will only be used to report comparisons among groups of people. We will never identify individuals or households with their responses. Please be as complete in your answers as possible. Thank you.

What is your age?

____

What is your gender?

- ◯ Male
- ◯ Female
- ◯ Non-binary
- ◯ Other __________

What is your race? Select one or more races to indicate what you consider yourself to be.

- ☐ Asian or Pacific Islander
- ☐ Black or African American
- ☐ Hispanic or Latinx
- ☐ Native American or Alaskan Native
- ☐ White or Caucasion
- ☐ Other __________

What is the highest level of education you have completed?

- ◯ Some high school
- ◯

High school graduate or equivalent

- ◯ Some college
- ◯ Associate's degree
- ◯ Bachelor's degree
- ◯ Master's degree
- ◯ Professional degree
- ◯ Doctorate degree

On average, how many hours do you work per week?

- ◯ 0 to 10
- ◯ 11 to 20
- ◯ 21 to 30
- ◯ 31 to 40
- ◯ 41 to 60
- ◯ above 60

What is your **pre-tax yearly household** income?

- ◯ Less than $20,000
- ◯ $20,000-$34,999
- ◯ $35,000-$49,999
- ◯ $50,000-$74,999
- ◯ $75,000-$99,999
- ◯ $100,000-$149,999
- ◯ $150,000-$199,999
- ◯ $200,000 or more

How many adults **(including yourself)** live in your household?

Raffle

Thank you for participating in this survey!

Participants who fully completed the survey have a chance to enter a raffle to win **one** out of five **$50 Amazon gift cards.**

If you would like to enter the raffle, please provide us with your email address below.
If you choose not to enter the raffle, just click the right arrow button below.

Note: your email address is used only for the raffle and will not be connected to your responses for this research. Once the raffle is completed, all email addresses will be deleted.

10 Appendix B. Shared Costs

Dependent Variable:		trips	
Model:	(1)	(2)	(3)
Variables			
Constant	3.565***	44.60***	
	(0.1770)	(14.60)	
Travel Cost ($)	-0.0051***	-0.0072***	-0.0128***
	(0.0019)	(0.0021)	(0.0035)
Contingent Behavior (*cb*	0.3900***	0.3597***	0.2605***
	(0.1206)	(0.1155)	(0.0951)
Travel cost to substitute Course	0.0030***	0.0018	
	(0.0010)	(0.0012)	
FDR	-0.5084***	-0.5598***	
	(0.1417)	(0.1442)	
Age		-0.0029	
		(0.0046)	
Male		-0.1671	
		(0.1933)	
White		0.3062	
		(0.2068)	
College Degree		-0.0924	
		(0.1148)	
Household Income		0.0188**	
		(0.0073)	
start_year		-0.0203***	
		(0.0072)	
Fixed-effects			
ResponseId			Yes
Fit statistics			
Observations	520	520	505
Squared Correlation	0.13537	0.18735	0.87160
Pseudo R^2	0.16813	0.21090	0.83607
BIC	26,870.2	25,527.7	5,947.6

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

11 Appendix C. Income Heterogeneity

Dependent Variable:	trips
Variables	
Travel Cost	-0.0266***
	(0.0047)
Contingent Behavior (*cb*)	0.1599
	(0.0983)
Travel cost × High Income	0.0144***
	(0.0051)
Fixed-effects	
ResponseId	Yes
Fit statistics	
Observations	505
Squared Correlation	0.87721
Pseudo R^2	0.84235
BIC	5,758.6

Clustered (ResponseId) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*