Managing No-Shows in Public Resource Allocation: The Economics of Campground Reservations

Jonathan E. Hughes[1,2]*

June 13, 2025

Abstract

Low prices, limited capacity and increased interest in outdoor recreation contribute to intense competition for public campsites in the United States. Yet, users and park managers report high vacancy rates due to unused reservations or "no-shows." I develop a simple model for the campground reservation, cancellation and no-show decisions. I numerically simulate pricing policies at a hypothetical but representative park. When capacity constraints are binding, the cancellation fees charged by many parks increase no-shows and decrease consumer surplus. In contrast, modestly higher prices and no-show fees dramatically reduce no-shows and increase social surplus 8 to 15 percent. However, these policies create different distributional effects. Higher prices raise revenue but decrease consumer surplus and discourage reservations from lower income users when income is positively correlated with trip utility. No-show fees increase consumer surplus and do not materially affect the income distribution of users. The optimal no-show fee, equal to the lost consumer surplus from the marginal no-show, maximizes consumer surplus and increases social surplus 8.5 percent.

"The National Parks are more than the storehouses of Nature's rarest treasures. They are the playlands of the people, wonderlands easily accessible to the rich and humble alike."
– Horace M. Albright, Director of the National Park Service from 1929 to 1933.

*I thank seminar participants at the University of Colorado at Boulder for helpful comments.

[1]Department of Economics, University of Colorado at Boulder. [2]Renewable and Sustainable Energy Institute, University of Colorado at Boulder. *email*: jonathan.e.hughes@colorado.edu

1 Introduction

Outdoor recreation contributes more than $639 billion to U.S. GDP (U.S. Bureau of Economic Analysis, 2025), with roughly 57 percent of Americans aged 6 and older participating annually (Outdoor Industry Association, 2024). Motivated by equity and accessibility concerns, public land managers set low prices for recreational activities. These low prices, high demand and limited capacity create intense competition for popular destinations (Sloss, 2022). The problem is particularly acute for public campgrounds where peak season occupancy has increased 39 percent between 2014 and 2020 (McIntosh, 2021). Because expansions are costly or undesirable, optimal management of existing capacity is critically important. However, park managers and users report high vacancy rates due to un-used reservations or “no-shows” (Pohle, 2023). No-shows are inefficient not only because they waste capacity, but also because they generate negative externalities when users fail to consider the exclusionary effects of their actions on other users.

This paper answers two questions. First, how do park pricing policies contribute to no-shows and associated inefficiencies? Second, can policy changes correct these inefficiencies while meeting park managers goals of revenue adequacy and improved access? To answer these questions, I propose a simple theoretical framework describing users’ reservation, cancellation and no-show decisions where heterogenous users face uncertainty in their ability to travel and have nonzero cancellation costs. Park managers have finite camping capacity and set prices, cancellation and no-show fees. Users weigh their utility from camping against their costs when choosing to reserve and if they do not travel, minimize their costs when deciding whether to cancel or no-show.

There are four main theoretical results. First, cancellation fees can increase or decrease no-shows when campground capacity constraints are not binding but strictly increase no-shows when capacity constraints are binding. Second, increasing trip prices strictly decreases no-shows. Third, increasing no-show fees strictly decreases no-shows. Fourth, when trip utility is positively correlated with income, increasing prices increases the mean income of campers who reserve and increasing no-show fees weakly increases mean income.

To quantify the size of these effects, I numerically simulate reservations at a hypothetical but representative National Park (NP). When capacity constraints are binding, cancellation fees decrease social surplus by creating high no-show rates. In contrast, modestly higher prices or no-show fees ($40) essentially eliminate no-shows and increase social surplus 15 percent and 8 percent, respectively. However, price increases and no-show fees have different distributional effects. Higher prices increase revenue (56%) but reduce consumer surplus (11%). No-show fees modestly increase park revenue (1.5%) but increase consumer surplus (12%).

Because park managers are interested in the effects of policies on access for different types of users (Rice et al., 2022), I simulate policy alternatives when user characteristics are correlated with income. A \$40 increase in price increases the mean income of reservation holders \$2,900 (2%). In contrast, a \$40 increase in no-show fee causes little change in income. Finally, I estimate outcomes under an optimal no-show fee (\$150) equal to the marginal external cost of a no-show (the lost consumer surplus of a denied a reservation). This fee eliminates no-shows, increasing consumer surplus by 14 percent and social surplus by 8.5 percent. Further, a more modest \$40 no-show fee attains over 96% of the social surplus gain of the optimal fee.

While the problem of inefficient pricing of public resources is known (Taylor, Tsui, and Zhu, 2003; Scrogin, 2005; Evans, Vossler, and Flores, 2009), no attention has been paid to the growing issue of no-shows. No-shows share key features with classic environmental externalities and the economics of crime (Becker, 1968; Ehrlich, 1996), but differ in that policy decisions by park managers can unintentionally exacerbate the issue. The results presented here may have important implications for other markets where no-shows are costly such as healthcare, services, travel and leisure (Bech, 2005; Dantas et al., 2018; Kaplan-Lewis and Percac-Lima, 2013; Kim et al., 2025; Schreyer and Torgler, 2021).

2 Model

User i's utility from a camping trip, net of time and travel costs, is $U_{trip,i}$. The price of a trip is P_{trip}. Trip reservations are made in advance and whether user i travels and uses the reservation is uncertain. Assume user i travels with probability ρ_i and does not travel with probability $(1-\rho_i)$. If user i does not travel, they may cancel their reservation and receive a refund of P_{trip}, less a transaction cost τ_i, where that latter represents the user's non-pecuniary cost of cancelling the reservation.[1] Alternatively, user i may choose to no-show to avoid paying τ_i by keeping their reservation and forfeiting P_{trip}.

Park managers assess fees in addition to P_{trip} that affect the reservation and cancellation decisions. At all reservable campsites managed by Recreation.gov and at many state parks, cancelled reservations incur an additional fee, F_{cancel}, ostensibly to prevent frivolous reservations or to recoup administrative costs. At staffed campgrounds, no-shows may be subject to a penalty $F_{no-show}$.

[1]For instance the hassle, time and cognitive costs of logging on to the reservation system or the option value of keeping a reservation.

Under these assumptions, user i's expected utility from reserving is:

$$\mathbb{E}[\mathrm{U}_i] = \rho_i\big(U_{trip,i} \; - \; P_{trip}\big) \; - \; (1-\rho_i) \; \min\!\big(\tau_i + F_{cancel}, \; P_{trip} + F_{no-show}\big),$$

where the final term captures the different costs from cancelling or no-show and assumes user i chooses the lesser. Assuming user i reserves a campsite when their expected utility is positive, their problem can be written as:

$$\text{Reserve} \; = \begin{cases} \rho_i \, U_{trip,i} \; \geq \; \rho_i \, P_{trip} \; + \; (1-\rho_i)\,(\tau_i + F_{cancel}), & \text{if } \tau_i + F_{cancel} < P_{trip} + F_{no-show}, \\ \rho_i \, U_{trip,i} \; \geq \; \rho_i \, P_{trip} \; + \; (1-\rho_i)\,(P_{trip} + F_{no-show}), & \text{if } \tau_i + F_{cancel} \geq P_{trip} + F_{no-show}, \end{cases} \tag{1}$$

$$\text{No-show if: } \tau_i + F_{cancel} \geq P_{trip} + F_{no-show}$$

User i is more likely to reserve when $U_{trip,i}$ and ρ_i are large and when P_{trip} is small. For $\tau_i + F_{cancel} < P_{trip} + F_{no-show}$, user i will reserve if $\rho_i U_{trip,i} \geq \rho_i P_{trip} + (1-\rho_i)(\tau_i + F_{cancel})$, but will always cancel if they do not travel. However if $\tau_i + F_{cancel} \geq P_{trip} + F_{no-show}$, a user will reserve if $\rho_i U_{trip} \geq \rho_i P_{trip} + (1-\rho_i)(P_{trip} + F_{no-show})$, and will always no-show if they do not travel. Here, F_{cancel} increases the threshold for canceling potentially yielding an increase in no-shows while $F_{no-show}$ works in the opposite direction.

Changes to P_{trip}, F_{cancel} and $F_{no-show}$ can also affect users at risk of no-show through the reservation margin when capacity constraints are not binding. However if there is excess demand, fee changes do not change total reservations because for each user who decides not to reserve there is another user to take their place.

Finally, I assume continuous distributions of the parameters (ρ, U_{trip}, τ) around the reservation and no-show thresholds such that changes in fees smoothly shift characteristics of the marginal user. Under these assumptions, I derive the results below. Proofs of each proposition are provided in Online Appendix A.

Proposition 1: *Increasing F_{cancel} can increase or decrease no-shows.*

Intuitively, a higher cancellation fee F_{cancel}, weakly decreases reservations for users who would cancel but strictly increases the proportion of non-travelers who no-show. Hence, the net effect on no-shows is ambiguous.

Corollary 1: *Increasing F_{cancel} strictly increases no-shows when capacity constraints are binding.*

With a binding capacity constraint, the number of reservations is fixed and hence the number at risk of no-show is constant. Since higher cancellation fees strictly increase no-shows among non-travelers, no-shows increase.

Proposition 2: *Increasing P_{trip} strictly decreases no-shows.*

If the campground capacity constraint is binding, increasing P_{trip} has no effect on the number of reservations but increasing P_{trip} strictly reduces no-shows among reservation holders who do not travel and therefore decreases no-shows overall. If the campground capacity constraint is non-binding, increasing P_{trip} strictly reduces reservations, further reducing no-shows.

Proposition 3: *Increasing $F_{no-show}$ strictly decreases no-shows.*

Following the same logic as Proposition 2, increasing $F_{no-show}$ strictly decreases no-shows among non-travelers. If the campground capacity constraint is non-binding, then increasing $F_{no-show}$ also weakly decreases reservations, further reducing no-shows.

Park managers interested in the differential effects of fee changes on the *types* of users who travel express concern higher fees may disproportionately impact lower income users. Proposition 4 considers cases when income is correlated with user characteristics.

Proposition 4: *If U_{trip} is positively correlated with income, increasing P_{trip} increases the mean income of users who reserve.*

Increasing P_{trip} raises the reservation threshold. If lower income users have lower trip utility, then increasing price will preferentially screen out these users, increasing the mean.

Corollary 4.1: *When U_{trip} and income are positively correlated, increasing $F_{no-show}$ weakly increases the mean income of users who reserve.*

Increasing $F_{no-show}$ raises the reservation threshold for users who no-show (those with high τ), again screening out lower income users. However, only those users at risk of no-show are affected.

Overall, cancellation fees likely exacerbate no-shows while trip and no-show fees reduce no-shows. However, trip and no-show fees likely generate different distributional effects, particularly when user characteristics are correlated with income. The next section quantifies the magnitudes of these effects.

3 Numerical simulations

3.1 Model setup

I model peak season at a representative park with median capacity of 10,000 user stays (400 sites $\times$ 25 weekends/year).[2] In the baseline scenario, P_{trip}= \$70, F_{cancel}= \$10 and $F_{no-show}$= \$0.[3] For simplicity, I ignore the costs of park operation. I assume a heterogenous population of 100,000 users with $U_{trip} \sim N(\$200, \$75^2)$ consistent with Rosenberger (2016). Users' cancellation costs τ are distributed $\sim N(\$50, \$25^2)$. Users' incomes are distributed $\sim N(\$135,000, \$25,000^2)$ consistent with NP surveys (Otak, Inc. et al., 2024) and the probability of traveling is uniformly distributed as $\rho \sim U(0, 1)$.

Each user is simulated by taking draws from the distributions of ρ, U_{trip}, τ, and income. Initially these draws are independent. However, subsequent simulations assume income and $U_{trip,i}$ or income and τ_i are correlated. The decision whether to reserve is made according to Equation 1 conditional on the fee structure (P_{trip}, F_{cancel} and $F_{no-show}$). If the desired number of reservations exceeds park capacity, reservations are allocated randomly amongst users who would reserve. Users who are rationed pay nothing and receive no trip utility. Users who make a reservation pay P_{trip}.

Among reservations holders, the decision to travel is determined based on a new draw of ρ with success probability ρ_i. Users who travel receive $U_{trip,i}$. Users who cancel receive no trip utility but pay F_{cancel}, τ_i and are refunded P_{trip}. Users who no-show pay $F_{no-show}$ and forfeit P_{trip}. With a binding capacity constraint, every cancelled reservation is rebooked at P_{trip} and assigned the mean utility and income of users who would reserve. Park revenue is calculated as the sum of P_{trip}, F_{cancel} and $F_{no-show}$. For travelers, consumer surplus is calculated as $U_{trip,i} - P_{trip}$. For non-travelers, consumer surplus is calculated as the net fees paid plus τ_i if the reservation is cancelled.

3.2 Fees, no-shows, park revenues and consumer surplus

Simulation results are shown in Table 1. The capacity constraint is binding (reservations = 10,000) representative of most NP campgrounds during peak season. Results for a non-binding capacity constraint are discussed in Online Appendix D. While I lack data required for a formal model

[2]See Figure C1 in the Online Appendix for the distribution of capacities in National Parks.

[3]Price assumes a two-night stay. Reservations on Recreation.gov are subject to a \$10 cancellation fee. While staffed campgrounds do impose a no-show fee, many popular campgrounds are unstaffed and anecdotal evidence suggests enforcement is poor where no-show fees do exist.

	Price	Cancellation Fee	No-Show Fee	Reservations	% Travel	% No-Show	Revenue	Consumer Surplus	Social Surplus	%Δ SS
Baseline	$70	$10	$0	10,000	64.1%	10.2%	$725,681	$1,134,629	$1,860,310	
Inc. F_{cancel}	$70	$20	$0	10,000	65.3%	15.4%	$738,561	$1,043,935	$1,782,496	-4.2%
Inc. P_{trip}	$110	$10	$0	10,000	66.8%	0.4%	$1,132,766	$1,011,763	$2,144,529	15.3%
Inc. $F_{no\text{-}show}$	$70	$10	$40	10,000	64.6%	0.5%	$736,879	$1,275,000	$2,011,878	8.1%
Opt. $F^*_{no\text{-}show}$	$70	$10	$150	10,000	64.6%	0.000%	$735,378	$1,282,303	$2,017,681	8.5%
Opt. $F^*_{no\text{-}show}$	$70	$0	$149	10,000	62.7%	0.000%	$700,000	$1,298,164	$1,998,164	7.4%

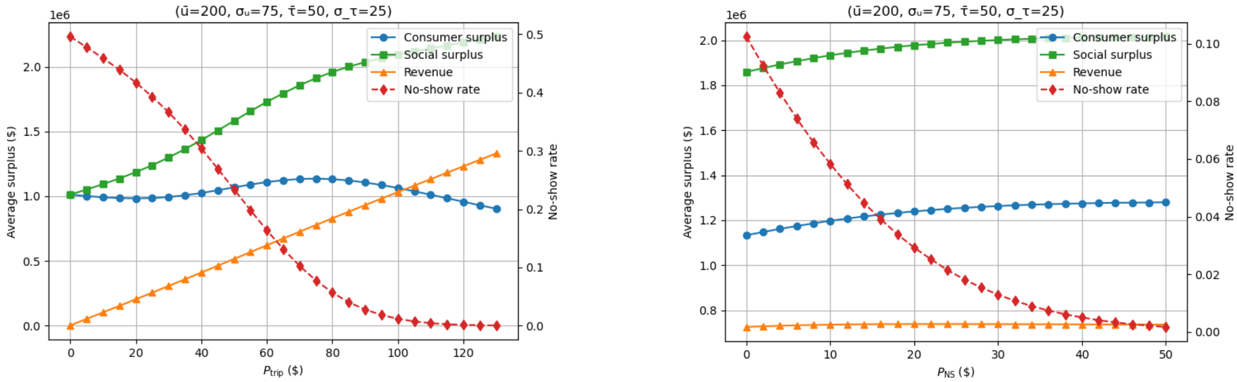
Table 1: Simulated campground reservation, cancellation and no-show activity under different fee structures. U_{trip} is $\sim N(200, 75^2)$. Transaction costs, τ are $\sim N(50, 25^2)$ and the probability of traveling, ρ is $\sim U(0, 1)$. Park revenue is the sum of all collected fees. Consumer surplus is $U_{trip} - P_{trip}$ for travelers and $0 -$ fees paid for non-travelers. Each data point is the average over 1000 simulated choice occasions.

calibration,[4] the model and baseline fees (row one) produce outcomes consistent with recent surveys from The Dyrt (2025). Of those with reservations, approximately 64 percent travel while survey respondents traveled between 59 percent (2023) and 71 percent (2024) of the time. Approximately 10 percent of users with reservations no-show, consistent with respondents who admitted to no-showing or arriving one day late approximately 8 percent of the time. Finally, 26 percent of users cancel, the same share of survey respondents who report cancelling at least 2 days ahead of the scheduled arrival date.

Increasing cancellation fees from $10 to $20 (row two) increases no shows, from around 10 percent to over 15 percent and decreases social surplus approximately 4 percent. Online Appendix D shows eliminating the cancellation fee would reduce no shows to 6 percent and increase social surplus 3 percent. Increasing price from $70 to $110 reduces no-shows to near zero (0.4 percent) despite the binding capacity constraint, consistent with Proposition 2. Revenues increase substantially, approximately 56 percent, and consumer surplus decreases approximately 10.8 percent. Overall, social surplus increases 15 percent. Similarly, a $40 no-show fee also nearly eliminates no shows, consistent with Proposition 3. Here, revenues increase modestly, approximately 1.5 percent. However, consumer surplus increases approximately 12.4 percent such that social surplus increases 8 percent. Thus, while both higher price and higher no-show fees increase social surplus, they lead to different distributional effects. Higher prices increase park revenues while no-show fees mainly increase consumer surplus by reducing the number of unused campsites.

Figure 1 illustrates how consumer surplus, revenues and no-shows vary across different levels

[4] I am unaware of any dataset or broad survey that robustly quantifies campground cancellation rates.



(a) P_{trip} increase

(b) $F_{no-show}$ increase

Figure 1: Panel (a) plots simulated outcomes for different P_{trip} policies. Panel (b) plots simulated outcomes for different $F_{no-show}$ policies. Consumer surplus, revenue and social surplus are plotted in dollars (\$). The no-show rate is the fraction of users holding a reservation who no-show. U_{trip} is $\sim N(200, 75^2)$. Income is $\sim N(135,000, 75,000^2)$ and τ is $\sim N(50, 25^2)$. Campground capacity is 10,000 user trips and there are 100,000 potential users. In panel (a) $F_{no-show} = \$0$ and $F_{cancel} = \$10$, In panel (b), $P_{trip} = \$70$ and $F_{cancel} = \$10$. Each data point is the average over 1000 simulated choice occasions.

of P_{trip} and $F_{no-show}$. Figure 1a shows no-show rates decrease from approximately 50 percent, at $P_{trip} = \$0$ to zero at $P_{trip} = \$115$. Consumer surplus is s-shaped in prices. When P_{trip} is low, price increases raise costs for all reservation holders but are too low to substantially reduce no-shows. However for moderately high prices, the effect of fewer no-shows dominates. Consumer surplus achieves a maximum when P_{trip} is approximately \$75 and the no-show rate is about 5 percent. For higher price, the higher cost of reservations again dominates and consumer surplus decreases. Perhaps somewhat counterintuitively, very low prices are *detrimental* to consumers due to high no-show rates. Overall, because higher prices increase revenues (linearly), increasing P_{trip} always increases social surplus, though high prices may be undesirable to managers concerned with access.

Figure 1b shows the effects of different no-show fees. No-show rates decrease from around 10 percent at $F_{no-show} = \$0$ to *approximately* zero when $F_{no-show}$ is \$50. Increasing no-show fees increases consumer surplus. Revenues are essentially flat since higher fees reduce the number of no-shows and thus generate little additional revenue. Overall, social surplus increases with higher $F_{no-show}$. Figure E in the Online Appendix shows the trends in Figure 1 are robust to different assumptions about the distributions of U_{trip} and τ.

3.3 Optimal no-show fee

I calculate the optimal no-show fee as follows. Assume a binding capacity constraint and that reservation are filled at random from the pool of would-reserve users. User who obtain cancelled reservations travel with certainty. Under these assumptions, the marginal external cost of a no-show is the average consumer surplus of those in the pool of would-reserve users.[5] Consistent with Becker (1968), the optimal fee equals the marginal external cost of the socially undesirable behavior, *i.e.* no-shows. Here, social costs arise from the fact a user who desires a reservation is excluded by another user who no-shows. Because changes in the no-show fee affect the pool of users who would reserve (per Equation 1), I solve for the optimal fee numerically. Results are presented in the last two rows of Table 1 for cases with and without the standard $10 cancellation fee. Focusing on the cases where F_{cancel}=$10, the optimal no-show fee of approximately $150 decreases no-shows to zero. Consumer surplus increases approximately $150,000 or about 13 percent relative to the baseline scenario. Social surplus increases 8.5 percent overall. Importantly, note the more modest $F_{no-show}$=$40 achieves over 96% of the social surplus gain of the optimal fee.

3.4 Distributional effects of fee policies

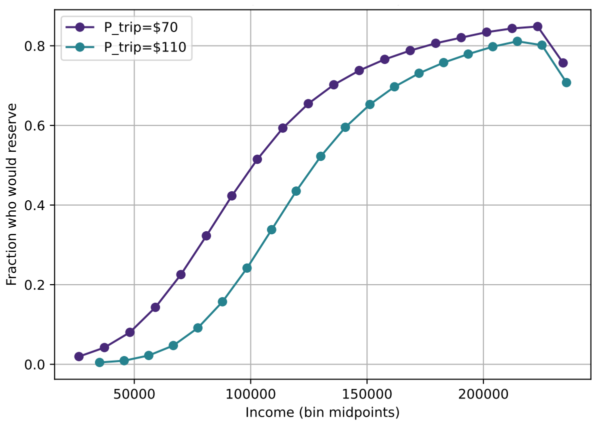
While both higher prices and no-show fees have efficiency benefits, users and park managers may be concerned about the distributional effects of higher prices on lower income users.[6] Underlying these concerns is a belief that trip utility is positively correlated with income. In this case, Proposition 4 shows higher prices can increase the mean income of users who reserve. To quantify these effects, I estimate fraction of users who would reserve for the baseline fees and when P_{trip}=$110 and $F_{no-show}$=$40. I simulate 1,000 choice occasions where 100,000 potential users decide whether to reserve assuming $\text{Corr}(U_{\text{trip}}, \text{Income}) = 0.70$.

Figure 2a plots Engel curves for P_{trip}=$70 and P_{trip}=$110. Intuitively, the likelihood of reserving increases with income when trip utility and income are positively correlated. At the baseline fees (purple) the odds of reserving are roughly even for a user with income of approximately $100,000. A user with a $50,000 income has about a 10 percent chance of reserving. A user with an income of $200,000 has a greater than 80 percent chance of reserving.

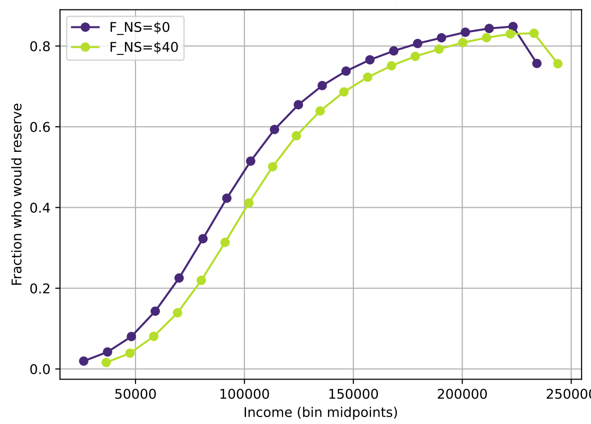
Increasing price reduces the likelihood users will reserve, particularly in the middle and lower third of the income distribution. Combined, this effects shifts the mean of income distribution of

[5]See Online Appendix B for further discussion of the optimal no-show fee.

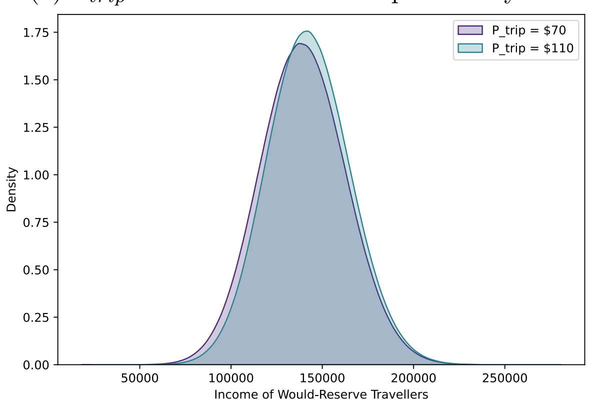
[6]Online Appendix E.1 explores the effects of correlations between income and τ and finds the effects to be minor.



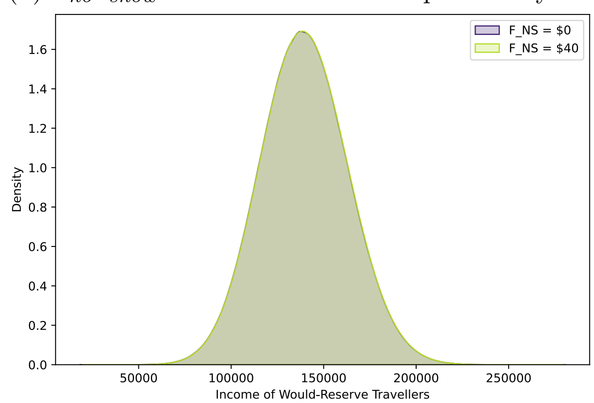
(a) P_{trip} increase: Reservation probability



(b) $F_{no-show}$ increase: Reservation probability



(c) P_{trip} increase: Income distribution



(d) $F_{no-show}$ increase: Income distribution

Figure 2: Distributional effects when U_{trip} is correlated with income. U_{trip} is $\sim N(500, 250^2)$. Income is $\sim N(135,000, 75,000^2)$ and $\text{Corr}(U_{\text{trip}}, \text{Income}) = 0.70$. Campground capacity is 10,000 user trips and there are 100,000 potential users. Panel (a) shows the fraction of potential users who wish to reserve at various points in the income distribution for a $P_{trip} = \$70$ and $P_{trip} = \$110$. Panel (b) plots the fraction of potential users who would reserve with and without a \$40 no-show fee. Panel (c) plots the income distributions of users who would reserve under different prices. Panel (d) plots the income distributions of users who would reserve with and without the no-show fee. Each plot shows results averaged over 1000 simulated choice occasions.

users who reserve by approximately \$2,900 (2%). This effect is larger or smaller depending on the magnitude of $\mathrm{Corr}(U_{\mathrm{trip}}, \mathrm{Income})$.

Figure 2c plots Engel curves for no-show fees of \$0 and \$40. Again, the dark purple curve is the baseline scenario. Increasing no-show fees decreases the likelihood of reserving. However, while Corollary 4.1 predicts increasing $F_{no-show}$ can increase mean income, the effects are less pronounced than with price increases. The shift in the income distribution of those who would reserve, Figure 2d, is barely perceptible. The mean income of those who would reserve only increases approximately \$100.

4 Discussion and conclusions

Public land managers face the difficult task of ensuring equitable access while balancing increasing demand and congestion. When managers rely on reservation systems, no-shows are particularly problematic when there is excess demand and non-zero cancellation costs. I show cancellation fees exacerbate these problems while price increases and no-show fees can mitigate no-shows and associated social costs. However, price increases can create distributional effects when income is correlated with trip utility, while no-show fees largely avoid this problem. Finally, taking into account the characteristics of typical park camping reservation systems, I estimate the optimal no-show fee, equal to the marginal external cost of no-show. Relative to the baseline scenario, this fee eliminates no-shows, maximizes consumer surplus and increases social surplus approximately 8.5 percent.

References

Bech, Mickael. 2005. "The economics of non-attendance and the expected effect of charging a fine on non-attendees." *Health Policy* 74 (2):181–191.

Becker, Gary S. 1968. "Crime and punishment: An economic approach." *Journal of Political Economy* 76 (2):169–217.

Dantas, Leila F., Julia L. Fleck, Fernando L. Cyrino Oliveira, and Silvio Hamacher. 2018. "No-shows in appointment scheduling – a systematic literature review." *Health Policy* 122 (4):412–421.

Ehrlich, Isaac. 1996. "Crime, punishment, and the market for offenses." *Journal of Economic Perspectives* 10 (1):43–67.

Evans, Mary F, Christian A Vossler, and Nicholas E Flores. 2009. "Hybrid allocation mechanisms for publicly provided goods." *Journal of Public Economics* 93 (1-2):311–325.

Guzman, Gloria and Melissa Kollar. 2024. "Income in the United States: 2023." Current population reports, p60-282, U.S. Census Bureau. URL `https://www.census.gov/library/publications/2024/demo/p60-282.html`. Accessed: 2025-05-22.

Kaplan-Lewis, Emma and Sanja Percac-Lima. 2013. "No-show to primary care appointments: why patients do not come." *Journal of Primary Care & Community Health* 4 (4):251–255.

Kim, Esther L., Jason Tang, Minji Kim, and Eun Joo Kim. 2025. "The effects of restaurant cancellation policies and no-show awareness campaigns on reservation behaviors." *International Journal of Consumer Studies* 49:e70069.

McIntosh, Tyler. 2021. "The Camping Crunch: Camping's Rise in Popularity on America's Public Lands." Tech. rep., Center for Western Priorities. URL `https://westernpriorities.org/the-camping-crunch/`. Accessed: 2025-06-03.

Otak, Inc., RRC Associates, University of Montana, Institute for Tourism & Recreation Research, and GAIA Environmental Consulting, LLC. 2024. "2023 Socioeconomic Research of National Park Service Visitors: Report on 2023 Data Collection." Tech. rep., National Park Service, U.S. Department of the Interior, Fort Collins, CO. URL `https://irma.nps.gov/DataStore/Reference/Profile/2305803`. Natural Resource Stewardship and Science.

Outdoor Industry Association. 2024. "2024 Outdoor Participation Trends Report: Executive Summary." URL `https://outdoorindustry.org/`. Accessed June 4, 2025.

Pohle, Allison. 2023. "Campsites Are Fully Booked. They're Also Half-Empty." *The Wall Street Journal* URL `https://www.wsj.com/lifestyle/travel/campground-reservations-sold-out-empty-ecf012`
Accessed: 2025-06-03.

Recreation.gov. 2025. "Recreation Information Database." `https://ridb.recreation.gov/`. Accessed: 2025-05-22.

Rice, William L, Jaclyn R Rushing, Jennifer M Thomsen, and Peter Whitney. 2022. "Exclusionary effects of campsite allocation through reservations in US National Parks: Evidence from mobile device location data." *Journal of Park and Recreation Administration* 40 (4):45.

Rosenberger, Randall S. 2016. “Recreation Use Values Database.” https://recvaluation.forestry.oregonstate.edu/database. Corvallis, OR: Oregon State University, College of Forestry. Accessed May 7, 2025.

Schreyer, Dominik and Benno Torgler. 2021. “Predicting season ticket holder no-show behaviour: More nuanced evidence from Switzerland.” *Applied Economics* 53 (48):5549–5566.

Scrogin, David. 2005. “Lottery-rationed public access under alternative tariff arrangements: changes in quality, quantity, and expected utility.” *Journal of Environmental Economics and Management* 50 (1):189–211.

Sloss, Lauren. 2022. “National Park Booking App Leaves Users Feeling Lost in the Woods.” *The New York Times* URL https://www.nytimes.com/2022/07/29/travel/nps-recreation-gov.html. Accessed: 2025-06-05.

Taylor, Grant A, Kevin KK Tsui, and Lijing Zhu. 2003. “Lottery or waiting-line auction?” *Journal of Public Economics* 87 (5-6):1313–1334.

The Dyrt. 2025. “The Dyrt’s 2025 Camping Report Presented by Toyota Trucks.” URL https://thedyrt.com/magazine/press/camping-report/. Accessed: 2025-05-07.

U.S. Bureau of Economic Analysis. 2025. “Outdoor Recreation Satellite Account.” https://www.bea.gov/data/special-topics/outdoor-recreation. Accessed: 2025-06-05.

Online Appendix

A Proofs of propositions

A.1 Proof of Proposition 1

No-shows depend on both the reservation and cancellation decisions. Therefore, I divide the proof below into two parts – the effect of the fee change on reservations and the effect on the cancellation versus no-show decision, conditional on not traveling.

Proposition 1a. *Cancellation fees weakly decrease reservations*:

Assume $\rho \in [0,1]$ and $U_{\text{trip}} \in \mathbb{R}_{+}$. Let

$$m(F_{\text{cancel}}) \;=\; \min\bigl\{\tau + F_{\text{cancel}},\, P_{\text{trip}} + F_{\text{no-show}}\bigr\}, \qquad T(F_{\text{cancel}}) \;=\; \rho\, P_{\text{trip}} + (1-\rho)\, m(F_{\text{cancel}}).$$

Lemma 1.1 $m(F_{\text{cancel}})$ is non-decreasing in F_{cancel}.

Proof. Because $\tau + F_{\text{cancel}}$ is strictly increasing in F_{cancel} and $P_{\text{trip}} + F_{\text{no-show}}$ is constant, their point-wise minimum is non-decreasing.

Lemma 1.2 $T(F_{\text{cancel}})$ is non-decreasing in F_{cancel} (by Lemma 1.1).

Proof. Define the reservation set

$$\Omega(F_{\text{cancel}}) := \{\ (\rho, U_{\text{trip}})\ :\ \rho\, U_{\text{trip}} \geq T(F_{\text{cancel}})\ \}.$$

If $F'_{\text{cancel}} > F_{\text{cancel}}$ then $T(F'_{\text{cancel}}) \geq T(F_{\text{cancel}})$ (Lemma 1.2), hence $\Omega(F'_{\text{cancel}}) \subseteq \Omega(F_{\text{cancel}})$. Therefore the reservation probability, $\Pr\bigl[(\rho, U_{\text{trip}}) \in \Omega(F_{\text{cancel}})\bigr]$, is weakly decreasing in F_{cancel}.

Proposition 1b *Cancellation fees increase the likelihood of no-show for non-travelers*:

Proof. The decision to no-show conditional on *not* traveling (for a given traveler) occurs when: $\tau + F_{cancel} > P_{trip} + F_{no-show}$. The probability a user who elects not to travel will no-show is: $\Pr[\tau + F_{cancel} \geq P_{trip} + F_{no-show}] = \Pr[P_{trip} + F_{no-show} < \tau + F_{cancel}]$. As F_{cancel} increases, the inequality is more easily satisfied. Define $G(F_{cancel}) = \Pr[P_{trip} + F_{no-show} < \tau + F_{cancel}]$. $G(F_{cancel})$ is a weakly increasing function of F_{cancel}. For any $F'_{cancel} > F_{cancel}$, Let:

$$\{P_{trip} + F_{no-show} < \tau + F_{cancel}\} \subseteq \{P_{trip} + F_{no-show} < \tau + F'_{cancel}\} \implies$$

$$\Pr[P_{trip} + F_{no-show} < \tau + F_{cancel}] \leq \Pr[P_{trip} + F_{no-show} < \tau + F'_{cancel}]$$

Thus $F'_{cancel} > F_{cancel} \implies G(F'_{cancel}) \geq G(F_{cancel})$. Hence G is monotone non-decreasing in the cancellation fee and increasing the cancellation fee can only increase or maintain the number of users choosing to no-show if they do not travel.

Therefore, there are two competing effects on no-shows. First, cancellation fees decrease reservations, potentially reducing the number of users are risk of no-show when capacity constraints are non-binding. Second, cancellation fees increase no-shows among reservation holders who do not travel. The net effect of these two mechanisms is ambiguous.

Corollary 1 *Cancellation fees strictly increase no-shows when capacity constraints are binding:*

Assume that campground capacity is C and the capacity constraint is binding, *i.e.* every site is reserved and every cancelled site is immediately re-booked. Further, the joint distribution of $(\rho, U_{\text{trip}}, \tau)$ has a continuous density that is strictly positive in the neighborhood of the threshold. Finally, the fee schedule $(P_{\text{trip}}, F_{\text{cancel}}, F_{\text{no-show}})$ yields a strictly positive probability of cancellation, *i.e.* $\Pr[\tau + F_{\text{cancel}} < P_{\text{trip}} + F_{\text{no-show}}] > 0$.

Proof. Because capacity is binding, the number of confirmed reservations is fixed at C and does *not* depend on F_{cancel}. Hence a strict increase in the *rate* of no-show behavior translates one-for-one into a strict increase in the *count* of no-shows.

From Proposition 1b we know:

$$G(F_{\text{cancel}}) \;=\; \Pr\big[\tau + F_{\text{cancel}} > P_{\text{trip}} + F_{\text{no-show}}\big]$$

is weakly increasing in F_{cancel}. To show the increase is *strict* consider some $F'_{\text{cancel}} > F_{\text{cancel}}$ that shifts the no-show threshold leftward. Since the density of τ is strictly positive in the neighborhood of the threshold, this change adds positive probability mass to the no-show region.

$$\Pr\big[\tau + F'_{\text{cancel}} > P_{\text{trip}} + F_{\text{no-show}}\big] > \Pr\big[\tau + F_{\text{cancel}} > P_{\text{trip}} + F_{\text{no-show}}\big]$$

By assumption this mass is non-empty, because some reservations currently cancel rather than no-show. Hence $G(F'_{\text{cancel}}) > G(F_{\text{cancel}})$ for every $F'_{\text{cancel}} > F_{\text{cancel}}$, and since the number of confirmed reservations remains fixed at C, the strict increase in the no-show probability implies a strict increase in the expected count of no-shows. In other words, a binding capacity constraint means that because there are enough users still willing to reserve there is no reservation effect on no-shows. In this case, no-shows increase due to the effect of cancellation fees on the no-show cancellation decision for non-travelers.

A.2 Proof of Proposition 2

The proof consists of two parts, the effect on reservations and the effect of no-shows among users who hold a reservation but choose not to travel. If the campground capacity constraint is binding (and any cancellations are immediately re-booked), increasing P_{trip} has no effect on reservations. However, if the campground capacity constraint is non-binding, then increasing P_{trip} strictly reduces reservations, and thus users at risk of no-show. Further, increasing P_{trip} strictly reduces no-shows among reservation holders who choose not to travel.

Proposition 2a. *Price increases strictly decrease reservations when the campground capacity constraint is non-binding*:
Let

$$m(P_{\text{trip}}) \;=\; \min\bigl\{\tau + F_{\text{cancel}},\, P_{\text{trip}} + F_{\text{no-show}}\bigr\}, \qquad T(P_{\text{trip}}) \;=\; \rho\, P_{\text{trip}} + (1-\rho)\, m(P_{\text{trip}}).$$

Further, assume the number of users who would reserve is less than C.

Lemma 2.1 $m(P_{\text{trip}})$ is non-decreasing in P_{trip}.

Proof. Since $\tau + F_{\text{cancel}}$ does not vary with P_{trip} and $P_{\text{trip}} + F_{\text{no-show}}$ is strictly increasing in P_{trip}, their point-wise minimum is non-decreasing.

Lemma 2.2 $T(P_{\text{trip}})$ is strictly increasing in P_{trip} (by Lemma 2.1).

Proof. Because ρP_{trip} is strictly increasing whenever $\rho > 0$, T is strictly monotone.

Define the reservation set

$$\Omega(P_{\text{trip}}) := \{\ (\rho, U_{\text{trip}})\ :\ \rho\, U_{\text{trip}} \geq T(P_{\text{trip}})\ \}.$$

If $P'_{\text{trip}} > P_{\text{trip}}$ then $T(P'_{\text{trip}}) > T(P_{\text{trip}})$ (Lemma 2.2), hence $\Omega(P'_{\text{trip}}) \subset \Omega(P_{\text{trip}})$. Therefore the reservation probability, $\Pr\big[(\rho, U_{\text{trip}}) \in \Omega(P_{\text{trip}})\big]$, is strictly decreasing in P_{trip}.

Intuitively, higher prices reduce demand. However, this only affects the number of reservations when the number of users who would reserve falls below the capacity constraint.

Proposition 2b. *Higher prices strictly decrease the likelihood of no-show for non-travelers*:

Proof. Define the probability of no-show as:

$$H(P_{\text{trip}}) = \Pr\big[\tau + F_{\text{cancel}} \geq P_{\text{trip}} + F_{\text{no-show}}\big].$$

Since P_{trip} appears on the right-hand side of inequality, and the distribution of τ has a strictly positive density near the threshold, $H(P_{\text{trip}})$ is strictly decreasing in P_{trip}. Thus, for any $P'_{\text{trip}} > P_{\text{trip}}$, we have:

$$H(P'_{\text{trip}}) < H(P_{\text{trip}}).$$

Therefore, increasing P_{trip} strictly decreases the number of no-shows among these with reservations who choose not to travel.

In summary, higher prices always decrease no-shows through the no-show cancellation decision as long as there are some users who would choose to no-show if they do not travel. With a non-binding capacity constraint, the effect of higher prices on no-shows can be larger due to a reduction in the number of reservations.

A.3 Proof of Proposition 3

Again, we consider the reservation decision and the no-show decision separately. No-show fees weakly decrease reservations when capacity constraints are non-binding but strictly decrease no-shows among reservations holders who do not travel. Thus, the overall effect strictly decreases no-shows when there is a positive probability of no-show.

Proposition 3a. *Increasing no-show fees weakly decreases reservations when the campground capacity constraint is non-binding*:

Let

$$m(F_{\text{no-show}}) \; = \; \min\big\{\tau + F_{\text{cancel}},\, P_{\text{trip}} + F_{\text{no-show}}\big\}, \qquad T(F_{\text{no-show}}) \; = \; \rho\, P_{\text{trip}} + (1-\rho)\, m(F_{\text{no-show}}).$$

Lemma 3.1 $m(F_{\text{no}-\text{show}})$ is non-decreasing in $F_{\text{no}-\text{show}}$.

Proof. $P_{\text{trip}} + F_{\text{no}-\text{show}}$ is strictly increasing in $F_{no-show}$. $\tau + F_{\text{cancel}}$ is constant in $F_{no-show}$. Therefore, their point-wise minimum is non-decreasing in $F_{no-show}$.

Lemma 3.2 $T(F_{\text{no}-\text{show}})$ is non-decreasing in $F_{\text{no}-\text{show}}$ (by Lemma 3.1).

Define the reservation set

$$\Omega(F_{\text{no}-\text{show}}) := \{\ (\rho, U_{\text{trip}})\ :\ \rho\, U_{\text{trip}} \geq T(F_{\text{no}-\text{show}})\ \}.$$

If $F'_{\text{no}-\text{show}} > F_{\text{no}-\text{show}}$ then $T(F'_{\text{no}-\text{show}}) \geq T(F_{\text{no}-\text{show}})$ (Lemma 3.2), which implies $\Omega(F'_{\text{no}-\text{show}}) \subseteq \Omega(F_{\text{no}-\text{show}})$. Therefore the reservation probability, $\Pr\big[(\rho, U_{\text{trip}}) \in \Omega(F_{\text{no}-\text{show}})\big]$, is weakly decreasing in $F_{\text{no}-\text{show}}$.

Proposition 3b. *Higher prices strictly decrease the likelihood of no-show for non-travelers*:

Proof. Following similar logic as 1b and 2b, define:

$$J(F_{\text{no-show}}) \;=\; \Pr\big[\tau + F_{\text{cancel}} \geq P_{\text{trip}} + F_{\text{no-show}}\big].$$

This is the probability that a user who chooses not to travel will no-show rather than cancel, conditional on their type. Note that $J(F_{\text{no-show}})$ is strictly decreasing in $F_{\text{no-show}}$: as the no-show fee increases, the inequality becomes harder to satisfy, and more non-travelers will choose to cancel instead of no-showing.

Assume the distribution of τ has a continuous and strictly positive density in a neighborhood of the no-show threshold. Then for any $F'_{\text{no-show}} > F_{\text{no-show}}$,

$$\Pr\big[\tau + F_{\text{cancel}} \geq P_{\text{trip}} + F'_{\text{no-show}}\big] \;<\; \Pr\big[\tau + F_{\text{cancel}} \geq P_{\text{trip}} + F_{\text{no-show}}\big].$$

Hence, $J(F_{\text{no-show}})$ is strictly decreasing in the no-show fee.

Therefore, increasing $F_{\text{no-show}}$ strictly reduces the probability of no-show among users with reservations who do not travel. When the campground capacity constraint is binding, this is the only marginal affected. However, when the constraint is not binding, higher no-show fees also weakly reduce the number of reservations, further lowering the number of potential no-shows.

A.4 Proof of Proposition 4

Proposition 4 deals with a variety of distributional effects of fee changes when user characteristics are correlated with income. In each case, the effects come from the effect of fee changes on the threshold above which, a user would make a reservation. Changes in the reservation threshold preferentially screen out different types of users, *e.g.* low utility or high cancellation cost, and lead to distributional effects when these characteristics are correlated with income.

Proposition 4: *Higher prices increase the mean income of users who make reservations when U_{trip} and income are positively correlated*:

Assume that campground capacity is C and the capacity constraint is binding, *i.e.* every site is reserved and cancellations are immediately re-booked. Further, the joint distribution of $(\rho, U_{\text{trip}}, \tau)$ has a continuous density that is strictly positive in the neighborhood of the threshold. Finally, assume income is stochastically increasing in U_{trip}.

Proof. Let:

$$T(P_{\text{trip}}) = \rho\, P_{\text{trip}} + (1-\rho)\, \min\{\tau + F_{\text{cancel}},\, P_{\text{trip}} + F_{\text{no-show}}\},$$

and

$$\Omega(P_{\text{trip}}) = \{(\rho, U_{\text{trip}}) : \rho\, U_{\text{trip}} \geq T(P_{\text{trip}})\}.$$

Since T is strictly increasing in P_{trip} (Proposition 2a), $P'_{\text{trip}} > P_{\text{trip}}$ implies $\Omega(P'_{\text{trip}}) \subset \Omega(P_{\text{trip}})$.

Define the mean utility of users who would reserve as:

$$\bar{U}(P_{\text{trip}}) = \mathbb{E}\big[U_{\text{trip}} \mid (\rho, U_{\text{trip}}) \in \Omega(P_{\text{trip}})\big].$$

Since the joint density of individuals parameters is continuous by assumption (above), this implies $\bar{U}(P'_{\text{trip}}) > \bar{U}(P_{\text{trip}})$. Intuitively, increasing P_{trip} shrinks the reservation set removing lower utility users, thereby increasing the average utility among those who still choose to reserve.

Define the mean income of users who would reserve as:

$$\bar{I}(P_{\text{trip}}) = \mathbb{E}\big[I \mid (\rho, U_{\text{trip}}) \in \Omega(P_{\text{trip}})\big]$$

Finally, assuming a positive correlation between U_{trip} and income and since $\bar{U}(P'_{\text{trip}}) > \bar{U}(P_{\text{trip}})$ (from above) we know $\bar{I}(P'_{\text{trip}}) > \bar{I}(P_{\text{trip}})$.

Therefore, when income is positively correlated with trip utility, increasing price raises the average income of reserving users by deterring lower-utility (and therefore lower-income) individuals from reserving. This occurs because the higher price raises the threshold for reservation, shrinking the pool to higher-utility types.

Corollary 4.1 *When U_{trip} and income are positively correlated, increasing no-show fees weakly increases the average income of users who reserve:*

Proof. Under assumptions above, further assume that the fee structure is such that for some subset of users:

$$\Pr[\tau + F_{cancel} \geq P_{trip} + F_{no-show}] > 0$$

i.e. some users would choose to no-show if they do not travel. Then for any $F'_{no-show} > F_{no-show}$, the reservation set

$$\Omega(F_{\text{no-show}}) = \{(\rho, U_{\text{trip}}) : \rho\, U_{\text{trip}} \geq T(F_{\text{no-show}})\},$$

shrinks, i.e.

$$\Omega(F'_{no-show}) \subseteq \Omega(F_{no-show}).$$

Define the conditional mean income

$$\bar{I}(F_{no-show}) = \mathbb{E}\big[I \mid (\rho, U_{\text{trip}}) \in \Omega(F_{no-show})\big].$$

Then $\bar{I}(F_{no-show})$ is *weakly increasing* in $F_{no-show}$, and *strictly increases* whenever

$$\Pr\big[\tau + F_{\text{cancel}} \geq P_{\text{trip}} + F_{no-show}\big] > 0.$$

If income is positively correlated with trip utility and some users are at risk of no-show, then increasing no-show fees weakly raises the average income of reserving users by discouraging lower-utility (and by assumption, lower income) types from reserving. However, this only affects users who would no-show if they do not travel.

Corollary 4.2 *When τ and income are negatively correlated, increasing price weakly increases the average income of users who reserve:*

Proof. Under the assumptions above, further assume income is stochastically decreasing in τ i.e., users with higher τ tend to have lower income and, again, the fee structure is such that:

$$\Pr[\tau + F_{cancel} \geq P_{trip} + F_{no-show}] > 0$$

for some subset of users. Then for any $P'_{trip} > P_{trip}$, the reservation set

$$\Omega(P_{\text{trip}}) = \{(\rho, U_{\text{trip}}) : \rho\, U_{\text{trip}} \geq T(P_{\text{trip}})\},$$

shrinks such that $\Omega(P'_{trip}) \subseteq \Omega(P_{trip})$. Here, the shrinking reservation set removes high τ low income types (who would previously have no-showed and now do not reserve). Define the conditional mean of τ

$$\bar{\tau}(P_{\text{trip}}) := \mathbb{E}\big[\tau \mid (\rho, U_{\text{trip}}) \in \Omega(P_{\text{trip}})\big].$$

As Ω shrinks, $\bar{\tau}(P_{\text{trip}})$ weakly decreases. If there is positive mass near the no-show threshold, then $\bar{\tau}(P'_{\text{trip}}) < \bar{\tau}(P_{\text{trip}})$.

Because income is stochastically decreasing in τ, $\bar{I}(P_{trip})$ is *weakly increasing* in P_{trip}, and *strictly increases* whenever the reduction in $\bar{\tau}(P_{\text{trip}})$ is strict.

When income is negatively correlated with τ, increasing the trip price weakly increases the average income of users who would reserve by disproportionately screening out high-τ, low-income types who are more likely to no-show.

Corollary 4.3 *When τ and income are negatively correlated, increasing no-show fees weakly increases the average income of users who reserve:*

Proof. Under the same assumptions above and for the fee structure where:

$$\Pr[\tau + F_{cancel} \geq P_{trip} + F_{no-show}] > 0$$

for some subset of users. Define the reservation threshold function as:

$$T(F_{\text{no-show}}) = \rho\, P_{\text{trip}} + (1 - \rho)\, \min\{\tau + F_{\text{cancel}},\, P_{\text{trip}} + F_{\text{no-show}}\},$$

For any $F'_{no-show} > F_{no-show}$, the reservation set

$$\Omega(F_{\text{no-show}}) = \{(\rho, U_{\text{trip}}) : \rho\, U_{\text{trip}} \geq T(F_{\text{no-show}})\},$$

shrinks such that $\Omega(F'_{no-show}) \subseteq \Omega(F_{no-show})$. Again, the shrinking reservation set removes users with relatively high τ, who (by assumption) tend to have lower income. Define the conditional mean of τ as:

$$\bar{\tau}(F_{no-show}) := \mathbb{E}\big[\tau \mid (\rho, U_{\text{trip}}) \in \Omega(F_{no-show})\big].$$

As Ω shrinks, $\bar{\tau}(F_{no-show})$ weakly decreases and $\bar{\tau}(F'_{\text{no-show}}) \leq \bar{\tau}(F_{\text{no-show}})$. Since income is stochastically decreasing in τ, $\bar{I}(F_{no-show})$ is *weakly increasing* in $F_{no-show}$, and *strictly increases* whenever

$$\Pr\big[\tau + F_{\text{cancel}} \geq P_{\text{trip}} + F_{no-show}\big] \; > \; 0.$$

If income is negatively correlated with τ, then raising no-show fees deters high-τ individuals, who are more likely to no-show and tend to have lower income, from reserving in the first place.

B Optimal no-show fee

I calculate the optimal no-show fee under the following assumptions that reflect the characteristics of the real world reservation problem. First, I assume a binding capacity constraint. Second, I assume cancelled reservations are filled at random from the pool of would-reserve users. This choice reflects the limitations of park managers information and the reservation system. As in the case with rationing under a binding capacity constraint during the initial reservation period, park managers cannot distinguish between users and lack a mechanism for discriminatory pricing. Thus, I assume the cancelled reservation is awarded at random. Third, I assume user who obtain cancelled reservations travel with certainty. This choice is made primarily for convenience as it avoids modeling subsequent travel probabilities and potentially, another round of cancellations and no-shows. However, it also seems reasonable as uncertainty around travel likely decreases closer to the trip date (and after the initial reservation period). Under these assumptions, the marginal external cost of a no-show is the average consumer surplus of those in the pool of would-reserve users.

To see this, consider social surplus defined as:

$$\begin{aligned} S \;=\; & \underbrace{\sum_{i \in \text{travelers}} (U_{\text{trip},i} - P_{\text{trip}})}_{\text{CS from travelers}} \;+\; \underbrace{\sum_{i \in \text{cancelers}} -(\tau_i + F_{\text{cancel}})}_{\text{CS from cancelers}} \;+ \\ & \underbrace{\sum_{i \in \text{no-shows}} -(P_{\text{trip}} + F_{\text{no-show}})}_{\text{CS from no-shows}} \;+\; \underbrace{\sum_{i \in \text{re-bookers}} (\bar{U}_{\text{trip}} - P_{\text{trip}})}_{\text{CS from re-bookers}} \;+ \\ & \underbrace{\sum_{i \in \text{travelers}} P_{\text{trip}}}_{\text{Rev. from travelers}} \;+\; \underbrace{\sum_{i \in \text{cancelers}} F_{\text{cancel}}}_{\text{Rev. from cancelers}} \;+\; \underbrace{\sum_{i \in \text{no-shows}} F_{\text{no-shows}}}_{\text{Rev. from no-shows}} \end{aligned} \tag{2}$$

Where $\bar{U}_{trip}$ is the average trip utility of a random users in the would-reserve pool ("rebookers"). Since fees are transfers from consumers to park-managers, they are welfare neutral and Equation

2 can be simplified by removing F_{trip}, F_{cancel} and $F_{no-show}$ from the above, such that:

$$S = \sum_{i \in \text{travelers}} U_{\text{trip},i} + \sum_{i \in \text{cancelers}} -\tau_i + \sum_{i \in \text{rebookers}} \bar{U}_{\text{trip}}$$

The optimal $F_{no-show}$ occurs when the marginal change in surplus from a marginal change in $F_{no-show}$ is zero, *i.e.* when $\frac{\partial S}{\partial F_{no-show}} = 0$. Under the assumption that cancellations are filled randomly with a user from the pool of users who would reserve, the marginal user from each pool (traveler and rebooker) are equivalent (since the former are also selected randomly when the capacity constraint is binding). In this case, the first order condition for the optimal no-show fee ($F^*_{no-show}$) is: $\bar{U}_{trip} - \tau^*_i = 0$, where τ^*_i is the private cancellation cost of the marginal no-show. Since for the marginal no-show $\tau_i + F_{cancel} = F_{trip} + F^*_{no-show}$, the optimal no-show fee can be derived as:

$$\begin{aligned} \bar{U}_{trip} - \tau^*_i &= 0 \\ \bar{U}_{trip} &= \tau^*_i \\ \bar{U}_{trip} &= F_{trip} + F^*_{no-show} - F_{cancel} \\ F^*_{no-show} &= \bar{U}_{trip} - F_{trip} + F_{cancel} \end{aligned} \tag{3}$$

And under the assumption F_{cancel}=0,

$$F^*_{no-show} = \bar{U}_{trip} - F_{trip}$$

which says the optimal no-show fee equals the (lost) consumer surplus of the marginal excluded user.

Recall, that since changes in $F_{no-show}$ change the reservation threshold (for users who no-show), τ^*_i and the average $U_{trip,i}$ depend on $Fee_{no-show}$. As a result, there is no direct solution for $Fee^*_{no-show}$. Instead, I solve for $F^*_{no-show}$ as the unique fixed-point of the equation:

$$F^*_{\text{no-show}} = \mathbb{E}\Big[U_{\text{trip}} - P_{\text{trip}} \;\Big|\; \textit{would-reserve at } F^*_{\text{no-show}} \Big].$$

I solve for $F^*_{no-show}$ numerically for the simulated population using Brent's method.

C Simulation model assumptions

Here I describe the data and procedure used to parameterize the simulation model. When possible, parameter values are taken from the literature. Other parameters are selected to ensure the baseline model yields outcomes that reflect camper behavior.

Campground capacity and fees

For capacity of the representative campground, I first collect information on the capacity of National Park Campgrounds from the online reservation system Recreation.gov (2025). Figure C1 plots the distribution of total campsites (for all campgrounds) in each park. The median park has approximately 400 campsites. I assume the representative park has a 25 week season. Focusing on 2-night stays, *e.g.* weekends, I assume a capacity of 10,000 trips. Campground fees are set

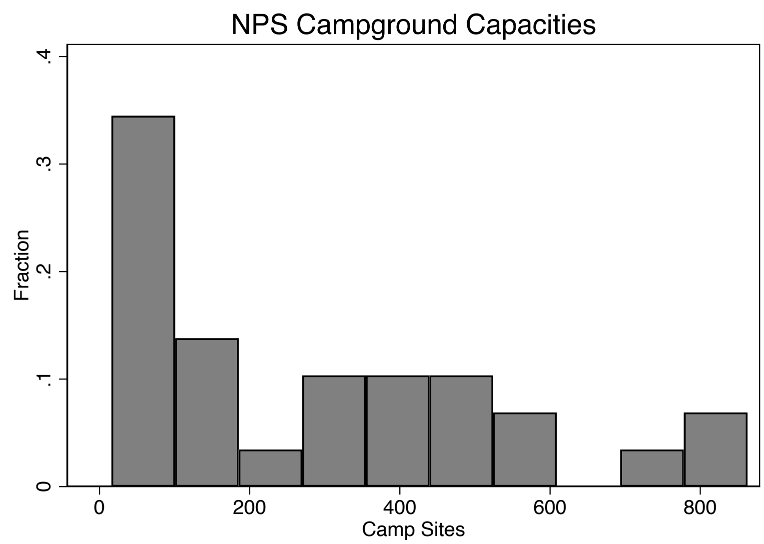


Figure C1: Total number of campsites by National Park listed on Recreation.gov.

to approximate current fees at National Park campgrounds. I assume a \$35 nightly fee such that the baseline trip price is \$70. This figure is consistent with fees at major parks such as Grand Canyon (\$30/night), Rocky Mountain (\$35/night), Great Smoky Mountain (\$30/night-\$36/night) and Yosemite (\$24/night-\$36/night) as reported on Recreation.gov (2025). The baseline fee structure assumes a \$10 cancellation fee. Most reservations made on Recreation.gov are subject to a \$10 modification or cancellation fee. Late cancellations may incur additional fees such as forfeiture of the nightly fee. In principle, campground reservations are also subject to a no-show fee of \$20 plus the first night's fees (Recreation.gov, 2025). However, no-shows are only recorded at staffed campground and anecdotes suggest enforcement is poor. As such, the baseline fee structure assumes \$0 no-show fee.

User characteristics

I obtain information on the income of park visitors from the National Park Service Socioeconomic Monitoring (SEM) Program (Otak, Inc. et al., 2024). The SEM reports the share of park visitors in various income bins. I estimate the mean value ($135,000) using the mid-point of each bin and calculate the weighted average based on the reported shares. Note the mean income is substantially higher than U.S. median household income, approximately $80,000 (Guzman and Kollar, 2024). I collect information on willingness to pay for camping from the Recreation Use Values Database (Rosenberger, 2016). Because National Park campgrounds provide access to a range of recreational opportunities, I take an activity-based approach rather than focusing on values for camping alone. Mean trip utility ($200) is the average daily value of three activities: wildlife viewing; hiking and sightseeing, adjusted for inflation (2025 dollars) for a two-night stay. The transaction costs of cancelling a reservation (τ) for a user who does not travel can include a variety of non-pecuniary costs such as the hassle, time and cognitive costs of logging on to the reservation system or contacting the park or customer service center. It may also include the option value of holding on to a reservation in case travel plans change (enabling a trip) after a park's cancellation deadline. Therefore, the cost is likely to be higher than simply the value of time spent in the act of cancelling. I experimented with several values (see Online Appendix E). The baseline value ($50) was selected because it produced no-show and cancellation behavior consistant with recent surveys of the camping industry (The Dyrt, 2025). The probability of travel (ρ) ranges from zero to one and is assumed to be uniformly distributed.

D Additional simulation results

D.1 Non-binding capacity constraint

I model a non-binding capacity constraint assuming a large campground with 100,000 stay capacity and holding the distributions of user parameters constant. Simulation results for this scenario are shown in Table D1. In the first row F_{cancel} = $0. The second row is the baseline policy with F_{cancel} = $10, P_{trip} = $70 and $F_{no-show}$ = $0. Raising the cancellation fees (rows two and three) decreases reservations and consumer surplus but increases revenues and social surplus. No-shows increase, however, this is of little concern as the campground has sufficient capacity. On the other hand, increasing the price (row four) or no-show fee (row five) decreases social surplus by 13 percent when price is increased from $70 to $110 and by 6 percent when the no-show fee is $40. With sufficient campground capacity cancellation fees are justified in terms of social surplus, while higher prices or no-show fees are not.

No Capacity Constraint										
	Price	Cancellation Fee	No-Show Fee	Reservations	% Travel	% No-Show	Revenue	Consumer Surplus	Social Surplus	%Δ SS
No F_{cancel}	\$70	\$0	\$0	68,021	62.5%	6.0%	\$3,260,703	\$5,059,110	\$8,319,814	-1%
Baseline	\$70	\$10	\$0	64,969	64.1%	10.2%	\$3,547,208	\$4,868,415	\$8,415,623	
Inc. F_{cancel}	\$70	\$20	\$0	62,674	65.3%	15.4%	\$3,783,556	\$4,724,267	\$8,507,822	1%
Inc. P_{trip}	\$110	\$10	\$0	52,917	66.8%	0.4%	\$4,086,507	\$3,235,060	\$7,321,568	-13%
Inc. $F_{no\text{-}show}$	\$70	\$10	\$40	63,541	64.6%	0.5%	\$3,129,649	\$4,772,097	\$7,901,746	-6%

Table D1: Simulated campground reservation, cancellation and no-show activity under different fee structures. U_{trip} is $\sim N(200, 75^2)$. Transaction costs, τ are $\sim N(50, 25^2)$ and the probability of traveling, ρ is $\sim U(0, 1)$. Park revenue is the sum of all collected fees. Consumer surplus is $U_{trip} - P_{trip}$ for travelers and $0 -$ fees paid for non-travelers. Each data point is the average over 1000 simulated choice occasions.

D.2 Eliminating the cancellation fee

Table D2 explores the possibility of eliminating the standard cancellation fee and replacing lost revenue with a higher price or no-show fee. Eliminating cancellation fees (row two) decreases no-shows from approximately 10 percent to about 6 percent and increases social surplus 3 percent. Row three shows a modest price increase, approximately \$3, would offset the cancellation fee revenue and still yield an increase in social surplus. Thus, replacing Fee_{cancel} with higher prices could be a desirable option for park managers. However, lost cancellation revenues cannot be easily offset with higher no-show fees because higher fees reduce no-show activity. $F_{no-show} =$ \$10 (row four) raises only \$3,000 in additional revenue, despite deceasing no-shows to 3 percent.

E Simulation robustness

This section explores the robustness of the simulation results to changes the distributions of U_{trip} and τ. I focus on cases where reservations exceed campground capacity. Thus, the results below highlight the robustness of the simulations to different assumptions when no-show behavior is a concern. However, some parameter combination result in either camping demand below capacity or cancellations that are essentially costless. In these cases, policies to reduce no-shows are not warranted.

Revenue Neutral Trip and NS Fees

	Price	Cancellation Fee	No-Show Fee	Reservations	% Travel	% No-Show	Revenue	Consumer Surplus	Social Surplus	%Δ SS
Baseline	$70	$10	$0	10,000	64.1%	10.2%	$725,681	$1,134,629	$1,860,310	
No F_{cancel}	$70	$0	$0	10,000	62.5%	6.0%	$700,000	$1,211,290	$1,911,290	3%
Inc. P_{trip}	$73	$0	$0	10,000	62.6%	5.1%	$725,660	$1,207,318	$1,932,978	4%
Inc. $F_{no\text{-}show}$	$70	$0	$10	10,000	62.6%	3.0%	$703,009	$1,254,672	$1,957,681	5%

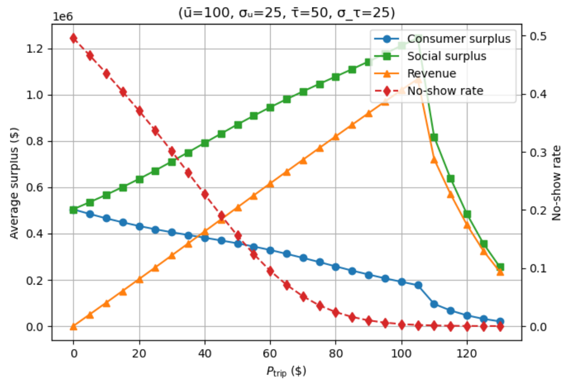
Table D2: Simulated campground reservation, cancellation and no-show activity under different fee structures. U_{trip} is $\sim N(200, 75^2)$. Transaction costs, τ are $\sim N(50, 25^2)$ and the probability of traveling, ρ is $\sim U(0, 1)$. Park revenue is the sum of all collected fees. Consumer surplus is $U_{trip} - P_{trip}$ for travelers and $0 -$ fees paid for non-travelers. Each data point is the average over 1000 simulated choice occasions.

Figure E2 explores increases in P_{trip} under low and high trip utility (U_{trip}) scenarios. The relationships discussed above, *i.e.*, revenue and social surplus increase with P_{trip} and consumer surplus first decreases then increases, all hold for moderate to high willingness-to-pay for camping. However, for very low mean utility, U_{trip} is $\sim N(100, 25^2)$, higher prices decrease consumer surplus. Once P_{trip} begins to exceed users willingness-to-pay the number desiring reservations decreases until the capacity constraint is now longer binding. This leads to a decrease in revenue, and hence social surplus, for values of P_{trip} greater than $100.

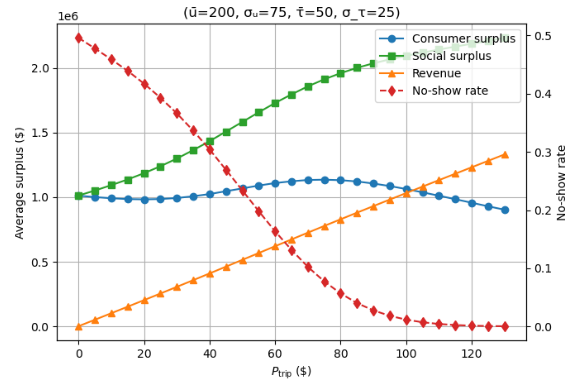
Figure E3 explores increases in P_{trip} under different low and high trip transaction cost (τ) scenarios. Consumer surplus shows the same s-shaped behavior discussed previously. However, low and narrowly distributed transactions costs, panel's (a) and (b), lead to rapid decreases in no-shows and abrupt increases in consumer surplus, with increases in P_{trip}. Once on-shows are driven to zero, increasing price reduces consumer surplus in all scenarios. Revenues increase with prices in all scenarios. Overall, increasing P_{trip} increases social surplus in all scenarios.

Figure E4 investigates increases in $F_{no-show}$ under low and high willingness-to-pay for camping. Here $P_{trip} = \$70$ as in the baseline scenario. The qualitative relationships between $F_{no-show}$ and consumer surplus, revenue and social surplus are similar to those under the baseline parameter assumptions. Increasing $F_{no-show}$ decreases no-shows increasing consumer surplus and social surplus. Revenues are effectively independent of no-show fee increases.

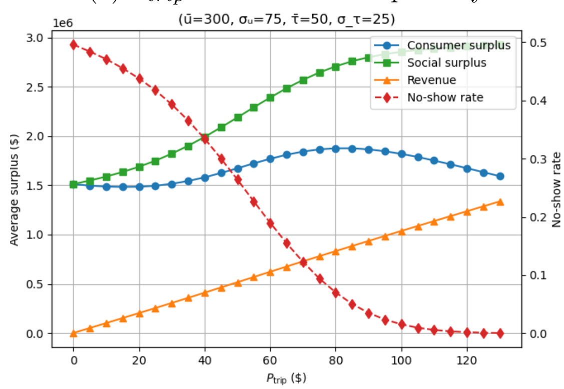
Finally, Figure E5 explores assumption around transaction costs (τ) and no-show fees. When transaction costs are low, as in panels (a) and (b), cancellations are preferred and the no-show rate is zero. For larger τ, (c) the baseline scenario and (d) high mean τ, we see qualitatively similar



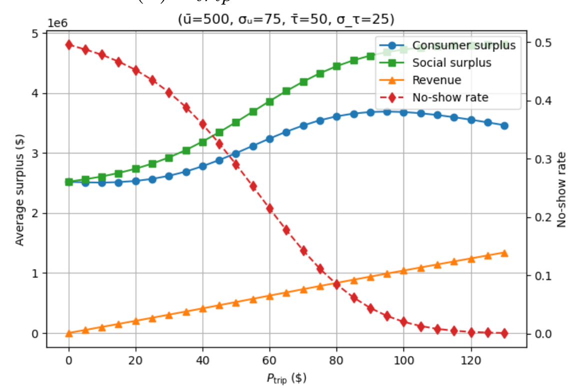
(a) P_{trip} increase: Low trip utility



(b) P_{trip} increase: Baseline

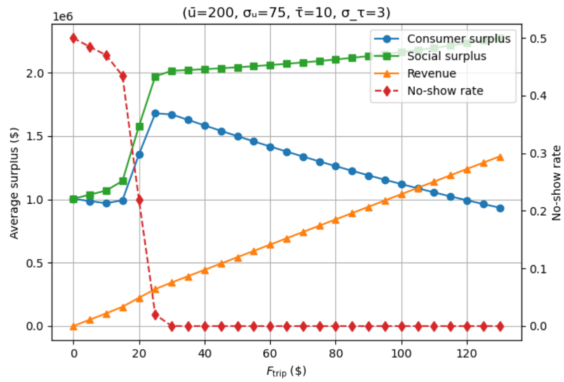


(c) P_{trip} increase: High trip utility

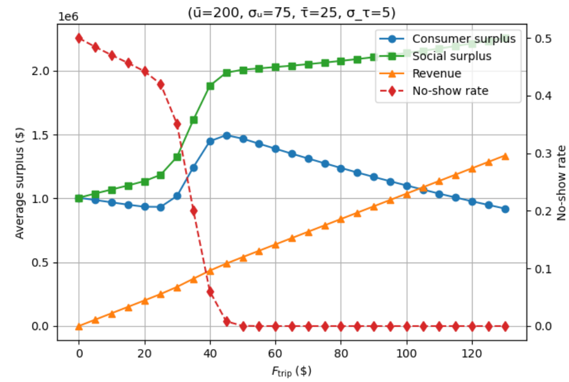


(d) P_{trip} increase: Very high trip utility

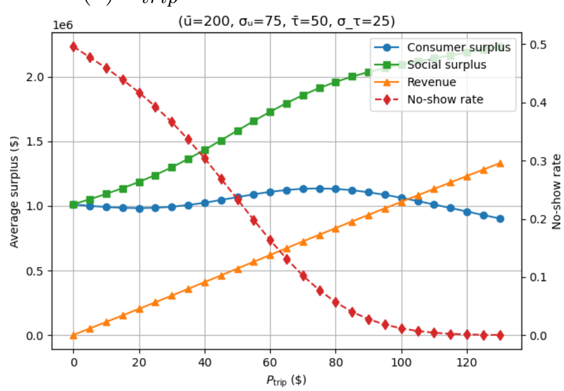
Figure E2: Robustness of P_{trip} simulation results to different assumptions for the distribution of U_{trip}. Panel (a) U_{trip} is $\sim N(100, 25^2)$, panel (b) U_{trip} is $\sim N(200, 75^2)$, panel (c) U_{trip} is $\sim N(300, 75^2)$ and panel (d) U_{trip} is $\sim N(500, 75^2)$. Consumer surplus, revenue and social surplus are plotted in dollars ($). The no-show rate is the fraction of users holding a reservation who no-show. Income is $\sim N(135,000, 75,000^2)$ and τ is $\sim N(50, 25^2)$. Campground capacity is 10,000 user trips and there are 100,000 potential users. $F_{no-show} = \$0$ and $F_{cancel} = \$10$ in all simulations. Each plot shows results averaged over 1000 simulated choice occasions.



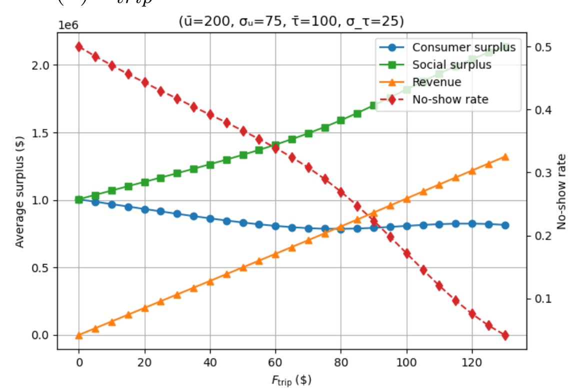
(a) P_{trip} increase: Low trans. costs



(b) P_{trip} increase: Moderate trans. costs

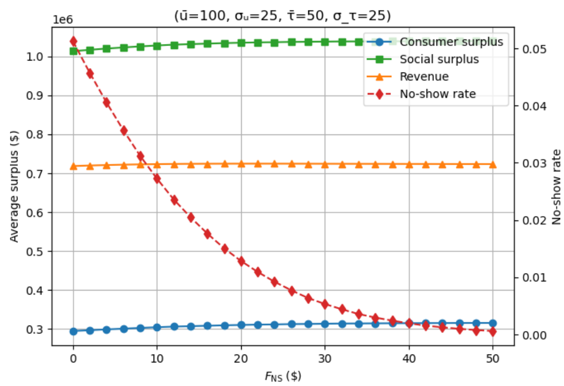


(c) P_{trip} increase: Baseline

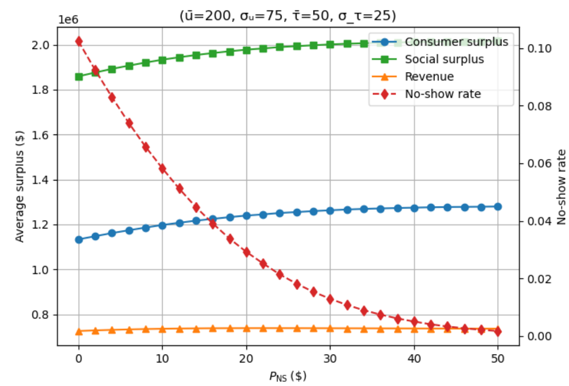


(d) P_{trip} increase: High trans. costs

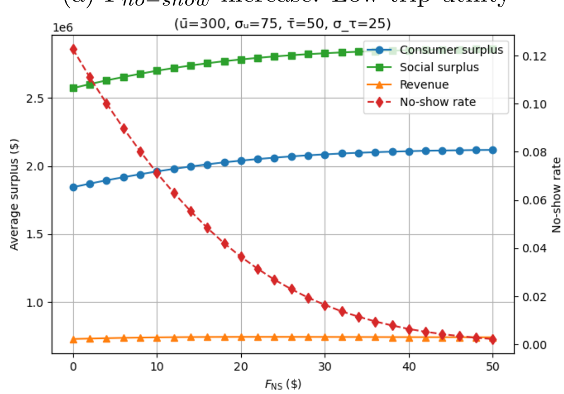
Figure E3: Robustness of P_{trip} simulation results to different assumptions for the distribution of τ. Panel (a) τ is $\sim N(10, 3^2)$, panel (b) τ is $\sim N(25, 5^2)$, panel (c) τ is $\sim N(50, 25^2)$ and panel (d) τ is $\sim N(100, 25^2)$. Consumer surplus, revenue and social surplus are plotted in dollars (\$). The no-show rate is the fraction of users holding a reservation who no-show. Income is $\sim N(135,000, 75,000^2)$ and τ is $\sim N(50, 25^2)$. Campground capacity is 10,000 user trips and there are 100,000 potential users. $F_{no-show}$ = \$0 and F_{cancel} = \$10 in all simulations. Each plot shows results averaged over 1000 simulated choice occasions.



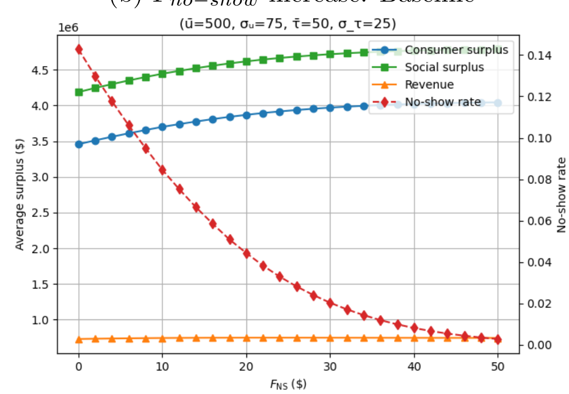
(a) $F_{no-show}$ increase: Low trip utility



(b) $F_{no-show}$ increase: Baseline



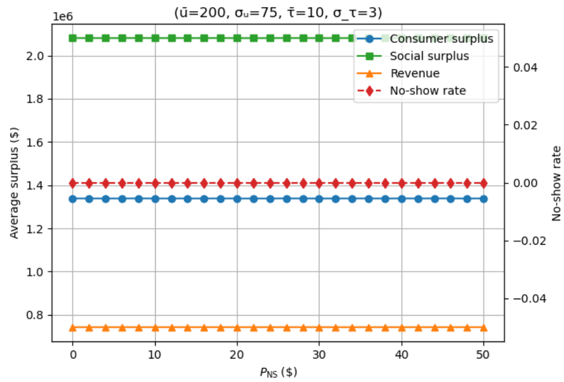
(c) $F_{no-show}$ increase: High trip utility



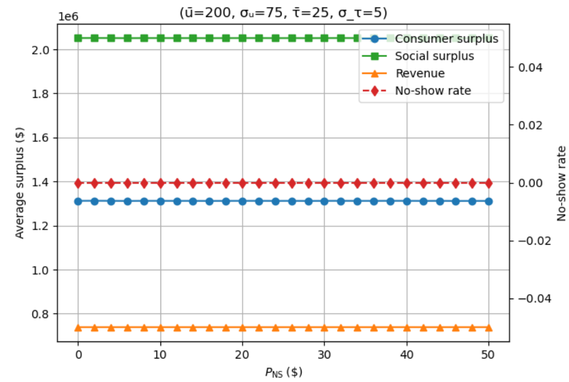
(d) $F_{no-show}$ increase: Very high trip utility

Figure E4: Robustness of $F_{no-show}$ simulation results to different assumptions for the distribution of U_{trip}. Panel (a) U_{trip} is $\sim N(100, 25^2)$, panel (b) U_{trip} is $\sim N(200, 75^2)$, panel (c) U_{trip} is $\sim N(300, 75^2)$ and panel (d) U_{trip} is $\sim N(500, 75^2)$. Consumer surplus, revenue and social surplus are plotted in dollars ($). The no-show rate is the fraction of users holding a reservation who no-show. Income is $\sim N(135{,}000, 75{,}000^2)$ and τ is $\sim N(50, 25^2)$. Campground capacity is 10,000 user trips and there are 100,000 potential users. $P_{trip} = \$70$ and $F_{cancel} = \$10$ in all simulations. Each plot shows results averaged over 1000 simulated choice occasions.

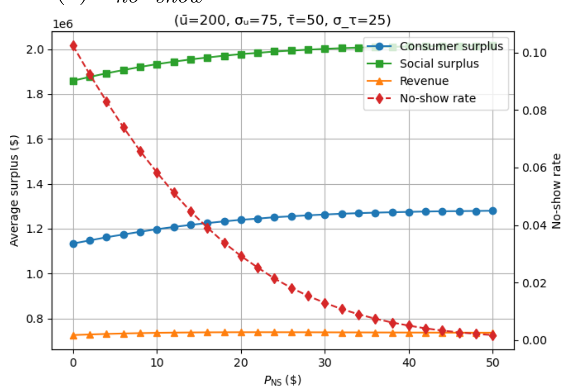
behavior. Increasing $F_{no-show}$ reduces no-shows, increases consumer surplus and social surplus.



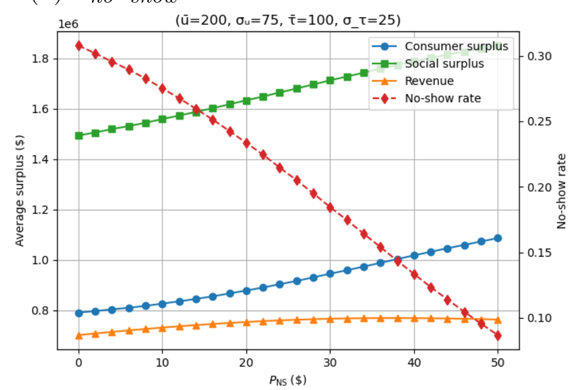
(a) $F_{no-show}$ increase: Low trans. costs



(b) $F_{no-show}$ increase: Moderate trans. costs



(c) $F_{no-show}$ increase: Baseline



(d) $F_{no-show}$ increase: High trans. costs

Figure E5: Robustness of $F_{no-show}$ simulation results to different assumptions for the distribution of τ. Panel (a) τ is $\sim N(10, 3^2)$, panel (b) τ is $\sim N(25, 5^2)$, panel (c) τ is $\sim N(50, 25^2)$ and panel (d) τ is $\sim N(100, 25^2)$. Consumer surplus, revenue and social surplus are plotted in dollars ($). The no-show rate is the fraction of users holding a reservation who no-show. Income is $\sim N(135,000, 75,000^2)$ and τ is $\sim N(50, 25^2)$. Campground capacity is 10,000 user trips and there are 100,000 potential users. P_{trip} = \$70 and F_{cancel} = \$10 in all simulations. Each plot shows results averaged over 1000 simulated choice occasions.

E.1 Distributional effects when τ is correlated with income

Similar to the distributional effects considered when income is positively correlated with trip utility (Proposition 4), we may wonder whether equity issues arise when users' private cancellation costs τ are correlated with income. In this case, I derive the following theoretical results (see Online Appendix A for proofs of these results).

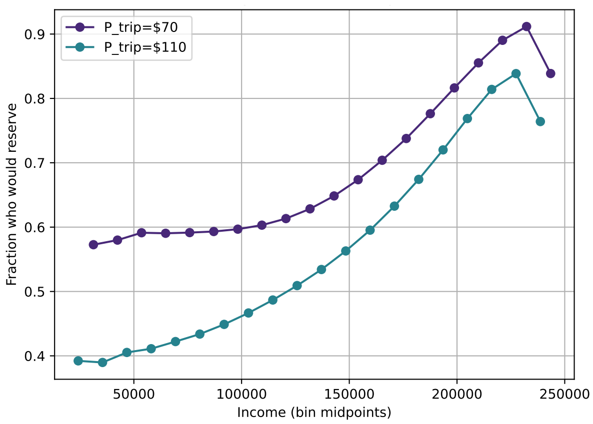
Corollary 4.2: *When τ and income are negatively correlated, increasing P_{trip} weakly increases the mean income of users who reserve.*

Increasing P_{trip} raises the reservation threshold for users who no-show if they do not travel (high τ). When τ is negatively correlated with income, this preferentially discourages lower income users from reserving.

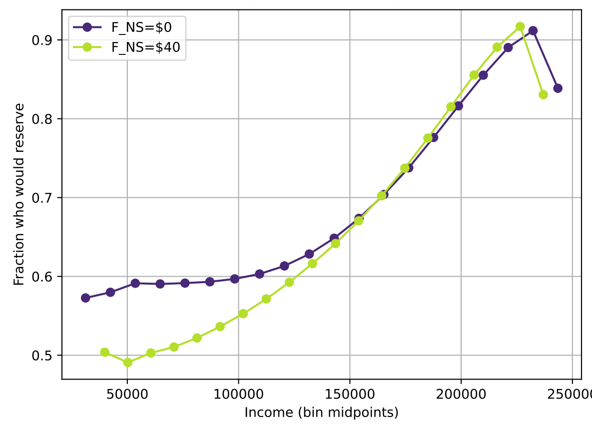
Corollary 4.3: *When τ and income are negatively correlated, increasing $F_{no-show}$ weakly increases the mean income of users who reserve.*

For users who no-show if they do not travel, raising $F_{no-show}$ discourages high τ users from reserving. When τ is correlated with income this preferentially discourages a subset of lower income users from reserving.

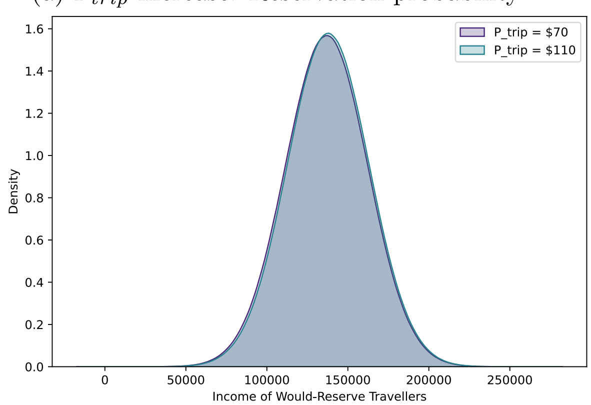
I further investigate this possibility with a simulation assuming $\text{Corr}(\tau_i, \text{Income}) = -0.70$. Corollary 4.2 states raising $F_{no-show}$ will increase mean income when τ and income are negatively correlated. Figure E6a and Figure E6b show the effect of the higher trip and higher no-show fee on reservation probability by income. Both fee increases disproportionately impact lower income users. However, since there are fewer potential reservers in the lower end of the income distribution, the effects on mean income, Figure E6c and Figure E6d are quite minor.



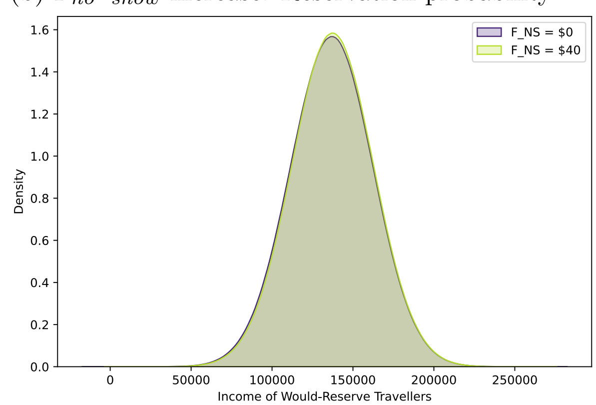
(a) P_{trip} increase: Reservation probability



(b) $F_{no-show}$ increase: Reservation probability



(c) P_{trip} increase: Income distribution



(d) $F_{no-show}$ increase: Income distribution

Figure E6: Distributional effects when τ is correlated with income. U_{trip} is $\sim N(500, 250^2)$. Income is $\sim N(135,000, 75,000^2)$ and $\text{Corr}(U_{\text{trip}}, \text{Income}) = -0.70$. Campground capacity is 10,000 user trips and there are 100,000 potential users. Panel (a) shows the fraction of potential users who wish to reserve at various points in the income distribution for $P_{trip} = \$70$ trip and $P_{trip} = \$110$. Panel (b) plots the fraction of potential users who would reserve with and without a \$40 no-show fee. Panel (c) plots the income distributions of users who would reserve under different prices. Panel (d) plots the income distributions of users who would reserve with and without the no-show fee. Each plot shows results averaged over 1000 simulated choice occasions.