Outdoor Equity App Technical Documentation

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Chapter 1

Abstract

Outdoor recreation and access to nature have well-documented positive impacts on mental and physical well-being. Federal public land management agencies in the United States offer a variety of outdoor recreation activities to visitors. However, people from different socioeconomic and identity groups access federal public lands unequally due to historical discrimination and current inequities. This project uses data from the Recreation Information Database (RIDB) and the United States Census Bureau (US Census) to explore patterns of visitor use of reservable overnight sites (such as campgrounds, cabins, hike-in, and more). Specifically, we used 2018 reservation data and US Census data from the next available year to 2018 (i.e. 2018 median income data, 2015 language data). We created the interactive Outdoor Equity App that gives users tools to summarize data, explore relationships between RIDB and US Census variables, view maps of where visitors are coming from for reservable sites in California, and download subset data. This technical documentation includes information on metadata, application maintenance, and next steps for expanding the app to include visitor data from more locations and time periods.

Chapter 2

Executive Summary

Outdoor recreation and access to nature have well-documented positive impacts on mental physical well-being. Federal public land management agencies in the United States offer a wide variety of activities to visitors. However, people from different socioeconomic and identity groups access federal public lands unequally due to historical discrimination and current inequities. The multi-agency program, Recreation One Stop (R1S), oversees the operations of Recreation.gov and aims to increase access to recreation by providing online resources about nationwide recreational opportunities, allowing visitors to make reservations, and making the associated data accessible to all. The rich data on visitors that R1S collects presents an opportunity for the creation of more robust data-driven analytical tools to understand the patterns and correlations of this unequal access across the country and within individual recreation areas. Decision-makers can use these tools to explore and visualize how recreational opportunities on federal public lands are accessed.

Our overarching objective is to design and built an interactive web application that allows users to analyze patterns in the access and demand of visitors at reservable overnight sites (such as campgrounds, cabins, hike-in, and more), using data from the Recreation Information Database (RIDB) and the United States Census Bureau (US Census). These analyses will allow federal public land managers to explore relationships among attributes of recreation opportunities, reservation practices, and socioeconomic data from the regions of visitor origin. We achieved this goal through the creation of an interactive web application, the Outdoor Equity App, that allows for a wide range of visualization, metadata documentation, and subset data downloads. This technical documentation serves to document the Outdoor Equity App creation process, include information for ongoing maintenance, and provide suggestions for future use and expansion.

The app - which is implemented using the R programming language - accesses public RIDB and US Census data via direct download and application program-

ming interfaces (API). All data and R code scripts are stored on the UCSB Taylor Server and version-controlled through GitHub. We isolated necessary variables and defined, standardized, and aggregated values in the data cleaning process. We calculated additional derived variables for each reservation, such as distance traveled and booking window, and summary statistics (e.g., mean and median) for census data at the ZIP code level. A data set that combines the US Census and RIDB data based on visitors' home ZIP code is the foundation for the Outdoor Equity App. We visualized distributions of variables and relationships between them with simple, straightforward figures. Within the app, users can subset the data to a specific overnight reservable site and visualize the distribution of a single variable, the relationship between two variables, or the visitorshed map (i.e. area from where visitors are coming) for the selected site. The app currently only includes data for California reservable sites in fiscal year 2018 due to project scope limitations.

Throughout the analysis and app creation processes, external advisors and federal public land managers have reviewed and tested the Outdoor Equity App. We incorporated feedback into all parts of the processes to ensure our data, analysis, and final products are robust. Potential future updates to the Outdoor Equity App are discussed in this technical documentation and include temporal and spatial expansions and app maintenance. The temporal expansion would include cleaning additional datasets for years from 2012 to 2021 as well as expanding the app's interface to allow for temporal selections when subsetting data. The spatial expansion would focus on updating the app structure and server hosting capabilities so the app runs smoothly with data from the full United States.

As environmental justice is increasingly recognized as a necessary lens to achieve environmental goals, equitable access to outdoor recreation is a high priority for managers. This tool assists managers to be equity-conscious decision-makers, can be a springboard for researchers who have questions about outdoor recreation, and strengthens nonprofit organizations' advocacy efforts. We also hope it will be a dynamic tool that empowers visitors to access the information and resources they need to explore outdoor recreation.

Chapter 3

Problem Statement

3.1 Background

Outdoor recreation provides critical health and well-being benefits to communities, and in the United States, federal public lands play an important role in providing access to nature. However, access is not equal for all people Ewert and Hollenhorst [1990]; Flores et al. [2018], which has been recognized as an environmental injustice Floyd and Johnson [2002]. Many studies have shown that federally managed public land is accessed unequally due to historical discrimination and current inequities Floyd and Johnson [2002]; Shelby et al. [1989]; Xiao et al. [2021].

The challenge now facing public land management agencies is how to allocate quality visitor experiences to a more diverse user base. Simply increasing recreation opportunities on public land is not a viable solution to this rising demand. Many land management agencies in the U.S. are tasked with the dual mandate of providing recreational opportunities for visitors while also preserving and conserving natural resources and places Shartaj and Suter [2020]. For over a century, striking the balance necessary to uphold this mandate has proven a challenge for federal agencies like the National Parks Service Meinecke [1937]; Sax [1980], and the recent growth of recreation (Figure 3.1) has renewed concerns about its potential negative environmental impacts and changes to the visitor experience Hammitt et al. [2015]; Timmons [2019].

While managers seek to allocate existing resources (e.g. campsites) through the fairest means possible, including reservation systems, equal opportunities do not translate to equitable access Shelby et al. [1989]. Historically, policies of segregation barred certain racial groups from using federal public lands and the legacy of these policies has perpetuated inequitable access for certain racial groups to this day Xiao et al. [2021]. Additionally, previous and current inequities like

lack of time, disposable income, access to technology, and lack of social or institutional knowledge about reservation systems impact access to federal public lands Scott and Lee [2018]. At present, park visitation and camping are seeing a surge in popularity, heightened even more by the COVID-19 pandemic, and this rapid increase in demand for recreation opportunities may only further these inequities.

3.2 Significance

Currently, much of our understanding about trends in recreation on public lands comes from the Integrated Resource Management Applications (IRMA) Portal, which the National Parks Service uses to monitor visitor counts over time Bergstrom et al. [2020]. However, these data lack information on where visitors are coming from. This project leverages the Recreation Information Database (RIDB), managed by Recreation One Stop, an inter-agency partnership that provides reservation services and trip-planning tools on Recreation.gov. The RIDB is far more robust, including data from other land management agencies, and information on visitor zip codes, costs, group sizes, and dates of both reservations and recreation activities. While it is available for public download, there are few robust data-driven analytical tools to understand the patterns and relationships of these inequities within individual recreation areas.

Previous research has demonstrated the value of RIDB data in forecasting future recreation demand for single park units Rice et al. [2019] and analyzing preferential characteristics for popular recreational facilities Rice and Park [2021]. A recent study summarizing RIDB data from national parks Walls et al. [2018] also identified broad patterns in reservations. For example, campsite reservations are made far in advance, but many are canceled last minute (Figure 3.2); visitors tend to visit national parks near their homes (Figure 3.3); and the distribution of incomes of campers appears to be similar to the U.S. population as a whole (Figure 3.4). However, overall, the vast RIDB data has received limited system-level research attention to date, and this work will be the first to explore issues of equity with RIDB data.

Furthermore, much of the existing research on outdoor recreation focuses on National Park Service lands (e.g., Walls et al. [2018]), which is only a small percentage of all federal land used by the public. The other land management agencies, including US Forest Service, Bureau of Land Management, and Army Corps of Engineers, often lack the capacity and funding to process reservation data, and are less frequently the subjects of outside research. Little is known about how patterns of access and demand vary across land management types. The RIDB includes data from all federal land management agencies, and therefore has tremendous promise to inform our understanding of patterns and trends in recreation across space and time and to inform policies for more equitable campground access for all federal public lands.

Our overarching objective for this project is to utilize data from RIDB and US Census to analyze spatial and demand patterns of visitor access at reservable overnight sites (such as campgrounds, cabins, hike-in, and more). We chose to focus on reservable sites since recent studies have shown this type of outdoor recreation to be a good proxy for visitation to federal public lands Walls et al. [2018]. These analyses will provide federal public managers an opportunity to explore relationships between and within socioeconomic and reservation variables.

3.3 Figures

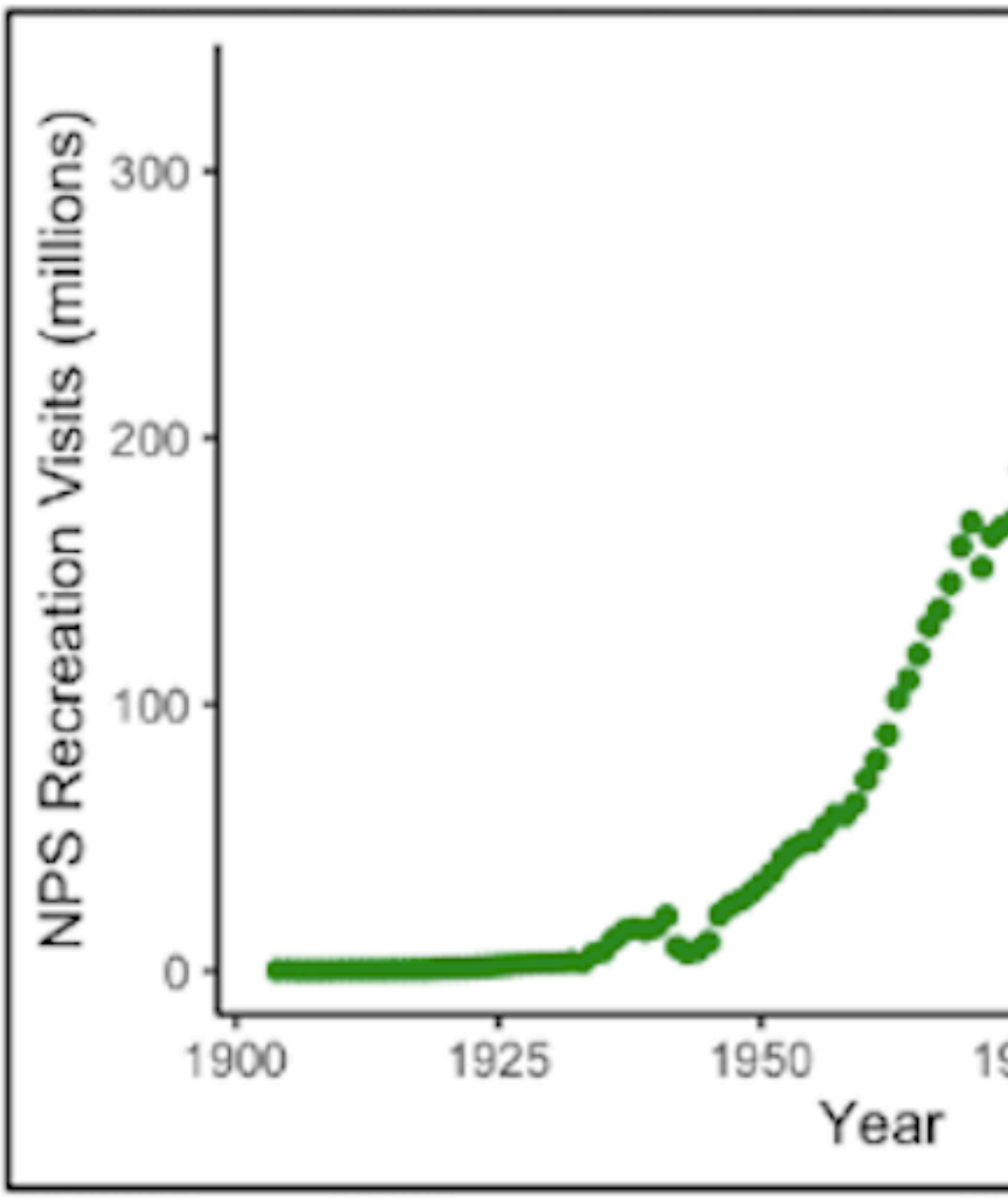

Figure 3.1: Total annual visitors to the National Park Service system, since its inception through 2020. Visitation has been rapidly increasing, particularly within the last decade. (Source: [IRMA](https://irma.nps.gov/Portal/))

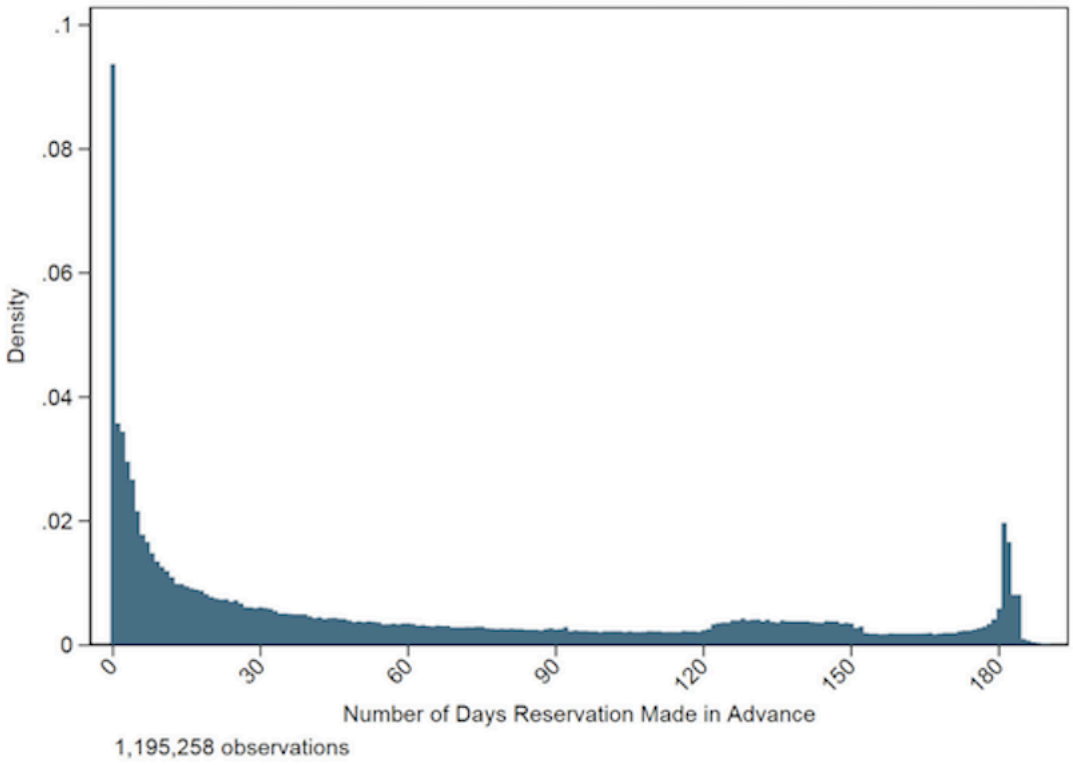

Figure 3.2: Reproduced from @Walls2018. Days in advance that National Park campsite reservations are made from 2014 to 2016. Reservations are made far in advance, but many reservations are canceled at the last minute.

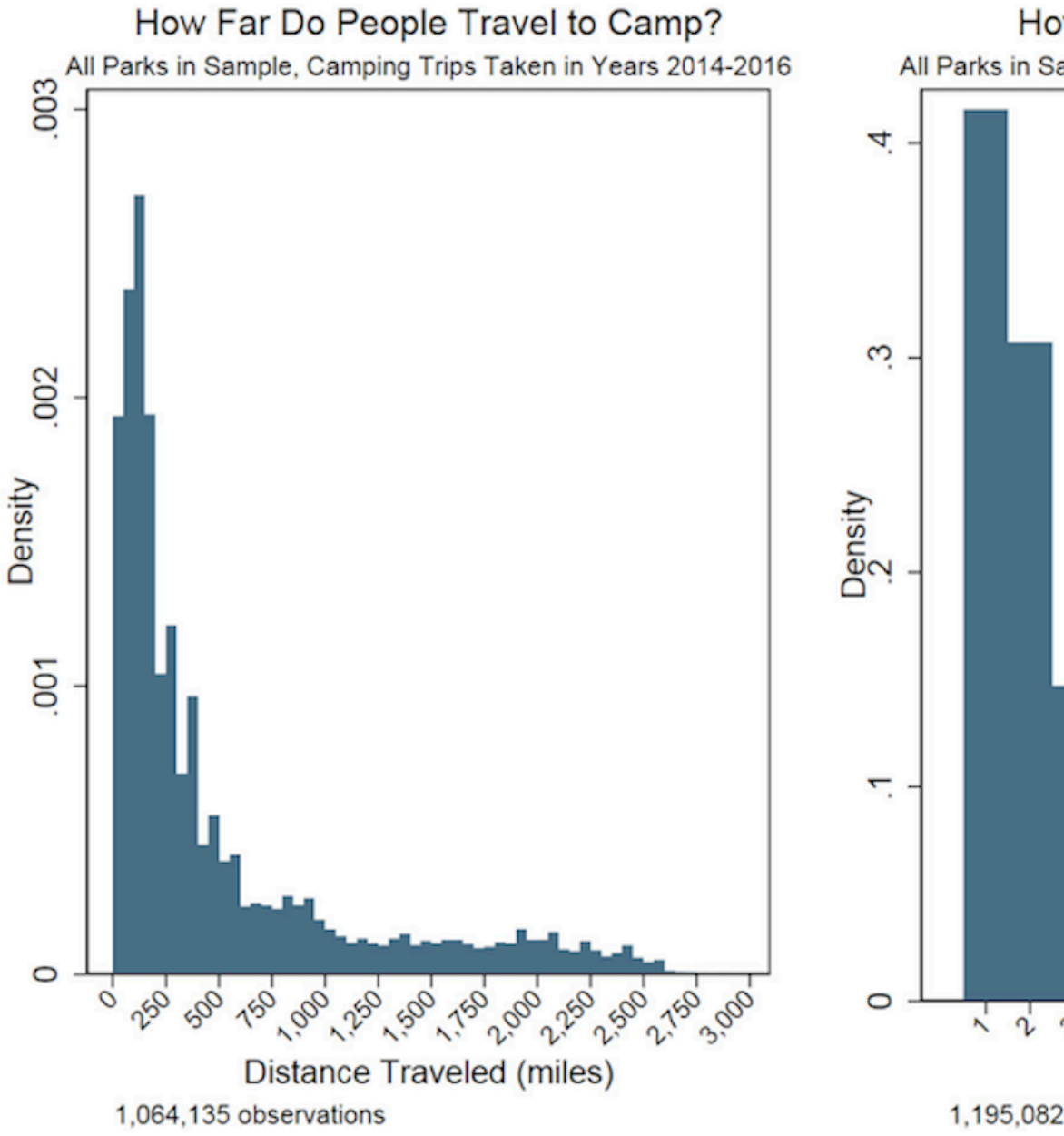

Figure 3.3: Reproduced from @Walls2018. Distance traveled and duration of stay for National Park camping visits from 2014 to 2016. Visitors tend to visit national parks near their homes and stay only two nights, and longer trips are rare.

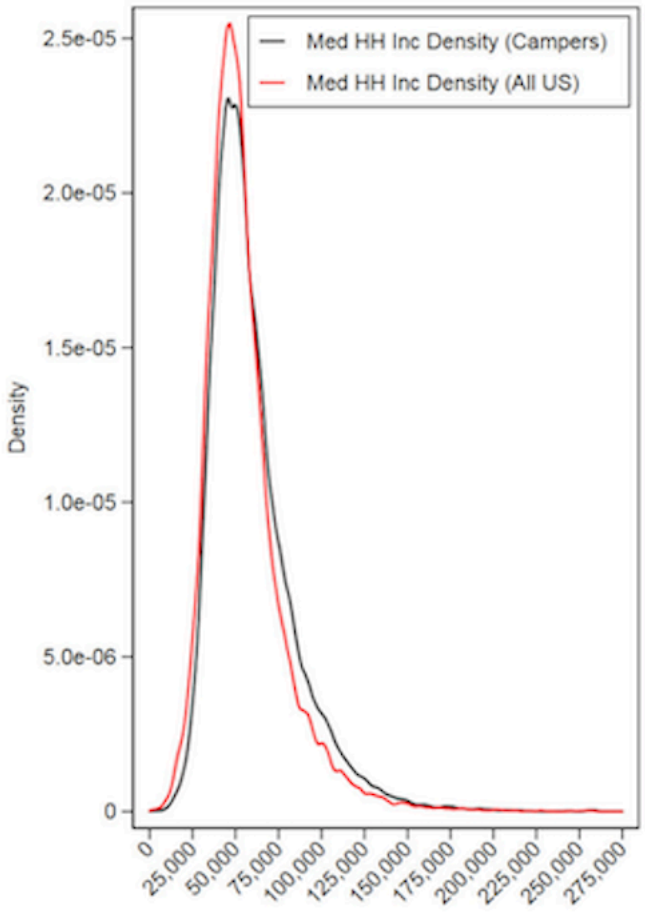

Figure 3.4: Reproduced from @Walls2018. Median household income (by zip code) for National Park campers and for US Population. The black line estimates the distribution of median household (HH) income of campers from 2014 to 2016. The red line estimates the distribution of median household for all zip codes in the U.S. using average median household income from 2014 to 2016 where each zip code is an observation.

Chapter 4

Specific Objectives

Federal lands in the United States provide important recreation opportunities to the public, but there is a **growing need to understand and mitigate inequities in access to outdoor recreation.** This project addressed this need by creating the Outdoor Equity App, an **interactive platform** for summarizing and visualizing site-specific patterns and trends in visitation volume, demand, and visitors' location of origin. The platform will integrate nationwide Recreation.gov reservation data with US census data to:

- Gain insights into **demand for reservations** across different types of recreation areas.
- Analyze access to federal public lands among **historically underserved groups** in relation to recreation **site type, cost, location, and demand**.
- Clearly define all variables and values in the **metadata documentation**.
- Allow users to **download a subset of the combined data** for further analysis.

Chapter 5

Summary of Solution Design

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