DIVISION OF RESEARCH, INNOVATION & SYSTEM INFORMATION
Research Initial Scope of Work – Fall 2025

Task ID: 4018

Task Title: California HOT Lane User Impact Study

Problem Statement

The State of California employs a variety of tolling methods both to fund major infrastructure projects and to manage traffic demand. Tolls are an effective funding mechanism because they function as direct user fees and only those who use a facility and benefit from it are required to pay. In the case of managed lanes (most commonly high-occupancy toll (HOT) lanes) users are given a choice: they can use the general-purpose lanes, which are free but often congested, or pay for a faster trip in the HOT lanes.

HOT lane tolls are dynamic, meaning prices adjust throughout the day based on demand. This creates a real-time "market price" that helps regulate usage, ensuring that drivers only pay when the time savings is worth the cost. Because drivers can choose whether or not to use these lanes based on their own assessment of value, payment is both voluntary and based on perceived benefit. Typically, HOT lanes are restricted to passenger vehicles, with trucks excluded.

However, despite these advantages, tolls place a financial burden on users. While they are technically fair in the sense that only users pay, the costs can be a significant hardship for low-income travelers. These individuals may be unable to afford tolls on a regular basis, which can force them to forgo trips altogether or take longer, less direct routes to reach their destinations.

As a result, concerns have been raised by the State Legislature and various advocacy and interest groups about the fairness and accessibility of tolling practices across California. Studies conducted in other states, such as on I-405 in Washington and I-85 in Georgia, have offered valuable insights into how tolling impacts different income groups. However, there is still limited understanding of how California's tolling systems affect low-income and underserved communities.

Objective

The objective of this project is to conduct an initial, data-driven analysis of how the costs and benefits of tolling are distributed across different population groups in California. Specifically, the study will assess the usage patterns and economic impacts of five toll facilities, including four HOT lane corridors and one conventional toll road.

This analysis aims to evaluate the fairness and accessibility of tolling systems by examining who uses these facilities, who pays tolls, and who receives benefits such as discounted or free access through carpooling. The findings will provide a baseline understanding of the demographic and geographic distribution of tolling impacts across the state.

This foundational analysis is intended to inform future policy development and guide the implementation of strategies aligned with California’s broader transportation fairness and

accessibility goals. The baseline established will also serve as a reference point for future monitoring efforts to assess progress toward more balanced tolling practices.

Description of Work

This project involves a comprehensive analysis of the fairness and distributional impacts of five toll facilities in California, including four HOT lanes (I-15 San Diego, I-10 and I-110 Los Angeles, and I-580 Bay Area) and one conventional toll facility (South Bay Expressway). The methodology builds on previous HOT lane analyses conducted in Washington State, extending it to include a conventional toll facility. Detailed toll transaction data, including timestamps, plaza locations, de-identified user IDs, HOV status, and tolls paid were aggregated into trip records with entry and exit times and locations. Most trips were linked to users' census block groups, enabling demographic analysis using census data. Additional data included facility speed, volume, and travel times across both HOT and general-purpose lanes in fine time intervals[1].

The scope includes a sequence of interrelated tasks:

1. **Understanding Toll Data:** Collaborate with toll authorities to understand tolling approaches and data structures.
2. **Data Extraction:** Collaborate with toll authorities to extract toll data from authority databases and geocode the billing addresses to census block groups while protecting user privacy. Obtain travel time, speed, volume, and origin/destination data for both HOT lanes and general-purpose lanes to quantify travel time savings and reliability. Assign demographic characteristics from census data to toll data to estimate income and other demographic factors. Fuse toll data with facility performance data to create a comprehensive analytical database capturing trip details, travel times, and user characteristics. If additional information is needed, examples of useful data sources include PeMS for facility performance metrics, commercial mobility data for aggregated trip and demographic insights, available survey data for broader travel and demographic trends, and travel demand models to estimate toll use by income groups while keeping in mind the limitations of each.
3. **Value of Time Computations:** Calculate value of travel time and reliability savings for trips to quantify user benefits.
4. **Impact Analysis:** Analyze the distribution of toll facility usage, benefits, and net impacts by geographic location, income level, time of day, and user type, generating summary statistics and insights. User characteristics should also be compared to those of similar non-priced facilities, recognizing that lower-income individuals typically drive less overall, not only on priced facilities.
5. **Final Reporting:** Prepare and deliver a comprehensive final report including an executive summary, incorporating all findings and analyses.

[1] https://www.wsdot.wa.gov/publications/fulltext/design/ConsultantSrvs/I-405ExpressTollLanes.pdf

6. **Project Presentation:** Present the study results to stakeholders, summarizing key outcomes and policy implications.

Estimate of Duration

18 months

Expected Deliverables

The project will produce a series of technical memoranda, progress reports, and a final report and presentation. These deliverables ensure accountability, transparency, and clear communication with Caltrans throughout the course of the project. Each deliverable corresponds to a specific task outlined in the scope of work and needs to include due dates to track progress over the project timeline.

1. **Quarterly Progress Reports:** Regular updates summarizing task progress, milestones achieved, challenges encountered, and upcoming work.
2. **Technical Memo (Data Acquisition Summary):** Overview of all toll data, census data, facility performance data, and supplementary datasets acquired for the analysis.
3. **Technical Memo (Analytical Database):** Description of the analytical database created by fusing toll, demographic, and facility performance data; includes metadata and structure.
4. **Technical Memo (Value of Time and Reliability Computations):** Detailed explanation of value of time and travel time reliability savings estimates for trips across the five toll facilities.
5. **Technical Memo (Impact Analysis):** Findings from the analysis of toll facility usage, benefits, and net impacts, broken down by geography, income group, time of day, and user type.
6. **Draft Final Report:** A complete draft summarizing all project activities, methodologies, and key findings, including an executive summary for broader audiences.
7. **Final Report and Response to Comments:** Final version of the report incorporating feedback from Caltrans and toll authorities, along with a response-to-comments memorandum.
8. **Final Presentation:** Virtual presentation to Caltrans and relevant stakeholders summarizing the study's findings and policy implications.

Background

As tolling becomes an increasingly common tool for funding infrastructure and managing congestion, concerns about fairness in transportation have become central to policy and planning

discussions. In this context, fairness refers to how the costs and benefits of tolled facilities are distributed across different population groups, ensuring that no community is disproportionately burdened or excluded from the advantages these systems provide. Understanding the fairness implications of tolling is essential to creating transportation systems that are both efficient and socially responsible.

Fairness in transportation pricing is understood through several dimensions. Horizontal fairness focuses on treating individuals in similar circumstances (such as drivers with comparable incomes) in a consistent manner. Vertical fairness recognizes that different groups have different abilities to pay, placing particular emphasis on low-income and vulnerable populations. Procedural fairness relates to the transparency and inclusiveness of the decision-making process, ensuring that all voices, especially from disadvantaged communities, are heard in toll policy development. Spatial fairness addresses how toll infrastructure affects different geographic areas, including concerns about displacement, accessibility, and integration with public transit. Environmental fairness considers the impact of tolling on local environments, particularly in communities already facing higher exposure to pollution and traffic congestion.

Among these dimensions, vertical fairness is especially critical in the context of tolled facilities, as tolls often impose a heavier financial burden on lower-income individuals. Without thoughtful design, tolling policies can deepen existing issues, limiting mobility for those who can least afford it and contributing to broader social and economic divides.

Related Research

The literature consistently highlights that tolls can have a regressive impact on low-income groups, as the cost represents a larger proportion of their income compared to higher-income groups. Key findings include:

- **Population and Demographic Shifts:** Equity Impacts of Toll Roads in North Texas[2] highlights significant disparities linked to toll roads, with wealthier populations clustering around toll corridors and more disadvantaged populations around non-toll roads. This outcome is flagged as a fairness problem because it suggests that transportation infrastructure (which should serve all residents) may be contributing to social and economic divides.
- **Financial Burden:** Regional Toll Roads and Median Income[3] study highlights that toll roads create economic barriers for lower-income communities, worsening regional transportation gaps. The biggest determinant of public acceptance is how toll revenues are used, with strong support when funds are allocated toward transit improvements.
- **Travel Time:** Regional Toll Roads and Median Income[2] explores the relationship between toll roads and income levels, concluding that while toll roads help reduce congestion, they often exclude those who cannot afford the high fees, forcing them into longer, less efficient commutes. To address these disparities, policy changes such as income-based toll

[2] https://mavmatrix.uta.edu/planning_reports/22/
[3] https://digitalscholarship.tsu.edu/cgi/viewcontent.cgi?article=1068&context=theses

discounts, expanded transit options, and toll relief programs could make toll roads more accessible.

- **Behavioral Changes:** I-405 Express Toll Lanes[4] are being used by a mix of income groups, not just the wealthy, and they deliver significant time savings and reliability improvements that many drivers find worth the cost. Higher-income users do use the lanes more often, but lower-income users gain substantial value on the occasions they choose to use the lanes, especially during rush hour. The facility as a whole provides a net positive benefit to the region in terms of travel time saved versus tolls paid. Policy tweaks, such as adjusting toll rate minimums or maximums, show potential to slightly increase efficiency or revenue without disproportionately harming lower-income users, indicating that careful toll policy design can maintain a balance between revenue generation, travel behavior, and fair access.

Deployment Potential

Is this an incremental part of a larger research project? No.

[4] https://www.wsdot.wa.gov/publications/fulltext/design/ConsultantSrvs/I-405ExpressTollLanes.pdf