Joint Transportation Research Program

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Evaluating the Impacts of Time-of-Day Tolling on Indiana Roadways

Introduction

Due to increasing shortfalls in road construction and maintenance funding, federal, state, and local governments are seeking new mechanisms of infrastructure financing including tolling. Toll roads have diverse impacts on a region's traffic, land use, economy, and citizens' welfare, and tolling is a useful traffic management strategy. Traffic on state highways varies by the time of day and is sensitive to the toll amount. Time-of-day (TOD) tolling imposes different toll fees at different times of the day, with fees typically lower during off-peak hours.

Time-of-day pricing is an important financing mechanism, but its overall costs and benefits need to be evaluated. Currently, INDOT's planning models are unable to forecast the impact of time-of-day tolls.

This project employed the Indiana Statewide Travel Demand Model (ISTDM) to capture the relationships between time-of-day tolls and route choices based on empirical data. Subsequently, the impacts of time-of-day tolls can be computed for various state roadways based on anticipated changes in route choices. The study used I-465 as the hypothetical toll road and investigated the impacts of toll rates on a nine-county region in the Indianapolis area. Revenue, monetary savings, travel times, speeds, vehicle hours traveled (VHT), vehicle miles traveled (VMT), and welfare were computed based on anticipated changes in route choice. The research product is the TOD Tolling Analysis Pack: time-of-day analysis software that can drastically reduce the time and effort spent analyzing the costs and impacts of any TOD tolling project. This software can also be used to evaluate network-wide impacts of alternating tolling scenarios based on empirical data. Two advantages are that the TOD Tolling Analysis Pack can be integrated with INDOT's existing TransCAD models and can be used by various stakeholders at INDOT.

Findings

The results of this study reveal an increasing trend in revenue from 2015 to 2025 across different scenarios:

- The revenue reaches peaks at 8 AM and during the 4 PM–6 PM block. Relatively low revenues are collected from midnight to 6 AM. The highest revenues result from implementing the most expensive toll option.
- VMT varies during times of day. It is lowest for the 12 AM–6 AM block and highest at 8 AM and for the 4 PM–6 PM block. VMTs generally increase at peak times during any of the three years (i.e., 2010, 2015, and 2025). Additionally, the average travel times have patterns similar to those of the VMTs.
- Average speeds have trends inverse to those of average travel time. Intuitively, speeds reduce during peak hours but they are fairly stable at other times. For higher toll rates, faster travel speeds are observed. Therefore, it can be inferred that toll prices may assure higher speeds and improve the travel time reliability.
- As expected, VHT decreases as tolls are increased. The highest sensitivity of VHT to toll rates is during peak hours.
- Welfare calculations show that the impact of tolling on I-465 does not result in the driver being better off as compared to the no-toll case scenario. This is mainly because the highway capacity for the years analyzed is able to accommodate the traffic

volumes for most periods of the day. As a result, the savings in monetary equivalent of travel times is not enough to cover the toll levied. Therefore, it does not generate enough benefit for people who use the toll road.

Implementation

Successful implementation of the study can be facilitated because the research product:

1. Developed a model that captures the relationship between time-of-day toll and route choice.
2. Developed a time-of-day analysis software (the TOD Tolling Analysis Pack) that quickly evaluates the impacts of various time-of-day tolling scenarios.
3. Enables visualization of traffic flows on roadways for the various tolling scenarios. In addition, the TOD Tolling Analysis Pack displays the most impacted roads under any tolling scenario.
4. Has the capability to generate intuitive plots of revenue, monetary savings, travel times, speeds, VHT, VMT, and welfare from the results.
5. Incorporates a TOD Tolling Analysis Pack that can be used to compute the impacts of fixed toll rate scenarios by setting fixed values for all times of day. This information can help policymakers and transportation officials determine which scenario to implement and which roads to give management priority (i.e., capacity expansion).

The TOD Tolling Analysis Pack can also be used to analyze the impacts of time-of-day tolling on any highway. An advantage is that this software can be easily compiled to TransCAD software, which is commonly used in transportation agencies. Along with the software, a user's manual, post-analysis tools, and tutorial videos were also developed.

Finally, the TOD Tolling Analysis Pack can drastically reduce the time and effort spent analyzing the impacts of any time-of-day tolling project. It also provides a convenient and flexible tool for testing the impacts of various tolling scenarios for any highway. The visualization features can illustrate the diversion of traffic due to tolling implementation and display the top ten most impacted roads. Moreover, this software can be integrated with Google Maps, which provides the users with additional information on the study area.

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