

Forecasting Commercial Vehicle Miles Traveled (VMT) in Urban California Areas

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Steve Chung, PhD

Jaymin Kwon, PhD

Yushin Ahn, PhD

Introduction

This research examines the total commercial vehicle miles traveled (VMT) across six diverse California counties over the period of 2000 to 2020. By examining the interplay between demographics, economics, pollution, and VMT trends, this study aims to uncover the key determinants influencing commercial transportation patterns in urban areas. The primary goal is to understand how economic fluctuations, demographic shifts, and pollution levels impact commercial VMT, with a focus on providing insights for policymakers, urban planners, and environmental agencies. By employing correlation analysis, LASSO regression, and elastic net regression techniques, this research identifies significant predictors of total VMT and sheds light on the implications for transportation and environmental policies. Understanding these dynamics is crucial for fostering sustainable transportation practices and enhancing economic resilience in urban communities.

Study Methods

The study focuses on six diverse California counties, including Imperial, Los Angeles, Riverside, San Bernardino, San Diego, and San Francisco, each offering unique demographics, landscapes, and socioeconomic characteristics. By examining these counties collectively, the research aims to capture California's varied communities' multifaceted nature, providing insights into public health, transportation, and social services issues within the state. The dataset, spanning from 2000 to 2020, is sourced from two primary sources: FRED (Federal Reserve Economic Data) and EMFAC (EMission FACTor model). It includes variables categorized into demographics, economics, and pollution, offering a comprehensive view of the counties' dynamics over two decades. The study focuses on total VMT by commercial truck vehicles, classified based on vehicle class from medium-duty to heavy-heavy-duty trucks. The analysis explores correlations between input variables

and total VMT, revealing relationships with trip counts, emissions, fuel consumption, unemployment, and poverty rates across the counties. To address the challenge of estimating parameters effectively due to an equal number of variables and observations, the study employs penalized regression methods like LASSO and elastic net regression. These techniques help prevent overfitting and enhance model interpretability by selecting relevant features and performing regularization simultaneously. The inclusion of lagged total VMT allows for the exploration of temporal dependencies, uncovering how past VMT levels influence current VMT patterns. This comprehensive approach offers valuable insights into the factors driving commercial VMT in California and their implications for transportation and environmental policies.

Findings

The analyses conducted using LASSO and elastic net regression methods on standardized data have provided valuable insights into the factors influencing total commercial vehicle miles traveled (VMT) across selected California counties. The standardization process ensured fair comparison of variables, highlighting their relative importance. LASSO regression, with its variable selection feature, revealed that vehicle population and fuel consumption consistently had positive impacts on total commercial VMT across counties. Pollution variables like CO₂ and PM_{2.5} were also significant predictors, while economic factors such as median income and number of employed individuals showed varying impacts. Elastic net regression, combining LASSO and ridge techniques, included a broader range of variables for each county. This method's flexibility allowed for the inclusion of more predictors like number of trips and house price index alongside vehicle population and fuel consumption. The pollution variables CO₂ and PM_{2.5} remained important across all counties.

The high adjusted R-squared values exceeding 0.98 for both LASSO and elastic net models indicate that the selected variables collectively explain over 98% of the variability in commercial VMT. This suggests that the models, with their chosen inputs, effectively capture the trends and patterns in commercial transportation across counties. These findings underscore the significance of factors like vehicle population, fuel consumption, pollution levels, and economic indicators in predicting commercial VMT. The models' robust performance highlights their effectiveness in explaining variations in commercial transportation, providing valuable insights for transportation planning and policymaking in these regions.

The predictors influencing total commercial VMT are vehicle population, fuel consumption, CO₂ and PM_{2.5} pollution, median income, number of employed individuals, and poverty.

Policy/Practice Recommendations

Based on the study and findings of the analysis of commercial vehicle miles traveled (VMT) in six diverse California counties, several policy and practice recommendations can be made:

1. **Promotion of Sustainable Transportation:** Encourage the adoption of sustainable transportation practices among commercial vehicle operators, such as investing in fuel-efficient vehicles, adopting alternative fuels, and implementing eco-friendly logistics strategies.
2. **Air Quality Improvement Initiatives:** Implement measures to reduce pollution emissions from commercial vehicles, including stricter emission standards, incentives for cleaner technologies, and promoting the use of electric and hybrid vehicles.
3. **Economic Support for Sustainable Practices:** Provide economic support and incentives for businesses that adopt sustainable practices in their commercial transportation operations, such as tax credits for fuel-efficient vehicles or grants for eco-friendly logistics solutions.

4. **Data-Driven Decision Making:** Continue to invest in data collection and analysis to monitor commercial VMT trends, pollution levels, and economic indicators, enabling evidence-based policy decisions and targeted interventions.

About the Authors

Steve Chung, PhD is an Associate Professor in the Department of Mathematics at California State University, Fresno.

Jaymin Kwon, PhD is an Associate Professor in the Department of Public Health at California State University, Fresno.

Yushin Ahn, PhD is an Associate Professor in the Department of Civil and Geomatics Engineering at California State University, Fresno.

To Learn More

For more details about the study, download the full report at transweb.sjsu.edu/research/2315



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