Identifying Important Roadway Corridor Factors Which Affect Crashes Influenced by Unsafe Driving Behaviors to Help Law Enforcement Proactively Reduce Crashes

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Introduction

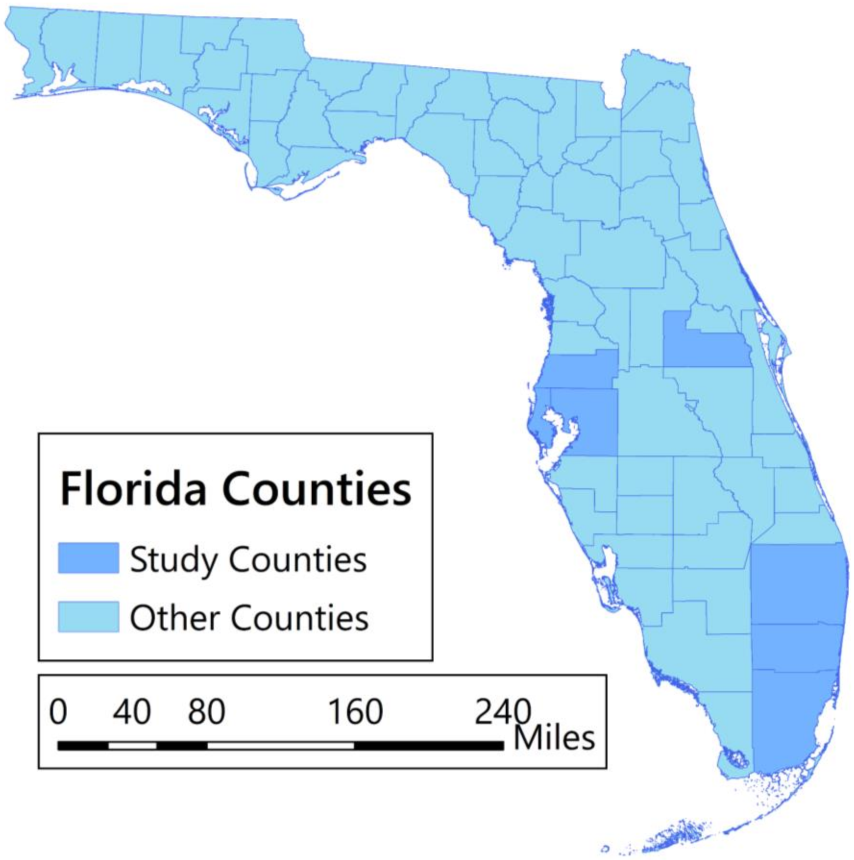
- Limited traffic enforcement staffing in recent years.
- Rise in fatal and injury (FI) crashes and unsafe driving behaviors since COVID-19.
- Proactive enforcement can help prevent crashes, but knowing the best locations for enforcement can be challenging.
- Identifying roadway factors which affect crashes involving unsafe driving behaviors can help law enforcement allocate their officers effectively.

Research Problem and Goal

- Main goal: Identify important roadway corridor factors which affect crash rates for unsafe driving behaviors.
- Factors identified via corridor-level random forest regression models using data from Florida arterials.
- This research can help law enforcement agencies prioritize locations for adjustments to enforcement to prevent crashes influenced by unsafe driving behaviors.

Data Scope

- Data retrieved for urban and suburban arterial roadways in seven Florida counties.
  - Orange, Hillsborough, Pinellas, Pasco, Palm Beach, Broward, and Miami-Dade.
  - Previously identified by the Florida Department of Transportation (FDOT) as high-risk with many FI crashes.
  - Likely have the most potential for crash reduction through proactive enforcement.



Roadway Data

- Geographic information system (GIS) files from FDOT.
  - Inventoried roadway data: lane count, traffic signal locations, functional classification, context classification.
  - Operational data: historical annual average daily traffic (AADT), speed limits.
- Google Maps satellite and Street View imagery.
  - Intersection counts, primary median type.
  - Presence of school zones, railroad crossings, limited access facility exits or entrances, bus stops, lighting, bicycle lanes, sidewalks, crosswalks, midblock crossings.

Citation Data

- Law enforcement citation data from 2017-2021 for seven unsafe driving behaviors.
- Citations related to non-driver behaviors or complex behaviors were not considered.

1. Failure to obey a traffic control device
2. Failure to stop at a steady red signal
3. Failure to drive in a single lane
4. Failure to yield while turning left
5. Driving under the influence
6. Reckless driving
7. Careless driving

Corridor Identification

- Corridors identified using geoprocessing tools in ArcMap.
  - Primary features (cannot change within a corridor): context classification, lane count.
  - Additional features: at least four years of AADT data, at least one lane in each direction, even number of lanes, contain at least one signalized intersection, at least 0.5 miles long.
- 548 corridors identified using this corridor definition.
- After filtering for corridors with known enforcement and removing outliers, 406 corridors covering over 800 centerline miles of arterial roadway were retained.

Corridor Summary Statistics

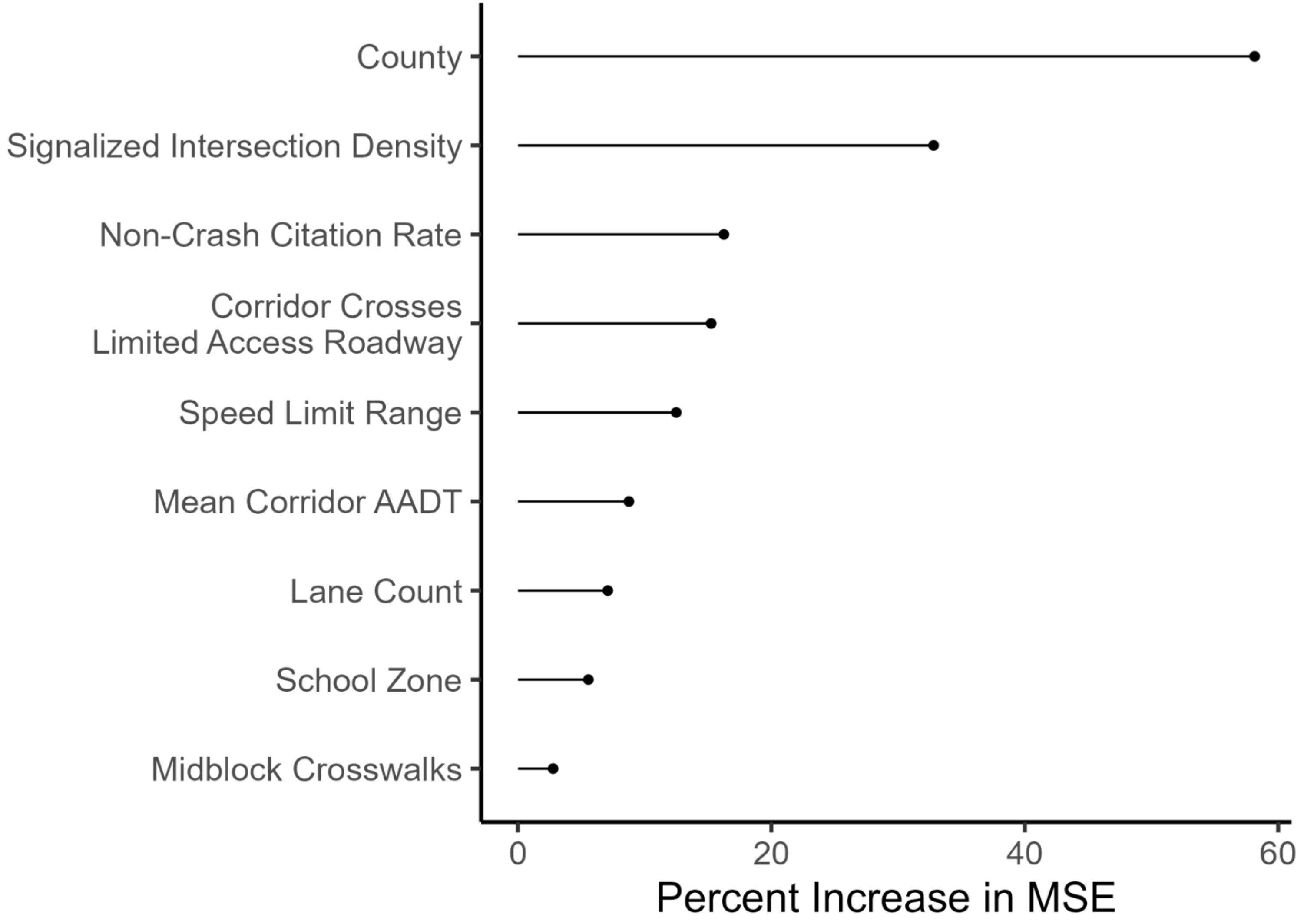
- 406 corridors contained 21,876 citations for the seven considered violations during the study period.
- Over two-thirds of the total citations were issued for careless driving.
- 85% of citations (18,518) were related to a crash.
  - 27% of these crashes (5,053) were FI crashes.
- Mean corridor traffic volume of about 37,500 vehicles/day.

Random Forest Models

- Variable importance plots (VIPs) show the order of important variables in a model.
  - Higher percent increase in mean squared error (MSE) means greater importance for prediction.
- Partial dependence plots (PDPs) show the marginal effect of one variable on the predicted value of the response.
- Three models developed:
  - Total crash rate (model 1).
  - FI crash rate (model 2).
  - FI crash rate for careless and reckless driving (model 3).

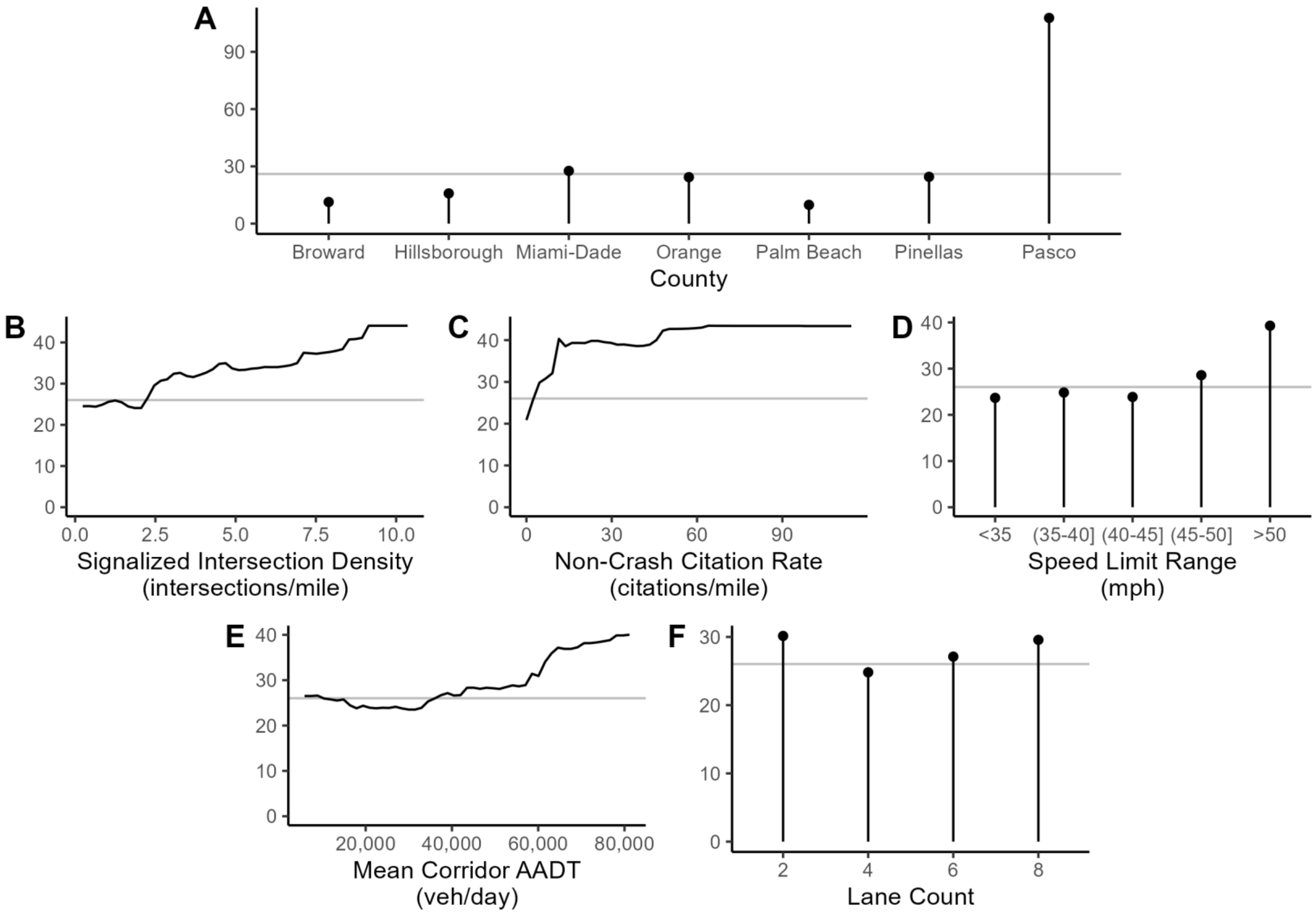
Model 1 Results & VIP

- 406 corridors containing 18,518 crashes.
- Pseudo R^2 = 45.96%.
- Four variables used at each tree split.
- Most important variables: County, Signalized Intersection Density.



Model 1 PDPs

- Attributes of corridors likely to benefit from proactive enforcement:
  - In Pasco County.
  - High signalized intersection densities.
  - Contain limited access exit or entrance.
  - Speed limits greater than 45 mph.
  - Mean corridor traffic volumes greater than 60,000 vehicles/day.



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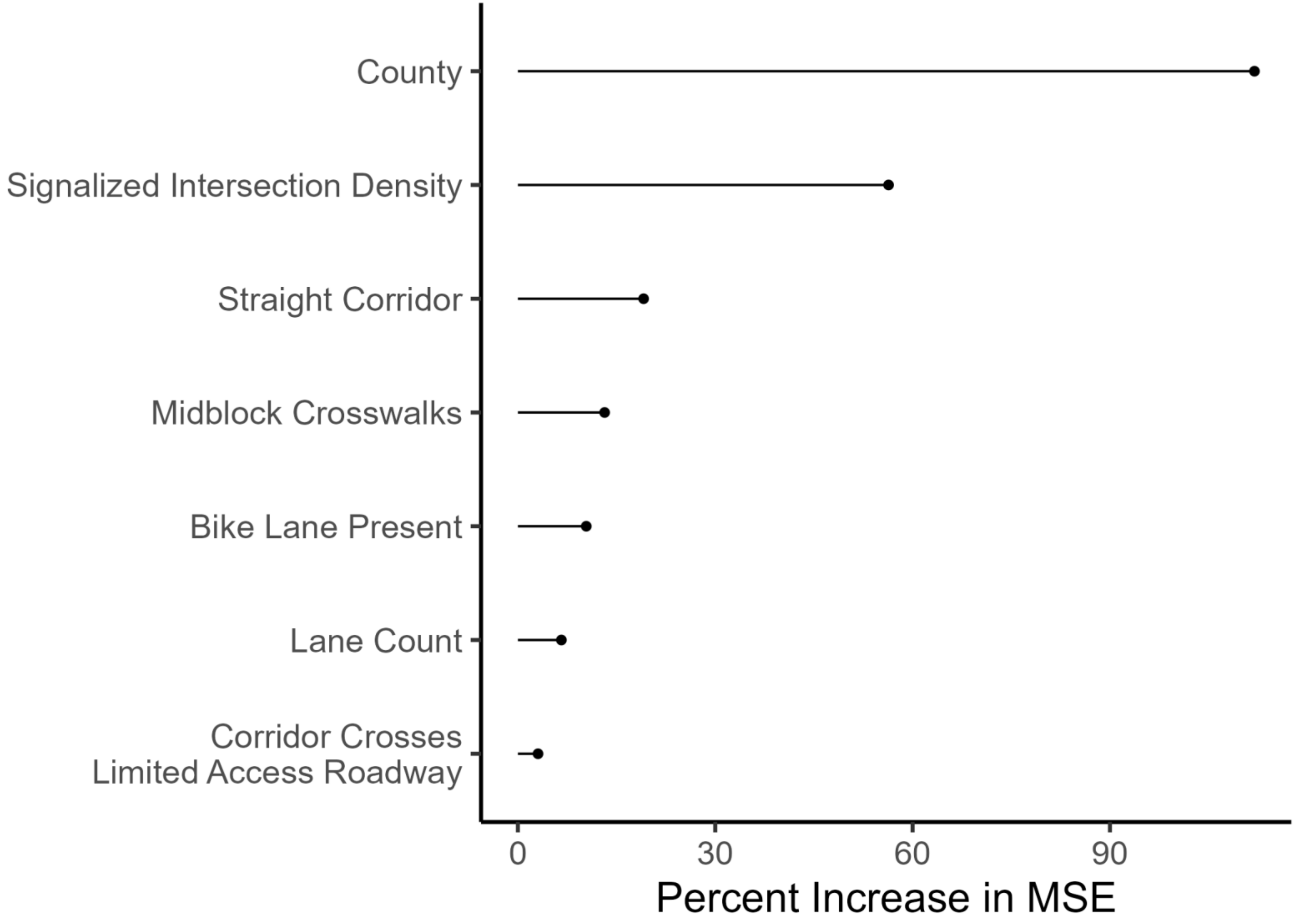
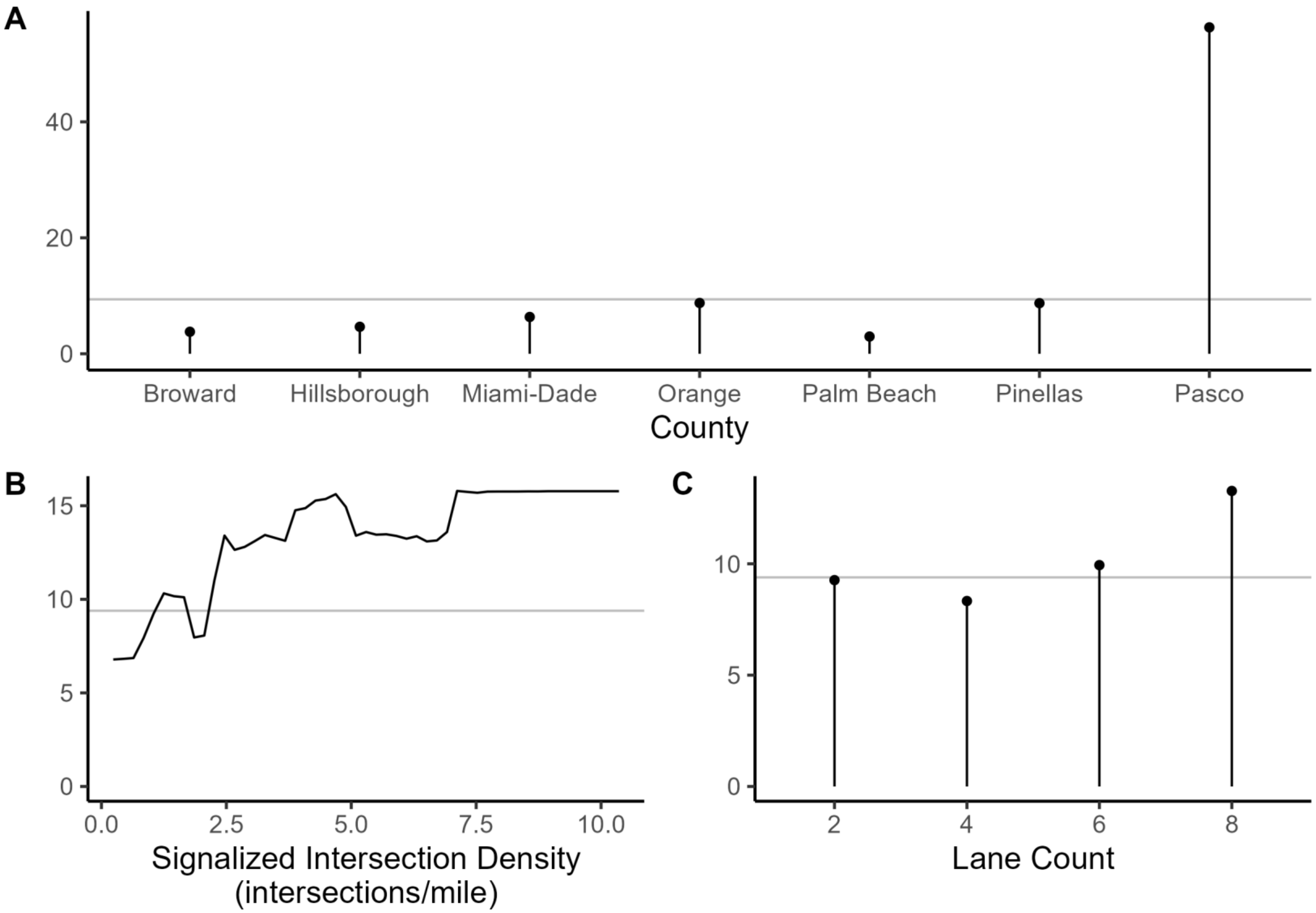
Model 2 Results & VIP

- 314 corridors containing 5,053 FI crashes.
- Pseudo R^2 = 57.02%.
- Seven variables used at each tree split.
- Straight corridors and corridors with bicycle lanes now identified as important.



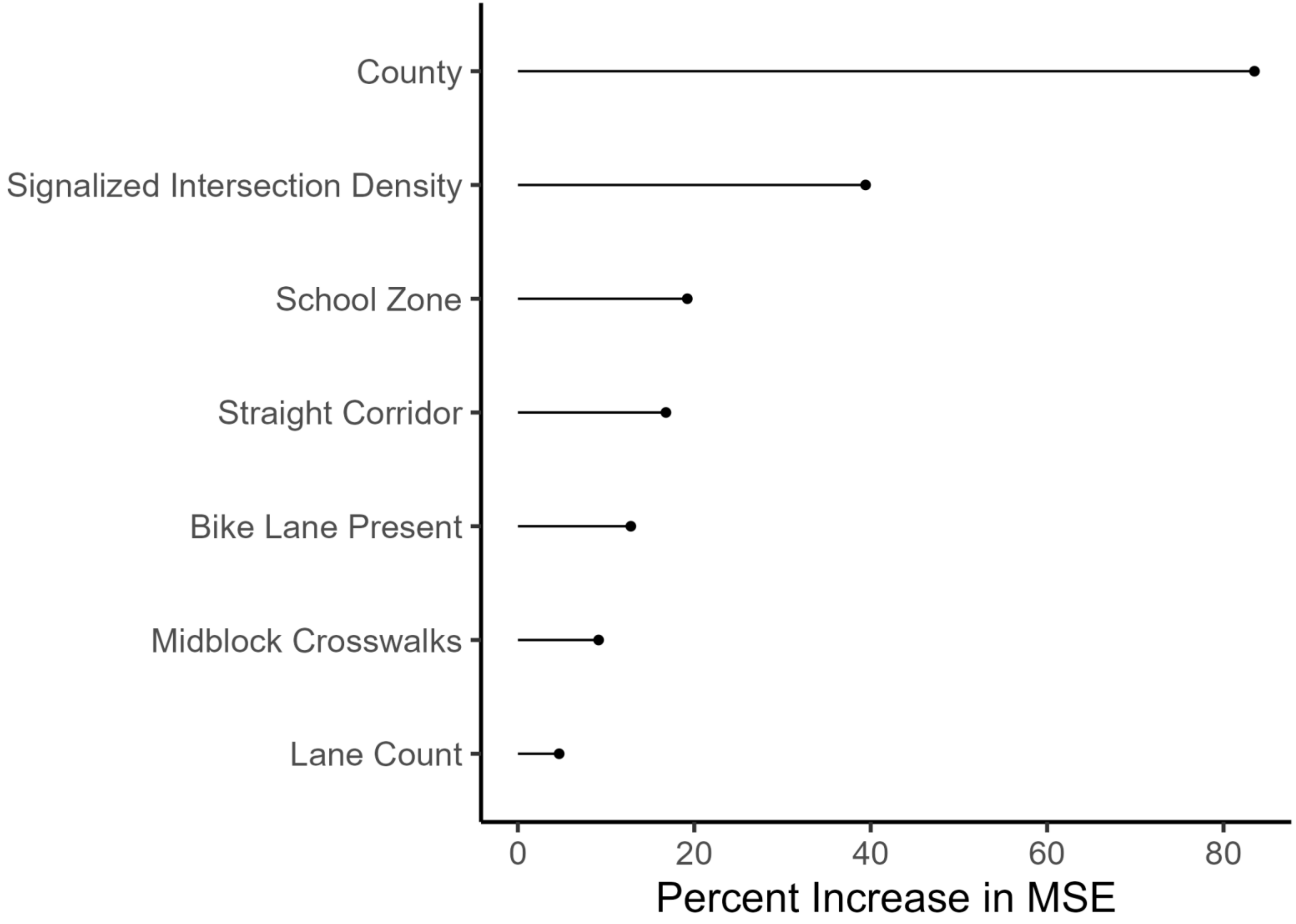
Model 2 PDPs

- Attributes of corridors likely to benefit from proactive enforcement:
  - In Pasco County.
  - High signalized intersection densities.
  - Limited horizontal curvature.
  - Contain midblock crossings.
  - Contain bicycle lanes.
  - Have six or more lanes.



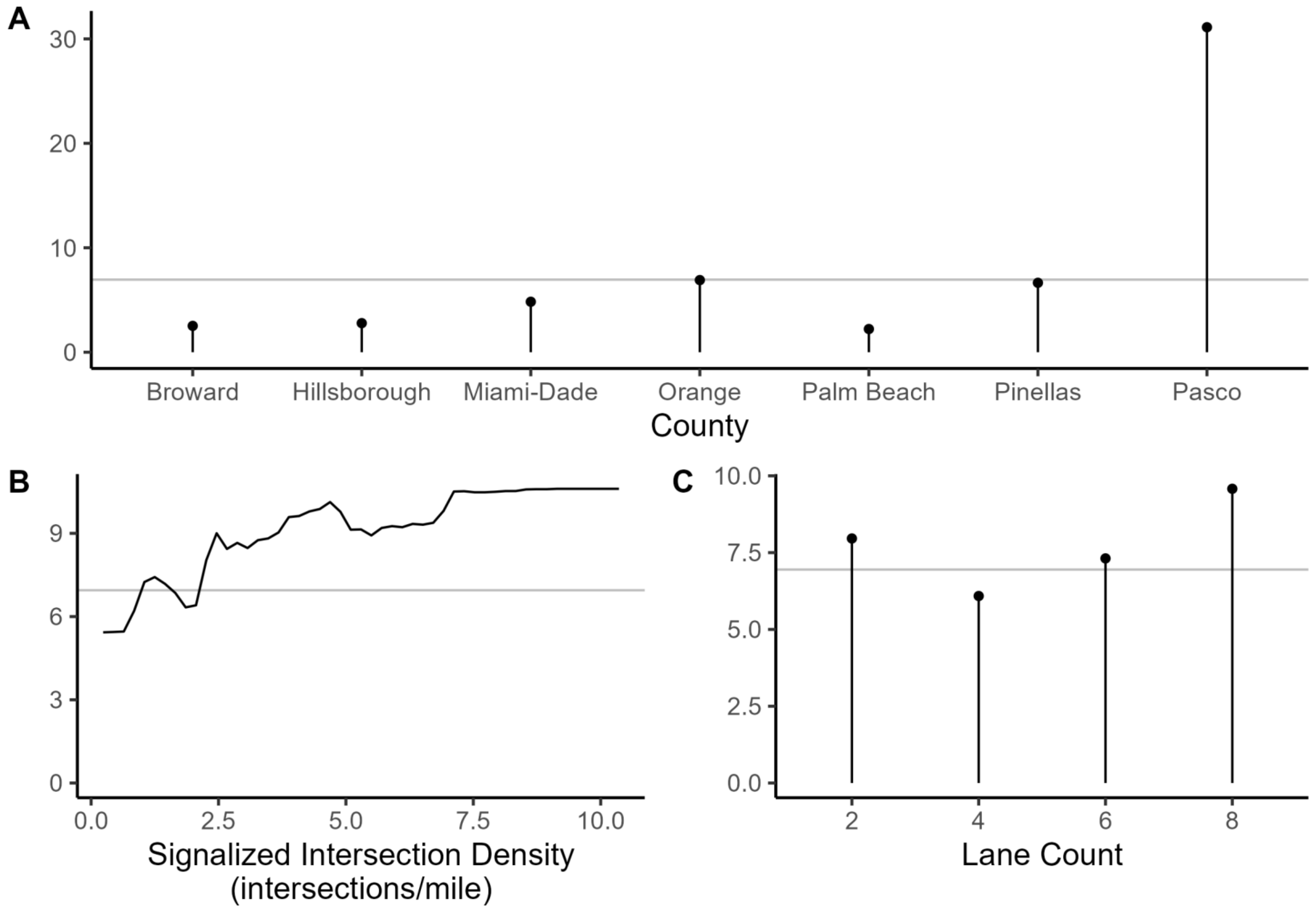
Model 3 Results & VIP

- 289 corridors containing 3,467 FI crashes that involved careless or reckless driving.
- Pseudo R^2 = 59.38%.
- Four variables used at each tree split.
- School zone presence identified as more important in Model 3 than in Model 1.



Model 3 PDPs

- Attributes of corridors likely to benefit from proactive enforcement:
  - In Pasco County.
  - High signalized intersection densities.
  - Do not contain a school zone.
  - Limited horizontal curvature.
  - Contain bicycle lanes.
  - Contain midblock crossings.
  - Have either two lanes or more than four lanes.



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Summary and Conclusions

- Using random forests with law enforcement data can help agencies with limited staffing prioritize locations for proactive enforcement.
  - Important variables show which features can affect crash frequency due to unsafe driving behaviors.
  - Random forests can capture non-linear effects typical models cannot.
- County and signalized intersection density were consistently identified as important factors affecting crashes.
  - Pasco County corridors and corridors with greater than 7.5 signalized intersections/mile would likely benefit the most from proactive law enforcement.

Future Research

- Non-crash citation rate was important in model 1, but the relationship between crashes and non-crash citations needs further study.
- Future research can incorporate data on existing law enforcement patrols to recommend specific adjustments or explore other analysis methods, such as neural networks.

Questions?

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