

The Relationship Between Driver Home Range and Age, Travel Mode, and Residence

- Analysis Using Property Damage Only Crash Data as Samples of Driver Movement -

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KEY WORDS: Human engineering, Driver characteristics, Home Range, Property Damage Only Crash Data(C2)

Understanding driver mobility is essential for transportation planning and mobility-related product development. However, conventional methods such as GPS surveys and person-trip surveys require substantial cost and are limited in sample size, making large-scale observation of driver mobility difficult. This study proposes a new analytical approach that interprets property damage only (PDO) crash data as samples of driver movement and uses the distance between a driver's residence and the crash location as a proxy for home range.

A total of 233,428 drivers involved in PDO crashes in Niigata Prefecture between 2022 and 2025 were analyzed. The distance between each driver's residence and crash location was calculated, and its logarithm was used as the dependent variable in a multiple linear regression model. Explanatory variables included driver attributes, such as age, sex, vehicle type, and municipality of residence, together with crash circumstances, including road type, time of day, weather, crash type, month, and year.

The regression model achieved an adjusted coefficient of determination of 0.217, while the average coefficient of determination obtained by five-fold cross-validation was 0.216, indicating stable model performance. The analysis revealed a three-stage age-related pattern in driver home range (Figure 1). Home range expanded rapidly from childhood to late adolescence, remained relatively stable throughout adulthood, and gradually contracted after approximately 60 years of age. This tendency remained consistent after controlling for driver attributes and crash circumstances.

Significant differences were also observed according to vehicle type and residential area. Drivers of heavy trucks, large passenger vehicles, and large-displacement motorcycles exhibited larger home ranges than drivers of ordinary passenger cars. In addition, residents of densely populated urban districts exhibited smaller home ranges than those living in mountainous, rural, and border municipalities, reflecting regional differences in daily mobility requirements (Figure 2).

These findings suggest that home-to-crash distance has reasonable validity as a proxy indicator reflecting characteristics of driver home range. The proposed approach demonstrates the potential for quantitatively analyzing driver mobility characteristics using routinely collected PDO crash data without dedicated GPS surveys or large-scale travel behavior surveys. This methodology may provide a useful analytical basis for understanding driver home range and for transportation planning, mobility service design, and evaluation of regional dependence on private vehicle use.

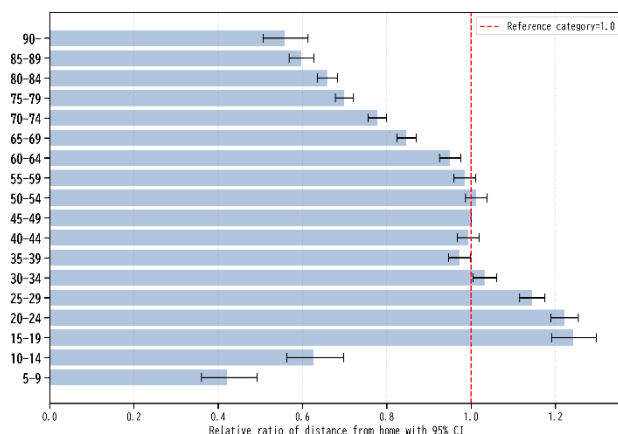


Fig.1 Relative Ratio by Age (5-year intervals)

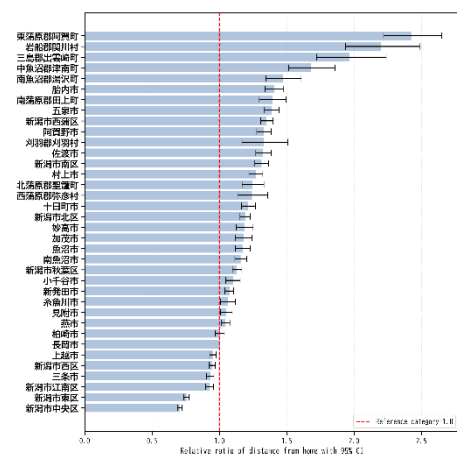


Fig.2 Relative Ratio by Residence (Municipality)