

Trip Generation for Various Sites

Introduction

The purpose of this project was to determine whether ITE trip rates, published in the ITE Trip Generation Manual, are appropriate for use in Louisiana for a selection of land use types. Based on previous work conducted by LTRC for strip malls, it was anticipated that the published trip rates may not be applicable in Louisiana for a number of different land use types, six of which are investigated in this project (i.e., apartment complexes, urgent care facilities, dollar stores, car washes, drive-thru banks, and drive-thru daiquiri/boil shops). Further, the rates may be affected by contextual factors not included in the ITE Manual.

Objective

This research aimed to answer six questions:

1. How much variability is there in the trip rates among sites and throughout the week?
2. Are the trip rates significantly different from ITE, so as to warrant further determination of rates?
3. Is variability with contextual factors apparent?
4. What should be the priority for determining new trip generation rates for use in Louisiana, as evidenced by deviation from ITE and potential impact on traffic planning?
5. Can the new smart micro-radars provide more accurate counts?
6. Can third-party mobility datasets provide accurate count data for computing trip rates?

Scope

The scope of this project was exploratory. First, it was intended to explore recent technology that may be used for collecting data at site driveways, rather than using people, road tubes, etc., to count vehicles arriving and departing. Second, it was intended to explore the extent to which trip rates vary by day of week and by site location and contextual factors. Third, it was intended to explore the extent to which trip rates at sites in Louisiana are close to or depart significantly from the ITE trip rates. Fourth, it was intended to determine whether third-party datasets can substitute for real-time measurement of trip rates. It was not expected that this project would recommend new trip rates, but rather identify priorities for further research to develop better trip rates for use in Louisiana. The budget and time allowed for this project permitted the identification of six land use types and approximately six sites for each land use type for data collection. These sites were selected to represent a range of values for three contextual variables: population density, jobs per worker, and AADT. Two levels of each of the three contextual variables were used, and it was stipulated that the six sites chosen for each land use should cover six different combinations of these levels.

Methodology

To complete the work outlined in the objectives and scope, nine tasks were identified:

1. Undertake a literature review with respect to the issues under research in this project.
2. Develop a sample of sites of land use types to be measured, and develop a schedule for measurement.
3. Conduct a pilot test of the micro-radar device to determine if it is suitable and compare these results to those from counting cameras.
4. Collect the data using the devices found to provide the most accurate data.
5. Verify the data from approximately 10% of the measurements at each site.
6. Clean the data as necessary, based on the results of the verification.

Principal Investigator

Ruijie “Rebecca” Bian, Ph.D., P.E.
207-501-5106

LTRC Contact

Julius Codjoe, Ph.D., P.E.
225-767-9761

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7. Analyze the data to produce appropriate trip rates for each site and land use type for comparison purposes.
8. Acquire third-party count data for those sites for which it was available and compare results.
9. Document the research in a final report, and present this report to the PRC.

Conclusions

Objective 1: How Much Variability is There Among Sites and Across Days of the Week?

For all six land use types studied in this project, site variability ranged from moderate to extreme. Across days of the week, it ranged from low to high, with urgent care and dollar store sites both showing low day-to-day variability, while the other four land uses showed moderate to high variability. Hence, it can be concluded that future research on trip rates for these six land use types should include a sufficiently large, geographically diverse sample of sites and generally involve measurement throughout the week.

Objective 2: Are the Trip Rates Significantly Different from ITE Trip Rates?

Significance in the statistical sense cannot be ascertained from the very small samples used in this study. However, for all evaluated land use types, ITE trip rates do not appear to be reasonable estimates. For apartment complexes, car washes, dollar stores, and urgent care facilities, the ITE trip rates were consistently higher than the observed rates, with the observed rates often 20 to 25% of the ITE trip rates. For drive-thru banks, the observed rates ranged from 25 to 230% of the ITE trip rates, with only Site E exceeding the ITE rates. For drive-thru daiquiri shops and boil shops, there are no corresponding ITE trip rates. Further, these two land uses were shown to require separate consideration.

Objective 3: Is there Apparent Variability with Contextual Factors?

All land use types showed variability across at least two of the three contextual factors selected for this research. The linear mixed-effect models for each land use provided strong evidence of the impact of contextual factors on observed trip rates. Additional research may be warranted to refine the selection of contextual factors, but those used in this study generally showed effects consistent with expectations.

Objective 4: What Should be the Priority for Analyzing Land Uses in Louisiana?

Drive-thru daiquiri shops and boil shops appear to be of the highest priority because of the very high variability from site to site and by day of week, and, as noted below, their apparent sensitivity to contextual variables. Additionally, the number of trips generated by this land use type is high, resulting in a large impact on adjacent streets. The remaining land use types, ranked in priority order, are apartment complexes, car washes, drive-thru banks, dollar stores, and urgent care facilities. The two drive-thru shop types are considered of the highest priority, because there are no appropriate rates in the ITE Trip Generation Manual, and the volume of trips

generated is quite high. Urgent care facilities generate very few trips and are therefore considered to be of the lowest priority.

Objective 5: Can New Smart Micro-Radars Provide More Accurate Counts?

In this research, smart micro-radars were used. Subsequently, the research team supplemented radar data collection with video recordings and automated video processing using the YOLO tool, achieving higher accuracy in trip count estimation, especially in locations where radar detected phantom vehicles. However, video-based counts could not be obtained in low-light conditions.

The micro-radar devices were found to exhibit inconsistent performance, with accuracy varying between days due to environmental factors (e.g., traffic flow, rain, temperature) and within the same day (e.g., morning, afternoon, and evening periods). In some areas, signal issues can affect connectivity, hindering the on-time completion of the required on-site configuration. Overall, it is concluded that the forward-firing micro-radar devices are not suitable for this application, but side-firing micro-radar devices may be potentially much more useful.

Objective 6: Can Third-Party Mobility Datasets Provide Accurate Count Data for Computing Trip Rates?

Third-party mobility datasets were found for all the land use types evaluated, except for apartment complexes. In no case was there a statistically significant correlation between the raw or normalized counts and the actual data observed through the video cameras and smart micro-radar devices. In all cases, when looking at daily counts, the R² between actual and mobility raw or normalized counts was less than 0.2, except for dollar stores, where it was 0.23. Also, the scatter plots for the daily counts do not reveal an obvious non-linear relationship that could be explored.

Recommendations

Because of the high impact and considerable variability in trip rates across sites, it is recommended that the highest priority for further research be to conduct a study of drive-thru daiquiri shops and boil shops throughout Louisiana. This study should collect data from a sufficiently large sample of sites to allow for statistically robust relationships between trip rates and the three candidate contextual variables, requiring a minimum of 42 sites, assuming two levels for each contextual variable. Ideally, sites should be selected from throughout Louisiana. At a minimum, sites should be added in DOTD Districts 02, 03, and 08, together with those in Districts 61, 62, and 05. It is also recommended that this research include a test of side-firing radar devices, particularly those that are equipped to provide automatic counts.

Further research should be undertaken for apartment complexes. Because of the potential of mobility data to significantly reduce the amount of time and effort required to collect the data to produce observed counts by land use and contextual variables, further research into the hourly distribution of visits is worthwhile.