Trip Generation Study for Drive-Through Restaurants in Malaysia

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Abstract. Trip generation refers to the total number of vehicles entering and leaving a specific location within a given period. The "Malaysia Trip Generation Manual" does not include data for drive-through restaurants, categorizing them instead as regular restaurants. For planning new drive-through restaurants or land use changes, independent vehicle generation data for drive-through restaurants is required. Data is primarily collected by counting vehicles during peak hours. Vehicle generation is influenced by various factors, with convenience, time, availability of parking spaces, and ease of purchase being key. Data shows that the average time for a drive-through service is three minutes, and the vehicle generation at night is significantly correlated with the total floor area of the restaurant, while the correlation during the afternoon hours is not significant. The number of seats and parking spaces is unrelated to trip generation. These data reflect that the successful operation of drive-through restaurants requires coordination with the planning and management of the surrounding transportation network, considering factors such as location, design, and traffic management.

Keywords: Trip Generation, Drive-through Restaurants, Transportation Networks.

1 Introduction

1.1 Urban Trip Generation in Asian Cities

Urbanization and motorization are rapidly increasing in most Asian cities, leading to a substantial rise in urban travel demand and trip generation. The study of trip generation at fast-food establishments is crucial for transportation authorities, both in assessing the impacts of new developments and in responding to shifts in land use patterns. Estimating the number of trips generated by new urban developments is crucial in transportation planning and traffic engineering (Ahmed, Abdulameer et al., 2014).

Trip generation refers to the overall number of in and out vehicle trips to or from a site over a specified time. It involves estimating daily site traffic volumes and peak hour

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for a specific land use and developing correlation between land use properties and vehicle trips. The validity of trip generation rates of existing developments depends on a comprehensive review of relevant survey data. Regional differences and the age of trip generation rates can impact their validity, with older data becoming less significant due to changes in travel patterns over time (Uddin et. al., 2012).

Trip generation at drive-through restaurants is a critical subject for transportation planners, particularly when assessing the effects of new developments or land use changes.

1.2 The Impact of Land Use on Trip Generation and Travel Behavior

The built environment of a region also has an impact on the number of trips generated in residential communities (Sun & Yang, 2018). Tian et. al. (2020) discovered that 19.7% of trips in mixed land use developments were captured internally, indicating lower trip generation. Institutional land uses tend to have higher trip rates on weekdays compared to weekends, whereas shopping areas attract more trips on weekends. Sarkar & Chunchu, (2016) introduced novel metrics, namely an area index and a mix type index, for the purpose of analysing trip length and non-motorized mode choice. Their research revealed that the combination of different land uses has a major impact on the way people travel. Similarly, (Abu-Eisheh & Irshaid, 2020) constructed a trip generation model for Palestine by analysing land-use characteristics and collecting data from 309 families. Their findings indicated that land use has a considerable impact on travel behaviour, with noticeable differences in the frequency of trips among different forms of land use. This highlights the necessity of considering the characteristics of land use when predicting the number of trips made. To build models that predict trip generation for a variety of activities, including daily journeys for socializing, recreational, educational, and shopping purposes, a research project focused on mixed land use collected household socioeconomic, demographic, and trip data. In the research region, stratified and random samples of houses were gathered from 14 distinct traffic analysis zones. The data was processed using multivariable regression analysis to create general models of daily trip creation as well as more focused models divided into trip purpose and time of day segments. The models for off-peak visits had the lowest R^2 values, while the models for instructional trips had the greatest R^2 values. The incorporation of land use factors into the regression models produced only slight gains, even though most independent variables correctly predicted socioeconomic characteristics (Abu–Eisheh et al., 2024).

1.3 Drive-Through Services in Malaysia

In Malaysia, drive-through services are offered primarily by fast-food chains such as McDonald's, KFC, Starbucks, and Burger King. Over the past decade, increased car ownership due to rising personal incomes has led to the rapid expansion of drive-through restaurants. Urbanization and motorization have also driven demand for convenient and time-saving services. Studies on trip generation at drive-through restaurants, such as those conducted in Jeddah, Saudi Arabia, and Virginia, USA, have used parameters like gross floor area, number of employees, and number of seats (Al-Zahrani

& Hasan, 2008). However, MTGM does not distinctly separate trip generation rates for drive-through restaurants from other types of restaurants. This study aims to identify and count trip generation at drive-through restaurants, advocating for their inclusion in future editions of MTGM for use by local traffic engineers in project design.

2 Data collection

In this study, the number of survey sites is set, and ten appropriate sites were selected randomly. Manual vehicle counts were conducted at the entrances and exits of each drive-through restaurant. Next step is finding relevant trip generation rate or equations. Before using the appropriate trip rate or equation, the period to be used for analysis must be identified. The manual provides five options: the AM commuter period, the AM generator period, the PM commuter period, the PM generator period, and the daily trip generation figures but the chosen period are afternoon and evening peak hour. The survey period is set during afternoon and evening peak hour (12:00–15:00 and 18:00–21:00) respectively. After that, a regression equation for both afternoon and evening peak hour were attempted.

3 Methodology

Trip generation analysis is a fundamental tool for traffic engineers, urban planners, and policymakers to estimate the number of vehicle trips associated with a particular land use. It provides insight into transportation demand and supports infrastructure planning. In this study, three methods were considered for estimating trip generation rates:
a) Manual calculation of the number of completed trips
b) Site observation
c) Questionnaire to assess public behaviour in using drive-through services
Trip generation patterns may vary significantly across different regions of the country due to differences in vehicle ownership levels and the configuration of local transportation networks. In the Klang Valley, a substantial number of fast-food outlets have been established over the past decade, often without prior evaluation of how surrounding transportation infrastructure may affect customer accessibility and trip frequency. This study seeks to explore potential correlations between trip generation rates and key characteristics of fast-food restaurant land use. The variables examined include: (1) seating capacity, (2) availability of parking spaces, and (3) gross floor area (GFA). These factors were selected based on their relevance to customer accommodation and site accessibility, especially within diverse urban transportation contexts.

3.1 Site Selection and Data Collection Procedure

Survey locations were selected to reflect a representative mix of urban and suburban environments, ensuring brand diversity and regional distribution among fast-food drive-through establishments. Manual vehicle counts were conducted during pre-defined observation windows across three consecutive weekdays, covering both afternoon

and evening peak periods. Each site was monitored by two trained surveyors using standardized data collection forms to ensure consistency. To enhance data reliability, recorded observations were cross-validated, and where available, supported with secondary sources such as CCTV footage.

3.2 Observation Time Windows

Afternoon and evening peak periods (12:00–15:00 and 18:00–21:00) were selected based on preliminary site observations and informal interviews with restaurant managers. These time frames were consistently identified as the busiest hours for customer traffic, especially for drive-through orders. While this study focuses on peak periods to capture maximum traffic demand, future research should consider including off-peak hours to reflect a more comprehensive daily traffic profile.

4 Results

Table 1 presents data on various drive-through restaurant locations, detailing them physical attribute.

Table 1. Date collections

Locations	Number of storeys	Floor area (m^2)	Gross area of the lot (m^2)	FAR	GFA (m^2)	Number of seats	Number of parking spaces
Equine Park	1	854.12	3987.23	0.21	854.12	200	41
Bandar Puteri Puchong	3	395.89	1216.87	0.98	1187.67	161	28
Petronas KLIA	1	425.16	1489.82	0.29	425.16	128	55
Cyberjaya	2	269.05	1213.18	0.44	538.1	124	35
Putrajaya	2	604.71	2814.06	0.43	1209.4	213	48
Puchong Gateway	1	623.55	2381.22	0.26	623.55	146	43
Kota Laksamana	1	704.24	3818.81	0.18	704.24	160	87
Batu Berendam	1	511.34	2636.32	0.19	511.34	153	34
MITC	1	565. 74	3990.72	0.14	565.74	170	46
Taman Buaya	1	387.52	2590.58	0.15	387.52	180	36

4.1 Analysis of vehicle trips during peak hours:

Table 2 presents a comparison of gross floor area (GFA) and the number of vehicle trips during afternoon and evening peak hours at various fast-food restaurant locations. Across most sites, afternoon peak hour trips were generally higher than those recorded during the evening. Equine Park exhibited the highest volume, with 251 vehicles in the afternoon and 184 in the evening, which may reflect stronger midday demand influenced by surrounding land uses and traffic accessibility.

Table 2. Statistics of GFA and vehicle trip during peak hours at various locations

Locations	GFA (m^2)	Afternoon Peak Hour	Evening Peak Hour
Equine Park	854.12	251	184
Bandar Puteri Puchong	395.89	163	185
Petronas KLIA	425.16	132	153
Cyberjaya	269.05	161	152
Putrajaya	604.71	230	233
Puchong Gateway	623.55	164	164
Kota Laksamana	704.24	155	152
Batu Berendam	511.34	142	139
MITC	565.74	180	183
Taman Buaya	387.52	88	81

Although GFA is listed for comparison, this section does not attempt to analyse its direct influence on vehicle trips. A more detailed statistical analysis of correlations between GFA and trip generation is provided in Section 4.2.

4.2 The relationship between GFA and vehicle trip:

The regression analysis revealed a moderate correlation between gross floor area (GFA) and vehicle trips during the evening peak period. However, seating capacity and parking availability demonstrated weak correlations with trip generation, as reflected in their relatively low R^2 values.

This limited explanatory power may stem from omitted variables and operational characteristics not captured in the current model. Factors such as drive-through service efficiency, customer turnover rate, brand popularity, and the presence of nearby competing establishments may significantly influence trip generation patterns.

The weak correlation between seating capacity, parking availability, and trip generation may also be attributed to the unique nature of drive-through operations. For instance, many customers complete their purchases without parking, and high service speeds reduce vehicle dwell time. These factors diminish the role of on-site parking in generating trips.

While peak-period analysis offers insight into maximum traffic impact, future studies should also investigate non-peak hours to account for temporal variation throughout the day. Incorporating a broader range of variables and observation periods could lead to a more robust and generalizable trip generation model.

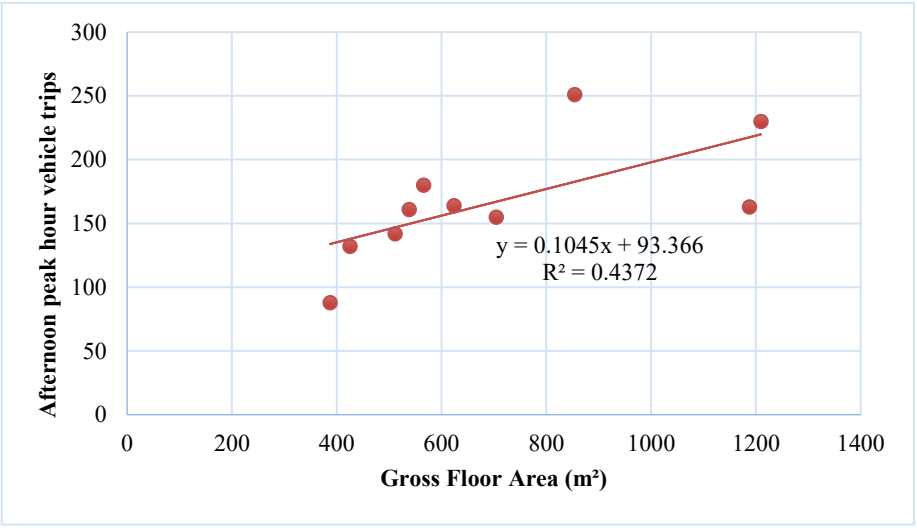

Fig. 1. Afternoon peak hour vehicle trips versus GFA

Analyze the correlation between building area and vehicle trip and discuss the degree of influence of floor area on vehicle trip. **Fig. 2**. The R^2 value of 0.4372 implies that gross floor area slightly affects vehicle trips.

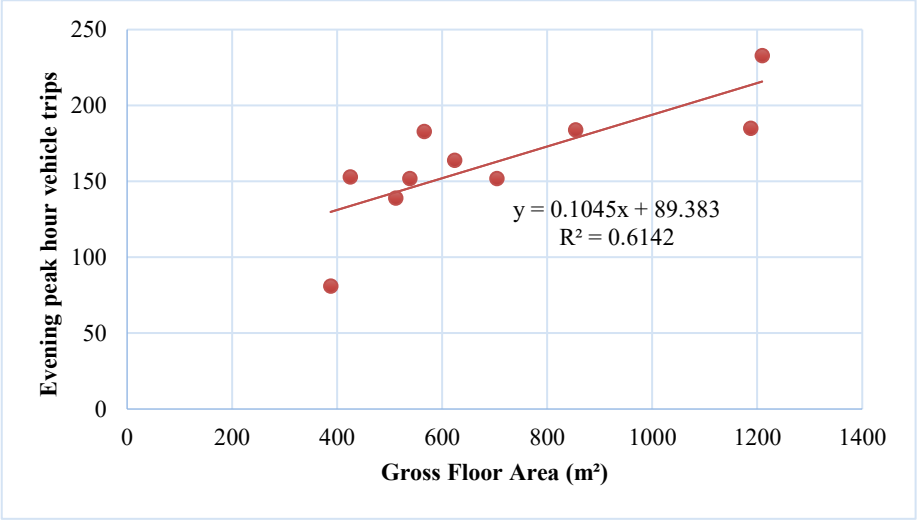

Fig. 2. Evening peak hour vehicle trips versus GFA

Fig. 2. An R^2 value of 0.61 indicated that the variance in the independent variable accounts for 61 percent of the variance in trips. R^2 values approaching 1.0 reflect a good fit, and values near zero indicate a poor fit.

The high value of R^2 proved that the Y-value (evening peak hour vehicle trips) depends on the X-value (gross floor area). The graph also shows that evening peak-hour vehicle trips are directly proportional to gross floor area. The evening peak hour vehicle trips

increase when the gross floor area increases. These results were in line with the previous study done in Malaysia. (I. Ahmed, Abdulameer, et al., 2014). This study demonstrates that the GFA is a crucial factor for calculating the quantity of trip generations. This aligns with the ITE Trip Generation and the Malaysia instructions.

4.3 The relationship between seat number and travel number:

The relationship between the number of seats and vehicle trips is a fundamental aspect of transportation planning and management, particularly in sectors like aviation, rail, and bus services.

From the **Table 3**, in most cases, there is a positive correlation between seating capacity and traffic flow; that is, as seating capacity increases, vehicle trip also tends to increase. However, at a seating capacity of 180, there is a significant decrease in traffic flow, with afternoon peak and evening peak traffic flows of 88 and 81, respectively. For seating capacities of 200, 161, 128, 124, 213, 146, 160, 153, and 170, the afternoon peak vehicle trip is generally higher than the evening peak. For instance, with a seating capacity of 200, the afternoon peak vehicle trip is 251, and the evening peak is 184; with a seating capacity of 213, the afternoon peak is 230, and the evening peak is 233.

Table 3. The relationship between vehicle trips during peak hours and number of seats

Number of parking spaces	Number of seats	Afternoon Peak Hour	Evening Peak Hour
41	200	251	184
28	161	163	185
55	128	132	153
35	124	161	152
48	213	230	233
43	146	164	164
87	160	155	152
34	153	142	139
46	170	180	183
36	180	88	81

Generally, increasing seating capacity helps to accommodate higher traffic flow, especially during peak hours. However, at a seating capacity of 180, there is a significant decrease in traffic flow, which may be related to factors such as service quality, frequency of service, or other operational issues. In most cases, the afternoon peak vehicle trip is higher than the evening peak, which may be related to customers' destinations and travel preferences.

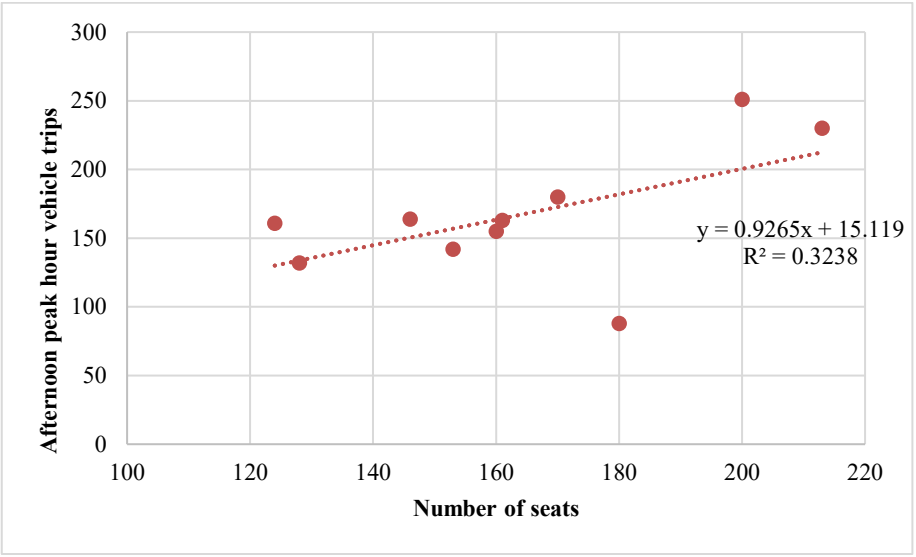

Fig. 3. Data plot of afternoon peak hour vehicle trips versus seating capacity

The trip generation is not depending on the seating capacity in the drive-through restaurants based on the R^2 values. Although the value of R^2 is low, the evening hour vehicle trips has better relationship with number of seats in the drive-through restaurants at afternoon more than evening.

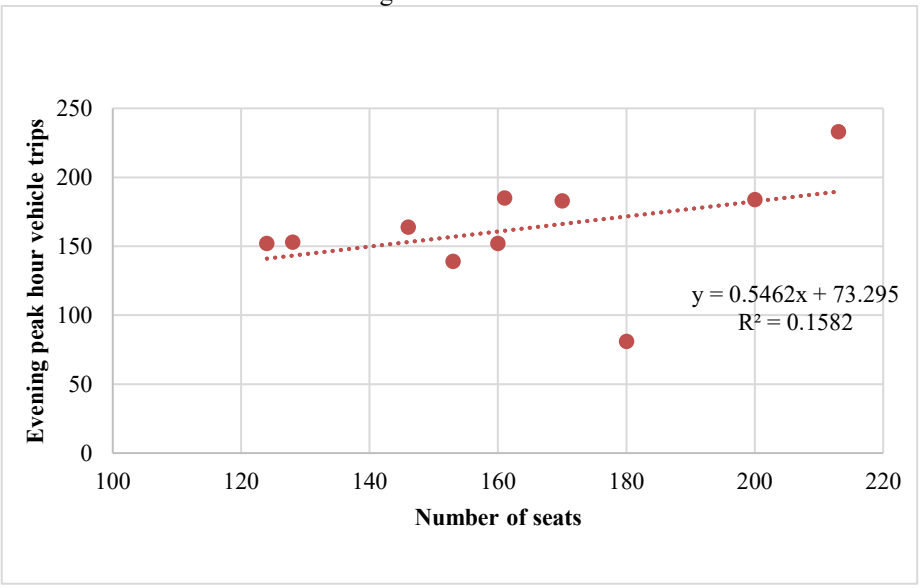

Fig. 4. Data plot of evening peak hour vehicle trips versus number of seats

The number of seats at drive-through restaurants in Malaysia was not affected the number of trips. The number of seats has a better relationship than parking space for trip generation but still low in total.

4.4 The relationship between parking space quantity and vehicle trip:

Study the correlation between the number of parking spaces and vehicle trips and assess the impact of parking space quantity on vehicle trips. Locations with more parking spaces, such as Kota Laksamana (87 parking spaces), also tend to have a relatively higher peak vehicle trip.

However, the relationship between the number of parking spaces and vehicle trip is not direct. The R2 values shows that the data is scattered and not consistent, The R^2 was not significant for both evening and afternoon with 0.003, and 0.0004, respectively.

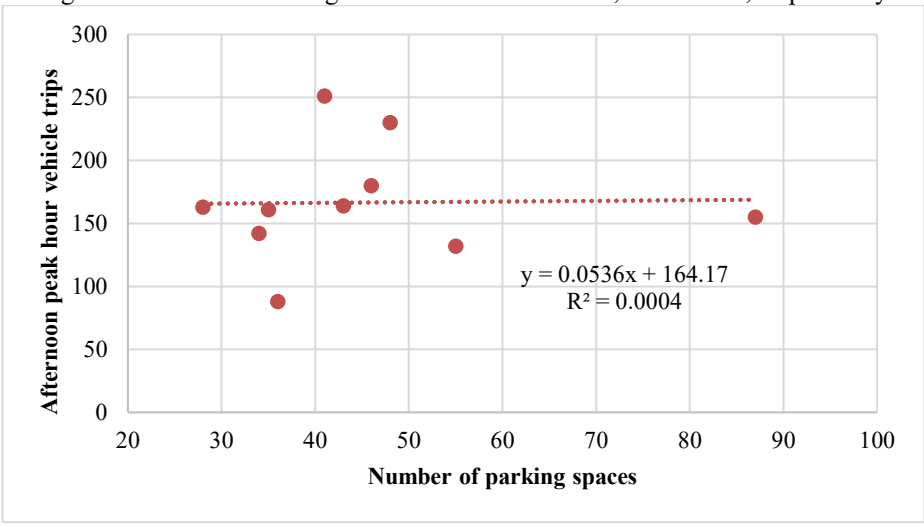

Fig. 5. Data plot of afternoon peak hour vehicle trips versus availability of parking places

There was no correlation between the amount of parking spaces available for drive-through restaurants in Malaysia and the number of trips made.

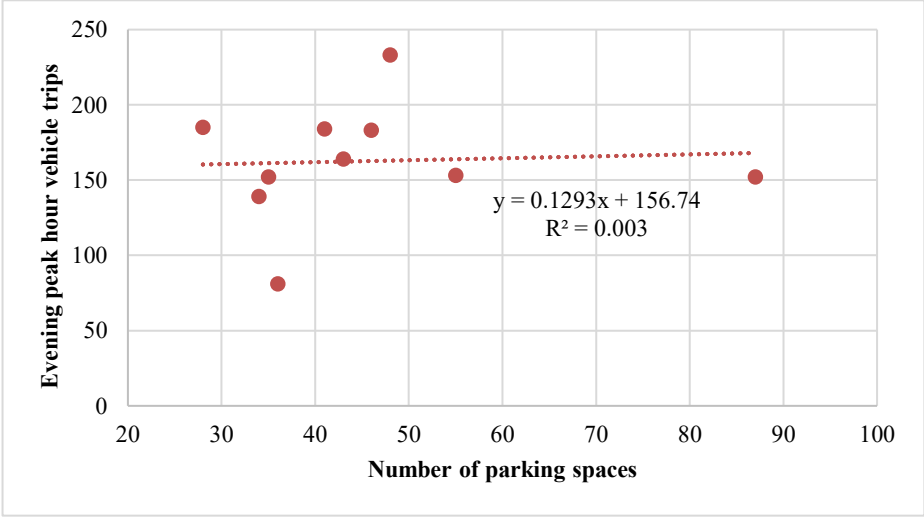

Fig. 6. Data plot of evening peak hour vehicle trips versus availability of parking places

5 Conclusions

The findings of this study suggest that gross floor area (GFA) plays a role in determining trip generation during the evening period, although no significant relationship was observed during the afternoon. In contrast, the availability of parking spaces appears to be unrelated to the number of trips, indicating that parking may not be a primary consideration for customers of drive-through restaurants. This aligns with the inherent convenience-oriented nature of such facilities.

The developed trip generation models offer preliminary insight into travel demand patterns for fast-food drive-through businesses. However, the relatively low R^2 values and limited sample size indicate that the findings should be interpreted with caution. Future studies are encouraged to incorporate a broader range of variables—such as service speed, customer behaviour, and brand popularity—as well as data from off-peak periods, to enhance model robustness and generalizability.

Despite these limitations, the study supports the development of tailored trip generation models specifically for drive-through restaurants. Such models may enhance the accuracy of traffic impact assessments and inform urban planning decisions. In practice, the results can guide transportation engineers in simulating traffic flow, estimating lane demand, and designing queue management systems.

Additionally, site designers and developers may apply these insights to optimize drive-through configurations, including the layout of entry and exit points, internal circulation, and service lane length, to improve customer throughput and reduce congestion.

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