# Trip Generation Modelling of Lipa City

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**Abstract**: This study aimed to create models for the first of the four-step model of travel demand forecasting – that is, trip generation. Lipa City, which is a first class component city in the province of Batangas and is composed of 72 barangays or zones, is the study area considered. Household Interview Surveys is conducted by the Office of Transportation Cooperatives and the results are encoded in a database. Two modelling techniques are used, namely: (1) regression analysis; and (2) trip rate method. For the regression analysis, fifteen (15) independent variables and two (2) dependent variables (*i.e.,* trips produced and trips attracted) are considered by trip purpose. Eight (8) trip purposes were identified: To Home; To Work; To School; To Private Business; To Employer's Business; To Medical; To Shopping; and To Church. Results of regression analysis showed that the population per zone, number of households per zone, workers per zone, students per zone and household head monthly income per zone are significant parameters for a particular zone to produce and attract trips. For the trip rate method, cross-classification tables are made for each purpose. Different household characteristics are cross-classified for each purpose (*i.e.,* household size and household income for purpose 'To Home', or household income and occupation for purpose 'To Work'.) Results of the trip rate method illustrated the trip generation rates from different trip purposes.

## 1. INTRODUCTION

### 1.1 Background of the Study

Travel demand forecasting is the key of a transportation engineer to model or predict the volume of a given traffic element in the future. It has been said in the National Cooperative Highway Research Program Report 716 (2012) that estimating travel demand is very essential in making decisions that involve system and facility design and operations – and also developing transportation policies. For instance, the results which would be the models that have been derived by analyzing the travel demand could predict the number of vehicles that would occupy a certain road or any transportation element -- this would, in return, give a transportation engineer an idea of what would come out in the future and a possible solution would then be carried out.

The process to forecast or model the travel demand can be divided into manageable steps. This includes trip generation, trip distribution, modal split and route assignment. Meanwhile, it is important to note that this study considered only the first step – that is, trip generation.

Trip generation is used to estimate the total number of trips generated and attracted by each area unit (*i.e.,*traffic analysis zone) in combination with the land use and the socio-economic characteristics of each zone (Makinde and Oyedepo, 2009). The analysis may be done through cross-classification, multiple regression analysis or experience-based analysis. Trip generation is represented by the question "How many person trips?" Generally, the output that would be obtained from trip generation is used to predict the number of trips originating in or destined for a given traffic analysis zone.

### 1.2 Study Area

Lipa City is one of the three cities in Batangas (*i.e.,*Lipa City, Batangas City and Tanauan City). The city is considered to be a first class component city in the province of Batangas; and is located 78 kilometers south of Manila (*i.e.,* the Philippines' capital city). According to the data of National Statistics Office, in 2007, the city has a population of 260, 558 and has 41, 962 households.

At present, Lipa is comprised of 72 barangays wherein 12 of which are part of the poblacion. The total land area of Lipa is 20, 940 hectares – according to the website of the Lipa City Government.

The city is considered to be the transportation hub for Batangas and nearby provinces. Some of its major highways include Jose P. Laurel Highway, STAR Tollway, Ayala Highway.

### 1.3 Statement of the Problem

Since Lipa City has a wide extension of road network, it has been considered as the transportation hub not only for Batangas but also for the nearby areas especially for the National Capital Region – this scenario has led the highly urbanized city into its present state of experiencing traffic congestion due to rapid urbanization and development. This might seem to be from the lack of planning for transportation systems to serve the increasing demand for transport services – this means that travel demand model must be done which starts with trip generation modelling.

### 1.4 Objective

This research is aimed to generate models for trip generation of Lipa City using the Household Interview Survey (HIS) data. Specifically, this study is expected to create models using the two modelling techniques: (1) regression analysis; and (2) trip rate method.

### 1.5 Significance of the Study

The trip generation model for Lipa City will be very useful in planning for transport systems for existing and future land use and urban development scenarios.

### 1.6 Scope and Limitations

This study would be using the data from the Household Interview Survey (HIS) of 1,252 households in Lipa City to be provided by the Office of Transportation Cooperatives (OTC). The survey covers 24 hours beginning at 3:00 am and ending at 3:00 am of the following day. The survey data limits to a weekday. In addition, the surveying was held on a day starting from May 7, 2012 to August 27, 2012.

For the trip generation analysis, only the traffic analysis zones (*i.e.*, barangays) inside the Lipa City would be considered since these are the areas which have the socioeconomic data that were obtained by the researchers.

### 1.7 Study Flow

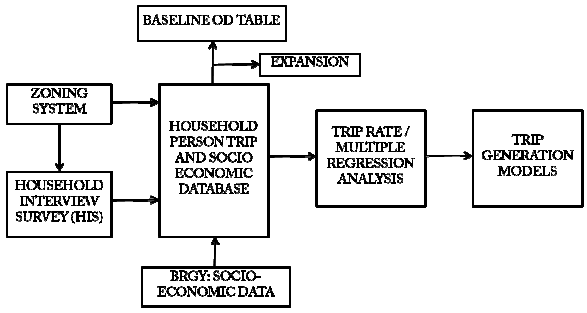


**Figure 1.Study Flow**

The zoning system that would be employed for Lipa City is on a barangay basis. Since there are 72 barangays in Lipa, there would be 72 traffic analysis zones that would be used throughout the course of this study. The zoning system was implemented in answering the Household Interview Survey (HIS) which was made successful through the Office of Transportation Cooperatives under the Department of Transportation and Communication. The results of the HIS that integrates the zoning system were encoded to have a database that could be used to get the socio-economic characteristics needed. To avoid statistical difference in the socio-economic data obtained from the database, expansion factors were applied. Not all desired socioeconomic data could be found in the Lipa City Household Interview Survey database, some of them were obtained from the Local Government Unit of Lipa City. Two (2) techniques were used, namely: (1) regression analysis; and (2) trip rate method to create trip generation models.

## 2. METHODOLOGY

### 2.1 Data Collection

The study would be using the Household Interview Survey conducted to different barangays in Lipa City through the Office of Transportation Cooperatives. There were 1,252 surveys collected from different households and the results would be presented using Microsoft Access.

#### 2.1.1 Household Interview Survey

There were three (3) forms to be filled-up by the household, namely:

(1) Household Information: covers the socioeconomic characteristics of household members, household structure, car ownership, income level, location of residence, etc.

(2) Household Member Information: covers the socioeconomic characteristics of household

members 4 years old and above. These include age, sex, occupation, work and/or school address, income and so on.

and (3) Trip Information: covers the characteristics of trips made by residents of the study area, including origin and destination, trip purpose, travel mode, transfer departure and arrival time, and so on.

### 2.1.2 The Lipa City Household Interview Survey Database

After getting all 1,252 surveys, the results would be encoded into the Microsoft (MS) Access to function as the database of the data. The MS Access file would be composed of three (3) tables, namely: (1) Household; (2) HouseholdMember; and (3) PersonTrip – these tables correspond to the forms 1 to 3 of the Household Interview Survey.

## 2.2 Regression Analysis

### 2.2.1 Multiple Linear Regression Analysis

The multiple linear regression approach consists of developing the equations in which the trips are related to independent variables, which explain the variation in the dependent variables. The equations are usually developed by trip purpose and generally are based on the data aggregated to the zone level as observations. In using the multiple linear regression method in this study, it is assumed that the relationships developed for the model are linear, and will remain the same for the future and so if land-use and socioeconomic factors can be predicted; future trips can be estimated for any proposed transport system.

Among the different trip generation models available, the multiple regression model has been selected because of its clear and simple structure and its application is easy. Most transportation studies involving trip generation have relied on the technique extensively, therefore producing a substantial amount of understanding of travel.

The general equation of this modeling technique is of the form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n \qquad (1)$$

where Y: dependent variable which are the trips produced or trips attracted by a zone or facility

$X_1, X_2, X_3 \ldots X_n$: independent variables representing various parameters mate

$\beta_0, \beta_1, \beta_2, \beta_3 \ldots \beta_n$: coefficients obtained by regression analysis

### 2.2.2 Dependent Variables

It has been known that most multiple linear regression models make use of the trip purpose to categorize trips. In line with this, the researchers chose the following trips purpose to have a count of trips produced and trips attracted. The dependent variables are the trips produced and the trips attracted -- these are on a trip purpose basis trip productions and attractions are factors of trip ends. Trip ends are generally the start or the end of the trip. In addition, trip production is the home end of a home-based trip and the beginning of a non-home-based trip.

Meanwhile, trip attraction is the non-home end of a home-based trip and the end of a non-home-based trip. To illustrate the idea, a model is shown below.

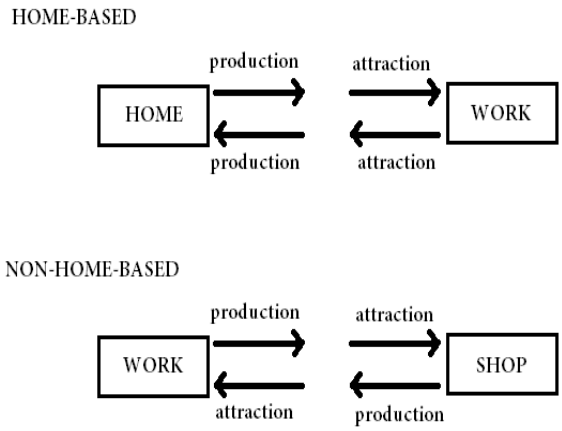


**Figure 2.Trip Productions and Trip Attractions for Home-Based and Non-Home-Based Trips**

### 2.2.3 Independent Variables

The independent or explanatory variables used in this study were the socioeconomic data of the barangays of Lipa City – hence, for the Traffic Analysis Zones. Some of the data were obtained with the help of the Local Government Unit of Lipa City while the other remaining variables were acquired from the MS Access database which based from the Household Interview Survey.

Assumptions must be first known before finding the independent variables. The assumptions include: (1) all the independent variables must be independent from one another; (2) all the independent variables must follow a normal distribution; and (3) all the independent variables must be continuous.

The independent variables considered are the following:

1. Population
2. Number of Households
3. Population Density
4. Average Household Size

5. Ave. Number of Workers per Household
6. Workers per Zone
7. Car ownership
8. Household Head Income per Month
9. Elementary Students per Household
10. High School Students per Household
11. College Students per Household
12. Ave. Number of Students per Household
13. Students per Zone
14. Primary and Secondary Students in Public Schools
15. Primary and Secondary Students in Private Schools

It must be noted that the population, number of households, population density, primary and secondary students in public schools and primary and secondary students in private schools were obtained from the Local Government Unit of Lipa – and thus, represented by the total population of Lipa City – unlike the remaining variables which were acquired only from the Household Interview Survey. Those variables that were represented only by the household samples from the survey must be carefully identified since expansion factors would later be applied to them.

### 2.2.4 Expansion Factors

Since the data are collected from random sampling of households in the different zones of the study area, biases are present in the sampled data. To eliminate these biases, an expansion factor is set according to the distribution of known attributes, so that no statistically significant difference exists.

The expansion factors are applied to each zone, and are computed to be:

$$E_f = \frac{N_z}{N_h} \quad (2)$$

whereEf: expansion factor per zone
$N_Z$: total number of households per zone
$N_h$: total number of sample households per zone

### 2.2.5 Correlation Matrix

Before identifying the list of independent variables to be included for the multiple regression model, correlation matrix must first be employed. Generally, the correlation matrix would allow the evaluation of combining variables. For instance, given that there are two independent variables that are the same but the only difference is the unit of measurement used – in this case, it would be redundant if these two variables are to be included in an equation. This follows the reason that a correlation matrix is hereby needed to eliminate redundancy among the models.

To facilitate the elimination of redundant variables, two guidelines would be followed:

1. Independent variables that are highly correlated with the dependent variable should be considered for the model

2. Independent variables that are highly correlated with each other are considered redundant if it would be in the same equation.

After the elimination of nuisance and redundant variables, multiple regression analysis would then follow. At present, there exists various software which could be used to solve for the coefficients mentioned for the general equation of multiple regression model. The researchers of this study hereby utilized the regression function of Microsoft Excel which could already give the coefficient of determination – in this case, for multiple linear regression analysis.

The coefficient of determination is actually important to know the goodness of fit of the model employed. The values of the coefficient of determination would only range from 0 to 1 – that is, as it goes nearer to 1, the more related the variables are.

### 2.2.6 Test of Significance of Individual Correlation Coefficients

Hypothesis testing must be needed to determine the significance of the individual coefficients obtained from the multiple regression analysis. With this, t-test will be used for the testing of hypothesis. The statements of hypothesis to test the significance of a regression coefficient, $\beta_i$, are:

$$H_0: \beta_i = 0$$
$$H_1: \beta_i \neq 0$$

The $H_0$ is the null hypothesis which says that the regression coefficient is not significant and $H_1$ is the alternative hypothesis which says the opposite. The test statistic for t-test is shown below.

$$T_0 = \frac{\hat{\beta}_i}{se(\hat{\beta}_i)} \quad (3)$$

where $T_0$: test statistic
$\hat{\beta}_i$: regression coefficient
$se(\hat{\beta}_i)$: standard error of the regression coefficient

The null hypothesis will be accepted if the test statistic computed lies in the acceptance region:

$$-t_{\frac{\alpha}{2},n-2} < T_0 < t_{\frac{\alpha}{2},n-2}$$

where α: value of significance (usually 0.1)
n: number of samples

The upper and lower t-values can be found in the student's t-distribution table. It must be noted that when using this test of hypothesis, the test for a particular regression coefficient $\beta_i$ must be done in a model with $X_1$, $X_2$,…,$X_n$ depending on the independent variables used.

### 2.3 Trip Rate Method

A trip generation model expresses the relationship between the socio-economic factors of the population or the households in the area and the number of trips produced from the area in one day. Another common form of trip generation model that represents this relationship is the cross-classification table.

A cross-classification model is one type of model used to determine trip productions. This model is based on estimating the response (*e.g.*, the number of trip productions per household for a given purpose) as a function of the household characteristics. Trip rates are derived empirically from travel surveys with the same household characteristics. Cross-classification is based on grouping the households in different strata; for example, a specific cell is based on household size and household income. The trip production rate for that specific cell then is the total number of trips in that cell divided by the number of households that exhibit the same household characteristics. The relationship can be equated as:

$$t_h = \frac{T_h}{H_h} \qquad (4)$$

where h: households with a particular combinations of characteristics
$t_h$: trip rate for purpose *p* made by members of households of type *h*
$T_h$: total number of trips by purpose *p* made by households in cell *h*
$H_h$: number of households in cell *h*

The trips generated by the study zone are divided into 8 major purposes. (1) To Home, (2) To Work, (3) To School, (4) To Private Business, (5) To Employer's Business, (6) To Medical, (7) To Shopping, and (8) To Church. The categorization of the household characteristics defines the set of attributes that will be associated with a household, for a particular trip purpose. For these 8 purposes, the following characteristics are used:

(1) To Home
- Household size vs Household income

(2) To Work
- Occupation type vs Household Income

(3) To School
- Student type vs Household Income

(4) To Private Business
- Household size vs Household income

(5) To Employer's Business
- Household size vs Household income

(6) To Medical
- Household income vs Car availability

(7) To Shopping
- Household size vs Household income

(8) To Church
- Household size vs Car availability

## 3. RESULTS

### 3.1 Regression Analysis

**Table 1.Correlation Matrix Between the Independent and Dependent Variables**

| | TO HOME | | TO WORK | | TO SCHOOL | | TO PRIVATE BUSINESS | |
|---|---|---|---|---|---|---|---|---|
| | Production | Attraction | Production | Attraction | Production | Attraction | Production | Attraction |
| Population | 0.745 | 0.536 | 0.868 | 0.417 | 0.737 | 0.496 | 0.253 | 0.308 |
| No. of Households | 0.745 | 0.536 | 0.868 | 0.417 | 0.737 | 0.496 | 0.253 | 0.308 |
| Population Density | 0.002 | 0.002 | 0.000 | 0.000 | 0.008 | 0.001 | 0.000 | 0.002 |
| Ave. Household Size | 0.000 | 0.002 | 0.003 | 0.002 | 0.017 | 0.000 | 0.020 | 0.002 |
| Ave. No. of Worker per Household | 0.000 | 0.013 | 0.027 | 0.014 | 0.000 | 0.009 | 0.007 | 0.004 |
| Workers per Zone | 0.354 | 0.924 | 0.536 | 0.987 | 0.370 | 0.679 | 0.106 | 0.788 |
| Car Ownership per Zone | 0.067 | 0.001 | 0.006 | 0.000 | 0.033 | 0.004 | 0.136 | 0.004 |
| Monthly Household Head Income | 0.000 | 0.000 | 0.004 | 0.001 | 0.000 | 0.000 | 0.000 | 0.053 |
| Elem Students per Household | 0.044 | 0.008 | 0.002 | 0.002 | 0.098 | 0.022 | 0.008 | 0.003 |
| HS Students per Household | 0.009 | 0.000 | 0.001 | 0.000 | 0.042 | 0.000 | 0.003 | 0.008 |
| College Students per Household | 0.000 | 0.005 | 0.007 | 0.006 | 0.006 | 0.004 | 0.002 | 0.002 |
| Ave. No. of Students per Household | 0.026 | 0.000 | 0.004 | 0.001 | 0.102 | 0.002 | 0.008 | 0.000 |
| Students per Zone | 0.360 | 0.877 | 0.444 | 0.672 | 0.425 | 0.972 | 0.063 | 0.534 |
| Primary and Secondary (Public) | 0.092 | 0.083 | 0.119 | 0.031 | 0.093 | 0.151 | 0.037 | 0.016 |
| Primary and Secondary (Private) | 0.123 | 0.167 | 0.120 | 0.069 | 0.142 | 0.237 | 0.061 | 0.093 |

**Table 2.Correlation Matrix Between the Independent and Dependent Variables**

| | TO EMPLOYER'S BUSINESS | | TO MEDICAL | | TO SHOPPING | | TO CHURCH | |
|---|---|---|---|---|---|---|---|---|
| | Production | Attraction | Production | Attraction | Production | Attraction | Production | Attraction |
| Population | 0.236 | 0.350 | 0.049 | 0.141 | 0.377 | 0.206 | 0.508 | 0.000 |
| No. of Households | 0.236 | 0.350 | 0.049 | 0.141 | 0.377 | 0.207 | 0.508 | 0.000 |
| Population Density | 0.001 | 0.039 | 0.004 | 0.009 | 0.018 | 0.107 | 0.000 | 0.051 |
| Ave. Household Size | 0.004 | 0.000 | 0.007 | 0.013 | 0.008 | 0.001 | 0.003 | 0.016 |
| Ave. No. of Worker per Household | 0.011 | 0.008 | 0.030 | 0.000 | 0.006 | 0.005 | 0.020 | 0.000 |
| Workers per Zone | 0.015 | 0.486 | 0.045 | 0.024 | 0.319 | 0.473 | 0.610 | 0.000 |
| Car Ownership per Zone | 0.001 | 0.004 | 0.000 | 0.002 | 0.061 | 0.016 | 0.005 | 0.008 |
| Monthly Household Head Income | 0.000 | 0.002 | 0.704 | 0.000 | 0.002 | 0.002 | 0.000 | 0.001 |
| Elem Students per Household | 0.000 | 0.002 | 0.040 | 0.012 | 0.000 | 0.001 | 0.001 | 0.016 |
| HS Students per Household | 0.002 | 0.001 | 0.131 | 0.014 | 0.002 | 0.005 | 0.001 | 0.005 |
| College Students per Household | 0.009 | 0.007 | 0.164 | 0.000 | 0.011 | 0.006 | 0.018 | 0.001 |
| Ave. No. of Students per Household | 0.002 | 0.000 | 0.006 | 0.005 | 0.000 | 0.002 | 0.005 | 0.011 |
| Students per Zone | 0.003 | 0.747 | 0.023 | 0.082 | 0.331 | 0.300 | 0.386 | 0.012 |
| Primary and Secondary (Public) | 0.012 | 0.020 | 0.004 | 0.050 | 0.148 | 0.002 | 0.026 | 0.303 |
| Primary and Secondary (Private) | 0.018 | 0.164 | 0.022 | 0.221 | 0.249 | 0.053 | 0.030 | 0.154 |

**Table 3.Correlation Matrix Among the Independent Variables**

| | X1 | X2 | X3 | X4 | X5 | X6 | X7 | X8 | X9 | X10 | X11 | X12 | X13 | X14 | X15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X1 | 1.000 | 1.000 | 0.001 | 0.010 | 0.003 | 0.466 | 0.020 | 0.001 | 0.000 | 0.000 | 0.002 | 0.002 | 0.516 | 0.184 | 0.161 |
| X2 | | 1.000 | 0.001 | 0.010 | 0.003 | 0.466 | 0.020 | 0.001 | 0.000 | 0.000 | 0.002 | 0.002 | 0.516 | 0.184 | 0.161 |
| X3 | | | 1.000 | 0.019 | 0.004 | 0.000 | 0.002 | 0.004 | 0.018 | 0.022 | 0.009 | 0.028 | 0.002 | 0.001 | 0.037 |
| X4 | | | | 1.000 | 0.213 | 0.001 | 0.001 | 0.003 | 0.225 | 0.091 | 0.006 | 0.320 | 0.001 | 0.016 | 0.002 |
| X5 | | | | | 1.000 | 0.020 | 0.006 | 0.031 | 0.001 | 0.007 | 0.105 | 0.014 | 0.013 | 0.001 | 0.006 |
| X6 | | | | | | 1.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.007 | 0.002 | 0.698 | 0.038 | 0.077 |
| X7 | | | | | | | 1.000 | 0.001 | 0.023 | 0.006 | 0.035 | 0.013 | 0.001 | 0.028 | 0.000 |
| X8 | | | | | | | | 1.000 | 0.037 | 0.166 | 0.131 | 0.021 | 0.001 | 0.000 | 0.001 |
| X9 | | | | | | | | | 1.000 | 0.009 | 0.010 | 0.539 | 0.016 | 0.006 | 0.004 |
| X10 | | | | | | | | | | 1.000 | 0.005 | 0.176 | 0.000 | 0.001 | 0.001 |
| X11 | | | | | | | | | | | 1.000 | 0.121 | 0.005 | 0.001 | 0.002 |
| X12 | | | | | | | | | | | | 1.000 | 0.001 | 0.013 | 0.003 |
| X13 | | | | | | | | | | | | | 1.000 | 0.164 | 0.255 |
| X14 | | | | | | | | | | | | | | 1.000 | 0.126 |
| X15 | | | | | | | | | | | | | | | 1.000 |

It is assumed that high correlation means that the coefficient of determination ranges from 0.7 up to 1.0. For the "To Home"trips – for the trip production, it can be seen from Table 1 that only X1 and X2 qualified for high correlation with the dependent variable – but since the second guideline for the elimination of redundancy among the variables had to be followed – X1 and X2 should not be in the same equation (i.e., the variables are perfectly related with each other having a coefficient of determination of 1.0). In line with this, it can be concluded that the regression should be having two models (*i.e.*, linear) which are: the dependent variable P and X1 and the dependent variable P and X2. Consequently, the

researchers had chosen the better equation – that is, the one with the higher coefficient of determination.

For the "To Home"trips – for the trip attraction, only the variables, workers per zone and students per zone qualified for having the high correlation with the dependent variable, trips attracted. Also, through the second guideline, it can be said that the two independent variables were not highly correlated so both variables could be in the same equation. With these two variables to be related to the dependent variable, regression function of MS Excel is used. After getting the multiple linear regression equation, the coefficient of determination should be examined if it resulted to a high correlation – that is, having a value within the range of 0.7 to 1.

The same procedure was done for "To Work" Trips. By looking at Table 1, it can be said that the population and number of households were the independent variables that yielded high correlation with the dependent variable, trips produced. However, it was said earlier that these two variables were perfectly related – therefore, these variables should not be found in the same equation. Again, the researchers just used the better equation, which is the one with the higher coefficient of determination.

For the trips produced of the "To Work"trips, only the independent variable, X6 was able to have a high correlation with the dependent variable – thus, the regression equation would only have trips produced as the dependent variable and workers per zone, as the independent variable. Same process was done for the To School, To Private Business, To Employer's Business, To Medical, To Shopping and To Church. Generally, the first to observe was the values of the coefficient of determination that defined the relationship of the dependent variable with the independent variables. This is done by just looking at the second row of the correlation matrix or by just looking directly at Tables 1 to 2. The next thing to look at is if the independent variables that presented high correlation with the dependent variable are highly correlated among each other. After the elimination of nuisance and redundant variables, regression analysis would then be employed.

**Table 4.Regression Models**

| TRIP PURPOSE | MODEL TYPE | INDEPENDENT VARIABLES | REGRESSION | $R^2$ |
|---|---|---|---|---|
| TO HOME | PRODUCED | POPULATION | $P = 0.514X_1 - 9.717$ | 0.745 |
| | ATTRACTED | WORKERS PER ZONE & STUDENTS PER ZONE | $A = 0.812X_6 + 0.943X_{13} - 84.621$ | 0.983 |
| TO WORK | PRODUCED | NO. OF HOUSEHOLDS | $P = 1.368X_2 - 225.047$ | 0.868 |
| | ATTRACTED | WORKERS PER ZONE | $A = 0.8698X_6 - 192.25$ | 0.987 |
| TO SCHOOL | PRODUCED | NO. OF HOUSEHOLDS | $P = 0.9851X_2 + 43.649$ | 0.737 |
| | ATTRACTED | STUDENTS PER ZONE | $A = 0.8355X_{13} + 41.39$ | 0.972 |
| TO PRIVATE BUSINESS | PRODUCED | - | - | - |
| | ATTRACTED | WORKERS PER ZONE | $A = 0.0455X_6 - 1.4839$ | 0.788 |
| TO EMPLOYER'S BUSINESS | PRODUCED | - | - | - |
| | ATTRACTED | NO. OF HOUSEHOLDS, WORKERS PER ZONE & STUDENTS PER ZONE | $A = -0.0028X_2 - 0.00074X_6 + 0.016X_{13} - 2.279$ | 0.750 |
| TO MEDICAL | PRODUCED | HOUSEHOLD HEAD INCOME | $P = 0.0075X_8 - 29.118$ | 0.704 |
| | ATTRACTED | - | - | - |
| TO SHOPPING | PRODUCED | - | - | - |
| | ATTRACTED | - | - | - |
| TO CHURCH | PRODUCED | NO. OF HOUSEHOLDS, WORKERS PER ZONE & STUDENTS PER ZONE | $P = 0.0712X_2 + 0.0233X_6 - 0.0151X_{13} - 40.096$ | 0.696 |
| | ATTRACTED | - | - | - |

For the hypothesis testing, since the value of significance (*i.e.,* 0.1) tested for hypothesis testing and the value of the number of samples is equal to 72 are the same for all, the t-value obtained in the t-distribution table would also be the same. Only the t-statistic values would determine if the null or the alternative hypothesis would be accepted.

Using the t distribution table and considering the two tails distribution for $\alpha = 0.10$ with large number of degrees of freedom, the t-value will be 1.645. Thus, the t-statistic should not range from -1.645 to 1.645 to accept the alternative hypothesis. Otherwise, the regression coefficient should be eliminated since it would not be significant to include it in the model. The result of the testing of hypothesis is shown in the table below.

**Table 5.Hypothesis Testing**

| PURPOSE | MODEL TYPE | COEFFICIENT TESTED | t-statistic | DECISION |
|---|---|---|---|---|
| TO HOME | PRODUCED | $\beta_1$ | 14.31 | Reject $H_0$ |
| | ATTRACTED | $\beta_6$ | 20.79 | Reject $H_0$ |
| | ATTRACTED | $\beta_{13}$ | 15.44 | Reject $H_0$ |
| TO WORK | PRODUCED | $\beta_2$ | 21.49 | Reject $H_0$ |
| | ATTRACTED | $\beta_6$ | 74.01 | Reject $H_0$ |
| TO SCHOOL | PRODUCED | $\beta_2$ | 14.02 | Reject $H_0$ |
| | ATTRACTED | $\beta_{13}$ | 49.12 | Reject $H_0$ |
| TO PRIVATE BUSINESS | ATTRACTED | $\beta_6$ | 16.14 | Reject $H_0$ |
| TO EMPLOYER'S BUSINESS | ATTRACTED | $\beta_2$ | -0.54 | Accept $H_0$ |
| | ATTRACTED | $\beta_6$ | -0.61 | Accept $H_0$ |
| | ATTRACTED | $\beta_{13}$ | 8.07 | Reject $H_0$ |
| TO MEDICAL | PRODUCED | $\beta_8$ | 12.90 | Reject $H_0$ |
| TO CHURCH | PRODUCED | $\beta_2$ | 4.30 | Reject $H_0$ |
| | PRODUCED | $\beta_6$ | 6.03 | Reject $H_0$ |
| | PRODUCED | $\beta_{13}$ | -2.37 | Reject $H_0$ |

It can be seen from Table 5 that for the "To Employer's Business" trips of the trip attraction model, the coefficients $\beta_2$ and $\beta_6$ are values ranging from -1.645 to +1.645 – thus, they should be eliminated from the model. Having been able to

eliminate the insignificant coefficients and their corresponding variables, the new equation for the To Employer's Business trip of the trip attraction model is $A = 0.0144X_{13} - 3.815$ with a coefficient of determination equal to 0.75.

### 3.2 Trip Rate Method

The cross-classification tables produced indicates the trip generation rates for the study zone, for each purpose. Household characteristics differ for each purpose, and the characteristics used for each purpose are based on the independent variables on the initial results of the multiple linear regression approach.

**Table 6. For Purpose "To Home", (unit: trips/day)**

| | Trips | Household Size | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| Household Income | 1 | 2 | 15 | 31 | 36 | 31 | 10 | 14 | 7 | 5 | 3 | 2 | 1 | 0 | 157 |
| | 2 | 2 | 37 | 71 | 101 | 75 | 51 | 22 | 7 | 13 | 2 | 1 | 1 | 0 | 383 |
| | 3 | 7 | 71 | 111 | 133 | 130 | 63 | 34 | 19 | 12 | 11 | 2 | 0 | 0 | 593 |
| | 4 | 0 | 39 | 75 | 89 | 68 | 57 | 15 | 4 | 4 | 4 | 1 | 0 | 1 | 357 |
| | 5 | 3 | 13 | 46 | 44 | 37 | 21 | 6 | 1 | 0 | 2 | 0 | 1 | 1 | 175 |
| | 6 | 0 | 18 | 35 | 48 | 18 | 12 | 8 | 2 | 1 | 1 | 0 | 0 | 0 | 143 |
| | 7 | 1 | 5 | 6 | 10 | 7 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 31 |
| | 8 | 0 | 0 | 5 | 6 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 15 | 198 | 380 | 467 | 369 | 215 | 101 | 40 | 35 | 23 | 6 | 3 | 2 | 1854 |

**Table 7. For Purpose "To Home", (unit: households)**

| | Household | Household Size | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| Household Income | 1 | 2 | 12 | 27 | 24 | 22 | 9 | 10 | 5 | 2 | 2 | 1 | 1 | 0 | 117 |
| | 2 | 2 | 31 | 59 | 78 | 53 | 32 | 16 | 7 | 4 | 2 | 1 | 1 | 0 | 286 |
| | 3 | 6 | 58 | 86 | 101 | 92 | 46 | 23 | 14 | 6 | 4 | 1 | 0 | 0 | 437 |
| | 4 | 0 | 30 | 59 | 72 | 52 | 44 | 10 | 4 | 4 | 3 | 1 | 0 | 1 | 280 |
| | 5 | 3 | 12 | 43 | 33 | 31 | 17 | 5 | 1 | 0 | 1 | 0 | 1 | 1 | 148 |
| | 6 | 0 | 15 | 26 | 41 | 16 | 9 | 5 | 2 | 1 | 1 | 0 | 0 | 0 | 116 |
| | 7 | 1 | 3 | 5 | 10 | 7 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 28 |
| | 8 | 0 | 0 | 4 | 6 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 14 | 161 | 309 | 365 | 276 | 158 | 71 | 33 | 17 | 13 | 4 | 3 | 2 | 1426 |

Then in the computation of trip rates, values from cells in Table 24 are divided by the values from cells in table 25. Average values are also computed for the trip rates.

**Table 8: For Purpose "To Home", (unit: trips/household/day)**

| | Trip RATES | Household Size | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | AVERAGE |
| Household Income | 1 | 1.000 | 1.250 | 1.148 | 1.500 | 1.409 | 1.111 | 1.400 | 1.400 | 2.500 | 1.500 | 2.000 | 1.000 | - | 1.342 |
| | 2 | 1.000 | 1.194 | 1.203 | 1.295 | 1.415 | 1.594 | 1.375 | 1.000 | 3.250 | 1.000 | 1.000 | 1.000 | - | 1.339 |
| | 3 | 1.167 | 1.224 | 1.291 | 1.317 | 1.413 | 1.370 | 1.478 | 1.357 | 2.000 | 2.750 | 2.000 | - | - | 1.357 |
| | 4 | - | 1.300 | 1.271 | 1.236 | 1.308 | 1.295 | 1.500 | 1.000 | 1.000 | 1.333 | 1.000 | - | 1.000 | 1.275 |
| | 5 | 1.000 | 1.083 | 1.070 | 1.333 | 1.194 | 1.235 | 1.200 | 1.000 | - | 2.000 | - | 1.000 | 1.000 | 1.182 |
| | 6 | - | 1.200 | 1.346 | 1.171 | 1.125 | 1.333 | 1.600 | 1.000 | 1.000 | 1.000 | - | - | - | 1.233 |
| | 7 | 1.000 | 1.667 | 1.200 | 1.000 | 1.000 | 1.000 | 1.000 | - | - | - | - | - | - | 1.107 |
| | 8 | - | - | 1.250 | 1.000 | 1.000 | - | 1.000 | - | - | - | - | - | - | 1.071 |
| | 9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 12 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | AVERAGE | 1.071 | 1.230 | 1.230 | 1.279 | 1.337 | 1.361 | 1.423 | 1.212 | 2.059 | 1.769 | 1.500 | 1.000 | 1.000 | 1.300 |

For the other trip purposes, only the tables showing the trip rates are illustrated.

Household Income shown in the tables are the categorization of the income brackets. These brackets are:

| | |
|---|---|
| 1 | Under 3,000 |
| 2 | 3,000-5,999 |
| 3 | 6000-9,999 |
| 4 | 10,000-14,999 |
| 5 | 15,000-19,999 |
| 6 | 20,000-29,999 |
| 7 | 30,000-39,999 |
| 8 | 40,000-59,999 |
| 9 | 60,000-99,999 |
| 10 | 100,000-149,999 |
| 11 | 150,000-199,999 |
| 12 | 200,000-over |

**Table 8. For Purpose "To Work", (unit: trips/household/day)**

| | Trip RATES | Occupation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 15 | AVERA |
| Household Income | 1 | 1.429 | 1.100 | 1.000 | 1.100 | 1.059 | 1.000 | 1.143 | 1.000 | 1.143 | 1.000 | 1.100 |
| | 2 | 1.048 | 1.143 | - | 1.000 | 1.130 | 1.000 | 1.074 | 1.182 | 1.091 | 1.111 | 1.103 |
| | 3 | 1.077 | 1.149 | 1.000 | 1.229 | 1.105 | 1.000 | 1.158 | 1.094 | 1.138 | 1.156 | 1.129 |
| | 4 | 1.217 | 1.138 | 1.000 | 1.000 | 1.075 | 1.000 | 1.045 | 1.129 | 1.024 | 1.095 | 1.090 |
| | 5 | 1.043 | 1.111 | 1.000 | 1.063 | 1.000 | - | 1.200 | 1.000 | 1.000 | 1.000 | 1.051 |
| | 6 | 1.286 | 1.000 | - | 1.000 | 1.111 | 1.000 | 1.000 | 1.000 | 1.133 | 1.154 | 1.097 |
| | 7 | 1.000 | 1.000 | - | - | 1.000 | - | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| | 8 | 1.000 | - | - | - | 1.000 | - | 1.000 | 1.000 | 1.000 | 1.333 | 1.077 |
| | 9 | - | 1.000 | - | - | - | - | - | - | - | - | 1.000 |
| | 10 | - | - | - | 1.000 | - | - | - | - | - | - | 1.000 |
| | 11 | - | - | - | - | - | - | - | - | - | - | - |
| | 12 | - | - | - | - | - | - | - | - | - | - | - |
| | AVERAGE | 1.128 | 1.127 | 1.000 | 1.088 | 1.091 | 1.000 | 1.087 | 1.095 | 1.090 | 1.110 | 1.100 |

Occupation is also categorized as follows:

| | |
|---|---|
| 1 | Official of Gov't & Special Interest Org., Corporate Executive, Manager |
| 2 | Professional |
| 3 | Technician |
| 4 | Clerical Worker |
| 5 | Service Worker & Shop & Market Worker |
| 6 | Farmers, Forestry Workers & Fisherman |
| 7 | Traders & Related Workers |
| 8 | Plant & Machine Operators & Assemblers |
| 9 | Laborers & Unskilled Workers |
| 10 | Student (Elem.) |
| 11 | Student (HS |
| 12 | Student (Univ.) |
| 13 | Housewife |
| 14 | Jobless |
| 15 | Others, specify |

**Table 9. For Purpose "To School", (unit: trips/household/day)**

| | Trip RATES | Student Type | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | AVERA |
| Household Income | 1 | 1.000 | - | 1.000 | 1.000 |
| | 2 | 1.000 | 1.000 | 1.000 | 1.000 |
| | 3 | 1.167 | 1.000 | 1.000 | 1.091 |
| | 4 | 1.000 | 1.000 | - | 1.000 |
| | 5 | 1.000 | - | - | 1.000 |
| | 6 | 1.000 | 1.000 | - | 1.000 |
| | 7 | 1.000 | - | - | 1.000 |
| | 8 | 1.000 | - | - | 1.000 |
| | 9 | - | - | - | - |
| | 10 | - | - | - | - |
| | 11 | - | - | - | - |
| | 12 | - | - | - | - |
| | AVERAGE | 1.048 | 1.000 | 1.000 | 1.026 |

**Table 10. For Purpose "To Private Business", (unit: trips/household/day)**

| Household Income \ Household Size | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | AVERAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | 1.000 | 1.000 | 1.000 | 1.000 | - | - | 1.000 | - | - | - | - | - | 1.000 |
| 2 | - | 1.000 | 1.000 | 1.833 | 1.250 | 2.000 | 1.000 | 1.000 | 1.000 | - | - | - | - | 1.368 |
| 3 | - | 1.000 | 1.000 | 1.000 | 1.000 | - | - | 4.000 | - | - | - | - | - | 1.300 |
| 4 | - | 1.000 | 1.000 | 2.000 | 1.000 | 1.000 | - | - | - | - | - | - | - | 1.333 |
| 5 | 1.000 | 1.000 | 1.000 | 1.000 | 1.250 | - | - | - | - | - | - | - | - | 1.100 |
| 6 | - | 1.000 | - | - | 1.000 | 1.500 | - | - | - | - | - | - | - | 1.143 |
| 7 | - | - | - | 1.000 | 1.000 | - | - | - | - | - | - | - | - | 1.000 |
| 8 | - | - | - | - | 1.000 | - | - | - | - | - | - | - | - | 1.000 |
| 9 | - | - | - | 1.000 | - | - | - | - | - | - | - | - | - | 1.000 |
| 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| AVERAGE | 1.000 | 1.000 | 1.000 | 1.471 | 1.125 | 1.500 | 1.000 | 2.000 | 1.000 | - | - | - | - | 1.231 |

**Table 11. For Purpose "To Employer's Business", (unit: trips/household/day)**

| Household Income \ Household Size | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | AVERAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | 1.000 | - | - | - | - | - | - | - | - | - | 1.000 |
| 2 | - | 1.000 | 1.000 | - | - | - | - | - | - | - | - | - | - | 1.000 |
| 3 | - | 1.000 | - | 1.000 | - | - | 1.000 | - | - | - | - | - | - | 1.250 |
| 4 | - | 1.000 | - | - | - | - | - | - | - | - | - | - | - | 1.000 |
| 5 | - | - | - | - | 1.000 | - | - | - | - | - | - | - | - | 2.000 |
| 6 | - | - | - | 1.500 | 1.000 | - | - | - | - | - | - | - | - | 1.333 |
| 7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| AVERAGE | - | 1.000 | 2.000 | 1.400 | 1.000 | - | 1.000 | - | - | - | - | - | - | 1.231 |

**Table 12. For Purpose "To Medical", (unit: trips/household/day)**

| Household Income \ Vehicle Ownership | 1 | 2 | 3 | AVERA |
|---|---|---|---|---|
| 1 | 1.000 | - | - | 1.000 |
| 2 | 1.000 | - | - | 1.000 |
| 3 | 1.500 | - | - | 1.500 |
| 4 | 1.000 | 1.000 | - | 1.000 |
| 5 | 1.000 | - | - | 1.000 |
| 6 | 1.000 | - | 1.000 | 1.000 |
| 7 | 1.000 | - | - | 1.000 |
| 8 | - | - | - | - |
| 9 | - | - | - | - |
| 10 | - | - | - | - |
| 11 | - | - | - | - |
| 12 | - | - | - | - |
| AVERAGE | 1.091 | 1.000 | - | 1.083 |

**Table 13. For Purpose "To Shopping", (unit: trips/household/day)**

| Household Income \ Household Size | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | AVERAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.000 | 1.000 | 1.000 | 1.125 | 1.600 | 1.500 | - | - | - | - | - | - | - | 1.217 |
| 2 | - | 1.100 | 1.182 | 1.176 | 1.143 | 1.286 | 1.000 | - | - | - | - | - | - | 1.170 |
| 3 | - | 1.000 | 1.000 | 1.071 | 1.000 | 1.000 | - | 1.000 | - | - | - | - | - | 1.023 |
| 4 | - | 1.333 | 1.400 | 1.000 | 1.000 | - | 1.000 | - | - | - | - | - | - | 1.200 |
| 5 | - | 1.000 | 1.000 | - | 1.000 | 1.000 | 1.000 | - | - | - | - | - | - | 1.000 |
| 6 | - | 1.000 | 1.250 | 1.400 | 1.000 | 1.000 | 1.000 | - | - | - | - | - | - | 1.188 |
| 7 | 1.000 | 1.000 | - | 1.000 | 1.000 | - | - | - | - | - | - | - | - | 1.000 |
| 8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| AVERAGE | 1.000 | 1.069 | 1.135 | 1.143 | 1.148 | 1.231 | 1.000 | 1.000 | - | - | - | - | - | 1.128 |

**Table 14. For Purpose "To Church", (unit: trips/household/day)**

| Household Income \ Vehicle Ownership | 1 | 2 | 3 | AVERA |
|---|---|---|---|---|
| 1 | - | - | - | - |
| 2 | 1.000 | 1.000 | - | 1.000 |
| 3 | 1.000 | - | - | 1.000 |
| 4 | 1.000 | - | - | 1.000 |
| 5 | 1.000 | - | 1.000 | 1.000 |
| 6 | 1.000 | - | - | 1.000 |
| 7 | 1.000 | - | - | 1.000 |
| 8 | 1.000 | - | - | 1.000 |
| 9 | - | - | - | - |
| 10 | - | - | - | - |
| 11 | - | - | - | - |
| 12 | - | - | - | - |
| AVERAGE | 1.000 | 1.000 | 1.000 | 1.000 |

## 4. CONCLUSIONS

This study used two trip generation modelling techniques, namely: (1) regression analysis; and (2) trip rate method. For the regression analysis, it has been observed that the population per zone, number of households per zone, workers per zone, students per zone and household head monthly income per zone are significant parameters for a particular zone to produce and attract trips.

**Table 15.Regression Models**

| TRIP PURPOSE | MODEL TYPE | INDEPENDENT VARIABLES | REGRESSION | $R^2$ |
|---|---|---|---|---|
| TO HOME | PRODUCED | POPULATION | $P = 0.514X_1 - 9.717$ | 0.745 |
| | ATTRACTED | WORKERS PER ZONE & STUDENTS PER ZONE | $A = 0.812X_6 + 0.943X_{13} - 84.621$ | 0.983 |
| TO WORK | PRODUCED | NO. OF HOUSEHOLDS | $P = 1.368X_2 - 225.047$ | 0.868 |
| | ATTRACTED | WORKERS PER ZONE | $A = 0.8698X_6 - 192.25$ | 0.987 |
| TO SCHOOL | PRODUCED | NO. OF HOUSEHOLDS | $P = 0.9851X_2 + 43.649$ | 0.737 |
| | ATTRACTED | STUDENTS PER ZONE | $A = 0.8355X_{13} + 41.39$ | 0.972 |
| TO PRIVATE BUSINESS | PRODUCED | - | - | - |
| | ATTRACTED | WORKERS PER ZONE | $A = 0.0455X_6 - 1.4839$ | 0.788 |
| TO EMPLOYER'S BUSINESS | PRODUCED | - | - | - |
| | ATTRACTED | STUDENTS PER ZONE | $A = 0.0144X_{13} - 3.815$ | 0.750 |
| TO MEDICAL | PRODUCED | HOUSEHOLD HEAD INCOME | $P = 0.0075X_8 - 29.118$ | 0.704 |
| | ATTRACTED | - | - | - |
| TO SHOPPING | PRODUCED | - | - | - |
| | ATTRACTED | - | - | - |
| TO CHURCH | PRODUCED | NO. OF HOUSEHOLDS, WORKERS PER ZONE & STUDENTS PER ZONE | $P = 0.0712X_2 + 0.0233X_6 - 0.0151X_{13} - 40.096$ | 0.696 |
| | ATTRACTED | - | - | - |

For the trip rate method, cross-classification tables are made for each purpose. Different household characteristics are cross-classified for each purpose (*i.e.*, household size and household income for purpose 'To Home', or household income and occupation for purpose 'To Work'.) Results of the trip rate method illustrated the trip generation rates from different trip purposes.

## 5. RECOMMENDATIONS

The HIS covered only residents of Lipa City which accepted for internal-internal and internal-external trips. Additional roadside interview surveys to cover external-internal and external-external trips can be done to complete the OD Table.

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