Method for Estimating Potential Increases in Traffic Volumes Based on O-D Survey Data from a Mid-Western City

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An attempt is made to estimate the possible increase in trip generation which could occur in a community if the number of households remained constant over a period of time during which the vehicle ownership by households and/or the intensity of vehicle use by households increased. The information is based on the data secured in the home interviews of an origin-destination survey conducted in Champaign-Urbana in the spring of 1958.

The study was based on the assumption that households or families are the basic traffic-generating units in a community. The averages for household characteristics were correlated by zones with the average number of vehicular trips per zone. The validity of the procedure was supported by the results of a variance analysis which indicated that the differences between zones were significantly greater statistically than the differences within zones in respect to traffic generation. The fact that the family is a significant unit of traffic generation was shown in the findings that two-car families on the average made only 40 percent more trips than one-car families. Increasing the number of vehicles in families already owning vehicles, therefore, does not proportionately increase the number of vehicular trips.

A statistical factor analysis was made of about 30 variables reported in the home interview which conceivably might be linked to traffic generation by households in the survey zones. Four major factors associated with trip generation were derived—a traffic volume factor, a trip purpose factor, a distance factor, and a time-of-trip factor. The fact that the traffic volume factor most clearly included socio-economic traits of households was accepted as a demonstration that socio-economic influences are the basic source of variations between zones of a community in production of traffic.

The proportion of potential trip makers in households who make trips appeared to be the best measure of the differences between zones in the production of traffic. On the basis of this criterion, three types of survey zones each with a different trip generating potential were determined. The zones with lowest potential were generally close to the CBD, were often inhabited by minority or low-ranked occupational groups, or were areas of changing land use. The zones with the highest potential were either very high on the occupational-economic scale or at extreme distances from the CBD. The medium or average potential zones were average in economic criteria of households and tended to be average distances from the CBD. Socio-economic level and proportion of land use devoted to single-family residence seem to be the principal criteria associated with trip-generating potential of zones.

A socio-economic scale combining occupational level and proportion of land use in single-family residence was developed. Values for types of zones correlated well with measures of trip generation by zones. It was estimated on the basis of the growth of the gross national product for the past decade that a community might increase the level of its socio-economic scale value about 20 percent between 1960 and 1970. If this estimate of a 20 percent increase in

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community socio-economic level were applied to the Champaign-Urbana data, then assuming no increase in the number of households in the community from 1960 to 1970, the number of vehicles would increase by 8 percent and trips by 24 percent. This disproportionate increase in the number of trips represents the greater intensity of vehicular use by households at higher socio-economic levels.

•A NUMBER of studies have used the origin-destination survey data to determine the attributes of persons and communities associated with local traffic generation. In all of these studies the number of vehicles found in a community correlates most highly with vehicular trip generation (1-5). However, there has been little systematic consideration of factors underlying a long-run trend in the relation between number of vehicles and the volume of trips produced by these vehicles. The present report, part of a larger study dealing with the social factors in traffic generation, attempts to estimate the possible increase in trip generation which would be associated with increased ownership of vehicles and more intensive use of vehicles.

This report is based on the data obtained in the home interviews of an O-D survey conducted in Champaign-Urbana in the spring of 1958 (6). The study was based on the assumption that households or families are the basic traffic-generating units in a community. There were a total of 4,400 households in the sample, but the analysis was made largely in terms of the 2,000 which were classified as non-student households since it was felt that understanding traffic generation by student households would not be particularly useful for estimating vehicular trips in most other communities. The original internal survey area contained over 50 zones, but of these only 41 reported 10 or more non-student households in the sample. Therefore, the present study was made in terms of these 41 zones.

DEFINITIONS OF TECHNICAL AND STATISTICAL PROCEDURES

The following definitions of techniques and devices used or referred to in the text are included to clarify the discussion.

Variance—the statistical term for the sum of the squares of the deviations from the mean value of a numerical distribution divided by the number of cases in the distribution. The variance as a measure gives an indication of the range of values of the cases in the distribution.

Analysis of variance—the statistical comparison of two or more numerical distributions normally with the purpose of determining whether or not these distributions are alike or different in respect to some criterion. In the report, analysis of variance was used to compare the relation of the number of vehicles per zone to the number of trips to determine if the variance in respect to this relation was greater within the survey zones or between the survey zones.

F-test—a statistical measure to determine if the differences between a criterion for two numerical distributions are significant or could simply be a product of sampling error or random probability. The F-test was used in the report to show that variance between and within survey zones in respect to the number of vehicular trips was significant.

Factor analysis—a statistical method for determining a smaller number of underlying dimensions or factors which exist in the correlations between a larger number of specific variables. Normally a factor analysis begins with a matrix of product-moment correlations and then reduces them a number of patterns which account for the pattern of correlations. In the report, factor analysis begins with a matrix showing the intercorrelations of 30 variables involving trip generation and household traits by survey zone. Through mathematical manipulation this matrix was reduced to five dimensions or axes which account for a good part of the actual number of correlations secured. The factors, therefore, show which variables tend to cluster together. The largest single cluster in terms of association of traits was the factor which showed the association between trip generation and socio-economic traits.

Cumulative or Guttman scaling—a statistical technique for ordering observations of objects so that the order numerically describes variations in some common property shared by all the objects. For example, if a boy can be seen to climb to the top of very tall trees, it can be assumed that he can climb to the top of small and medium trees. If, however, a boy is seen to climb only small trees, it cannot be assumed that he can climb to the top of tall trees. In this situation it would be possible to create a cumulative scale whereby boys observed climbing to the top of tall trees are given scale value of 3, those to the top of medium trees the value 2, and those up in small trees the value of 1. In this way it is possible to prepare numerical measures of properties of phenomena which cannot normally be given such a numerical ranking. In the report this procedure was applied to occupations so as to measure the occupational level of survey zones and to measure land use in terms of the variations in single-family, multi-family and commercial use. These two scales were then combined into one scale of socio-economic ranking of zones.

VARIANCE ANALYSIS TEST OF VALIDITY OF INDICES USED

The statistical procedure was to correlate zone averages for the number of passenger or vehicular trips by household with the zone averages by household of such traits as occupation, number of cars per household, and age of drivers. The statistical relationships, therefore, are measures representing the statistical correlations of the averages of the 41 zones. There are certain problems inherent in using averages as the basis of correlations, but it was assumed that the statistical variance in respect to any of the traits studied was less within than between zones. If the validity of this assumption could be demonstrated, the method of product-moment correlations would appear to be a correct device for establishing statistical relations between traits represented as zone averages. It was, therefore, decided to make a variance analysis by zones of the relationship between the number of vehicles and the number of passenger trips for each zone. By applying the F-test to the results of the analysis, it would be possible to estimate whether the variance in this key relationship was mainly within or between zones. In a sense this test is also an estimation of the homogeneity of the survey zones as indices of traffic generation. The results of the variance analysis, shown in Table 1, indicate that there is a very high probability that the statistical relation between the number of vehicles in zones and the rate of traffic generation by zones, as established by this O-D survey, is due to actual differences between the zones themselves and not to differences within the zones.

FACTOR ANALYSIS OF TRAFFIC GENERATION

The demonstration of this point, therefore, gave strong support to the effort to prepare product-moment correlations between a number of indices based on the Champaign-Urbana survey data as they might pertain to traffic generation. The technique utilized to develop this point was that of factor analysis. Intercorrelations between some 30 averages of indices for the zones, including five which concerned traffic generation, were computed. The matrix of intercorrelations thus secured was then factor analyzed to a centroid solution and rotated to an orthogonal solution according to the Illiac programs of the University of Illinois. The results of these procedures produced five factors, four of which showed a clear relation of zone indices to traffic generation. The results of this analysis and the identification of the factors secured are shown in Table 2.

These four factors account for almost 55 percent of the variance in the correlations among 28 variables which described either qualities of traffic generation or socio-economic indices of survey zones.

TABLE 1

SUMMARY OF ANALYSIS OF VARIANCE[a]

Source	Sum of Squares	Deg. of Freedom	Variance Est.	F-Ratio
Between zones	4,600.286	53	86.797	2.355[b]
Within zones	60,404.036	1,639	36.854	
Total	65,004.322	1,692		

[a]Regression relation between number of vehicles per zone and passenger trips per zone. [b]Significant at better than 0.01 level.

TABLE 2

FACTOR ANALYSIS OF TRAFFIC GENERATION—URBANA-CHAMPAIGN

Factor No.	Description	% of Tot. Var.[a]	Interpretation
1	Traffic volume	21.9	Economic and occupational measures of zones correlate most highly with measures of number of trips by zones.
2	Trip purpose	14.6	Trip purpose associated with driver characteristics such as age and length of residence.
3	Time of trip	9.0	Times at which trips are made during day are associated with distance which driver lives from CBD.
4	Household size and value of residence	8.8	Non-traffic factor indicates that large households live in lower value residences.

[a]Accounted for by factor.

What is important in the findings given in the table is that three of the four major factors are made of variables which are attributes of traffic and also of socio-economic indices of zones. The importance of Factor 4 is that it provides confirmation that the relationships of traffic with other indices, at least in this body of data, are valid and not merely a reflection of the manner in which the data were assembled. Attributes of traffic such as volume, purpose, and time of trip cluster with certain socio-economic indicators.

Factor 1 is significant because it indicates that traffic volume in a community is most closely linked to occupational-economic traits of zones. Also, the amount of variance accounted for by this factor suggests that the association of socio-economic traits with the amount of traffic is one of the most significant statistical clusters which can be found in the information derived from a typical O-D survey. It was this finding that prompted investigation of the question of how variations in the occupational-economic averages of zones were associated with variations in the volumes of trip generation. The aim of this approach was to estimate how much increases in the occupational-economic status of zones would increase the traffic generation of such zones if no other influences were operating in a community. The actual model of the research design was one of zones in which changes in socio-economic factors alone were operating. The fundamental question was what effect such change would have on rates of traffic generation.

CONDITIONS UNDER WHICH RATE OF TRAFFIC GENERATION MIGHT CHANGE WITHOUT CORRESPONDING CHANGE IN NUMBER OF HOUSEHOLDS

Assuming that the number of households in the zones of a community were fixed, changes in the community rate of vehicular or passenger traffic generation would presumably be a result of the change in the intensity of vehicle use by the household or of change in the number of vehicles in the household. The patterns of community traffic generation, however, reflect the differential generation by zones. The variation between zones in the number of vehicular trips generated can be accounted for by zone in terms of (a) the number or proportion of households owning cars, (b) the number of cars owned, on the average, by households, and (c) the intensity of the use of vehicles by households. The attempt to account for the influence of changes in economic-occupational traits on traffic generation must, therefore, be seen in terms of its influence on all three of these indices.

Although occupational-economic traits as a cluster of attributes seem most closely associated with the number of trips generated by the zones, no single occupational-

TABLE 3

COEFFICIENTS OF CORRELATION OF MEDIAN NUMBER OF PASSENGER TRIPS WITH SOCIAL AND ECONOMIC CHARACTERISTICS OF ZONE[a]

Characteristics	Correl. Coeff.	Std. Error of Est.	Slope b
Avg. No. of cars per household	0.797	1.198	6.215
Distance from CBD	0.461	1.758	0.118
Socio-economic status	-0.495	1.652	-0.989
Avg. length of residence	000	-	-
Median year of cars	-0.262	-	-
Avg. make of cars	0.187	-	-
Avg. value of structure	-0.453	-	-0.096
Percentage of potential trip makers making trips	0.733	1.350	0.137
Avg. No. of trips per household, having 2 cars	0.249	1.707	0.281
Having 1 car	0.802	1.184	1.406

[a] n = 41 for all of calculations.

economic trait shows as close a correlation with the number of trips generated by zones as the correlation between number of cars and number of trips in zones. The data in Table 3 demonstrate this point.

In view of the relatively low values of correlations, it appeared that an analytic technique other than statistical correlation would offer a clearer preliminary insight into the manner in which economic-occupational measures are associated with change either of vehicular ownership by households or of intensity of vehicular use. The technique used was that of analytic types based on the frequency distribution by zones of percentage of potential trip makers making trips. The data in Table 3 indicate this trait to be highly correlated with trip generation; its distribution frequency approaches that of a normal curve, making it appropriate for the derivation of analytic types of zones classified by potential trip makers who make trips. The frequency distribution of this trait is given in Table 4.

On the basis of this distribution, it was possible to derive three types of zones, one low in potential trip making, one average, and one high in this trait. The average zones, eight in number, were those which were either the mean or median values in the distribution. The low zones were one standard deviation below the mean and included seven zones in which 45 percent or less of potential trip makers made trips. The high zones were one standard deviation above the mean and included the seven in which 65 percent or more of trip makers made trips. The types, therefore, included one-half of the actual cases located at the extreme and central points of the distribution.

TABLE 4

PERCENTAGE OF POTENTIAL TRIP MAKERS MAKING TRIPS BY ZONE

Percent	No. of Zones
< 34	1
35-39	2
40-44	2
45-49	6
50-54	5
55-59	14
60-64	4
65-69	5
70-74	2
Total	41

When a number of variables associated with traffic generation are arranged by these types, several significant points become apparent, as can be seen in Table 5. This table depicts the marked differences between types of zones in their capacity or propensity to produce trip volumes. The high zones which altogether contain only slightly more households than the low zones produce almost $2\frac{1}{2}$ times as many vehicular trips and almost 5 times as many trips among households owning two cars. This decisive differential suggests how great an increase might possibly occur in local traffic volumes if existing households which are low in traffic genera-

TABLE 5

TRAITS RELATED TO TRAFFIC GENERATION OF ZONES[a]

Trait	% of Pot. Trip Makers Making Trips		
	Low Zone	Medium Zone	High Zone
% of households in tot. sample	14.7	26.6	17.3
% of veh. owned	12.6	26.2	19.8
% of all veh. trips	9.7	26.4	23.0
% of trips made by 1-car families	9.9	27.2	19.9
% of trips made by 2-car families	5.0	27.3	32.6
Veh. trips per developed acre	0.87	2.11	1.35
Occupational level	3.9	2.5	1.4

[a]Percentages are of totals for all zones.

tion were raised to the level of households which are high in this quality. The average type of zone is also of interest because it produces trips of all categories in almost exact proportion to its number among all households.

As might be expected, each type shows variation in certain general characteristics. One of the important factors in such differentiation is the predominant land use established by the local zoning code. When the possible land use is more varied, the rate of trip making is lower. Also when the proportion of single-family residences or the occupational level is higher, the rate of trip making is greater. In general, the trip-making rate is lower in areas closer to the CBD, but these areas also tend to be more heterogeneous in land use, lower in proportion of areas devoted to single-family residency, and lower in occupational level. In addition, zones at extreme distances from the CBD may be low in the occupational level, but high in the rate of trip making. In short, it appears that the influences associated with zones as they affect trip making appear to be multiple in number and not necessarily constant in effect. Zones with high occupational levels and with a high proportion of single-family residences, however, appear to represent a complex of traits leading to high traffic production. It is assumed that this complex represents a socio-economic way of life which calls for a high rate of traffic production.

INFLUENCE OF MULTIPLE-VEHICLE OWNERSHIP ON TRIP GENERATION

To estimate how changes in characteristics of households are correlated with changes in traffic volumes, some attention should be given to the influence exercised by multiple-vehicle ownership on trip production. Increase in multiple-car ownership does not proportionately increase the number of vehicular trips made by the household; for example, a two-car household does not make, on the average, twice the number of trips of a one-car household. The complicating element here, however, is that zones having a high proportion of two-car families are also those in which the use of all vehicles is intensive. This point will be treated later. The data in Table 6 demonstrate the influence of multiple-car ownership on trip production and suggest several points concerning the effect of household characteristics on trip production. First, about 15 percent of the sample of local families own no vehicles and approximately the same proportion own two. Of interest is the fact that trips with only the driver in the car are more than twice as frequent as those with driver and passenger. This is equally true of both one- and two-car-owning households, which is somewhat surprising as it had been hypothesized in households with two cars, that there would be considerably more trips made with only the driver in the car. Most pertinent, perhaps, is the fact that two-car households produce about 25 percent of vehicular trips

TABLE 6

AVERAGE NUMBER OF VEHICULAR TRIPS PER FAMILY AND PER VEHICLE

No. Cars/Family	No. Families	No. Vehicular Trips			No. Trips/ Family (avg.)	No. Trips/ Car (avg.)
		Driver Only	Driver and Passenger(s)	Total		
0	321	0	0	0	0	0
1	1,365	5,134	2,508	7,642	5.6	5.6
2	301	1,664	718	2,382	7.9	4.0
Total	1,987	6,798	3,226	10,024		

although they account for only 15 percent of households. These conditions, obviously, must be considered in the estimation of the potential increase in traffic generation which might be introduced by changing the characteristics of households.

A number of the relationships between trip generation by two-vehicle households and other criteria associated with vehicular trips were explored. First, as indicated in Table 3, the correlation between the average number of trips per zones and the average number of trips of two-vehicle households by zone is very low. This fact would seem to suggest that pattern of trip production by multi-vehicle households diverges from that of single-vehicle households. However, correlation of the differences between average number of trips made by single-vehicle and two-vehicle households in each zone with the average number of trips by two-vehicle households per zone shows that this is not the case. A plot of these two series as a scattergram indicated that there was a high and consistent relationship among them. Computation of the regression equation between them by Eq. 1 gave the following results:

$$Y = a + bX$$

$$Y = -5.51 + 1.01X \qquad (1)$$

where

X = average number of vehicular trips by two-vehicle households per zone; and
Y = difference between average number of vehicular trips for one- and two-vehicle families per zone.

This equation can be interpreted as meaning that an increase of one unit in the average number of trips by two-vehicle households implies an increase of one unit in the difference between the average number of vehicular trips by one- and two-vehicle households. It suggests that since the average number of vehicular trips by zone for two-vehicle households does not correlate with total vehicular trips by zone, the average generation of trips by households increases at a different rate than that of total trips by zones. This conclusion can be related to vehicular trip production by stating that in zones of high trip production both single- and two-vehicle households produce relatively more trips since the differences between these groups is constant. The only exception to this statement is the case of multi-vehicle households in zones which are lowest in trip production. In other words, the production of vehicular trips by two-vehicle households is not independent of the trip production of the zone in which the two-vehicle household is located. This conclusion is in agreement with the implications of the findings in Table 1, although it might be hypothesized, without the evidence presented thus far, that when a household enters the status of multi-vehicle ownership, its pattern of trip production may vary considerably from the other households in its survey zone. As noted, the only apparent actual exception is for the zones at the lowest level of trip production by resident households.

ESTIMATING INFLUENCE OF INCREASES IN SOCIO-ECONOMIC STATUS ON TRIP GENERATION

To estimate how much influence an increase in the socio-economic status of households would have on trip generation, it was necessary to establish some index of socio-economic status. The research staff decided that such a measure should include three criteria which appeared to be correlated with trip generation by zones and which also were apparently indices of the socio-economic way of life of households as it influenced the typical pattern of trip generation. These criteria were (a) the average occupational level, (b) the dominant pattern of land use of the zone as defined by local zoning ordinances, and (c) extreme distances of zones from the CBD which included areas outside the city limits of the Champaign-Urbana community. This last item was considered because households in this category were unique in their combination of socio-economic traits and patterns of trip generation.

TABLE 7

WEIGHTED SCALE OF OCCUPATIONS BY ZONES[a]

Composition	Criteria	Scale Type[b]	Weight	No. of Zones
Order (1 2 3)	A category receives a "1" if the percent in the zone who work in that occupation is equal to or greater than the median percent for all zones (a "0" is received if this percent is less than the median); 0 percents are included in the determination of the median.	001	1	4
1. Laborers and unskilled		011	2	8
2. Craftsmen, foremen, and skilled or clerical, sales and kindred workers		010	3	3
		111	4	2
3. Professions and semi-professions or managers and officials		110	5	2
		100	6	3

[a]Source of data: occupation of driver reported in household survey.
[b]When there are two industries in any single category, the category receives a "1" if either or both industries placed in that category qualify for a score of "1" which indicates a proportionately prevalent number of workers in that industrial category.

The index developed was a Guttman-type scale which combined only the average occupational level of zones and prevailing legal land use. Extreme distance of zone from the CBD did not appear to be a dimension of this scale, but allowance was made for this trait by independently estimating its influence on traffic generation. The primary scale developed was regarded as a measure of the average socio-economic level of households in a zone. The occupational index for each zone was derived from the occupations reported on the No. 2 card of the household survey. These occupations were scaled according to the prestige and income rankings of occupation as reported in a study of the National Opinions Research Center (7). A 6-point scale was devised which when applied to the 22 zones represented in Table 5 gave the results indicated in Table 7.

The second dimension of socio-economic status included in the scale was based on the predominant land use of zones as defined by the local zoning code of Champaign-Urbana. The proportions of the land area of each zone devoted to legally permitted categories of land use were determined by studying local zoning maps. The community as a whole appeared to have a distribution of land use roughly comparable to other communities of this size. The distribution for the whole community is given in Table 8.

A scale was developed representing the predominant land use of each zone in terms of the proportions of the zone represented by the land-use categories in Table 8. This scale was applied to the 22 sample zones. The distribution of these zones on a 3-point scale and the criteria of the scale are given in Table 9.

These two dimensions were then combined in a Guttman-type scale for the 22 zones as indicated in Table 10. The resulting scale distribution had a coefficient of reproducibility of 0.89 with a relatively broad distribution across a 6-point scale. Despite the small sample of zones, this scale appears to be a measure of a uni-dimensional trait representing the socio-economic status of the local community. It is important to note that the two dimensions of the scale were developed from independent bodies of data and therefore the high degree of association is not an artifact of the household survey itself.

TABLE 8

LAND-USE DISTRIBUTION, CHAMPAIGN-URBANA COMMUNITY

Description	Acreage	Percent Total Acreage
Single family use	4,074	49.2
Multi-family	1,237	14.9
Commercial	492	5.9
Industrial	921	11.1
Public[a]	1,557	18.8
Total urbanized acres[a]	8,281	100.0

[a]Does not include street acreage included in each category which constitutes approximately 30 percent of total acreage.

The scale in Table 8 provides a relatively simple measure of the socio-economic differences of the zones. The next problem in the investigation was to determine the extent to which these differences were associated with differences in the three types of zones representing different proportions of trip makers. When the occupation scale is applied to these three types, as in Table 11, clearly discernible differences are apparent in the socio-economic status of the types of zones as defined in terms of their traffic-generating

TABLE 9

LAND-USE TYPES

Scale Type	Description	Definition	No. of Zones
I	Single-family dwellings	> 50 percent acreage in residence but ≥ 60 percent of total acreage in single-family dwellings.	9
II	Multiple-family dwellings	> 50 percent acreage in residence but < 60 percent in single-family dwellings.	8
III	Commercial—mixed	< 50 percent residential and combination of public land and industrial, railroad and commercial ≥ 50 percent of developed acreage.	5

TABLE 10

SOCIO-ECONOMIC STATUS OF SAMPLE ZONES[a]

Scale Value[b]	No. of Zones
2	4
3	5
4	5
5	6
6	3

[a]Based on Guttman-type scale combining occupation and prevailing land use.

[b]The lower the scale value, the higher the socio-economic status.

TABLE 11

RANKINGS OF ZONES DISTINGUISHED BY TRAFFIC-GENERATING POTENTIAL

Type of Zone[a]	Socio-Economic Avg. of Zones
Low	4.6
Medium	3.6
High	2.3[b]

[a]From Table 5. [b]Does not include zones extending outside city limits.

potential. The differences between these zones, if we can assume that the 6-point scale of Table 7 roughly represents the total socio-economic range, is approximately 20 percent. In other words, the socio-economic level of the medium traffic potential type is 20 percent above the low traffic potential type and that of the high type is about 20 percent above the level of the medium type. On the basis of these data some estimation may be made of the extent that increase in socio-economic status, with other factors held constant, may lead to increase in traffic generation.

ESTIMATING INFLUENCE OF INCREASE IN SOCIO-ECONOMIC STATUS ON VEHICULAR TRAFFIC GENERATION

Table 11 provides an index of the range in socio-economic status of present zones. The aim of the report is to estimate how much traffic generation would increase if the number of households in the community remained constant but the socio-economic status of the community were raised. The assumption here, of course, is that changes or rises in national and regional prosperity will be reflected in improvement of the community occupational level and a rise in the level of home ownership represented in the pattern of local residential land use. Occupation and residential land use are the primary dimensions of the scale reported in Table 11.

Any estimate of how national and regional economic trends affect any particular local community must be hypothetical unless some specific relationship has already been established between these two variables. An estimate of the increase in traffic generation in Champaign-Urbana for the decade 1960-1970, for example, would be based on the following assumptions:

1. That the long-run trend of most communities follows the long-run national economic growth represented by the change in the gross national product;
2. That the increase in the gross national product (in constant dollars) of approximately 20 percent for Champaign-Urbana from 1950 to 1960 (8) was paralleled by an equivalent increase in the economic status of the community for this period, and that this increase will be replicated for the decade 1960-1970;
3. That the number of households will remain constant over the 10 years;
4. That the present relation between trips by household to the socio-economic level of the household will remain the same;
5. That since the socio-economic differences between each of the three types is roughly 20 percent, and it is also expected that the economic level of the community will increase 20 percent over the period of 1960 to 1970, each of the two lower zone types will move up during these years to the level of the next higher type;
6. That the high type of zone, with respect to traffic-generating potential as indicated in Table 3, will go to the highest socio-economic level of any zone included in this type; and
7. That the proportion of the community households in each type will remain the same. (The ground for this assumption is that there will obviously be a range in socio-economic levels of the community in 1970, and, since there is no basis for a better estimate, the distribution of the proportions of households at each level will be similar to what it was in 1960 shortly after the household survey.)

Given these assumptions, the steps in the estimation of traffic generation are as follows.

1. Estimate for each type the new number of (a) single-vehicle households and (b) multiple-vehicle households.
2. Estimate the new rate of vehicular trip generation (a) for single-vehicle households and (b) multiple-vehicle households.
3. Total the results for the three types of Steps 2 a and b.
4. Compare the estimated results of Step 3 to results obtained from the original survey in respect to the estimated increase in number of vehicular trips.

The completion of these steps gives the results indicated in Table 12. These estimates are derived by applying the trip-generation rates of 1960 for the households in the next higher type to all households in each zone. In the case of the high type, the rates for the highest zone in this classification were used. The results of Table 12 may be summarized in the form given in Table 13.

TABLE 12

ESTIMATED INCREASE IN VEHICULAR OWNERSHIP TRIP GENERATION, CHAMPAIGN-URBANA, 1960-1970[a]

Type of Zone	No. of Households						Trips			
	No Vehicles		1 Vehicle		2 Vehicles		1-Veh Household		2-Veh Household	
	1960	1970	1960	1970	1960	1970	1960	1970	1960	1970
Low	89	41	180	208	28	44	759	1,144	212	317
Medium	92	26	357	369	78	132	2,077	2,325	565	1,162
High	17	0	239	223	87	120	1,522	1,673	777	1,152
Total	198	67	776	800	193	296	4,358	5,142	1,554	2,634

[a]Based on assumption of no increase in number of households and that increase in vehicular ownership and trip generation can be attributed to general increase in community economic level.

TABLE 13

SUMMARY OF ESTIMATED INCREASE IN NUMBER OF VEHICLES AND VEHICULAR TRIP GENERATION, CHAMPAIGN-URBANA, 1960-1970[a]

Trait	1960	1970	Increase (%)
No. of vehicles	1,162	1,396	8.3
No. of trips	5,912	7,773	24.0

[a]Assuming no increase in number of households.

CONCLUSIONS

The figures in Table 13 provide the conclusions which this report attempts to establish. Since vehicle ownership and trip generation are apparently related to the socio-economic levels of households in the community, if the pattern of vehicle ownership and trip generation of this community at the time of the 1958 O-D survey continues to hold and if the socio-economic levels continue to rise at the existing national rate, there will be an increase of slightly less than 10 percent in the number of vehicles owned by the households at the time of the survey. This increase would result from the acquisition of vehicles by households not possessing them and from households owning one vehicle moving to two-vehicle ownership. At the same time, however, the rate of trip generation would increase as households moved to a higher socio-economic level as a consequence of general economic growth of the society. Consequently, the rate of increase of trip generation would be considerably greater than that of the rate of increase in vehicle ownership by households.

These conclusions appear consistent with the evidence provided by the various phases of this study. The method of demonstration was to select samples representing types of zones whose traffic-generating patterns are clearly delineated in terms of the proportions of potential trip makers actually making trips as reported in the household survey. This procedure was followed because of its analytical precision in revealing social and economic factors associated with trip generation. The survey zones involved in the sample accounted for only about 50 percent of the zones reported in the original survey, but insofar as the sample zones represented the whole range of traffic-generating patterns of the community, it would seem that conclusions based on their characteristics would be adequate descriptions of dimensions of traffic generation for the whole community.

It should be kept in mind that the community in question is specifically a middle-sized city with an atypical economic base. Obviously projection of these findings to traffic generation in general requires further testing on communities of both similar and dissimilar population size. A tentative comparison of these findings with some of the conclusions of the major surveys reported for Detroit and Chicago suggests confirmation of some of the results and differences with others. Continued systematic comparisons of such O-D studies will be necessary to develop the understanding of traffic generation necessary for effective planning for traffic engineering and control.

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