Abridgment

Transit User Identification in an Employer-Based Subsidy Program

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A transit assistance program was provided to all state employees in Iowa to encourage public transit use and to decrease the demand for parking facilities. The state subsidized 50 percent of the cost of monthly passes. The objectives of this paper are to identify the distinguishing characteristics of program subscribers and nonsubscribers and the consistency of factors in different cities. Discriminant analysis models were used to identify the relative importance of socioeconomic, transportation, and attitudinal factors. The most important characteristic for distinguishing between users and nonusers was the attitudinal variable. Socioeconomic factors were generally more important discriminating variables than were transportation supply factors. Transit cost was the policy variable manipulated by the transit subsidy program, but cost differences were not significant in the discriminant models once the attitudinal factor was already included. The discriminant models correctly classified approximately 80 percent of the users and nonusers in the city in which they were calibrated as well as in the other cities studied. The results suggest that, even though the transit service and community characteristics are variable, consistency in the behavioral responses is sufficient to allow transfer of information from city to city. However, the models from the research are not forecasting tools for general application because they are based on nonproportionate sample sizes.

A statewide transit subsidy program was undertaken by Iowa in 1978 to encourage state employees to use public transit. The primary impetus for the program was the desire to reduce the need for parking spaces around the state capitol office buildings in Des Moines. However, the program allowed state employees in all cities to purchase monthly passes at 50 percent below the regular monthly price. In return, the employees were to agree not to park in a state-owned lot. As part of a research project to evaluate the program, an effort was made to identify characteristics that distinguished program subscribers (users) from nonsubscribers (nonusers) (1). The intent was to (a) define the socioeconomic, attitudinal, and transportation supply factors that would improve ridership forecasts and (b) identify characteristics that could be emphasized when developing marketing programs in a unique employee group.

Several researchers have compared the socioeconomic, demographic, transportation, and attitudinal characteristics of traditional transit riders with the characteristics of the nonuser population. However, the relative importance of these factors has been judged to be different in the studies. For example, Hartgen (2) and Howe and Cohen (3) found situational factors to be more important than attitudinal factors. On the other hand, Dobson and Tischer (4) noted that socioeconomic and transportation variables were less important than personal perception for describing behavioral differences. Spear (5) developed a general attitudinal variable related to convenience and noted that the variable increased the goodness-of-fit statistics, but the attitudinal variable did not increase the predictive capability of the model.

The differences in the conclusions from these studies may be attributable to specific differences in survey methodology, analytical tools, trip purposes, or the population subsamples selected for analysis. Because the Iowa subsidy program addressed a unique group of potential riders, we were interested in determining whether program subscribers exhibited the general characteristics attributed to transit riders examined in the more traditional transit market. State employees are not in population groups normally categorized as transit users: They are generally between 18 and 65 years of age, they have higher incomes than average transit users, and they have reasonable access to transportation.

The subsidy program provided an opportunity not only to evaluate subscriber and nonsubscriber differences in one transit system, but the program provided a unique opportunity to evaluate the ridership in different cities in which there were variations in transit and highway system supply.

STUDY DESIGN

Sample Selection

Although employees in 18 cities were eligible to participate in the subsidy program, more than 94 percent of the 1167 subscribers lived in Des Moines (301), Iowa City (768), and Ames (33). The Ames area represented only a small fraction of the total users, but it was included in the analysis because one of the three major state universities and the department of transportation are located there. All users in Des Moines and Ames and 330 users in Iowa City were surveyed. A comparable number of nonusers who live within three blocks of a transit line were also selected. The models used only employees who had access to both automobile and bus modes. The final sample included 99, 98, and 12 subscribers from Des Moines, Iowa City, and Ames, respectively. There were also 75, 26, and 20 nonsubscribers from the same cities.

Variables Included in the Analyses

The socioeconomic data obtained in the surveys were standard elements, including age, sex, family size, employed persons, automobile ownership and availability, and income. Age and income were reported in one of five categories.

Transportation data included automobile and bus travel times and costs as well as waiting, walking, and pick-up times for each mode. Travel times were recorded as one-way times and later translated to round-trip times. Costs were recorded as daily costs including daily parking charges. The daily bus costs were automatically coded by the researchers, who assumed that the subsidized pass was used 20 days/month.

Attitudinal study concepts were used in this study, but no attempt was made to define new psychological constructs based on the factoring of responses from the employees. Instead, we selected a series of statements about service components of automobile and bus travel and measured the affection or bias of the respondents toward the basic modes. The statements selected were based on other research as well as on current issues. The employees were asked to identify the degree to which they agreed or disagreed with statements related to travel time cost, parking issues, fuel savings, and others. Each of the 12 statements was analyzed by using a five-point successive-category scale; a composite score (ATTSUM) was developed to assess the degree to which individuals have positive or negative reactions to bus and automobile travel. The higher the ATTSUM score (maximum of 60), the more positive was the reaction to public transit.

The variable definitions are cited in the list below. Note that all times are in minutes for a one-way trip. The line-haul time is total time minus excess time.

BTT--Total bus travel time;
BWA--Bus walking and waiting time (excess time);
AUTT--Total automobile travel time;
AUPUT--Automobile pick-up and walking time (excess time);
TIMDF--Time difference (BTT minus AUTT);
COSDF--Cost difference in cents (daily bus costs minus automobile costs);
LHDF--Line-haul time difference (bus time minus automobile time);
ATTSUM--Composite attitude score;
AGE--Age (five categories, converted to years in the tables);
SEX--Sex;
FS--Family size;
EMP--Number of other household members who are employed;
LIC--Licensed driver (yes or no);
CAR--Number of cars, pickups, and vans in the household;
AVA--Automobile availability for the work trip (yes or no);
INC--Income (five categories, converted to dollars in the tables);
BLK1--Number of blocks from home to bus stop;
BLK2--Number of blocks from bus stop to office; and
TRF--Transfer required (yes or no).

The average reported values are shown in Table 1. The program subscribers were noted to possess characteristics similar to those of the traditional transit rider. The users are generally younger, from smaller families that have lower automobile ownership rates and lower incomes than the nonusers. Also, subscribers perceived automobile time and costs to be greater than did nonusers, and nonusers perceived bus times to be longer than did the users. In actuality, the researchers could not identify any reason for real differences to exist in these elements.

DISCRIMINANT ANALYSIS IN CHOICE BEHAVIOR

The modeling objective for this research was to focus on employee characteristics that could be used to identify those employees who would be most likely to participate in the transit assistance program. The actual coefficients of a particular model were not the major concern because the employee sample being analyzed did not represent a sample of the entire employee population. Therefore, the model was not expected to be directly applicable to other general populations. The discriminant model, which addresses the principal objective of group classification, was used in this study.

The statistical package for the social sciences (SPSS) computer program DISCRIMINANT was used to develop the models and the statistical measures. The overall models were evaluated by chi-square statistics. Because it is possible to have an overall model that is highly significant, but contains variables that do not make a significant contribution to the discriminating power of the model, individual F-statistics are computed for each variable. Any variable that is not important at a specified significance level may be eliminated. During the exploratory phases the researchers allowed liberal inclusion levels in order to determine the general order of importance of the explanatory variables. The variables that were significant at the five percent level or better are marked in the tables.

Discriminant Model Results

Several models were developed that allowed different combinations of variables to enter the equation in each of the cities. Table 2 shows the results of the models that allowed all variables to enter the model; however, only the variables entered at the 0.05 significance level are shown. The predominant variable in the discriminant function for all cities was the attitudinal variable. None of the transportation characteristics were significant in Des Moines and only bus travel-time factors distinguished between users and nonusers in Iowa City and Ames. BWA was a significant deterrent to nonusers in Iowa City, where peak-period headways average 30 min and where there are more transfers required than in Des Moines, where headways are 15 min. The Ames model included BTT, but an anomaly was noted. Although BTT entered the model after ATTSUM was already included, the differences between users' and nonusers' BTT were not significant when analyzed alone.

Transportation cost, the policy variable manipulated by the subsidy program, was never a significant discriminator once the attitudinal factor was included. Therefore, other models were constructed to force this cost variable into the model. Those models suggested that the average nonuser placed a value on time that exceeded the bus cost savings even if the fare had been zero.

Model Consistency Between Cities

The models were able to classify approximately 80 percent of the employees into the correct user and nonuser group in each city. Researchers had hypothesized that sufficient behavioral similarities existed among employees such that information obtained from the employees in one city might be applicable for estimating travel choices in other cities. The hypothesis was tested by applying the discriminant model for each city in the other two cities. This is equivalent to a hold-out sample used to verify an original model, but it is even more demanding because the samples were not selected from the same populations. The degree to which a model correctly classifies users and nonusers in other cities was taken as a measure of transferability of the models.

The results are given in Table 3. One finds generally favorable, but not overwhelming, capability in classifying employees in cities other than the one for which the model was developed. Five of the 12 cells are either no better than or significantly poorer than a random choice, 50-50 assignment. However, three of those five cells are from predictions in Ames or by using the Ames model. We noted earlier that the sample size here was small and that an internal inconsistency was evident in the model. These discrepancies were, therefore, not considered further. The greater concern was that the Des Moines model underpredicted Iowa City nonusers, and the Iowa City model underpredicted Des Moines and Ames users. To try to identify why this happened, a case-by-case review of every nonuser in Iowa City whom the Des Moines model had predicted to be a user was completed. The review indicated that 8 of the 14 nonusers who were misclassified had positive attitudes toward the service, which caused the models to classify them as

Table 1. Average statistics for independent variables considered in discriminant models.

	Des Moines		Iowa City		Ames	
Variable	User	Nonuser	User	Nonuser	User	Nonuser
BTT	33.4	42.5	24.1	27.9	23.7	25.1
BWA	9.1	10.9	6.7	10.5	8.5	10.0
AUTT	19.2	17.9	15.4	13.2	13.7	10.6
AUPUT	5.0	4.2	5.2	3.6	3.8	3.1
TIMDF	14.2	24.6	8.6	14.7	10.0	14.4
COSDF	-90.9	-57.3	-103.5	-71.4	-25.0	-24.4
LHDF	10.1	17.8	7.2	7.8	5.3	7.6
ATTSUM	46.1	37.2	48.5	41.3	43.5	34.8
BLK1	1.5	2.0	0.9	1.5	1.5	1.8
BLK2	1.2	1.1	1.1	1.4	0.7	1.6
AGE	38	42	33	40	42	43
SEX, male %	50	50	42	65	67	80
FS	2.2	2.6	2.6	2.5	2.3	2.4
EMP	0.7	1.0	0.7	0.7	0.8	0.9
LIC, yes %	100	100	99	96	100	95
CAR	1.5	1.8	1.4	1.5	1.5	1.6
AVA, yes %	90	100	89	96	90	100
INC, $000s	21.9	25.1	18.7	27.3	25.8	26.0

Table 2. Summary of discriminant analysis.

City	Variables Included in Model, in Order[a]	Residual Variance (%)	Percentage Classified Correctly	
			User	Nonuser
Des Moines	ATTSUM, CAR, AGE	54	80	84
Iowa City	ATTSUM, INC, BWA	62	81	77
Ames	ATTSUM, BTT, BLK2	44	100	80

[a]Variables were significant at the 0.05 level.

Table 3. Transferability of model results among cities.

City	Group Classified	Percentage of Correct Classifications for Models		
		Des Moines	Iowa City	Ames
Des Moines	User	80	57	94
	Nonuser	84	91	23
Iowa City	User	92	81	95
	Nonuser	46	77	30
Ames	User	75	25	100
	Nonuser	85	90	80

users; but, in fact, they could not use the bus due to personal or work-related conditions. In effect, these persons did not have the transit choice available that was assumed to exist by the researchers.

Overall, the percentage of correct classification was 78 percent. The weighted average is nearly the same as the value obtained from the models applied only in the city in which they were calibrated.

SUMMARY AND CONCLUSIONS

In this research the attitudinal responses of employees were predominant in the models for classifying employees into user and nonuser groups. The models correctly classified approximately 80 percent of the cases in each user group and the classification capability fell off only slightly when the models were applied in different cities.

This research began after the subsidy program was initiated so the models discussed here are not truly forecasting. The cause and effect relationship between response pattern and mode choice can never be truly established; however, we thought that the detailed modal response developed in the study can assist the planner in identifying ridership potential much more effectively than would the "would you ride if" questions frequently used. It is recommended that employees could be grouped by using the current transit riders as the user group base. Employees who responded in patterns similar to transit riders would represent the market segment most likely to try transit when offered an incentive. A follow-up analysis indicated the possibility of using mean and variance data rather than the more sophisticated discriminant models. A cut-off point for participation was estimated to be one standard deviation unit below the mean ATTSUM score of the current bus users. By using this base, approximately 80 percent of the Des Moines respondents would have been classified correctly.

ACKNOWLEDGMENT

This research was sponsored by the Office of Policy Research, Urban Mass Transportation Administration. Additional support was provided by the Engineering Research Institute, Iowa State University. The Public Transit Division of the Iowa Department of Transportation contributed invaluable assistance by providing preliminary data and transit user listings.

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Publication of this paper sponsored by Committee on Public Transportation Planning and Development.