# NEW JERSEY'S LINKS TO THE 21ST CENTURY: MAXIMIZING THE IMPACT OF INFRASTRUCTURE INVESTMENT

**Working Paper No. 11**

## MULTIVARIATE ANALYSIS OF THE RELATIONSHIP BETWEEN TRANSIT ACCESSIBILITY AND RESIDENTIAL LOCATION CHOICE

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**February 8, 2002**

*Partial support for this study has been provided by the United States Department of Transportation and the New Jersey Department of Transportation, through a grant to the City College of New York, Rutgers University and Dowling College through the University Transportation Research Center. The views and opinions stated herein are the opinions of the authors.*

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# MULTIVARIATE ANALYSIS OF THE RELATIONSHIP BETWEEN TRANSIT ACCESSIBILITY AND RESIDENTIAL LOCATION CHOICE

## INTRODUCTION

The importance of commuter rail as a transit mode has increased with the expansion of services to new metropolitan areas, such as San Diego, Los Angeles, South Florida, Dallas, and Washington, D.C., and with the expansion of existing services in areas of New York, Chicago, Boston, and San Francisco. This expansion of services can have economic impacts in the communities served by rail stations. Some of the economic impacts of a commuter rail service have been studied. The overall impact of a commuter rail station in single-family residential property values located near of the station can range up to an increase of 6.7 percent (Armstrong, 1996).

Other economic impacts of a commuter rail service are the benefits associated with the relocation of residents and workers in order to take advantages of the accessibility offered by a new or improved commuter rail service. The objective of this research is to conduct an investigation on the impacts of transit accessibility changes upon residential location.

### *Scope*

This research focuses on the analyses of the impacts of transit accessibility changes upon residential location choice as captured in a survey of rail transit users. The target population is a sample of users of the Midtown Direct, a rail transit improvement project built by New Jersey Transit (NJT) in 1996 that reduced the travel time from selected origins to New York City by 20 minutes. Following the opening of the Midtown Direct, New Jersey Transit conducted a survey that revealed that 8% of the respondents had changed residence "because of the Midtown Direct." The NJT 1996 survey was complemented with another survey conducted by the staff of the City College of New York (CCNY) in 2001. The data set used in this research consists of the responses from these two surveys.

The main objective of this project was to develop a model that would explain the choice of Midtown Direct users to relocate in response to the improvement in transportation to New

York City.. The modeling process used the data gathered from the different surveys. The data set contained information about four major areas:

a) Socio-economic attributes of the decision maker;

b) Attributes of the previous and current neighborhood,

c) Ease of access to jobs or business, including reduction in travel time that would cause the respondents to move from their previous neighborhood, and

d) Importance ratings of the different variables described above.

The modeling component of this research has been conducted using a host of behavioral and multivariate models, including discrete choice models (Binary Logit and Probit) and Discriminant Analysis. Discrete choice models, which are based on random utility theory that postulates that individuals make decisions so as to maximize their utility, were deemed appropriate to capture the decision to locate residence. On the other hand, Discriminant Analysis finds a linear combination of predictor variables that best discriminates between variable-groups.

## *Background*

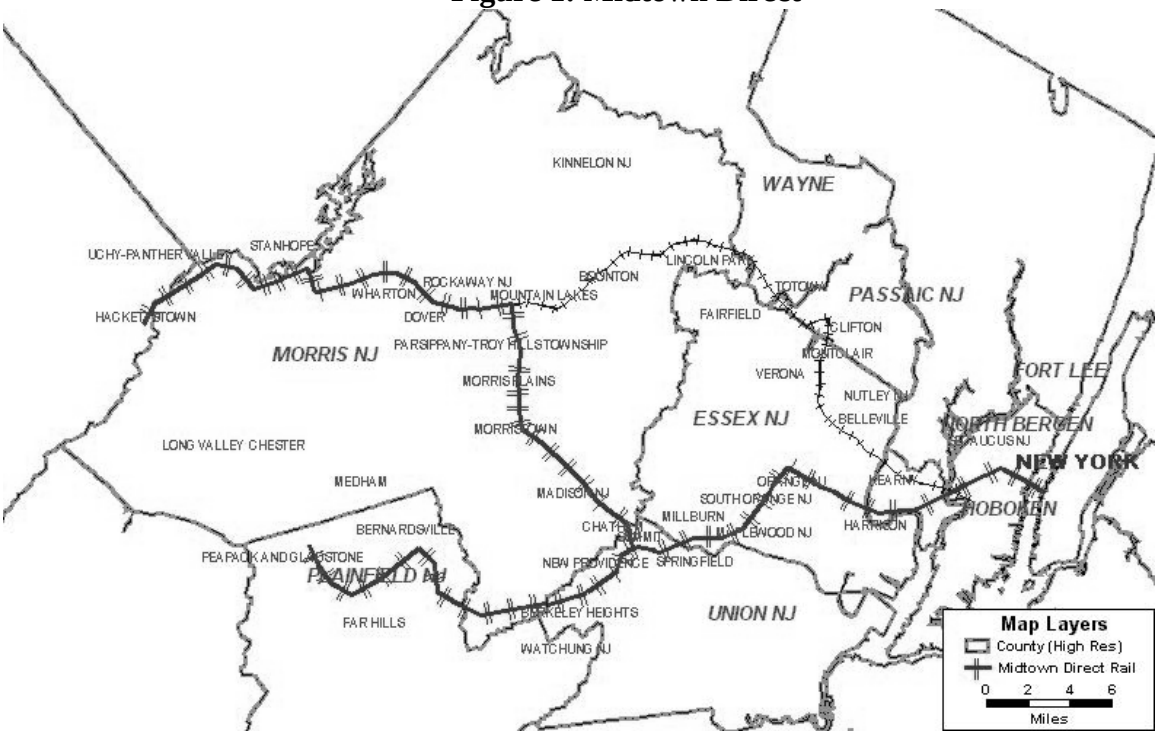
### The Midtown Direct service and its impacts

The Midtown Direct (MD) service started in 1996 over a new rail connection which allows direct access from a major branch of New Jersey Transit's rail system to Midtown Manhattan (Figure 1). The Morris and Essex (M&E) is an electrified rail service with three branches, 39 stations and 69 km of track, which previously operated to Hoboken, NJ To reach New York City, riders had to transfer at Hoboken to either the Port Authority Trans Hudson (PATH) rapid transit system or ferry service to reach Lower and Midtown Manhattan. After the completion of the new connection in June 1996, riders can travel directly to Penn Station in Midtown Manhattan via Midtown Direct. Besides eliminating the transfer, MD service saves 15 to 20 minutes of travel time for commuters to Midtown.. Following the opening of the MD, NJT conducted an analysis of its impacts upon the local economy, as documented in Marchwinski (1997).

In November 1996, five months after the new service was opened, NJT conducted a survey of 6,000 Eastbound (New Jersey –to New York) peak period riders. The total ridership on

the Morris and Essex branches before MD was 16,000 riders/day; after the rail service improvement there was an increased of 2,400 riders/day. The survey had a 40% response rate. Some 54% of the respondents were regular riders before and after the institution of MD. Eight percent (8%) of the respondents indicated that they had relocated their residence because of the MD rail service. Based on the survey, Marchwinski assessed the local economic impacts of MD to communities in the proximity of the rail.

**Figure 1: Midtown Direct**




The following are Marchwinski's key findings:

- About 40.5 percent of rail riders stopped at stores or services within 800 meters (0.5 mi) radius of the boarding station (800 m radius is defined by NJT staff as the primary rail station's impact area). In the 38 primary impact station areas along M&E, the riders spent $16.74 per rider per week, which makes a total of $20.7 million per year. New riders spent approximately 30 percent more per rider than the existing riders.

- The improvement in the rail service induced 2,400 new rail riders in the first five months (November 1996). A year later, in 1997, the ridership had increased by 20%.
- The mean annual household income of new riders was $111,300, 8% higher than the existing riders ($102,700).
- 8% of the respondents stated that they relocated their residence because of the MD rail service.

***Data sources used in the analysis***

This paper is based upon two different data sources. The first one is the original 1996 survey described by Marchwinski and the second is the 2001 survey conducted by CCNY.

**NJT 1996 survey**

The NJT 1996 survey was comprised of 41 questions about travel patterns on a typical day for trips from New Jersey to New York or trips within New Jersey. The questionnaire includes questions about (the survey instrument is shown in Appendix I):

1. Origin and destination for one-way and return trips
2. Mode of transportation for access to the station and alternative modes used
3. Trip purpose, trip length and travel time to station
4. Frequency of travel
5. Out of pocket cost (parking)
6. Mode of transportation used before MD
7. Before and after scenario with respect to travel time from origin to destination
8. Rating of service attributes for MD rail service and station accessibility
9. Frequency of visits to stores and, expenditures
10. Socioeconomic characteristics (demographics)
11. Whether the respondent moved because of Midtown Direct rail improvement.

This last question was of particular interest to the relocation of residence.

**Complementary 2001 survey**

The 1996 survey collected by NJ Transit had an important limitation for residential choice modeling; it did not collect information about the attributes of the "previous" and the "current" neighborhoods. In order to gather this information, the City College of New York (CCNY), as part of a project funded by the New Jersey Department of Transportation (NJDOT) and the United State Department of Transportation through the University Transportation Research Center (UTRC) designed a revealed preference (RP) survey to gather data about the key characteristics of the respondent's neighborhoods. The 2001 survey was sent to 1,242 regular riders selected from the NJT survey. The 2001 CCNY survey is shown in Appendix II. The survey had 22% of response rate.

This survey had four main sections:

1) Attributes of the neighborhood: information about home ownership, value, and the size of current and previous residence.
2) Rating of neighborhood services, which was divided in tree subsections:
    a. ease of access to institutions and services,
    b. quality rating of neighborhood conditions and,
    c. importance rating of ease of access and quality of neighborhood to the respondents
3) Travel time savings: reduction in travel time that would cause the respondents to relocate from their previous home.
4) Socioeconomic characteristics of the respondents

**Sample population**

The 2001 survey was mailed to two groups all of whom were respondents of the 1996 NJT survey: (a) 242 regular users of MD who specified they had moved because of the MD rail service improvement, and (b) 1,000 randomly selected respondents that stated they did not move because of the rail improvement (see Figure 2). The set (a) is referred to as "movers" and the set (b) is referred to as "non-movers". The survey was sent in three rounds, the first round to the movers (242), the second (500) and third (500) round to the non-movers. For each survey, reminders (with additional surveys) were sent to non-respondents (see Figure 3).

Of the 1,242 surveys mailed, 231 completed (i.e., 90% of the questionnaire was filled in) were returned. Of the 231 responses, 20 were not included in the analysis because the data corresponding to the 1996 survey were missing.

The final data set used in this analysis corresponds to 211 regular riders of MD rail who made home-based trips. Of these, 31 stated they had moved because of the MD service improvement and the rest had not move or had not moved because of the MD service improvement.

The breakdown of the responses for both the NJT 1996 and the CCNY 2001 surveys are shown in Figures 2 and 3.

The demographics of the sample compared to the earlier survey and compared to the population of Northern New Jersey are described in Working Paper # 10.

## Figure 2: Supplementary survey sampling structure

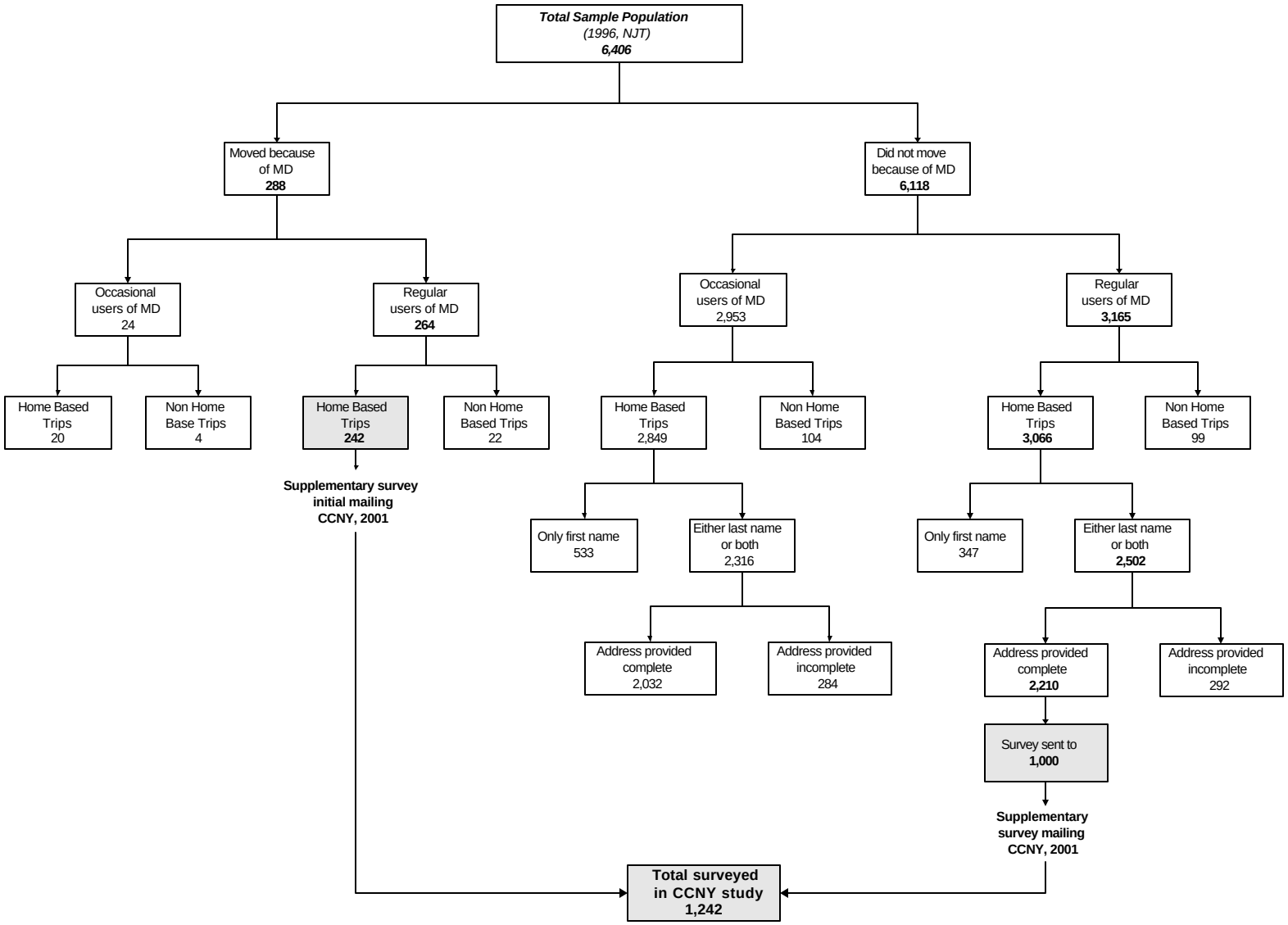
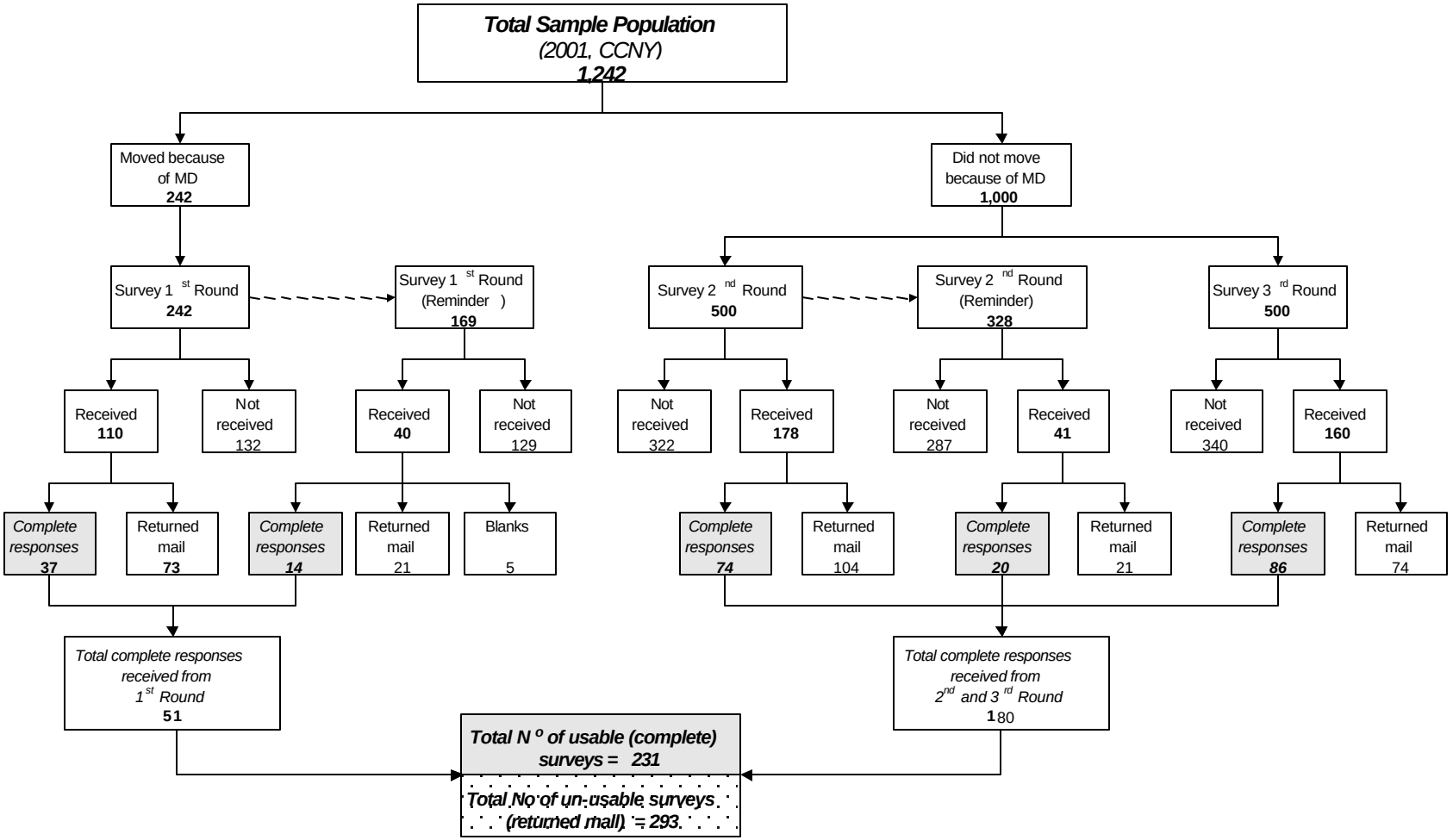


**Figure 3: Sampling population and responses to supplementary survey (CCNY, 2001)**



# METHODOLOGY

This section describes, in general terms, the methodology used in the modeling process. In the first part of the section, the major steps followed (i.e., definition of variables, transformation of variables, estimation of sampling weights used in Logit and Probit models, and model estimation) are described. In the second section, a brief summary of the modeling approaches is provided. Limdep version 7.0 was used to estimate the Binary Logit and Probit models. SPSS version 10.1 was used to estimate the discriminant function.

### *Definition of variables*

The dependent variable in this analysis is the respondent's decision to move or not to move (MOV), which has been represented as a binary variable equal to 1 if the respondent moved and 0 otherwise. The independent variables and acronyms corresponding to socioeconomic characteristics of the respondents, importance rating, ease of access and, quality rating are listed in Table 1, Table 2 and, Table 3 respectively.

**Table 1: Socio-economic characteristics**

| Independent Variables | Description |
|---|---|
| *Socio-economic characteristics* | |
| P_OWNER | Previous owner |
| HH_SIZE | Household size |
| HH_EMP | # of workers in household |
| V_OWN | Vehicle ownership |
| SINGL | Single without children |
| SINGL_CH | Single with children |
| MARR_CH | Married with children |
| MARR_NCH | Married with no children |
| PRIM_SCH | Primary School |
| M_SCH | Middle School |
| H_SCH | High School |
| COLLEGE | College |
| GRAD | Graduate |
| AGE | Age |
| HHINC | Household Income |

**Table 2: Importance rating**

| *Importance rating (current - previous)* | |
|---|---|
| *Varible is 1 to 5,* | |
| *with 5 representing very important* | |
| ACCJOB_R | Access to job or bussiness |
| SEC_R | Neighborhood security |
| PARK_R | Parking availability |
| APOLL_R | Air pollution |
| RECREA_R | Access to recreation facilities |
| RENTC_R | Rental costs |
| ACCSCH_R | Access to school |
| ETHNIC_R | Same ethnicity as neighbors |
| RELG_R | Religious Institutions |
| MEDS_R | Access to medical services |
| REALST_R | Real state value |
| CLEAN_R | Cleanliness of streets |
| SHOP_R | Access to shoping malls |
| WRAMP_R | Wheel chair ramp |
| PARKCH_R | Parking charges |
| NPOLL_R | Noise pollution |
| CONG_R | Congestion concerns |
| SIDEW_R | Sidewalk sufficiency |
| TSTAT_R | Access to transit stations |

**Table 3: Ease of access and quality conditions of the previous and current neighborhood**

| **Independent Variables** | **Description** |
|---|---|
| DTIME | Reduction in travel time that would causethe respondent to move from their previous home (2001 survey) |
| *Ease of access (current - previous conditions)* | |
| *Varible is 1 to 5, with 5 representing very easy* | |
| SCH_AC | School |
| MEDS_AC | Medical Services |
| EMGS_AC | Emerging Services |
| JOB_SC | Job or bussiness |
| SHOP_AC | Shopping mall |
| RECR_AC | Recreational facilities |
| RELG_AC | Religious Institutions |
| *Quality Rating of conditions in neighborhood (current - previous conditions)* | |
| *Varible is 1 to 5, with 5 representing very good* | |
| CONG_Q | Traffic congestion |
| SIDEW_Q | Sidewalk sufficiency |
| TSTAT_Q | Transit stations availability |
| PARK_Q | Parking availability |
| APOLL_Q | Air pollution |
| SEC_Q | Security |
| CLEAN_Q | Cleanliness of streets |
| RACIAL_Q | Racial concerns |
| REALST_Q | Real state value |
| WRAMP_Q | Wheel chair ramp |
| TWORK_Q | Transportation to work |
| PARKCH_Q | Parking charges |
| NPOLL_Q | Noise pollution |

***Transformations of variables***

An important component of mathematical modeling is to ensure that the mathematical scales used for the analysis are consistent with the properties of the real-life phenomenon. For a scale to be representative, it should establish an isomorphic relation between the characteristics of the real world and the elements comprising the scale (Holguín-Veras, 1997). There are four types of scales: (1) nominal; (2) ordinal; (3) interval; and (4) ratio. Table 4 summarizes the characteristics of the different scales and the permissible mathematical operations.

**Table 4: Scales of measurement (Holguín-Veras, 1997)**

| Scale | Characteristics | Permissible mathematical operations |
|---|---|---|
| Nominal | Identity | Operations concerning modes and counting frequency |
| Ordinal | Identity<br>Order | Modes, frequencies, medians, percentiles, and order correlation |
| Interval | Identity<br>Order<br>Distance | Modes, frequencies, medians, percentiles, order correlation, mean, standard deviation, product-moment, skewness, and correlation (correlation coefficient is not allowed because it depends on the origin) |
| Ratio | Identity<br>Order<br>Distance<br>Natural Origin | All of the above |

In this particular project, the research team had ensured that the variables used in the analysis were properly treated. This necessitated the following:

- The variable Gender was transformed to FEMALE, which had a value of 1 for female respondents and a value of 0 otherwise.
- Variables such as MARITAL STATUS and EDUCATION, which are nominal scales with multiple categories, were represented by sets of (n-1) binary variables, where n is the number of categories. This process is described next.
- MARITAL STATUS has four categories: single, single with children, married with children and married with no children. Tree new variables were defined: SING_CH, MARR_CH and, MARR_NCH. Their values are presented in Table 5.

**Table 5: Binary variables used to describe Marital Status**

| Variable | Categories | | | |
|---|---|---|---|---|
| | *Single* | *Single with children* | *Married with children* | *Married w/no children* |
| *SINGL_CH* | 0 | 1 | 0 | 0 |
| *MARR_CH* | 0 | 0 | 1 | 0 |
| *MARR_NCH* | 0 | 0 | 0 | 1 |

- The variable EDUCATION has five categories: primary school, middle school, high school, college and graduate. Four new variables were defined: M_SCH, H_SCH, COLLEGE, and GRAD. Their values are shown in Table 6.

**Table 6: Binary variables used to describe Education**

| Variable | Categories | | | | |
|---|---|---|---|---|---|
| | *Primary school* | *Middle school* | *High school* | *College* | *Graduate* |
| *M_SCH* | 0 | 1 | 0 | 0 | 0 |
| *H_SCH* | 0 | 0 | 1 | 0 | 0 |
| *COLLEGE* | 0 | 0 | 0 | 1 | 0 |
| *GRAD* | 0 | 0 | 0 | 0 | 1 |

- Income (HHINC), differential of time 2001 (DTIME), and age (AGE) are ratio scales that in order to be used have to be transformed to numerals. DTIME refers to the reduction in travel time that would cause the respondents to relocate from their previous residence. The value for these variables is the mid value of the category as is illustrated in Table 7.

**Table 7: Variables used to describe Age, Income and Differential of time**

| Age | | Income | | Differential of time | |
|---|---|---|---|---|---|
| *Category* | *Value* | *Category* | *Value* | *Category* | *Value* |
| < 20 | 18 | < 15,000 | 11,500 | N/A | 999 |
| 20 to 25 years | 23 | $15-24,999 | 20,000 | < 10 minutes | 8 |
| 26 to 30 years | 28 | $25-34,999 | 30,000 | 10 to 20 minutes | 15 |
| 31 to 36 years | 34 | $35-49,999 | 43,000 | 21 to 25 minutes | 23 |
| 37 to 45 years | 41 | $50-74,999 | 63,000 | 26 to 30 minutes | 28 |
| 46 to 55 years | 51 | $75-99,999 | 88,000 | 31 to 45 minutes | 38 |
| 56 to 65 years | 61 | $100-124,999 | 113,000 | 46 to 60 minutes | 53 |
| 66 to 75 years | 71 | $125-149,000 | 138,000 | Over 60 minutes | 60 |
| > 75 years | 75 | > $150,000 | 155,000 | | |

The variables measuring the different attributes of the neighborhoods (before and after) were taken into account in terms of the difference between their values for the before (old neighborhood) and after (new neighborhood) condition. This transformation was applied to the variables that measure: a) ease of access to institutions and services; b) quality rating of neighborhood conditions; and c) how important are the ease of access and quality of neighborhood to the respondent. For example, the variable "Access to School" (SCH_ACC) is equal to the rating of school access in the current neighborhood minus the rating of the school access in the previous neighborhood.

In addition to the variables directly captured in the survey, interaction terms between the quality ratings and importance ratings were included. These interaction terms were considered in the Binary Probit and Discriminant Analysis models. Table 8 shows the definition of these variables.

**Table 8: Interaction terms**

| **Independent Variables** | **Description** | **Definition** |
|---|---|---|
| *Interaction terms* | | |
| ACCJOB_I | Access to job or bussiness | ACCJOB_R*JOB_AC |
| SEC_I | Neighborhood security | SEC_R*SEC_Q |
| PARK_I | Parking availability | PARK_R*PARK_Q |
| APOLL_I | Air pollution | APOLL_R*APOLL_Q |
| RECREA_I | Access to recreation facilities | RECREA_R*RECR_AC |
| ACCSCH_I | Access to school | ACSCH_R*SCH_AC |
| RACIAL_I | Same ethnicity as neighbors | ETHNIC_R*RACIAL_Q |
| RELG_I | Religious Institutions | RELG_R*RELG_AC |
| MEDS_I | Access to medical services | MEDS_R*MEDS_AC |
| REALST_I | Real state value | REALST_R*REALST_Q |
| CLEAN_I | Cleanliness of streets | CLEAN_*CLEAN_Q |
| SHOP_I | Access to shoping malls | SHOP_I*SHOP_AC |
| WRAMP_I | Wheel chair ramp | WRAMP_R*WRAMP_Q |
| PARKCH_I | Parking charges | PARKCH_R*PARKCH_Q |
| NPOLL_I | Noise pollution | NPOLLR*NPOLL_Q |
| CONG_I | Congestion concerns | CONG_R*CONG_Q |
| SIDEW_I | Sidewalk sufficiency | SIDEW_R*SIDEW_Q |
| TSTAT_I | Access to transit stations | TSTAT_R*TSTAT_Q |

***Sampling weights***

The data from the survey of 2001 (211 respondents) corresponds to a sample population of 3,308 regular users of MD that made home base trips (survey of 1996). Since the proportion of both samples was not the same, sampling weights were used to correct the sample in order to

make it representative of the population (based on the 1996 survey). Table 9 shows the sampling weights for movers and non-movers.

**Table 9: Weights based on 1996 and 2001 survey**

| Regular users of MD | Regular users of MD Home Based Trips | | | | |
|---|---|---|---|---|---|
| | *1996* | | *2001* | | *Weights* |
| | *Count* | *%* | *Count* | *%* | |
| *Movers* | 242 | 7.32 | 31 | 14.69 | 0.4979 |
| *Non-movers* | 3066 | 92.68 | 180 | 85.31 | 1.0865 |
| *Total* | 3308 | 100 | 211 | 100 | |

***Brief review of modeling approaches***

Three modeling approaches were used to describe the decision-making behavior of the travelers: (a) Binary Logit; (b) Binary Probit; and (c) Discriminant Analysis. This section describes each of these approaches.

**Discrete choice models**

Binary Logit and Binary Probit models belong to the family of Discrete Choices Models. These models are based on the Random Utility Theory, which postulates that when individuals choose among a number of alternatives, they are assumed to choose the alternative with greatest utility for them (Ortúzar, 1994). The utility is assumed to have two components:

$$U_{in} = V_{in} + e_{in} \quad (1)$$

Where:

$U_{in}$ is the utility of the alternative $i$ for the individual $n$, $V_{in}$ is the systematic component and $\varepsilon_{in}$ is the random component.

$$U_{in} = U(Z_{in}, S_n) \quad (2)$$

Where:

$Z_{in}$ represents the attributes of the alternative $i$ that are available to the individual $n$, and $S_n$ represents the socio-economic characteristics of individual $n$.

The utility of choice *i* for individual *n* can be stated as:

$$U_{in} = {}_0 + b_1 x_{in1} + \ldots + b_k x_{ink} + e \qquad (3)$$

Where $\beta_o$ through $\beta_k$ are the unknown parameters, $X_{in1}$ through $X_{ink}$ are the independent variables and $\varepsilon_{in}$ is the random error.

The probability of choosing alternative *i* from a set of alternatives *i and j* is equal to the probability that the utility of alternative *i* to the individual is greater than the utility of alternative *j* to the same individual.

$$\Pr(i) = \Pr(U_{in} \geq U_j) = \Pr[(V_{in} - V_{jn}) > (e_{jn} - e_{in})] \qquad (4)$$

If $(\varepsilon_{jn} - \varepsilon_{in})$ is logistically distributed the result is Binary Logit.

If $e_{jn}$ and $e_{in}$ are both normal with a mean of zero and an arbitrary covariance matrix, the result is Binary Probit. The probability that an individual chooses alternative *i* is:

$$\text{Prob}(i) = \frac{e^{V_i}}{\sum_{j=1}^{J} e^{V_j}} \qquad (5)$$

Discrete choice models are disaggregate models which take into account individual characteristics. Market shares can be obtained from equation 6, that indicates that the probability that a set of individuals choose to relocate [*Prob (i)*] is the summation of the probability to relocate of each individual [*P(i)*] divided by the total number of individuals [N].

$$\text{Prob}(i) = \frac{\sum_{n=1}^{N} P(i)}{N} \qquad (6)$$

The basis for model selection was two-fold: statistical significance and conceptual validity. The *t-statistic* was used to determine the statistical significance of the model parameters. The conceptual validity was accessed by deciding if the independent variables with statistical significance had conceptually correct signs.

To test the statistical significance, the critical *t* value (±1.96) was specified for a two-sided test. This is based on 50 independent variables against 211 observations, and therefore the degree of freedom is 211-50 or greater than 120.

**Discriminant Analysis**

The objective of discriminant analysis, a multivariate technique developed by Fischer (1936) as a classification procedure, is to obtain the linear combination of independent variables, i.e., predictors, that minimizes the probability of mis-classification. Once successfully estimated based on an initial calibration data set, the discriminant function is used to classify other observations. Discriminant analysis has been used numerous times in transportation. It has been applied to valuation of commuters travel time (Lisco, 1967), modeling pavement serviceability (Holguín-Veras, 1997), among many other applications.

Figure 4 shows a conceptual representation of a discriminant function. The independent variables X and Y (the predictors) are measured along the x and y axes, while the black or white coded circles represent the actual observations. As shown in Figure 4, use of either X or Y as the classification variable would result in a significant probability of mis-classification (determined by the overlap of the probability distributions). The probability of mis-classification is minimized when the variance within each group is minimized and the axis is rotated along the discriminant function, A-A' in the figure.

In Discriminant Analysis, a discriminant function, based on a linear combination of predictor variables (i.e., observed characteristics) that provide the best discrimination between groups, is computed from a sample whose group membership is predefined. The functions can then be applied to new observations with unknown group membership. In two-group discriminant analysis (movers and non-movers) it is necessary to examine whether a set of variables is capable of discriminating between two groups. As a result, we search for a linear combination of the discriminating variables in such a way that the two groups are maximally distinguished (Tacq, 1997). This linear combination is called discriminant function and generally has the following form:

$$D - \overline{D} = k_1(X_1 - \overline{X_1}) + k_2(X_2 - \overline{X_2}) + \ldots + k_p(X_p - \overline{X_p}) \qquad (7)$$

or

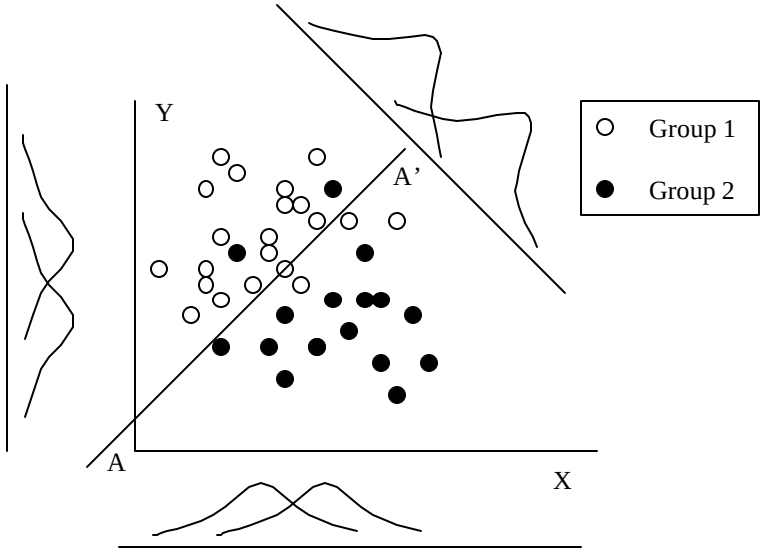
$$d = k_1 x_1 + k_2 x_2 + ... + k_p x_p \quad (8)$$

Where:

$d$ and $x_i$ are expressed as deviations of the mean. The coefficients $k_i$ are called discriminant weights. The variables $x_1$ to $x_p$ are discriminating variables.

After the discriminant function is estimated, the next steps are analysis and classification. In the analysis phase, the $x$ variables are tested to determine the extent they are capable of discriminating among the groups. In the classification phase the discriminant function is examined to test if it is a good predictor of the cases considered in the calibration. Next, new observations can be classified to the different groups (Tacq, 1997).

**Figure 4: Schematic of discriminant model**




The discriminant analysis model does not rely upon behavioral assumptions. Instead, it tries to exploit the multivariate clustering patterns embedded in the data.

**Stepwise selection of variables**

There are three stepwise selection techniques used to delete or add variables: forward selection, backward elimination, and stepwise selection. These techniques are briefly described next.

*Forward selection*. At each step all variables are reviewed and evaluated to determine which one will contribute most to the discrimination between groups. This variable is the one

that maximizes the partial F-statistic based on Wilks'λ (Rencher, 1995). The variable will then be included in the model, and the process starts again.

*Backward elimination.* In this case all variables are included in the model and then, at each step, the variables that contribute least to the prediction of group are eliminated (Rencher, 1995).

*Stepwise selection* is a combination of the forward and backward procedures. Variables are selected one at a time, and at each step, the variables are reexamined to see if any variable that entered earlier has become useless in the presence of recently added variables (Rencher, 1995). The respective F to enter and F to remove values guide the stepwise procedure. The F value is a measure of the extent to which a variable makes an unique contribution to the prediction of group membership.

In order to evaluate the statistical significance of the discriminant function and the discriminators (independent variables that are included in the discriminant function), it is necessary to conduct the following tests: Wilk's Lambda, Eigenvalue, Mahalanobis Distance, Canonical Correlation and F Statistic.

# RESULTS

In this section the analyses and results of the three modeling approaches are presented. The adequacy and appropriateness of the models are assessed on the basis of their statistical significance, conceptual validity, and explanatory power.

***Binary Logit***

In the first model, all the variables were tested and those variables with a low t-statistic were rejected. The statistical significance and the conceptual validity of nine models were tested until a final model, statistically significant and conceptually valid, was obtained. The models resulting from this process are shown in Appendix III, and the best model from this group is shown in equation (9) below. The utility function for "Non-Movers" was assumed to be, for estimation purposes, equal to zero. Its classification ability is shown in Table 10:

$$V_{MOV} = 2.235 - 0.109AGE \qquad (9)$$
$$(1.566) \quad (-3.162) \qquad \text{(t-statistic in parenthesis)}$$

**Table 10: Classification ability of Binary Logit model**

| Actual | Group membership | | Total |
|---|---|---|---|
| | Non-movers | Movers | |
| Non-movers | 180 | 0 | 180 |
| Movers | 31 | 0 | 31 |
| Total | 211 | 0 | 211 |

Comments:

This model is statically significant and conceptually valid but it has an extremely poor explanatory power. Although predicting correctly the decision of non-movers, the model completely failed to replicate the choice to relocate by movers. For that reason, the model is rejected.

***Binary Probit***

The Binary Probit model was applied both without and with interaction terms. As with the binary logit procedure, variables with a very low t-statistic were rejected. , The models resulting from this process are presented in Appendix IV. The best models , first without interaction terms and second with interaction terms, were:

$$V_{MOV} = 0.799 - 0.506AGE \qquad (10)$$
(1.134) (-3.127) (t-statistic in parenthesis)

**Table 11: Classification ability of Binary Logit model**

| Actual | Group membership | | Total |
|---|---|---|---|
| | Non-movers | Movers | |
| Non-movers | 180 | 0 | 180 |
| Movers | 31 | 0 | 31 |
| Total | 211 | 0 | 211 |

**Binary Probit model with interaction terms**

$$V_{MOV} = 0.442MARR\_CH - 0.348AGE \qquad (11)$$
(1.329) (-9.971) (t-statistic in parenthesis)

**Table 12: Classification ability of Binary Logit model**

| Actual | Group membership | | Total |
|---|---|---|---|
| | Non-movers | Movers | |
| Non-movers | 180 | 0 | 180 |
| Movers | 31 | 0 | 31 |
| Total | 211 | 0 | 211 |

Comments:

The best models are statically significant and conceptually valid but they were rejected because these models, like the previous one, have low explanatory power.

***Discriminant Analysis***

A stepwise procedure was used to conduct discriminant analysis. All the independent variables were tested together as predictors of membership in either of the two groups: movers and non-movers. Five types of predictors were used: (a) socioeconomic characteristics; (b) difference between attributes of the current and previous neighborhood; (c) relative ease of access to jobs or business; (d) reduction in travel time; (e) the current - previous ratings of neighborhood's characteristics (ease of access and quality of neighborhood); ( and (f) interaction terms between importance rating, quality conditions and ease of access to jobs or business (the difference between the current and previous of each neighborhood characteristic weighted by the importance of the characteristic).

Observations that had one or more predictor variables missing (69 of the observations) were eliminated from the data base; this left 142 valid observations for the calibration of a discriminant model.

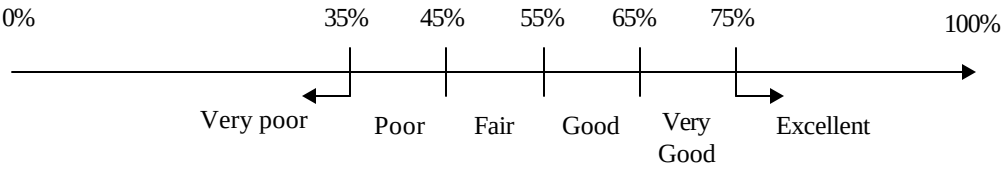
To estimate the discriminant function that best describes the actual decision making of the respondents, the 142 observations in the data base were divided into two samples: a calibration sample and a hold-out sample. Hold-out samples are used to test the ability of the model to correctly classify the cases. The use of a hold-out sample is important because the statistical significance of the model does not guarantee that the same model is able to correctly classify a sample different than the one used in its calibration (Holguin-Veras, 1997).

To create the calibration sample, 70 percent of the observations were randomly selected from the data base; the remaining 30 percent of the observations constituted the hold-out sample. This process was repeated 15 times, so that 15 sets of different calibration (each of 99 valid observations) and hold-out samples (each of 43 valid observations) were created.

Three different families of model were tested: (1) models without interaction terms between importance rating and the quality conditions and ease of access to jobs or business; (2) models with socioeconomic characteristics, reduction in travel time, and interaction terms; and (3) models with socioeconomic characteristics, difference between quality conditions of the current and previous neighborhood, relative ease of access to jobs or business, and reduction in travel time. The discriminant functions were obtained for each of these samples, and the classification ability of the resulting model was tested with the corresponding hold-out sample.

The basis for model selection was three-fold: statistical significance, conceptual validity, and classification ability. The model is considered conceptually valid if the coefficients have the expected sign. The classification ability refers to the capability of the discriminant function to correctly classify the hold-out sample. The classification ability was determined depending of the percentage of movers and non-movers correctly classified from the hold-out sample using the classification shown in Figure 5.

**Figure 5: Classification scale of hold-out sample**




The sign of the coefficients or discriminant weights of the discriminant functions is interpreted depending of the sign of the group centroid of movers and non-movers. If the sign of the group centroid corresponding to movers is positive, and the coefficient of the discriminant variable is also positive, it indicates that if the value of the discriminant variable increases, the utility associated to the decision to move increases. If the coefficient of the discriminant variable is negative, it indicates that if the value of the discriminant variable increases, the utility associated to the decision to move decreases.

If the sign of the group centroid corresponding to movers is negative, and the coefficient of the discriminant variable is positive, it indicates that if the value of the discriminant variable increases, the utility associated to the decision to move decreases. If the coefficient of the discriminant variable is negative, it indicates that if the value of the discriminant variable increases, the utility associated to the decision to move increases.

In the first family group (Table 13), 15 randomly selected samples from the same database were tested. From each model, the statistics corresponding to Wilk's Lambda, Canonical Correlation, and the classification ability are shown. The coefficients resulting from each model; the group centroid corresponding to non-movers and movers; the conceptual validity, statistical significance, the classification ability and the decision to accept or reject the model based on the statistics mentioned above are shown in Table 13. None of the models from this family groupwere accepted.

The discriminant functions estimated using interaction terms are shown in Table 14. For each of the models the same information given in the previous table is shown. Again, none of the models from this family group were accepted.

The discriminant functions corresponding to the third family (without importance rating and interaction terms) were estimated (see Table 15). From this family group only two discriminant functions were accepted (model 3 and model 12). Both models are statistically

significant and conceptually valid, but model 12 has better classification ability because it correctly classified 88% of the movers and 77% of the non-movers.

## Table 13: Discriminant functions without interaction terms

| Statistics and coefficients | Family 1 | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 12B | 13 | 14 | 15 | 15B |
| *Statistics* | | | | | | | | | | | | | | | | | |
| Canonical correlation | 0.635 | 0.652 | 0.569 | 0.485 | 0.663 | 0.570 | 0.678 | 0.641 | 0.830 | 0.628 | 0.719 | 0.570 | 0.397 | 0.427 | 0.274 | 0.569 | 0.447 |
| Wilks-lambda | 0.597 | 0.575 | 0.677 | 0.765 | 0.560 | 0.675 | 0.540 | 0.589 | 0.311 | 0.605 | 0.482 | 0.675 | 0.842 | 0.817 | 0.925 | 0.676 | 0.800 |
| Chi-square | 47.989 | 43.998 | 34.576 | 22.114 | 42.280 | 32.398 | 54.257 | 408.000 | 95.839 | 39.176 | 53.217 | 32.601 | 14.593 | 16.528 | 6.826 | 36.415 | 21.492 |
| Significance level | 8.23E-08 | 2.32E-08 | 1.83E-06 | 6.18E-05 | 5.62E-08 | 4.95E-06 | 6.15E-09 | 3.17E-07 | 1.27E-12 | 6.61E-07 | 6.79E-08 | 1.25E-05 | 1.00E-03 | 2.58E-04 | 9.00E-03 | 2.29E-06 | 8.32E-05 |
| % of correct class. movers | 33 | 50 | 60 | 57 | 25 | 22 | 38 | 17 | 22 | 36 | 67 | 63 | 63 | 25 | 75 | 75 | 71 |
| % of correct class. non-mov. | 61 | 64 | 61 | 76 | 83 | 77 | 78 | 71 | 81 | 74 | 74 | 71 | 82 | 58 | 66 | 61 | 62 |
| *Coefficients* | | | | | | | | | | | | | | | | | |
| DTIME | | | | | | | | | | 0.001 | | 0.001 | | | | | |
| AGE | 0.083 | 0.122 | 0.100 | 0.105 | 0.053 | | 0.067 | 0.077 | 0.071 | 0.051 | | 0.080 | 0.098 | | 0.110 | 0.098 | 0.101 |
| C_OWNER | | -3.479 | -3.084 | | -3.371 | | | | -3.497 | | 2.060 | | | | | | |
| HH_EMP | | 0.693 | | | | | | | | | | | | | | 0.709 | |
| HH_INC | | | | | | | | | 2.52E-05 | | -1.98E-05 | | | | | | |
| HH_SIZE | | | | | | | 0.656 | | | | | | | | | | |
| MARR_CH | | | | -1.121 | | | | | | -1.969 | | -1.328 | -1.634 | | | | |
| V_OWN | | 0.761 | 0.918 | | 0.891 | 0.706 | | 0.843 | 0.333 | | | | | | | | 0.691 |
| EMGS_AC | | | | | | | 0.396 | | 0.618 | | | | | | | | |
| JOB_AC | | | | | | | | | | | 0.454 | | | | | | |
| MEDS_AC | | | | | 0.510 | | | | | | -0.698 | | | | | 0.312 | |
| RECR_AC | | | | | | | | | -0.342 | | | | | | | | |
| RELG_AC | | | | | -0.523 | | | | | | | | | | | | |
| SCH_AC | | | | | | | -0.178 | | | | | | | | | | |
| SHOP_AC | 0.256 | | | | | 0.493 | | | | | | | | | | | |
| APOLL_Q | -0.541 | | | | | | | | -0.301 | | 0.921 | | | 0.705 | | -0.510 | |
| CONG_Q | | | | | | -0.456 | | | -0.063 | | | | | | | | |
| PARKCH_Q | | | | | | | | | -0.174 | | 0.255 | | | | | | |
| SEC_Q | | | | | | | | | | | -0.569 | | | | | | |
| TSTAT_Q | | | | | | | 0.401 | 0.363 | 0.271 | | | | | | | | |
| TWORK_Q | -0.517 | | | | | -0.562 | -0.583 | -0.571 | -0.538 | -0.271 | | | | 0.485 | | | |
| ACCSCH_R | | | 0.201 | | | | | | | | | | | | | 0.248 | 0.227 |
| CLEAN_R | | | | | | | | 0.533 | | | | | | | | | |
| CONG_R | 0.028 | | | | 0.028 | | | | 0.106 | | | | | | | 0.048 | |
| MEDS_R | | | | | | | -0.802 | | | | 0.686 | | | | | | |
| NPOLL_R | | | | | | | | | -0.064 | | | | | | | | |
| PARK_R | | | | | | | | | -0.373 | | | | | | | | |
| REALST_R | | | -0.020 | | -0.020 | | | | -0.013 | -0.015 | | -0.025 | | | | | |
| RELG_R | 0.494 | 0.465 | | | | | | | | | | | | | | | |
| RENTC_R | | | | | | | | | | | | 0.225 | | | | | |
| SHOP_R | | | | | | | | | -0.369 | | 0.464 | | | | | | |
| SIDEW_R | 0.507 | | | 0.631 | 0.636 | 0.418 | | 0.322 | 0.689 | | -0.534 | 0.370 | | | | | |
| TSTAT_R | | | | | | | 0.534 | | | 0.466 | | | | | | | |
| Constant | -3.863 | -5.359 | -4.068 | -4.620 | -1.092 | -1.463 | -5.400 | -5.839 | -4.539 | -3.090 | 0.790 | -3.866 | -4.128 | -0.528 | -5.038 | -5.785 | -6.439 |
| Group centroid N.Mov. | 0.403 | 0.380 | 0.335 | 0.282 | 0.405 | 0.300 | 0.429 | 0.422 | 0.620 | 0.328 | -0.408 | 0.336 | 0.209 | -0.233 | 0.131 | 0.336 | 0.247 |
| Group centroid Mov. | -1.572 | -1.899 | -1.396 | -1.065 | -1.898 | -1.565 | -1.944 | -1.614 | -3.500 | -1.941 | 2.562 | -1.401 | -0.874 | 0.934 | -0.606 | -1.397 | -0.989 |
| *Conceptual validity* | No | No | No | No | No | No | No | No | No | No | No | No | Ok | Ok | Ok | No | No |
| *Statistical significance* | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | No | Ok | No | Ok | Ok |
| *Classification ability* | VP | F | G | G | VP | VP | P | VP | VP | P | VG | G | G | VP | VG | G | G |
| *Decision* | Reject | Reject | Reject | Reject | Reject | Reject | Reject | Reject | Reject | Reject | Reject | Reject | Reject | Reject | Reject | Reject | Reject |

## Table 14: Discriminant functions with interaction terms

| Statistics and coefficients | Family 2 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| *Statistics* | | | | | | | | | | | | | | | |
| Canonical correlation | 0.407 | 0.647 | 0.629 | 0.587 | 0.459 | 0.412 | 0.485 | 0.445 | 0.700 | 0.549 | 0.531 | 0.473 | 0.600 | 0.438 | 0.480 |
| Wilks-lambda | 0.835 | 0.581 | 0.604 | 0.656 | 0.790 | 0.831 | 0.765 | 0.802 | 0.510 | 0.698 | 0.719 | 0.776 | 0.640 | 0.808 | 0.770 |
| Chi-square | 17.799 | 46.674 | 45.379 | 36.060 | 21.834 | 16.612 | 25.962 | 18.334 | 62.891 | 29.618 | 26.775 | 22.294 | 36.839 | 19.583 | 25.607 |
| Significance level | 4.84E-04 | 2.17E-08 | 3.12E-07 | 7.06E-06 | 7.06E-05 | 8.49E-04 | 3.22E-05 | 1.04E-04 | 3.70E-10 | 1.75E-05 | 2.21E-05 | 1.75E-04 | 5.03E-06 | 6.03E-04 | 3.80E-05 |
| % of correct class. movers | 60 | 22 | 65 | 50 | 0 | 20 | 63 | 57 | 30 | 46 | 25 | 38 | 75 | 63 | 50 |
| % of correct class. non-mov. | 65 | 73 | 83 | 58 | 79 | 68 | 62 | 75 | 65 | 57 | 78 | 73 | 78 | 88 | 69 |
| *Coefficients* | | | | | | | | | | | | | | | |
| DTIME | | | | | | | | | 6.989E-04 | 1.400E-03 | | | | | |
| AGE | 0.075 | 0.114 | 0.078 | 0.089 | | | 0.101 | 0.105 | 0.085 | | | 0.081 | 0.060 | 0.053 | 0.076 |
| C_OWNER | | -3.179 | -2.012 | -3.484 | | -2.807 | -2.628 | | -3.414 | | -3.258 | | -2.454 | | |
| HH_EMP | | 0.807 | 0.874 | 0.570 | | | 0.850 | | 0.670 | | | | | | |
| HH_INC | | | 2.362E-05 | | | 2.208E-05 | | | 1.892E-05 | 2.464E-05 | 4.068E-05 | | | 1.633E-05 | |
| H_SCH | | | | | | | | | -2.644 | | | | -4.447 | | |
| COLLEGE | | | | | | | | | | | | | | | 1.018 |
| HH_SIZE | | 0.466 | | | | | 0.615 | | | | | | | | |
| MARR_CH | | | | | | | | | | -3.172 | | | | | |
| MARR_NCH | | | | | | | | | | -1.488 | | 1.094 | | | |
| V_OWN | 0.741 | | | 0.729 | 0.948 | 0.855 | | | | | | | 0.800 | | 0.723 |
| PARKCH_I | 0.218 | | | | 0.215 | | | | | | | | | 0.214 | |
| CONG_I | | -0.019 | -0.018 | | -0.028 | | | | -0.022 | | -0.316 | | | -0.027 | -0.024 |
| SIDEW_I | | -0.105 | | | | | | | -0.209 | | | | | | |
| ACCJOB_I | | | 0.232 | | | | | | | | 0.249 | | | | |
| RECREA_I | | | 0.191 | | | | | | | | | 0.246 | 0.412 | | |
| REALST_I | | | 1.887E-04 | 2.356E-04 | | | | | 3.158E-04 | 2.867E-04 | | | | | |
| APOLL_I | | | | 0.394 | | | | | | | | | | | |
| NPOLL_I | | | | 4.945E-04 | | | | | | | | | 5.739E-04 | | |
| CLEAN_I | | | | | | | | 0.450 | | | | | | | |
| PARKCH_I | | | | | | | | | | | | 0.198 | 0.156 | | |
| Constant | -5.013 | -4.991 | -6.647 | -3.507 | -1.986 | -2.146 | -5.570 | -5.044 | -4.743 | -2.716 | -2.364 | -4.567 | -2.297 | -4.475 | -5.447 |
| Group centroid N Mov | 0.231 | 0.388 | 0.411 | 0.368 | 0.245 | 0.204 | 0.264 | 0.262 | 0.423 | 0.284 | 0.263 | 0.271 | 0.376 | 0.232 | 0.259 |
| Group centroid Mov | -0.840 | -1.818 | -1.562 | -1.394 | -1.063 | -0.980 | -1.139 | -0.923 | -2.222 | -1.483 | -1.456 | -1.041 | -1.463 | -1.003 | -1.131 |
| *Conceptual validity* | No | No | No | No | No | Ok | No | No | No | No | No | No | No | No | Ok |
| *Statistical significance* | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok |
| *Classification ability* | G | VP | VG | F | VP | VP | G | G | VP | F | Vp | P | Exc | G | F |
| *Decision* | Rejected | Rejected | Rejected | Rejected | Rejected | Rejected | Rejected | Rejected | Rejected | Rejected | Rejected | Rejected | Rejected | Rejected | Rejected |

## Table 15: Discriminant functions without importance rating and interaction terms

| Statistics and coefficients | Family 3 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| *Statistics* | | | | | | | | | | | | | | | |
| Canonical correlation | 0.502 | 0.616 | 0.503 | 0.502 | 0.498 | 0.540 | 0.569 | 0.556 | 0.561 | 0.571 | 0.410 | 0.452 | 0.455 | 0.301 | 0.390 |
| Wilks-lambda | 0.748 | 0.621 | 0.747 | 0.748 | 0.752 | 0.708 | 0.677 | 0.691 | 0.685 | 0.674 | 0.832 | 0.795 | 0.793 | 0.909 | 0.848 |
| Chi-square | 29.905 | 43.886 | 28.673 | 25.869 | 27.398 | 31.410 | 39.270 | 32.126 | 38.014 | 35.721 | 15.642 | 21.868 | 20.665 | 9.380 | 17.371 |
| Significance level | 5.1E-06 | 6.8E-09 | 2.6E-06 | 3.4E-05 | 1.7E-05 | 2.5E-06 | 1.7E-06 | 1.8E-06 | 3.7E-07 | 1.1E-06 | 4.0E-04 | 7.0E-05 | 3.3E-05 | 2.2E-03 | 1.7E-04 |
| % of correct class. movers | 50 | 27 | 67 | 57 | 11 | 40 | 50 | 33 | 36 | 36 | 46 | 88 | 25 | 75 | 71 |
| % of correct class. non-mov. | 72 | 69 | 69 | 51 | 65 | 79 | 63 | 67 | 87 | 69 | 59 | 77 | 58 | 66 | 51 |
| *Coefficients* | | | | | | | | | | | | | | | |
| DTIME | | | | | | | | | | 8.19E-04 | | | | | |
| AGE | 0.085 | 0.113 | 0.077 | 0.090 | | | 0.093 | 0.073 | 0.084 | 0.053 | | -0.095 | | 0.112 | 0.094 |
| C_OWNER | | -3.359 | | | -2.798 | | -2.602 | | -3.341 | | | | | | |
| HH_EMP | | 0.706 | | | | | 0.530 | | | | | | | | |
| HH_INC | | | 1.75E-05 | | | -1.75E-05 | | | 2.24E-05 | 1.36E-05 | -2.23E-05 | | | | |
| HH_SIZE | | | | | | | 0.487 | | | | | | | | |
| MARR_CH | | | | -1.529 | | | | | | -1.932 | | 1.550 | | | |
| V_OWN | | 0.772 | | | 1.013 | | | 0.719 | | | | | | | 0.724 |
| EMGS_AC | | | | 0.383 | | | | | | | | | | | |
| JOB_AC | | | | | | | -0.480 | | | | | | | | |
| MEDS_AC | 0.364 | | | | | | | | | | | | | | |
| RELG_AC | | | | | -0.654 | | | | | | | | | | |
| SHOP_AC | | | | | 0.366 | -0.413 | | | | | | | | | |
| APOLL_Q | -0.462 | | | | | | | | | | 0.763 | | 0.686 | | |
| CONG_Q | | | | -0.440 | | 0.509 | | | | | | | | | |
| TSTAT_Q | | | | | | | 0.380 | 0.360 | 0.300 | | | | | | |
| TWORK_Q | -0.459 | | -0.476 | | | 0.611 | | -0.680 | -0.636 | -0.407 | | 0.333 | 0.506 | | |
| WRAMP_Q | | | | | | | -0.307 | | | | | | | | |
| Constant | -3.693 | -4.872 | -5.879 | -3.728 | 0.582 | 2.147 | -4.711 | -5.072 | -3.698 | -4.409 | 2.446 | 3.985 | -0.453 | -5.095 | -5.965 |
| Group centroid N Mov | 0.293 | 0.333 | 0.284 | 0.291 | 0.257 | -0.286 | 0.320 | 0.340 | 0.285 | 0.286 | -0.177 | -0.245 | -0.249 | 0.146 | 0.200 |
| Group centroid Mov | -1.130 | -1.798 | -1.165 | -1.134 | -1.257 | 1.412 | -1.466 | -1.287 | -1.584 | -1.656 | 1.118 | 1.030 | 1.025 | -0.672 | -0.881 |
| *Conceptual validity* | No | Ok | Ok | No | No | No | No | No | No | Ok | Ok | Ok | Ok | Ok | Ok |
| *Statistical significance* | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | Ok | No | No |
| *Classification ability* | F | VP | VG | F | VP | P | F | VP | P | P | F | Exc. | VP | VG | F |
| *Decision* | Rejected | Rejected | Accepted | Rejected | Rejected | Rejected | Rejected | Rejected | Rejected | Rejected | Rejected | Accepted | Rejected | Rejected | Rejected |

The discriminators resulting from model 12 were MARR_CH, AGE and TWORK_Q. The discriminant function was:

$$d = 3.985 - 0.095\,AGE + 1.550\,MARR\_CH + 0.333\,TWORK\_Q \qquad (12)$$

The variables AGE, MARR_CH and TWORK_Q (i.e., the difference between the "quality of transportation to work" for the current and the previous neighborhood) were selected as the ones that best discriminate between movers and non-movers.

The canonical correlation of the discriminant function was low (0.452) meaning that there was a weak relationship between the decision to move and the difference of the conditions in the current and previous neighborhood related to transportation to work and socioeconomic characteristics (AGE and MARR_CH).

It was necessarily to examine if there was a significant difference between the centroid of movers and the centroid of non-movers (multivariate test). This is a test of the global model. *F* is distributed with *p* and *n-p-1* degrees of freedom (Tacq, 1997). In the calibration data set there were *three parameters*(that is, three discriminant variables) 99 valid observations; thus degrees of freedom were 3 and 95

The overall significance of the model was assessed using the F statistic. The F value of the model is 8.148 (see Appendix V). For 3 and 95 degrees of freedom and for $\propto = 0.05$, the critical F value is 2.71. Thus, there is a significant difference between the centroids of the two groupsand the model is significant.

**Classification and prediction**

The discriminant function was used to classify 132 valid cases from the calibration group. (Note: now that only three predictor variables are considered, the number of invalid observations is reduced from 69 to 15; thus the size of the calibration and hold out samples both increase.) The expected discriminant score (the d value) of each of the observations was calculated using the discriminant function. (See Figure 6.) The centroids of the two groups (movers and non movers) projected onto the d axis are shown in Table 16.

**Table 16: Functions at group centroids**

| | Function |
|---|---|
| MOV | 1 |
| 0 | -.245 |
| 1 | 1.030 |

The point midway between the two group centroids is the "cutoff point": $dc = [(-0.245) + (1.030)] / 2 = 0.3925$. (The location of the "cutoff point" is shown by the horizontal line above the origin in Figure 6.) If the two groups had been of equal size, this cutoff point would have been in the origin.

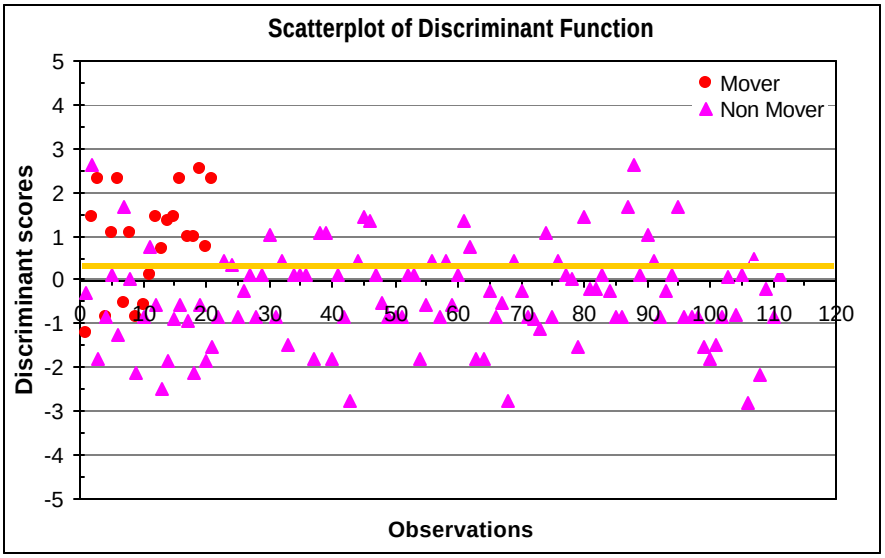
The discriminant scores of the 132 cases are shown in Figure 6; whether the case is a mover or non-mover is indicated by the symbol (circle or triangle) used. The scores above dc $(d_i > dc)$ are assigned to group 1 (movers) and below dc $(d_i < dc)$ are assigned to group 0 (non-movers).

Comparing the original scores with the predicted group membership, 86 of the 111 non-movers were correctly predicted (77.5 %) while 15 of the 21 movers were correctly predicted (71.4%), see Table 17.

**Table 17: Classification results of calibration group**

| | | | | **Predicted Group Membership** | |
|---|---|---|---|---|---|
| | | | *MOV* | *Non-mover* | *Mover* | *Total* |
| Original | Count | Non-mover | | 86 | 25 | 111 |
| | | Mover | | 6 | 15 | 21 |
| | % | Non-mover | | 77.5 | 22.5 | 100 |
| | | Mover | | 28.6 | 71.4 | 100 |

**FIGURE 6 Discriminant scores**




In Figure 6 if the percentage of correct classification was 100%, all the movers would be above of the cutoff point and all the non-movers would be below the cutoff point.

**Classification of the hold-out sample**

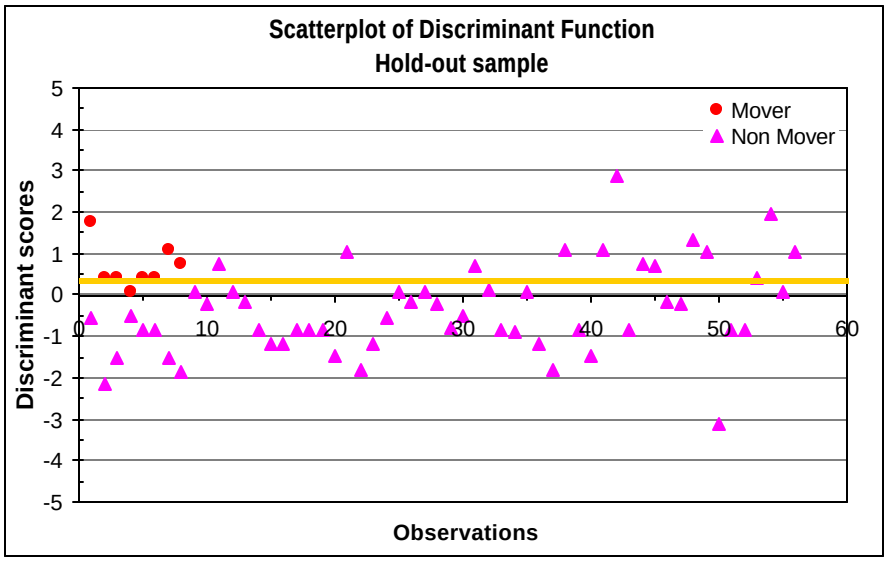
Some 64 valid cases corresponding to the hold-out sample were classified. In Table 18 the predicted group membership is presented with its respective percentages of group membership correctly predicted. From the total hold-out sample, 78.1% of the cases were correctly predicted: (a) 76.8% non-movers, (b) 87.5% movers.

**Table 18: Predicted group membership of the hold-out sample**

| | | | **Predicted Group Membership** | | |
|---|---|---|---|---|---|
| | | *MOV* | *Non-mover* | *Mover* | *Total* |
| Original | Count | Non-mover | 43 | 13 | 56 |
| | | Mover | 1 | 7 | 8 |
| | % | Non-mover | 76.8 | 23.2 | 100 |
| | | Mover | 12.5 | 87.5 | 100 |

The discriminant scores of the 64 hold out cases are shown in Figure 7.. The scores above the cut off point (*dc)* are assigned to movers group and those below *dc* are assigned to non-movers group.

**FIGURE 7 Discriminant scores of hold-out sample**



# CONCLUSIONS

In this paper, three different models were used to analyze the relationship between changes in transit accessibility and residential choice. An extensive modeling process was undertaken to ensure that the research team examined the wide spectrum of model formulations. This involved the estimation of two different variants of discrete choice models (binary logit and binary probit), as well as discriminant analysis models.

In general terms, the discrete choice models did not produce satisfactory results. The best model of the Binary Logit family was rejected because, although it was statistically significant and conceptually valid, it had a low explanatory power. This model failed to correctly predict the decision to move by "movers." The Binary Probit models produced results similar to those of the Binary Logit model, and for that reason they were rejected also.

However, the discriminant analysis model was successful in estimating a conceptually valid and statistically significant model. This estimation required the use of a bootstrapping technique by which 15 different randomly selected sample were generated, used for estimation and tested against a hold-out sample. The best model of the discriminant analysis family classified correctly the 78.1% of the cases.

The analysis of the independent variables that were found to have a significant role in explaining the decision to move indicates the following:

- Reduction in the travel time did not have a statistically significant role as a explanatory variables of the residential choice process. This result seems to indicate that the decision to change residence is conditioned by other variables such as overall accessibility (for all modes).
- Two variables that are related to “Stage of Life” were found to have a significant role as explanatory variables (AGE and MARR_CH). The parameters of the model selected indicate that AGE reduces the propensity to relocate; while married couples with children are more prone to relocate than other families in similar conditions.

- The difference between the quality of the work commute from the current and from the previous neighborhood was found to have a highly significant role as explanatory variable. This indicates that decision makers take into account the overall characteristics of the commute (including travel time, comfort, convenience, among others) while making residential choice decisions, as opposed to the sole consideration of travel time.

In general terms, the results obtained in this research highlight the significance of stage of life variables and quality of the work commute as explanatory variables of residential choice. The significant importance of the quality of work variable highlights the importance of qualitative elements that previously were not deemed relevant to this complex choice process.

## ACKNOWLEDGEMENTS

The research team benefited from the insightful comments made by Mr. Herbert Levinson that significantly enhanced the quality of the analyses. The assistance of Mr. Thomas Marchwinski, and his colleagues from New Jersey Transit, in providing access to the 1996 data set is both acknowledged and appreciated. This project was conducted with a grant to the City College of New York, Rutgers University and Dowling College, from the New Jersey Department of Transportation and the U.S. Department of Transportation through the University Transportation Research Center (UTRC) Region 2.

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# APPENDIX I: NJT 1996 SURVEY

**4.** **If you currently get to the station by auto, would you consider the following alternatives?**
*(Please indicate under what conditions and/or improvements you would consider these alternatives.)*

**Walking**
- No
- Sometimes, if ▷ _____
- Always, if ▷ _____

**Biking**
- No
- Sometimes, if ▷ _____
- Always, if ▷ _____

**Taking a feeder bus/van**
- No
- Sometimes, if ▷ _____
- Always, if ▷ _____

---

**5.** **A. Where did you start your trip today?**

- Home
- Work/Office
- Eating/Entertainment
- Shopping
- School
- Company Business
- Medical/Personal
- Other

**B. What is that address?**

Number and Street OR Street Intersection _____

Borough, Town _____ State ____ ZIP Code ____

---

**6.** **How long from the above address did it take you to reach the station and how many miles is that?**

**TIME**

____ *minutes*

**DISTANCE**
- Less than 1/4 mile
- 1/4–1/2 mile
- 1/2–1 mile
- 1–2 miles
- 2–3 miles
- 3–5 miles
- 5–10 miles
- Over 10 miles

**7.** **At what station will you get off the NJ TRANSIT train?** *(If you switch to another NJ TRANSIT train in New Jersey, tell us where you will finally leave the railroad.)*
- New York Penn Station
- Hoboken
- Broad Street Station, Newark
- Other *(Please specify.)* _____

---

**8.** **A. Where are you going?**

- Home
- Work/Office
- Eating/Entertainment
- Shopping
- School
- Company Business
- Medical/Personal
- Other

**B. What is that address?**

Number and Street OR Street Intersection _____

Borough, Town _____ State ____ ZIP Code ____

---

**9.** **What type of train ticket are you using for this trip?**
- Monthly
- Weekly
- 10-Trip
- Round Trip Excursion
- One-Way
- Senior Citizen
- Children
- Customers with a Disability

**▷ If your final destination is NEW YORK, complete Questions 10–15.**
**▷ If your final destination is NEW JERSEY, complete Question 16.**

## ▶ *For Trips to New York City*

**10. How will you reach New York City today?**
*(Fill in all ovals that apply.)*

- NJ TRANSIT MidTOWN DIRECT train to NY Penn Station
- NJ TRANSIT train to a MidTOWN DIRECT train to NYC
- NJ TRANSIT train to Hoboken then:
  - Switch to PATH WTC Line *(Which exit station?)* _____
  - Switch to PATH 33rd St. Line *(Which exit station?)* _____
  - Switch to Ferry
  - Switch to bus *(Which route?)* _____

**11. Once in New York, how will you reach your final destination?**
*(Fill in only one.)*

- Walk only
- NYC Subway *(Which line?)* _____
- NYC Bus *(Which route?)* _____
- Taxi
- Other *(Please specify.)* _____

**12. If you commute to *New York* on a regular basis, how often do you take *each of the following*?**
*(Fill out every line.)*

| | *5 or More Days a Week* | *4 Days a Week* | *1–3 Days a Week* | *Less Than Once a Week* | *Never* |
|---|---|---|---|---|---|
| NJ TRANSIT MidTOWN DIRECT | | | | | |
| NJ TRANSIT Hoboken train | | | | | |
| PATH 33rd Station Line | | | | | |
| PATH WTC Line | | | | | |
| Ferry | | | | | |
| Bus | | | | | |
| Auto | | | | | |
| Other | | | | | |

**▶ If you NEVER use MidTOWN DIRECT, skip to Question 19.**

**13. If you have to transfer to/from the MidTOWN DIRECT train, at what station do you transfer?**

- Dover
- Summit
- Brick Church
- Broad Street, Newark
- Other *(Please specify.)* _____
- Does not apply

**14. If you are taking MidTOWN DIRECT now, how did you commute *before* MidTOWN DIRECT service started?**
*(Fill in all ovals that apply.)*

- NJ TRANSIT train to Hoboken and then PATH to 33rd Street line
- NJ TRANSIT train to Hoboken and then PATH to WTC line
- NJ TRANSIT train to Hoboken and then Ferry
- Drove alone to New York
- Carpooled to New York
- Drove to Newark and took NJ TRANSIT train to New York
- Bus to Newark Penn Station and NJ TRANSIT train to NY
- Drove to a PATH station *(Which station?)* _____
- NJ TRANSIT bus to NY *(Which route?)* _____
- Other bus to NY *(Please specify.)* Lakeland
- Other *(Please specify.)* _____
- Did not travel from NJ to New York

**15.** **What was the *one main reason*** that prompted you to switch to taking **MidTOWN DIRECT?** *(Fill in one oval.)*

One seat travel to New York City
Travel time savings
Cost saving
Not having to switch to PATH
Other *(Please specify.)* _____

▷ **All who answered Questions 10 through 15, skip to Question 18.**

## ▷ *For Trips within New Jersey*

**16.** **Riders who stay in New Jersey, how will you reach your final destination after you leave the NJ TRANSIT train?** *(Fill in one oval.)*

Walk only
Local Bus *(Which route?)* _____
PATH *(Which exiting station?)* _____
Taxi
Car Pickup
Other *(Please specify.)* _____

**17.** **How often do you usually make this trip?** *(Fill in one oval.)*

5 or more days a week
4 days a week
1–3 days a week
Less than once a week

## ▷ *For Your Typical Reverse Trip*

**18.** **Do you usually make the reverse trip the same way you traveled on this trip?**

Yes ▷ ***If yes, go to Question 20.***
No ▷ ***If no, continue with Question 19.***

**19.** **How do you typically travel for the reverse trip?** *(Fill in all ovals that apply.)*

MidTOWN DIRECT train
PATH to Hoboken
PATH to Newark
NJ TRANSIT train from Hoboken
Bus *(Which route?)* _____
Newark City Subway
Taxi
Car
Other
I will (did) not make the trip today.

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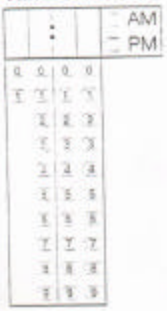
win FREE tickets on NJ TRANSIT trains
[illegible] Thanks for your help!

**20.** **If your reverse trip involves a NJ TRANSIT train, what is the scheduled departure time for your train and what station will you get off the train?**
*(Please fill in the appropriate ovals for the time and the exit station for your return trip.)*

**TIME DEPART?**




**REVERSE TRIP—Where do you get off?**

**Gladstone Branch**
- Gladstone
- Peapack
- Far Hills
- Bernardsville
- Basking Ridge
- Lyons
- Millington
- Stirling
- Gillette
- Berkeley Heights
- Murray Hill
- New Providence

**Montclair Branch**
- Montclair-Bay St.
- Glen Ridge
- Bloomfield
- Watsessing

**Morristown Line**
- Hackettstown
- Mount Olive
- Netcong
- Lake Hopatcong
- Dover
- Denville
- Mt. Tabor
- Morris Plains
- Morristown
- Convent Station
- Madison
- Chatham
- Summit
- Short Hills
- Millburn
- Maplewood
- South Orange
- Mountain Station
- Highland Avenue
- Orange
- Brick Church
- East Orange
- Newark Broad Street

## > *For Everyone*

**21.** **How long have you been riding NJ TRANSIT trains?**
*(Fill in one oval.)*

- Less than six months
- Six months to less than 1 year
- Between 1 year and 2 years
- Between 2 and 5 years
- Between 5 years and 10 years
- More than 10 years

**22.** **Currently, what is the average time it takes you to travel door-to-door, one-way, from your origin location to your current destination?**

**TIME** *(Hours/Min.)*


**23.** ***On June 10, 1996, there were service and schedule changes on NJ TRANSIT's Morris and Essex lines.*** **If you travel to the same destination before the service change, whether you took the train, bus, auto, or PATH, what was the average time it took for you to travel door-to-door, one way, *before June 10, 1996*?**

**TIME** *(Hours/Min.)*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win FREE tickets on NJ TRANSIT trains
for a whole month!
Thanks for your help!

> *Please Continue . . .*

**24.** **On a scale of 1 to 10, please rate NJ TRANSIT on the following attributes of our service, where *0 = Not At All Acceptable, 5 = Acceptable and 10 = Excellent.*** *(Please remember that you can mark any oval between 0 and 10 or "Not Applicable".)*

| ***Train Service*** | *Not Applicable* | *Not At All Acceptable* | | | | | *Acceptable* | | | | *Excellent* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Seating availability during peak period | N/A | | | | | | | | | | | |
| Seating availability during off-peak hours | N/A | | | | | | | | | | | |
| Train frequency at peak times | N/A | | | | | | | | | | | |
| Train frequency at off-peak times | N/A | | | | | | | | | | | |
| Connections at intermediate stations | N/A | | | | | | | | | | | |
| Connections ***to*** other transit service | N/A | | | | | | | | | | | |
| Connections ***from*** other transit service | N/A | | | | | | | | | | | |
| On-time performance at destination | N/A | | | | | | | | | | | |
| Mechanical reliability | N/A | | | | | | | | | | | |
| Safety | N/A | | | | | | | | | | | |
| Personal security | N/A | | | | | | | | | | | |
| Travel time | N/A | | | | | | | | | | | |
| Fares | N/A | | | | | | | | | | | |
| Employee performance | N/A | | | | | | | | | | | |
| Train crew courtesy | N/A | | | | | | | | | | | |
| Overall satisfaction with NJ TRANSIT | N/A | | | | | | | | | | | |
| Overall value for the money | N/A | | | | | | | | | | | |

| ***Station Accessibility*** | *Not Applicable* | *Not At All Acceptable* | | | | | *Acceptable* | | | | *Excellent* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Pedestrian sidewalks/paths | N/A | | | | | | | | | | | |
| Bicycle access | N/A | | | | | | | | | | | |
| Bicycle racks/locker availability | N/A | | | | | | | | | | | |
| Bus/shuttle access | N/A | | | | | | | | | | | |
| Safety of roads near station | N/A | | | | | | | | | | | |
| Traffic of roads near station | N/A | | | | | | | | | | | |
| Directional signs to station area | N/A | | | | | | | | | | | |
| Car drop-off location | N/A | | | | | | | | | | | |
| Parking availability | N/A | | | | | | | | | | | |
| Parking cost | N/A | | | | | | | | | | | |

THIRTY PRIZES!!!
win FREE tickets on NJ TRANSIT trains
for a whole month!
Thanks for your help!

**25.** **How often do you make intermediate stops within *half a mile* of your boarding station to shop at stores or use services?**

- ○ Never ▶ *Skip to Question 27.*
- ○ Less than once a week
- ○ 1–3 days a week
- ○ 4 days a week
- ○ 5 or more days a week

**26.** **Please fill the oval next to the type of stores you stop at, and for those types you stop at, please tell us how often you visit and the amount you spend per month.**

| | | *Number of Times Visited per Month* ▼ | *Dollars Spent per Month* ▼ |
|---|---|---|---|
| 1 | ○ Sit down restaurants | _____ | $ _____ |
| 2 | ○ Fast food/take out | _____ | $ _____ |
| 3 | ○ Newspaper stand | _____ | $ _____ |
| 4 | ○ Coffee/snack shop | _____ | $ _____ |
| 5 | ○ Bakery | _____ | $ _____ |
| 6 | ○ Supermarket/mini-market | _____ | $ _____ |
| 7 | ○ Dry cleaners | _____ | $ _____ |
| 8 | ○ Shoe repair | _____ | $ _____ |
| 9 | ○ Bank/automatic teller machine | _____ | $ _____ |
| 10 | ○ Video store | _____ | $ _____ |
| 11 | ○ Drug store | _____ | $ _____ |
| 12 | ○ Retail (clothing, home furnishing, gifts) | _____ | $ _____ |
| 13 | ○ Wine/liquor | _____ | $ _____ |
| 14 | ○ Day care | _____ | $ _____ |
| 15 | ○ Auto repair | _____ | $ _____ |
| 16 | ○ Other *(Please specify.)* _____ | _____ | $ _____ |

**27.** **Please choose from the list in Question 26 above the three most important shops/stores or services that are or would be most important to have near your boarding station.**

**MOST IMPORTANT** ▶ 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
**SECOND MOST IMPORTANT** ▶ 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
**THIRD MOST IMPORTANT** ▶ 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

## ➤ *Demographics*

**28.** **Are you . . . ?**

- ○ Male
- ○ Female

**29.** **What is your age?**

- ○ Under 18 years
- ○ 18–24 years
- ○ 25–34 years
- ○ 35–44 years
- ○ 45–54 years
- ○ 55–65 years
- ○ 65 years and over

**30.** **How many people are there in your household?**

- ○ One
- ○ Two
- ○ Three
- ○ Four
- ○ Five or more

**31.** **Typically, how many people in your household, including yourself, commute by NJT train?**

- ○ One
- ○ Two
- ○ Three or more

**32.** **Do your own or rent your current home?**

- ○ Own
- ○ Rent

**33.** **How long have you lived at your current address?**

- ○ Less than 6 months
- ○ 6 months to less than 1 year
- ○ Between 1 year and 2 years
- ○ Between 2 years and 5 years
- ○ Between 5 years and 10 years
- ○ More than 10 years

▶ ***Go to Question 36.***

**34.** **If you moved to your current address within the last 2 years, where did you move from?**

- ○ Essex, Morris, Somerset and Union Counties, NJ
- ○ Other New Jersey counties
- ○ Manhattan
- ○ Other New York City Boroughs
- ○ Other New York State
- ○ Other State *(Please specify.)* _____

**35.** **A.** How important was NJ TRANSIT rail service in choosing your current home location?

| Does Not Apply | Not Important | Somewhat Important | Very Important |
|---|---|---|---|
| ○ | ○ | ○ | ○ |

**B.** Did you move because of MidTOWN DIRECT?
○ Yes ○ No

**36.** Do you have a physical condition that makes it difficult for you to use the train?
○ No
○ Yes ➤ **Do you use . . . ?**
○ Wheel chair
○ Other mobility device

**37.** Does your business/employer reimburse you for any part of the following commuting expenses?
*(Fill in all ovals that apply.)*
○ Transit fare
○ Gas, mileage, etc.
○ Company car
○ Tolls
○ Parking
○ Other
○ No commuting expenses are reimbursed. ➤ *Skip to Question 39.*

**38.** For how much of your commuting expenses are you reimbursed?

$ _____ ○ Per day ○ Per month

**39.** What is your approximate annual household income?
○ Under $15,000
○ $15,000–$24,999
○ $25,000–$34,999
○ $35,000–$49,999
○ $ 50,000–$ 74,999
○ $ 75,000–$ 99,999
○ $100,000–$149,999
○ $150,000 and over



**40.** Are you of Hispanic origin?
No
Yes *(Please specify.)* _____

**41.** Are you . . . ?
○ White
○ Black
○ Asian or Pacific Islander
○ American Indian
○ Other *(Please specify.)* _____

➤ ***If you would like to enter our drawing for a chance to win free train rides for a month, please give us your name, address, and telephone number. If you have any other comments, please provide them on the remaining lines.***

Name _____ Telephone: ( ) - -

Address _____

City _____ State _____ ZIP Code _____

***Additional Comments*** _____

THIRTY PRIZES!!!
win FREE tickets on NJ TRANSIT trains
for a whole month!

**Thank you for your help!**

PLEASE DO NOT WRITE IN THIS AREA

18868

# APPENDIX II: COMPLEMENTARY 2001 SURVEY

New Jersey Department of Transportation and the University Transporation Research Center are conducting a study on the QUALITY OF LIFE in New Jersey.
Please take a few moments to fill in this questionnaire.
Please mail back the completed questionnaire in the provided return envelope. Thank You.

1. How long have you lived at your **current** address? _____Years

2. What was your **previous** (immediate previous) address?

_____

_____ Zip Code ☐☐☐☐☐

3. For how long did you live at this **previous** address? _____Years

## COMPARISON OF HOMES - CURRENT VS PREVIOUS

| **CURRENT ADDRESS** | **PREVIOUS ADDRESS** |
|---|---|
| 4a. Do you rent or own your **current** home? Rent ☐ Own ☐ | 5a. Did you rent or own your **previous** home? Rent ☐ Own ☐ |
| 4b. Is your **current** home an apartment or single dwelling home? Apartment ☐ Single dwelling home ☐ | 5b. Was your **previous** home an apartment or single dwelling home? Apartment ☐ Single dwelling home ☐ |
| 4c. Number of Bedrooms in **current** home _____ | 5c. Number of bedrooms in **previous** home _____ |
| 6a. If you own your **current** home, what is your estimate of its value? | 6b. If you owned your **previous** home, what is your estimate of its value then? |
| up to $50,000 ☐ $100-150,000 ☐ $201-300,000 ☐<br>$51-100,000 ☐ $151-200,000 ☐ $301-500,000 ☐<br>>$500,000 ☐ | up to $50,000 ☐ $100-150,000 ☐ $201-300,000 ☐<br>$51-100,000 ☐ $151-200,000 ☐ $301-500,000 ☐<br>>$500,000 ☐ |
| 7a. If you rent your **current** home, how much do you pay per month<br>up to $500 ☐ $1,001-1,500 ☐ $2,001-3,000 ☐<br>$500-1,000 ☐ $1,501-2,000 ☐ >$3,000 ☐ | 7b. If you rented your **previous** home, how much did you pay per month?<br>up to $500 ☐ $1,001-1,500 ☐ $2,001-3,000 ☐<br>$500-1,000 ☐ $1,501-2,000 ☐ >$3,000 ☐ |

## RATING OF NEIGHBORHOOD SERVICES

**CURRENT ADDRESS**

8a. From your **current** residence, how easy is it to travel to these places?

| | | Verv Difficult | | Average | | Verv Easv |
|---|---|---|---|---|---|---|
| School | n/a | 1 | 2 | 3 | 4 | 5 |
| Medical Services | n/a | 1 | 2 | 3 | 4 | 5 |
| Emergency Services | n/a | 1 | 2 | 3 | 4 | 5 |
| Job or Business | n/a | 1 | 2 | 3 | 4 | 5 |
| Shopping malls | n/a | 1 | 2 | 3 | 4 | 5 |
| Recreational facilities | n/a | 1 | 2 | 3 | 4 | 5 |
| Religious Institutions | n/a | 1 | 2 | 3 | 4 | 5 |

9a. How would you rate these conditions in your **current** neighborhood?

| | | Verv Bad | | Average | | Verv Good |
|---|---|---|---|---|---|---|
| Traffic Congestion | n/a | 1 | 2 | 3 | 4 | 5 |
| Sidewalks sufficiency | n/a | 1 | 2 | 3 | 4 | 5 |
| Transit stations' availability | n/a | 1 | 2 | 3 | 4 | 5 |
| Parking availability | n/a | 1 | 2 | 3 | 4 | 5 |
| Air Pollution | n/a | 1 | 2 | 3 | 4 | 5 |
| Security | n/a | 1 | 2 | 3 | 4 | 5 |
| Cleanliness of streets | n/a | 1 | 2 | 3 | 4 | 5 |
| Racial concerns | n/a | 1 | 2 | 3 | 4 | 5 |
| Real Estate Value | n/a | 1 | 2 | 3 | 4 | 5 |
| Wheel chair ramps | n/a | 1 | 2 | 3 | 4 | 5 |
| Transportation to Work | n/a | 1 | 2 | 3 | 4 | 5 |
| Parking charges | n/a | 1 | 2 | 3 | 4 | 5 |
| Noise Pollution | n/a | 1 | 2 | 3 | 4 | 5 |
| Other Please Specify | | | | | | |

**PREVIOUS ADDRESS**

8b. From your **previous** residence, how easy was it to travel to these places?

| | | Verv Difficult | | Average | | Verv Easv |
|---|---|---|---|---|---|---|
| School | n/a | 1 | 2 | 3 | 4 | 5 |
| Medical Services | n/a | 1 | 2 | 3 | 4 | 5 |
| Emergency Services | n/a | 1 | 2 | 3 | 4 | 5 |
| Job or Business | n/a | 1 | 2 | 3 | 4 | 5 |
| Shopping malls | n/a | 1 | 2 | 3 | 4 | 5 |
| Recreational facilities | n/a | 1 | 2 | 3 | 4 | 5 |
| Religious Institutions | n/a | 1 | 2 | 3 | 4 | 5 |

9b. How would you rate these conditions in your **previous** neighborhood?

| | | Verv Bad | | Average | | Verv Good |
|---|---|---|---|---|---|---|
| Traffic Congestion | n/a | 1 | 2 | 3 | 4 | 5 |
| Sidewalks sufficiency | n/a | 1 | 2 | 3 | 4 | 5 |
| Transit stations' availability | n/a | 1 | 2 | 3 | 4 | 5 |
| Parking availability | n/a | 1 | 2 | 3 | 4 | 5 |
| Air Pollution | n/a | 1 | 2 | 3 | 4 | 5 |
| Security | n/a | 1 | 2 | 3 | 4 | 5 |
| Cleanliness of streets | n/a | 1 | 2 | 3 | 4 | 5 |
| Racial concerns | n/a | 1 | 2 | 3 | 4 | 5 |
| Real Estate Value | n/a | 1 | 2 | 3 | 4 | 5 |
| Wheel chair ramps | n/a | 1 | 2 | 3 | 4 | 5 |
| Transportation to Work | n/a | 1 | 2 | 3 | 4 | 5 |
| Parking charges | n/a | 1 | 2 | 3 | 4 | 5 |
| Noise Pollution | n/a | 1 | 2 | 3 | 4 | 5 |
| Other Please Specify | | | | | | |

## RATING OF NEIGHBORHOOD SERVICES -continued-

**CURRENT ADDRESS** | **PREVIOUS ADDRESS**

10a. How important are the following to you in your **current** neighborhood?

| | | Unimportant | | | Important | Very Important |
|---|---|---|---|---|---|---|
| Access to job/business | n/a | 1 | 2 | 3 | 4 | 5 |
| Neighborhood Security | n/a | 1 | 2 | 3 | 4 | 5 |
| Parking availability | n/a | 1 | 2 | 3 | 4 | 5 |
| Air pollution | n/a | 1 | 2 | 3 | 4 | 5 |
| Access to recreation facilitie | n/a | 1 | 2 | 3 | 4 | 5 |
| Rental costs | n/a | 1 | 2 | 3 | 4 | 5 |
| Access to Schools | n/a | 1 | 2 | 3 | 4 | 5 |
| Same ethnicity as neighbors | n/a | 1 | 2 | 3 | 4 | 5 |
| Religious Insitutions | n/a | 1 | 2 | 3 | 4 | 5 |
| Access to medical services | n/a | 1 | 2 | 3 | 4 | 5 |
| Real estate value | n/a | 1 | 2 | 3 | 4 | 5 |
| Cleanliness of Streets | n/a | 1 | 2 | 3 | 4 | 5 |
| Access to shopping malls | n/a | 1 | 2 | 3 | 4 | 5 |
| Wheel Chair ramps | n/a | 1 | 2 | 3 | 4 | 5 |
| Parking charges | n/a | 1 | 2 | 3 | 4 | 5 |
| Noise pollution | n/a | 1 | 2 | 3 | 4 | 5 |
| Congestion concerns | n/a | 1 | 2 | 3 | 4 | 5 |
| Sidewalk sufficiency | n/a | 1 | 2 | 3 | 4 | 5 |
| Access transit stations | n/a | 1 | 2 | 3 | 4 | 5 |
| Other Please Specify | | | | | | |

10b. How important were the following to you at your **previous** neighborhood?

| | | Unimportant | | | Important | Very Important |
|---|---|---|---|---|---|---|
| Access to job/business | n/a | 1 | 2 | 3 | 4 | 5 |
| Neighborhood Security | n/a | 1 | 2 | 3 | 4 | 5 |
| Parking availability | n/a | 1 | 2 | 3 | 4 | 5 |
| Air pollution | n/a | 1 | 2 | 3 | 4 | 5 |
| Access to recreation facilities | n/a | 1 | 2 | 3 | 4 | 5 |
| Rental costs | n/a | 1 | 2 | 3 | 4 | 5 |
| Access to Schools | n/a | 1 | 2 | 3 | 4 | 5 |
| Same ethnicity as neighbors | n/a | 1 | 2 | 3 | 4 | 5 |
| Religious Insitutions | n/a | 1 | 2 | 3 | 4 | 5 |
| Access to medical services | n/a | 1 | 2 | 3 | 4 | 5 |
| Real estate value | n/a | 1 | 2 | 3 | 4 | 5 |
| Cleanliness of Streets | n/a | 1 | 2 | 3 | 4 | 5 |
| Access to shopping malls | n/a | 1 | 2 | 3 | 4 | 5 |
| Wheel Chair ramps | n/a | 1 | 2 | 3 | 4 | 5 |
| Parking charges | n/a | 1 | 2 | 3 | 4 | 5 |
| Noise pollution | n/a | 1 | 2 | 3 | 4 | 5 |
| Congestion concerns | n/a | 1 | 2 | 3 | 4 | 5 |
| Sidewalk sufficiency | n/a | 1 | 2 | 3 | 4 | 5 |
| Access transit stations | n/a | 1 | 2 | 3 | 4 | 5 |
| Other Please Specify | | | | | | |

11a. All other things remaining the same, how much of a reduction in travel time to work would cause you to move from your **current** home?

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Not applicable | ☐ | 10 to 20 Minutes | ☐ | 26 to 30 Minutes | ☐ | 46 to 60 Minutes | ☐ |
| <10 Minutes | ☐ | 21 to 25 Minutes | ☐ | 31 to 45 Minutes | ☐ | Over 60 Minutes | ☐ |

11b. How much of reduction of travel time would have caused you to move from your **previous** home?

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Not applicable | ☐ | 10 to 20 Minutes | ☐ | 26 to 30 Minutes | ☐ | 46 to 60 Minutes | ☐ |
| <10 Minutes | ☐ | 21 to 25 Minutes | ☐ | 31 to 45 Minutes | ☐ | Over 60 Minutes | ☐ |

## ABOUT YOURSELF

a) Number of people in your Household

b) Are you…? Male ☐ Female ☐

c) Number of workers in your household _____

d) Number of vehicles in your household is _____

e) Marital Status: Are you…? Single ☐ Married without children ☐ Single with Children ☐ Married with children ☐

f) Highest education attained is.. Primary school ☐ Middle School ☐ High School ☐ College ☐ Graduate ☐

g) Your Age Group is…

| | | | | | |
|---|---|---|---|---|---|
| < 20 years | ☐ | 31 to 36 years | ☐ | 56 to 65 years | ☐ |
| 20 to 25 years | ☐ | 37 to 45 years | ☐ | 66 to 75 years | ☐ |
| 26 to 30 years | ☐ | 46 to 55 years | ☐ | >75 years | ☐ |

h) Your Household Income is...

| | | | | | |
|---|---|---|---|---|---|
| <$15,000 | ☐ | $35-49,999 | ☐ | $100- 124,999 | ☐ |
| $15-24,999 | ☐ | $50-74,999 | ☐ | $125- 149,000 | ☐ |
| $25-34,999 | ☐ | $75-99,999 | ☐ | >$150,000 | ☐ |

**COMMENTS** _____

**NJDOT and UTRC are grateful for your support and cooperation. The CONFIDENTIALITY of your responses is guaranteed.**

# APPENDIX III: BINARY LOGIT MODELS

## Model 1a

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X | |
|---|---|---|---|---|---|---|
| Characteristics in numerator of Prob[Y = 1] | | | | | | |
| Constant | .7032822556 | .25600476 | 2.747 | .0060 | | |
| DTIME | -.4238698888E-04 | .46494914E-04 | -.912 | .3620 | 622.76492 | |
| P_OWNER | .1361578361E-03 | .19260766E-03 | .707 | .4796 | -25.098640 | |
| HH_SIZE | .1209852760E-03 | .86855789E-04 | 1.393 | .1636 | -79.080929 | |
| HH_EMP | .1713847547E-03 | .19383067E-03 | .884 | .3766 | -13.747882 | |
| V_OWN | -.2042993800E-03 | .14993169E-03 | -1.363 | .1730 | -25.860884 | |
| MARR_CH | .2909703864E-01 | .79362794E-01 | .367 | .7139 | .15752894 | |
| MARR_NCH | -.4731601849E-01 | .68290875E-01 | -.693 | .4884 | .70976514 | |
| H_SCH | -.4820888573E-02 | .26558586 | -.018 | .9855 | .28039199E-01 | |
| COLLEGE | -.1322221228 | .22761274 | -.581 | .5613 | .36172511 | |
| GRAD | -.1352684538 | .22612244 | -.598 | .5497 | .59760834 | |
| AGE | -.8122237569E-02 | .22843155E-02 | -3.556 | .0004 | 47.568078 | |
| HHINC | -.3366387958E-06 | .48255497E-06 | -.698 | .4854 | 122075.25 | |
| SCH_AC | -.1881568260E-02 | .11658327E-01 | -.161 | .8718 | -50.553478 | |
| MEDS_AC | .3574944305E-03 | .81996171E-03 | .436 | .6628 | -45.816862 | |
| EMGS_AC | .1322011520E-03 | .15724617E-03 | .841 | .4005 | -61.221215 | |
| JOB_AC | .1931637388E-03 | .24378272E-03 | .792 | .4282 | -56.978641 | Hessian |
| SHOP_AC | -.6696636726E-03 | .45033605E-03 | -1.487 | .1370 | -50.578496 | |
| RECR_AC | .2026499342E-02 | .11633321E-01 | .174 | .8617 | -50.714655 | |
| RELG_AC | .5298674949E-04 | .26499853E-03 | .200 | .8415 | -55.979505 | |
| CONG_Q | -.1219474660E-03 | .22381193E-03 | -.545 | .5858 | -71.329345 | |
| SIDEW_Q | -.2761010261E-03 | .38357452E-03 | -.720 | .4716 | -64.464205 | |
| TSTAT_Q | .6044603357E-03 | .36213013E-02 | .167 | .8674 | -58.251160 | |
| PARK_Q | .5035921488E-04 | .26639223E-03 | .189 | .8501 | -63.585385 | |
| APOLL_Q | -.2904334878E-03 | .22413142E-03 | -1.296 | .1950 | -66.237005 | |
| SEC_Q | .4721145512E-03 | .35890818E-02 | .132 | .8953 | -58.405084 | |
| CLEAN_Q | -.2209108344E-03 | .17813491E-03 | -1.240 | .2149 | -70.088476 | |
| RACIAL_Q | .1447985532E-03 | .20933695E-03 | .692 | .4891 | -67.337693 | |
| REALST_Q | .1562101891E-04 | .15589041E-03 | .100 | .9202 | -77.602500 | |
| WRAMP_Q | -.2297824539E-03 | .24873452E-03 | -.924 | .3556 | -79.074050 | |
| TWORK_Q | -.7222705743E-03 | .31797733E-03 | -2.271 | .0231 | -71.453029 | |
| PARKCH_Q | .6037837216E-03 | .34099703E-03 | 1.771 | .0766 | -78.997033 | |
| NPOLL_Q | -.6267416137E-04 | .25423517E-03 | -.247 | .8053 | -68.313345 | |
| ACCJOB_R | .3968648255E-04 | .22767876E-03 | .174 | .8616 | -86.951105 | |
| PARK_R | .1724561410E-04 | .26757450E-03 | .064 | .9486 | -91.718739 | |
| APOLL_R | -.3204752132E-03 | .25071093E-02 | -.128 | .8983 | -87.054714 | |
| RECREA_R | .4113528690E-03 | .35362451E-03 | 1.163 | .2447 | -91.682346 | |
| RENTC_R | -.1393856806E-03 | .16190465E-03 | -.861 | .3893 | -100.33504 | |
| ACCSCH_R | .4003036378E-04 | .18010909E-03 | .222 | .8241 | -91.402192 | |
| ETHNIC_R | -.3001554884E-04 | .15894913E-03 | -.189 | .8502 | -97.032177 | |
| RELG_R | .1677437991E-06 | .27077324E-03 | .001 | .9995 | -91.646817 | |
| MEDS_R | .2626329880E-01 | .15724751E-01 | 1.670 | .0949 | -91.645759 | |
| REALST_R | .9239125292E-03 | .82503110E-03 | 1.120 | .2628 | -93.678354 | |
| CLEAN_R | -.2108448510E-02 | .23708804E-02 | -.889 | .3738 | -85.951062 | |
| SHOP_R | .9077081582E-03 | .43466175E-03 | 2.088 | .0368 | -91.655602 | |
| WRAMP_R | .1900013420E-03 | .36186354E-03 | .525 | .5995 | -96.921941 | |
| PARKCH_R | -.2432356773E-01 | .15024032E-01 | -1.619 | .1055 | -91.647443 | |
| NPOLL_R | .1298808757E-03 | .24752442E-02 | .052 | .9582 | -92.393040 | |
| CONG_R | -.2455314685E-02 | .31061014E-02 | -.790 | .4292 | -92.368649 | |
| SIDEW_R | .4586669077E-04 | .27075644E-03 | .169 | .8655 | -97.018881 | |
| TSTAT_R | .2823858097E-03 | .24224382E-03 | 1.166 | .2437 | -101.77624 | |

Remarks:

In the first attempt, all the variables (50) corresponding to 2001's survey are tested.

Conclusions:

The variables with t-statistic less or equal than 0.4 are rejected. The variable JOB_AC is rejected because it yields multicollinearity in the model (Hessian property).

**Model 1c**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 6.719980102 | 3.6541437 | 1.839 | .0659 | |
| DTIME | -.1320864340E-02 | .97872952E-03 | -1.350 | .1772 | 622.76492 |
| P_OWNER | .2494829239 | .85847323 | .291 | .7713 | -25.098640 |
| HH_SIZE | .5134696817 | .40472219 | 1.269 | .2045 | -79.080929 |
| HH_EMP | .6608679100E-02 | .33155092E-01 | .199 | .8420 | -13.747882 |
| V_OWN | -.3823643027E-02 | .24904153E-02 | -1.535 | .1247 | -25.860884 |
| MEDS_AC | -.2796547660 | .36330646 | -.770 | .4414 | -45.816862 |
| EMGS_AC | .5671817923 | .39218965 | 1.446 | .1481 | -61.221215 |
| MARR_CH | -.1072794031 | 1.3711223 | -.078 | .9376 | .15752894 |
| MARR_NCH | -1.942764029 | 1.6707708 | -1.163 | .2449 | .70976514 |
| COLLEGE | -1.485502104 | 2.4234331 | -.613 | .5399 | .36172511 |
| GRAD | -1.409152409 | 2.2859013 | -.616 | .5376 | .59760834 |
| AGE | -.1801081640 | .61242284E-01 | -2.941 | .0033 | 47.568078 |
| HHINC | -.4952301295E-05 | .95736452E-05 | -.517 | .6050 | 122075.25 |
| CONG_Q | -.3488751343E-03 | .35093621E-02 | -.099 | .9208 | -71.329345 |
| SIDEW_Q | -.4049171011 | .21574730 | -1.877 | .0605 | -64.464205 |
| SHOP_AC | -.2825725517 | .24023617 | -1.176 | .2395 | -50.578496 |
| APOLL_Q | -.3874756139E-02 | .25438212E-02 | -1.523 | .1277 | -66.237005 |
| CLEAN_Q | -.7204918141E-02 | .40338572E-02 | -1.786 | .0741 | -70.088476 |
| RACIAL_Q | .1944835748E-01 | .16618613E-01 | 1.170 | .2419 | -67.337693 |
| WRAMP_Q | .1638201666 | .26244622 | .624 | .5325 | -79.074050 |
| TWORK_Q | -.1253676262 | .30290966 | -.414 | .6790 | -71.453029 |
| PARKCH_Q | .3588171837 | .23545855 | 1.524 | .1275 | -78.997033 |
| RECREA_R | .7982500697E-02 | .26326223E-01 | .303 | .7617 | -91.682346 |
| RENTC_R | -.2278327721E-02 | .34986004E-02 | -.651 | .5149 | -100.33504 |
| MEDS_R | .8251888643 | .49745493 | 1.659 | .0972 | -91.645759 |
| REALST_R | .2644502453E-01 | .29812150E-01 | .887 | .3750 | -93.678354 |
| CLEAN_R | -1.455487603 | .64416616 | -2.259 | .0239 | -85.951062 |
| SHOP_R | .5121619049 | .46883178 | 1.092 | .2746 | -91.655602 |
| WRAMP_R | .3961439566 | .39237793 | 1.010 | .3127 | -96.921941 |
| PARKCH_R | -.2867684215 | .26402840 | -1.086 | .2774 | -91.647443 |
| CONG_R | -.3250913771E-01 | .89099987E-01 | -.365 | .7152 | -92.368649 |
| TSTAT_R | .5911652616E-02 | .13638070E-01 | .433 | .6647 | -101.77624 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 180 | 0 | 180 |
| 1 | 19 | 13 | 32 |
| Total | 199 | 12 | 211 |

Conclusions:

The variables with *t-statistic* less or equal than 0.6 are rejected.

This model is a good predictor of the non-movers, but for 31 respondents who moved, the model only predict 12 cases correctly.

**Model 1d**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 4.400156467 | 2.7999218 | 1.572 | .1161 | |
| DTIME | -.7115157652E-03 | .79639998E-03 | -.893 | .3716 | 622.76492 |
| HH_SIZE | .5569194814 | .36261126 | 1.536 | .1246 | -79.080929 |
| V_OWN | -.2314683930E-02 | .19225201E-02 | -1.204 | .2286 | -25.860884 |
| MEDS_AC | -.4120303230 | .30868531 | -1.335 | .1819 | -45.816862 |
| EMGS_AC | .6943060738 | .33130416 | 2.096 | .0361 | -61.221215 |
| MARR_NCH | -1.998638932 | 1.1049804 | -1.809 | .0705 | .70976514 |
| COLLEGE | -.1892495433 | 1.9677677 | -.096 | .9234 | .36172511 |
| GRAD | -.1845040738 | 1.8705822 | -.099 | .9214 | .59760834 |
| AGE | -.1748547979 | .52765298E-01 | -3.314 | .0009 | 47.568078 |
| SIDEW_Q | -.3834540851 | .19741393 | -1.942 | .0521 | -64.464205 |
| SHOP_AC | -.2732148478 | .21936871 | -1.245 | .2130 | -50.578496 |
| APOLL_Q | -.2709573260E-02 | .21657176E-02 | -1.251 | .2109 | -66.237005 |
| CLEAN_Q | -.5182121042E-02 | .28465043E-02 | -1.821 | .0687 | -70.088476 |
| RACIAL_Q | .8508269812E-02 | .72117139E-02 | 1.180 | .2381 | -67.337693 |
| WRAMP_Q | .5237233080E-01 | .21134833 | .248 | .8043 | -79.074050 |
| PARKCH_Q | .3313238937 | .20347212 | 1.628 | .1035 | -78.997033 |
| RENTC_R | -.9892049158E-03 | .22594624E-02 | -.438 | .6615 | -100.33504 |
| MEDS_R | .8171153168 | .46742108 | 1.748 | .0804 | -91.645759 |
| CLEAN_R | -1.483448739 | .53561398 | -2.770 | .0056 | -85.951062 |
| SHOP_R | .5030748401 | .37618073 | 1.337 | .1811 | -91.655602 |
| WRAMP_R | .4062896180 | .37142992 | 1.094 | .2740 | -96.921941 |
| PARKCH_R | -.2450633541 | .23346392 | -1.050 | .2939 | -91.647443 |

| | *Predicted* | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 179 | 1 | 180 |
| 1 | 19 | 12 | 32 |
| Total | 198 | 14 | 212 |

Conclusions:

The variables with t-statistic less or equal than 1.0 are rejected.

**Model 1e**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 3.718873072 | 1.9915699 | 1.867 | .0619 | |
| HH_SIZE | .5813894724 | .35327018 | 1.646 | .0998 | -79.080929 |
| V_OWN | -.2470165625E-02 | .17696926E-02 | -1.396 | .1628 | -25.860884 |
| MEDS_AC | -.3855544981 | .29988304 | -1.286 | .1986 | -45.816862 |

| | | | | | |
|---|---|---|---|---|---|
| EMGS_AC | .6218924876 | .31387482 | 1.981 | .0476 | -61.221215 |
| MARR_NCH | -2.196453740 | 1.0391169 | -2.114 | .0345 | .70976514 |
| AGE | -.1700156508 | .47839711E-01 | -3.554 | .0004 | 47.568078 |
| SIDEW_Q | -.3535161290 | .15382004 | -2.298 | .0215 | -64.464205 |
| SHOP_AC | -.2271898636 | .20927793 | -1.086 | .2777 | -50.578496 |
| APOLL_Q | -.2954533282E-02 | .21482654E-02 | -1.375 | .1690 | -66.237005 |
| CLEAN_Q | -.5065551177E-02 | .31262567E-02 | -1.620 | .1052 | -70.088476 |
| RACIAL_Q | .7963670139E-02 | .80487790E-02 | .989 | .3225 | -67.337693 |
| PARKCH_Q | .3546695112 | .15371299 | 2.307 | .0210 | -78.997033 |
| MEDS_R | .8312262130 | .46692926 | 1.780 | .0750 | -91.645759 |
| CLEAN_R | -1.447175736 | .51890762 | -2.789 | .0053 | -85.951062 |
| SHOP_R | .4432646664 | .36198197 | 1.225 | .2207 | -91.655602 |
| WRAMP_R | .4197510907 | .37111498 | 1.131 | .2580 | -96.921941 |
| PARKCH_R | -.2501193195 | .22778941 | -1.098 | .2722 | -91.647443 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 180 | 0 | 180 |
| 1 | 20 | 12 | 32 |
| Total | 200 | 12 | 212 |

Conclusions:

The variables with t-statistic less or equal than 1.0 are rejected.

**Model 1f**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 3.767338903 | 1.9945719 | 1.889 | .0589 | |
| HH_SIZE | .5545787973 | .35016704 | 1.584 | .1132 | -79.080929 |
| V_OWN | -.2395200478E-02 | .17624826E-02 | -1.359 | .1741 | -25.860884 |
| MEDS_AC | -.3783324668 | .29901445 | -1.265 | .2058 | -45.816862 |
| EMGS_AC | .6228399749 | .31146835 | 2.000 | .0455 | -61.221215 |
| MARR_NCH | -2.165015251 | 1.0322747 | -2.097 | .0360 | .70976514 |
| AGE | -.1684939289 | .47302440E-01 | -3.562 | .0004 | 47.568078 |
| SIDEW_Q | -.3525522234 | .15375785 | -2.293 | .0219 | -64.464205 |
| SHOP_AC | -.2353789640 | .20484449 | -1.149 | .2505 | -50.578496 |
| APOLL_Q | -.2200430752E-02 | .19806705E-02 | -1.111 | .2666 | -66.237005 |
| CLEAN_Q | -.4808353354E-02 | .31467839E-02 | -1.528 | .1265 | -70.088476 |
| PARKCH_Q | .3605192635 | .15441009 | 2.335 | .0196 | -78.997033 |
| MEDS_R | .8264666814 | .46216224 | 1.788 | .0737 | -91.645759 |
| CLEAN_R | -1.420796020 | .51365386 | -2.766 | .0057 | -85.951062 |
| SHOP_R | .4193410158 | .35589244 | 1.178 | .2387 | -91.655602 |
| WRAMP_R | .4228912743 | .36937506 | 1.145 | .2523 | -96.921941 |
| PARKCH_R | -.2508444205 | .22971704 | -1.092 | .2748 | -91.647443 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 179 | 1 | 180 |
| 1 | 21 | 11 | 32 |
| Total | 200 | 12 | 212 |

Conclusions:

The variables with t-statistic less or equal than 1.2 are rejected.

**Model 1g**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 2.586082371 | 1.8175585 | 1.423 | .1548 | |
| HH_SIZE | .4408579972 | .32283024 | 1.366 | .1721 | -79.080929 |
| V_OWN | -.1978936696E-02 | .17096385E-02 | -1.158 | .2471 | -25.860884 |
| MEDS_AC | -.4511821734 | .25248483 | -1.787 | .0739 | -45.816862 |
| EMGS_AC | .4605253128 | .25301610 | 1.820 | .0687 | -61.221215 |
| MARR_NCH | -1.836700889 | .91623151 | -2.005 | .0450 | .70976514 |
| AGE | -.1358719637 | .40421940E-01 | -3.361 | .0008 | 47.568078 |
| SIDEW_Q | -.3201697692 | .13779776 | -2.323 | .0202 | -64.464205 |
| CLEAN_Q | -.4025556222E-02 | .26983038E-02 | -1.492 | .1357 | -70.088476 |
| PARKCH_Q | .3249971485 | .13860431 | 2.345 | .0190 | -78.997033 |
| MEDS_R | 1.046253543 | .37557126 | 2.786 | .0053 | -91.645759 |
| CLEAN_R | -1.049078393 | .37590218 | -2.791 | .0053 | -85.951062 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 178 | 2 | 180 |
| 1 | 26 | 6 | 32 |
| Total | 204 | 8 | 212 |

Conclusions:

The variables MEDS_AC, SIDEW_Q, CLEAN_Q and CLEAN_R are not conceptually valid because the expected sign for these variables is positive.

**Model 1h**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 2.916464976 | 1.6669583 | 1.750 | .0802 | |
| HH_SIZE | .1958219517 | .28554969 | .686 | .4929 | -79.080929 |
| V_OWN | -.1111728511E-02 | .16749577E-02 | -.664 | .5069 | -25.860884 |
| EMGS_AC | .1321093845E-01 | .19736313 | .067 | .9466 | -61.221215 |
| MARR_NCH | -.9645714949 | .79182997 | -1.218 | .2232 | .70976514 |
| AGE | -.1205346618 | .37645137E-01 | -3.202 | .0014 | 47.568078 |
| PARKCH_Q | .3611093829E-03 | .15808203E-02 | .228 | .8193 | -78.997033 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 180 | 0 | 180 |
| 1 | 31 | 1 | 32 |
| Total | 211 | 1 | 212 |

Conclusions:

The variables with t-statistic less or equal than 1.0 are rejected.

**Model 1i**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 2.422887926 | 1.4260062 | 1.699 | .0893 | |
| MARR_NCH | -.3473217531 | .56693825 | -.613 | .5401 | .70976514 |
| AGE | -.1070530288 | .33794295E-01 | -3.168 | .0015 | 47.568078 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 180 | 0 | 180 |
| 1 | 32 | 0 | 32 |
| Total | 212 | 0 | 212 |

Conclusions:

The variable MARR_NCH is rejected because its t-statistic is lower than 1.2.

**Model 1j**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 2.235256244 | 1.4275461 | 1.566 | .1174 | |
| AGE | -.1090095341 | .34474416E-01 | -3.162 | .0016 | 47.583568 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 180 | 0 | 180 |
| 1 | 31 | 0 | 31 |
| Total | 211 | 0 | 211 |

Conclusions:

This model is statically significant and conceptually valid but it is rejected because it has a low explanatory power. Although predicting correctly the decision of non-movers, the model completely failed to replicate the choice to relocate by movers.

# APPENDIX IV: BINARY PROBIT MODELS

**Model 2a**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | .6993833006 | .26483308 | 2.641 | .0083 | |
| DTIME | -.4250118721E-04 | .46677974E-04 | -.911 | .3625 | 622.76492 |
| P_OWNER | .1367558435E-03 | .19346135E-03 | .707 | .4796 | -25.098640 |
| HH_SIZE | .1209082000E-03 | .87135199E-04 | 1.388 | .1653 | -79.080929 |
| HH_EMP | .1702947542E-03 | .19527354E-03 | .872 | .3832 | -13.747882 |
| V_OWN | -.2037335915E-03 | .15069084E-03 | -1.352 | .1764 | -25.860884 |
| SINGL_CH | .8111892300E-02 | .13467318 | .060 | .9520 | .33176480E-01 |
| MARR_CH | .3122078175E-01 | .87067904E-01 | .359 | .7199 | .15752894 |
| MARR_NCH | -.4514822782E-01 | .77381728E-01 | -.583 | .5596 | .70976514 |
| H_SCH | -.3088383925E-02 | .26795969 | -.012 | .9908 | .28039199E-01 |
| COLLEGE | -.1299772823 | .23134202 | -.562 | .5742 | .36172511 |
| GRAD | -.1334324208 | .22886437 | -.583 | .5599 | .59760834 |
| AGE | -.8129617129E-02 | .22946898E-02 | -3.543 | .0004 | 47.568078 |
| HHINC | -.3356750186E-06 | .48431950E-06 | -.693 | .4883 | 122075.25 |
| SCH_AC | -.1900728468E-02 | .11698895E-01 | -.162 | .8709 | -50.553478 |
| MEDS_AC | .3609612619E-03 | .82452210E-03 | .438 | .6615 | -45.816862 |
| EMGS_AC | .1315668025E-03 | .15808619E-03 | .832 | .4053 | -61.221215 |
| JOB_AC | .1933654688E-03 | .24456352E-03 | .791 | .4291 | -56.978641 |
| SHOP_AC | -.6692247187E-03 | .45179482E-03 | -1.481 | .1385 | -50.578496 |
| RECR_AC | .2041440979E-02 | .11672123E-01 | .175 | .8612 | -50.714655 |
| RELG_AC | .5280713926E-04 | .26583908E-03 | .199 | .8425 | -55.979505 |
| CONG_Q | -.1218146011E-03 | .22451855E-03 | -.543 | .5874 | -71.329345 |
| SIDEW_Q | -.2759862618E-03 | .38477168E-03 | -.717 | .4732 | -64.464205 |
| TSTAT_Q | .5800005548E-03 | .36551862E-02 | .159 | .8739 | -58.251160 |
| PARK_Q | .5021977220E-04 | .26723040E-03 | .188 | .8509 | -63.585385 |
| APOLL_Q | -.2904741433E-03 | .22482920E-03 | -1.292 | .1964 | -66.237005 |
| SEC_Q | .4977362294E-03 | .36252811E-02 | .137 | .8908 | -58.405084 |
| CLEAN_Q | -.2208814962E-03 | .17868935E-03 | -1.236 | .2164 | -70.088476 |
| RACIAL_Q | .1445780382E-03 | .21001964E-03 | .688 | .4912 | -67.337693 |
| REALST_Q | .1525228616E-04 | .15649481E-03 | .097 | .9224 | -77.602500 |
| WRAMP_Q | -.2298948338E-03 | .24951476E-03 | -.921 | .3569 | -79.074050 |
| TWORK_Q | -.7223279606E-03 | .31896727E-03 | -2.265 | .0235 | -71.453029 |
| PARKCH_Q | .6035433462E-03 | .34208038E-03 | 1.764 | .0777 | -78.997033 |
| NPOLL_Q | -.6301901688E-04 | .25508979E-03 | -.247 | .8049 | -68.313345 |
| ACCJOB_R | .4050866556E-04 | .22879410E-03 | .177 | .8595 | -86.951105 |
| PARK_R | .1694073735E-04 | .26845404E-03 | .063 | .9497 | -91.718739 |
| APOLL_R | -.3195664157E-03 | .25149485E-02 | -.127 | .8989 | -87.054714 |
| RECREA_R | .4110905068E-03 | .35475059E-03 | 1.159 | .2465 | -91.682346 |
| RENTC_R | -.1394341491E-03 | .16240996E-03 | -.859 | .3906 | -100.33504 |
| ACCSCH_R | .3914455411E-04 | .18126655E-03 | .216 | .8290 | -91.402192 |
| ETHNIC_R | -.3011753664E-04 | .15945225E-03 | -.189 | .8502 | -97.032177 |
| RELG_R | .1155056967E-06 | .27161639E-03 | .000 | .9997 | -91.646817 |
| MEDS_R | .2635257632E-01 | .15843119E-01 | 1.663 | .0962 | -91.645759 |
| REALST_R | .9238395425E-03 | .82759681E-03 | 1.116 | .2643 | -93.678354 |
| CLEAN_R | -.2108451068E-02 | .23782509E-02 | -.887 | .3753 | -85.951062 |
| SHOP_R | .9076089003E-03 | .43601612E-03 | 2.082 | .0374 | -91.655602 |
| WRAMP_R | .1901482896E-03 | .36299669E-03 | .524 | .6004 | -96.921941 |
| PARKCH_R | -.2440216813E-01 | .15127127E-01 | -1.613 | .1067 | -91.647443 |
| NPOLL_R | .1029190288E-03 | .25229644E-02 | .041 | .9675 | -92.393040 |
| CONG_R | -.2437648754E-02 | .31295309E-02 | -.779 | .4360 | -92.368649 |
| SIDEW_R | .4552150734E-04 | .27165860E-03 | .168 | .8669 | -97.018881 |
| TSTAT_R | .2813400919E-03 | .24361628E-03 | 1.155 | .2482 | -101.77624 |

Remarks:

In this model all the variables of the survey 2001 are tested.

Conclusions:

The variables with t-statistic less or equal than 0.2 are rejected.

**Model 2b**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 2.911285154 | 1.9778594 | 1.472 | .1410 | |
| DTIME | -.4741427516E-03 | .49074768E-03 | -.966 | .3340 | 622.76492 |
| P_OWNER | -.8154143804E-02 | .20992322 | -.039 | .9690 | -25.098640 |
| HH_SIZE | .2376807973 | .21984765 | 1.081 | .2796 | -79.080929 |
| HH_EMP | .2747815295E-02 | .10280038E-01 | .267 | .7892 | -13.747882 |
| V_OWN | -.1218702116E-02 | .12765040E-02 | -.955 | .3397 | -25.860884 |
| MARR_CH | .2932216087 | .86204220 | .340 | .7337 | .15752894 |
| MARR_NCH | -.5852703101 | .94041844 | -.622 | .5337 | .70976514 |
| COLLEGE | -1.020384267 | 1.1428984 | -.893 | .3720 | .36172511 |
| GRAD | -.8566772599 | 1.0827581 | -.791 | .4288 | .59760834 |
| AGE | -.9223556337E-01 | .30119159E-01 | -3.062 | .0022 | 47.568078 |
| HHINC | .1229922997E-05 | .57267818E-05 | .215 | .8299 | 122075.25 |
| MEDS_AC | -.2482794713 | .20962194 | -1.184 | .2362 | -45.816862 |
| EMGS_AC | .1931260966 | .20821517 | .928 | .3537 | -61.221215 |
| JOB_AC | .3258788455 | .20430618 | 1.595 | .1107 | -56.978641 |
| SHOP_AC | -.2567201307 | .16540455 | -1.552 | .1206 | -50.578496 |
| CONG_Q | -.1003805854E-02 | .14263937E-02 | -.704 | .4816 | -71.329345 |
| SIDEW_Q | -.2579157212 | .11865129 | -2.174 | .0297 | -64.464205 |
| APOLL_Q | -.2811865782E-02 | .14567453E-02 | -1.930 | .0536 | -66.237005 |
| CLEAN_Q | -.5043258954E-02 | .22621533E-02 | -2.229 | .0258 | -70.088476 |
| RACIAL_Q | .1799667713E-02 | .12117381E-01 | .149 | .8819 | -67.337693 |
| WRAMP_Q | .1887737503 | .16522762 | 1.143 | .2532 | -79.074050 |
| TWORK_Q | -.1788411520 | .19975101 | -.895 | .3706 | -71.453029 |
| PARKCH_Q | .2458460423 | .13423000 | 1.832 | .0670 | -78.997033 |
| NPOLL_Q | .9113633637E-02 | .15218184E-01 | .599 | .5493 | -68.313345 |
| RECREA_R | .3182149548E-02 | .97839021E-02 | .325 | .7450 | -91.682346 |
| RENTC_R | -.1221198194E-02 | .21095766E-02 | -.579 | .5627 | -100.33504 |
| ACCSCH_R | .1102083144E-02 | .29383424E-02 | .375 | .7076 | -91.402192 |
| WRAMP_R | .2168183131 | .21741064 | .997 | .3186 | -96.921941 |
| MEDS_R | .4145226842 | .27684044 | 1.497 | .1343 | -91.645759 |
| REALST_R | .1863048385E-01 | .14703786E-01 | 1.267 | .2051 | -93.678354 |
| CLEAN_R | -.7056982488 | .33606404 | -2.100 | .0357 | -85.951062 |
| SHOP_R | .2997081532 | .27870162 | 1.075 | .2822 | -91.655602 |
| PARKCH_R | -.2196400685 | .15495066 | -1.417 | .1563 | -91.647443 |
| CONG_R | -.3148877983E-01 | .30335540E-01 | -1.038 | .2993 | -92.368649 |
| TSTAT_R | .2306695976E-02 | .59868180E-02 | .385 | .7000 | -101.77624 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 180 | 0 | 180 |
| 1 | 15 | 17 | 32 |
| Total | 195 | 17 | 212 |

Conclusions:

The variables with t-statistic less or equal than 0.4 are rejected.

**Model 2c**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 3.315880558 | 1.7546680 | 1.890 | .0588 | |
| DTIME | -.4750226222E-03 | .46580044E-03 | -1.020 | .3078 | 622.76492 |
| HH_SIZE | .2342490212 | .21043942 | 1.113 | .2656 | -79.080929 |
| V_OWN | -.6531490206E-03 | .10046217E-02 | -.650 | .5156 | -25.860884 |
| MARR_NCH | -.6108453751 | .63903057 | -.956 | .3391 | .70976514 |
| COLLEGE | -1.261319045 | 1.0975953 | -1.149 | .2505 | .36172511 |
| GRAD | -1.043602075 | 1.0493767 | -.994 | .3200 | .59760834 |
| AGE | -.9147774352E-01 | .28106792E-01 | -3.255 | .0011 | 47.568078 |
| MEDS_AC | -.2417071889 | .19371596 | -1.248 | .2121 | -45.816862 |
| EMGS_AC | .2074301035 | .20602088 | 1.007 | .3140 | -61.221215 |
| JOB_AC | .3612674701 | .19734332 | 1.831 | .0672 | -56.978641 |
| SHOP_AC | -.2654957212 | .16003505 | -1.659 | .0971 | -50.578496 |
| CONG_Q | -.9181718166E-03 | .14145016E-02 | -.649 | .5163 | -71.329345 |
| SIDEW_Q | -.2474707051 | .11500578 | -2.152 | .0314 | -64.464205 |
| APOLL_Q | -.2776938044E-02 | .14240854E-02 | -1.950 | .0512 | -66.237005 |
| CLEAN_Q | -.4925270200E-02 | .21313034E-02 | -2.311 | .0208 | -70.088476 |
| WRAMP_Q | .2010132536 | .15884511 | 1.265 | .2057 | -79.074050 |
| TWORK_Q | -.1929704266 | .19700164 | -.980 | .3273 | -71.453029 |
| PARKCH_Q | .2394722665 | .12822028 | 1.868 | .0618 | -78.997033 |
| NPOLL_Q | .8413485346E-02 | .10274936E-01 | .819 | .4129 | -68.313345 |
| RENTC_R | -.2855533481E-03 | .15960205E-02 | -.179 | .8580 | -100.33504 |
| WRAMP_R | .1707765041 | .19680816 | .868 | .3855 | -96.921941 |
| MEDS_R | .4119306728 | .27009611 | 1.525 | .1272 | -91.645759 |
| REALST_R | .1779846958E-01 | .13549177E-01 | 1.314 | .1890 | -93.678354 |
| CLEAN_R | -.7651567872 | .32244558 | -2.373 | .0176 | -85.951062 |
| SHOP_R | .3814574173 | .25585314 | 1.491 | .1360 | -91.655602 |
| PARKCH_R | -.1832479827 | .13896782 | -1.319 | .1873 | -91.647443 |
| CONG_R | -.3501199491E-01 | .29973402E-01 | -1.168 | .2428 | -92.368649 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 180 | 0 | 180 |
| 1 | 16 | 16 | 32 |
| Total | 196 | 16 | 212 |

Conclusions:

The variables with t-statistic less or equal than 0.8 are rejected.

**Model 2d**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 3.295784770 | 1.7220146 | 1.914 | .0556 | |
| DTIME | -.5296906790E-03 | .45454867E-03 | -1.165 | .2439 | 622.76492 |
| HH_SIZE | .2210132630 | .20742222 | 1.066 | .2866 | -79.080929 |
| MARR_NCH | -.4862300040 | .61900660 | -.786 | .4322 | .70976514 |
| COLLEGE | -1.307640121 | 1.0898688 | -1.200 | .2302 | .36172511 |
| GRAD | -1.056296143 | 1.0372550 | -1.018 | .3085 | .59760834 |
| AGE | -.8961277725E-01 | .27188189E-01 | -3.296 | .0010 | 47.568078 |
| MEDS_AC | -.2327554003 | .18960862 | -1.228 | .2196 | -45.816862 |

| | | | | | |
|---|---|---|---|---|---|
| EMGS_AC | .2056221530 | .20029168 | 1.027 | .3046 | -61.221215 |
| JOB_AC | .3771393857 | .19456850 | 1.938 | .0526 | -56.978641 |
| SHOP_AC | -.2344695052 | .15446009 | -1.518 | .1290 | -50.578496 |
| SIDEW_Q | -.2283333036 | .11119547 | -2.053 | .0400 | -64.464205 |
| APOLL_Q | -.2723101567E-02 | .14206462E-02 | -1.917 | .0553 | -66.237005 |
| CLEAN_Q | -.4880899546E-02 | .21161598E-02 | -2.306 | .0211 | -70.088476 |
| WRAMP_Q | .2016007741 | .15625691 | 1.290 | .1970 | -79.074050 |
| TWORK_Q | -.2323774850 | .19013313 | -1.222 | .2216 | -71.453029 |
| PARKCH_Q | .2584798957 | .12597039 | 2.052 | .0402 | -78.997033 |
| NPOLL_Q | .7955564497E-02 | .10281066E-01 | .774 | .4390 | -68.313345 |
| WRAMP_R | .1781015282 | .19566272 | .910 | .3627 | -96.921941 |
| MEDS_R | .4092212987 | .26433831 | 1.548 | .1216 | -91.645759 |
| REALST_R | .1896071412E-01 | .13446467E-01 | 1.410 | .1585 | -93.678354 |
| CLEAN_R | -.7639191323 | .30811471 | -2.479 | .0132 | -85.951062 |
| SHOP_R | .3785460526 | .25026076 | 1.513 | .1304 | -91.655602 |
| PARKCH_R | -.1857178672 | .13534360 | -1.372 | .1700 | -91.647443 |
| CONG_R | -.3674786734E-01 | .29504332E-01 | -1.246 | .2129 | -92.368649 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 180 | 0 | 180 |
| 1 | 17 | 15 | 32 |
| Total | 197 | 15 | 212 |

Conclusions:

The variables with t-statistic less or equal than 1.0 are rejected.

**Model 2e**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 3.295784770 | 1.7220146 | 1.914 | .0556 | |
| DTIME | -.5296906790E-03 | .45454867E-03 | -1.165 | .2439 | 622.76492 |
| HH_SIZE | .2210132630 | .20742222 | 1.066 | .2866 | -79.080929 |
| MARR_NCH | -.4862300040 | .61900660 | -.786 | .4322 | .70976514 |
| COLLEGE | -1.307640121 | 1.0898688 | -1.200 | .2302 | .36172511 |
| GRAD | -1.056296143 | 1.0372550 | -1.018 | .3085 | .59760834 |
| AGE | -.8961277725E-01 | .27188189E-01 | -3.296 | .0010 | 47.568078 |
| MEDS_AC | -.2327554003 | .18960862 | -1.228 | .2196 | -45.816862 |
| EMGS_AC | .2056221530 | .20029168 | 1.027 | .3046 | -61.221215 |
| JOB_AC | .3771393857 | .19456850 | 1.938 | .0526 | -56.978641 |
| SHOP_AC | -.2344695052 | .15446009 | -1.518 | .1290 | -50.578496 |
| SIDEW_Q | -.2283333036 | .11119547 | -2.053 | .0400 | -64.464205 |
| APOLL_Q | -.2723101567E-02 | .14206462E-02 | -1.917 | .0553 | -66.237005 |
| CLEAN_Q | -.4880899546E-02 | .21161598E-02 | -2.306 | .0211 | -70.088476 |
| WRAMP_Q | .2016007741 | .15625691 | 1.290 | .1970 | -79.074050 |
| TWORK_Q | -.2323774850 | .19013313 | -1.222 | .2216 | -71.453029 |
| PARKCH_Q | .2584798957 | .12597039 | 2.052 | .0402 | -78.997033 |
| NPOLL_Q | .7955564497E-02 | .10281066E-01 | .774 | .4390 | -68.313345 |
| WRAMP_R | .1781015282 | .19566272 | .910 | .3627 | -96.921941 |
| MEDS_R | .4092212987 | .26433831 | 1.548 | .1216 | -91.645759 |
| REALST_R | .1896071412E-01 | .13446467E-01 | 1.410 | .1585 | -93.678354 |
| CLEAN_R | -.7639191323 | .30811471 | -2.479 | .0132 | -85.951062 |
| SHOP_R | .3785460526 | .25026076 | 1.513 | .1304 | -91.655602 |
| PARKCH_R | -.1857178672 | .13534360 | -1.372 | .1700 | -91.647443 |
| CONG_R | -.3674786734E-01 | .29504332E-01 | -1.246 | .2129 | -92.368649 |

```
            Predicted
------  ----------  +  -----
Actual       0    1  |  Total
------  ----------  +  -----
  0        180    0  |    180
  1         17   15  |     32
------  ----------  +  -----
Total      197   15  |    212
```

Conclusions:

The variables with t-statistic less or equal than 1.1 are rejected.

**Model 2f**

```
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  .4377114062      .10258224        4.267   .0000
 DTIME    -.4386313147E-04  .40178879E-04   -1.092   .2750  622.76492
 COLLEGE  -.3402303574E-02  .39798997E-01    -.085   .9319  .36172511
 AGE      -.6921135488E-02  .19689877E-02   -3.515   .0004  47.568078
 MEDS_AC   .3441575581E-03  .53299939E-03     .646   .5185 -45.816862
 JOB_AC    .1399466151E-03  .22497773E-03     .622   .5339 -56.978641 Hessian
 SHOP_AC  -.2280584808E-03  .37729142E-03    -.604   .5455 -50.578496
 SIDEW_Q   .1165316921E-03  .30365116E-03     .384   .7012 -64.464205
 APOLL_Q  -.8752465872E-04  .18916078E-03    -.463   .6436 -66.237005
 CLEAN_Q  -.4779923037E-04  .15350720E-03    -.311   .7555 -70.088476
 WRAMP_Q  -.6947900563E-04  .17200209E-03    -.404   .6863 -79.074050
 TWORK_Q  -.3659942809E-03  .23520593E-03   -1.556   .1197 -71.453029
 PARKCH_Q  .2884707926E-03  .27705459E-03    1.041   .2978 -78.997033
 MEDS_R    .2603833541E-01  .13043661E-01    1.996   .0459 -91.645759
 REALST_R  .4821793959E-03  .71580889E-03     .674   .5006 -93.678354
 CLEAN_R  -.1108772810E-02  .83414208E-03   -1.329   .1838 -85.951062
 SHOP_R    .4481703940E-03  .34354233E-03    1.305   .1920 -91.655602
 PARKCH_R -.2304315783E-01  .12573069E-01   -1.833   .0668 -91.647443
 CONG_R   -.2841532620E-02  .22857662E-02   -1.243   .2138 -92.368649
```

Conclusions:

The variable JOB_AC was rejected because it yields multicollinearity in the model.

**Model 2g**

```
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  1.978001858      .98245237        2.013   .0441
 DTIME    -.5680162317E-03  .36867817E-03   -1.541   .1234  622.76492
 COLLEGE  -.1241612149      .35933718        -.346   .7297  .36172511
 AGE      -.7408104059E-01  .21677073E-01   -3.417   .0006  47.568078
 MEDS_AC   .5528243532E-01  .10599153         .522   .6020 -45.816862
 SHOP_AC  -.5193514732E-01  .10598284        -.490   .6241 -50.578496
 SIDEW_Q  -.1144069169      .87266000E-01   -1.311   .1899 -64.464205
 APOLL_Q  -.1182433320E-02  .10698174E-02   -1.105   .2690 -66.237005
 CLEAN_Q  -.8170494415E-03  .11694477E-02    -.699   .4848 -70.088476
 WRAMP_Q   .2931303261E-01  .10806164         .271   .7862 -79.074050
 TWORK_Q  -.1283292301E-01  .11573886        -.111   .9117 -71.453029
```

| | | | | | |
|---|---|---|---|---|---|
| PARKCH_Q | .9974365235E-01 | .89452903E-01 | 1.115 | .2648 | -78.997033 |
| MEDS_R | .3882395371 | .20593934 | 1.885 | .0594 | -91.645759 |
| REALST_R | .6181678309E-02 | .76970716E-02 | .803 | .4219 | -93.678354 |
| CLEAN_R | -.4429102227 | .22453287 | -1.973 | .0485 | -85.951062 |
| SHOP_R | .1734320747 | .19622818 | .884 | .3768 | -91.655602 |
| PARKCH_R | -.1029540556 | .11146876 | -.924 | .3557 | -91.647443 |
| CONG_R | -.2253737231E-01 | .18549270E-01 | -1.215 | .2244 | -92.368649 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 179 | 1 | 180 |
| 1 | 29 | 3 | 32 |
| Total | 208 | 4 | 212 |

Conclusions:

The variables with t-statistic less or equal than 1.0 are rejected.

**Model 2h**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 1.372319840 | .83528007 | 1.643 | .1004 | |
| DTIME | -.3149069297E-03 | .32017604E-03 | -.984 | .3253 | 622.76492 |
| AGE | -.6445739675E-01 | .19430201E-01 | -3.317 | .0009 | 47.568078 |
| SIDEW_Q | -.1155537442 | .62743015E-01 | -1.842 | .0655 | -64.464205 |
| APOLL_Q | -.9527283409E-03 | .10691436E-02 | -.891 | .3729 | -66.237005 |
| PARKCH_Q | .1174136400 | .62523419E-01 | 1.878 | .0604 | -78.997033 |
| MEDS_R | .5055258342 | .17554207 | 2.880 | .0040 | -91.645759 |
| CLEAN_R | -.4873639527 | .17227635 | -2.829 | .0047 | -85.951062 |
| CONG_R | -.1858451970E-01 | .14874273E-01 | -1.249 | .2115 | -92.368649 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 178 | 2 | 180 |
| 1 | 29 | 3 | 32 |
| Total | 207 | 5 | 212 |

Conclusions:

The variables with t-statistic less or equal than 1.0 are rejected.

**Model 2i**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 1.169073831 | .81504194 | 1.434 | .1515 | |
| AGE | -.6310745633E-01 | .19002229E-01 | -3.321 | .0009 | 47.568078 |
| SIDEW_Q | -.1123454294 | .60413476E-01 | -1.860 | .0629 | -64.464205 |
| PARKCH_Q | .1133384643 | .60354537E-01 | 1.878 | .0604 | -78.997033 |
| MEDS_R | .4880530823 | .17200600 | 2.837 | .0045 | -91.645759 |
| CLEAN_R | -.4719668421 | .16896018 | -2.793 | .0052 | -85.951062 |
| CONG_R | -.1650240895E-01 | .14553702E-01 | -1.134 | .2568 | -92.368649 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 178 | 2 | 180 |
| 1 | 30 | 2 | 32 |
| Total | 208 | 4 | 212 |

Conclusions:

The variables with t-statistic less or equal than 1.2 are rejected.

**Model 2j**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 1.260879385 | .80843864 | 1.560 | .1188 | |
| AGE | -.6449730285E-01 | .18993816E-01 | -3.396 | .0007 | 47.583568 |
| SIDEW_Q | -.9471688323E-01 | .59281257E-01 | -1.598 | .1101 | -64.611517 |
| PARKCH_Q | .9575298470E-01 | .59241639E-01 | 1.616 | .1060 | -79.188052 |
| MEDS_R | .4634677660 | .17387443 | 2.666 | .0077 | -91.861891 |
| CLEAN_R | -.4638791434 | .17392546 | -2.667 | .0077 | -86.153764 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 179 | 1 | 180 |
| 1 | 30 | 1 | 31 |
| Total | 209 | 2 | 211 |

Conclusions:

The variables SIDEW_Q, CLEAN_R, were not conceptually valid because their expected sign is positive.

**Model 2k**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 1.028550784 | .74900352 | 1.373 | .1697 | |
| AGE | -.5502200231E-01 | .17106408E-01 | -3.216 | .0013 | 47.583568 |
| PARKCH_Q | .9368932005E-03 | .98055549E-03 | .955 | .3393 | -79.188052 |
| MEDS_R | -.1291462165E-03 | .73072428E-03 | -.177 | .8597 | -91.861891 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 180 | 0 | 180 |
| 1 | 31 | 0 | 31 |
| Total | 211 | 0 | 211 |

Conclusions:

The variables with t-statistic less or equal than 1.0 are rejected.

**Model 2l**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | .7995166967 | .70509788 | 1.134 | .2568 | |
| AGE | -.5064442170E-01 | .16195193E-01 | -3.127 | .0018 | 47.583568 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 180 | 0 | 180 |
| 1 | 31 | 0 | 31 |
| Total | 211 | 0 | 211 |

Conclusions:

This model is statically significant and conceptually valid but it is rejected because it has a low explanatory power.

## Binary Probit Models with interaction terms

### Model 3a

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | .4643472100 | .26327054 | 1.764 | .0778 | |
| DTIME | -.3417369594E-04 | .42691853E-04 | -.800 | .4234 | 621.87762 |
| P_OWNER | .2296539479E-03 | .15513089E-03 | 1.480 | .1388 | -25.160189 |
| HH_SIZE | .6306598544E-04 | .79665288E-04 | .792 | .4286 | -79.279221 |
| HH_EMP | .1161632508E-03 | .16429788E-03 | .707 | .4795 | -13.785021 |
| V_OWN | -.1245315266E-03 | .13715852E-03 | -.908 | .3639 | -25.926589 |
| MARR_CH | .7662971292E-01 | .76462944E-01 | 1.002 | .3163 | .15790045 |
| MARR_NCH | .2437910804E-01 | .65082515E-01 | .375 | .7080 | .71143901 |
| H_SCH | .1100460774 | .26321288 | .418 | .6759 | .28105325E-01 |
| COLLEGE | .3082217124E-01 | .22974280 | .134 | .8933 | .36257818 |
| GRAD | .1498382211E-01 | .22789647 | .066 | .9476 | .59901770 |
| AGE | -.7882010261E-02 | .21594878E-02 | -3.650 | .0003 | 47.583568 |
| HHINC | -.3167577095E-06 | .44234826E-06 | -.716 | .4739 | 121997.61 |
| TWORK_Q | -.8045716058E-04 | .13669574E-03 | -.589 | .5561 | -71.621540 |
| RENTC_R | -.4898927624E-04 | .14549578E-03 | -.337 | .7363 | -100.57167 |
| ACCJOB_I | .5646729449E-04 | .16328041E-03 | .346 | .7295 | -91.488539 |
| SEC_I | -.1332214949E-04 | .37344867E-04 | -.357 | .7213 | -44.834574 |
| PARK_I | .4016730756E-04 | .16474472E-03 | .244 | .8074 | -102.33403 |
| APOLL_I | -.2120103771E-03 | .18537833E-03 | -1.144 | .2528 | -100.45914 |
| RECREA_I | .3615299960E-07 | .24650938E-03 | .000 | .9999 | -96.774610 |
| ACCSCH_I | -.2100618810E-04 | .15708113E-03 | -.134 | .8936 | -95.051661 |
| RACIAL_I | -.5365324171E-05 | .27257111E-04 | -.197 | .8440 | -59.572147 |
| RELG_I | -.7798337389E-06 | .18481175E-03 | -.004 | .9966 | -101.99378 |
| MEDS_I | -.9687011112E-04 | .36121875E-03 | -.268 | .7886 | -91.767277 |
| REALST_I | -.9719304436E-05 | .12673042E-04 | -.767 | .4431 | 186.71839 |
| CLEAN_I | -.1436193573E-04 | .28084367E-04 | -.511 | .6091 | -56.740331 |
| SHOP_I | .1324577663E-03 | .22687533E-03 | .584 | .5593 | -96.622963 |
| WRAMP_I | -.3860130612E-04 | .17583216E-03 | -.220 | .8262 | -112.60771 |
| PARKCH_I | -.3918664525E-04 | .26424947E-03 | -.148 | .8821 | -107.48531 |
| NPOLL_I | -.1809594097E-04 | .23999073E-04 | -.754 | .4508 | -223.05950 |
| CONG_I | -.1068353464E-03 | .18266628E-03 | -.585 | .5586 | -109.85737 |
| SIDEW_I | .1966273639E-03 | .23184661E-03 | .848 | .3964 | -107.16936 |
| TSTAT_I | .2238990378E-03 | .18451470E-03 | 1.213 | .2250 | -106.64522 |

Conclusions:

The variables with T-Statistic less or equal than 0.2 are rejected.

### Model 3b

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 2.554053772 | 1.2573931 | 2.031 | .0422 | |
| DTIME | -.4227754457E-03 | .35947628E-03 | -1.176 | .2396 | 621.87762 |
| P_OWNER | .4665424467E-02 | .23057674E-01 | .202 | .8397 | -25.160189 |
| HH_SIZE | .1400205531 | .18681436 | .750 | .4535 | -79.279221 |
| HH_EMP | .3400020093E-02 | .10013488E-01 | .340 | .7342 | -13.785021 |
| V_OWN | -.7532425138E-03 | .12538887E-02 | -.601 | .5480 | -25.926589 |
| MARR_CH | .5311523935 | .73043077 | .727 | .4671 | .15790045 |
| MARR_NCH | -.1696305073 | .81552811 | -.208 | .8352 | .71143901 |
| H_SCH | 3.495493281 | 1.7431385 | 2.005 | .0449 | .28105325E-01 |
| AGE | -.9532396514E-01 | .26044480E-01 | -3.660 | .0003 | 47.583568 |
| HHINC | -.1119354674E-05 | .41883608E-05 | -.267 | .7893 | 121997.61 |

| | | | | | |
|---|---|---|---|---|---|
| TWORK_Q | -.1025765330E-02 | .11108744E-02 | -.923 | .3558 | -71.621540 |
| RENTC_R | -.5778969609E-03 | .11681555E-02 | -.495 | .6208 | -100.57167 |
| ACCJOB_I | .1012686374E-02 | .28772656E-02 | .352 | .7249 | -91.488539 |
| SEC_I | -.1482062611 | .10305755 | -1.438 | .1504 | -44.834574 |
| PARK_I | .8590415851E-01 | .51720612E-01 | 1.661 | .0967 | -102.33403 |
| APOLL_I | -.1597894726E-02 | .11157807E-02 | -1.432 | .1521 | -100.45914 |
| MEDS_I | -.1955322033E-01 | .92130259E-01 | -.212 | .8319 | -91.767277 |
| REALST_I | -.3871780147E-03 | .20081395E-03 | -1.928 | .0538 | 186.71839 |
| CLEAN_I | -.3822954221E-02 | .15278293E-02 | -2.502 | .0123 | -56.740331 |
| SHOP_I | .7367462997E-02 | .58331186E-01 | .126 | .8995 | -96.622963 |
| WRAMP_I | -.4532148410E-03 | .10461678E-01 | -.043 | .9654 | -112.60771 |
| NPOLL_I | -.6261321308E-04 | .14752301E-03 | -.424 | .6713 | -223.05950 |
| CONG_I | -.6421882185E-03 | .11432121E-02 | -.562 | .5743 | -109.85737 |
| SIDEW_I | .7890622268E-01 | .41331744E-01 | 1.909 | .0562 | -107.16936 |
| TSTAT_I | .2523951812E-02 | .64882056E-02 | .389 | .6973 | -106.64522 |

| | Predicted | | |
|---|---|---|---|
| Actual | 0 | 1 | Total |
| 0 | 180 | 0 | 180 |
| 1 | 23 | 8 | 31 |
| Total | 203 | 8 | 211 |

Conclusions:

The variables with t-statistic less or equal than 0.4 are rejected.

**Model 3c**

| Variable | Coefficient | Standard Error | b/St.Er. | P[\|Z\|>z] | Mean of X |
|---|---|---|---|---|---|
| Constant | 1.561752608 | 1.0437402 | 1.496 | .1346 | |
| DTIME | -.2918838872E-03 | .32983478E-03 | -.885 | .3762 | 621.87762 |
| HH_SIZE | .1199886023 | .13966091 | .859 | .3903 | -79.279221 |
| V_OWN | -.4764527483E-03 | .10139699E-02 | -.470 | .6384 | -25.926589 |
| MARR_CH | .7970463254 | .43201212 | 1.845 | .0650 | .15790045 |
| H_SCH | 1.704119006 | 1.0314871 | 1.652 | .0985 | .28105325E-01 |
| AGE | -.7897997058E-01 | .22646754E-01 | -3.487 | .0005 | 47.583568 |
| TWORK_Q | .1592856143E-03 | .89269721E-03 | .178 | .8584 | -71.621540 |
| RENTC_R | -.6571183234E-03 | .10889357E-02 | -.603 | .5462 | -100.57167 |
| SEC_I | -.1361727854 | .64120779E-01 | -2.124 | .0337 | -44.834574 |
| PARK_I | .6987850133E-01 | .45527250E-01 | 1.535 | .1248 | -102.33403 |
| APOLL_I | -.1497830095E-02 | .10930296E-02 | -1.370 | .1706 | -100.45914 |
| REALST_I | -.2484273563E-03 | .15691529E-03 | -1.583 | .1134 | 186.71839 |
| CLEAN_I | -.3066055284E-02 | .13914213E-02 | -2.204 | .0276 | -56.740331 |
| NPOLL_I | -.9116645376E-04 | .13332684E-03 | -.684 | .4941 | -223.05950 |
| CONG_I | -.6855651393E-03 | .11033661E-02 | -.621 | .5344 | -109.85737 |
| SIDEW_I | .7279079726E-01 | .37851824E-01 | 1.923 | .0545 | -107.16936 |

```
         Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0       180    0  |    180
  1        27    4  |     31
------  ----------  +  -----
Total     207    4  |    211
```

Conclusions:

The variables with t-statistic less or equal than 0.8 are rejected.

**Model 3d**

```
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  1.715373670      1.0073657        1.703   .0886
 DTIME    -.3124174773E-03  .32127794E-03    -.972   .3308  621.87762
 HH_SIZE   .9652268905E-01  .13380700         .721   .4707 -79.279221
 MARR_CH   .6931566737      .41582128        1.667   .0955  .15790045
 H_SCH     1.540694018      .93320545        1.651   .0987  .28105325E-01
 AGE      -.7839079610E-01  .22079763E-01   -3.550   .0004  47.583568
 SEC_I    -.1258323695      .60701141E-01   -2.073   .0382 -44.834574
 PARK_I    .6789596732E-01  .43628898E-01    1.556   .1197 -102.33403
 APOLL_I  -.1448763019E-02  .10825672E-02   -1.338   .1808 -100.45914
 REALST_I -.2363682137E-03  .15130617E-03   -1.562   .1182  186.71839
 CLEAN_I  -.2911624323E-02  .13696907E-02   -2.126   .0335 -56.740331
 SIDEW_I   .6296928422E-01  .36955459E-01    1.704   .0884 -107.16936
```

```
     Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0       180    0  |    180
  1        29    2  |     31
------  ----------  +  -----
Total     209    2  |    211
```

Conclusions:

The variables with t-statistic less or equal than 1.0 are rejected.

**Model 3e**

```
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  1.421460790      .83081709        1.711   .0871
 MARR_CH   .5486605364      .36479471        1.504   .1326  .15790045
 H_SCH     .8075107530      .80276551        1.006   .3145  .28105325E-01
 AGE      -.6777248858E-01  .19598576E-01   -3.458   .0005  47.583568
 SEC_I    -.9705525631E-01  .54177293E-01   -1.791   .0732 -44.834574
 PARK_I    .5584713829E-01  .41139060E-01    1.358   .1746 -102.33403
 APOLL_I  -.1504191032E-02  .10734370E-02   -1.401   .1611 -100.45914
 REALST_I -.1206454796E-03  .11534752E-03   -1.046   .2956  186.71839
 CLEAN_I  -.1211647140E-02  .10580373E-02   -1.145   .2521 -56.740331
```

```
 SIDEW_I   .4440192384E-01  .32480222E-01    1.367   .1716 -107.16936
```

```
        Predicted
------  ----------  +  -----
Actual       0    1  |  Total
------  ----------  +  -----
  0        180    0  |    180
  1         29    2  |     31
------  ----------  +  -----
Total      209    2  |    211
```

Conclusions:

The variables with t-statistic less or equal than 1.2 are rejected.

**Model 3f**

```
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  1.165788261      .77612913        1.502   .1331
 MARR_CH    .5077121936     .35379626        1.435   .1513   .15790045
 AGE       -.6121465133E-01  .18133320E-01   -3.376   .0007  47.583568
 SEC_I     -.7572509601E-01  .49480033E-01   -1.530   .1259 -44.834574
 PARK_I     .4157060735E-01  .38166290E-01    1.089   .2761 -102.33403
 APOLL_I   -.1420755074E-02  .10694270E-02   -1.329   .1840 -100.45914
 SIDEW_I    .3590803850E-01  .31494436E-01    1.140   .2542 -107.16936
```

```
         Predicted
------  ----------  +  -----
Actual       0    1  |  Total
------  ----------  +  -----
  0        180    0  |    180
  1         30    1  |     31
------  ----------  +  -----
Total      210    1  |    211
```

Conclusions:

The variables with t-statistic less or equal than 1.2 are rejected.

**Model 3g**

```
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant   .7917325315      .71780326        1.103   .2700
 MARR_CH    .4396901717      .34242231        1.284   .1991   .15790045
 AGE       -.5235391493E-01  .16476636E-01   -3.177   .0015  47.583568
 SEC_I      .2196383008E-04  .24416384E-03     .090   .9283 -44.834574
 APOLL_I    .1445940351E-04  .52096406E-03     .028   .9779 -100.45914
```

```
       Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0       180    0  |    180
  1        31    0  |     31
------  ----------  +  -----
Total     211    0  |    211
```

Conclusions:

The variables with t-statistic less or equal than 1.0 are rejected.

**Model 3h**

```
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  .7802756522      .70786334        1.102   .2703
 MARR_CH   .4411173574      .33994581        1.298   .1944  .15790045
 AGE      -.5215639312E-01  .16355057E-01   -3.189   .0014  47.583568
```

```
            Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0       180    0  |    180
  1        31    0  |     31
------  ----------  +  -----
Total     211    0  |    211
```

Conclusions:

The variables with t-statistic less or equal than 1.2 are rejected.

**Model 3i**

```
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 MARR_CH   .4421220142      .33279178        1.329   .1840  .15790045
 AGE      -.3481639743E-01  .34916067E-02   -9.971   .0000  47.583568
```

```
            Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0       180    0  |    180
  1        31    0  |     31
------  ----------  +  -----
Total     211    0  |    211
```

Conclusions:

This model is statically significant and conceptually valid but it is rejected because it has a low explanatory power.

# APPENDIX V: DISCRIMINANT ANALYSIS

# Model 12 (without interaction terms and importance rating)

**Analysis Case Processing Summary**

| Unweighted Cases | | N | Percent |
|---|---|---|---|
| Valid | | 99 | 46.9 |
| Excluded | Missing or out-of-range group codes | 0 | .0 |
| | At least one missing discriminating variable | 69 | 32.7 |
| | Both missing or out-of-range group codes and at least one missing discriminating variable | 0 | .0 |
| | Unselected | 43 | 20.4 |
| | Total | 112 | 53.1 |
| Total | | 211 | 100.0 |

## Analysis

### *Stepwise Statistics*

**Variables Entered/Removed[a,b,c,d]**

| | | Wilks' Lambda | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Exact F | | | |
| Step | Entered | Statistic | df1 | df2 | df3 | Statistic | df1 | df2 | Sig. |
| 1 | AGE | .892 | 1 | 1 | 97.000 | 11.802 | 1 | 97.000 | .001 |
| 2 | MARR_CH | .835 | 2 | 1 | 97.000 | 9.452 | 2 | 96.000 | .000 |
| 3 | TWORK_Q | .795 | 3 | 1 | 97.000 | 8.148 | 3 | 95.000 | .000 |

At each step, the variable that minimizes the overall Wilks' Lambda is entered.

a. Maximum number of steps is 66.

b. Maximum significance of F to enter is .05.

c. Minimum significance of F to remove is .20.

d. F level, tolerance, or VIN insufficient for further computation.

**Variables in the Analysis**

| Step | | Tolerance | Sig. of F to Remove | Wilks' Lambda |
|---|---|---|---|---|
| 1 | AGE | 1.000 | .001 | |
| 2 | AGE | .981 | .000 | .952 |
| | MARR_CH | .981 | .013 | .892 |
| 3 | AGE | .974 | .000 | .913 |
| | MARR_CH | .969 | .008 | .857 |
| | TWORK_Q | .982 | .031 | .835 |

**Wilks' Lambda**

| Step | Number of Variables | Lambda | df1 | df2 | df3 | Exact F | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Statistic | df1 | df2 | Sig. |
| 1 | 1 | .892 | 1 | 1 | 97 | 11.802 | 1 | 97.000 | 8.723E-04 |
| 2 | 2 | .835 | 2 | 1 | 97 | 9.452 | 2 | 96.000 | 1.790E-04 |
| 3 | 3 | .795 | 3 | 1 | 97 | 8.148 | 3 | 95.000 | 6.959E-05 |

## *Summary of Canonical Discriminant Functions*

**Eigenvalues**

| Function | Eigenvalue | % of Variance | Cumulative % | Canonical Correlation |
|---|---|---|---|---|
| 1 | .257[a] | 100.0 | 100.0 | .452 |

a. First 1 canonical discriminant functions were used in the analysis.

**Wilks' Lambda**

| Test of Function(s) | Wilks' Lambda | Chi-square | df | Sig. |
|---|---|---|---|---|
| 1 | .795 | 21.868 | 3 | .000 |

**Standardized Canonical Discriminant Function Coefficients**

| | Function |
|---|---|
| | 1 |
| MARR_CH | .602 |
| AGE | -.805 |
| TWORK_Q | .489 |

**Canonical Discriminant Function Coefficients**

| | Function |
|---|---|
| | 1 |
| MARR_CH | 1.550 |
| AGE | -.095 |
| TWORK_Q | .333 |
| (Constant) | 3.985 |

Unstandardized coefficients

**Functions at Group Centroids**

| | Function |
|---|---|
| MOV | 1 |
| 0 | -.245 |
| 1 | 1.030 |

Unstandardized canonical discriminant functions evaluated at group means

## Classification

**Classification Processing Summary**

| | | |
|---|---|---|
| Processed | | 211 |
| Excluded | Missing or out-of-range group codes | 0 |
| | At least one missing discriminating variable | 15 |
| Used in Output | | 196 |

**Classification Results[a,b]**

| | | | | Predicted Group Membership | | |
|---|---|---|---|---|---|---|
| | | | MOV | 0 | 1 | Total |
| Cases Selected | Original | Count | 0 | 86 | 25 | 111 |
| | | | 1 | 6 | 15 | 21 |
| | | % | 0 | 77.5 | 22.5 | 100.0 |
| | | | 1 | 28.6 | 71.4 | 100.0 |
| Cases Not Selected | Original | Count | 0 | 43 | 13 | 56 |
| | | | 1 | 1 | 7 | 8 |
| | | % | 0 | 76.8 | 23.2 | 100.0 |
| | | | 1 | 12.5 | 87.5 | 100.0 |

a. 76.5% of selected original grouped cases correctly classified.

b. 78.1% of unselected original grouped cases correctly classified.

## *Casewise statistics*

| Case Number | Actual Group | Predicted Group | Squared Mahalanobis Distance to Centroid | Discriminant Scores |
|---|---|---|---|---|
| 1 | 1 | 0 | 4.921 | -1.188 |
| 2 | 1 | 1 | 2.791 | 1.426 |
| 3 | 1 | 1 | 6.519 | 2.309 |
| 4 | 1 | 1 | 4.008 | 1.757 |
| 5 | 1 | 0 | 3.555 | -0.855 |
| 6 | 1 | 1 | 1.785 | 1.091 |
| 7 | 1 | 1 | 6.519 | 2.309 |
| 8 | 1 | 0 | 2.410 | -0.522 |
| 9 | 1 | 1 | 1.785 | 1.091 |
| 10 | 1 | 0 | 3.555 | -0.855 |
| 11 | 1 | 1 | 0.449 | 0.426 |
| 13 | 1 | 0 | 2.567 | -0.572 |
| 14 | 1 | 0 | 0.877 | 0.094 |
| 15 | 1 | 1 | 0.449 | 0.426 |
| 16 | 1 | 0 | 0.877 | 0.094 |
| 17 | 1 | 1 | 2.791 | 1.426 |
| 18 | 1 | 1 | 0.431 | 0.412 |
| 19 | 1 | 1 | 0.883 | 0.695 |
| 20 | 1 | 1 | 0.451 | 0.427 |
| 21 | 1 | 1 | 2.578 | 1.361 |
| 22 | 1 | 1 | 1.785 | 1.091 |
| 23 | 1 | 1 | 2.786 | 1.424 |
| 24 | 1 | 1 | 1.006 | 0.758 |
| 25 | 1 | 1 | 6.519 | 2.309 |
| 26 | 1 | 1 | 1.537 | 0.995 |
| 27 | 1 | 1 | 1.537 | 0.995 |
| 28 | 1 | 1 | 7.783 | 2.545 |
| 30 | 1 | 1 | 1.006 | 0.758 |
| 31 | 1 | 1 | 6.527 | 2.310 |
| 32 | 0 | 0 | 1.780 | -0.304 |
| 33 | 0 | 1 | 8.330 | 2.642 |
| 34 | 0 | 0 | 2.567 | -0.572 |
| 35 | 0 | 0 | 8.034 | -1.804 |
| 36 | 0 | 0 | 3.555 | -0.855 |
| 37 | 0 | 0 | 0.879 | 0.093 |
| 38 | 0 | 0 | 10.033 | -2.137 |
| 39 | 0 | 0 | 6.509 | -1.521 |
| 40 | 0 | 0 | 2.410 | -0.522 |
| 41 | 0 | 0 | 3.555 | -0.855 |
| 42 | 0 | 0 | 5.213 | -1.253 |
| 43 | 0 | 1 | 3.568 | 1.644 |
| 44 | 0 | 0 | 1.002 | 0.029 |
| 46 | 0 | 0 | 3.555 | -0.855 |
| 47 | 0 | 0 | 10.033 | -2.137 |
| 49 | 0 | 0 | 3.555 | -0.855 |
| 51 | 0 | 0 | 6.509 | -1.521 |
| 52 | 0 | 0 | 8.319 | -1.854 |
| 53 | 0 | 1 | 1.006 | 0.758 |
| 54 | 0 | 0 | 0.877 | 0.094 |
| 55 | 0 | 0 | 1.611 | -0.239 |
| 56 | 0 | 0 | 2.567 | -0.572 |
| 57 | 0 | 0 | 12.253 | -2.470 |
| 58 | 0 | 1 | 1.009 | 0.760 |
| 59 | 0 | 0 | 0.877 | 0.094 |
| 60 | 0 | 0 | 8.319 | -1.854 |
| 61 | 0 | 0 | 1.487 | -0.189 |
| 62 | 0 | 0 | 3.750 | -0.906 |
| 64 | 0 | 0 | 2.567 | -0.572 |
| 65 | 0 | 0 | 3.804 | -0.920 |
| 66 | 0 | 0 | 3.555 | -0.855 |
| 67 | 0 | 0 | 4.921 | -1.188 |
| 68 | 0 | 0 | 10.033 | -2.137 |

| Case Number | Actual Group | Predicted Group | Squared Mahalanobis Distance to Centroid | Discriminant Scores |
|---|---|---|---|---|
| 69 | 0 | 0 | 2.567 | -0.572 |
| 70 | 0 | 0 | 8.319 | -1.854 |
| 71 | 0 | 0 | 6.509 | -1.521 |
| 73 | 0 | 0 | 3.555 | -0.855 |
| 74 | 0 | 0 | 4.921 | -1.188 |
| 75 | 0 | 1 | 0.449 | 0.426 |
| 77 | 0 | 0 | 0.446 | 0.362 |
| 78 | 0 | 0 | 3.555 | -0.855 |
| 79 | 0 | 0 | 1.650 | -0.254 |
| 80 | 0 | 0 | 0.877 | 0.094 |
| 81 | 0 | 0 | 3.555 | -0.855 |
| 82 | 0 | 0 | 3.555 | -0.855 |
| 83 | 0 | 0 | 3.555 | -0.855 |
| 84 | 0 | 0 | 3.555 | -0.855 |
| 85 | 0 | 0 | 0.877 | 0.094 |
| 86 | 0 | 1 | 1.620 | 1.028 |
| 87 | 0 | 0 | 6.258 | -1.471 |
| 88 | 0 | 0 | 3.555 | -0.855 |
| 89 | 0 | 1 | 0.451 | 0.427 |
| 90 | 0 | 1 | 1.620 | 1.028 |
| 91 | 0 | 0 | 8.034 | -1.804 |
| 92 | 0 | 0 | 4.988 | -1.203 |
| 93 | 0 | 0 | 6.258 | -1.471 |
| 94 | 0 | 0 | 2.567 | -0.572 |
| 95 | 0 | 0 | 0.877 | 0.094 |
| 96 | 0 | 0 | 0.877 | 0.094 |
| 97 | 0 | 0 | 0.877 | 0.094 |
| 98 | 0 | 0 | 8.034 | -1.804 |
| 100 | 0 | 1 | 1.785 | 1.091 |
| 101 | 0 | 1 | 1.785 | 1.091 |
| 102 | 0 | 0 | 8.034 | -1.804 |
| 103 | 0 | 0 | 0.877 | 0.094 |
| 104 | 0 | 0 | 3.555 | -0.855 |
| 105 | 0 | 0 | 0.877 | 0.094 |
| 106 | 0 | 0 | 14.316 | -2.753 |
| 107 | 0 | 0 | 1.487 | -0.189 |
| 108 | 0 | 1 | 0.451 | 0.427 |
| 109 | 0 | 1 | 2.786 | 1.424 |
| 110 | 0 | 1 | 2.578 | 1.361 |
| 111 | 0 | 0 | 0.877 | 0.094 |
| 113 | 0 | 0 | 0.877 | 0.094 |
| 114 | 0 | 0 | 2.410 | -0.522 |
| 115 | 0 | 0 | 3.555 | -0.855 |
| 116 | 0 | 0 | 1.611 | -0.239 |
| 117 | 0 | 0 | 3.370 | -0.805 |
| 118 | 0 | 0 | 3.555 | -0.855 |
| 119 | 0 | 0 | 2.410 | -0.522 |
| 120 | 0 | 0 | 3.555 | -0.855 |
| 121 | 0 | 1 | 0.883 | 0.695 |
| 122 | 0 | 0 | 0.877 | 0.094 |
| 123 | 0 | 0 | 0.786 | 0.144 |
| 124 | 0 | 0 | 0.877 | 0.094 |
| 126 | 0 | 0 | 3.555 | -0.855 |
| 127 | 0 | 0 | 8.034 | -1.804 |
| 128 | 0 | 0 | 2.567 | -0.572 |
| 129 | 0 | 1 | 0.449 | 0.426 |
| 130 | 0 | 0 | 3.555 | -0.855 |
| 131 | 0 | 0 | 3.745 | -0.905 |
| 132 | 0 | 0 | 0.877 | 0.094 |
| 133 | 0 | 1 | 0.451 | 0.427 |
| 134 | 0 | 0 | 4.921 | -1.188 |
| 135 | 0 | 0 | 2.567 | -0.572 |
| 136 | 0 | 0 | 0.877 | 0.094 |
| 137 | 0 | 1 | 2.473 | 1.328 |

| Case Number | Actual Group | Predicted Group | Squared Mahalanobis Distance to Centroid | Discriminant Scores |
|---|---|---|---|---|
| 138 | 0 | 0 | 8.034 | -1.804 |
| 139 | 0 | 1 | 1.009 | 0.760 |
| 140 | 0 | 0 | 8.034 | -1.804 |
| 141 | 0 | 1 | 1.789 | 1.093 |
| 142 | 0 | 0 | 3.555 | -0.855 |
| 143 | 0 | 0 | 8.034 | -1.804 |
| 144 | 0 | 0 | 6.258 | -1.471 |
| 145 | 0 | 0 | 1.611 | -0.239 |
| 146 | 0 | 0 | 3.555 | -0.855 |
| 147 | 0 | 0 | 2.410 | -0.522 |
| 149 | 0 | 0 | 14.316 | -2.753 |
| 150 | 0 | 1 | 0.451 | 0.427 |
| 152 | 0 | 1 | 1.785 | 1.091 |
| 153 | 0 | 0 | 1.611 | -0.239 |
| 154 | 0 | 1 | 9.752 | 2.878 |
| 155 | 0 | 0 | 3.555 | -0.855 |
| 156 | 0 | 0 | 3.745 | -0.905 |
| 157 | 0 | 0 | 4.703 | -1.138 |
| 158 | 0 | 1 | 1.789 | 1.093 |
| 159 | 0 | 0 | 3.555 | -0.855 |
| 160 | 0 | 1 | 0.451 | 0.427 |
| 161 | 0 | 0 | 0.877 | 0.094 |
| 162 | 0 | 0 | 3.555 | -0.855 |
| 163 | 0 | 1 | 1.009 | 0.760 |
| 164 | 0 | 1 | 0.883 | 0.695 |
| 165 | 0 | 0 | 1.002 | 0.029 |
| 166 | 0 | 0 | 1.487 | -0.189 |
| 167 | 0 | 0 | 6.509 | -1.521 |
| 168 | 0 | 1 | 2.786 | 1.424 |
| 169 | 0 | 0 | 1.487 | -0.189 |
| 170 | 0 | 0 | 1.487 | -0.189 |
| 171 | 0 | 0 | 1.611 | -0.239 |
| 172 | 0 | 0 | 0.879 | 0.093 |
| 173 | 0 | 0 | 1.611 | -0.239 |
| 174 | 0 | 1 | 2.421 | 1.311 |
| 175 | 0 | 1 | 1.620 | 1.028 |
| 176 | 0 | 0 | 17.333 | -3.133 |
| 177 | 0 | 0 | 3.555 | -0.855 |
| 178 | 0 | 0 | 3.555 | -0.855 |
| 179 | 0 | 0 | 3.555 | -0.855 |
| 181 | 0 | 1 | 3.568 | 1.644 |
| 182 | 0 | 1 | 8.330 | 2.642 |
| 183 | 0 | 0 | 0.877 | 0.094 |
| 185 | 0 | 1 | 1.620 | 1.028 |
| 186 | 0 | 1 | 0.451 | 0.427 |
| 187 | 0 | 0 | 3.555 | -0.855 |
| 188 | 0 | 1 | 0.451 | 0.427 |
| 189 | 0 | 0 | 3.555 | -0.855 |
| 190 | 0 | 0 | 1.611 | -0.239 |
| 191 | 0 | 0 | 0.877 | 0.094 |
| 192 | 0 | 1 | 3.568 | 1.644 |
| 193 | 0 | 0 | 3.555 | -0.855 |
| 194 | 0 | 0 | 3.555 | -0.855 |
| 195 | 0 | 1 | 4.937 | 1.977 |
| 196 | 0 | 0 | 0.877 | 0.094 |
| 197 | 0 | 0 | 3.555 | -0.855 |
| 198 | 0 | 0 | 6.509 | -1.521 |
| 199 | 0 | 0 | 8.034 | -1.804 |
| 200 | 0 | 0 | 6.258 | -1.471 |
| 201 | 0 | 1 | 1.620 | 1.028 |
| 202 | 0 | 0 | 3.555 | -0.855 |
| 203 | 0 | 0 | 0.905 | 0.079 |
| 204 | 0 | 0 | 3.370 | -0.805 |

| Case Number | Actual Group | Predicted Group | Squared Mahalanobis Distance to Centroid | Discriminant Scores |
|---|---|---|---|---|
| 205 | 0 | 0 | 0.877 | 0.094 |
| 206 | 0 | 0 | 14.694 | -2.803 |
| 207 | 0 | 1 | 0.520 | 0.477 |
| 208 | 0 | 0 | 10.350 | -2.187 |
| 209 | 0 | 0 | 1.487 | -0.189 |
| 210 | 0 | 0 | 3.555 | -0.855 |
| 211 | 0 | 0 | 0.877 | 0.094 |