

Appendix C: Mode Choice Analysis Data

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C.1 BT Service Survey Questionnaire Form.

Dear Blacksburg Residents:

The Center for Transportation Research at Virginia Tech is conducting a research project to help planners improve BT services. On the attached questionnaire there are several questions concerning your travel mode. We would appreciate very much if you could answer these questions and return this form into the blue box beside exit.

This form is anonymous and the information provided will be held in the strictest confidence. Thank you for your help.

Sincerely yours,

Chulho Bang, Researcher

* Your comment about BT service:

Thank you very much. Your answer will help us improve the BT service.

Please use a No. 2 or HB pencil only.

Please return the questionnaire after filling out into the blue box beside the exit.

Please use a No. 2 or HB pencil only.
QUESTIONNAIRE

1. What is your profession ? :
 1. Student 2.F/S 3.Other
2. Where do you live? :
 1. On-Campus 2. Off-Campus
3. What is your annual income range ? (\$1,000) :
 1. 0 ~ 5 2. 6 ~ 10 3. 11 ~ 15 4. 16 ~ 20 5. 21 ~ 25
 6. 26 ~ 30 7. 31 ~ 40 8. 41 ~ 50 9. 51 ~ 60 10. 61 ~
4. How many times do you attend school during weekdays (except Saturday, Sunday)?
 0. 1 1. 2 2. 3 3. 4 4. 5

** A Typical bus trip comprises several distinct time segments : access, waiting, and in-vehicle times. Please estimate the approximate times taken for each segment in your trip.*

5. Access time from home to the bus stop excluding the waiting time (minutes);
 1. 0 ~ 2 2. 3 ~ 4 3. 5 ~ 6 4. 7 ~ 8 5. 9 ~ 10
 6. 11 ~ 12 7. 13 ~ 14 8. 15 ~ 16 9. 17 ~ 18 10. 19 ~
6. Typical waiting time (minutes);
 1. 0 ~ 2 2. 3 ~ 4 3. 5 ~ 6 4. 7 ~ 8 5. 9 ~ 10
 6. 11 ~ 12 7. 13 ~ 14 8. 15 ~ 16 9. 17 ~ 18 10. 19 ~
7. In-vehicle travel time (minutes);
 1. 0 ~ 3 2. 4 ~ 6 3. 7 ~ 9 4. 10 ~ 12 5. 13 ~ 15
 6. 16 ~ 18 7. 19 ~ 21 8. 22 ~ 24 9. 25 ~ 27 10. 28 ~
8. Access time from BT stop to your destination (minutes);
 1. 0 ~ 2 2. 3 ~ 4 3. 5 ~ 6 4. 7 ~ 8 5. 9 ~ 10
 6. 11 ~ 12 7. 13 ~ 14 8. 15 ~ 16 9. 17 ~ 18 10. 19 ~
9. What is the overall level of service of Blacksburg Transit ?
 1. Excellent ←-----→ 7. Terrible
 1. 2. 3. 4. 5. 6. 7.
10. Suppose that you could get full & precise information through media (Internet, Signboard on bus stop, TV, Radio, Phone call) about the present bus location and arrival time to the stop you are boarding any time you want. Then the information would reduce the waiting time (question 6) by the following amount (minutes) ;
 1. No Reduction 2. 1 ~ 2 3. 3 ~ 4 4. 5 ~ 6 5. 7 ~ 8
 6. 9 ~ 10 7. 11 ~ 12 8. 13 ~ 14 9. 15 ~ 16 10. 17 ~
11. What would be the overall level of service for BT after full & precise information is provided ?
 1. Excellent ←-----→ 7. Terrible
 1. 2. 3. 4. 5. 6. 7.
12. Do you own a car ?
 1. Yes 2. No

** If you answered 'Yes' to Question 12, please answer Questions 13 ~ 23*

** If you answered 'No' to Question 12, please answer Questions 17 ~ 23*

13. Did you purchase a parking permit this academic year from VT ?
 1. Yes 2. No
14. Normally what is the mode of transportation between school and home ?
 1. Auto 2. BT 3. Other
15. What was the mode of transportation used yesterday from school to home ?
 1. Auto 2. BT 3. Other
16. What is the average expenditure on your car per month ?
 (\$, excluding installment & including gas, insurance, parking violation fee, etc.)
 1. 0 ~ 50 2. 51 ~ 100 3. 101 ~ 150 4. 151 ~ 200 5. 201 ~ 250
 6. 251 ~ 300 7. 301 ~ 350 8. 351 ~ 400 9. 401 ~ 450 10. 451 ~

**When you use the car for the same trip, what are the values of following times*

17. Access time to your car including walking time (minutes) ;
 1. 0 ~ 2 2. 3 ~ 4 3. 5 ~ 6 4. 7 ~ 8 5. 9 ~ 10
 6. 11 ~ 12 7. 13 ~ 14 8. 15 ~ 16 9. 17 ~ 18 10. 19~
18. In-vehicle travel time (minutes);

0. 0 ~ 3 1. 4 ~ 6 2. 7 ~ 9 3. 10 ~ 12 4. 13 ~ 15
6. 16 ~ 18 7. 19 ~ 21 8. 22 ~ 24 9. 25 ~ 27 10. 28 ~
19. Access time from parking lot to your destination (minutes, parking, walking time, etc.);
1. 0 ~ 2 2. 3 ~ 4 3. 5 ~ 6 4. 7 ~ 8 5. 9 ~ 10
6. 11 ~ 12 7. 13 ~ 14 8. 15 ~ 16 9. 17 ~ 18 10. 19~
20. What is the perceived level of service of auto facilities in **VT**?
(parking lot space, regulations, parking permit cost, violation fees, etc.)
1. Excellent ←—————→ 7. Terrible
1. 2. 3. 4. 5. 6. 7.

**When you use the other mode(walk, bicycle, etc.) for the same trip, what are(would be) the values of following times*

21. What is the total travel time from your home to your final destination (minutes) ? ;
(Access time, waiting time, in-vehicle or travel time, and egress time to your destination) (_____ min.)
22. What is the actual (in-vehicle) travel time (minutes) ; (_____ min.)
23. What is perceived level of service provided from **VT** for the other mode?
1. Excellent ←—————→ 7. Terrible
1. 2. 3. 4. 5. 6. 7.

Thank you very much. Please return this form to the box beside the exit.

C.2 Logit Model Estimation Program Source Code Using SAS Statistical Package.

```

/*****
/*          S A S  L O G I T  PROGRAM                               */
/*
/*          */
/*  NAME: LOGIT FINAL
/*          */
/*  TITLE: BT MODE CHOICE ANALYSIS AFTER AVL                       */
/*  PRODUCT: SAS
/*          */
/*  DATA:3/13/97 10:00AM -14:00PM FROM ON- CAMPUS BERGER KING    */
/*  NOTES:
/*          */
*****/
data DATAMODE;
missing X;
input      job 1      home 2 r_income 3 rschlday 4 r__BTA 5
          r__BTW 6 r__BTT 7 r__BTE 8 r__BTLOS 9 rAVLTIME 10
          r_AVLLOS 11  owncar 12  prkperm 13 rgenmode 14 ryestmod 15
          rcarexpd 16 r__carA 17 r__carT 18 r__carE 19 r__VTLOS 20
          OTHRAWTE 21-24 OTHRTT 26-29 OTHRLOS 31 @@;
/*  Q 1      job = What is your profession? 0: Student, 1:F/S, 2: other
/*          */
/*  Q 2      home = Where are you live?          0: On-campus, 1:Off-Campus
/*          */
/*  Q 3      r_income = Annual income range
/*          */
/*  Q 4      rschlday = days attend school
/*          */
/*  Q 5      r__BTA = BT Access time from home to the bus stop
/*          */
/*  Q 6      r__BTW = BT waiting time
/*          */
/*  Q 7      r__BTT = BT travel time
/*          */
/*  Q 8      r__BTE = time BT to destination
/*          */
/*  Q 9      r__BTLOS = BT LOS
/*          */
/*  Q10      rAVLTIME = information price
/*          */
/*  Q11      r_AVLLOS = BT LOS after AVL
/*          */
/*  Q12      owncar = have car?
/*          */
/*  Q13      prkperm = have permit?
/*          */
/*  Q14      rgenmode = generally selected mode
/*          */
/*  Q15      ryestmod = yesterday mode
/*          */

```

```

/* Q16 rcarexpd = car expenditure
*/
/* Q17 r__carA = car access time
*/
/* Q18 r__carT = car travel time
*/
/* Q19 r__carE = time car to destination
*/
/* Q20 r__VTLOS = VT parking service
*/
/* Q21 OTHRAWTE = TOTAL TRAVEL TIME OF OTHER MODE */
/* Q22 OTHRTT = TRAVEL IN-VEHICLE TIME OF OTHER MODE */
/* Q23 OTHRLOS = LOS OF OTHER MODE
*/

if owncar ~= 0 then delete;
/*if home ~= 1 then delete; */
/*if rgenmode ~= 0 and rgenmode ~=1 then delete; */
if job ~= 0 then delete;
if 6<= r_income <= 9 then income = r_income * 10000 - 25000;
else if 1<= r_income <=5 then income = r_income * 5000 + 2500;
else if 0 = r_income then income = 2500;
if r__BTA = 0 then BTA = 1;
else if 1<= r__BTA <= 9 then BTA = r__BTA * 2 + 1.5;
if r__BTW = 0 then BTW = 1;
else if 1<= r__BTW <= 9 then BTW = r__BTW * 2 + 1.5;
if r__BTT = 0 then BTT = 1.5;
else if 1<= r__BTT <= 9 then BTT = r__BTT * 3 + 2;
if r__BTE = 0 then BTE = 1;
else if 1<= r__BTE <= 9 then BTE = r__BTE * 2 + 1.5;
BTLOS = 7 - r__BTLOS;
AVLLOS = 7 - r__AVLLOS;
VTLOS = 7 - r__VTLOS;
if rAVLTIME = 0 then AVLTIME = 0;
else if 1<= rAVLTIME <= 9 then AVLTIME = rAVLTIME * 2 - .5;
if BTW >= AVLTIME then AVL = BTW - AVLTIME;
else if BTW < AVLTIME then AVL = 0;
BTAWTE = BTA + BTW + BTE;
BTAWTE = BTAWTE + BTT;
AVLAE = BTA + AVL + BTE;
AVLATE = AVLAE + BTT;
/* BTrelt = relative travel time of BT comparing the off-vehicle time */
BTrelt = BTT / BTAWTE;
/* AVLrelt = relative travel time of BT after AVL
*/
AVLrelt = BTT / AVLATE;
if job = 0 then BTcost = 0;
else BTcost = .5; /* MUST CHECK
*/
BTcstinc = BTcost*365 / income; /*BTcstinc = BT(cost/income) of Btriders */
if rgenmode = 0 then genmode = 'AUTO';
else if rgenmode = 1 then genmode = 'BT';
else if rgenmode = 2 then genmode = 'OTHER';
if ryestmod = 0 then yestmode = 'AUTO';
else if ryestmod = 1 then yestmode = 'BT';
else if ryestmod = 2 then yestmode = 'OTHER';

```

```

if rcarexpd = 0 then carexpd = 25/20;
  else if 1 <= rcarexpd <= 9 then carexpd = ( rcarexpd * 50 + 25 ) / 20;
if r__carA = 0 then carA = 1;
  else if 1 <= r__carA <= 9 then carA = r__carA * 2 + 1.5;
if r__carT = 0 then carT = 1.5;
  else if 1 <= r__carT <= 9 then carT = r__carT * 3 + 2;
if r__carE = 0 then carE = 1;
  else if 1 <= r__carE <= 9 then carE = r__carE * 2 + 1.5;
carAE = carA + carE;
carATE = carAE + carT;
/* carrelt = relative travel time of auto comparing the off-vehicle time */
carrelt = carT / carATE;
OTHRRELT = OTHRTT / OTHRAWTE;
if owncar = 0 then
  if prkperm = 0 then
    if job = 0 then carcost = 40/217 + carexpd;
    else if 1 <= job <= 2 then carcost = 50/217 + carexpd;
    else if prkperm = 1 then carcost = carexpd;
  else if owncar = 1 then carcost = 0;
  /*carcstin = auto ( cost / income ) of auto riders*/
othrcost = 0;
OTHRCSIN = 0;
own = 1-owncar;
carcstin = carcost *365 / income;

/*
QQQQQQQQQQQQQQQQQQQQ
11111111112
12345678901234567890*/
cards;

```

0104001110000001214551.5	01540010 0 00001073360.0	0133425221100051324 48.5
48.0 2	60.0 1	10.5 1
0184221022101221001410.5	0161022002200002070552.5	0124123211100001223351.5
10.5 5	52.5 2	48.0 2
012372371121 0	0102035232000005072648.5	012 070711100001082451.5
0104031132000002076544.5	48.0 1	48.0 2
44.0 2	0 4 1 5 0 217 615.0	0104154322100000062539.7
0104540131100002072648.5	10.0 7	38.5 2
40.5 1	0 1 2 40 2 175 7	0104255443200223223513.5
012 070711100001082451.5	6	13.5 7
48.0 2	010411433031 0	211420231111 2
0104154322100000062539.7	0102014522300011071551.5	0104002113000000071655.5
38.5 2	48.0 2	42.5 1
0104255443200223223513.5	011412111211 2	0114000220200000252652.5
13.5 7	0104003131101220023510.5	39.5 2
010323322121 0	10.5 5	001123522111 2
0104002113000000071655.5	010400111111 1	0 0 1 5545.0
42.5 1	010442104141 0	20.0 5
0104013220201221035416.5	00042247202012201423 7.5	0114000220200000252652.5
16.5 6	7.5 4	39.5 2
0104046130300001031360.0	0104502110300113015652.5	0 1 4 550 2 6 7
60.0 1	22.0 2	6
0104026211100101013348.5	0114132253200112014651.5	0 66 2 1 066 4 5 60.0
40.5 1	25.0 2	30.0 5
	000404401011 1	

01240000 4 00000333439.7	0010 1 1	0104124420200001035555.5
38.5 2	011424305221 0	42.5 1
01141735261012220425 7.5	012402521011 0	0104021131100000102651.5
7.5 4	0104213239201110012552.5	48.0 2
0104312121100004015560.0	39.5 2	0153113630400101033344.5
60.0 1	0174322100100005260460.0	44.0 2
010301240101 0	60.0 1	010 224132200003079648.5
012401231111 1	0114313110101201013610.5	40.5 1
0104003131101220023510.5	10.5 7	010412724141 1
10.5 5	0122011110101110000244.5	000432422211 1
001423422211 1	44.0 2	0104011410000000426448.5
00042247202012201423 7.5	010401312021 0	48.5 1
7.5 4	0104011211100111013560.0	000223003031 2
000416312301 2	60.0 1	0104023212100000012360.0
0104505110300113015652.5	0134000301000001012260.0	60.0 1
22.0 2	60.0 1	0174 002200111 4.5
0114135253200112014651.5	0104021133201110022644.5	4.5 6
25.0 2	44.0 2	0102035232000005072648.5
0133425221100051324 48.5	0123002110000001024439.7	48.0 1
10.5 1	38.5 2	010430221211 1
0 1 4 04 6 4 6	0194 000001122652.5	01240000 4 00000333439.7
7	39.5 2	38.5 2
000422995501 1	01042 10 00220011310.5	01141735261012220425 7.5
0 1 42 5504 666 56	10.5 6	7.5 4
6	0114322320100112011255.5	010401143131 1
0 1 1 2 0 166 7	42.5 1	0104312121100004015560.0
5	0124 01222010210.5	60.0 1
0124123211100001223351.5	5.5 6	011401402211 2
48.0 2	010413321101 0	010401241101 1
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60.0 1	000400361211 2	39.5 2
010403453321 2	012422 11000001024360.0	00047434130002244315 9.0
0133001210101111020251.5	60.0 1	9.0 7
48.0 2	010135122011 2	01041342322002230035 5.5
010404533311 1	0103124012000002034551.5	5.5 5
010441202011 2	48.0 2	01041201100012210023 4.5
0104228131300001050260.0	0104523730400000344652.5	4.5 5
60.0 1	39.5 2	010200002511 2
0104124420200001035555.5	0102014522300011071551.5	0004003430100111013455.0
42.5 1	48.0 2	46.5 1
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48.0 2	0104011410000000426448.5	48.0 2
0153113630400101033344.5	48.5 1	0104234220201221033616.5
44.0 2	0104023212100000012360.0	16.5 5
0124 1 2	60.0 1	0104012021201110011655.5
0 2 0 1 1 45.0	0174 002200111 4.5	42.5 1
30.0 6	4.5 6	010301222101 1
010 224132200003079648.5	0110012300400001323652.5	0104013221000000423360.0
40.5 1	39.5 2	60.0 1
0 6 610 1 1	0124741239200001212348.5	000401111101 0
7	40.5 1	0104114311100112022344.5
0104031132000002076544.5	0114000201000001002460.0	44.0 2
44.0 2	60.0 1	0121110060601221 6 4.5
0 1 0 1 30.0	0133001210101111020251.5	4.5 7
15.0 6	48.0 2	0104013621101112026455.0
0104540131100002072648.5	0104228131300001050260.0	46.5 1
40.5 1	60.0 1	

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60.0 1
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44.0 2
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60.0 1
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48.0 2
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40.5 1
0103 1 00002414460.0
60.0 1
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40.5 1
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60.0 1
0174 00000162360.0
60.0 1
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48.0 2
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0114274213100001024344.5
44.0 2
011402403121 1
0132342313100001012551.5
48.0 2
02 24 2 0 74 15
6
0 2 1 0 1 2 7
6
0123021030300205012513.5
13.5 5
013299969400009494552.5
39.5 2
0104014120200000012444.5
44.0 2
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60.0 1
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42.5 1
0124022222100001011439.7
38.5 2
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42.5 1
004421421211 1
0103000000000000014360.0
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42.5 1
010402022111 1
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39.5 2
0124741239200001212348.5
40.5 1

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16.5 6
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60.0 1
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40.5 1
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42.5 1
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60.0 1
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42.5 1
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44.0 2
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48.0 2
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35.5 2
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6.5 5
00041351433012201256 6.5
6.5 5

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4.0 6
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46.5 1
0104 00000111260.0
60.0 1
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010434114321 1
01010324000012210003 3.5
3.5 7
010 00002012655.0
46.5 1
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60.0 1
01047406333000001024 3.5
3.5 7
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38.5 2
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46.5 1
0124022112101000012355.0
46.5 1
0104 012200054 3.5
3.5 7
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5
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3.5 7
0104023120200001010355.0
46.5 1
01040222010012200246 7.5
7.0 7
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4.5 6
0134133113000001022335.5
35.5 2
01241132100012110235 3.5
3.5 6
0133323212100001035535.5
35.5 2
01240100111012200002 4.5
4.5 7
0184969013100001030355.0
46.5 1
0 2 2 1 033431 630.0
25.0 6
0104330322100000203439.7
38.5 2
011402111111 1
0104014100000000014335.5
35.5 2
0104013812000001035633.5
30.5 3
01444424202012200214 5.0
5.0 7
0104122711000000016255.0
46.5 1

01040020101012200204 4.5 4.5 7	0114012210100012011435.5 35.5 2 0114012111000001022539.7 38.5 2 0132043103000002014035.5 35.5 2 000433341301 2 0163033102000000014135.5 35.5 2 0104321112000003012539.7 38.5 2 0004324012001020312433.5 30.5 3 0 2 2 520345 4 5 7 010402411201 1 0104214 0201 2 0104063222000002012255.0 46.5 1 02 22 5 0 1 2 7 7 0 1 4 0 7 2 650.0 40.0 7 0104033214000001011355.0 46.5 1 010411241111 1 0120203230200002001535.5 35.5 2 0104423410100000014555.0 46.5 1 010401211111 0 01141110101012210016 4.5 4.5 7 0104081655000001003655.0 46.5 1 0 1 541 250 3 4 3 7 7 0113211011000018112255.0 46.5 1 01040000100002224234 4.5 4.5 6 00040000604002213016 4.5 4.5 7 0133142723000002022439.7 38.5 2 01444424202012200214 5.0 5.0 7 0104122711000000016255.0 46.5 1 002406702231 1 01040020101012200204 4.5 4.5 7	0114012210100012011435.5 35.5 2 0114012111000001022539.7 38.5 2 0132043103000002014035.5 35.5 2 000403712211 1 0163033102000000014135.5 35.5 2 010401312021 1 0 2 2 5 0 3 645.0 40.0 7 0 1 5 2 0 34 3 5 5.0 5.0 6 0104321112000003012539.7 38.5 2 0004324012001020312433.5 30.5 3 0104063222000002012255.0 46.5 1
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0104033214000001011355.0          000411402111 1          011270003021 2
46.5 1                              0104423410100000014555.0      01040000100002224234 4.5
010425555251 2                      46.5 1                              4.5 6
02 4554 5 034 3 4 5                 01141110101012210016 4.5          00040000604002213016 4.5
5                                      4.5 7                              4.5 7
002412222201 1                      0104081655000001003655.0          0133142723000002022440.0
0          0 3 4 5                   46.5 1                              010202341011 1
7                                      0113211011000018112255.0
0120203230200002001535.5           46.5 1
35.5 2
/*
proc print data = DATAMODE(OBS=20);
run;
*/
PROC MEANS DATA = DATAMODE N NMISS MEAN MIN MAX RANGE;
TITLE 'BASIC STATISTICS OF SURVEY DATA SET';
VAR carA carT carE carAE carATE carcost carrelt carcstin BTLOS AVLLOS
    BTA BTW BTT BTE BTAWTE BTAWTE BTcost BTrelt AVL AVLAE AVLATE
    AVLrelt BTcstinc income VTLOS OTHRAWTE OTHRTT OTHRLOS OTHRRELT OTHRCOST;
RUN;
/*
proc freq;
tables job*home/missing;
title 'JOB(0:STUDENT 1:F/S 2:OTHER) * HOME(0:ON-CAMP. 1:OFF-CAMP)';
RUN;
proc freq;
tables job*home;
title 'JOB(0:STUDENT 1:F/S 2:OTHER) * HOME(0:ON-CAMP. 1:OFF-CAMP)';
RUN;
proc freq;
tables HOME*OWNCAR/missing;
title 'HOME(0:ON-CAMP. 1:OFF-CAMP) * OWNCAR(0:YES 1:NO)';
RUN;
proc freq;
tables HOME*OWNCAR;
title 'HOME(0:ON-CAMP. 1:OFF-CAMP) * OWNCAR(0:YES 1:NO)';
RUN;
proc freq;
tables job*OWNCAR/missing;
title 'JOB(0:STUDENT 1:F/S 2:OTHER) * OWNCAR(0:YES 1:NO)';
RUN;
proc freq;
tables job*OWNCAR;
title 'JOB(0:STUDENT 1:F/S 2:OTHER) * OWNCAR(0:YES 1:NO)';
RUN;
*/
proc freq;
tables OWNCAR*GENMODE/missing;
title 'OWNCAR(0:YES 1:NO) * GENMODE(0:AUTO 1:BT 2:OTHER)';
RUN;
proc freq;
tables OWNCAR*GENMODE;
title 'OWNCAR(0:YES 1:NO) * GENMODE(0:AUTO 1:BT 2:OTHER)';
RUN;

```

```

/*
proc freq;
tables OWNCAR*GENMODE;
title 'OWNCAR(0:YES 1:NO) * GENMODE(0:AUTO 1:BT 2:OTHER)';
RUN;
proc freq;
tables HOME*GENMODE/missing;
title 'HOME(0:ON-CAMP. 1:OFF-CAMP) * GENMODE(0:AUTO 1:BT 2:OTHER)';
RUN;
proc freq;
tables HOME*GENMODE;
title 'HOME(0:ON-CAMP. 1:OFF-CAMP) * GENMODE(0:AUTO 1:BT 2:OTHER)';
RUN;
proc freq;
tables job*GENMODE/missing;
title 'JOB(0:STUDENT 1:F/S 2:OTHER) * GENMODE(0:AUTO 1:BT 2:OTHER)';
RUN;
proc freq;
tables job*GENMODE;
title 'JOB(0:STUDENT 1:F/S 2:OTHER) * GENMODE(0:AUTO 1:BT 2:OTHER)';
RUN;
*/
data choice;
  array T1[3] carT BTT othrTT ;
  array AWTE1[3] carATE BTAWTE OTHRAWTE ;
  array relt1[3] carrelt BTrelt OTHRRELT;
  array cost1[3] carcost BTcost OTHRCOST;
  array relcost1[3] carcstin BTcstinc OTHRCOSIN;
  array LOS1[3] VTLOS BTLOS OTHRLOS;
  array modes1[3] $ _temporary_ ('AUTO' 'BT' 'OTHE');
  set DATAMODE;
  subject = _n_;
  do i = 1 to 3;
    modes = modes1[i];
    T = T1[i];
    AWTE = AWTE1[i];
    relt = relt1[i];
    relcost = relcost1[i];
    LOS = LOS1[i];
    select = 2 - (genmode eq modes);
    auto = (i eq 1);
    BT = (i eq 2);
    cost = cost1[i];
    autoincm = auto * income;
    BTincome = BT * income;
  output;
end;
keep subject modes select auto BT T AWTE relt relcost cost autoincm BTincome LOS;
run;
proc print data = choice;
  title 'Modified Data Set for PHREG Procedure';
  run;
proc phreg data = choice;
  model select*select(2) = auto BT relt / ties=breslow;

```

```

strata subject;
title 'mode = f1(auto, BT, relcost)';
run;
proc phreg data = choice;
model select*select(2) = auto BT LOS / ties=breslow;
strata subject;
title 'mode = f2(auto, BT, relcost)';
run;
proc phreg data = choice;
model select*select(2) = auto BT relcost / ties=breslow;
strata subject;
title 'mode = f3(auto, BT, relcost)';
run;
proc phreg data = choice;
model select*select(2) = auto BT relt relcost / ties=breslow;
strata subject;
title 'mode = f4(auto, BT, relcost)';
run;
proc phreg data = choice;
model select*select(2) = auto BT relt LOS / ties=breslow;
strata subject;
title 'mode = f5(auto, BT, relcost)';
run;
proc phreg data = choice;
model select*select(2) = auto BT LOS relcost / ties=breslow;
strata subject;
title 'mode = f6(auto, BT, relcost)';
run;

```

C.3 SAS Program Outputs.

BASIC STATISTICS OF SURVEY DATA SET

1176

20:37 Sunday, March 16, 1997

Variable	N	N Nmiss	Mean	Minimum	Maximum	Range
CARA	215	12	2.893023	1	17.5	16.5
CART	211	16	9.106635	1.5	29	27.5
CARE	208	19	6.84375	1	19.5	18.5
CARAE	204	23	9.357843	2	33	31
CARATE	202	25	18.21535	3.5	58	54.5
CARCOST	160	67	4.871832	1.434332	23.93433	22.5
CARRELT	202	25	0.463519	0.103448	0.92	0.816552
CARCSTIN	159	68	0.471672	0.011634	2.399412	2.387778
BTLOS	187	40	5.192513	1	7	6
AVLLOS	194	33	5.731959	1	7	6
BTA	197	30	3.918782	1	19.5	18.5
BTW	200	27	5.7875	1	19.5	18.5
BTT	197	30	9.769036	1.5	29	27.5
BTE	200	27	6.0925	1	19.5	18.5
BTAWE	190	37	15.73947	3	58.5	55.5
BTAWTE	189	38	25.3836	4.5	87.5	83
BTCOST	227	0	0	0	0	0
BTRELT	189	38	0.389987	0.0375	0.727273	0.689773

AVL	208	19	3.266827	0	19.5	19.5
AVLAE	192	35	13.3724	2	41	39
AVLATE	189	38	23.04762	3.5	70	66.5
AVLRELT	189	38	0.428611	0.043478	0.809524	0.766046
BTCSTINC	206	21	0	0	0	0
INCOME	206	21	8701.46	2500	65000	62500
VTLOS	220	7	2.695455	0	7	7
OTHRWTE	213	14	40.72864	3.5	60	56.5
OTHRRT	213	14	36.20423	3.5	60	56.5
OTHRLOS	227	0	2.867841	1	7	6
OTHRRELT	213	14	0.907531	0.216495	1	0.783505
OTHRCOST	227	0	0	0	0	0

OWNCAR(0:YES 1:NO) * GENMODE(0:AUTO 1:BT 2:OTHER)

1177

20:37 Sunday, March 16, 1997

TABLE OF OWNCAR BY GENMODE

OWNCAR	GENMODE				Total
	AUTO	BT	OTHE		
Frequency					
Percent					
Row Pct					
Col Pct					
0	18	135	27	47	227
	7.93	59.47	11.89	20.70	100.0
	7.93	59.47	11.89	20.70	0
	100.0	100.0	100.0	100.0	
	0	0	0	0	
Total	18	135	27	47	227
	7.93	59.47	11.89	20.70	100.0
					0

OWNCAR(0:YES 1:NO) * GENMODE(0:AUTO 1:BT 2:OTHER)

1178

20:37 Sunday, March 16,

1997

TABLE OF OWNCAR BY GENMODE

OWNCAR	GENMODE			Total
	AUTO	BT	OTHE	
Frequency				
Percent				

Row Pct				
Col Pct				
0	135	27	47	209
	64.59	12.92	22.49	100.0
	64.59	12.92	22.49	0
	100.0	100.0	100.0	
	0	0	0	
Total	135	27	47	209
	64.59	12.92	22.49	100.0
				0

Frequency Missing = 18

OWNCAR(0:YES 1:NO) * GENMODE(0:AUTO 1:BT 2:OTHER)

56

00:46 Monday, March 17,

1997

TABLE OF OWNCAR BY GENMODE

OWNCAR	GENMODE			Total
	AUTO	BT	OTHE	
HAVE CAR	11,30	2,25	3,935	17,49
	2	9	17.54	6
	50.37	10.0	22.49	77.99
	64.59	7	74.60	
	91.84	12.9		
		2		
		46.5		
		5		
NO CAR	1,005	2,59	1,339	4,940
	4.48	6	5.97	22.01
	20.34	11.5	27.12	
	8.16	7	25.40	
		52.5		
		4		
		53.4		
		5		
Total	12,30	4,85	5,274	22,43
	7	5	23.51	7
	54.85	21.6		100.0
		4		0

24,481(# OF STUDENT) * 4.58/5 (# OF DAYS ATTENDING SCHOOL)

= 22,437 (# OF STUDENT WHO ATTEND SCHOOL A WEEKDAY)

mode = f1(auto, BT, relcost)

1193

Testing Global Null Hypothesis: BETA=0

Criterion	Without Covariates	With Covariates	Model Chi-Square
-2 LOG L	433.062	327.793	105.269 with 3 DF (p=0.0001)
Score	.	.	106.227 with 3 DF (p=0.0001)
Wald	.	.	83.047 with 3 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Risk Ratio
AUTO	1	2.363085	0.41250	32.81731	0.0001	10.624
BT	1	0.830545	0.46544	3.18416	0.0744	2.295
LOS	1	2.551896	0.73389	12.09104	0.0005	12.831

mode = f2(auto, BT, relcost)

1199

Testing Global Null Hypothesis: BETA=0

Criterion	Without Covariates	With Covariates	Model Chi-Square
-2 LOG L	432.826	254.034	178.792 with 3 DF (p=0.0001)
Score	.	.	159.421 with 3 DF (p=0.0001)
Wald	.	.	98.526 with 3 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Risk Ratio
AUTO	1	1.394180	0.23286	35.84805	0.0001	4.032
BT	1	-2.167632	0.35907	36.44247	0.0001	0.114
LOS	1	0.697567	0.09088	58.91674	0.0001	2.009

mode = f3(auto, BT, relcost)

1205

Testing Global Null Hypothesis: BETA=0

Criterion	Without Covariates	With Covariates	Model Chi-Square
-2 LOG L	403.424	238.138	165.286 with 3 DF (p=0.0001)
Score	.	.	170.354 with 3 DF (p=0.0001)
Wald	.	.	110.659 with 3 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Risk Ratio
AUTO	1	2.357928	0.32014	54.24758	0.0001	10.569
BT	1	-0.628609	0.25276	6.18494	0.0129	0.533
RELCOST	1	-0.888666	0.39048	5.17941	0.0229	0.411

mode = f4(auto, BT, relcost)

1211

Testing Global Null Hypothesis: BETA=0

Criterion	Without Covariates	With Covariates	Model Chi-Square
-2 LOG L	388.723	208.434	180.289 with 4 DF (p=0.0001)
Score	.	.	171.882 with 4 DF (p=0.0001)
Wald	.	.	93.722 with 4 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Risk Ratio
AUTO	1	4.950169	0.72292	46.88804	0.0001	141.199
BT	1	2.074188	0.62762	10.92185	0.0010	7.958
RELT	1	4.764925	1.05117	20.54766	0.0001	117.322
RELCOST	1	-1.046570	0.41888	6.24247	0.0125	0.351

mode = f5(auto, BT, relcost)

1217

Testing Global Null Hypothesis: BETA=0

Criterion	Without Covariates	With Covariates	Model Chi-Square
-2 LOG L	425.424	247.587	177.837 with 4 DF

Score	.	.	(p=0.0001) 158.176 with 4 DF
Wald	.	.	(p=0.0001) 98.151 with 4 DF
			(p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Risk Ratio
AUTO	1	2.204982	0.45370	23.61943	0.0001	9.070
BT	1	-1.128622	0.56948	3.92770	0.0475	0.323
RELT	1	1.758404	0.81135	4.69704	0.0302	5.803
LOS	1	0.667046	0.09260	51.88728	0.0001	1.948

mode = f6(auto, BT, relcost)

1223

Testing Global Null Hypothesis: BETA=0

Criterion	Without Covariates	With Covariates	Model Chi-Square
-2 LOG L	383.518	179.439	204.079 with 4 DF (p=0.0001)
Score	.	.	185.468 with 4 DF (p=0.0001)
Wald	.	.	95.963 with 4 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Risk Ratio
AUTO	1	2.488930	0.40382	37.98896	0.0001	12.048
BT	1	-1.722967	0.38006	20.55161	0.0001	0.179
LOS	1	0.674547	0.11071	37.12204	0.0001	1.963
RELCOST	1	-0.473503	0.43265	1.19775	0.2738	0.62