APPENDIX D. RESIDENTIAL AND FIRM LOCATION CHOICE MODEL SPECIFICATION AND ESTIMATION

This document summarizes the latest location choice estimation for Greater Boston Land Use model. It contains residential location choice, residential rent model, and firm location choice model. The residential location choice and rent models are updated on Dec 14, 2015. The firm location choice models are updated on May 2, 2016. They are implemented in Cube Land for the Greater Boston Integrated Transport and Land Use model (BosLUT).

[Contributors: Menghan Li, Pablo Posada, and Victor Rocco]

# 1. Residential location choice model

## 1.1 Specification

Bidding = log(rooms)+is\_mf+I(Jobs\_tot\_PT\_AM / Jobs\_tot\_AUTO\_AM)+ Acc\_HH1 +Acc\_HH8 + Acc\_HH11 + pop\_den + race+ log(mid\_inc)

## 1.2 Variables

-rooms: number of rooms of housing unit  
-is\_mf: multi-family  
-(Jobs\_tot\_PT\_AM / Jobs\_tot\_AUTO\_AM): Ratio of transit accessibility to total jobs to auto accessibility to total jobs (accessibility measured by cross-product of jobs and friction factor)  
-Acc\_HH1, Acc\_HH8, Acc\_HH11: accessibility to group 1, 8, 11  
-pop\_den: zonal population density (people/ha)  
-race: white people ratio  
-mid\_inc: zonal median income/1000

## 1.3 Variables that have been tried but are not significant in the bidding function:

- SAT score  
- FAR: average floor area ratio in the zone  
- Share of Recreational Space  
- Share of Conservative Space  
- Distance to Recreational Space  
- Distance to Recreational Space  
- Distance to coast/ dummy variable if the zone is adjacent to the coast  
- Zonal employment density  
- Distance to MBTA station/dummy variable if the distance to T is less than 1km  
- Many measures of accessibility, including  
    ~ accessibility to downtown jobs by auto  
    ~ accessibility to all households by auto  
    ~ many other decay functions/travel times/combinations

## 1.4 Group definition

|  |  |  |
| --- | --- | --- |
| Agent ID | obs. | Description |
| 1 | 73 | Young (15-34), low inc, size<=2 |
| 2 | 111 | Young (15-34), low inc, size>=3 |
| 3 | 123 | Young (15-34), high inc, size<=2 |
| 4 | 107 | Young (15-34), high inc, size>=3 |
| 5 | 646 | Mid-age (35-64), low inc, size<=2 |
| 6 | 913 | Mid-age (35-64), low inc, size>=3 |
| 7 | 1284 | Mid-age (35-64), high inc, size<=2 |
| 8 | 1382 | Mid-age (35-64), high inc, size>=3 |
| 9 | 440 | Old (65+), low inc, size<=2 |
| 10 | 84 | Old (65+), low inc, size>=3 |
| 11 | 318 | Old (65+), high inc, size<=2 |
| 12 | 35 | Old (65+), high inc, size>=3 |

## 1.5 Result 1- didn’t fix non-significant coefficients:

(file: share\_LU model/Estimation/Residential/201511214\_Finals/ model\_17\_Accs+den~2.html)

Number of estimated parameters: 110

Number of observations: 5119

Number of individuals: 5119

Null log-likelihood: -12720.237

Cte log-likelihood: -10283.881

Init log-likelihood: -16912.941

Final log-likelihood: -9578.471

Likelihood ratio test: 6283.533

Rho-square: 0.247

Adjusted rho-square: 0.238

Final gradient norm: +1.031e-03

Diagnostic: Iterations are stucked

Iterations: 189

Run time: 07:12

Variance-covariance: from analytical hessian

Sample file: Sample\_Acc\_FF\_PA\_20151214.dat

**Table 1 Model Estimation Results**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name | Value | Rob. std err | Rob. t-test | Rob. p-val |  |
| ASC\_1 | 0 |  |  |  |  |
| ASC\_10 | -1.87 | 2.41 | -0.78 | 0.44 | \* |
| ASC\_11 | -7 | 1.93 | -3.63 | 0 |  |
| ASC\_12 | -10.2 | 3.58 | -2.86 | 0 |  |
| ASC\_2 | 0.354 | 2.05 | 0.17 | 0.86 | \* |
| ASC\_3 | -0.849 | 1.97 | -0.43 | 0.67 | \* |
| ASC\_4 | -7.72 | 2.22 | -3.48 | 0 |  |
| ASC\_5 | 3.22 | 1.66 | 1.94 | 0.05 | \* |
| ASC\_6 | -0.126 | 1.71 | -0.07 | 0.94 | \* |
| ASC\_7 | -2.41 | 1.7 | -1.42 | 0.16 | \* |
| ASC\_8 | -9.34 | 1.77 | -5.29 | 0 |  |
| ASC\_9 | 0.457 | 1.74 | 0.26 | 0.79 | \* |
| bAccTot\_PA\_ratio1 | 0 |  |  |  |  |
| bAccTot\_PA\_ratio10 | 15.4 | 11.9 | 1.3 | 0.2 | \* |
| bAccTot\_PA\_ratio11 | 21.6 | 9.36 | 2.31 | 0.02 |  |
| bAccTot\_PA\_ratio12 | 34.1 | 12.5 | 2.73 | 0.01 |  |
| bAccTot\_PA\_ratio2 | 5.66 | 12 | 0.47 | 0.64 | \* |
| bAccTot\_PA\_ratio3 | 11.9 | 10.2 | 1.16 | 0.25 | \* |
| bAccTot\_PA\_ratio4 | 26.8 | 10.2 | 2.64 | 0.01 |  |
| bAccTot\_PA\_ratio5 | 18.4 | 9.07 | 2.03 | 0.04 |  |
| bAccTot\_PA\_ratio6 | 19 | 9.21 | 2.07 | 0.04 |  |
| bAccTot\_PA\_ratio7 | 27.4 | 8.88 | 3.08 | 0 |  |
| bAccTot\_PA\_ratio8 | 20.8 | 9.32 | 2.23 | 0.03 |  |
| bAccTot\_PA\_ratio9 | 11.9 | 9.7 | 1.22 | 0.22 | \* |
| bAcc\_HH11\_1 | 0 |  |  |  |  |
| bAcc\_HH11\_10 | -0.00772 | 0.0282 | -0.27 | 0.78 | \* |
| bAcc\_HH11\_11 | 0.0303 | 0.0217 | 1.4 | 0.16 | \* |
| bAcc\_HH11\_12 | 0.0528 | 0.0222 | 2.38 | 0.02 |  |
| bAcc\_HH11\_2 | 0.022 | 0.0222 | 0.99 | 0.32 | \* |
| bAcc\_HH11\_3 | 0.0136 | 0.024 | 0.57 | 0.57 | \* |
| bAcc\_HH11\_4 | 0.0377 | 0.0229 | 1.65 | 0.1 | \* |
| bAcc\_HH11\_5 | 0.0194 | 0.0206 | 0.94 | 0.35 | \* |
| bAcc\_HH11\_6 | 0.0103 | 0.021 | 0.49 | 0.62 | \* |
| bAcc\_HH11\_7 | 0.0243 | 0.0206 | 1.18 | 0.24 | \* |
| bAcc\_HH11\_8 | 0.000478 | 0.0209 | 0.02 | 0.98 | \* |
| bAcc\_HH11\_9 | 0.027 | 0.021 | 1.29 | 0.2 | \* |
| bAcc\_HH1\_1 | 0 |  |  |  |  |
| bAcc\_HH1\_10 | -0.0206 | 0.0186 | -1.1 | 0.27 | \* |
| bAcc\_HH1\_11 | -0.00962 | 0.0101 | -0.96 | 0.34 | \* |
| bAcc\_HH1\_12 | 0.00458 | 0.0204 | 0.22 | 0.82 | \* |
| bAcc\_HH1\_2 | -0.00767 | 0.0121 | -0.63 | 0.53 | \* |
| bAcc\_HH1\_3 | -0.00281 | 0.0102 | -0.28 | 0.78 | \* |
| bAcc\_HH1\_4 | -0.0149 | 0.0123 | -1.21 | 0.23 | \* |
| bAcc\_HH1\_5 | -0.0205 | 0.00938 | -2.19 | 0.03 |  |
| bAcc\_HH1\_6 | -0.0228 | 0.00974 | -2.34 | 0.02 |  |
| bAcc\_HH1\_7 | -0.0129 | 0.00876 | -1.47 | 0.14 | \* |
| bAcc\_HH1\_8 | -0.00786 | 0.00966 | -0.81 | 0.42 | \* |
| bAcc\_HH1\_9 | -0.0238 | 0.0107 | -2.23 | 0.03 |  |
| bAcc\_HH8\_1 | 0 |  |  |  |  |
| bAcc\_HH8\_10 | 0.0196 | 0.0165 | 1.18 | 0.24 | \* |
| bAcc\_HH8\_11 | -0.0172 | 0.015 | -1.15 | 0.25 | \* |
| bAcc\_HH8\_12 | -0.0021 | 0.0252 | -0.08 | 0.93 | \* |
| bAcc\_HH8\_2 | 0.0244 | 0.0156 | 1.57 | 0.12 | \* |
| bAcc\_HH8\_3 | -0.011 | 0.0162 | -0.68 | 0.5 | \* |
| bAcc\_HH8\_4 | -0.00166 | 0.0171 | -0.1 | 0.92 | \* |
| bAcc\_HH8\_5 | 0.0134 | 0.014 | 0.95 | 0.34 | \* |
| bAcc\_HH8\_6 | 0.031 | 0.014 | 2.21 | 0.03 |  |
| bAcc\_HH8\_7 | 0.00103 | 0.0139 | 0.07 | 0.94 | \* |
| bAcc\_HH8\_8 | 0.0121 | 0.0141 | 0.86 | 0.39 | \* |
| bAcc\_HH8\_9 | 0.013 | 0.0143 | 0.91 | 0.36 | \* |
| bInc\_log1 | 0 |  |  |  |  |
| bInc\_log10 | -0.116 | 0.546 | -0.21 | 0.83 | \* |
| bInc\_log11 | 1.7 | 0.423 | 4.01 | 0 |  |
| bInc\_log12 | 0.424 | 0.699 | 0.61 | 0.54 | \* |
| bInc\_log2 | 0.125 | 0.459 | 0.27 | 0.79 | \* |
| bInc\_log3 | 0.0744 | 0.443 | 0.17 | 0.87 | \* |
| bInc\_log4 | 1.02 | 0.477 | 2.14 | 0.03 |  |
| bInc\_log5 | -0.221 | 0.374 | -0.59 | 0.55 | \* |
| bInc\_log6 | 0.102 | 0.384 | 0.27 | 0.79 | \* |
| bInc\_log7 | 0.927 | 0.382 | 2.43 | 0.02 |  |
| bInc\_log8 | 1.43 | 0.394 | 3.64 | 0 |  |
| bInc\_log9 | 0.39 | 0.396 | 0.98 | 0.32 | \* |
| bismf1 | 0 |  |  |  |  |
| bismf10 | -2.76 | 0.643 | -4.29 | 0 |  |
| bismf11 | -1.45 | 0.388 | -3.74 | 0 |  |
| bismf12 | -0.716 | 0.856 | -0.84 | 0.4 | \* |
| bismf2 | -0.955 | 0.429 | -2.23 | 0.03 |  |
| bismf3 | -0.386 | 0.411 | -0.94 | 0.35 | \* |
| bismf4 | -0.95 | 0.445 | -2.14 | 0.03 |  |
| bismf5 | -1.03 | 0.355 | -2.9 | 0 |  |
| bismf6 | -1.53 | 0.357 | -4.28 | 0 |  |
| bismf7 | -1.23 | 0.35 | -3.5 | 0 |  |
| bismf8 | -1.77 | 0.361 | -4.9 | 0 |  |
| bismf9 | -1.56 | 0.367 | -4.27 | 0 |  |
| bpop\_den1 | 0 |  |  |  |  |
| bpop\_den10 | -0.00634 | 0.00771 | -0.82 | 0.41 | \* |
| bpop\_den11 | -0.00386 | 0.00498 | -0.78 | 0.44 | \* |
| bpop\_den12 | -0.024 | 0.0116 | -2.07 | 0.04 |  |
| bpop\_den2 | -0.00303 | 0.00545 | -0.56 | 0.58 | \* |
| bpop\_den3 | -0.0016 | 0.00512 | -0.31 | 0.75 | \* |
| bpop\_den4 | -0.00361 | 0.00505 | -0.72 | 0.47 | \* |
| bpop\_den5 | -0.00496 | 0.00418 | -1.19 | 0.23 | \* |
| bpop\_den6 | -0.00544 | 0.00445 | -1.22 | 0.22 | \* |
| bpop\_den7 | -0.0057 | 0.0041 | -1.39 | 0.16 | \* |
| bpop\_den8 | -0.00458 | 0.00446 | -1.03 | 0.31 | \* |
| bpop\_den9 | -0.00396 | 0.00453 | -0.87 | 0.38 | \* |
| brace1 | 0 |  |  |  |  |
| brace10 | -0.228 | 1.1 | -0.21 | 0.84 | \* |
| brace11 | 0.638 | 0.934 | 0.68 | 0.49 | \* |
| brace12 | 0.183 | 1.81 | 0.1 | 0.92 | \* |
| brace2 | -0.727 | 0.91 | -0.8 | 0.42 | \* |
| brace3 | 1.83 | 0.982 | 1.87 | 0.06 | \* |
| brace4 | 1.34 | 1.03 | 1.3 | 0.19 | \* |
| brace5 | 0.255 | 0.81 | 0.32 | 0.75 | \* |
| brace6 | 1.05 | 0.821 | 1.28 | 0.2 | \* |
| brace7 | 0.48 | 0.813 | 0.59 | 0.55 | \* |
| brace8 | 1.03 | 0.827 | 1.24 | 0.21 | \* |
| brace9 | 0.0118 | 0.847 | 0.01 | 0.99 | \* |
| broom\_log1 | 0 |  |  |  |  |
| broom\_log10 | 1.96 | 0.616 | 3.18 | 0 |  |
| broom\_log11 | 0.729 | 0.37 | 1.97 | 0.05 |  |
| broom\_log12 | 4.08 | 0.881 | 4.62 | 0 |  |
| broom\_log2 | -0.0922 | 0.33 | -0.28 | 0.78 | \* |
| broom\_log3 | -0.0493 | 0.322 | -0.15 | 0.88 | \* |
| broom\_log4 | 1.54 | 0.505 | 3.05 | 0 |  |
| broom\_log5 | -0.0115 | 0.267 | -0.04 | 0.97 | \* |
| broom\_log6 | 0.858 | 0.319 | 2.69 | 0.01 |  |
| broom\_log7 | 0.736 | 0.312 | 2.36 | 0.02 |  |
| broom\_log8 | 3.04 | 0.332 | 9.16 | 0 |  |
| broom\_log9 | 0.0612 | 0.282 | 0.22 | 0.83 | \* |

## 1.6 Result 2- fix non-significant coefficients

directory: share\_LU model/Estimation/Residential/20151229\_fix\_non\_significant/model\_18\_Accs~9.html

|  |  |
| --- | --- |
| **Model**: | Logit |
| **Number of estimated parameters**: | 66 |
| **Number of observations**: | 5119 |
| **Number of individuals**: | 5119 |
| **Null log likelihood**: | -12720.237 |
| **Cte log likelihood**: | -10283.881 |
| **Init log likelihood**: | -13052.925 |
| **Final log likelihood**: | -9598.771 |
| **Likelihood ratio test**: | 6242.932 |
| **Rho-square**: | 0.245 |
| **Adjusted rho-square**: | 0.240 |
| **Final gradient norm**: | +4.546e-004 |
| **Diagnostic**: | Normal termination. Obj: 6.05545e-006 Const: 6.05545e-006 |
| **Iterations**: | 111 |
| **Run time**: | 02:50 |
| **Variance-covariance**: | from analytical hessian |
| **Sample file**: | Sample\_Acc\_FF\_PA\_20151214.dat |

**Table 2 Model Estimation Results**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Value** | **Robust Std err** | **Robust t-test** | **p-value** |
| ASC\_1 | 0 |  |  |  |
| ASC\_10 | -2.72 | 1.06 | -2.57 | 0.01 |
| ASC\_11 | -7.93 | 1.12 | -7.11 | 0 |
| ASC\_12 | -12.9 | 3.03 | -4.25 | 0 |
| ASC\_2 | 0 |  |  |  |
| ASC\_3 | -1.62 | 1.26 | -1.29 | 0.2 |
| ASC\_4 | -8.79 | 1.59 | -5.53 | 0 |
| ASC\_5 | 2.39 | 0.205 | 11.65 | 0 |
| ASC\_6 | -1.22 | 0.713 | -1.72 | 0.09 |
| ASC\_7 | -3.44 | 0.699 | -4.92 | 0 |
| ASC\_8 | -10.3 | 0.795 | -12.94 | 0 |
| ASC\_9 | -0.0992 | 0.757 | -0.13 | 0.9 |
| bAccTot\_PA\_ratio1 | 0 |  |  |  |
| bAccTot\_PA\_ratio10 | 4.11 | 7.3 | 0.56 | 0.57 |
| bAccTot\_PA\_ratio11 | 7.6 | 3.77 | 2.02 | 0.04 |
| bAccTot\_PA\_ratio12 | 8.44 | 10.5 | 0.8 | 0.42 |
| bAccTot\_PA\_ratio2 | 0 |  |  |  |
| bAccTot\_PA\_ratio3 | 0.0478 | 4.35 | 0.01 | 0.99 |
| bAccTot\_PA\_ratio4 | 10.6 | 4.56 | 2.32 | 0.02 |
| bAccTot\_PA\_ratio5 | 4.59 | 2.97 | 1.55 | 0.12 |
| bAccTot\_PA\_ratio6 | 0 |  |  |  |
| bAccTot\_PA\_ratio7 | 12.2 | 2.41 | 5.06 | 0 |
| bAccTot\_PA\_ratio8 | 4.43 | 3.02 | 1.47 | 0.14 |
| bAccTot\_PA\_ratio9 | 0 |  |  |  |
| bAcc\_HH11\_1 | 0 |  |  |  |
| bAcc\_HH11\_10 | 0 |  |  |  |
| bAcc\_HH11\_11 | 0.0283 | 0.00884 | 3.21 | 0 |
| bAcc\_HH11\_12 | 0.0514 | 0.0124 | 4.14 | 0 |
| bAcc\_HH11\_2 | 0 |  |  |  |
| bAcc\_HH11\_3 | 0.0217 | 0.011 | 1.98 | 0.05 |
| bAcc\_HH11\_4 | 0.0314 | 0.0104 | 3.01 | 0 |
| bAcc\_HH11\_5 | 0.0155 | 0.00682 | 2.27 | 0.02 |
| bAcc\_HH11\_6 | 0.0109 | 0.00695 | 1.56 | 0.12 |
| bAcc\_HH11\_7 | 0.0224 | 0.00594 | 3.77 | 0 |
| bAcc\_HH11\_8 | 0 |  |  |  |
| bAcc\_HH11\_9 | 0.0213 | 0.00748 | 2.85 | 0 |
| bAcc\_HH1\_1 | 0 |  |  |  |
| bAcc\_HH1\_10 | -0.0253 | 0.0152 | -1.66 | 0.1 |
| bAcc\_HH1\_11 | -0.00346 | 0.00521 | -0.66 | 0.51 |
| bAcc\_HH1\_12 | 0 |  |  |  |
| bAcc\_HH1\_2 | 0 |  |  |  |
| bAcc\_HH1\_3 | 0 |  |  |  |
| bAcc\_HH1\_4 | 0 |  |  |  |
| bAcc\_HH1\_5 | -0.0164 | 0.00531 | -3.1 | 0 |
| bAcc\_HH1\_6 | -0.0153 | 0.00473 | -3.24 | 0 |
| bAcc\_HH1\_7 | -0.0089 | 0.00366 | -2.43 | 0.01 |
| bAcc\_HH1\_8 | 0 |  |  |  |
| bAcc\_HH1\_9 | -0.0192 | 0.00664 | -2.89 | 0 |
| bAcc\_HH8\_1 | 0 |  |  |  |
| bAcc\_HH8\_10 | 0.0196 | 0.00887 | 2.21 | 0.03 |
| bAcc\_HH8\_11 | -0.0188 | 0.00661 | -2.84 | 0 |
| bAcc\_HH8\_12 | 0 |  |  |  |
| bAcc\_HH8\_2 | 0.0351 | 0.00519 | 6.76 | 0 |
| bAcc\_HH8\_3 | -0.0191 | 0.00891 | -2.15 | 0.03 |
| bAcc\_HH8\_4 | 0 |  |  |  |
| bAcc\_HH8\_5 | 0.0137 | 0.00433 | 3.16 | 0 |
| bAcc\_HH8\_6 | 0.0271 | 0.0039 | 6.94 | 0 |
| bAcc\_HH8\_7 | 0 |  |  |  |
| bAcc\_HH8\_8 | 0.00952 | 0.00405 | 2.35 | 0.02 |
| bAcc\_HH8\_9 | 0.0145 | 0.00479 | 3.02 | 0 |
| bInc\_log1 | 0 |  |  |  |
| bInc\_log10 | 0 |  |  |  |
| bInc\_log11 | 2.03 | 0.219 | 9.27 | 0 |
| bInc\_log12 | 1.02 | 0.498 | 2.05 | 0.04 |
| bInc\_log2 | 0 |  |  |  |
| bInc\_log3 | 0.595 | 0.257 | 2.31 | 0.02 |
| bInc\_log4 | 1.51 | 0.299 | 5.04 | 0 |
| bInc\_log5 | 0 |  |  |  |
| bInc\_log6 | 0.571 | 0.139 | 4.1 | 0 |
| bInc\_log7 | 1.25 | 0.135 | 9.24 | 0 |
| bInc\_log8 | 1.85 | 0.154 | 12.01 | 0 |
| bInc\_log9 | 0.532 | 0.16 | 3.33 | 0 |
| bismf1 | 0 |  |  |  |
| bismf10 | -2.71 | 0.553 | -4.9 | 0 |
| bismf11 | -1.44 | 0.287 | -5.03 | 0 |
| bismf12 | -1.02 | 0.718 | -1.42 | 0.15 |
| bismf2 | -0.883 | 0.246 | -3.58 | 0 |
| bismf3 | -0.35 | 0.293 | -1.19 | 0.23 |
| bismf4 | -1.02 | 0.345 | -2.97 | 0 |
| bismf5 | -1.01 | 0.233 | -4.32 | 0 |
| bismf6 | -1.55 | 0.242 | -6.41 | 0 |
| bismf7 | -1.23 | 0.237 | -5.19 | 0 |
| bismf8 | -1.8 | 0.25 | -7.18 | 0 |
| bismf9 | -1.55 | 0.249 | -6.24 | 0 |
| bpop\_den1 | 0 |  |  |  |
| bpop\_den10 | 0 |  |  |  |
| bpop\_den11 | 0 |  |  |  |
| bpop\_den12 | 0 |  |  |  |
| bpop\_den2 | 0 |  |  |  |
| bpop\_den3 | 0 |  |  |  |
| bpop\_den4 | 0 |  |  |  |
| bpop\_den5 | 0 |  |  |  |
| bpop\_den6 | 0 |  |  |  |
| bpop\_den7 | 0 |  |  |  |
| bpop\_den8 | 0 |  |  |  |
| bpop\_den9 | 0 |  |  |  |
| brace1 | 0 |  |  |  |
| brace10 | 0 |  |  |  |
| brace11 | 0 |  |  |  |
| brace12 | 0 |  |  |  |
| brace2 | 0 |  |  |  |
| brace3 | 0 |  |  |  |
| brace4 | 0 |  |  |  |
| brace5 | 0 |  |  |  |
| brace6 | 0 |  |  |  |
| brace7 | 0 |  |  |  |
| brace8 | 0 |  |  |  |
| brace9 | 0 |  |  |  |
| broom\_log1 | 0 |  |  |  |
| broom\_log10 | 1.96 | 0.539 | 3.64 | 0 |
| broom\_log11 | 0.711 | 0.276 | 2.58 | 0.01 |
| broom\_log12 | 4.01 | 0.85 | 4.72 | 0 |
| broom\_log2 | 0 |  |  |  |
| broom\_log3 | 0 |  |  |  |
| broom\_log4 | 1.49 | 0.438 | 3.41 | 0 |
| broom\_log5 | 0 |  |  |  |
| broom\_log6 | 0.806 | 0.194 | 4.16 | 0 |
| broom\_log7 | 0.717 | 0.192 | 3.74 | 0 |
| broom\_log8 | 3 | 0.22 | 13.68 | 0 |
| broom\_log9 | 0 |  |  |  |

Coefficient in red: fixed

# 2. Residential Rent model

Updated: 20151205

## 2.1 Specification and result

**Table 3 Model Estimation Results**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | t value | Pr(>|t|) |  |
| (Intercept) | -2.69E+00 | 1.71E-01 | -1.58E+01 | < 2e-16 | \*\*\* |
| logSum | 7.24E-01 | 1.54E-02 | 4.70E+01 | < 2e-16 | \*\*\* |
| Jobs\_tot\_AUTO\_AM | 6.78E-09 | 3.36E-10 | 2.02E+01 | < 2e-16 | \*\*\* |
| Rec\_share | 5.20E-01 | 1.13E-01 | 4.60E+00 | 4.38E-06 | \*\*\* |
| crime | -3.35E-01 | 6.21E-02 | -5.39E+00 | 7.36E-08 | \*\*\* |
| SAT\_ratio | 1.08E+00 | 1.76E-01 | 6.14E+00 | 9.11E-10 | \*\*\* |
| mid\_inc | 5.32E-03 | 5.39E-04 | 9.86E+00 | < 2e-16 | \*\*\* |
| race | 6.57E-01 | 6.13E-02 | 1.07E+01 | < 2e-16 | \*\*\* |
| FAR | 1.58E-01 | 4.54E-02 | 3.48E+00 | 0.000504 | \*\*\* |
| data$dis\_MBT <= 1000TRUE | 2.29E-01 | 3.74E-02 | 6.13E+00 | 9.58E-10 | \*\*\* |
| Acc\_HH\_tot | -7.37E-04 | 1.12E-04 | -6.59E+00 | 5.00E-11 | \*\*\* |

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.6176 on 3772 degrees of freedom

Multiple R-squared: 0.5739, Adjusted R-squared: 0.5727

F-statistic: 507.9 on 10 and 3772 DF, p-value: < 2.2e-16

## 2.2 Variable explanation

- logSum: expected highest bid   
- Jobs\_tot\_AUTO\_AM: auto accessibility to total jobs during AM peak hour  
- Rec\_share: share of recreational space within the zone  
- (COAST <= 2000: dummy variable that equals to 1 if the distance from zonal centriod to the coast is no greater than 2000)---taken out in this version  
- crime: crime index = town-level (violate crime rate + 0.8\*property crime rate)/max(violate crime rate + 0.8\*property crime rate)  
- SAT\_ratio: SAT score of the school district/highest SAT score at school district level  
- mid\_inc: median zonal income  
- race: white people ratio in the zone  
- FAR: average floor area ratio in the zone  
- dis\_MBT: distance from TAZ centroid to closest MBTA  
- Acc\_HH\_tot: accessibility to all households by auto during AM peak hour

## 2.3 Variables that have been tried but are not significant in rent model

- population density in the zone  
- employment density in the zone  
- distance to recreational space  
- log form or dummy form of distance to MBTA/Recreational Space  
- log form of median income

## 2.4 Other notes

-Acc\_HH1, Acc\_HH2, Acc\_HH12 are significant in the rent model, but I didn't include because it's very hard to interpret why all people want to live close to group 1 and far from group 2, 12

## 2.5 Multi-collinearity check

**Table 4 Correlation Matrix of Explanatory Variables**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | logSum | Jobs\_tot\_AUTO\_AM | Rec\_share | X.COAST....2000. | crime | SAT\_ratio | mid\_inc | race | FAR | X.data.dis\_MBT....1000. | Acc\_HH\_tot |
| logSum | 1.00 | -0.57 | 0.05 | -0.17 | -0.43 | 0.32 | 0.46 | 0.42 | -0.59 | -0.44 | 0.14 |
| Jobs\_tot\_AUTO\_AM | -0.57 | 1.00 | -0.04 | 0.17 | 0.53 | -0.30 | -0.23 | -0.40 | 0.78 | 0.66 | -0.08 |
| Rec\_share | 0.05 | -0.04 | 1.00 | 0.00 | -0.07 | 0.07 | 0.08 | 0.10 | -0.13 | -0.02 | 0.05 |
| X.COAST....2000. | -0.17 | 0.17 | 0.00 | 1.00 | 0.27 | -0.22 | -0.28 | -0.13 | 0.27 | 0.20 | 0.10 |
| crime | -0.43 | 0.53 | -0.07 | 0.27 | 1.00 | -0.69 | -0.50 | -0.61 | 0.55 | 0.42 | -0.09 |
| SAT\_ratio | 0.32 | -0.30 | 0.07 | -0.22 | -0.69 | 1.00 | 0.58 | 0.49 | -0.40 | -0.22 | 0.00 |
| mid\_inc | 0.46 | -0.23 | 0.08 | -0.28 | -0.50 | 0.58 | 1.00 | 0.52 | -0.36 | -0.18 | 0.00 |
| race | 0.42 | -0.40 | 0.10 | -0.13 | -0.61 | 0.49 | 0.52 | 1.00 | -0.44 | -0.30 | 0.10 |
| FAR | -0.59 | 0.78 | -0.13 | 0.27 | 0.55 | -0.40 | -0.36 | -0.44 | 1.00 | 0.61 | -0.04 |
| X.data.dis\_MBT....1000. | -0.44 | 0.66 | -0.02 | 0.20 | 0.42 | -0.22 | -0.18 | -0.30 | 0.61 | 1.00 | -0.10 |
| Acc\_HH\_tot | 0.14 | -0.08 | 0.05 | 0.10 | -0.09 | 0.00 | 0.00 | 0.10 | -0.04 | -0.10 | 1.00 |

# 3. Firm location choice model

Updated: 20160502

## 3.1 Specification

B = acc\_hwy + acc\_pop + acc\_emp + ind\_den\_1 + ind\_den\_2 + ind\_den\_6 + ind\_den\_11 + log(mid\_inc+1) + SF\_C + WareH + far + LoDen + HiDen

## 3.2 Variables

* acc\_hwy: accesibility to highway, calculated by distance to specific highway entries ("Limited" zonal variables from MAPC)
* acc\_pop: AM driving accessibility to 2727 zonal population, calculated by gravity model with friction factor
* acc\_emp: AM driving accessibility to 2727 zonal employment, calculated by gravity model with friction factor
* ind\_den\_1, ind\_den\_2, ind\_den\_6, ind\_den\_11: density of jobs in industry sector 1, 2, 6, 11
* log(mid\_inc+1): log transform of (zonal median income/1000), log(mid\_inc+1)=ln(mid\_inc/1000+1)
* SF\_C: dummy for sites 10,000-39,999 square feet (MAPC)
* WareH: dummy for warehouse, industrial, utilities land use type (MAPC)
* far: real estate far (MAPC)
* LoDen: Real estate product variable from MAPC, dummy variable indicating whether the parcel is of the low density retail, entertainment, services, medical, office, hospitality land use type
* HiDen: Real estate product variable from MAPC, dummy variable indicating whether the parcel is of the high density retail, entertainment, services, medical, office, hospitality land use type

## 3.3 Variables that have been tried but are not significant in the bidding function

* Acc\_HH: accessibility to total household, correlated with acc\_pop

## 3.4 Group definition

**Table 5 Group Definitions for the Firms**

|  |  |  |
| --- | --- | --- |
| Agent ID | Obs. | Agent Description |
| (Ref) 1 | 184 | Construction |
| 2 | 397 | Health and Education |
| 3 | 382 | Finance |
| 4 | 89 | Government |
| 5 | 133 | Information |
| 6 | 1064 | Retail & Leisure |
| 7 | 296 | Manufacture |
| 8 | 5 | Nat Res and Extraction |
| 9 | 218 | Other Services |
| 10 | 512 | Professional Serv. |
| 11 | 260 | Utility/Transp/Wholesale |

## 3.5 Result

(file: share\_LU model/Estimation/Non-Residential/20160501\_rejoin2\_MAPCdata/Firms\_2010\_CL\_simplify~1)

|  |  |
| --- | --- |
| **Model**: | Multinomial Logit |
| **Number of estimated parameters**: | 140 |
| **Number of observations**: | 7486 |
| **Number of individuals**: | 7486 |
| **Null log-likelihood**: | -17950.644 |
| **Cte log-likelihood**: | -15863.480 |
| **Init log-likelihood**: | -6352134.043 |
| **Final log-likelihood**: | -13543.191 |
| **Likelihood ratio test**: | 8814.906 |
| **Rho-square**: | 0.246 |
| **Adjusted rho-square**: | 0.238 |
| **Final gradient norm**: | +8.829e-04 |
| **Diagnostic**: | Normal termination. Obj: 6.05545e-06 Const: 6.05545e-06 |
| **Iterations**: | 239 |
| **Run time**: | 23:39 |
| **Variance-covariance**: | from analytical hessian |
| **Sample file**: | Firms\_2010\_BG\_160501.dat |

**Table 6 Model Estimation Results for Firm Location Choice Model**

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Value | Rob. p-val |  |
| ASC\_1 | 0 |  |  |
| ASC\_10 | -1.58 | 0.06 | \* |
| ASC\_11 | -0.249 | 0.77 | \* |
| ASC\_2 | 0.364 | 0.62 | \* |
| ASC\_3 | -1.19 | 0.17 | \* |
| ASC\_4 | 0.261 | 0.76 | \* |
| ASC\_5 | -0.617 | 0.51 | \* |
| ASC\_6 | 0.695 | 0.33 | \* |
| ASC\_7 | -1.72 | 0.06 | \* |
| ASC\_8 | -2.15 | 0.6 | \* |
| ASC\_9 | 0.487 | 0.57 | \* |
| HiDen1 | 0 |  |  |
| HiDen10 | 1.04 | 0 |  |
| HiDen11 | -0.664 | 0.13 | \* |
| HiDen2 | 0.0175 | 0.96 | \* |
| HiDen3 | 0.753 | 0.02 |  |
| HiDen4 | 0.282 | 0.52 | \* |
| HiDen5 | 1.81 | 0 |  |
| HiDen6 | 0.506 | 0.11 | \* |
| HiDen7 | -0.283 | 0.49 | \* |
| HiDen8 | -24.9 | 1 | \* |
| HiDen9 | 0.438 | 0.22 | \* |
| LoDen1 | 0 |  |  |
| LoDen10 | 0.504 | 0.04 |  |
| LoDen11 | -0.0282 | 0.92 | \* |
| LoDen2 | 0.143 | 0.55 | \* |
| LoDen3 | 0.0593 | 0.81 | \* |
| LoDen4 | -0.452 | 0.18 | \* |
| LoDen5 | 1.11 | 0 |  |
| LoDen6 | 0.362 | 0.1 | \* |
| LoDen7 | -0.0249 | 0.93 | \* |
| LoDen8 | 0.416 | 0.67 | \* |
| LoDen9 | -0.121 | 0.65 | \* |
| SFC\_is\_C1 | 0 |  |  |
| SFC\_is\_C10 | 0.539 | 0.02 |  |
| SFC\_is\_C11 | 2.91 | 0 |  |
| SFC\_is\_C2 | 1.69 | 0 |  |
| SFC\_is\_C3 | 0.599 | 0.01 |  |
| SFC\_is\_C4 | 2.6 | 0 |  |
| SFC\_is\_C5 | 3.08 | 0 |  |
| SFC\_is\_C6 | 0.547 | 0.01 |  |
| SFC\_is\_C7 | 2.97 | 0 |  |
| SFC\_is\_C8 | 3.18 | 0 |  |
| SFC\_is\_C9 | 0.729 | 0.01 |  |
| WareH1 | 0 |  |  |
| WareH10 | -0.846 | 0 |  |
| WareH11 | -0.203 | 0.46 | \* |
| WareH2 | -2.49 | 0 |  |
| WareH3 | -2.03 | 0 |  |
| WareH4 | -2.53 | 0 |  |
| WareH5 | -1.14 | 0.02 |  |
| WareH6 | -2.07 | 0 |  |
| WareH7 | 0.0776 | 0.77 | \* |
| WareH8 | -19.2 | 0 |  |
| WareH9 | -1.57 | 0 |  |
| acc\_emp1 | 0 |  |  |
| acc\_emp10 | 0.000819 | 0.04 |  |
| acc\_emp11 | 0.000587 | 0.18 | \* |
| acc\_emp2 | 0.000665 | 0.11 | \* |
| acc\_emp3 | 4.62E-05 | 0.91 | \* |
| acc\_emp4 | 0.000534 | 0.27 | \* |
| acc\_emp5 | 0.000989 | 0.03 |  |
| acc\_emp6 | 0.00043 | 0.27 | \* |
| acc\_emp7 | 0.001 | 0.02 |  |
| acc\_emp8 | 0.000757 | 0.55 | \* |
| acc\_emp9 | -0.000221 | 0.64 | \* |
| acc\_hwy1 | 0 |  |  |
| acc\_hwy10 | -1.68 | 0.14 | \* |
| acc\_hwy11 | 0.932 | 0.37 | \* |
| acc\_hwy2 | 0.31 | 0.76 | \* |
| acc\_hwy3 | -3.77 | 0 |  |
| acc\_hwy4 | 0.734 | 0.67 | \* |
| acc\_hwy5 | -0.227 | 0.89 | \* |
| acc\_hwy6 | 0.688 | 0.44 | \* |
| acc\_hwy7 | 0.956 | 0.34 | \* |
| acc\_hwy8 | 3.83 | 0.36 | \* |
| acc\_hwy9 | 0.127 | 0.91 | \* |
| acc\_pop1 | 0 |  |  |
| acc\_pop10 | -0.00085 | 0.36 | \* |
| acc\_pop11 | -0.000932 | 0.37 | \* |
| acc\_pop2 | 0.0028 | 0 |  |
| acc\_pop3 | 0.00154 | 0.1 | \* |
| acc\_pop4 | 0.00154 | 0.22 | \* |
| acc\_pop5 | -0.00073 | 0.59 | \* |
| acc\_pop6 | 0.00129 | 0.12 | \* |
| acc\_pop7 | -0.000304 | 0.77 | \* |
| acc\_pop8 | -0.00251 | 0.59 | \* |
| acc\_pop9 | 0.00131 | 0.18 | \* |
| far1 | 0 |  |  |
| far10 | 0.372 | 0.26 | \* |
| far11 | 0.15 | 0.74 | \* |
| far2 | 0.23 | 0.49 | \* |
| far3 | 0.213 | 0.55 | \* |
| far4 | -0.127 | 0.83 | \* |
| far5 | 0.199 | 0.64 | \* |
| far6 | 0.222 | 0.48 | \* |
| far7 | 0.729 | 0.03 |  |
| far8 | -1.09 | 0.69 | \* |
| far9 | -0.12 | 0.78 | \* |
| gsize1 | 1 |  |  |
| gsize10 | 1 |  |  |
| gsize11 | 1 |  |  |
| gsize2 | 1 |  |  |
| gsize3 | 1 |  |  |
| gsize4 | 1 |  |  |
| gsize5 | 1 |  |  |
| gsize6 | 1 |  |  |
| gsize7 | 1 |  |  |
| gsize8 | 1 |  |  |
| gsize9 | 1 |  |  |
| ind\_den1\_1 | 0 |  |  |
| ind\_den1\_10 | -0.00317 | 0.39 | \* |
| ind\_den1\_11 | -0.0126 | 0.1 | \* |
| ind\_den1\_2 | -0.00838 | 0.06 | \* |
| ind\_den1\_3 | -0.00193 | 0.62 | \* |
| ind\_den1\_4 | -0.0073 | 0.2 | \* |
| ind\_den1\_5 | -0.0043 | 0.41 | \* |
| ind\_den1\_6 | -0.0107 | 0.01 |  |
| ind\_den1\_7 | -0.00578 | 0.31 | \* |
| ind\_den1\_8 | -0.111 | 0.34 | \* |
| ind\_den1\_9 | -0.00475 | 0.29 | \* |
| ind\_den2\_1 | 0 |  |  |
| ind\_den2\_10 | 0.00545 | 0.17 | \* |
| ind\_den2\_11 | 0.00155 | 0.77 | \* |
| ind\_den2\_2 | 0.00956 | 0.01 |  |
| ind\_den2\_3 | 0.00566 | 0.16 | \* |
| ind\_den2\_4 | 0.00814 | 0.04 |  |
| ind\_den2\_5 | 0.00639 | 0.11 | \* |
| ind\_den2\_6 | 0.007 | 0.07 | \* |
| ind\_den2\_7 | 0.00386 | 0.4 | \* |
| ind\_den2\_8 | 0.00489 | 0.39 | \* |
| ind\_den2\_9 | 0.00758 | 0.05 | \* |
| ind\_den6\_1 | 0 |  |  |
| ind\_den6\_10 | 0.0083 | 0.02 |  |
| ind\_den6\_11 | 0.00663 | 0.09 | \* |
| ind\_den6\_2 | 0.00534 | 0.16 | \* |
| ind\_den6\_3 | 0.00832 | 0.02 |  |
| ind\_den6\_4 | 0.00841 | 0.02 |  |
| ind\_den6\_5 | 0.00546 | 0.15 | \* |
| ind\_den6\_6 | 0.00957 | 0.01 |  |
| ind\_den6\_7 | 0.00485 | 0.21 | \* |
| ind\_den6\_8 | 0.0117 | 0.06 | \* |
| ind\_den6\_9 | 0.00774 | 0.03 |  |
| log\_mid\_inc1 | 0 |  |  |
| log\_mid\_inc10 | 0.204 | 0.26 | \* |
| log\_mid\_inc11 | -0.298 | 0.11 | \* |
| log\_mid\_inc2 | -0.382 | 0.02 |  |
| log\_mid\_inc3 | 0.253 | 0.18 | \* |
| log\_mid\_inc4 | -0.4 | 0.04 |  |
| log\_mid\_inc5 | -0.465 | 0.02 |  |
| log\_mid\_inc6 | -0.352 | 0.02 |  |
| log\_mid\_inc7 | -0.0793 | 0.69 | \* |
| log\_mid\_inc8 | 0.135 | 0.86 | \* |
| log\_mid\_inc9 | -0.175 | 0.35 | \* |