**APPENDIX A. GREATER BOSTON TRANSPORT MODEL SPECIFICATION AND ESTIMATION**

This document includes a brief summary of the model specification and estimation results for the four-step transport model developed for Boston Metropolitan Area. The four-step model includes vehicle ownership model, trip generation, trip distribution, mode choice and traffic assignments. We mainly use 2010-11 Massachusetts Travel Survey (2010MTS) and 1991 Boston Travel Survey (1991BTS) for model estimation. Some model parameters come from CTPP (Census Journey-to-Work) data for 2010 and 1990.

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# Vehicle Ownership Model

The vehicle ownership model has a logit model structure. The choice set consists of 0, 1, 2, 3+ vehicles as alternatives. Predictors include household characteristics and built environment variables. Table 1–1 shows the different model specifications. The variable representing the household’s race (categorical variable for race composition in the household) is only available for 2010. We estimated models of different specifications for 1991 and 2010, including a specification directly implementable in a four-step model in Cube (MCube). Note that by sequentially adding sets of variables, the complexity increases. Table 1–2 and Table 1–3 show the coefficients estimates for 1991 and 2010. Table 1–4 lists the model estimates for the Cube model specification (MCube) separately, as it is a simplified version. Table 1–5 and Table 1–6 summarize the model fit for all specifications. More details can be found in Han (2015)’s Master Thesis.

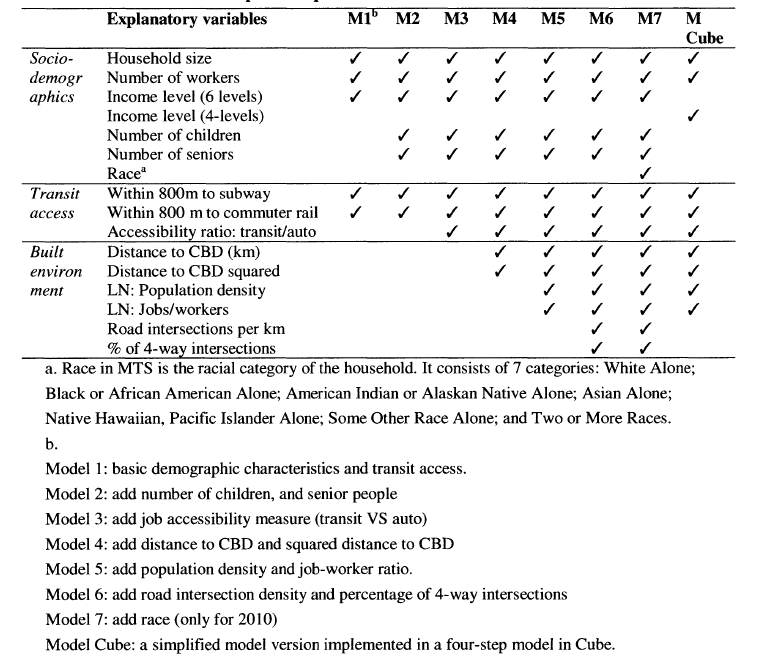
Table – Vehicle ownership model specifications

Table – Vehicle ownership model estimation results for 1991 (BTS)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | M1 |  |  | M2 |  |  | M3 |  |  | M4 |  |  | M5 |  |  | M6 |  |  |
|  | B | SE |  | B | SE |  | B | SE |  | B | SE |  | B | SE |  | B | SE |  |
| 1:(intercept) | 0.936 | 0.163 | \*\*\* | 0.639 | 0.208 | \*\* | 0.722 | 0.210 | \*\*\* | -0.657 | 0.373 |  | -0.117 | 0.514 |  | -0.337 | 0.596 |  |
| 2:(intercept) | -2.210 | 0.268 | \*\*\* | -2.411 | 0.301 | \*\*\* | -2.185 | 0.304 | \*\*\* | -4.576 | 0.471 | \*\*\* | -3.356 | 0.608 | \*\*\* | -3.606 | 0.719 | \*\*\* |
| 3:(intercept) | -2.836 | 0.415 | \*\*\* | -3.429 | 0.449 | \*\*\* | -3.160 | 0.452 | \*\*\* | -5.992 | 0.626 | \*\*\* | -4.687 | 0.758 | \*\*\* | -4.661 | 0.926 | \*\*\* |
| 1:Size: 2-pers | 0.594 | 0.180 | \*\*\* | 0.400 | 0.198 | \* | 0.367 | 0.201 |  | 0.414 | 0.203 | \* | 0.406 | 0.204 | \* | 0.409 | 0.204 | \* |
| 2:Size: 2-pers | 2.638 | 0.234 | \*\*\* | 2.536 | 0.249 | \*\*\* | 2.523 | 0.253 | \*\*\* | 2.599 | 0.257 | \*\*\* | 2.571 | 0.258 | \*\*\* | 2.572 | 0.258 | \*\*\* |
| 3:Size: 2-pers | 1.329 | 0.353 | \*\*\* | 1.129 | 0.369 | \*\* | 1.121 | 0.372 | \*\* | 1.204 | 0.375 | \*\*\* | 1.177 | 0.376 | \*\* | 1.183 | 0.376 | \*\* |
| 1:Size: 3-pers | 1.296 | 0.328 | \*\*\* | 1.426 | 0.380 | \*\*\* | 1.349 | 0.382 | \*\*\* | 1.363 | 0.386 | \*\*\* | 1.340 | 0.391 | \*\*\* | 1.358 | 0.392 | \*\*\* |
| 2:Size: 3-pers | 3.889 | 0.361 | \*\*\* | 4.301 | 0.410 | \*\*\* | 4.254 | 0.415 | \*\*\* | 4.295 | 0.419 | \*\*\* | 4.255 | 0.424 | \*\*\* | 4.275 | 0.425 | \*\*\* |
| 3:Size: 3-pers | 3.694 | 0.437 | \*\*\* | 4.205 | 0.484 | \*\*\* | 4.165 | 0.488 | \*\*\* | 4.205 | 0.492 | \*\*\* | 4.166 | 0.497 | \*\*\* | 4.188 | 0.497 | \*\*\* |
| 1:Size: 4-pers | 0.726 | 0.379 |  | 0.945 | 0.468 | \* | 0.824 | 0.468 |  | 0.832 | 0.476 |  | 0.822 | 0.479 |  | 0.847 | 0.480 |  |
| 2:Size: 4-pers | 3.820 | 0.401 | \*\*\* | 4.549 | 0.490 | \*\*\* | 4.445 | 0.494 | \*\*\* | 4.490 | 0.502 | \*\*\* | 4.490 | 0.506 | \*\*\* | 4.519 | 0.507 | \*\*\* |
| 3:Size: 4-pers | 3.346 | 0.475 | \*\*\* | 4.457 | 0.559 | \*\*\* | 4.357 | 0.562 | \*\*\* | 4.405 | 0.570 | \*\*\* | 4.413 | 0.573 | \*\*\* | 4.441 | 0.574 | \*\*\* |
| 1:Size: 5-pers+ | 1.652 | 0.583 | \*\* | 1.866 | 0.665 | \*\* | 1.739 | 0.695 | \* | 1.772 | 0.696 | \* | 1.707 | 0.691 | \* | 1.729 | 0.691 | \* |
| 2:Size: 5-pers+ | 4.308 | 0.600 | \*\*\* | 5.168 | 0.684 | \*\*\* | 5.037 | 0.714 | \*\*\* | 5.126 | 0.717 | \*\*\* | 5.047 | 0.712 | \*\*\* | 5.075 | 0.713 | \*\*\* |
| 3: Size: 5-pers+ | 3.864 | 0.653 | \*\*\* | 5.308 | 0.738 | \*\*\* | 5.196 | 0.767 | \*\*\* | 5.287 | 0.769 | \*\*\* | 5.210 | 0.766 | \*\*\* | 5.239 | 0.766 | \*\*\* |
| 1:Workers1 | 0.528 | 0.181 | \*\* | 0.786 | 0.203 | \*\*\* | 0.795 | 0.204 | \*\*\* | 0.830 | 0.208 | \*\*\* | 0.825 | 0.210 | \*\*\* | 0.831 | 0.211 | \*\*\* |
| 2:Workers1 | 0.862 | 0.230 | \*\*\* | 1.057 | 0.254 | \*\*\* | 1.051 | 0.257 | \*\*\* | 1.112 | 0.263 | \*\*\* | 1.118 | 0.265 | \*\*\* | 1.127 | 0.266 | \*\*\* |
| 3:Workers1 | 0.302 | 0.343 |  | 0.764 | 0.368 | \* | 0.768 | 0.369 | \* | 0.832 | 0.374 | \* | 0.846 | 0.375 | \* | 0.853 | 0.376 | \* |
| 1:Workers2 | -0.292 | 0.251 |  | 0.086 | 0.275 |  | 0.150 | 0.277 |  | 0.165 | 0.280 |  | 0.176 | 0.283 |  | 0.181 | 0.284 |  |
| 2:Workers2 | 0.470 | 0.280 |  | 0.747 | 0.311 | \* | 0.817 | 0.316 | \*\* | 0.868 | 0.321 | \*\* | 0.900 | 0.325 | \*\* | 0.912 | 0.325 | \*\* |
| 3:Workers2 | 0.471 | 0.376 |  | 1.129 | 0.413 | \*\* | 1.206 | 0.417 | \*\* | 1.264 | 0.421 | \*\* | 1.305 | 0.424 | \*\* | 1.314 | 0.424 | \*\* |
| 1:Workers3+ | -0.544 | 0.558 |  | -0.419 | 0.559 |  | -0.426 | 0.573 |  | -0.362 | 0.571 |  | -0.386 | 0.569 |  | -0.387 | 0.569 |  |
| 2:Workers3+ | -0.327 | 0.572 |  | -0.376 | 0.574 |  | -0.437 | 0.591 |  | -0.328 | 0.591 |  | -0.343 | 0.589 |  | -0.339 | 0.589 |  |
| 3:Workers3+ | 1.729 | 0.617 | \*\* | 1.908 | 0.630 | \*\* | 1.848 | 0.645 | \*\* | 1.972 | 0.647 | \*\* | 1.968 | 0.645 | \*\* | 1.967 | 0.645 | \*\* |
| 1:INC35-50K | 0.886 | 0.169 | \*\*\* | 0.888 | 0.173 | \*\*\* | 0.923 | 0.175 | \*\*\* | 0.934 | 0.177 | \*\*\* | 0.921 | 0.178 | \*\*\* | 0.915 | 0.179 | \*\*\* |
| 2:INC35-50K | 1.682 | 0.228 | \*\*\* | 1.670 | 0.230 | \*\*\* | 1.741 | 0.234 | \*\*\* | 1.784 | 0.238 | \*\*\* | 1.739 | 0.240 | \*\*\* | 1.733 | 0.240 | \*\*\* |
| 3:INC35-50K | 1.449 | 0.346 | \*\*\* | 1.461 | 0.351 | \*\*\* | 1.514 | 0.354 | \*\*\* | 1.556 | 0.356 | \*\*\* | 1.509 | 0.357 | \*\*\* | 1.506 | 0.357 | \*\*\* |
| 1:INC50-75K | 1.672 | 0.232 | \*\*\* | 1.700 | 0.235 | \*\*\* | 1.747 | 0.239 | \*\*\* | 1.765 | 0.240 | \*\*\* | 1.754 | 0.242 | \*\*\* | 1.735 | 0.243 | \*\*\* |
| 2:INC50-75K | 3.014 | 0.278 | \*\*\* | 3.006 | 0.280 | \*\*\* | 3.073 | 0.287 | \*\*\* | 3.143 | 0.290 | \*\*\* | 3.092 | 0.292 | \*\*\* | 3.070 | 0.293 | \*\*\* |
| 3:INC50-75K | 2.842 | 0.376 | \*\*\* | 2.846 | 0.382 | \*\*\* | 2.889 | 0.387 | \*\*\* | 2.960 | 0.389 | \*\*\* | 2.904 | 0.390 | \*\*\* | 2.886 | 0.390 | \*\*\* |
| 1:INC75-100K | 2.222 | 0.339 | \*\*\* | 2.295 | 0.342 | \*\*\* | 2.427 | 0.348 | \*\*\* | 2.454 | 0.347 | \*\*\* | 2.423 | 0.348 | \*\*\* | 2.380 | 0.351 | \*\*\* |
| 2:INC75-100K | 4.011 | 0.373 | \*\*\* | 4.051 | 0.376 | \*\*\* | 4.274 | 0.386 | \*\*\* | 4.343 | 0.387 | \*\*\* | 4.247 | 0.388 | \*\*\* | 4.195 | 0.391 | \*\*\* |
| 3:INC75-100K | 3.725 | 0.455 | \*\*\* | 3.837 | 0.461 | \*\*\* | 4.053 | 0.470 | \*\*\* | 4.119 | 0.470 | \*\*\* | 4.016 | 0.471 | \*\*\* | 3.971 | 0.473 | \*\*\* |
| 1:INC100-150K | 2.191 | 0.570 | \*\*\* | 2.227 | 0.571 | \*\*\* | 2.406 | 0.584 | \*\*\* | 2.385 | 0.581 | \*\*\* | 2.417 | 0.583 | \*\*\* | 2.415 | 0.583 | \*\*\* |
| 2:INC100-150K | 4.381 | 0.589 | \*\*\* | 4.378 | 0.589 | \*\*\* | 4.578 | 0.613 | \*\*\* | 4.611 | 0.608 | \*\*\* | 4.554 | 0.611 | \*\*\* | 4.552 | 0.612 | \*\*\* |
| 3:INC100-150K | 4.369 | 0.652 | \*\*\* | 4.366 | 0.657 | \*\*\* | 4.534 | 0.679 | \*\*\* | 4.566 | 0.675 | \*\*\* | 4.497 | 0.677 | \*\*\* | 4.493 | 0.678 | \*\*\* |
| 1:INCMT150K | 3.559 | 0.745 | \*\*\* | 3.580 | 0.747 | \*\*\* | 3.884 | 0.754 | \*\*\* | 3.815 | 0.753 | \*\*\* | 3.841 | 0.757 | \*\*\* | 3.782 | 0.758 | \*\*\* |
| 2:INCMT150K | 5.587 | 0.762 | \*\*\* | 5.568 | 0.763 | \*\*\* | 5.978 | 0.779 | \*\*\* | 5.934 | 0.776 | \*\*\* | 5.850 | 0.781 | \*\*\* | 5.781 | 0.782 | \*\*\* |
| 3:INCMT150K | 5.640 | 0.809 | \*\*\* | 5.624 | 0.814 | \*\*\* | 5.999 | 0.828 | \*\*\* | 5.953 | 0.826 | \*\*\* | 5.854 | 0.831 | \*\*\* | 5.785 | 0.832 | \*\*\* |
| 1:Child: 1 |  |  |  | -0.310 | 0.359 |  | -0.333 | 0.364 |  | -0.332 | 0.374 |  | -0.375 | 0.379 |  | -0.392 | 0.380 |  |
| 2:Child: 1 |  |  |  | -0.882 | 0.371 | \* | -0.995 | 0.379 | \*\* | -1.009 | 0.389 | \*\* | -1.067 | 0.394 | \*\* | -1.087 | 0.395 | \*\* |
| 3:Child: 1 |  |  |  | -1.377 | 0.397 | \*\*\* | -1.504 | 0.405 | \*\*\* | -1.510 | 0.414 | \*\*\* | -1.570 | 0.418 | \*\*\* | -1.587 | 0.419 | \*\*\* |
| 1:Child: 2+ |  |  |  | -0.448 | 0.505 |  | -0.414 | 0.510 |  | -0.390 | 0.519 |  | -0.367 | 0.517 |  | -0.391 | 0.518 |  |
| 2:Child: 2+ |  |  |  | -1.141 | 0.509 | \* | -1.174 | 0.517 | \* | -1.209 | 0.527 | \* | -1.198 | 0.525 | \* | -1.229 | 0.526 | \* |
| 3:Child: 2+ |  |  |  | -1.956 | 0.529 | \*\*\* | -2.001 | 0.539 | \*\*\* | -2.046 | 0.547 | \*\*\* | -2.046 | 0.546 | \*\*\* | -2.073 | 0.547 | \*\*\* |
| 1:Senior: 1 |  |  |  | 0.388 | 0.224 |  | 0.393 | 0.226 |  | 0.398 | 0.230 |  | 0.361 | 0.232 |  | 0.356 | 0.233 |  |
| 2:Senior: 1 |  |  |  | 0.291 | 0.265 |  | 0.232 | 0.269 |  | 0.247 | 0.274 |  | 0.168 | 0.276 |  | 0.163 | 0.277 |  |
| 3:Senior: 1 |  |  |  | 1.036 | 0.304 | \*\*\* | 0.974 | 0.308 | \*\* | 0.998 | 0.312 | \*\*\* | 0.918 | 0.314 | \*\* | 0.914 | 0.315 | \*\* |
| 1:Senior: 2+ |  |  |  | 1.399 | 0.420 | \*\*\* | 1.396 | 0.424 | \*\*\* | 1.391 | 0.428 | \*\*\* | 1.384 | 0.431 | \*\*\* | 1.366 | 0.432 | \*\* |
| 2:Senior: 2+ |  |  |  | 1.122 | 0.445 | \* | 1.063 | 0.450 | \* | 1.072 | 0.456 | \* | 1.032 | 0.460 | \* | 1.013 | 0.461 | \* |
| 3:Senior: 2+ |  |  |  | 1.767 | 0.508 | \*\*\* | 1.700 | 0.513 | \*\*\* | 1.713 | 0.519 | \*\*\* | 1.668 | 0.523 | \*\*\* | 1.650 | 0.523 | \*\* |
| 1:Subway | -2.042 | 0.155 | \*\*\* | -2.009 | 0.159 | \*\*\* | -1.222 | 0.239 | \*\*\* | -0.875 | 0.240 | \*\*\* | -0.804 | 0.242 | \*\*\* | -0.772 | 0.244 | \*\* |
| 2:Subway | -3.293 | 0.190 | \*\*\* | -3.318 | 0.194 | \*\*\* | -1.325 | 0.286 | \*\*\* | -0.852 | 0.288 | \*\* | -0.774 | 0.290 | \*\* | -0.738 | 0.292 | \* |
| 3:Subway | -3.671 | 0.270 | \*\*\* | -3.790 | 0.279 | \*\*\* | -1.610 | 0.384 | \*\*\* | -1.078 | 0.390 | \*\* | -0.994 | 0.392 | \* | -0.976 | 0.394 | \* |
| 1:CommRail | -0.551 | 0.153 | \*\*\* | -0.528 | 0.154 | \*\*\* | -0.217 | 0.172 |  | -0.347 | 0.174 | \* | -0.293 | 0.176 |  | -0.297 | 0.176 |  |
| 2:CommRail | -0.997 | 0.188 | \*\*\* | -0.970 | 0.189 | \*\*\* | -0.297 | 0.210 |  | -0.490 | 0.213 | \* | -0.375 | 0.215 |  | -0.384 | 0.215 |  |
| 3:CommRail | -1.107 | 0.248 | \*\*\* | -1.109 | 0.251 | \*\*\* | -0.377 | 0.271 |  | -0.582 | 0.274 | \* | -0.459 | 0.276 |  | -0.459 | 0.277 |  |
| 1:AccRatio |  |  |  |  |  |  | -0.111 | 0.025 | \*\*\* | -0.041 | 0.030 |  | -0.011 | 0.032 |  | -0.010 | 0.032 |  |
| 2:AccRatio |  |  |  |  |  |  | -0.308 | 0.033 | \*\*\* | -0.164 | 0.038 | \*\*\* | -0.113 | 0.040 | \*\* | -0.115 | 0.040 | \*\* |
| 3:AccRatio |  |  |  |  |  |  | -0.353 | 0.048 | \*\*\* | -0.171 | 0.054 | \*\* | -0.117 | 0.056 | \* | -0.117 | 0.056 | \* |
| 1:DISTCBD (km) |  |  |  |  |  |  |  |  |  | 0.113 | 0.028 | \*\*\* | 0.098 | 0.031 | \*\*\* | 0.106 | 0.032 | \*\*\* |
| 2:DISTCBD (km) |  |  |  |  |  |  |  |  |  | 0.171 | 0.030 | \*\*\* | 0.132 | 0.033 | \*\*\* | 0.140 | 0.035 | \*\*\* |
| 3:DISTCBD (km) |  |  |  |  |  |  |  |  |  | 0.199 | 0.034 | \*\*\* | 0.157 | 0.038 | \*\*\* | 0.161 | 0.040 | \*\*\* |
| 1:DISTCBD\_SQ |  |  |  |  |  |  |  |  |  | -0.002 | 0.000 | \*\*\* | -0.002 | 0.001 | \*\* | -0.002 | 0.001 | \*\* |
| 2:DISTCBD\_SQ |  |  |  |  |  |  |  |  |  | -0.002 | 0.001 | \*\*\* | -0.002 | 0.001 | \*\*\* | -0.002 | 0.001 | \*\*\* |
| 3:DISTCBD\_SQ |  |  |  |  |  |  |  |  |  | -0.003 | 0.001 | \*\*\* | -0.002 | 0.001 | \*\*\* | -0.003 | 0.001 | \*\*\* |
| 1:LN(DENPOP) |  |  |  |  |  |  |  |  |  |  |  |  | -0.266 | 0.122 | \* | -0.313 | 0.137 | \* |
| 2:LN(DENPOP) |  |  |  |  |  |  |  |  |  |  |  |  | -0.507 | 0.131 | \*\*\* | -0.566 | 0.154 | \*\*\* |
| 3:LN(DENPOP) |  |  |  |  |  |  |  |  |  |  |  |  | -0.543 | 0.146 | \*\*\* | -0.536 | 0.186 | \*\* |
| 1:LN(JWR) |  |  |  |  |  |  |  |  |  |  |  |  | -0.232 | 0.084 | \*\* | -0.240 | 0.085 | \*\* |
| 2:LN(JWR) |  |  |  |  |  |  |  |  |  |  |  |  | -0.275 | 0.096 | \*\* | -0.285 | 0.097 | \*\* |
| 3:LN(JWR) |  |  |  |  |  |  |  |  |  |  |  |  | -0.281 | 0.111 | \* | -0.286 | 0.113 | \* |
| 1:inters. per km |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 0.021 | 0.040 |  |
| 2:inters. per km |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 0.016 | 0.057 |  |
| 3:inters. per km |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | -0.021 | 0.088 |  |
| 1: % 4-way inters. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 0.578 | 0.670 |  |
| 2: % 4-way inters. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1.012 | 0.861 |  |
| 3: % 4-way inters. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 0.247 | 1.289 |  |

Notes: *JWR*: job-worker ratio. *DENPOP*: 1\*10-3 persons/square miles; *inters. per km*: 1\*10-3 intersections per road kilometer. AccRatio: job accessibility by transit/auto\*100. Significance level: \*0.05; \*\*0.01; \*\*\*0.001.

Table – Vehicle ownership model estimation results for 2010 (MTS)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | M1 |  |  | M2 |  |  | M3 |  |  | M4 |  |  | M5 |  |  |
|  | B | SE |  | B | SE |  | B | SE |  | B | SE |  | B | SE |  |
| 1:(intercept) | 0.552 | 0.069 | \*\*\* | 0.173 | 0.084 | \* | 0.259 | 0.085 | \*\* | -0.801 | 0.183 | \*\*\* | 0.726 | 0.250 | \*\* |
| 2:(intercept) | -2.487 | 0.135 | \*\*\* | -2.979 | 0.152 | \*\*\* | -2.761 | 0.153 | \*\*\* | -5.819 | 0.268 | \*\*\* | -3.279 | 0.328 | \*\*\* |
| 3:(intercept) | -3.896 | 0.221 | \*\*\* | -4.467 | 0.241 | \*\*\* | -4.169 | 0.242 | \*\*\* | -8.411 | 0.362 | \*\*\* | -5.286 | 0.414 | \*\*\* |
| 1:Size: 2-pers | 0.193 | 0.108 |  | 0.024 | 0.122 |  | 0.020 | 0.124 |  | 0.080 | 0.125 |  | 0.127 | 0.126 |  |
| 2:Size: 2-pers | 2.994 | 0.141 | \*\*\* | 2.869 | 0.153 | \*\*\* | 2.878 | 0.155 | \*\*\* | 3.034 | 0.159 | \*\*\* | 3.143 | 0.162 | \*\*\* |
| 3:Size: 2-pers | 2.662 | 0.199 | \*\*\* | 2.617 | 0.210 | \*\*\* | 2.622 | 0.212 | \*\*\* | 2.815 | 0.216 | \*\*\* | 2.957 | 0.219 | \*\*\* |
| 1:Size: 3-pers | 0.261 | 0.160 |  | -0.179 | 0.231 |  | -0.244 | 0.234 |  | -0.189 | 0.239 |  | -0.099 | 0.240 |  |
| 2:Size: 3-pers | 2.926 | 0.186 | \*\*\* | 3.285 | 0.251 | \*\*\* | 3.223 | 0.255 | \*\*\* | 3.369 | 0.263 | \*\*\* | 3.579 | 0.266 | \*\*\* |
| 3:Size: 3-pers | 3.206 | 0.233 | \*\*\* | 4.179 | 0.290 | \*\*\* | 4.122 | 0.294 | \*\*\* | 4.301 | 0.302 | \*\*\* | 4.563 | 0.306 | \*\*\* |
| 1:Size: 4-pers | 0.315 | 0.224 |  | -0.548 | 0.386 |  | -0.634 | 0.387 |  | -0.550 | 0.390 |  | -0.370 | 0.387 |  |
| 2:Size: 4-pers | 3.612 | 0.238 | \*\*\* | 4.290 | 0.399 | \*\*\* | 4.255 | 0.401 | \*\*\* | 4.455 | 0.409 | \*\*\* | 4.798 | 0.409 | \*\*\* |
| 3:Size: 4-pers | 3.376 | 0.278 | \*\*\* | 5.661 | 0.429 | \*\*\* | 5.636 | 0.432 | \*\*\* | 5.876 | 0.441 | \*\*\* | 6.284 | 0.443 | \*\*\* |
| 1:Size: 5-pers+ | 0.013 | 0.283 |  | -0.928 | 0.446 | \* | -1.005 | 0.446 | \* | -0.863 | 0.454 |  | -0.678 | 0.454 |  |
| 2:Size: 5-pers+ | 3.295 | 0.294 | \*\*\* | 4.011 | 0.457 | \*\*\* | 3.930 | 0.462 | \*\*\* | 4.225 | 0.475 | \*\*\* | 4.547 | 0.478 | \*\*\* |
| 3: Size: 5-pers+ | 3.245 | 0.329 | \*\*\* | 5.919 | 0.489 | \*\*\* | 5.828 | 0.495 | \*\*\* | 6.168 | 0.509 | \*\*\* | 6.549 | 0.513 | \*\*\* |
| 1:Workers1 | 0.312 | 0.094 | \*\*\* | 0.576 | 0.100 | \*\*\* | 0.608 | 0.101 | \*\*\* | 0.631 | 0.102 | \*\*\* | 0.640 | 0.104 | \*\*\* |
| 2:Workers1 | 0.472 | 0.123 | \*\*\* | 0.891 | 0.134 | \*\*\* | 0.933 | 0.136 | \*\*\* | 1.026 | 0.140 | \*\*\* | 1.044 | 0.143 | \*\*\* |
| 3:Workers1 | 0.608 | 0.168 | \*\*\* | 0.968 | 0.182 | \*\*\* | 1.032 | 0.184 | \*\*\* | 1.146 | 0.188 | \*\*\* | 1.174 | 0.191 | \*\*\* |
| 1:Workers2 | 0.582 | 0.175 | \*\*\* | 0.981 | 0.184 | \*\*\* | 1.046 | 0.186 | \*\*\* | 1.039 | 0.186 | \*\*\* | 0.995 | 0.187 | \*\*\* |
| 2:Workers2 | 1.300 | 0.187 | \*\*\* | 1.782 | 0.200 | \*\*\* | 1.890 | 0.203 | \*\*\* | 2.009 | 0.207 | \*\*\* | 1.991 | 0.209 | \*\*\* |
| 3:Workers2 | 1.627 | 0.219 | \*\*\* | 1.976 | 0.236 | \*\*\* | 2.119 | 0.239 | \*\*\* | 2.288 | 0.244 | \*\*\* | 2.302 | 0.246 | \*\*\* |
| 1:Workers3+ | 0.715 | 0.505 |  | 1.303 | 0.522 | \* | 1.481 | 0.525 | \*\* | 1.544 | 0.528 | \*\* | 1.508 | 0.534 | \*\* |
| 2:Workers3+ | 1.436 | 0.502 | \*\* | 1.670 | 0.522 | \*\*\* | 1.956 | 0.529 | \*\*\* | 2.145 | 0.533 | \*\*\* | 2.085 | 0.540 | \*\*\* |
| 3:Workers3+ | 3.739 | 0.511 | \*\*\* | 3.189 | 0.535 | \*\*\* | 3.517 | 0.543 | \*\*\* | 3.785 | 0.549 | \*\*\* | 3.750 | 0.555 | \*\*\* |
| 1:INC35-50K | 1.377 | 0.133 | \*\*\* | 1.336 | 0.135 | \*\*\* | 1.319 | 0.136 | \*\*\* | 1.336 | 0.137 | \*\*\* | 1.250 | 0.139 | \*\*\* |
| 2:INC35-50K | 1.786 | 0.167 | \*\*\* | 1.682 | 0.171 | \*\*\* | 1.621 | 0.173 | \*\*\* | 1.682 | 0.177 | \*\*\* | 1.491 | 0.181 | \*\*\* |
| 3:INC35-50K | 1.773 | 0.225 | \*\*\* | 1.694 | 0.233 | \*\*\* | 1.601 | 0.235 | \*\*\* | 1.696 | 0.240 | \*\*\* | 1.446 | 0.243 | \*\*\* |
| 1:INC50-75K | 1.555 | 0.129 | \*\*\* | 1.568 | 0.130 | \*\*\* | 1.579 | 0.132 | \*\*\* | 1.590 | 0.132 | \*\*\* | 1.484 | 0.134 | \*\*\* |
| 2:INC50-75K | 2.458 | 0.155 | \*\*\* | 2.463 | 0.158 | \*\*\* | 2.460 | 0.160 | \*\*\* | 2.537 | 0.163 | \*\*\* | 2.305 | 0.166 | \*\*\* |
| 3:INC50-75K | 2.639 | 0.199 | \*\*\* | 2.749 | 0.204 | \*\*\* | 2.729 | 0.206 | \*\*\* | 2.849 | 0.210 | \*\*\* | 2.558 | 0.213 | \*\*\* |
| 1:INC75-100K | 1.870 | 0.170 | \*\*\* | 1.883 | 0.171 | \*\*\* | 1.964 | 0.174 | \*\*\* | 1.949 | 0.173 | \*\*\* | 1.876 | 0.176 | \*\*\* |
| 2:INC75-100K | 3.110 | 0.190 | \*\*\* | 3.112 | 0.192 | \*\*\* | 3.190 | 0.197 | \*\*\* | 3.227 | 0.199 | \*\*\* | 2.998 | 0.203 | \*\*\* |
| 3:INC75-100K | 3.315 | 0.227 | \*\*\* | 3.451 | 0.231 | \*\*\* | 3.508 | 0.236 | \*\*\* | 3.595 | 0.239 | \*\*\* | 3.274 | 0.243 | \*\*\* |
| 1:INC100-150K | 2.278 | 0.213 | \*\*\* | 2.330 | 0.214 | \*\*\* | 2.463 | 0.219 | \*\*\* | 2.435 | 0.216 | \*\*\* | 2.368 | 0.219 | \*\*\* |
| 2:INC100-150K | 3.802 | 0.227 | \*\*\* | 3.880 | 0.229 | \*\*\* | 4.024 | 0.235 | \*\*\* | 4.066 | 0.235 | \*\*\* | 3.822 | 0.239 | \*\*\* |
| 3:INC100-150K | 4.099 | 0.256 | \*\*\* | 4.359 | 0.261 | \*\*\* | 4.479 | 0.267 | \*\*\* | 4.583 | 0.268 | \*\*\* | 4.236 | 0.273 | \*\*\* |
| 1:INCMT150K | 2.349 | 0.240 | \*\*\* | 2.374 | 0.240 | \*\*\* | 2.617 | 0.248 | \*\*\* | 2.537 | 0.244 | \*\*\* | 2.484 | 0.248 | \*\*\* |
| 2:INCMT150K | 4.029 | 0.251 | \*\*\* | 4.085 | 0.252 | \*\*\* | 4.365 | 0.263 | \*\*\* | 4.392 | 0.261 | \*\*\* | 4.130 | 0.266 | \*\*\* |
| 3:INCMT150K | 4.560 | 0.277 | \*\*\* | 4.819 | 0.281 | \*\*\* | 5.079 | 0.292 | \*\*\* | 5.232 | 0.291 | \*\*\* | 4.823 | 0.297 | \*\*\* |
| 1:Child: 1 |  |  |  | 0.328 | 0.207 |  | 0.359 | 0.210 |  | 0.356 | 0.215 |  | 0.297 | 0.216 |  |
| 2:Child: 1 |  |  |  | -0.684 | 0.218 | \*\* | -0.706 | 0.223 | \*\* | -0.733 | 0.229 | \*\*\* | -0.855 | 0.232 | \*\*\* |
| 3:Child: 1 |  |  |  | -1.486 | 0.230 | \*\*\* | -1.534 | 0.236 | \*\*\* | -1.582 | 0.242 | \*\*\* | -1.728 | 0.246 | \*\*\* |
| 1:Child: 2+ |  |  |  | 0.962 | 0.347 | \*\* | 0.984 | 0.347 | \*\* | 0.999 | 0.352 | \*\* | 0.908 | 0.350 | \*\* |
| 2:Child: 2+ |  |  |  | -0.709 | 0.357 | \* | -0.757 | 0.360 | \* | -0.821 | 0.369 | \* | -1.010 | 0.369 | \*\* |
| 3:Child: 2+ |  |  |  | -2.750 | 0.371 | \*\*\* | -2.815 | 0.375 | \*\*\* | -2.917 | 0.384 | \*\*\* | -3.154 | 0.385 | \*\*\* |
| 1:Senior: 1 |  |  |  | 0.797 | 0.108 | \*\*\* | 0.788 | 0.109 | \*\*\* | 0.763 | 0.110 | \*\*\* | 0.648 | 0.113 | \*\*\* |
| 2:Senior: 1 |  |  |  | 0.854 | 0.147 | \*\*\* | 0.851 | 0.148 | \*\*\* | 0.896 | 0.151 | \*\*\* | 0.717 | 0.153 | \*\*\* |
| 3:Senior: 1 |  |  |  | 0.874 | 0.174 | \*\*\* | 0.902 | 0.176 | \*\*\* | 0.993 | 0.179 | \*\*\* | 0.814 | 0.181 | \*\*\* |
| 1:Senior: 2+ |  |  |  | 1.334 | 0.269 | \*\*\* | 1.372 | 0.273 | \*\*\* | 1.365 | 0.274 | \*\*\* | 1.252 | 0.278 | \*\*\* |
| 2:Senior: 2+ |  |  |  | 1.605 | 0.275 | \*\*\* | 1.614 | 0.280 | \*\*\* | 1.661 | 0.285 | \*\*\* | 1.445 | 0.290 | \*\*\* |
| 3:Senior: 2+ |  |  |  | 1.337 | 0.299 | \*\*\* | 1.357 | 0.304 | \*\*\* | 1.449 | 0.309 | \*\*\* | 1.199 | 0.315 | \*\*\* |
| 1:Subway | -1.364 | 0.089 | \*\*\* | -1.327 | 0.090 | \*\*\* | -0.614 | 0.132 | \*\*\* | -0.396 | 0.131 | \*\* | -0.300 | 0.131 | \* |
| 2:Subway | -3.195 | 0.116 | \*\*\* | -3.189 | 0.117 | \*\*\* | -1.374 | 0.170 | \*\*\* | -0.855 | 0.170 | \*\*\* | -0.694 | 0.171 | \*\*\* |
| 3:Subway | -3.955 | 0.157 | \*\*\* | -4.004 | 0.162 | \*\*\* | -1.475 | 0.218 | \*\*\* | -0.792 | 0.228 | \*\*\* | -0.586 | 0.230 | \* |
| 1:CommRail | -0.526 | 0.096 | \*\*\* | -0.471 | 0.098 | \*\*\* | -0.233 | 0.104 | \* | -0.256 | 0.105 | \* | -0.168 | 0.105 |  |
| 2:CommRail | -1.004 | 0.122 | \*\*\* | -0.956 | 0.124 | \*\*\* | -0.401 | 0.132 | \*\* | -0.438 | 0.134 | \*\*\* | -0.301 | 0.136 | \* |
| 3:CommRail | -1.248 | 0.148 | \*\*\* | -1.226 | 0.152 | \*\*\* | -0.461 | 0.162 | \*\* | -0.452 | 0.165 | \*\* | -0.256 | 0.167 |  |
| 1:AccRatio |  |  |  |  |  |  | -0.124 | 0.017 | \*\*\* | -0.061 | 0.019 | \*\*\* | -0.008 | 0.020 |  |
| 2:AccRatio |  |  |  |  |  |  | -0.338 | 0.023 | \*\*\* | -0.143 | 0.026 | \*\*\* | -0.053 | 0.027 |  |
| 3:AccRatio |  |  |  |  |  |  | -0.523 | 0.034 | \*\*\* | -0.206 | 0.037 | \*\*\* | -0.090 | 0.037 | \* |
| 1:DISTCBD\_KM |  |  |  |  |  |  |  |  |  | 0.069 | 0.014 | \*\*\* | 0.033 | 0.015 | \* |
| 2:DISTCBD\_KM |  |  |  |  |  |  |  |  |  | 0.178 | 0.016 | \*\*\* | 0.110 | 0.018 | \*\*\* |
| 3:DISTCBD\_KM |  |  |  |  |  |  |  |  |  | 0.223 | 0.018 | \*\*\* | 0.135 | 0.020 | \*\*\* |
| 1:DISTCBD\_SQ |  |  |  |  |  |  |  |  |  | -0.001 | 0.000 | \*\*\* | -0.001 | 0.000 | \* |
| 2:DISTCBD\_SQ |  |  |  |  |  |  |  |  |  | -0.002 | 0.000 | \*\*\* | -0.002 | 0.000 | \*\*\* |
| 3:DISTCBD\_SQ |  |  |  |  |  |  |  |  |  | -0.002 | 0.000 | \*\*\* | -0.002 | 0.000 | \*\*\* |
| 1: LN(DENPOP) |  |  |  |  |  |  |  |  |  |  |  |  | -0.623 | 0.061 | \*\*\* |
| 2: LN(DENPOP) |  |  |  |  |  |  |  |  |  |  |  |  | -1.010 | 0.072 | \*\*\* |
| 3: LN(DENPOP) |  |  |  |  |  |  |  |  |  |  |  |  | -1.240 | 0.081 | \*\*\* |
| 1: LN(JWR) |  |  |  |  |  |  |  |  |  |  |  |  | -0.230 | 0.053 | \*\*\* |
| 2: LN(JWR) |  |  |  |  |  |  |  |  |  |  |  |  | -0.309 | 0.066 | \*\*\* |
| 3: LN(JWR) |  |  |  |  |  |  |  |  |  |  |  |  | -0.325 | 0.076 | \*\*\* |
| 1:inters\_per\_km |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2:inters\_per\_km |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3:inters\_per\_km |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1: % inters.4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2: % inters.4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3: % inters.4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1:Black |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2:Black |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3:Black |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1:Asian |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2:Asian |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3:Asian |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1:Others |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2:Others |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3:Others |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Table 1-3 cont’d**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | M6 |  |  | M7 |  |  |
|  | B | SE |  | B | SE |  |
| 1:(intercept) | 0.894 | 0.308 | \*\* | 0.928 | 0.256 | \*\*\* |
| 2:(intercept) | -2.778 | 0.405 | \*\*\* | -3.05 | 0.334 | \*\*\* |
| 3:(intercept) | -4.613 | 0.517 | \*\*\* | -5.024 | 0.419 | \*\*\* |
| 1:Size: 2-pers | 0.132 | 0.126 |  | 0.248 | 0.129 |  |
| 2:Size: 2-pers | 3.153 | 0.162 | \*\*\* | 3.283 | 0.164 | \*\*\* |
| 3:Size: 2-pers | 2.966 | 0.219 | \*\*\* | 3.103 | 0.221 | \*\*\* |
| 1:Size: 3-pers | -0.1 | 0.24 |  | 0.049 | 0.243 |  |
| 2:Size: 3-pers | 3.579 | 0.266 | \*\*\* | 3.751 | 0.27 | \*\*\* |
| 3:Size: 3-pers | 4.56 | 0.306 | \*\*\* | 4.744 | 0.31 | \*\*\* |
| 1:Size: 4-pers | -0.351 | 0.389 |  | -0.23 | 0.392 |  |
| 2:Size: 4-pers | 4.829 | 0.41 | \*\*\* | 4.99 | 0.415 | \*\*\* |
| 3:Size: 4-pers | 6.312 | 0.444 | \*\*\* | 6.505 | 0.449 | \*\*\* |
| 1:Size: 5-pers+ | -0.676 | 0.454 |  | -0.453 | 0.461 |  |
| 2:Size: 5-pers+ | 4.563 | 0.479 | \*\*\* | 4.841 | 0.488 | \*\*\* |
| 3: Size: 5-pers+ | 6.56 | 0.514 | \*\*\* | 6.88 | 0.522 | \*\*\* |
| 1:Workers1 | 0.637 | 0.104 | \*\*\* | 0.643 | 0.106 | \*\*\* |
| 2:Workers1 | 1.043 | 0.143 | \*\*\* | 1.056 | 0.144 | \*\*\* |
| 3:Workers1 | 1.173 | 0.191 | \*\*\* | 1.199 | 0.192 | \*\*\* |
| 1:Workers2 | 0.992 | 0.187 | \*\*\* | 0.956 | 0.189 | \*\*\* |
| 2:Workers2 | 1.989 | 0.209 | \*\*\* | 1.955 | 0.212 | \*\*\* |
| 3:Workers2 | 2.301 | 0.246 | \*\*\* | 2.27 | 0.248 | \*\*\* |
| 1:Workers3+ | 1.503 | 0.533 | \*\* | 1.536 | 0.536 | \*\* |
| 2:Workers3+ | 2.079 | 0.539 | \*\*\* | 2.131 | 0.544 | \*\*\* |
| 3:Workers3+ | 3.747 | 0.555 | \*\*\* | 3.793 | 0.559 | \*\*\* |
| 1:INC35-50K | 1.251 | 0.139 | \*\*\* | 1.156 | 0.141 | \*\*\* |
| 2:INC35-50K | 1.482 | 0.181 | \*\*\* | 1.375 | 0.183 | \*\*\* |
| 3:INC35-50K | 1.434 | 0.243 | \*\*\* | 1.331 | 0.245 | \*\*\* |
| 1:INC50-75K | 1.489 | 0.134 | \*\*\* | 1.38 | 0.135 | \*\*\* |
| 2:INC50-75K | 2.306 | 0.166 | \*\*\* | 2.173 | 0.168 | \*\*\* |
| 3:INC50-75K | 2.555 | 0.214 | \*\*\* | 2.429 | 0.215 | \*\*\* |
| 1:INC75-100K | 1.877 | 0.176 | \*\*\* | 1.707 | 0.178 | \*\*\* |
| 2:INC75-100K | 2.984 | 0.203 | \*\*\* | 2.786 | 0.205 | \*\*\* |
| 3:INC75-100K | 3.254 | 0.243 | \*\*\* | 3.052 | 0.246 | \*\*\* |
| 1:INC100-150K | 2.372 | 0.22 | \*\*\* | 2.167 | 0.222 | \*\*\* |
| 2:INC100-150K | 3.807 | 0.24 | \*\*\* | 3.577 | 0.243 | \*\*\* |
| 3:INC100-150K | 4.212 | 0.273 | \*\*\* | 3.981 | 0.276 | \*\*\* |
| 1:INCMT150K | 2.498 | 0.249 | \*\*\* | 2.226 | 0.251 | \*\*\* |
| 2:INCMT150K | 4.129 | 0.267 | \*\*\* | 3.816 | 0.269 | \*\*\* |
| 3:INCMT150K | 4.812 | 0.298 | \*\*\* | 4.503 | 0.3 | \*\*\* |
| 1:Child: 1 | 0.294 | 0.217 |  | 0.375 | 0.219 |  |
| 2:Child: 1 | -0.859 | 0.233 | \*\*\* | -0.764 | 0.236 | \*\*\* |
| 3:Child: 1 | -1.73 | 0.246 | \*\*\* | -1.624 | 0.249 | \*\*\* |
| 1:Child: 2+ | 0.902 | 0.351 | \*\* | 0.972 | 0.353 | \*\* |
| 2:Child: 2+ | -1.026 | 0.369 | \*\* | -0.973 | 0.373 | \*\* |
| 3:Child: 2+ | -3.168 | 0.386 | \*\*\* | -3.135 | 0.389 | \*\*\* |
| 1:Senior: 1 | 0.643 | 0.113 | \*\*\* | 0.618 | 0.114 | \*\*\* |
| 2:Senior: 1 | 0.711 | 0.153 | \*\*\* | 0.683 | 0.155 | \*\*\* |
| 3:Senior: 1 | 0.81 | 0.181 | \*\*\* | 0.777 | 0.182 | \*\*\* |
| 1:Senior: 2+ | 1.24 | 0.278 | \*\*\* | 1.199 | 0.285 | \*\*\* |
| 2:Senior: 2+ | 1.426 | 0.29 | \*\*\* | 1.371 | 0.298 | \*\*\* |
| 3:Senior: 2+ | 1.177 | 0.315 | \*\*\* | 1.118 | 0.322 | \*\*\* |
| 1:Subway | -0.304 | 0.132 | \* | -0.354 | 0.133 | \*\* |
| 2:Subway | -0.725 | 0.171 | \*\*\* | -0.758 | 0.173 | \*\*\* |
| 3:Subway | -0.624 | 0.231 | \*\* | -0.645 | 0.232 | \*\* |
| 1:CommRail | -0.165 | 0.106 |  | -0.105 | 0.108 |  |
| 2:CommRail | -0.282 | 0.136 | \* | -0.222 | 0.138 |  |
| 3:CommRail | -0.229 | 0.168 |  | -0.175 | 0.169 |  |
| 1:AccRatio | -0.006 | 0.02 |  | -0.014 | 0.02 |  |
| 2:AccRatio | -0.047 | 0.027 |  | -0.06 | 0.027 | \* |
| 3:AccRatio | -0.082 | 0.038 | \* | -0.098 | 0.038 | \*\* |
| 1:DISTCBD\_KM | 0.032 | 0.015 | \* | 0.026 | 0.015 |  |
| 2:DISTCBD\_KM | 0.107 | 0.018 | \*\*\* | 0.104 | 0.018 | \*\*\* |
| 3:DISTCBD\_KM | 0.13 | 0.02 | \*\*\* | 0.127 | 0.02 | \*\*\* |
| 1:DISTCBD\_SQ | -0.001 | 0 | \* | 0 | 0 |  |
| 2:DISTCBD\_SQ | -0.002 | 0 | \*\*\* | -0.002 | 0 | \*\*\* |
| 3:DISTCBD\_SQ | -0.002 | 0 | \*\*\* | -0.002 | 0 | \*\*\* |
| 1: LN(DENPOP) | -0.578 | 0.076 | \*\*\* | -0.572 | 0.062 | \*\*\* |
| 2: LN(DENPOP) | -0.871 | 0.094 | \*\*\* | -0.94 | 0.073 | \*\*\* |
| 3: LN(DENPOP) | -1.06 | 0.11 | \*\*\* | -1.167 | 0.082 | \*\*\* |
| 1: LN(JWR) | -0.213 | 0.056 | \*\*\* | -0.251 | 0.054 | \*\*\* |
| 2: LN(JWR) | -0.263 | 0.07 | \*\*\* | -0.327 | 0.067 | \*\*\* |
| 3: LN(JWR) | -0.273 | 0.079 | \*\*\* | -0.34 | 0.076 | \*\*\* |
| 1:inters\_per\_km | -0.034 | 0.033 |  |  |  |  |
| 2:inters\_per\_km | -0.075 | 0.045 |  |  |  |  |
| 3:inters\_per\_km | -0.096 | 0.058 |  |  |  |  |
| 1: % inters.4 | -0.173 | 0.517 |  |  |  |  |
| 2: % inters.4 | -1.326 | 0.696 |  |  |  |  |
| 3: % inters.4 | -1.862 | 0.93 | \* |  |  |  |
| 1:Black |  |  |  | -0.682 | 0.136 | \*\*\* |
| 2:Black |  |  |  | -0.928 | 0.208 | \*\*\* |
| 3:Black |  |  |  | -1.402 | 0.334 | \*\*\* |
| 1:Asian |  |  |  | -0.535 | 0.265 | \* |
| 2:Asian |  |  |  | -0.929 | 0.306 | \*\* |
| 3:Asian |  |  |  | -1.991 | 0.401 | \*\*\* |
| 1:Others |  |  |  | -0.917 | 0.133 | \*\*\* |
| 2:Others |  |  |  | -1.278 | 0.173 | \*\*\* |
| 3:Others |  |  |  | -1.329 | 0.213 | \*\*\* |

Table – Vehicle ownership model for Cube model implementation (MCube)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 1991 | |  | 2010 | |  |
|  | B | S.E. |  | B | S.E. |  |
| 1:(intercept) | 0.315 | 0.486 |  | 0.504 | 0.252 | \* |
| 2:(intercept) | -3.005 | 0.573 | \*\*\* | -3.822 | 0.324 | \*\*\* |
| 3:(intercept) | -3.966 | 0.706 | \*\*\* | -5.773 | 0.401 | \*\*\* |
| 1:SIZE2-pers | 0.530 | 0.185 | \*\* | 0.944 | 0.116 | \*\*\* |
| 2:SIZE2-pers | 2.492 | 0.241 | \*\*\* | 4.299 | 0.156 | \*\*\* |
| 3:SIZE2-pers | 1.133 | 0.362 | \*\* | 4.154 | 0.212 | \*\*\* |
| 1:SIZE3-pers | 1.680 | 0.340 | \*\*\* | 1.232 | 0.171 | \*\*\* |
| 2:SIZE3-pers | 4.637 | 0.377 | \*\*\* | 4.574 | 0.205 | \*\*\* |
| 3:SIZE3-pers | 4.410 | 0.454 | \*\*\* | 5.047 | 0.251 | \*\*\* |
| 1:SIZE4-pers+ | 1.388 | 0.348 | \*\*\* | 1.207 | 0.193 | \*\*\* |
| 2:SIZE4-pers+ | 4.685 | 0.382 | \*\*\* | 5.148 | 0.220 | \*\*\* |
| 3:SIZE4-pers+ | 4.180 | 0.458 | \*\*\* | 5.142 | 0.264 | \*\*\* |
| 1:WORKERS1 | 0.614 | 0.186 | \*\*\* | 0.329 | 0.100 | \*\* |
| 2:WORKERS1 | 1.063 | 0.236 | \*\*\* | 0.635 | 0.131 | \*\*\* |
| 3:WORKERS1 | 0.498 | 0.342 |  | 0.830 | 0.175 | \*\*\* |
| 1:WORKERS2 | -0.170 | 0.256 |  | 0.655 | 0.175 | \*\*\* |
| 2:WORKERS2 | 0.803 | 0.288 | \*\* | 1.671 | 0.191 | \*\*\* |
| 3:WORKERS2 | 0.796 | 0.376 | \* | 2.116 | 0.224 | \*\*\* |
| 1:WORKERS3+ | -0.262 | 0.540 |  | 1.097 | 0.506 | \* |
| 2:WORKERS3+ | 0.039 | 0.558 |  | 2.222 | 0.507 | \*\*\* |
| 3:WORKERS3+ | 2.108 | 0.601 | \*\*\* | 4.713 | 0.519 | \*\*\* |
| 1:IncGrpMid-low | 0.880 | 0.175 | \*\*\* | 1.213 | 0.108 | \*\*\* |
| 2:IncGrpMid-low | 1.779 | 0.212 | \*\*\* | 2.015 | 0.136 | \*\*\* |
| 3:IncGrpMid-low | 1.503 | 0.256 | \*\*\* | 1.986 | 0.167 | \*\*\* |
| 1:IncGrpMid-high | 1.871 | 0.229 | \*\*\* | 2.014 | 0.129 | \*\*\* |
| 2:IncGrpMid-high | 3.185 | 0.265 | \*\*\* | 3.272 | 0.159 | \*\*\* |
| 3:IncGrpMid-high | 3.082 | 0.303 | \*\*\* | 3.410 | 0.186 | \*\*\* |
| 1:IncGrpHigh | 2.727 | 0.397 | \*\*\* | 2.589 | 0.172 | \*\*\* |
| 2:IncGrpHigh | 4.572 | 0.416 | \*\*\* | 4.173 | 0.201 | \*\*\* |
| 3:IncGrpHigh | 4.615 | 0.444 | \*\*\* | 4.543 | 0.224 | \*\*\* |
| 1:Subway1 | -0.850 | 0.238 | \*\*\* | -0.331 | 0.130 | \* |
| 2:Subway1 | -0.830 | 0.285 | \*\* | -0.742 | 0.168 | \*\*\* |
| 3:Subway1 | -0.995 | 0.383 | \*\* | -0.656 | 0.223 | \*\* |
| 1:CommRail1 | -0.325 | 0.172 | . | -0.183 | 0.105 | . |
| 2:CommRail1 | -0.437 | 0.210 | \* | -0.332 | 0.134 | \* |
| 3:CommRail1 | -0.498 | 0.270 | . | -0.285 | 0.162 | . |
| 1:AccRatio | -0.00546 | 0.0310 |  | 0.00241 | 0.0200 |  |
| 2:AccRatio | -0.0975 | 0.0393 | \* | -0.0398 | 0.0267 |  |
| 3:AccRatio | -0.103 | 0.055 | . | -0.0768 | 0.0364 | \* |
| 1:DISTCBD\_KM | 0.0930 | 0.0305 | \*\* | 0.0334 | 0.0154 | \* |
| 2:DISTCBD\_KM | 0.126 | 0.0330 | \*\*\* | 0.107 | 0.0177 | \*\*\* |
| 3:DISTCBD\_KM | 0.152 | 0.0374 | \*\*\* | 0.129 | 0.0196 | \*\*\* |
| 1:DISTCBD\_SQ | -0.00152 | 0.000510 | \*\* | -0.00054 | 0.000262 | \* |
| 2:DISTCBD\_SQ | -0.00201 | 0.000544 | \*\*\* | -0.00157 | 0.000292 | \*\*\* |
| 3:DISTCBD\_SQ | -0.00240 | 0.000605 | \*\*\* | -0.00173 | 0.000314 | \*\*\* |
| 1:LN (DENPOP) | -0.309 | 0.121 | \* | -0.663 | 0.0616 | \*\*\* |
| 2:LN (DENPOP) | -0.546 | 0.130 | \*\*\* | -1.053 | 0.0718 | \*\*\* |
| 3:LN (DENPOP) | -0.566 | 0.144 | \*\*\* | -1.249 | 0.0794 | \*\*\* |
| 1:LN (JWR) | -0.219 | 0.082 | \*\* | -0.239 | 0.0535 | \*\*\* |
| 2:LN (JWR) | -0.254 | 0.093 | \*\* | -0.322 | 0.0658 | \*\*\* |
| 3:LN (JWR) | -0.264 | 0.109 | \* | -0.343 | 0.0744 | \*\*\* |

Table – Summary of model estimation for 1991

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1991** | **M1** | **M2** | **M3** | **M4** | **M5** | **M6** | **M7** | **Cube** |
| Null Log-Likelihood | -4357 | -4357 | -4357 | -4357 | -4357 | -4357 | n.a. | -4357 |
| Final log-Likelihood | -2996 | -2955 | -2897 | -2867 | -2853 | -2852 | n.a. | -2915 |
| Rho-squarea | 0.312 | 0.322 | 0.335 | 0.342 | 0.345 | 0.345 | n.a. | 0.331 |
| Adjusted rho-squareb | 0.302 | 0.309 | 0.321 | 0.327 | 0.329 | 0.327 | n.a. | 0.319 |
| Likelihood ratioc | 2721 | 2804 | 2919 | 2980 | 3007 | 3009 | n.a. | 2883 |
| Degree of freedom | 45 | 57 | 60 | 66 | 72 | 78 | n.a. | 51 |

a. 1 − (L(β)/L(0))

b. 1 − (L(β) − K)/L(0)

c. -2 (L(0)-L(β))

Table – Summary of model estimation for 2010

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **2010** | **M1** | **M2** | **M3** | **M4** | **M5** | **M6** | **M7** | **Cube** |
| Null Log-Likelihood | -12380 | -12380 | -12380 | -12380 | -12380 | -12380 | -12380 | -12380 |
| Final Log-Likelihood | -8498 | -8246 | -8076 | -7879 | -7748 | -7743 | -7694 | -8000 |
| Rho-square | 0.314 | 0.334 | 0.348 | 0.364 | 0.374 | 0.375 | 0.379 | 0.354 |
| Adjusted rho-square | 0.310 | 0.329 | 0.343 | 0.358 | 0.368 | 0.368 | 0.372 | 0.350 |
| Likelihood ratio | 7764 | 8268 | 8608 | 9004 | 9265 | 9274 | 9375 | 8761 |
| Degree of freedom | 45 | 57 | 60 | 66 | 72 | 78 | 81 | 51 |

# Trip Generation Model

## Household characterization

Cross-classification is a widely used approach for trip generation in the four-step model, due to its relative simplicity and ease of application using population data typically available from a census. We initially tried other trip generation model structures, including linear regression, Tobit, Poisson regression, negative binomial, and ordered logit models. But the forecast performances of these models turn out no better than the traditional cross-classification approach for the Boston data. So we proceeded with the cross-classification structure for the uncertainty analysis.

The classification approach divides households into categories based on their socioeconomic and demographic characteristics, with trip rates then computed for each category, and subsequently applied in the forecasts.

Household categories can be defined in various ways, the most common being size, number of workers, income and the number of motor vehicles. We choose three variations in characterizing households – size-worker-vehicle, size-worker-income, and size-worker-income-vehicle – and calculate trip rates for each approach. We then test if household characterization significantly affects trip generation forecasts, providing an example of uncertainty in model specification.

Table 2–1 shows the values for each categorical variable and the number of household categories for each characterization approach. Note that some categories have zero or too few observations in the surveys. We combine such small groups with their neighboring group to enlarge the sample size. After this consolidation, the “size-worker-vehicle” and “size-worker-income” categorizations have 22 and 50 categories respectively, with at least 10 observations from the surveys for each category. These two household characterizations are denoted as HH22 and HH50.

The most complex “size-worker-income-vehicle” characterization is dealt with differently. Originally it has 224 categories, many of which have fewer than 5 observations. Instead of consolidating them, we replace their trip rates with those from the upper-level group that the household belongs to. “Size-worker-income” – HH50 – is used as the upper-level backup. For example, household group P1W1I1C2 (P1: 1-person, W1: 1-worker, I1: low-income, and C2: 2-car) with fewer than 5 observations inherits the trip rates of its parent in the HH50, which is P1W1I1.

We define and assign the four income levels based on the survey’s original income categories and household size, since for households of different sizes, the four income levels should correspond to different income thresholds (Table 2–2). Table 2–3 shows the income level distribution for the 2010 CTPP population based on this definition.

Table – Household characterization details

|  |  |
| --- | --- |
| **Household characteristics** | **Values** |
| Size (P) | 1, 2, 3, 4+ |
| Worker (W) | 0, 1, 2, 3+ |
| Income (I) | Low, mid-low, mid-high, high |
| Vehicles (C) | 0, 1, 2, 3+ |
|  |  |
| **Household characterization** | **Number of household categories** |
| Size-worker-vehicle (HH22) | 22 |
| Size-worker-income (HH50) | 50 |
| Size-worker-income-vehicle (HH224) | 224 |

Table – Household income level definitions (K: 1000 dollars in 2010)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Income levels | 1-person | 2-person | 3-person | 4+person |
| Low | <15K | <35K | <50K | <50K |
| Mid-low | 15K-35K | 35K-75K | 50K-100K | 50K-100K |
| Mid-high | 35K-75K | 75K-150K | 100K-150K | 100K-150K |
| High | 75K+ | 150K+ | 150K+ | 150K+ |

Table – Four-level income level distribution for 2010 CTPP population

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P: persons  W: workers | Low | Mid-Low | Mid-High | High | Total | Low | Mid-Low | Mid-High | High | Total |
| 1P0W | 106,632 | 73,840 | 37,858 | 11,295 | 229,625 | 46.4% | 32.2% | 16.5% | 4.9% | 100.0% |
| 1P1W | 17,532 | 50,007 | 114,167 | 73,748 | 255,454 | 6.9% | 19.6% | 44.7% | 28.9% | 100.0% |
| 2P0W | 58,727 | 39,714 | 18,439 | 5,589 | 122,469 | 48.0% | 32.4% | 15.1% | 4.6% | 100.0% |
| 2P1W | 36,163 | 65,149 | 50,748 | 21,250 | 173,310 | 20.9% | 37.6% | 29.3% | 12.3% | 100.0% |
| 2P2W | 10,620 | 52,983 | 112,577 | 57,630 | 233,810 | 4.5% | 22.7% | 48.1% | 24.6% | 100.0% |
| 3P0W | 17,540 | 4,448 | 1,372 | 869 | 24,229 | 72.4% | 18.4% | 5.7% | 3.6% | 100.0% |
| 3P1W | 31,464 | 29,625 | 13,763 | 11,323 | 86,175 | 36.5% | 34.4% | 16.0% | 13.1% | 100.0% |
| 3P2W | 13,825 | 37,770 | 33,443 | 31,939 | 116,977 | 11.8% | 32.3% | 28.6% | 27.3% | 100.0% |
| 3P3W | 3,247 | 13,035 | 15,735 | 14,605 | 46,622 | 7.0% | 28.0% | 33.8% | 31.3% | 100.0% |
| 4P0W | 14,740 | 3,680 | 1,057 | 1,132 | 20,609 | 71.5% | 17.9% | 5.1% | 5.5% | 100.0% |
| 4P1W | 28,872 | 33,598 | 23,106 | 27,586 | 113,162 | 25.5% | 29.7% | 20.4% | 24.4% | 100.0% |
| 4P2W | 17,644 | 54,060 | 48,644 | 52,768 | 173,116 | 10.2% | 31.2% | 28.1% | 30.5% | 100.0% |
| 4P3W | 2,944 | 16,578 | 20,098 | 18,345 | 57,965 | 5.1% | 28.6% | 34.7% | 31.6% | 100.0% |
| 4P4W | 1,179 | 7,100 | 11,214 | 15,085 | 34,578 | 3.4% | 20.5% | 32.4% | 43.6% | 100.0% |
| Total | 361,129 | 481,587 | 502,221 | 343,164 | 1,688,101 |  |  |  |  |  |

Data source: 2010 CTPP.

## Trip rates by trip purposes

*List of trip purposes*

HBW: home-based work

HBWR: home-based work-related

HBSC: home-based school

HBPUDO: home-based pick-up/drop-off

HBSH: home-based shopping

HBBPB: home-based bank/personal business

HBSO: home-based social

HBEAT: home-based eating

HBREC: home-based recreation

HBO: home-based other

NHBW: non-home-based work/work-related

NHBO: non-home-based other

*HBW trips*

HBW trips are generated at the worker level. The 224 HH types are first split into 1120 HH types by 5 worker’s earning groups. Doing this has two purposes: 1) allowing trip distribution step to have HBW trip inputs by earning; and 2) allowing variations in work-at-home rates by earning.

HBW trips for HH type i (i from 1 to 1120) is:

HBW[i]=Number of workers[i] \* (1-workAtHome[i]) \* TR\_HBW

Note that work-at-home rate (Table 2–4) is from CTPP data. It varies across worker’s earning categories. HBW trips per worker (TR\_HBW) is calculated from 2010MTS and 1991BTS. It is the number of HBW or HBWR trips per worker who actually travels to work on the travel survey day

HBW trip attraction is computed based on jobs by earning in each TAZ. The attractions are matched to the trip production for each earning category.

Major changes in HBW generation include:

* Worker-level generation (vs. HH level generation)
* Including percentage of working at home, which varies by earning
* Having considered work-at-home rate variations across earning groups, we assume the same HBW trips per worker for every worker. This is debatable, because HBW trip rate also reflects trip-chaining behavior: higher value means less trip chaining during commute. This can vary across HH type. We use the same rate here for simplicity, assuming the difference in HBW trip production across HH types is fully captured by the different work-at-home ratios.
* Disaggregated HBW trip outputs according to worker’s earning level.

Table – Work-at-home rates by worker earning group

|  |  |  |
| --- | --- | --- |
| **Input parameters** | **1990** | **2010** |
| Work-at-home rate | 0.0231 | 0.0404 |
| Earn 1 | 0.042 | 0.049 |
| Earn 2 | 0.0142 | 0.0291 |
| Earn 3 | 0.012 | 0.0295 |
| Earn 4 | 0.0149 | 0.0417 |
| Earn 5 | 0.024 | 0.0586 |
| HBW trips per worker | 1.52 | 1.317 |

*Other trip purposes*

For other purposes, trips are generated at the HH level and computed from travel surveys in 1990 and 2010. Trip rates vary across the HH types. Attractions are based on three types of jobs: retail, service and the others. Total attractions are matched to the total productions.

# Gravity model calibration for trip distribution

Gravity model with friction factors is used for trip distribution. Friction factors are calibrated based on matching the observed travel time distribution with the predicted travel time distribution.

For HBW trips, we disaggregate trip distribution by 5 workers’ earning categories, and by choice (with car) and captive (no car) riders. It means that the trip productions and attractions are by earning group; and that the travel time distribution is earning-specific. The calibrated friction factors for HBW trips are shown in Table 3–1 and Table 3–2. Note that we cannot do a similar calibration for 1990, since the disaggregated data is not available in CTPP1990. For 1990, we calibrate the overall HBW friction factors instead of by earning group. For other trip purposes, the friction factors are calibrated for choice and captive riders using travel surveys.

## 2010 trip distribution calibration

Table – Friction factors for HBW CHO riders in 2010

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Time | Earn1 | Earn2 | Earn3 | Earn4 | Earn5 |
| 5 | 974.40 | 384.14 | 186.74 | 100.41 | 94.16 |
| 15 | 360.96 | 146.37 | 57.65 | 31.92 | 21.51 |
| 20 | 130.31 | 63.27 | 27.52 | 14.33 | 8.59 |
| 30 | 41.56 | 26.90 | 12.68 | 7.35 | 4.71 |
| 45 | 15.52 | 12.46 | 6.09 | 4.16 | 2.92 |
| 60 | 3.39 | 3.40 | 2.10 | 1.69 | 1.21 |
| 75 | 2.42 | 2.27 | 1.65 | 1.41 | 1.10 |
| 90 | 0.53 | 0.48 | 0.40 | 0.52 | 0.46 |
| 120 | 1 | 1 | 1 | 1 | 1 |

Table – Friction factors for HBW CAP riders in 2010

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Earn1 | Earn2 | Earn3 | Earn4 | Earn5 |
| 5 | 2286.0 | 685.4 | 170.5 | 3267.4 | 2274.9 |
| 15 | 713214.8 | 153660.9 | 277894.6 | 22047.5 | 11443.2 |
| 20 | 1398099.3 | 287412.6 | 734317.2 | 16321.0 | 46477.0 |
| 30 | 224351.2 | 76571.7 | 270251.0 | 8997.1 | 11998.7 |
| 45 | 42405.6 | 11326.9 | 89762.9 | 3001.6 | 1703.2 |
| 60 | 207.2 | 82.3 | 137.9 | 1.0 | 1.0 |
| 75 | 1 | 1 | 1 | 0 | 0 |
| 90 | 0 | 0 | 0 | 0 | 0 |
| 120 | 0 | 0 | 0 | 0 | 0 |

|  |  |
| --- | --- |
| F:\RA_Uncertainty\model_office\10192015\Models\CubeCatCong\Base\Year 2010\pyIO\Log_FF_HBW_CHO_Year 2010.png | F:\RA_Uncertainty\model_office\10192015\Models\CubeCatCong\Base\Year 2010\pyIO\Log_FF_HBW_CAP_Year 2010.png |
| Log FF for HBW CHO | Log FF for HBW CAP |

|  |  |
| --- | --- |
| F:\RA_Uncertainty\model_office\10192015\Models\CubeCatCong\Base\Year 2010\pyIO\OTLD_HBW_CHO_Year 2010.png | F:\RA_Uncertainty\model_office\10192015\Models\CubeCatCong\Base\Year 2010\pyIO\PTLD_HBW_CHO_Year 2010.png |
| Observed HBW TLD for **Choice** | Predicted HBW TLD for **Choice** |
| F:\RA_Uncertainty\model_office\10192015\Models\CubeCatCong\Base\Year 2010\pyIO\OTLD_HBW_CAP_Year 2010.png | F:\RA_Uncertainty\model_office\10192015\Models\CubeCatCong\Base\Year 2010\pyIO\PTLD_HBW_CAP_Year 2010.png |
| Observed HBW TLD for **Captives** | Predicted HBW TLD for **Captives** |

**Figure 3‑1 Friction factors and travel time distribution for choice and captive travelers in 2010.**

Table – Friction factors for other trip purposes for CHOICE in 2010

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Time**  **(min)** | **HBSC** | **HBPUDO** | **HBSH** | **HBBPB** | **HBSO** | **HBEAT** | **HBREC** | **HBO** | **NHBW** | **NHBO** |
| 5 | 44454.1 | 212927.9 | 809458.4 | 13586.0 | 36905.5 | 188842.7 | 15278.0 | 1.42E+24 | 15332.2 | 18193.1 |
| 10 | 3933.4 | 32743.5 | 116697.9 | 1991.2 | 1495.2 | 5666.8 | 1561.0 | 228.0 | 1842.2 | 5204.8 |
| 15 | 851.7 | 4655.7 | 21852.9 | 393.9 | 328.7 | 972.2 | 329.4 | 71.1 | 359.2 | 932.0 |
| 20 | 285.2 | 1046.1 | 5203.8 | 99.2 | 92.0 | 287.3 | 85.1 | 17.9 | 110.4 | 266.3 |
| 30 | 92.4 | 267.2 | 1274.2 | 27.6 | 26.1 | 59.8 | 22.5 | 6.9 | 41.5 | 71.6 |
| 45 | 16.3 | 40.0 | 154.5 | 4.7 | 5.2 | 8.4 | 2.8 | 2.3 | 10.4 | 11.7 |
| 60 | 3.3 | 6.3 | 33.8 | 1.2 | 1.1 | 1.5 | 0.8 | 0.9 | 3.1 | 2.5 |
| 75 | 0.9 | 2.4 | 9.9 | 0.5 | 0.5 | 0.5 | 0.5 | 0.7 | 1.2 | 1.3 |
| 90 | 0.5 | 1.0 | 5.6 | 0.4 | 0.6 | 0.4 | 0.6 | 0.3 | 0.9 | 1.2 |
| 120 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |

Table – Friction factors for other trip purposes for CAPTIVE in 2010

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Time**  **(min)** | **HBSC** | **HBPUDO** | **HBSH** | **HBBPB** | **HBSO** | **HBEAT** | **HBREC** | **HBO** | **HBOA** | **NHBW** | **NHBO** |
| 5 | 4813.0 | 11755.9 | 45226.5 | 1762.3 | 3491.9 | 8808.6 | 2016.4 | 78379.6 | 469.0 | 2593.9 | 2219.4 |
| 10 | 54441.8 | 666260.3 | 1879908.4 | 33801.9 | 8593.6 | 19158.1 | 18538.7 | 28.0 | 55036.9 | 14020.4 | 124446.9 |
| 15 | 5656.6 | 20855.5 | 127967.1 | 3626.5 | 1964.3 | 3562.6 | 2783.1 | 563.4 | 5115.0 | 2246.7 | 9250.1 |
| 20 | 2024.4 | 4647.5 | 26674.6 | 943.4 | 677.6 | 1391.4 | 810.0 | 350.7 | 1246.3 | 840.0 | 2565.7 |
| 30 | 827.2 | 1545.0 | 7303.0 | 355.2 | 275.9 | 427.1 | 297.8 | 221.0 | 409.6 | 418.2 | 840.0 |
| 45 | 182.5 | 319.8 | 1086.2 | 85.6 | 79.4 | 92.3 | 52.2 | 73.6 | 89.3 | 136.6 | 176.5 |
| 60 | 35.4 | 46.7 | 236.2 | 20.0 | 14.9 | 16.2 | 13.7 | 22.0 | 22.1 | 33.5 | 35.3 |
| 75 | 5.1 | 10.2 | 48.0 | 4.1 | 3.6 | 3.3 | 4.2 | 9.9 | 5.3 | 7.0 | 9.7 |
| 90 | 1.4 | 2.6 | 17.0 | 1.4 | 2.1 | 1.2 | 2.1 | 1.8 | 2.0 | 2.8 | 4.3 |
| 120 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

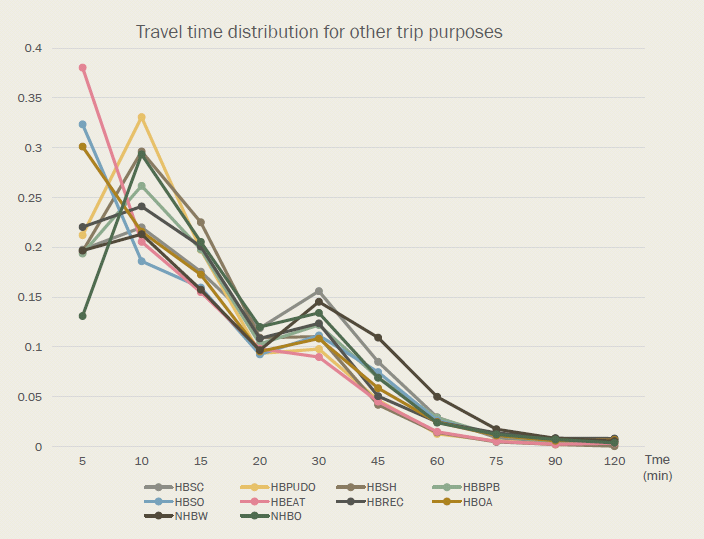


Figure ‑ Observed travel time distribution for other purposes in 2010.

## 1990 trip distribution calibration

Table – Observed HBW Travel Time Distribution for All Workers in 1990

|  |  |
| --- | --- |
| Journey to work  travel time | Percentage |
| 5 | 3.0% |
| 15 | 25.7% |
| 20 | 14.9% |
| 30 | 19.4% |
| 45 | 22.0% |
| 60 | 8.7% |
| 75 | 4.7% |
| 90 | 0.7% |
| 120 | 1.0% |

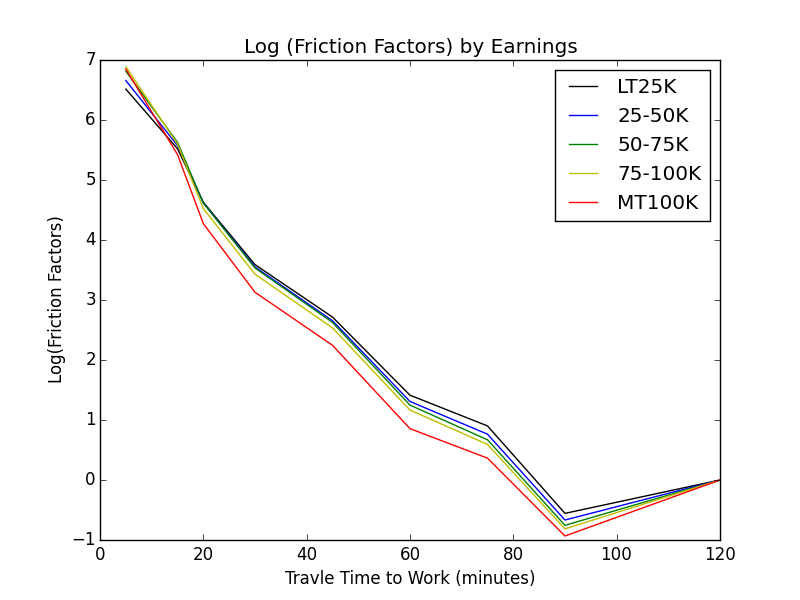


Figure ‑ 1990 Log of Friction Factors by Earning Groups for HBW Choice riders

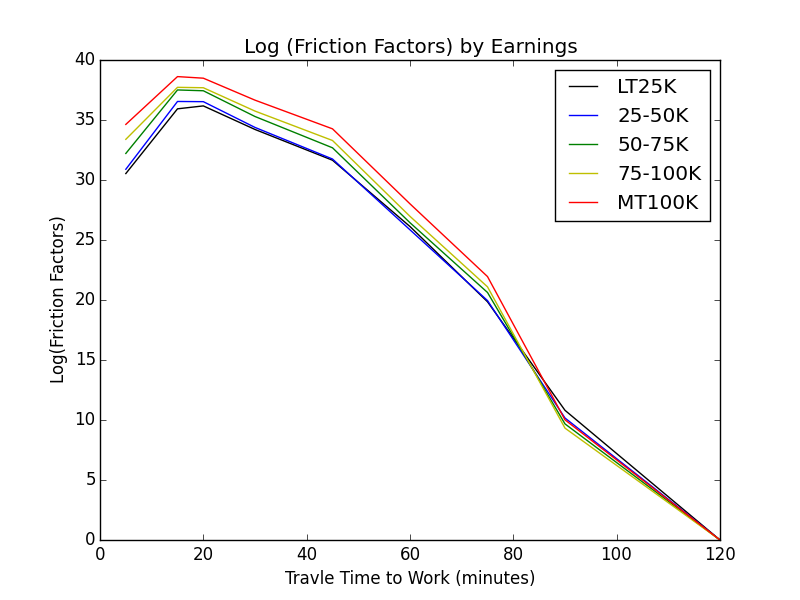


Figure ‑ 1990 Log of Friction Factors by Earning Groups for HBW Captive riders

*Other purposes*

Figure ‑ Observed Travel time distribution for other purposes in 1990.

Table – 1990 Friction Factors for Other Trip Purposes for Choice

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | HBSC | HBPUDO | HBSH | HBBPB | HBSO | HBEAT | HBREC | HBO | HBOA | NHBW | NHBO |
| 5 | 1115.5 | 19623.1 | 19664.6 | 15721.6 | 45760.0 | 1844.6 | 14141.3 | 212.5 | 8618.0 | 5030.1 | 12904.1 |
| 10 | 908.1 | 20561.3 | 15816.5 | 14306.5 | 41611.4 | 2767.3 | 21202.7 | 636.5 | 9269.2 | 3859.4 | 5939.8 |
| 15 | 331.8 | 4815.1 | 4111.3 | 3377.3 | 11176.0 | 871.4 | 5072.5 | 168.7 | 2367.3 | 840.7 | 1290.1 |
| 20 | 200.2 | 1737.7 | 1897.2 | 1500.3 | 6623.7 | 347.6 | 3238.0 | 55.2 | 1204.6 | 424.1 | 618.6 |
| 30 | 34.8 | 233.6 | 189.3 | 165.3 | 672.2 | 37.1 | 247.6 | 4.3 | 118.6 | 62.5 | 75.5 |
| 45 | 12.1 | 46.8 | 54.9 | 57.2 | 344.2 | 18.9 | 108.7 | 2.2 | 51.3 | 26.4 | 25.8 |
| 60 | 2.2 | 5.7 | 4.5 | 8.5 | 40.7 | 3.1 | 13.9 | 0.6 | 7.1 | 4.9 | 3.4 |
| 75 | 1.8 | 2.0 | 1.7 | 4.3 | 24.6 | 1.4 | 6.2 | 0.3 | 3.6 | 2.5 | 1.4 |
| 90 | 0.4 | 1.4 | 0.6 | 1.2 | 6.4 | 0.3 | 0.5 | 0.2 | 0.8 | 0.5 | 0.5 |
| 120 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |

Table – 1990 FF for Other Trip Purposes for Captives

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | HBSC | HBPUDO | HBSH | HBBPB | HBSO | HBEAT | HBREC | HBO | HBOA | NHBW | NHBO |
| 5 | 180.7 | 1810.2 | 1070.3 | 2266.0 | 6982.1 | 256.8 | 1717.7 | 21.1 | 1227.5 | 904.2 | 1783.4 |
| 10 | 12041.8 | 666481.4 | 402618.3 | 481106.8 | 712505.3 | 58229.8 | 424564.8 | 68444.1 | 212776.2 | 42222.4 | 124453.4 |
| 15 | 4980.5 | 52019.0 | 38347.5 | 43400.5 | 114908.6 | 11454.9 | 54908.7 | 4942.4 | 27751.6 | 6264.5 | 12498.9 |
| 20 | 3238.6 | 16554.5 | 15947.4 | 19820.4 | 82693.2 | 4615.2 | 44073.1 | 1088.9 | 15824.9 | 4042.9 | 6843.0 |
| 30 | 505.4 | 1844.2 | 1009.6 | 1926.6 | 7643.0 | 436.3 | 2655.3 | 56.3 | 1356.1 | 600.4 | 779.5 |
| 45 | 190.8 | 456.6 | 343.1 | 881.3 | 5239.5 | 290.4 | 1591.4 | 36.9 | 781.3 | 335.1 | 350.0 |
| 60 | 30.8 | 52.2 | 28.3 | 123.5 | 554.0 | 44.7 | 189.1 | 9.5 | 100.0 | 51.6 | 40.5 |
| 75 | 13.8 | 11.5 | 9.8 | 36.4 | 195.3 | 11.1 | 49.9 | 3.0 | 29.5 | 16.1 | 10.4 |
| 90 | 1.4 | 4.6 | 2.0 | 4.6 | 23.9 | 1.2 | 1.8 | 0.7 | 3.2 | 1.6 | 1.7 |
| 120 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |

# Mode choice models

Mode choice uses the multinomial logit model structure. The choice set consists of five alternatives: single-occupant vehicle (SOV), walk (WALK), walk-access-transit (WAT), drive-access-transit (DAT), and auto-passenger (APAX). The models are estimated using 2010 MTS and 1990 BTS. The travel impedance metrics are from Cube model skims.

## 2010 model estimation

Table – HBW Mode Choice Model Estimation

| **Name** | **Value** | **Std err** | **t-test** | **p-value** |  | **Robust Std err** | **Robust t-test** | **p-value** |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ASC\_APAX | -3.49 | 0.334 | -10.45 | 0.00 |  | 0.309 | -11.29 | 0.00 |  |
| ASC\_DAT | -4.38 | 0.589 | -7.44 | 0.00 |  | 0.620 | -7.07 | 0.00 |  |
| ASC\_SOV | -1.20 | 0.294 | -4.06 | 0.00 |  | 0.291 | -4.10 | 0.00 |  |
| ASC\_WALK | 0.00 | fixed |  |  |  |  |  |  |  |
| ASC\_WAT | 0.162 | 0.408 | 0.40 | 0.69 | \* | 0.397 | 0.41 | 0.68 | \* |
| B\_APAX\_COST\_INC | -0.00272 | 0.0647 | -0.04 | 0.97 | \* | 0.0699 | -0.04 | 0.97 | \* |
| B\_CAP\_APAX | -0.844 | 0.323 | -2.61 | 0.01 |  | 0.343 | -2.46 | 0.01 |  |
| B\_DAT\_ACCEGG | -0.0417 | 0.0106 | -3.92 | 0.00 |  | 0.0106 | -3.93 | 0.00 |  |
| B\_D\_CBD\_DAT | 3.46 | 0.337 | 10.28 | 0.00 |  | 0.359 | 9.64 | 0.00 |  |
| B\_D\_CBD\_WAT | 0.939 | 0.161 | 5.81 | 0.00 |  | 0.162 | 5.78 | 0.00 |  |
| B\_D\_JOBDEN10K\_SOV | -0.0371 | 0.00387 | -9.59 | 0.00 |  | 0.00433 | -8.57 | 0.00 |  |
| B\_HHSIZ\_APAX | 0.248 | 0.0458 | 5.41 | 0.00 |  | 0.0422 | 5.87 | 0.00 |  |
| B\_O\_CBD\_APAX | -0.487 | 0.278 | -1.75 | 0.08 | \* | 0.284 | -1.71 | 0.09 | \* |
| B\_O\_CBD\_SOV | -0.978 | 0.221 | -4.42 | 0.00 |  | 0.219 | -4.47 | 0.00 |  |
| B\_O\_CBD\_WAT | -0.793 | 0.243 | -3.27 | 0.00 |  | 0.240 | -3.31 | 0.00 |  |
| B\_O\_POPDEN10K\_WAT | 0.188 | 0.0571 | 3.29 | 0.00 |  | 0.0579 | 3.24 | 0.00 |  |
| B\_PT\_FARES\_DIST | -1.03 | 0.170 | -6.10 | 0.00 |  | 0.181 | -5.72 | 0.00 |  |
| B\_PT\_IVTT\_DIST | -0.140 | 0.0338 | -4.14 | 0.00 |  | 0.0317 | -4.42 | 0.00 |  |
| B\_PT\_IVTT\_DIST\_HIGHINC | -0.0718 | 0.0352 | -2.04 | 0.04 |  | 0.0345 | -2.08 | 0.04 |  |
| B\_PT\_IVTT\_DIST\_MIDHIGHINC | -0.0599 | 0.0343 | -1.75 | 0.08 | \* | 0.0328 | -1.83 | 0.07 | \* |
| B\_PT\_IVTT\_DIST\_MIDLOWINC | -0.0154 | 0.0342 | -0.45 | 0.65 | \* | 0.0338 | -0.46 | 0.65 | \* |
| B\_PT\_WAITT | -0.0241 | 0.0110 | -2.19 | 0.03 |  | 0.0106 | -2.27 | 0.02 |  |
| B\_SOV\_COST\_INC | -0.0594 | 0.0531 | -1.12 | 0.26 | \* | 0.0546 | -1.09 | 0.28 | \* |
| B\_TERMJ\_APAX | -0.151 | 0.0512 | -2.96 | 0.00 |  | 0.0533 | -2.84 | 0.00 |  |
| B\_TERMJ\_SOV | -0.187 | 0.0408 | -4.60 | 0.00 |  | 0.0416 | -4.50 | 0.00 |  |
| B\_VEHPWRK\_DAT | 1.50 | 0.155 | 9.70 | 0.00 |  | 0.193 | 7.77 | 0.00 |  |
| B\_VEHPWRK\_SOV | 1.59 | 0.117 | 13.56 | 0.00 |  | 0.166 | 9.61 | 0.00 |  |
| B\_WALK\_TT | -0.0785 | 0.00712 | -11.02 | 0.00 |  | 0.00714 | -10.99 | 0.00 |  |
| B\_WAT\_WALKT | -0.0518 | 0.00782 | -6.62 | 0.00 |  | 0.00796 | -6.51 | 0.00 |  |

Adjusted rho-square: 0.623

Table – HBSHOP Mode Choice Logit Model Estimation

| **Name** | **Value** | **Std err** | **t-test** | **p-value** |  | **Robust Std err** | **Robust t-test** | **p-value** |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ASC\_APAX | -2.34 | 0.383 | -6.11 | 0.00 |  | 0.368 | -6.36 | 0.00 |  |
| ASC\_DAT | -4.13 | 0.741 | -5.57 | 0.00 |  | 0.637 | -6.48 | 0.00 |  |
| ASC\_SOV | -0.836 | 0.373 | -2.24 | 0.02 |  | 0.372 | -2.25 | 0.02 |  |
| ASC\_WALK | 0.00 | fixed |  |  |  |  |  |  |  |
| ASC\_WAT | -1.50 | 0.696 | -2.15 | 0.03 |  | 0.770 | -1.95 | 0.05 | \* |
| B\_APAX\_COST\_INC | -0.220 | 0.216 | -1.02 | 0.31 | \* | 0.230 | -0.96 | 0.34 | \* |
| B\_CAP\_APAX | -0.700 | 0.344 | -2.04 | 0.04 |  | 0.353 | -1.99 | 0.05 |  |
| B\_CAP\_WAT | 1.96 | 0.427 | 4.60 | 0.00 |  | 0.442 | 4.45 | 0.00 |  |
| B\_DDENSITY10K\_APAX | -0.374 | 0.121 | -3.10 | 0.00 |  | 0.124 | -3.02 | 0.00 |  |
| B\_DDENSITY10K\_PT | 0.489 | 0.128 | 3.82 | 0.00 |  | 0.127 | 3.84 | 0.00 |  |
| B\_DDENSITY10K\_SOV | -0.247 | 0.0989 | -2.50 | 0.01 |  | 0.0951 | -2.60 | 0.01 |  |
| B\_D\_CBD\_APAX | -0.642 | 0.274 | -2.34 | 0.02 |  | 0.272 | -2.36 | 0.02 |  |
| B\_D\_CBD\_SOV | -0.900 | 0.239 | -3.77 | 0.00 |  | 0.236 | -3.80 | 0.00 |  |
| B\_HHSIZ\_APAX | 0.325 | 0.0441 | 7.37 | 0.00 |  | 0.0445 | 7.31 | 0.00 |  |
| B\_INCOME\_WAT | -0.128 | 0.0400 | -3.20 | 0.00 |  | 0.0488 | -2.62 | 0.01 |  |
| B\_PT\_FARES\_DIST | -1.65 | 0.341 | -4.84 | 0.00 |  | 0.354 | -4.67 | 0.00 |  |
| B\_PT\_WAITT | -0.112 | 0.0366 | -3.05 | 0.00 |  | 0.0340 | -3.29 | 0.00 |  |
| B\_PT\_XFERWT | -0.0240 | 0.0336 | -0.71 | 0.48 | \* | 0.0359 | -0.67 | 0.50 | \* |
| B\_SOV\_COST\_INC | -0.396 | 0.212 | -1.87 | 0.06 | \* | 0.222 | -1.79 | 0.07 | \* |
| B\_VEHPPER\_SOV | 1.04 | 0.175 | 5.95 | 0.00 |  | 0.197 | 5.27 | 0.00 |  |
| B\_WALK\_TT | -0.0863 | 0.0103 | -8.40 | 0.00 |  | 0.00991 | -8.70 | 0.00 |  |

Adjusted rho-square: 0.474

Table – HBO Mode Choice Logit Model Estimation

| **Name** | **Value** | **Std err** | **t-test** | **p-value** |  | **Robust Std err** | **Robust t-test** | **p-value** |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ASC\_APAX | -2.23 | 0.262 | -8.52 | 0.00 |  | 0.276 | -8.07 | 0.00 |  |
| ASC\_DAT | -1.04 | 0.856 | -1.22 | 0.22 | \* | 0.677 | -1.54 | 0.12 | \* |
| ASC\_SOV | -1.31 | 0.210 | -6.22 | 0.00 |  | 0.204 | -6.42 | 0.00 |  |
| ASC\_WALK | 0.00 | fixed |  |  |  |  |  |  |  |
| ASC\_WAT | -0.851 | 0.387 | -2.20 | 0.03 |  | 0.431 | -1.97 | 0.05 |  |
| B\_APAX\_COST\_INC | -0.0228 | 0.0648 | -0.35 | 0.73 | \* | 0.0786 | -0.29 | 0.77 | \* |
| B\_CAP\_APAX | -0.889 | 0.234 | -3.80 | 0.00 |  | 0.239 | -3.72 | 0.00 |  |
| B\_CAP\_WAT | 1.91 | 0.204 | 9.38 | 0.00 |  | 0.199 | 9.62 | 0.00 |  |
| B\_DAT\_ACCEGG | -0.107 | 0.0244 | -4.40 | 0.00 |  | 0.0188 | -5.72 | 0.00 |  |
| B\_DDENSITY10K\_APAX | -0.227 | 0.0535 | -4.25 | 0.00 |  | 0.0517 | -4.40 | 0.00 |  |
| B\_DDENSITY10K\_PT | 0.212 | 0.0543 | 3.92 | 0.00 |  | 0.0536 | 3.97 | 0.00 |  |
| B\_DDENSITY10K\_SOV | -0.215 | 0.0508 | -4.24 | 0.00 |  | 0.0500 | -4.31 | 0.00 |  |
| B\_D\_CBD\_APAX | -0.700 | 0.126 | -5.54 | 0.00 |  | 0.129 | -5.41 | 0.00 |  |
| B\_D\_CBD\_SOV | -0.612 | 0.121 | -5.06 | 0.00 |  | 0.126 | -4.86 | 0.00 |  |
| B\_HHSIZ\_APAX | 0.173 | 0.0397 | 4.36 | 0.00 |  | 0.0446 | 3.88 | 0.00 |  |
| B\_HHVEH\_APAX | 0.533 | 0.0945 | 5.64 | 0.00 |  | 0.0998 | 5.34 | 0.00 |  |
| B\_HHVEH\_SOV | 0.400 | 0.0749 | 5.34 | 0.00 |  | 0.0787 | 5.09 | 0.00 |  |
| B\_PT\_FARES\_DIST | -1.18 | 0.150 | -7.87 | 0.00 |  | 0.165 | -7.16 | 0.00 |  |
| B\_PT\_IVTT\_DIST | -0.0913 | 0.0276 | -3.31 | 0.00 |  | 0.0310 | -2.94 | 0.00 |  |
| B\_PT\_IVTT\_DIST\_HIGHINC | -0.150 | 0.0390 | -3.84 | 0.00 |  | 0.0383 | -3.92 | 0.00 |  |
| B\_PT\_IVTT\_DIST\_MIDHIGHINC | -0.0691 | 0.0305 | -2.27 | 0.02 |  | 0.0306 | -2.26 | 0.02 |  |
| B\_PT\_IVTT\_DIST\_MIDLOWINC | -0.0478 | 0.0264 | -1.81 | 0.07 | \* | 0.0261 | -1.83 | 0.07 | \* |
| B\_PT\_WAITT | -0.0728 | 0.0163 | -4.47 | 0.00 |  | 0.0157 | -4.63 | 0.00 |  |
| B\_PT\_XFERWT | -0.0416 | 0.0179 | -2.32 | 0.02 |  | 0.0210 | -1.98 | 0.05 |  |
| B\_SOV\_COST\_INC | -0.114 | 0.0644 | -1.76 | 0.08 | \* | 0.0770 | -1.47 | 0.14 | \* |
| B\_TERM\_J\_SOV | -0.0562 | 0.0214 | -2.63 | 0.01 |  | 0.0217 | -2.58 | 0.01 |  |
| B\_VEHPPER\_APAX | -1.07 | 0.261 | -4.10 | 0.00 |  | 0.291 | -3.68 | 0.00 |  |
| B\_VEHPPER\_DAT | 1.06 | 0.475 | 2.22 | 0.03 |  | 0.392 | 2.69 | 0.01 |  |
| B\_VEHPPER\_SOV | 0.537 | 0.166 | 3.24 | 0.00 |  | 0.168 | 3.20 | 0.00 |  |
| B\_WALK\_TT | -0.0931 | 0.00482 | -19.30 | 0.00 |  | 0.00466 | -19.96 | 0.00 |  |
| B\_WAT\_WALKT | -0.0432 | 0.0104 | -4.15 | 0.00 |  | 0.0110 | -3.94 | 0.00 |  |

Adjusted rho-square: 0.441

Table – NHBW Mode Choice Logit Model Estimation

| **Name** | **Value** | **Std err** | **t-test** | **p-value** |  | **Robust Std err** | **Robust t-test** | **p-value** |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ASC\_APAX | -3.86 | 0.225 | -17.11 | 0.00 |  | 0.227 | -17.01 | 0.00 |  |
| ASC\_DAT | -2.06 | 0.794 | -2.59 | 0.01 |  | 0.729 | -2.82 | 0.00 |  |
| ASC\_SOV | -1.23 | 0.248 | -4.97 | 0.00 |  | 0.248 | -4.96 | 0.00 |  |
| ASC\_WALK | 0.00 | fixed |  |  |  |  |  |  |  |
| ASC\_WAT | -1.42 | 0.410 | -3.46 | 0.00 |  | 0.430 | -3.30 | 0.00 |  |
| B\_APAX\_COST\_INC | -0.417 | 0.147 | -2.84 | 0.00 |  | 0.162 | -2.58 | 0.01 |  |
| B\_DAT\_ACCEGG | -0.0941 | 0.0209 | -4.50 | 0.00 |  | 0.0205 | -4.59 | 0.00 |  |
| B\_DDENSITY10K\_APAX | -0.247 | 0.0638 | -3.87 | 0.00 |  | 0.0676 | -3.65 | 0.00 |  |
| B\_DDENSITY10K\_PT | 0.136 | 0.0425 | 3.19 | 0.00 |  | 0.0423 | 3.20 | 0.00 |  |
| B\_DDENSITY10K\_SOV | -0.0668 | 0.0404 | -1.65 | 0.10 | \* | 0.0411 | -1.62 | 0.10 | \* |
| B\_D\_CBD\_PT | 0.397 | 0.194 | 2.04 | 0.04 |  | 0.195 | 2.04 | 0.04 |  |
| B\_D\_CBD\_SOV | -0.542 | 0.143 | -3.79 | 0.00 |  | 0.142 | -3.83 | 0.00 |  |
| B\_ODENSITY10K\_APAX | -0.286 | 0.0589 | -4.87 | 0.00 |  | 0.0719 | -3.98 | 0.00 |  |
| B\_ODENSITY10K\_SOV | -0.176 | 0.0350 | -5.03 | 0.00 |  | 0.0488 | -3.61 | 0.00 |  |
| B\_PT\_FARES\_DIST | -1.02 | 0.141 | -7.23 | 0.00 |  | 0.161 | -6.33 | 0.00 |  |
| B\_PT\_IVTT\_DIST | -0.0864 | 0.0415 | -2.08 | 0.04 |  | 0.0546 | -1.58 | 0.11 | \* |
| B\_PT\_IVTT\_DIST\_HIGHINC | -0.166 | 0.0456 | -3.64 | 0.00 |  | 0.0515 | -3.22 | 0.00 |  |
| B\_PT\_IVTT\_DIST\_MIDHIGHINC | -0.0939 | 0.0422 | -2.23 | 0.03 |  | 0.0491 | -1.91 | 0.06 | \* |
| B\_PT\_IVTT\_DIST\_MIDLOWINC | -0.119 | 0.0446 | -2.66 | 0.01 |  | 0.0513 | -2.31 | 0.02 |  |
| B\_PT\_WAITT | -0.0702 | 0.0196 | -3.58 | 0.00 |  | 0.0171 | -4.11 | 0.00 |  |
| B\_PT\_XFERWT | -0.0256 | 0.0177 | -1.44 | 0.15 | \* | 0.0180 | -1.42 | 0.15 | \* |
| B\_SOV\_COST\_INC | -0.178 | 0.0917 | -1.94 | 0.05 | \* | 0.0653 | -2.73 | 0.01 |  |
| B\_TERM\_I\_SOV | -0.244 | 0.0571 | -4.28 | 0.00 |  | 0.0586 | -4.16 | 0.00 |  |
| B\_TERM\_J\_SOV | -0.163 | 0.0388 | -4.21 | 0.00 |  | 0.0393 | -4.16 | 0.00 |  |
| B\_VEHPWRK\_DAT | 0.742 | 0.292 | 2.54 | 0.01 |  | 0.229 | 3.25 | 0.00 |  |
| B\_VEHPWRK\_SOV | 0.704 | 0.0921 | 7.65 | 0.00 |  | 0.102 | 6.87 | 0.00 |  |
| B\_WALK\_TT | -0.139 | 0.00722 | -19.30 | 0.00 |  | 0.00725 | -19.22 | 0.00 |  |
| B\_WAT\_WALKT | -0.0687 | 0.0124 | -5.55 | 0.00 |  | 0.0122 | -5.64 | 0.00 |  |

Adjusted rho-square: 0.677

Table – NHBO Mode Choice Logit Model Estimation

| **Name** | **Value** | **Std err** | **t-test** | **p-value** |  | **Robust Std err** | **Robust t-test** | **p-value** |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ASC\_APAX | -0.733 | 0.257 | -2.86 | 0.00 |  | 0.252 | -2.91 | 0.00 |  |
| ASC\_DAT | -3.96 | 0.368 | -10.76 | 0.00 |  | 0.352 | -11.22 | 0.00 |  |
| ASC\_SOV | -0.0934 | 0.223 | -0.42 | 0.68 | \* | 0.214 | -0.44 | 0.66 | \* |
| ASC\_WALK | 0.00 | fixed |  |  |  |  |  |  |  |
| ASC\_WAT | -0.115 | 0.416 | -0.28 | 0.78 | \* | 0.697 | -0.17 | 0.87 | \* |
| B\_APAX\_COST\_INC | -0.0131 | 0.0746 | -0.18 | 0.86 | \* | 0.0937 | -0.14 | 0.89 | \* |
| B\_CAP\_APAX | -2.17 | 0.219 | -9.93 | 0.00 |  | 0.223 | -9.74 | 0.00 |  |
| B\_DDENSITY10K\_APAX | -0.295 | 0.0463 | -6.38 | 0.00 |  | 0.0460 | -6.42 | 0.00 |  |
| B\_DDENSITY10K\_SOV | -0.234 | 0.0407 | -5.76 | 0.00 |  | 0.0411 | -5.71 | 0.00 |  |
| B\_D\_CBD\_PT | 0.622 | 0.167 | 3.72 | 0.00 |  | 0.172 | 3.62 | 0.00 |  |
| B\_HHSIZ\_APAX | 0.275 | 0.0215 | 12.83 | 0.00 |  | 0.0216 | 12.75 | 0.00 |  |
| B\_ODENSITY10K\_APAX | -0.301 | 0.0447 | -6.75 | 0.00 |  | 0.0445 | -6.78 | 0.00 |  |
| B\_ODENSITY10K\_SOV | -0.278 | 0.0399 | -6.98 | 0.00 |  | 0.0399 | -6.97 | 0.00 |  |
| B\_PT\_FARES\_DIST | -0.847 | 0.129 | -6.54 | 0.00 |  | 0.253 | -3.34 | 0.00 |  |
| B\_PT\_IVTT\_DIST | -0.0583 | 0.0272 | -2.14 | 0.03 |  | 0.0328 | -1.78 | 0.08 | \* |
| B\_PT\_IVTT\_DIST\_HIGHINC | -0.127 | 0.0388 | -3.27 | 0.00 |  | 0.0381 | -3.33 | 0.00 |  |
| B\_PT\_IVTT\_DIST\_MIDHIGHINC | -0.134 | 0.0350 | -3.83 | 0.00 |  | 0.0334 | -4.01 | 0.00 |  |
| B\_PT\_IVTT\_DIST\_MIDLOWINC | -0.0945 | 0.0293 | -3.22 | 0.00 |  | 0.0268 | -3.53 | 0.00 |  |
| B\_PT\_WAITT | -0.0649 | 0.0210 | -3.09 | 0.00 |  | 0.0194 | -3.35 | 0.00 |  |
| B\_PT\_XFERWT | -0.0306 | 0.0196 | -1.56 | 0.12 | \* | 0.0218 | -1.40 | 0.16 | \* |
| B\_SOV\_COST\_INC | -0.0502 | 0.0746 | -0.67 | 0.50 | \* | 0.0943 | -0.53 | 0.59 | \* |
| B\_TERM\_J\_APAX | -0.183 | 0.0376 | -4.87 | 0.00 |  | 0.0379 | -4.84 | 0.00 |  |
| B\_TERM\_J\_SOV | -0.206 | 0.0361 | -5.71 | 0.00 |  | 0.0360 | -5.72 | 0.00 |  |
| B\_VEHPPER\_APAX | -0.757 | 0.189 | -4.00 | 0.00 |  | 0.197 | -3.85 | 0.00 |  |
| B\_VEHPPER\_SOV | 0.853 | 0.168 | 5.09 | 0.00 |  | 0.169 | 5.05 | 0.00 |  |
| B\_VEHPPER\_WAT | -1.13 | 0.246 | -4.57 | 0.00 |  | 0.289 | -3.90 | 0.00 |  |
| B\_WALK\_TT | -0.0978 | 0.00546 | -17.89 | 0.00 |  | 0.00510 | -19.16 | 0.00 |  |
| B\_WAT\_WALKT | -0.0643 | 0.0124 | -5.20 | 0.00 |  | 0.0157 | -4.09 | 0.00 |  |

Adjusted rho-square: 0.450

Table – Value of Time by Household Income Groups in 2010

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Income groups | Low | Mid-Low | Mid-High | High |
| HBW | 8.2 | 9.1 | 11.6 | 12.3 |
| HBSHOP | NA | NA | NA | NA |
| HBO | 4.6 | 7.1 | 8.2 | 12.3 |
| NHBW | 5.1 | 12.1 | 10.6 | 14.8 |
| NHBO | 4.1 | 10.8 | 13.6 | 13.1 |

## 1990 model estimation

Table – HBW Mode Choice Model Estimation for 1990

| **Name** | **Value** | **Std err** | **t-test** | **p-value** |  | **Robust Std err** | **Robust t-test** | **p-value** |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ASC\_APAX | -0.979 | 0.341 | -2.87 | 0.00 |  | 0.331 | -2.96 | 0.00 |  |
| ASC\_DAT | -3.50 | 0.832 | -4.20 | 0.00 |  | 0.816 | -4.28 | 0.00 |  |
| ASC\_SOV | 0.369 | 0.330 | 1.12 | 0.26 | \* | 0.326 | 1.13 | 0.26 | \* |
| ASC\_WALK | 0.00 | fixed |  |  |  |  |  |  |  |
| ASC\_WAT | 1.48 | 0.502 | 2.94 | 0.00 |  | 0.522 | 2.83 | 0.00 |  |
| B\_APAX\_COST\_INC | -0.0615 | 0.183 | -0.34 | 0.74 | \* | 0.178 | -0.35 | 0.73 | \* |
| B\_CAP\_APAX | -2.72 | 0.465 | -5.86 | 0.00 |  | 0.505 | -5.40 | 0.00 |  |
| B\_CAP\_SOV | -2.73 | 0.414 | -6.59 | 0.00 |  | 0.375 | -7.28 | 0.00 |  |
| B\_D\_CBD\_DAT | 2.58 | 0.734 | 3.51 | 0.00 |  | 0.739 | 3.49 | 0.00 |  |
| B\_D\_JOBDEN10K\_APAX | -0.0574 | 0.0109 | -5.24 | 0.00 |  | 0.0120 | -4.79 | 0.00 |  |
| B\_D\_JOBDEN10K\_SOV | -0.0893 | 0.00822 | -10.86 | 0.00 |  | 0.00985 | -9.07 | 0.00 |  |
| B\_D\_POPDEN10K\_SOV | -0.188 | 0.0452 | -4.17 | 0.00 |  | 0.0449 | -4.20 | 0.00 |  |
| B\_HHSIZ\_APAX | 0.0755 | 0.0353 | 2.14 | 0.03 |  | 0.0329 | 2.29 | 0.02 |  |
| B\_O\_CBD\_SOV | -0.551 | 0.182 | -3.03 | 0.00 |  | 0.167 | -3.30 | 0.00 |  |
| B\_PT\_FARES\_DIST | -1.40 | 0.193 | -7.26 | 0.00 |  | 0.205 | -6.85 | 0.00 |  |
| B\_PT\_IVTT\_DIST | -0.144 | 0.0330 | -4.36 | 0.00 |  | 0.0360 | -4.00 | 0.00 |  |
| B\_PT\_IVTT\_DIST\_HIGHINC | -0.0507 | 0.0416 | -1.22 | 0.22 | \* | 0.0410 | -1.24 | 0.22 | \* |
| B\_PT\_IVTT\_DIST\_MIDHIGHINC | 0.00461 | 0.0270 | 0.17 | 0.86 | \* | 0.0267 | 0.17 | 0.86 | \* |
| B\_PT\_WAITT | -0.0365 | 0.0189 | -1.93 | 0.05 | \* | 0.0175 | -2.09 | 0.04 |  |
| B\_PT\_XFERWT | -0.0941 | 0.0220 | -4.27 | 0.00 |  | 0.0223 | -4.22 | 0.00 |  |
| B\_SOV\_COST\_INC | -0.242 | 0.176 | -1.38 | 0.17 | \* | 0.170 | -1.42 | 0.16 | \* |
| B\_TERMJ\_APAX | -0.260 | 0.0586 | -4.43 | 0.00 |  | 0.0592 | -4.39 | 0.00 |  |
| B\_TERMJ\_SOV | -0.223 | 0.0693 | -3.22 | 0.00 |  | 0.0648 | -3.44 | 0.00 |  |
| B\_VEHPWRK\_DAT | 0.732 | 0.298 | 2.45 | 0.01 |  | 0.303 | 2.41 | 0.02 |  |
| B\_VEHPWRK\_SOV | 1.17 | 0.116 | 10.08 | 0.00 |  | 0.139 | 8.40 | 0.00 |  |
| B\_WALK\_TT | -0.0526 | 0.00616 | -8.54 | 0.00 |  | 0.00593 | -8.86 | 0.00 |  |
| B\_WAT\_WALKT | -0.0491 | 0.0189 | -2.59 | 0.01 |  | 0.0203 | -2.42 | 0.02 |  |

Table – HBSHOP Mode Choice Model Estimation for 1990

| **Name** | **Value** | **Std err** | **t-test** | **p-value** |  | **Robust Std err** | **Robust t-test** | **p-value** |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ASC\_APAX | 0.166 | 0.333 | 0.50 | 0.62 | \* | 0.332 | 0.50 | 0.62 | \* |
| ASC\_DAT | -3.13 | 0.853 | -3.66 | 0.00 |  | 1.01 | -3.09 | 0.00 |  |
| ASC\_SOV | -0.555 | 0.331 | -1.68 | 0.09 | \* | 0.350 | -1.59 | 0.11 | \* |
| ASC\_WALK | 0.00 | fixed |  |  |  |  |  |  |  |
| ASC\_WAT | -1.92 | 0.439 | -4.38 | 0.00 |  | 0.431 | -4.46 | 0.00 |  |
| B\_APAX\_COST\_INC | -0.350 | 0.261 | -1.34 | 0.18 | \* | 0.184 | -1.90 | 0.06 | \* |
| B\_CAP\_APAX | -1.41 | 0.330 | -4.28 | 0.00 |  | 0.318 | -4.43 | 0.00 |  |
| B\_CAP\_SOV | -1.88 | 0.515 | -3.66 | 0.00 |  | 0.466 | -4.05 | 0.00 |  |
| B\_CAP\_WAT | 0.596 | 0.314 | 1.90 | 0.06 | \* | 0.299 | 1.99 | 0.05 |  |
| B\_DDENSITY10K\_APAX | -0.413 | 0.101 | -4.07 | 0.00 |  | 0.0922 | -4.48 | 0.00 |  |
| B\_DDENSITY10K\_SOV | -0.417 | 0.100 | -4.16 | 0.00 |  | 0.0956 | -4.36 | 0.00 |  |
| B\_HHSIZ\_APAX | 0.0774 | 0.0364 | 2.12 | 0.03 |  | 0.0366 | 2.11 | 0.03 |  |
| B\_ODENSITY10K\_APAX | -0.616 | 0.104 | -5.90 | 0.00 |  | 0.105 | -5.89 | 0.00 |  |
| B\_ODENSITY10K\_SOV | -0.522 | 0.102 | -5.10 | 0.00 |  | 0.107 | -4.87 | 0.00 |  |
| B\_PT\_FARES\_DIST | -0.571 | 0.208 | -2.75 | 0.01 |  | 0.236 | -2.42 | 0.02 |  |
| B\_PT\_WAITT | -0.0461 | 0.0473 | -0.97 | 0.33 | \* | 0.0491 | -0.94 | 0.35 | \* |
| B\_PT\_XFERWT | -0.0812 | 0.0412 | -1.97 | 0.05 |  | 0.0393 | -2.07 | 0.04 |  |
| B\_SOV\_COST\_INC | -0.938 | 0.272 | -3.45 | 0.00 |  | 0.200 | -4.70 | 0.00 |  |
| B\_VEHPPER\_SOV | 1.89 | 0.176 | 10.73 | 0.00 |  | 0.198 | 9.52 | 0.00 |  |
| B\_WALK\_TT | -0.0728 | 0.00848 | -8.58 | 0.00 |  | 0.00851 | -8.55 | 0.00 |  |

Table – HBO Mode Choice Model Estimation for 1990

| **Name** | **Value** | **Std err** | **t-test** | **p-value** |  | **Robust Std err** | **Robust t-test** | **p-value** |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ASC\_APAX | -0.329 | 0.216 | -1.52 | 0.13 | \* | 0.220 | -1.50 | 0.13 | \* |
| ASC\_DAT | -3.92 | 0.719 | -5.46 | 0.00 |  | 0.566 | -6.93 | 0.00 |  |
| ASC\_SOV | -0.730 | 0.208 | -3.51 | 0.00 |  | 0.221 | -3.30 | 0.00 |  |
| ASC\_WALK | 0.00 | fixed |  |  |  |  |  |  |  |
| ASC\_WAT | 0.680 | 0.543 | 1.25 | 0.21 | \* | 0.609 | 1.12 | 0.26 | \* |
| B\_APAX\_COST\_INC | -0.121 | 0.133 | -0.91 | 0.36 | \* | 0.136 | -0.89 | 0.37 | \* |
| B\_APAX\_TT | -0.0398 | 0.0198 | -2.01 | 0.04 |  | 0.0214 | -1.86 | 0.06 | \* |
| B\_CAP\_APAX | -1.06 | 0.214 | -4.95 | 0.00 |  | 0.223 | -4.75 | 0.00 |  |
| B\_CAP\_SOV | -1.48 | 0.290 | -5.10 | 0.00 |  | 0.291 | -5.08 | 0.00 |  |
| B\_CAP\_WAT | 0.809 | 0.207 | 3.90 | 0.00 |  | 0.203 | 3.98 | 0.00 |  |
| B\_DDENSITY10K\_APAX | -0.274 | 0.0501 | -5.47 | 0.00 |  | 0.0488 | -5.61 | 0.00 |  |
| B\_DDENSITY10K\_SOV | -0.278 | 0.0529 | -5.25 | 0.00 |  | 0.0513 | -5.41 | 0.00 |  |
| B\_D\_CBD\_APAX | -0.129 | 0.141 | -0.92 | 0.36 | \* | 0.133 | -0.97 | 0.33 | \* |
| B\_D\_CBD\_SOV | -0.257 | 0.149 | -1.73 | 0.08 | \* | 0.144 | -1.78 | 0.08 | \* |
| B\_HHSIZ\_APAX | 0.176 | 0.0297 | 5.92 | 0.00 |  | 0.0335 | 5.24 | 0.00 |  |
| B\_HHVEH\_APAX | 0.252 | 0.0768 | 3.28 | 0.00 |  | 0.0888 | 2.84 | 0.00 |  |
| B\_HHVEH\_SOV | 0.156 | 0.0778 | 2.00 | 0.05 |  | 0.0855 | 1.82 | 0.07 | \* |
| B\_ODENSITY10K\_APAX | -0.257 | 0.0476 | -5.39 | 0.00 |  | 0.0466 | -5.51 | 0.00 |  |
| B\_ODENSITY10K\_SOV | -0.274 | 0.0498 | -5.51 | 0.00 |  | 0.0470 | -5.84 | 0.00 |  |
| B\_PT\_FARES\_DIST | -0.965 | 0.168 | -5.74 | 0.00 |  | 0.204 | -4.73 | 0.00 |  |
| B\_PT\_IVTT\_DIST | -0.128 | 0.0358 | -3.59 | 0.00 |  | 0.0366 | -3.51 | 0.00 |  |
| B\_PT\_IVTT\_DIST\_HIGHINC | -0.0814 | 0.0539 | -1.51 | 0.13 | \* | 0.0455 | -1.79 | 0.07 | \* |
| B\_PT\_IVTT\_DIST\_MIDHIGHINC | -0.115 | 0.0346 | -3.31 | 0.00 |  | 0.0353 | -3.24 | 0.00 |  |
| B\_PT\_WAITT | -0.0406 | 0.0260 | -1.56 | 0.12 | \* | 0.0215 | -1.89 | 0.06 | \* |
| B\_PT\_XFERWT | -0.102 | 0.0320 | -3.18 | 0.00 |  | 0.0300 | -3.39 | 0.00 |  |
| B\_SOV\_COST\_INC | -0.260 | 0.135 | -1.93 | 0.05 | \* | 0.134 | -1.94 | 0.05 | \* |
| B\_SOV\_TT | -0.0378 | 0.0198 | -1.91 | 0.06 | \* | 0.0214 | -1.76 | 0.08 | \* |
| B\_VEHPPER\_DAT | 1.93 | 0.635 | 3.04 | 0.00 |  | 0.458 | 4.21 | 0.00 |  |
| B\_VEHPPER\_SOV | 1.52 | 0.140 | 10.84 | 0.00 |  | 0.177 | 8.60 | 0.00 |  |
| B\_WALK\_TT | -0.0544 | 0.00449 | -12.11 | 0.00 |  | 0.00485 | -11.22 | 0.00 |  |
| B\_WAT\_WALKT | -0.0779 | 0.0213 | -3.65 | 0.00 |  | 0.0213 | -3.66 | 0.00 |  |

Table – NHBW Mode Choice Model Estimation for 1990

| **Name** | **Value** | **Std err** | **t-test** | **p-value** |  | **Robust Std err** | **Robust t-test** | **p-value** |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ASC\_APAX | -1.70 | 0.262 | -6.50 | 0.00 |  | 0.260 | -6.55 | 0.00 |  |
| ASC\_DAT | -4.19 | 0.587 | -7.15 | 0.00 |  | 0.479 | -8.76 | 0.00 |  |
| ASC\_SOV | -0.765 | 0.248 | -3.09 | 0.00 |  | 0.243 | -3.14 | 0.00 |  |
| ASC\_WALK | 0.00 | fixed |  |  |  |  |  |  |  |
| ASC\_WAT | -1.29 | 0.575 | -2.25 | 0.02 |  | 0.575 | -2.25 | 0.02 |  |
| B\_APAX\_TT | -0.0431 | 0.0197 | -2.19 | 0.03 |  | 0.0178 | -2.42 | 0.02 |  |
| B\_CAP\_APAX | -1.43 | 0.333 | -4.30 | 0.00 |  | 0.331 | -4.32 | 0.00 |  |
| B\_CAP\_SOV | -2.34 | 0.356 | -6.57 | 0.00 |  | 0.381 | -6.14 | 0.00 |  |
| B\_DDENSITY10K\_APAX | -0.263 | 0.0611 | -4.31 | 0.00 |  | 0.0606 | -4.34 | 0.00 |  |
| B\_DDENSITY10K\_SOV | -0.312 | 0.0558 | -5.60 | 0.00 |  | 0.0535 | -5.83 | 0.00 |  |
| B\_D\_CBD\_PT | 0.836 | 0.259 | 3.22 | 0.00 |  | 0.248 | 3.38 | 0.00 |  |
| B\_D\_CBD\_SOV | -0.176 | 0.127 | -1.39 | 0.16 | \* | 0.130 | -1.36 | 0.18 | \* |
| B\_ODENSITY10K\_APAX | -0.199 | 0.0646 | -3.08 | 0.00 |  | 0.0657 | -3.03 | 0.00 |  |
| B\_ODENSITY10K\_SOV | -0.270 | 0.0570 | -4.73 | 0.00 |  | 0.0548 | -4.92 | 0.00 |  |
| B\_O\_CBD\_APAX | -0.736 | 0.182 | -4.05 | 0.00 |  | 0.183 | -4.02 | 0.00 |  |
| B\_O\_CBD\_SOV | -0.817 | 0.166 | -4.91 | 0.00 |  | 0.170 | -4.80 | 0.00 |  |
| B\_PT\_FARES\_DIST | -1.01 | 0.187 | -5.38 | 0.00 |  | 0.187 | -5.39 | 0.00 |  |
| B\_PT\_IVTT\_DIST | -0.113 | 0.0427 | -2.65 | 0.01 |  | 0.0444 | -2.55 | 0.01 |  |
| B\_PT\_IVTT\_DIST\_HIGHINC | -0.0371 | 0.0422 | -0.88 | 0.38 | \* | 0.0394 | -0.94 | 0.35 | \* |
| B\_PT\_IVTT\_DIST\_MIDHIGHINC | -0.0665 | 0.0359 | -1.85 | 0.06 | \* | 0.0364 | -1.83 | 0.07 | \* |
| B\_PT\_WAITT | -0.0452 | 0.0369 | -1.22 | 0.22 | \* | 0.0474 | -0.95 | 0.34 | \* |
| B\_PT\_XFERWT | -0.0582 | 0.0314 | -1.85 | 0.06 | \* | 0.0327 | -1.78 | 0.08 | \* |
| B\_SOV\_TT | -0.0329 | 0.0195 | -1.69 | 0.09 | \* | 0.0175 | -1.88 | 0.06 | \* |
| B\_VEHPWRK\_APAX | 0.0140 | 0.141 | 0.10 | 0.92 | \* | 0.148 | 0.09 | 0.92 | \* |
| B\_VEHPWRK\_SOV | 0.303 | 0.127 | 2.38 | 0.02 |  | 0.129 | 2.34 | 0.02 |  |
| B\_WALK\_TT | -0.101 | 0.00638 | -15.83 | 0.00 |  | 0.00706 | -14.31 | 0.00 |  |
| B\_WAT\_WALKT | -0.0990 | 0.0225 | -4.40 | 0.00 |  | 0.0228 | -4.34 | 0.00 |  |

Table – NHBO Mode Choice Model Estimation for 1990

| **Name** | **Value** | **Std err** | **t-test** | **p-value** |  | **Robust Std err** | **Robust t-test** | **p-value** |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ASC\_APAX | -0.815 | 0.354 | -2.30 | 0.02 |  | 0.345 | -2.36 | 0.02 |  |
| ASC\_DAT | -2.91 | 0.661 | -4.40 | 0.00 |  | 0.708 | -4.11 | 0.00 |  |
| ASC\_SOV | -0.836 | 0.320 | -2.61 | 0.01 |  | 0.303 | -2.75 | 0.01 |  |
| ASC\_WALK | 0.00 | fixed |  |  |  |  |  |  |  |
| ASC\_WAT | -0.492 | 0.658 | -0.75 | 0.45 | \* | 0.880 | -0.56 | 0.58 | \* |
| B\_APAX\_COST\_INC | -0.0590 | 0.183 | -0.32 | 0.75 | \* | 0.143 | -0.41 | 0.68 | \* |
| B\_APAX\_TT | -0.0474 | 0.0273 | -1.74 | 0.08 | \* | 0.0274 | -1.73 | 0.08 | \* |
| B\_CAP\_APAX | -1.82 | 0.310 | -5.87 | 0.00 |  | 0.302 | -6.03 | 0.00 |  |
| B\_CAP\_SOV | -1.95 | 0.356 | -5.49 | 0.00 |  | 0.344 | -5.67 | 0.00 |  |
| B\_DDENSITY10K\_APAX | -0.268 | 0.0720 | -3.72 | 0.00 |  | 0.0734 | -3.66 | 0.00 |  |
| B\_DDENSITY10K\_SOV | -0.265 | 0.0761 | -3.48 | 0.00 |  | 0.0763 | -3.47 | 0.00 |  |
| B\_D\_CBD\_APAX | -0.819 | 0.224 | -3.65 | 0.00 |  | 0.210 | -3.89 | 0.00 |  |
| B\_D\_CBD\_PT | 0.267 | 0.282 | 0.95 | 0.34 | \* | 0.267 | 1.00 | 0.32 | \* |
| B\_D\_CBD\_SOV | -0.656 | 0.234 | -2.80 | 0.01 |  | 0.219 | -2.99 | 0.00 |  |
| B\_HHSIZ\_APAX | 0.219 | 0.0313 | 6.99 | 0.00 |  | 0.0330 | 6.64 | 0.00 |  |
| B\_ODENSITY10K\_APAX | -0.188 | 0.0780 | -2.41 | 0.02 |  | 0.0785 | -2.40 | 0.02 |  |
| B\_ODENSITY10K\_SOV | -0.269 | 0.0833 | -3.23 | 0.00 |  | 0.0807 | -3.34 | 0.00 |  |
| B\_PT\_FARES\_DIST | -0.549 | 0.165 | -3.33 | 0.00 |  | 0.327 | -1.68 | 0.09 | \* |
| B\_PT\_IVTT\_DIST | -0.0474 | 0.0410 | -1.16 | 0.25 | \* | 0.0353 | -1.34 | 0.18 | \* |
| B\_PT\_IVTT\_DIST\_HIGHINC | -0.0842 | 0.0621 | -1.36 | 0.18 | \* | 0.0716 | -1.18 | 0.24 | \* |
| B\_PT\_IVTT\_DIST\_MIDHIGHINC | -0.0746 | 0.0372 | -2.00 | 0.05 |  | 0.0380 | -1.97 | 0.05 |  |
| B\_PT\_WAITT | -0.121 | 0.0440 | -2.76 | 0.01 |  | 0.0405 | -2.99 | 0.00 |  |
| B\_PT\_XFERWT | -0.103 | 0.0452 | -2.28 | 0.02 |  | 0.0441 | -2.34 | 0.02 |  |
| B\_SOV\_COST\_INC | -0.290 | 0.191 | -1.52 | 0.13 | \* | 0.154 | -1.88 | 0.06 | \* |
| B\_SOV\_TT | -0.0480 | 0.0274 | -1.75 | 0.08 | \* | 0.0274 | -1.75 | 0.08 | \* |
| B\_TERM\_J\_APAX | -0.0758 | 0.0760 | -1.00 | 0.32 | \* | 0.0739 | -1.03 | 0.31 | \* |
| B\_TERM\_J\_SOV | -0.109 | 0.0795 | -1.37 | 0.17 | \* | 0.0757 | -1.44 | 0.15 | \* |
| B\_VEHPPER\_APAX | 0.268 | 0.244 | 1.10 | 0.27 | \* | 0.247 | 1.09 | 0.28 | \* |
| B\_VEHPPER\_SOV | 1.18 | 0.231 | 5.11 | 0.00 |  | 0.228 | 5.16 | 0.00 |  |
| B\_VEHPPER\_WAT | -0.359 | 0.291 | -1.24 | 0.22 | \* | 0.280 | -1.28 | 0.20 | \* |
| B\_WALK\_TT | -0.0863 | 0.00714 | -12.09 | 0.00 |  | 0.00773 | -11.16 | 0.00 |  |
| B\_WAT\_WALKT | -0.0753 | 0.0248 | -3.03 | 0.00 |  | 0.0292 | -2.58 | 0.01 |  |

Table – Estimated Values of Time for 1990

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Income groups | HBW | HBO | NHBW | NHBO |
| Low & Middle income | 6.17 | 7.95 | 6.71 | 5.18 |
| Mid-High income | 5.97 | 15.11 | 10.67 | 13.33 |
| High income | 8.34 | 13.02 | 8.92 | 14.38 |

**References**

Han, Y. (2015) Temporal transferability assessments of vehicle ownership models and trip generation models for Boston Metropolitan Area. Thesis, MST & MCP, Massachusetts Institute of Technology, Department of Urban Studies and Planning, June.