APPENDIX C UNCERTAINTY PROPAGATION IN BOSTON FOUR-STEP TRANSPORT MODEL

Appendix C presents how uncertainty (model and behavior) propagates through the four-step model developed for Boston Metropolitan Area. We first define the uncertainty type and scenarios for a sub-model, and then run the full four-step model iterations to convergence. We evaluate the impact of uncertainty from one model on its subsequent steps, including the final impact on traffic and transit assignment.

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# Uncertainty in Vehicle Ownership Model

## Uncertainty Scenarios

We specified 5 scenarios for vehicle ownership model (Table 1–1).

Table 1–1 Uncertainty Scenarios for Vehicle Ownership Model

|  |  |  |
| --- | --- | --- |
|  | Source of Uncertainty | Descriptions |
| SC\_base | Baseline |  |
| SC\_high0 | Sampling uncertainty | Parameters that generate 95-percentile 0-veh share |
| SC\_low0 | Sampling uncertainty | Parameters that generate 5-percentile 0-veh share |
| SC\_noBE | Model uncertainty | No built environment variables |
| SC\_90to10 | Behavior uncertainty | 1990 model parameters applied to 2010 population |

The base-line model applies the VO model estimated from the 2010 Massachusetts Travel Survey (MTS). Its model structure is logit. Its utility specification includes socio-demographic, transit accessibility, and built environment variables. When applied to the four-step model, the expected values of the coefficients are used.

Variations in *model specification* is a source of model uncertainty. We consider 7 specifications, and selected two scenarios, *SC\_base* and *SC\_noBE*, for uncertainty propagation analysis in the four-step model. Compared to SC\_base, SC\_noBE does not have built environment (BE) variables: the accessibility ratio (transit accessibility/auto accessibility), distance to CBD, the squared distance to CBD, log of population density, and log of job-to-worker ratio in a TAZ. We compare the two scenarios to assess the uncertainty in outputs due to omitting BE variables.

Model estimation inherently has sampling uncertainty, since the parameters are estimated based on sample data. We first run 1000 simulations for VO model only, by randomly sampling from the joint distribution of the model parameters. Then we select out the critical scenarios – the sets of parameters that produce the 5 percentile and 95 percentile of the 1000 simulated outputs. We choose the predicted 0-vehicle households as the criteria for parameter selection, because the 0-vehicle households are the most uncertain (with the highest coefficient of variation (CV)) (Table 1–2).

The impact of behavior uncertainty is assessed through transferring the 1990 VO parameters to the VO model in the 2010 four-step model. This scenario is called SC\_90to10. It represents the circumstance when we do not know how people’s vehicle ownership preferences evolve over time, and make forecast for 20 years later.

Table 1–2 Summary of 1000 VO Simulations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Predicted households by vehicles | Mean | S.D. | CV | Confidence Interval | | 2010 CTPP[[1]](#footnote-1) |
| V0 | 202,332 | 8,907 | **0.044** | 184,776 | 219,638 | 226,034 |
| V1 | 555,393 | 11,338 | 0.020 | 532,626 | 576,818 | 594,736 |
| V2 | 628,757 | 9,123 | 0.015 | 610,469 | 646,301 | 619,171 |
| V3 | 295,556 | 6,822 | 0.023 | 282,281 | 309,478 | 242,097 |

Table 1–3 Percentiles of Predicted 0-vehicle Households from 1000 Simulations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Percentile | 5% | 25% | 50% | 75% | 95% |
| Predicted 0-veh HH | 187,471 | 196,427 | 202,487 | 208,415 | 216,476 |
| Relative to median | 0.93 | 0.97 | 1.00 | 1.03 | 1.07 |
| Simulation No[[2]](#footnote-2).(1-1000) | 314 | 508 | 24 | 772 | 437 |

## Propagation of Uncertainty from Vehicle Ownership Model

We run each of the scenarios specified above throughout the Boston four-step model, and compare their outputs for each stage of the four-step model. We find that among the five scenarios, behavior uncertainty (SC\_90to10) causes the largest discrepancy in VO forecast. Applying the 1990 model parameters to 2010, 0-vehicle and 3-vehicle households are under-predicted; while 1-vehicle and 2-vehicle households are greatly over-predicted.

We can see among the five scenarios (Table 1–4), behavior uncertainty (SC\_90to10) causes the largest discrepancy in VO forecast. Applying the 1990 model parameters to 2010, 0-vehicle and 3-vehicle households are under-predicted; while 1-vehicle and 2-vehicle households are greatly over-predicted.

Table 1–4 Summary of Vehicle Ownership Prediction by the 5 Scenarios

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | SC\_base |  | SC\_low0 |  | SC\_high0 |  | SC\_noBE |  | SC\_90to10 | |
|  | Counts | % | Counts | % | Counts | % | Counts | % | Counts | % |
| 0-veh | 201957 | 12.0 | 187471 | 11.1 | 216475 | 12.9 | 198397 | 11.8 | 129925 | 7.7 |
| 1-veh | 555660 | 33.0 | 572046 | 34.0 | 554974 | 33.0 | 556206 | 33.1 | 617208 | 36.7 |
| 2-veh | 629302 | 37.4 | 628124 | 37.3 | 617001 | 36.7 | 629341 | 37.4 | 711025 | 42.3 |
| 3-veh | 295663 | 17.6 | 294942 | 17.5 | 294131 | 17.5 | 298637 | 17.7 | 224424 | 13.3 |
| Total | 1682584 | 100.0 | 1682584 | 100 | 1682584 | 100 | 1682584 | 100 | 1682584 | 100 |

## Impact on Trip Generation

All persons are divided into Choice and Captive group based on the vehicle ownership status of their households. If a household has no car, all members of that household are Captive traveler; otherwise, they are Choice riders.

Home-based-work (HBW) trip generation is based on individual worker’s HBW trip rates. Since uncertainty in VO models affect the predicted share of 0-vehicle households, it also influences the number of trips by choice (P\_HBW\_CHO) vs. by captive workers (P\_HBW\_CAP), though the total HBW trips are constant given the same total number of workers. We observe that sampling uncertainty causes -15.7% to 11.2% discrepancy from the baseline, in terms of the predicted HBW trips for captives. Behavior uncertainty causes 32% underestimation of HBW trips for captives (Table 1–5).

Table 1–5 HBW Trip Production Results of 5 VO scenarios.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **SC\_Base** | **SC\_low0** | **Diff** | **SC\_high0** | **Diff** | **SC\_noBE** | **Diff** | **SC\_90to10** | **Diff** |
| ***P\_HBW\_CHO*** | | | | | | | | | |
| Earn1 | 679,033 | 686,888 | 1.2% | 672,077 | -1.0% | 682,480 | 0.5% | 696,431 | 2.6% |
| Earn2 | 746,677 | 752,077 | 0.7% | 742,574 | -0.5% | 749,300 | 0.4% | 758,447 | 1.6% |
| Earn3 | 552,362 | 555,933 | 0.6% | 550,771 | -0.3% | 553,375 | 0.2% | 558,355 | 1.1% |
| Earn4 | 285,020 | 286,913 | 0.7% | 284,005 | -0.4% | 285,129 | 0.0% | 288,259 | 1.1% |
| Earn5 | 291,738 | 293,383 | 0.6% | 290,790 | -0.3% | 291,757 | 0.0% | 294,884 | 1.1% |
| Total | 2,554,830 | 2,575,194 | 0.8% | 2,540,217 | -0.6% | 2,562,041 | 0.3% | 2,596,376 | 1.6% |
| ***P\_HBW\_CAP*** |  |  |  |  |  |  |  |  |  |
| Earn1 | 61,423 | 53,568 | -12.8% | 68,378 | 11.3% | 57,976 | -5.6% | 44,024 | -28.3% |
| Earn2 | 38,349 | 32,949 | -14.1% | 42,452 | 10.7% | 35,726 | -6.8% | 26,579 | -30.7% |
| Earn3 | 17,613 | 14,042 | -20.3% | 19,203 | 9.0% | 16,600 | -5.8% | 11,620 | -34.0% |
| Earn4 | 6,821 | 4,928 | -27.8% | 7,836 | *14.9%* | 6,712 | -1.6% | 3,582 | *-47.5%* |
| Earn5 | 5,689 | 4,045 | -28.9% | 6,638 | *16.7%* | 5,671 | -0.3% | 2,544 | *-55.3%* |
| Total | 129,895 | 109,531 | -15.7% | 144,508 | 11.2% | 122,684 | -5.6% | 88,349 | -32.0% |
| **P\_HBW**  **Total** | 2,684,725 | 2,684,725 |  | 2,684,725 |  | 2,684,725 |  | 2,684,725 |  |

For other trip purposes, the impact of VO uncertainty on trip generation step is trivial, because trip generation for non-HBW trips is based on the trip rates for 56 household types, which is independent from household vehicle ownership.

Table 1–6 Trip Production Results of 5 VO scenarios for Other Trip Purposes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | SC\_base | SC\_lowV0 | SC\_highV0 | SC\_noBE | SC\_90to10 |
| HBSC | 938,961 | 938,798 | 942,636 | 934,057 | 931,403 |
| HBPUDO | 1,352,788 | 1,354,237 | 1,351,472 | 1,350,174 | 1,392,008 |
| HBSH | 1,475,053 | 1,476,584 | 1,472,096 | 1,477,776 | 1,470,599 |
| HBBPB | 1,485,402 | 1,489,046 | 1,484,374 | 1,485,280 | 1,461,439 |
| HBSO | 765,194 | 766,956 | 763,640 | 765,680 | 768,106 |
| HBEAT | 583,788 | 585,022 | 582,505 | 584,927 | 581,651 |
| HBREC | 1,155,633 | 1,154,799 | 1,153,321 | 1,155,619 | 1,169,567 |
| HBO | 72,793 | 72,977 | 72,559 | 72,619 | 72,589 |
| HBOA | 4,062,810 | 4,068,800 | 4,056,399 | 4,064,125 | 4,053,352 |
| NHBW | 1,422,591 | 1,423,115 | 1,420,851 | 1,424,106 | 1,433,885 |
| NHBO | 2,526,583 | 2,533,052 | 2,518,661 | 2,526,690 | 2,534,373 |

## Impact on Mode Choice

Table 1–7 shows the predicted HBW mode shares for the 5 VO scenarios. There are two key observations. First, the mode split results for non-work trip purposes (HBSHOP, HBO, NHBO) are more sensitive to the uncertainty in VO step. This is probably because the relationship between mode choice and vehicle ownership is stronger for non-work trip purposes than that for work-related trip purposes.

Secondly, behavior uncertainty in VO model produces the largest discrepancy from the baseline at the mode choice stage. SC\_90to10 persistently over-predicts trips by SOV, APAX, and DAT; and under-estimates trips by WAT and WALK. This is consistent with the fact that SC\_90to10 under-predicts 0-vehicle households and over-predicts 2-vehicle households.

Table 1–7 Predicted Mode Shares of HBW Trips for 5 VO Scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | SC\_base | SC\_lowV0 | SC\_highV0 | SC\_noBE | SC\_90to10 |
| SOV | 1,993,685 | 2,001,361 | 1,982,830 | 2,000,503 | 2,024,354 |
| APAX | 117,980 | 118,371 | 118,580 | 120,157 | 122,395 |
| WAT | 216,298 | 218,376 | 218,787 | 210,898 | 210,943 |
| DAT | 117,049 | 117,530 | 117,240 | 118,026 | 118,468 |
| WALK | 239,711 | 229,085 | 247,286 | 235,138 | 208,562 |
| Total | 2,684,723 | 2,684,723 | 2,684,723 | 2,684,722 | 2,684,722 |
| *Compared to base* | |  |  |  |  |
| SOV | -- | 0.4% | -0.5% | 0.3% | 1.5% |
| APAX | -- | 0.3% | 0.5% | 1.8% | 3.7% |
| WAT | -- | 1.0% | 1.2% | -2.5% | -2.5% |
| DAT | -- | 0.4% | 0.2% | 0.8% | 1.2% |
| WALK | -- | -4.4% | 3.2% | -1.9% | -13.0% |

Table 1–8 Predicted Mode Shares of HBSHOP Trips for 5 VO Scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | SC\_base | SC\_lowV0 | SC\_highV0 | SC\_noBE | SC\_90to10 |
| SOV | 727,770 | 733,585 | 722,076 | 721,229 | 739,899 |
| APAX | 226,283 | 226,774 | 225,918 | 224,400 | 230,301 |
| WAT | 46,029 | 44,818 | 47,648 | 44,080 | 41,908 |
| DAT | 6,504 | 6,565 | 6,485 | 6,296 | 6,852 |
| WALK | 468,464 | 464,839 | 469,966 | 481,769 | 451,637 |
| *Compared to base* |  |  |  |  |  |
| SOV | -- | 0.8% | -0.8% | -0.9% | 1.7% |
| APAX | -- | 0.2% | -0.2% | -0.8% | 1.8% |
| WAT | -- | -2.6% | 3.5% | -4.2% | -9.0% |
| DAT | -- | 0.9% | -0.3% | -3.2% | 5.4% |
| WALK | -- | -0.8% | 0.3% | 2.8% | -3.6% |

Table 1–9 Predicted Mode Shares of HBO Trips for 5 VO Scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | SC\_base | SC\_lowV0 | SC\_highV0 | SC\_noBE | SC\_90to10 |
| SOV | 2,578,442 | 2,592,462 | 2,562,240 | 2,557,892 | 2,622,203 |
| APAX | 955,001 | 957,228 | 953,025 | 953,723 | 986,791 |
| WAT | 139,247 | 136,468 | 144,806 | 132,349 | 124,543 |
| DAT | 38,685 | 39,043 | 38,567 | 38,006 | 40,358 |
| WALK | 1,704,221 | 1,697,834 | 1,709,232 | 1,732,326 | 1,671,463 |
| TOTAL | 5,415,596 | 5,423,035 | 5,407,870 | 5,414,296 | 5,445,358 |
| *Compared to base:* | |  |  |  |  |
| SOV |  | 0.5% | -0.6% | -0.8% | 1.7% |
| APAX |  | 0.2% | -0.2% | -0.1% | 3.3% |
| WAT |  | -2.0% | 4.0% | -5.0% | -10.6% |
| DAT |  | 0.9% | -0.3% | -1.8% | 4.3% |
| WALK |  | -0.4% | 0.3% | 1.6% | -1.9% |

Table 1–10 Predicted Mode Shares of NHBW Trips for 5 VO Scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | SC\_base | SC\_lowV0 | SC\_highV0 | SC\_noBE | SC\_90to10 |
| SOV | 891,568 | 896,016 | 887,789 | 888,472 | 909,899 |
| APAX | 44,012 | 43,732 | 44,230 | 44,096 | 43,931 |
| WAT | 28,911 | 28,572 | 29,442 | 28,348 | 28,005 |
| DAT | 10,752 | 10,837 | 10,716 | 10,715 | 11,094 |
| WALK | 447,345 | 443,956 | 448,673 | 452,473 | 440,953 |
| TOTAL | 1,422,588 | 1,423,113 | 1,420,850 | 1,424,104 | 1,433,882 |
| *Compared to base:* | |  |  |  |  |
| SOV |  | 0.5% | -0.4% | -0.3% | 2.1% |
| APAX |  | -0.6% | 0.5% | 0.2% | -0.2% |
| WAT |  | -1.2% | 1.8% | -1.9% | -3.1% |
| DAT |  | 0.8% | -0.3% | -0.3% | 3.2% |
| WALK |  | -0.8% | 0.3% | 1.1% | -1.4% |

Table 1–11 Predicted Mode Shares of NHBO Trips for 5 VO Scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | SC\_base | SC\_lowV0 | SC\_highV0 | SC\_noBE | SC\_90to10 |
| SOV | 1,192,192 | 1,201,142 | 1,183,346 | 1,177,752 | 1,206,563 |
| APAX | 487,884 | 489,714 | 486,150 | 487,857 | 507,024 |
| WAT | 50,989 | 49,832 | 53,008 | 48,117 | 44,804 |
| DAT | 6,059 | 6,126 | 6,035 | 5,984 | 6,289 |
| WALK | 789,457 | 786,235 | 790,118 | 806,977 | 769,691 |
| TOTAL | 2,526,581 | 2,533,049 | 2,518,657 | 2,526,687 | 2,534,371 |
| *Compared to base:* | | |  |  |  |
| SOV |  | 0.8% | -0.7% | -1.2% | 1.2% |
| APAX |  | 0.4% | -0.4% | 0.0% | 3.9% |
| WAT |  | -2.3% | 4.0% | -5.6% | -12.1% |
| DAT |  | 1.1% | -0.4% | -1.2% | 3.8% |
| WALK |  | -0.4% | 0.1% | 2.2% | -2.5% |

## Impact on Traffic and Transit Assignment

Table 1–12 Predicted VMT and VHT for the 5 VO Scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | SC\_base | SC\_lowV0 | SC\_highV0 | SC\_noBE | SC\_90to10 |
| VMT | 84,826,543 | 85,237,833 | 84,533,237 | 83,690,436 | 85,123,361 |
| (diff) |  | 0.5% | -0.3% | -1.3% | 0.3% |
| VHT | 2,307,072 | 2,320,571 | 2,297,041 | 2,277,054 | 2,323,233 |
| (diff) |  | 0.6% | -0.4% | -1.3% | 0.7% |

Table –13 Predicted Transit Ridership for the 5 VO Scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **SC\_base** | **SC\_lowV0** | **SC\_highV0** | **SC\_noBE** | **SC\_90to10** |
| Bus | 503,326 | 498,201 | 516,552 | 463,988 | 461,307 |
| Silver line | 29,400 | 29,218 | 30,206 | 29,279 | 28,542 |
| Red line | 262,765 | 264,170 | 265,114 | 261,390 | 259,975 |
| Orange line | 237,027 | 239,210 | 237,749 | 236,321 | 238,469 |
| Blue line | 63,571 | 64,033 | 63,843 | 64,158 | 62,892 |
| Green line | 234,447 | 234,929 | 237,270 | 235,100 | 232,341 |
| Commuter Rail | 146,547 | 147,628 | 146,737 | 145,686 | 149,639 |
| **Compared to base** |  | **SC\_lowV0** | **SC\_highV0** | **SC\_noBE** | **SC\_90to10** |
| Bus |  | -1% | 3% | **-8%** | **-8%** |
| Silver line |  | -1% | 3% | 0% | -3% |
| Red line |  | 1% | 1% | -1% | -1% |
| Orange line |  | 1% | 0% | 0% | 1% |
| Blue line |  | 1% | 0% | 1% | -1% |
| Green line |  | 0% | 1% | 0% | -1% |
| Commuter Rail |  | 1% | 0% | -1% | 2% |

# Uncertainty in Trip Generation

## TG Scenarios

* + SC\_low: 5-percentile of the trip rate sampling distribution
  + SC\_high: 95-percentile of the trip rate sampling distribution
  + SC\_90to10: 1990 trip rates applied to 2010

## Predicted Trip Generation

Table 2–1 HBW Trip Production Results for 4 TG Scenarios

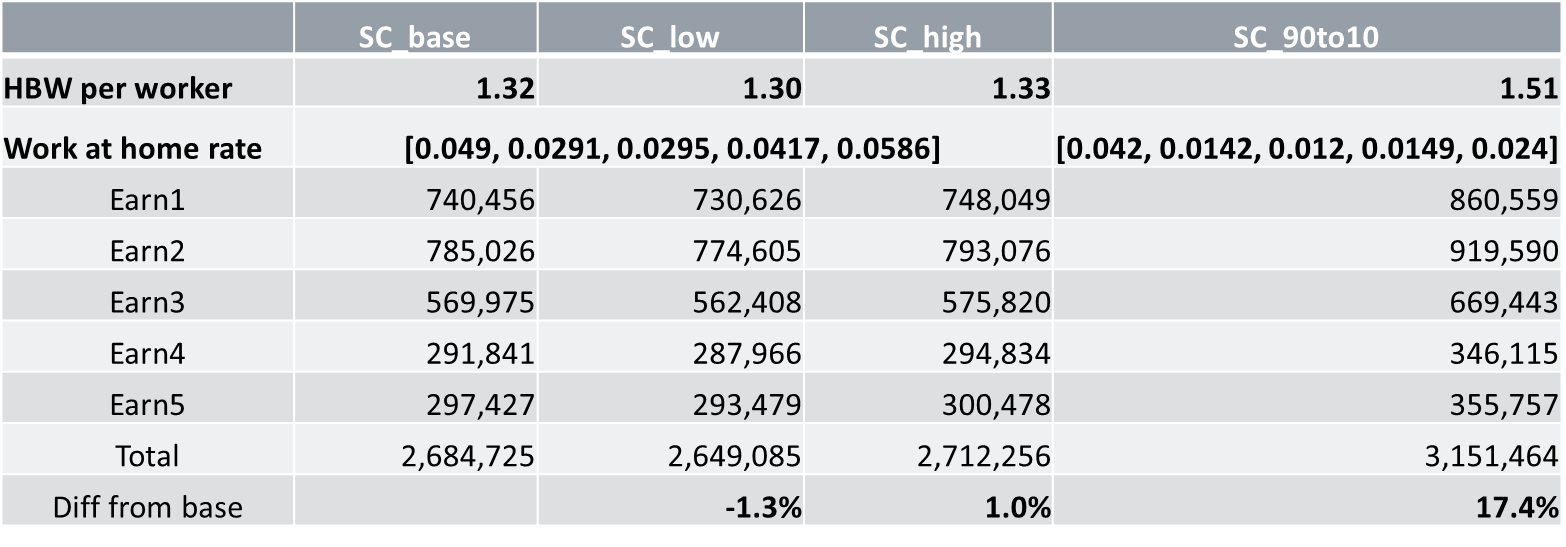


Figure 2‑1 Predicted Trips for Other Trip Purposes for TG scenarios

Table 2–2 Predicted Trips Compared to Base Scenario

|  |  |  |  |
| --- | --- | --- | --- |
|  | SC\_low | SC\_high | SC\_90to10 |
| HBSC | -11% | 10% | -5% |
| HBPUDO | -10% | 13% | -9% |
| HBSH | -10% | 12% | 23% |
| HBBPB | -11% | 12% | 11% |
| HBSO | -18% | 15% | 27% |
| HBEAT | -17% | 22% | 7% |
| HBREC | -10% | 18% | -24% |
| HBO | -33% | 50% | 32% |
| NHBW | -9% | 8% | 72% |
| NHBO | -9% | 11% | 8% |

## Impact on Traffic and Transit Assignment

Table 2–3 VMT and VHT Generated by the 4 TG Scenarios

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Total VMT | | | | Total VHT | | | |
|  | SC\_base | SC\_low | SC\_high | SC\_90to10 | SC\_base | SC\_low | SC\_high | SC\_90to10 |
| Expressways | 47,910,235 | 45,739,023 | 50,734,157 | 54,163,172 | 880,907 | 838,123 | 940,336 | 1,028,533 |
| Main Arterials | 4,575,151 | 4,364,070 | 4,853,723 | 5,115,878 | 125,786 | 118,944 | 135,145 | 145,549 |
| Minor Arterials | 15,363,804 | 14,436,722 | 16,603,387 | 17,976,887 | 563,335 | 526,654 | 611,712 | 670,125 |
| Main Distributors | 11,408,831 | 10,646,954 | 12,447,599 | 13,575,919 | 466,139 | 434,605 | 509,301 | 558,395 |
| Minor Distributors | 1,531,897 | 1,466,257 | 1,639,421 | 1,738,344 | 66,600 | 64,410 | 71,803 | 76,878 |
| Local streets | 4,036,625 | 3,746,566 | 4,459,649 | 4,862,342 | 204,305 | 189,275 | 226,235 | 247,765 |
| **Total** | **84,826,543** | **80,399,592** | **90,737,936** | **97,432,542** | **2,307,072** | **2,172,011** | **2,494,532** | **2,727,245** |
|  |  |  |  |  |  |  |  |  |
| Expressways |  | -5% | 6% | 13% |  | -5% | 7% | 17% |
| Main Arterials |  | -5% | 6% | 12% |  | -5% | 7% | 16% |
| Minor Arterials |  | -6% | 8% | 17% |  | -7% | 9% | 19% |
| Main Distributors |  | -7% | 9% | 19% |  | -7% | 9% | 20% |
| Minor Distributors |  | -4% | 7% | 13% |  | -3% | 8% | 15% |
| Local streets |  | -7% | 10% | 20% |  | -7% | 11% | 21% |
| **Total** |  | **-5%** | **7%** | **15%** |  | **-6%** | **8%** | **18%** |

Table 2–4 Transit Ridership Generated by the 4 TG Scenarios

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | SC\_base | SC\_low | SC\_high | SC\_90to10 |
| Bus | 503,326 | 474,406 | 565,576 | 586,560 |
| Silver line | 29,400 | 27,689 | 33,553 | 34,969 |
| Red | 262,765 | 250,669 | 284,860 | 302,320 |
| Orange line | 237,027 | 226,004 | 258,013 | 272,341 |
| Blue line | 63,571 | 60,798 | 69,895 | 73,165 |
| Green line | 234,447 | 222,895 | 254,809 | 268,897 |
| Commuter Rail | 146,547 | 142,142 | 153,074 | 162,717 |
| **Total** | **1,477,083** | **1,404,604** | **1,619,780** | **1,700,970** |
|  | SC\_base | SC\_low | SC\_high | SC\_90to10 |
| Bus |  | -6% | 12% | 17% |
| Silver line |  | -6% | 14% | 19% |
| Red |  | -5% | 8% | 15% |
| Orange line |  | -5% | 9% | 15% |
| Blue line |  | -4% | 10% | 15% |
| Green line |  | -5% | 9% | 15% |
| Commuter Rail |  | -3% | 4% | 11% |
| **Total** |  | **-5%** | **10%** | **15%** |

Table 2–5 Summary of the Impact of the TG Uncertainty Scenarios on Traffic Assignment

|  |  |  |  |
| --- | --- | --- | --- |
|  | **SC\_low** | **SC\_high** | **SC\_90to10** |
| Total trips | -9% | 11% | 14% |
| Total VMT | **-5%** | **7%** | **15%** |
| Total VHT | **-6%** | **8%** | **18%** |
| AM VMT | -3% | 2% | 17% |
| AM VHT | -3% | 3% | 21% |
| MD VMT | -6% | 9% | 22% |
| MD VHT | -7% | 10% | 26% |
| Transit Ridership | **-5%** | **10%** | **15%** |

# Uncertainty in Mode Choice

## Mode Choice Scenarios

* Base
* behav\_90to10 (behavior uncertainty)
* params\_highSOV (parameter uncertainty)
* params\_lowSOV (parameter uncertainty)

## Predicted Mode Shares by Mode

Table 3–1 Predicted HBW Mode Shares by 5 MC Scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **HBW** | base10 | lowSOV | highSOV | 90to10 | Observed |
| SOV | 74.6% | 74.4% | 75.0% | 70.4% | **71.9%** |
| APAX | 4.4% | 4.9% | 4.4% | 9.3% | **9.1%** |
| WAT | 7.4% | 7.7% | 6.9% | 6.0% | **13.5%** |
| DAT | 4.2% | 3.8% | 4.3% | 4.5% |
| WALK | 9.3% | 9.2% | 9.3% | 9.8% | **5.5%** |

Table 3–2 Predicted HBSHOP Mode Shares by 5 MC Scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **HBSHOP** | base10 | lowSOV | highSOV | 90to10 | Observed |
| SOV | 49.3% | 48.7% | 50.3% | 34.8% | **67.2%** |
| APAX | 15.4% | 15.4% | 14.3% | 30.6% | **18.9%** |
| WAT | 2.9% | 3.1% | 3.0% | 1.9% | **5.7%** |
| DAT | 0.4% | 0.7% | 0.5% | 0.3% | **0.1%** |
| WALK | 31.9% | 32.1% | 32.0% | 32.3% | **8.2%** |

Table 3–3 Predicted HBO Mode Shares by 5 MC Scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **HBO** | base10 | lowSOV | highSOV | 90to10 | Observed |
| SOV | 47.6% | 46.9% | 48.2% | 30.4% | 64.2% |
| APAX | 17.6% | 18.2% | 17.2% | 35.9% | 23.0% |
| WAT | 2.4% | 2.4% | 2.4% | 1.5% | 5.8% |
| DAT | 0.7% | 0.8% | 0.7% | 0.6% | 0.3% |
| WALK | 31.6% | 31.7% | 31.6% | 31.6% | 6.6% |

Table 3–4 Predicted NHBW Mode Shares by 5 MC Scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NHBW** | base10 | lowSOV | highSOV | 90to10 | Observed |
| SOV | 62.7% | 62.0% | 62.9% | 52.2% | 75.0% |
| APAX | 3.1% | 3.6% | 2.9% | 13.6% | 4.2% |
| WAT | 1.9% | 1.9% | 2.0% | 1.4% | 6.7% |
| DAT | 0.7% | 0.8% | 0.7% | 0.6% | 0.7% |
| WALK | 31.6% | 31.7% | 31.5% | 32.3% | 13.5% |

Table 3–5 Predicted NHBO Mode Shares by 5 MC Scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NHBO** | base10 | lowSOV | highSOV | 90to10 | Observed |
| SOV | 47.1% | 46.4% | 47.7% | 28.6% | **60.2%** |
| APAX | 19.3% | 20.1% | 18.9% | 36.6% | **26.1%** |
| WAT | 1.9% | 1.9% | 1.9% | 1.9% | **4.5%** |
| DAT | 0.2% | 0.3% | 0.2% | 1.2% | **0.1%** |
| WALK | 31.4% | 31.4% | 31.3% | 31.7% | **9.2%** |

## Impact on Traffic and Transit Assignment

Table 3–6 Differences in Predicted VMT from Base Scenario

|  |  |  |  |
| --- | --- | --- | --- |
|  | **SC\_lowSOV** | **SC\_highSOV** | **SC\_90to10** |
| Expressways | -0.7% | 0.6% | -21.1% |
| Main Arterials | -1.0% | 0.7% | -19.8% |
| Minor Arterials | -1.0% | 0.9% | -24.0% |
| Main Distributors | -1.1% | 1.0% | -25.6% |
| Minor Distributors | -0.8% | 0.8% | -21.2% |
| Local streets | -1.2% | 1.2% | -26.7% |
| Total | -0.9% | 0.8% | -22.4% |

Table –7 Predicted Transit Ridership by MC Scenarios

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **Compared to base** | | |
|  | **base10** | **lowSOV** | **highSOV** | **90to10** | **lowSOV** | **highSOV** | **90to10** |
| Bus | 458,200 | 471,895 | 445,721 | 337,836 | 3.0% | -2.7% | -26.3% |
| Silver line | 27,817 | 27,775 | 27,176 | 20,497 | -0.2% | -2.3% | -26.3% |
| Red | 252,605 | 256,073 | 245,274 | 221,986 | 1.4% | -2.9% | -12.1% |
| Orange line | 227,631 | 229,691 | 219,959 | 198,751 | 0.9% | -3.4% | -12.7% |
| Blue line | 61,577 | 62,010 | 60,405 | 55,372 | 0.7% | -1.9% | -10.1% |
| Green line | 227,266 | 227,846 | 220,562 | 198,130 | 0.3% | -2.9% | -12.8% |
| Commuter Rail | 142,870 | 143,152 | 141,121 | 139,101 | 0.2% | -1.2% | -2.6% |
| ***Total*** | ***1,397,967*** | ***1,418,443*** | ***1,360,219*** | ***1,171,674*** | ***1.5%*** | ***-4.1%*** | ***-13.9%*** |

1. Note that the population data 2010 CTPP is also based on survey with various expansion and imputation employed. See <http://www.fhwa.dot.gov/planning/census_issues/ctpp/faq/> ideally, the confidence interval of the prediction should be compared to the observed confidence interval from CTPP. [↑](#footnote-ref-1)
2. Random seed=7 [↑](#footnote-ref-2)