**Kevin Saavedra**

USP 587 – Homework 3

1. Trip Distribution

2000 Census data for the City of Redmond, WA, combined with Urban Area 50,000 to 199,999 tables were used to generate trip distribution table by TAZ and household size (Table 1).

***Table 1. HBW Trip Distribution by HH Size***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| TAZ | hh1 | hh2 | hh3 | hh4 | hh5+ | Total |
| 263 | 516.52 | 1419.528 | 642.466 | 571.064 | 344.284 | 3493.86 |
| 264 | 498.02 | 1254 | 672.676 | 602.072 | 400.724 | 3427.49 |
| 269 | 397.38 | 1105.192 | 545.794 | 576.232 | 316.064 | 2940.66 |
| 271 | 255.3 | 755.744 | 537.738 | 428.944 | 268.09 | 2245.82 |
| 272 | 91.02 | 63.536 | 10.07 | 15.504 | 0 | 180.13 |
| 274 | 485.44 | 1489.752 | 755.25 | 754.528 | 420.478 | 3905.45 |
| 499 | 170.94 | 443.08 | 171.19 | 126.616 | 118.524 | 1030.35 |
| 500 | 61.42 | 225.72 | 132.924 | 116.28 | 64.906 | 601.25 |
| 513 | 16.28 | 127.072 | 88.616 | 116.28 | 90.304 | 438.552 |
| 515 | 28.86 | 16.72 | 0 | 23.256 | 0 | 68.836 |
| 516 | 507.64 | 1093.488 | 418.912 | 224.808 | 124.168 | 2369.02 |
| 517 | 247.16 | 745.712 | 541.766 | 772.616 | 420.478 | 2727.73 |
| 518 | 402.56 | 1105.192 | 582.046 | 718.352 | 386.614 | 3194.76 |
| 519 | 421.8 | 1302.488 | 771.362 | 749.36 | 457.164 | 3702.17 |
| Total |  |  |  |  |  | 30326.1 |

The application of the formula *1.45 x Total Employment* for HBW trips allowed for the calculation of total trip attractions and balanced trip attractions using balance factor .299 (Table 2).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Table 2. Balanced HBW Trip Attractions*** | | |  |  |
| TAZ | Attractions | Balance Factor | Balanced trip attractions | |
| 263 | 8689.85 | 0.29919375 | 2599.94881 |  |
| 264 | 983.1 | 0.29919375 | 294.137375 |  |
| 269 | 261 | 0.29919375 | 78.0895687 |  |
| 271 | 3448.1 | 0.29919375 | 1031.64997 |  |
| 272 | 40800.1 | 0.29919375 | 12207.1349 |  |
| 274 | 372.65 | 0.29919375 | 111.494551 |  |
| 499 | 15662.9 | 0.29919375 | 4686.24178 |  |
| 500 | 1003.4 | 0.29919375 | 300.211009 |  |
| 513 | 343.65 | 0.29919375 | 102.817932 |  |
| 515 | 11868.25 | 0.29919375 | 3550.90622 |  |
| 516 | 15764.4 | 0.29919375 | 4716.60995 |  |
| 517 | 1149.85 | 0.29919375 | 344.027933 |  |
| 518 | 648.15 | 0.29919375 | 193.922429 |  |
| 519 | 363.95 | 0.29919375 | 108.891565 |  |
| Total | 101359.35 |  | 30326.084 |  |

The Iterative Proportional Fitting worksheets for both uncalibrated and calibrated F-factors can be seen in the attached Excel spreadsheets.

The resulting estimated average travel time per trip for the uncalibrated IPF process is 9.71 minutes, 30% higher than the observed 7.45 minutes. This overestimation is likely due to the use of a single factor, household size, for trip generation. A more fine-grained analysis such as HH size / income / number of vehicles for trip generation would likely be closer to the observed data.

***Fig 1. Observed vs Estimated Trip Length Frequency Distribution***

***Fig 2. Observed vs Estimated Trip Length Frequency Distribution - Calibrated F-Factors***

Using Calibrated – F Factors, the estimated average total time was reduced to 8.77 minutes, 18% higher than the observed data. While still not quite matching the observed data, the use of calibrated F-factors noticeably reduced the observed to estimated discrepancy (Table 3).

|  |  |
| --- | --- |
| ***Table 3. Average Travel Times*** |  |
|  | Avg Travel Time (min) |
| Observed | 7.45 |
| Estimated | 9.71 |
| Estimated (Calibrated F-Factor) | 8.77 |

1. Mode Choice Models

| ***Table 4. Mode Choice and Probabilities*** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Alternative** | **Available** | **Chosen** | **Proportion by Mode** | **Proportion All Modes** | **MNL Probability** |
| Drive Alone | 2755 | 3637 | 1.320 | 0.185 | 0.666 |
| Shared Ride 2 | 5029 | 517 | 0.103 | 0.026 | 0.078 |
| Shared Ride 3+ | 5029 | 161 | 0.032 | 0.008 | 0.078 |
| Transit | 4003 | 498 | 0.124 | 0.025 | 0.095 |
| Bike | 1738 | 50 | 0.029 | 0.002 | 0.024 |
| Walk | 1119 | 159 | 0.142 | 0.008 | 0.113 |

| ***Table 4. Mode Choice and Probabilities – excluding walk*** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Alternative** | **Available** | **Chosen** | **Proportion by Mode** | **Proportion All Modes** | **MNL Probability** |
| Drive Alone | 2755 | 3637 | 1.320 | 0.196 | 0.751 |
| Shared Ride 2 | 5029 | 517 | 0.103 | 0.078 | 0.088 |
| Shared Ride 3+ | 5029 | 161 | 0.032 | 0.078 | 0.088 |
| Transit | 4003 | 498 | 0.124 | 0.095 | 0.107 |
| Bike | 1738 | 50 | 0.029 | 0.024 | 0.027 |

Our calculated Chi-squared value for Model 2 (unrestricted) against Model 3 (restricted) for level of significance 0.01 with 3 degrees of freedom is 0.01. As this is much smaller than the table value of 11.35, MTC concludes that Model 3 is not significantly different from Model 2.