

travel
modelling
group



AUTO ASSIGNMENT CONVERGENCE REPORT

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Background

Since the move to a SOLA Traffic Assignment in GTAModel, no work has been done to determine the level of convergence within the assignment. Convergence within the model would ensure that changes in link volumes and travel times between scenarios are actually the result of network differences, rather than simply the difference between iterations. The GTAModel framework convergence criteria is currently prescribed to either reach a relative gap of 0.01 or hit the maximum number of iterations limit of 80. The other gaps (best relative and normal) are set to 0. When doing an assignment with the 2011 AM TTS demand, the assignment converges within 25 iterations due to the relative gap convergence criteria being met. This memo reports on work done by TMG to investigate the convergence of the auto assignment.

Setup

In order to investigate this issue, the Continue Traffic Assignment Tool was used. Although it is necessary to state that running a SOLA assignment for 5 iterations and then the continue Traffic Assignment Tool for another 5 iterations will not be the same as running the SOLA Assignment for 10 iterations at once. It is, however, a close match with the SOLA assignment run together being more converged than the alternate. For the purposes of this investigation, gaps, link volumes, and OD travel times were the main criteria for convergence. The number of max iterations for the purposes of this investigation was increased to 200 and the value of all the gaps were set to 0.

Results

After performing 200 iterations of the continue Traffic assignment tool, the value of the various gaps for each iteration are shown in Figure 1, Figure 2 and Figure 3. It can be seen that they all exhibit roughly the same behaviour, with normal gap being the odd one out in showing a more pronounced decrease in the latter iterations.

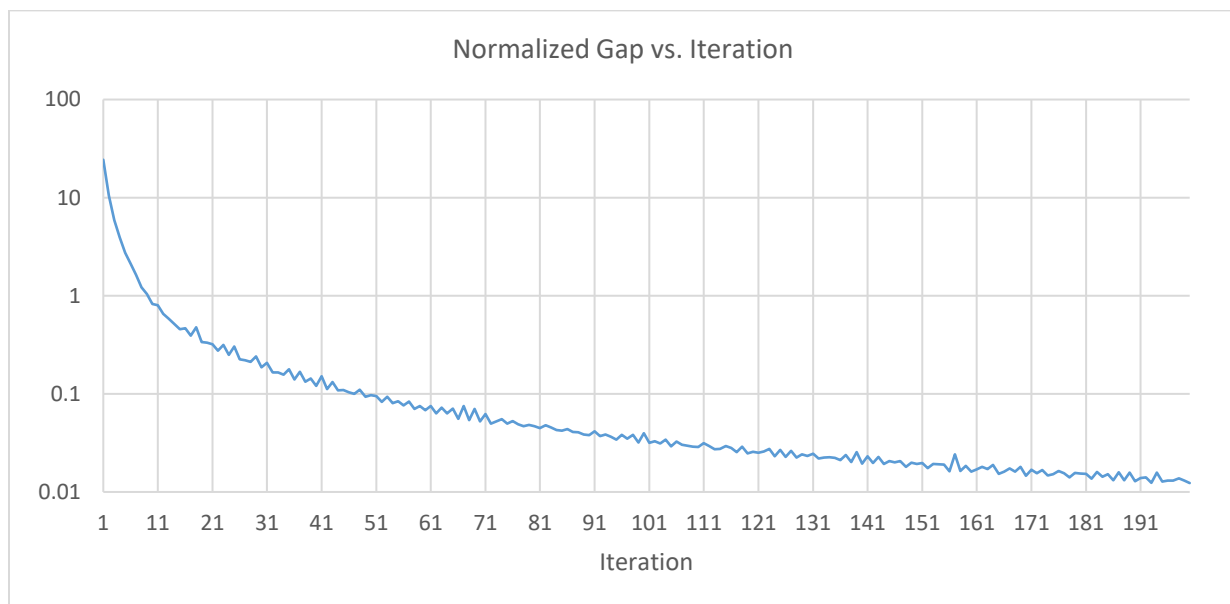


Figure 1 Normal Gap value across iterations

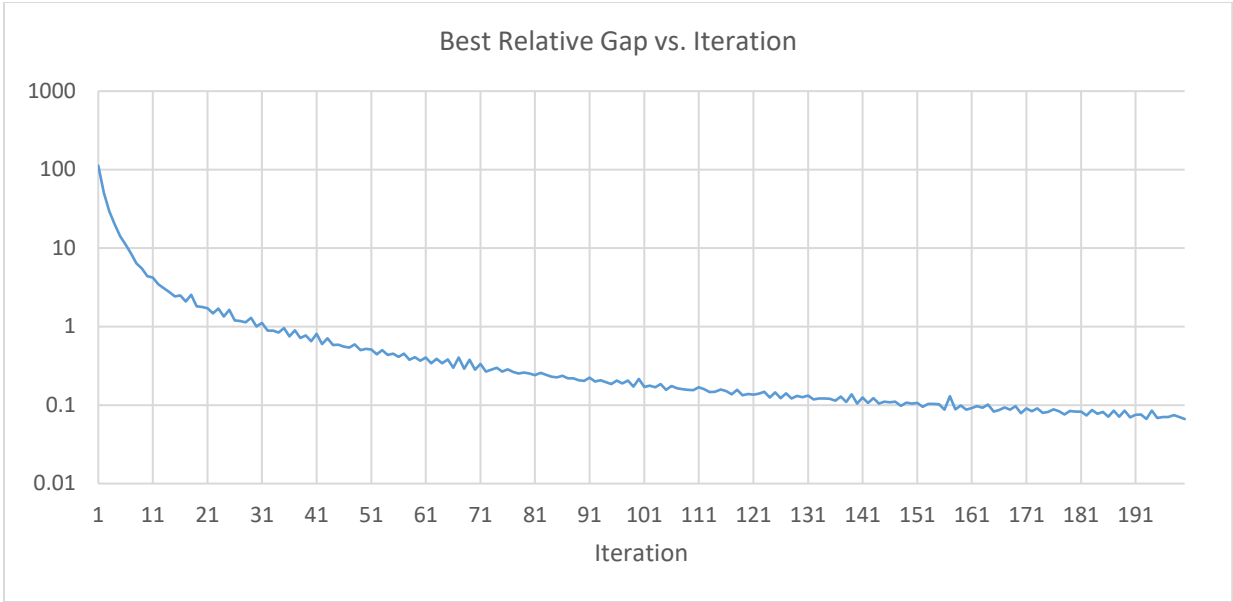


Figure 2 Best Relative Gap value across iterations

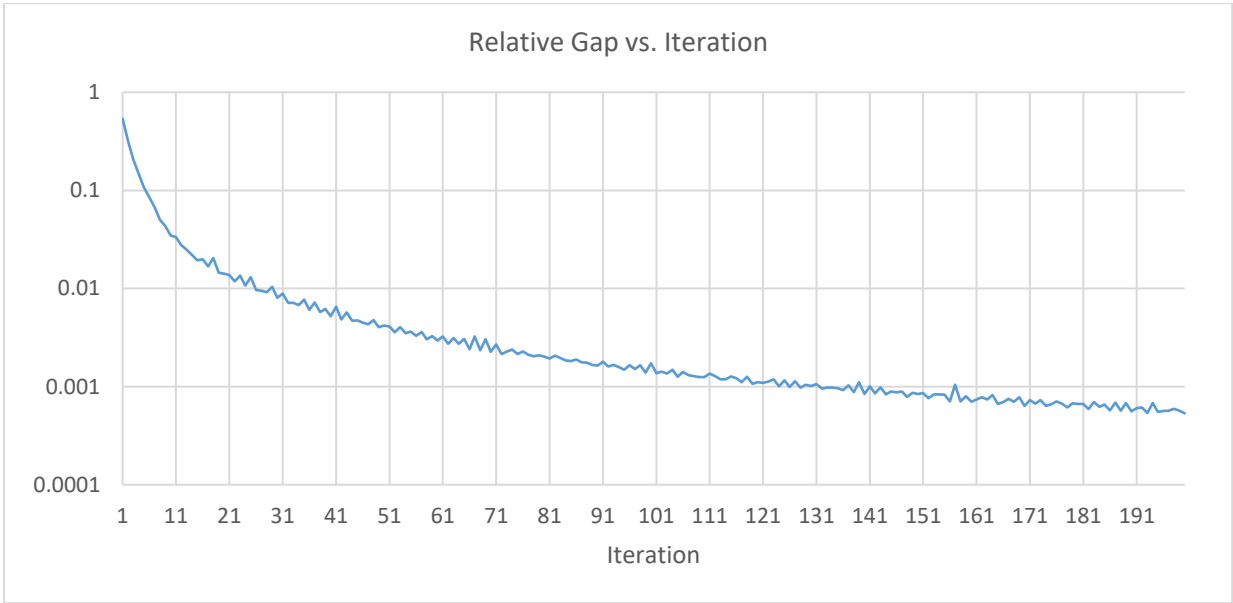


Figure 3 Relative Gap value across iterations

When looking at the change in OD travel time convergence as compared to the relative gap, it is seen in Figure 4 that at current gap level prescriptions, the maximum change in the shortest path between OD's is about 4 minutes, with the average, as shown in Figure 5, being about 0.25 minutes for each OD pair. It should be noted that this is the shortest path between OD's and not the weighted average path between OD's that GTAModel uses to determine OD times. This limitation is due to the way the INRO tools are set up. It is expected that the weighted average travel times will have a larger average effect but a smaller maximum one. The same kind of relationship that is shown in Figure 4 and Figure 5 also exists when comparing OD travel time to the other gaps.

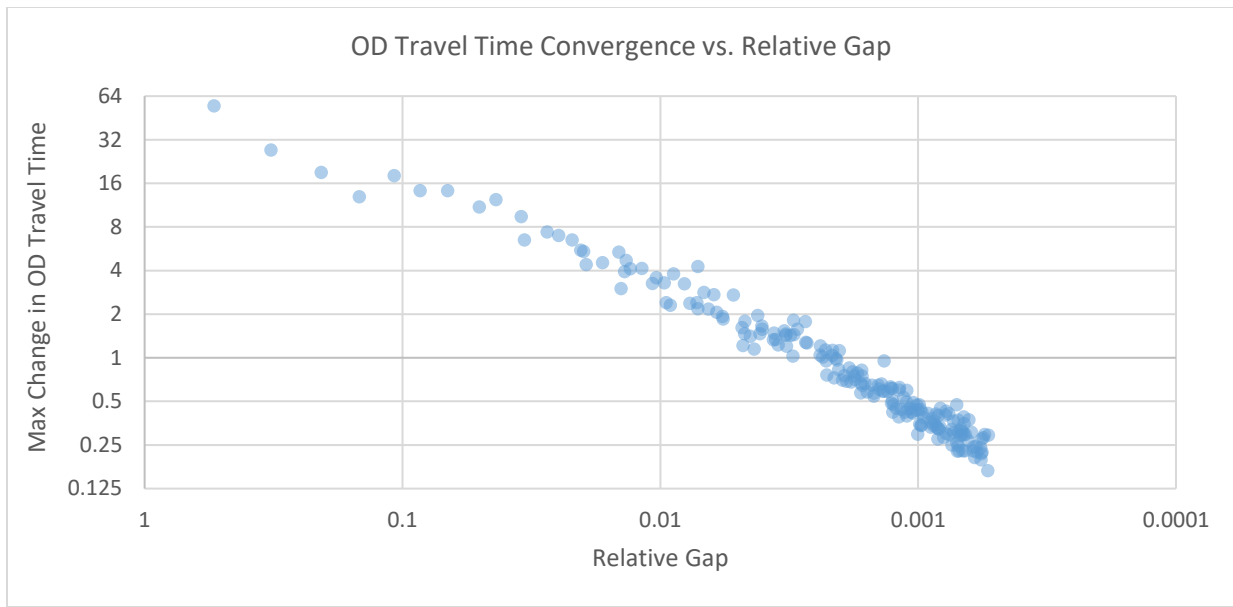


Figure 4 Maximum change in OD travel times when comparing to the relative gap

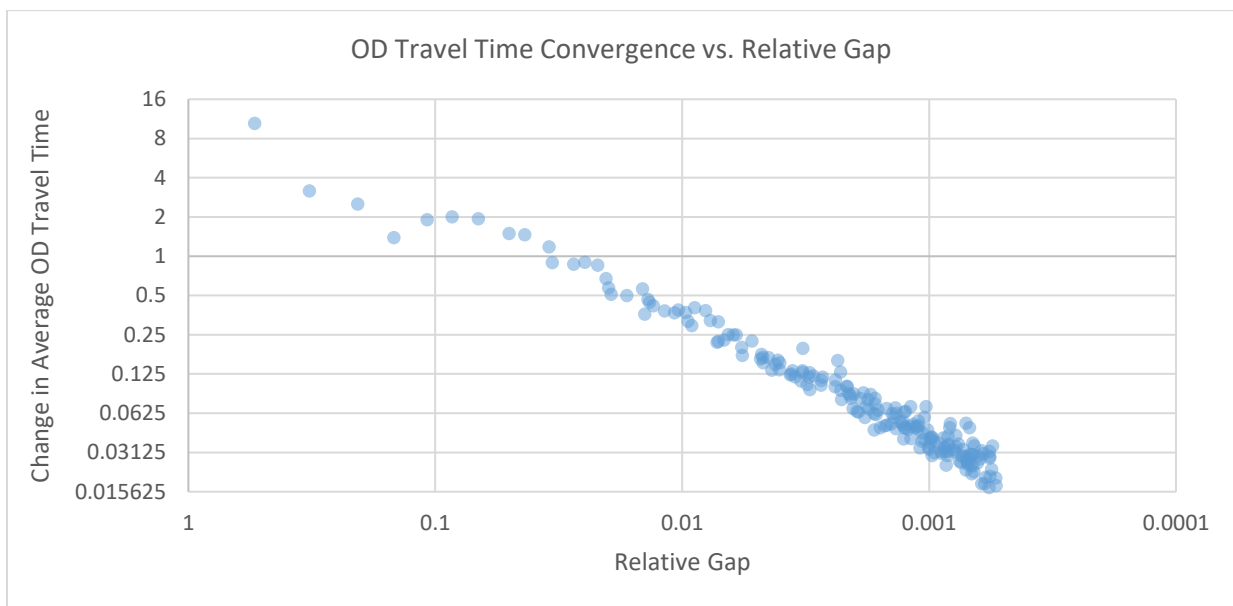


Figure 5 Average change in OD travel times when comparing to the relative gap

Figure 6 and Figure 7 show the maximum volume change on links as well as the average volume change on links, respectively, across the number of iterations. It is seen that trying to obtain a low max volume change of less than 100 vehicles would mean increasing the number of iterations to greater than 100, a more computationally challenging task. The average number of vehicles decreases to less than 5 vehicles after the 25th iteration.

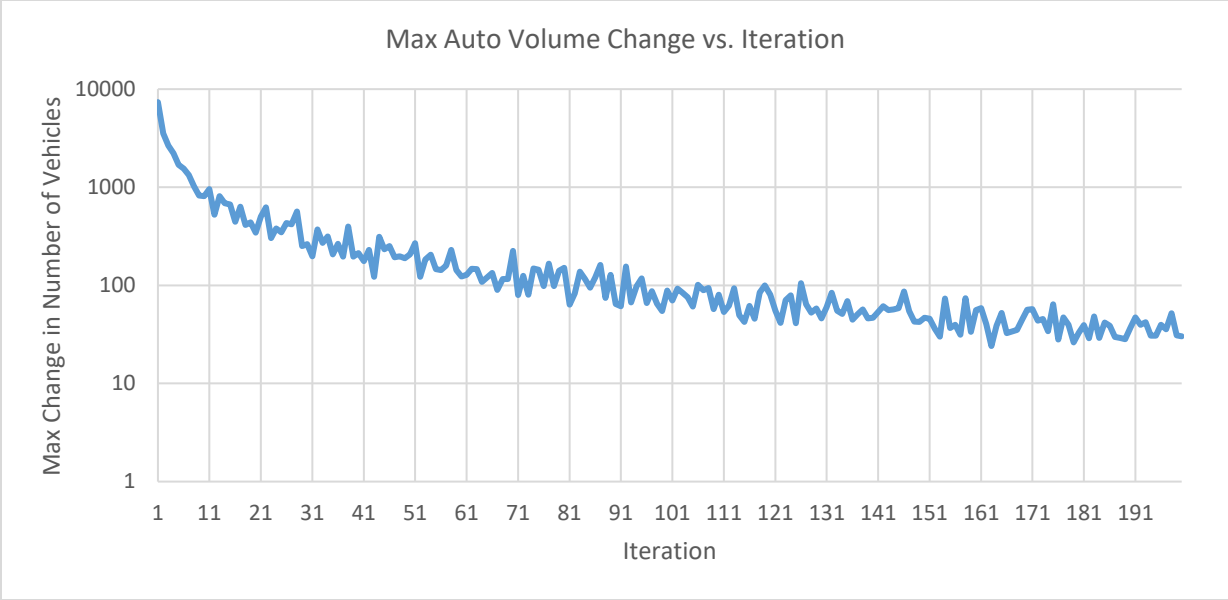


Figure 6 Maximum link volume change for each iteration (when compared to the previous iteration)

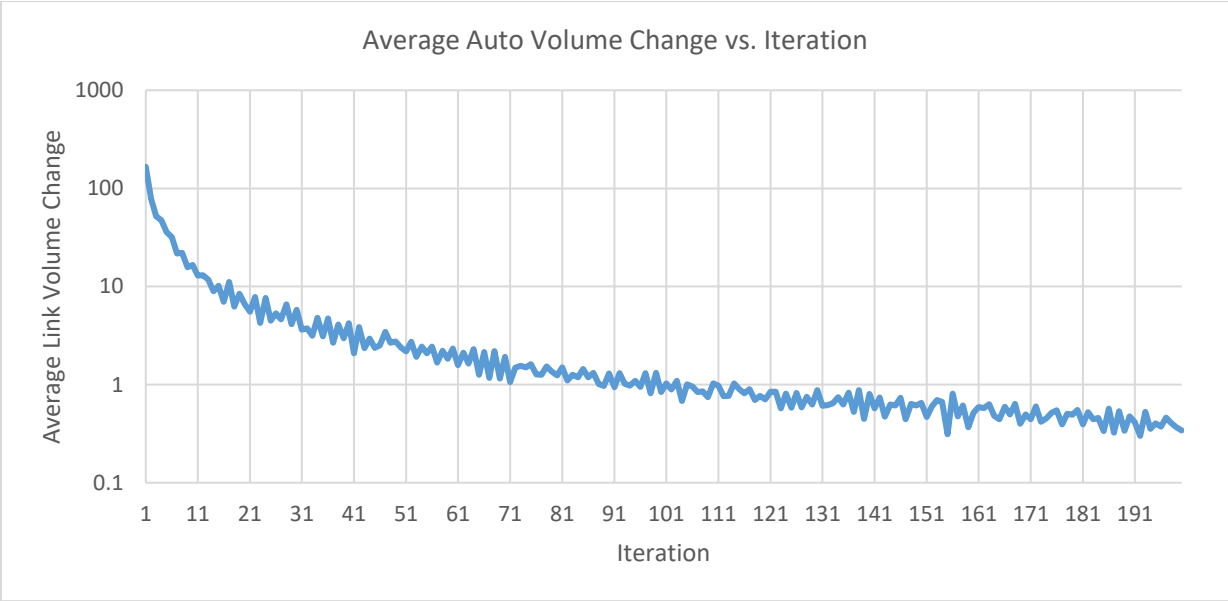


Figure 7 Average link volume change for each iteration (when compared to the previous iteration)

Lastly, Figure 8 shows how the tightening relative gap affects the average change in link volumes. The current gap level of 0.01 means that average change is between 4-8 vehicles on each link.

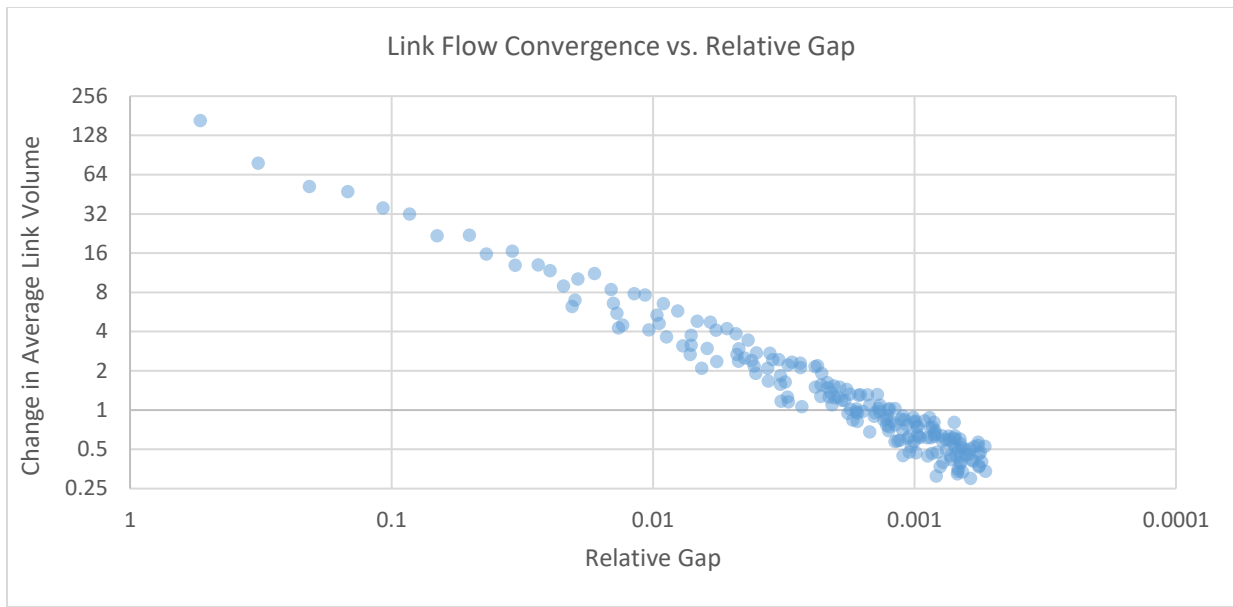


Figure 8 Change in average link volumes compared to the relative gap

The other aspect when looking at tightening convergence criteria is the additional computational time required for the assignment to converge. Figure 9 gives the run times for several different iteration numbers. Please note these times are based on a Workstation PC and not a server.

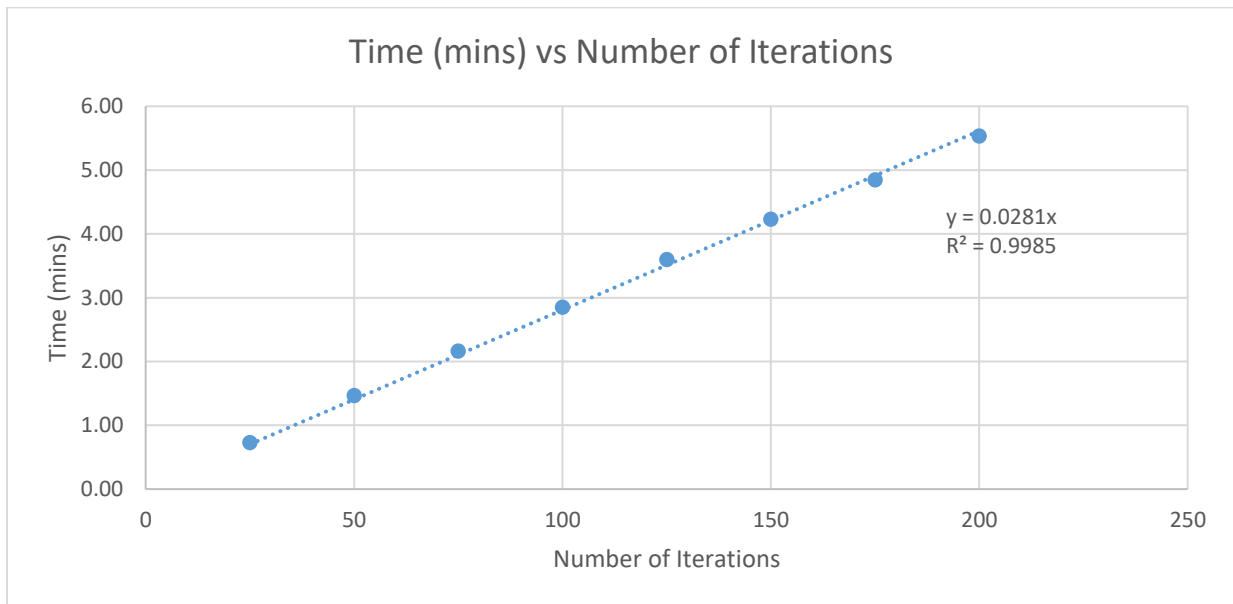


Figure 9 Assignment run times when comparing against the number of iterations

There is a linear relationship between the number of iterations and the time taken to run each assignment. However, since GTAModel does the time periods in parallel, increasing the number of iterations by 20 will only correspond to a total increase of 0.562 minutes in the runtime of GTAModel as a whole.

Recommendations

Based on these findings, TMG recommends that the convergence criteria that is currently established can be tightened somewhat. It is recommended that the relative gap be decreased to 0.001, but the max number of iterations should stay at 80, thereby establishing a limit on the increase in computation time.