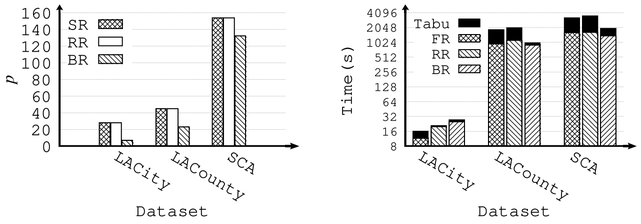
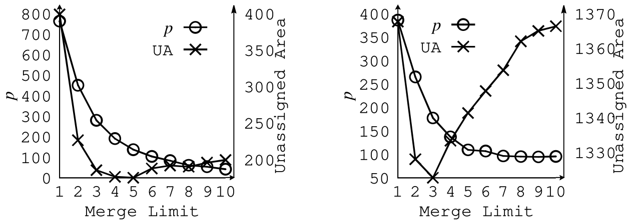


(a) p (b) Runtime

Fig. 17: Impact of area selection criteria (Step 2)



(a) Range: $3k \pm 1k$ (b) Range: $3k \pm 0.5k$

Fig. 18: Impact of varying merge limit

A. *Evaluating Design Decisions*

This section discusses the impact of two design decisions on the performance, the area selection criteria (Section -A1) and limiting the number of merge operations during the AVG construction step (Section -A2).

1) Area Selection Criteria: This section discusses the effect of area selection criteria on building regions during Steps 2 and 3 of the construction phase. In both Step 2 and Step 3, some operations require selecting a region to accommodate an area or selecting an area to swap between two neighboring regions. However, in each of those operations, there are multiple valid options to select from. We explore whether the order of selecting different options matters. We designed three ways of performing such a selection: (1) Making a sequential seeking-the-first selection. When selecting an area from a list, we pick the first one. (2) Making a random selection. (3) Making a greedy seeking-the-best choice. For example, when the algorithm tries to assign an area that is below the lower bound of the AVG constraint, it selects the most tolerant region whose value is increased the least. In this way, we expect that there remains a higher possibility for the region to accept more areas in the future so that the number of unassigned areas may be reduced. In theory, the best result given by the random order is not worse than the results of the other two approaches in the long run.

We evaluate three different choices, seeking-the-first selection denoted as F, the random selection denoted as R, and the seeking-the-best section denoted as B. The first letter indicates the criterion of selection for Step 2, while the second letter stands for the selection criteria for Step 3. Figure 17 shows the results for Step 2. For Step 2, FR and RR show similar performance. The BR approach gives a slightly smaller p, but the construction time and the local search time are much lower compared to FR and RR. Meanwhile, the number of unassigned areas for the three alternatives is similar. The intermediate results show a higher number of merges in BR compared to the other two alternatives, but it encounters a lower number of iterations, so the overall runtime is much shorter for satisfying AVG constraints. For Step 3, the performance of all alternatives is very close in both p value and runtime, so we omitted the results for space limitation.

2) Merge Limit: Step 2 of the construction phase limits the number of region merges to a bounded number. This section evaluates the impact of this parameter. Figure 18 shows the p value and number of unassigned areas (UA) for two threshold ranges: $3k \pm 1k$ and $3k \pm 0.5k$. For different ranges, the p value decreases and construction time increases with a larger merge limit value. These two measures trade off with the number of unassigned areas. With the tight range $3k \pm 0.5k$, there is an elbow point at merge limit 3 (Figure 18b) as more areas are assigned when merge limit is 1-3 and then fewer areas are assigned for merge limit > 3. With larger ranges, the number of unassigned areas improves with merge limit 3-5 but increases afterward, as shown in Figure 18a, and the same repeats for wider ranges. The larger region created with higher merge limits for one unassigned compresses the search space for the other unassigned areas and has an AVG attribute value close to one end of the specified range. This causes the number of unassigned areas to increase as the merge limit increases beyond 5. The Tabu search time in many cases slightly increases with larger merge limits. With wider threshold ranges, the number of unassigned areas is always very low and the merge limit value has no noticeable impact on it. Therefore, for all ranges, the low merge limit values, 2-3, are always enough to provide minimal unassigned areas, while keeping the total runtime and p value at acceptable levels.