Multistep Location Assignment for MATSim Demand Generation in a Regional Australian City

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MATSim
Multi-Agent Transport Simulation

MATSim demand generation for Greater Melbourne (AToM)

Stand alone activity-based demand model, with focus on activity scheduling and locations

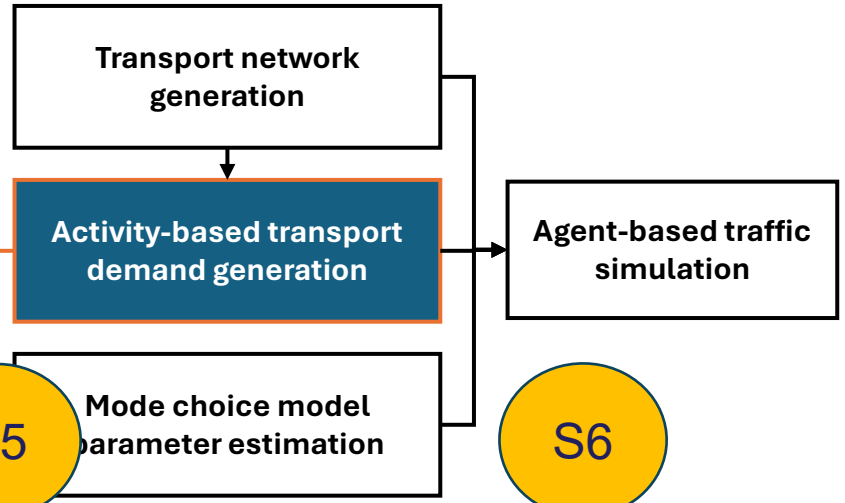
S3 // Select census-like person from cohort

S4 // Create VISTA-like activity plan in 30-min time bins

S5 // Assign non-home SA1 locations and arrival mode

S6 // Assign coordinates within SA1

S7 // Assign times to time bins



S4 S3 S5 S6 S7

Id	Activity	sBin	eBin	AgentId	SA1	LocType	ArrMode	X	Y	sTime	eTime
3857	Home	1	19	206061138P1947787	20606113828	home	NA	325204	5809300	00:28:00	09:08:00
3857	Personal	19	22	206061138P1947787	20701115409	commercial	car	328741	5814870	09:10:00	10:32:00
3857	Shop	22	28	206061138P1947787	20607114466	commercial	car	323238	5811164	10:52:00	13:38:00
3857	Other	29	32	206061138P1947787	20606113625	work	car	324392	5808585	14:29:00	15:36:00
3857	Home	32	48	206061138P1947787	21302134322	home	car	325204	5809300	15:56:00	23:56:00

Both, A., Singh, D., Jafari, A., Giles-Corti, B., & Gunn, L. (2021). An activity-based model of transport demand for Greater Melbourne. arXiv preprint arXiv:2111.10061.

Difficulty in modelling a regional city

	Urban Cities	Regional Cities
 Travel Pattern	Dense, Short and Routine Trips	Dispersed, Long-distance and varied trips
 Data Availability	Rich datasets	Limited dataset
 Transport Network	Complex, Detailed multi-modal	Simpler, Car-dominated
 Trip Origins and Destinations	Within the regions	Significant trips from/to outside the region

Regional cities require tailored modelling approaches due to distinct travel behaviors, data limitations, and infrastructural differences not captured in urban-centric models.

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Demand generation for regional city

This methodology is built upon the current AToM methodology.

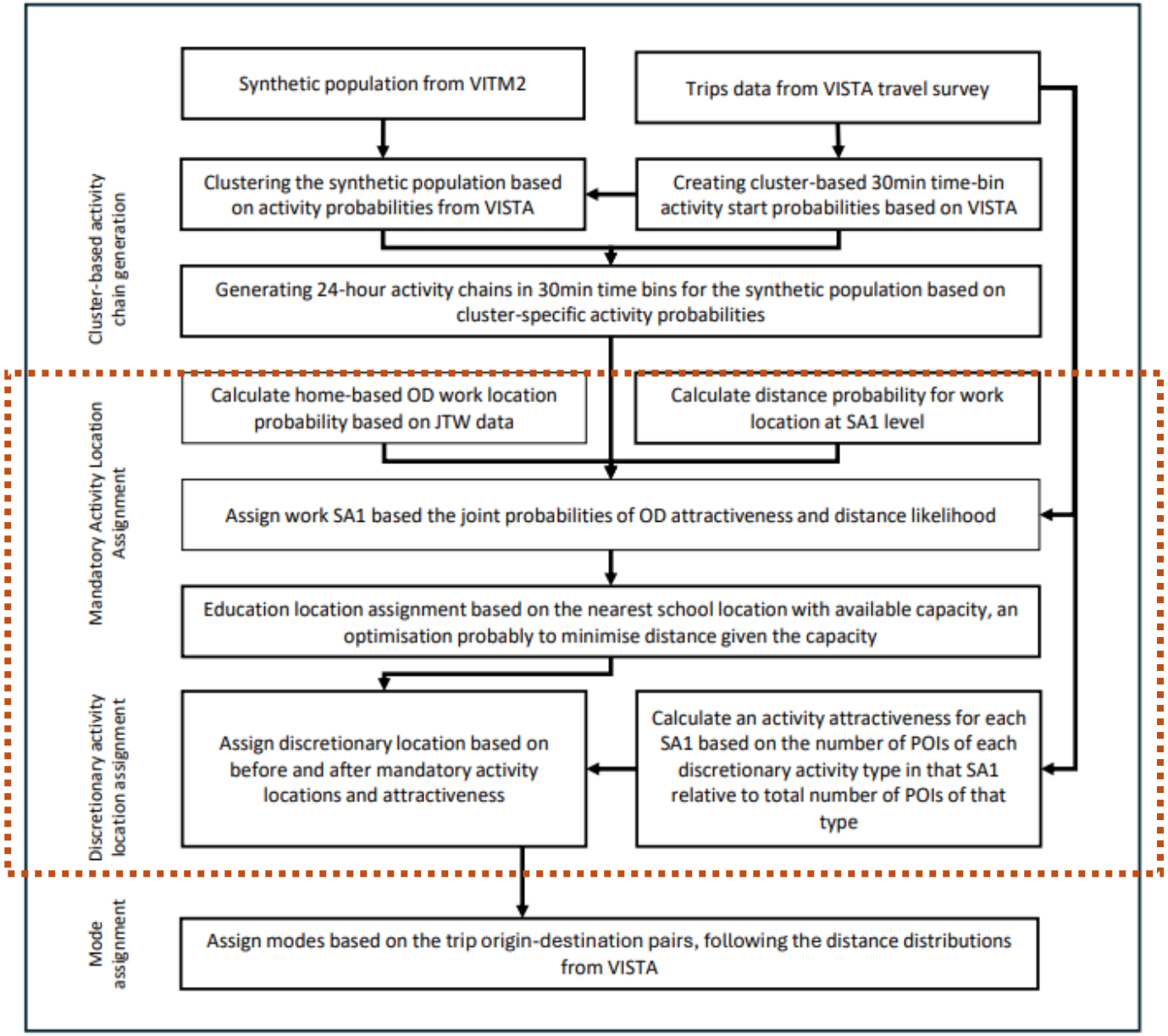
Specific changes have been made due to the differences in the data.

The work trips from outside the study regions were included in the modelling.

The primary cohorts were changed from Age/Sex to the agent's Main activities.

The location assignment step was enhanced to accommodate a specific type of activity, and separate strategies were employed for each.

We use VISTA (Victorian Integrated Survey of Travel and Activity) for travel survey data and Victorian Integrated Transport Model (VITM) 2 for synthetic persons with demographics.



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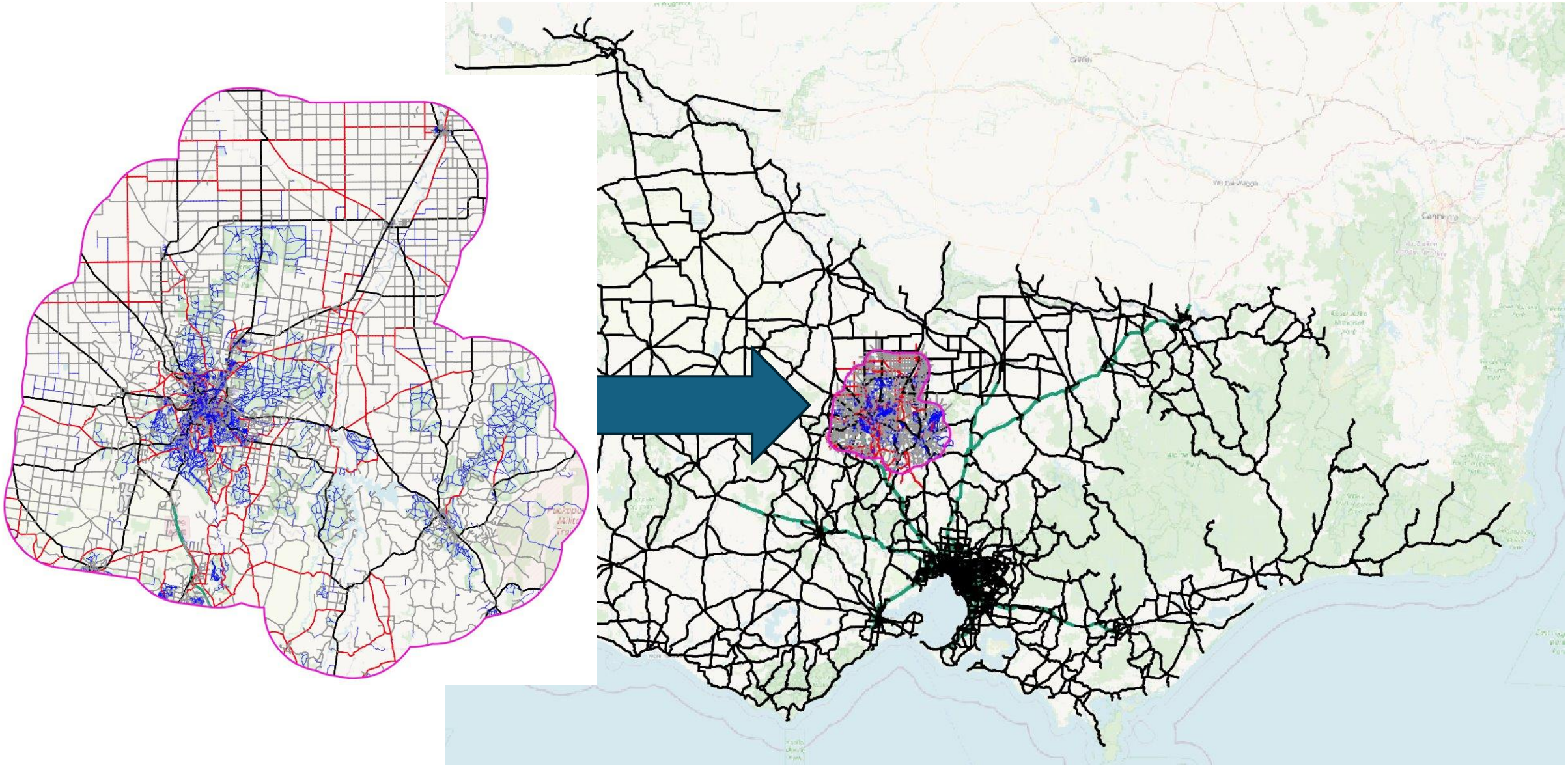
State-wide network



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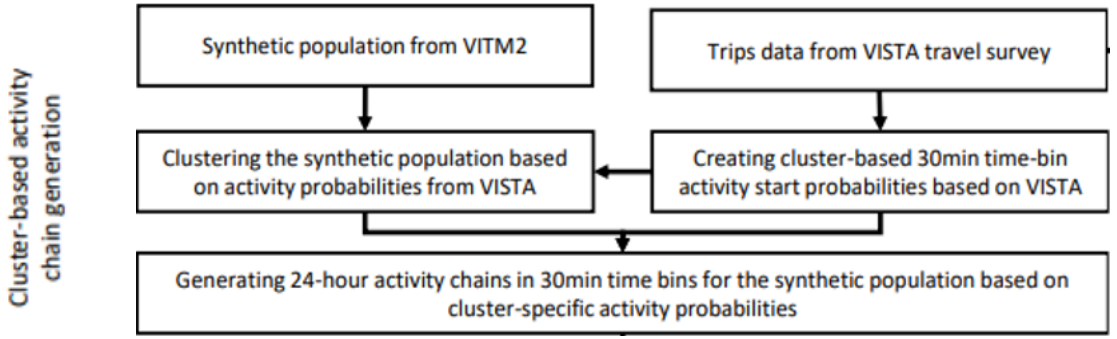
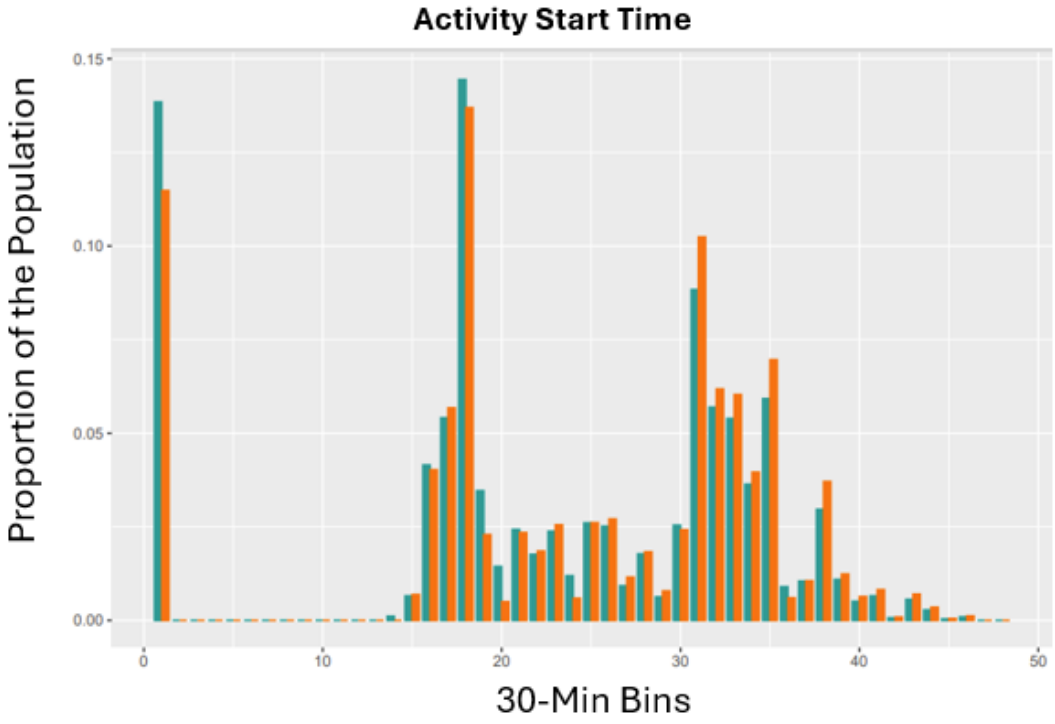
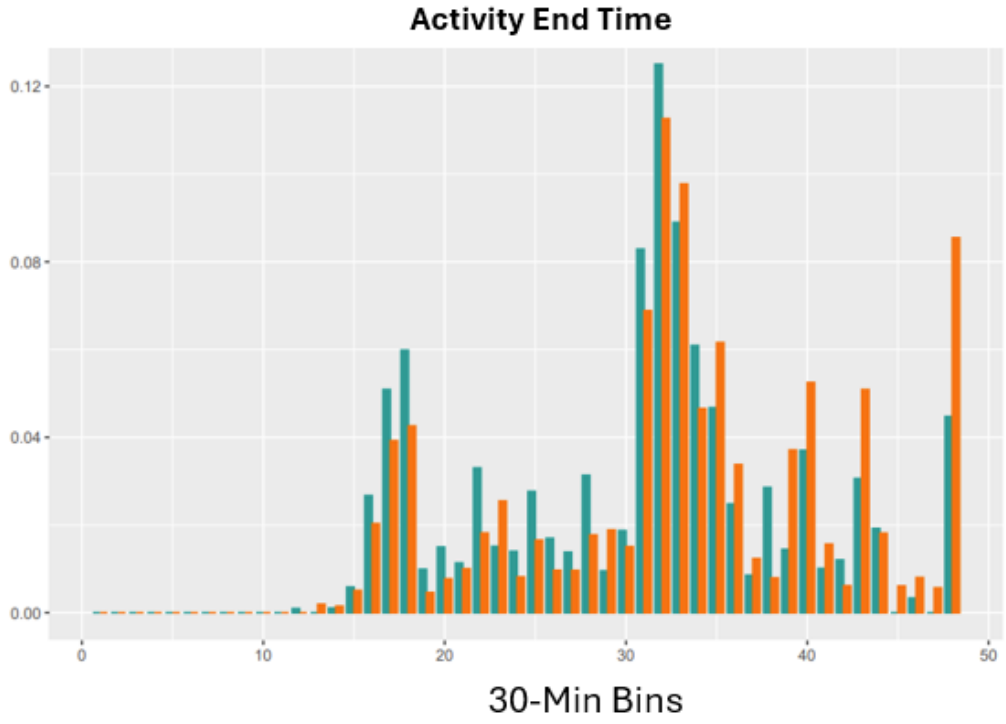
Overall distributions of generated activities







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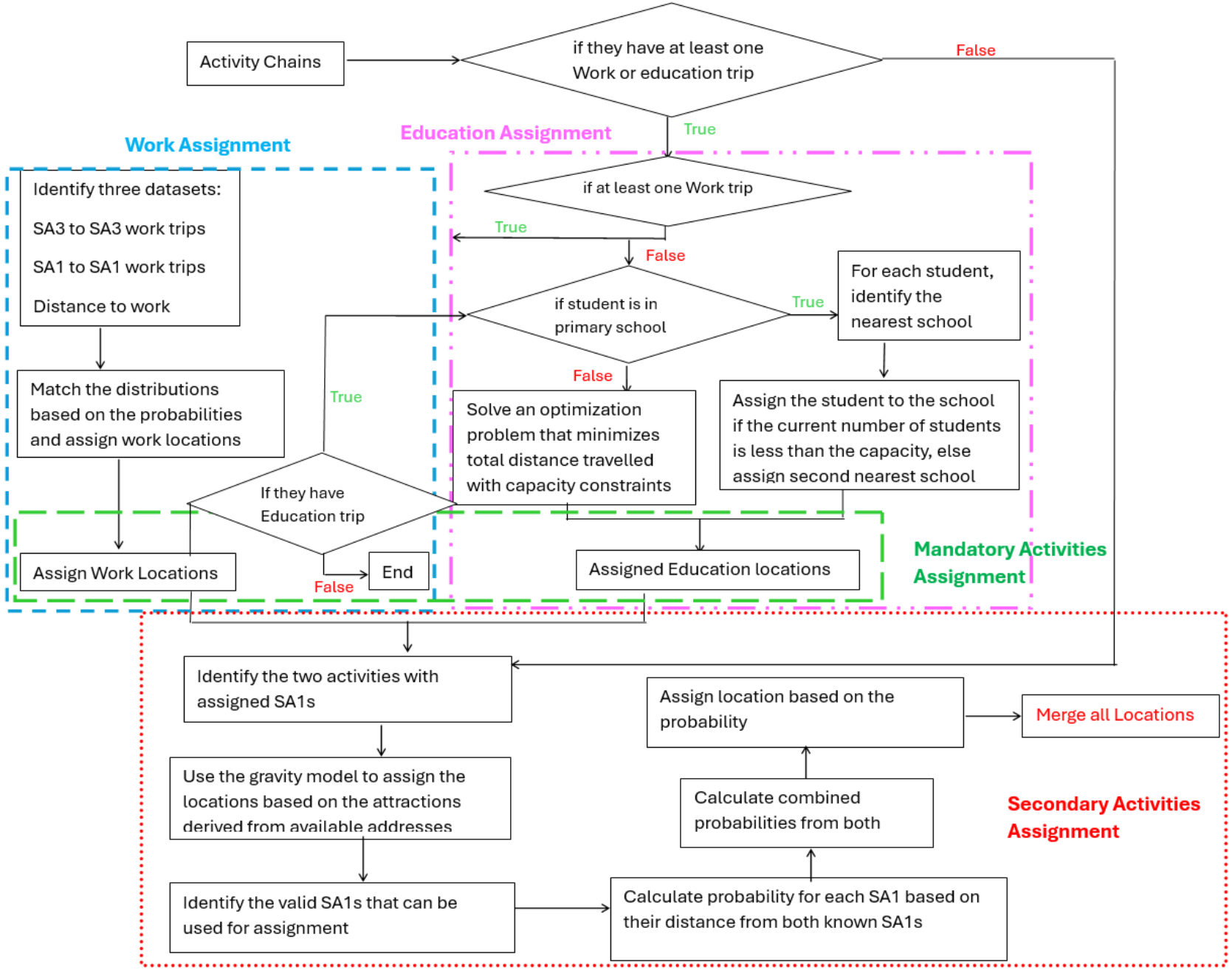
Location assignment

We divide the activities in two separate type: Mandatory (Work or Education) and Secondary activities and use separate algorithms for the assignment.



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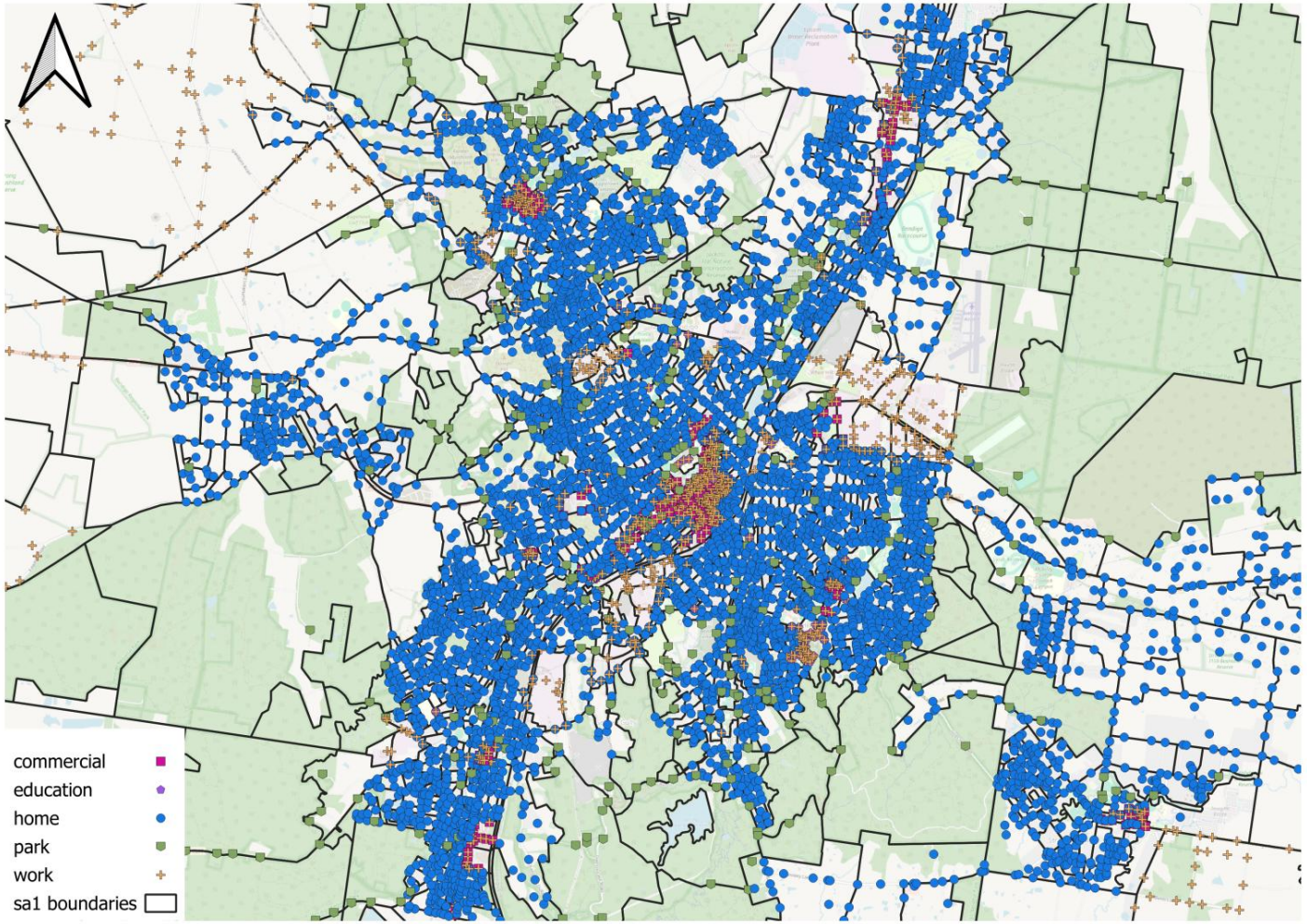
Work location assignment

The Australian Census journey-to-work data set is used to generate inputs.

The algorithm matches the distributions from the 3 main components:

1. People moving between SA3
2. People moving between SA1 within one SA3
3. Distance from home to work

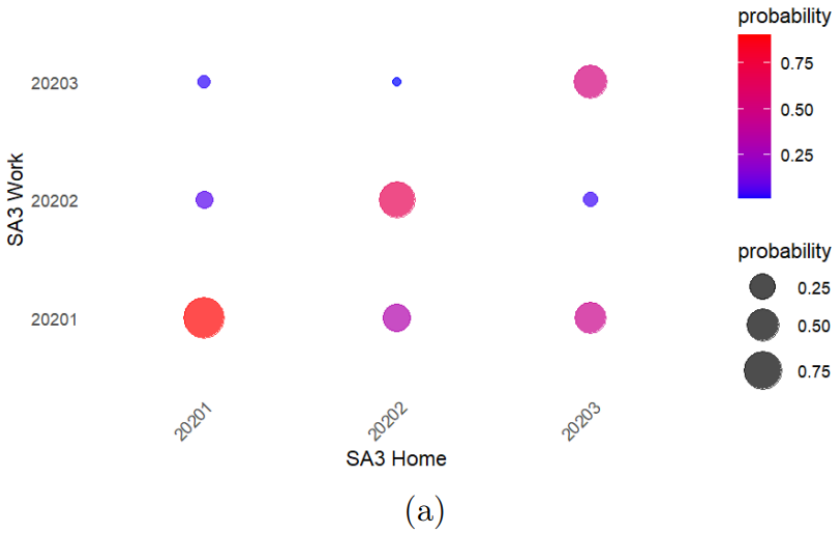
After the matches, based on an agent's home location, a work SA1 is allotted to them.



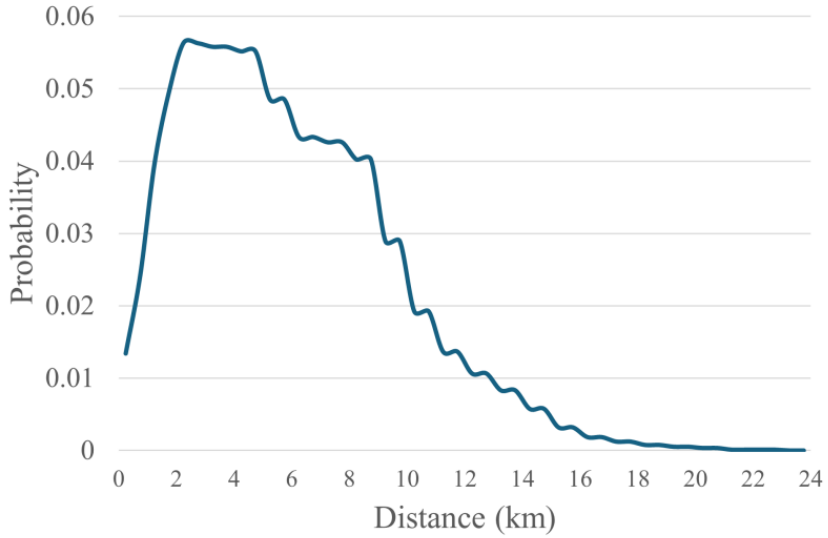
Different addresses within Greater Bendigo

Statistical Areas (SA) are sub-State regions classified under the Australian Statistical Geography Standard (ASGS), ranging from SA1 (smallest) to SA4 (largest)

Work location assignment



(a)



(b)

(a) Probability of choosing an SA3 work location for an SA3 home location; (b) Distance-based probability for choosing a work destination.

Education Location assignment

For primary students:

The primary students are assigned to the nearest schools from their home location.

For secondary and tertiary students:

- An optimization problem is solved to assign schools to the students with the aim is to minimize the total distance travelled by all students between their homes and schools.
- It starts with assigning nearby schools and then iteratively find better school till the total distance is minimized.
- The capacity constraints are used when assigning the locations to ensure a school does not have more than its capacity.

$$\min \sum_{i \in U_s \cup U_t} \sum_{j \in S} x_{ij} \cdot d(i,j)$$

Subject to:

$$x_{ij} \in \{0,1\}, \quad \forall i,j.$$

$$\sum_{j \in S} x_{ij} = 1, \quad \forall i \in U_s \cup U_t.$$

$$\sum_{i \in U_s \cup U_t} x_{ij} \leq C_s(s_j) \text{ or } C_t(s_j), \quad \forall j \in S.$$

Example Itinerary after mandatory location assignment

Id	Activity	StartBin	EndBin	SA1	LocationType
1	Home	1	16	20201102408	home
1	Other	16	17	NA	park
1	Shopping	17	18	NA	commercial
1	Work	18	34	20201101816	work
1	Pickup/Dropoff/Deliver	34	35	NA	commercial
1	Home	35	48	20201102408	home

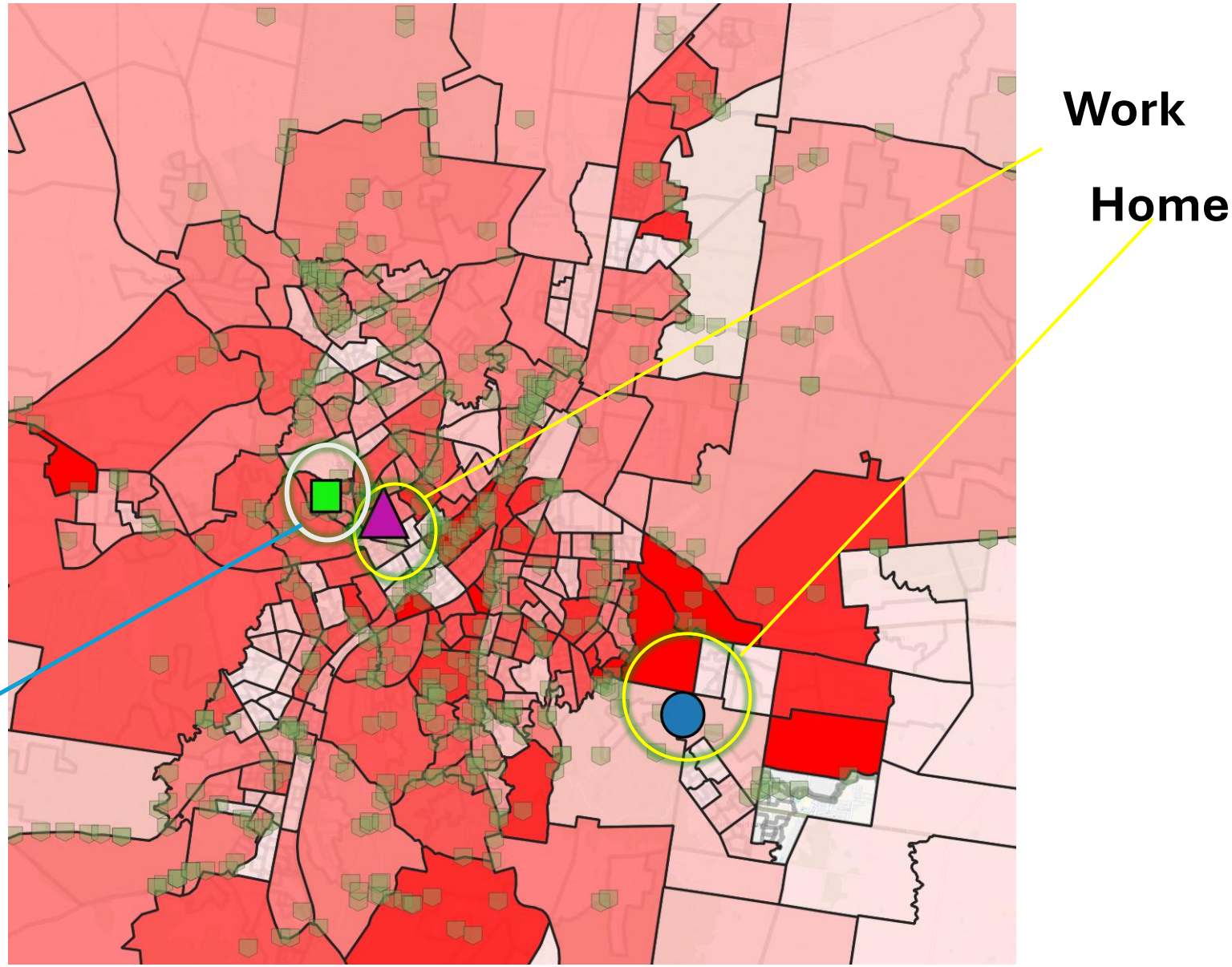
Secondary location assignment

- Used a gravity model, which assigns probabilities for both ends based on the attractions and distances.

- Literature shows that people tend to perform the secondary activities close to the locations of their primary activities.

- This is a dynamic process, which means after the assignment of one location, the probability is calculated for the current and next known activity's location.

Secondary location assignment



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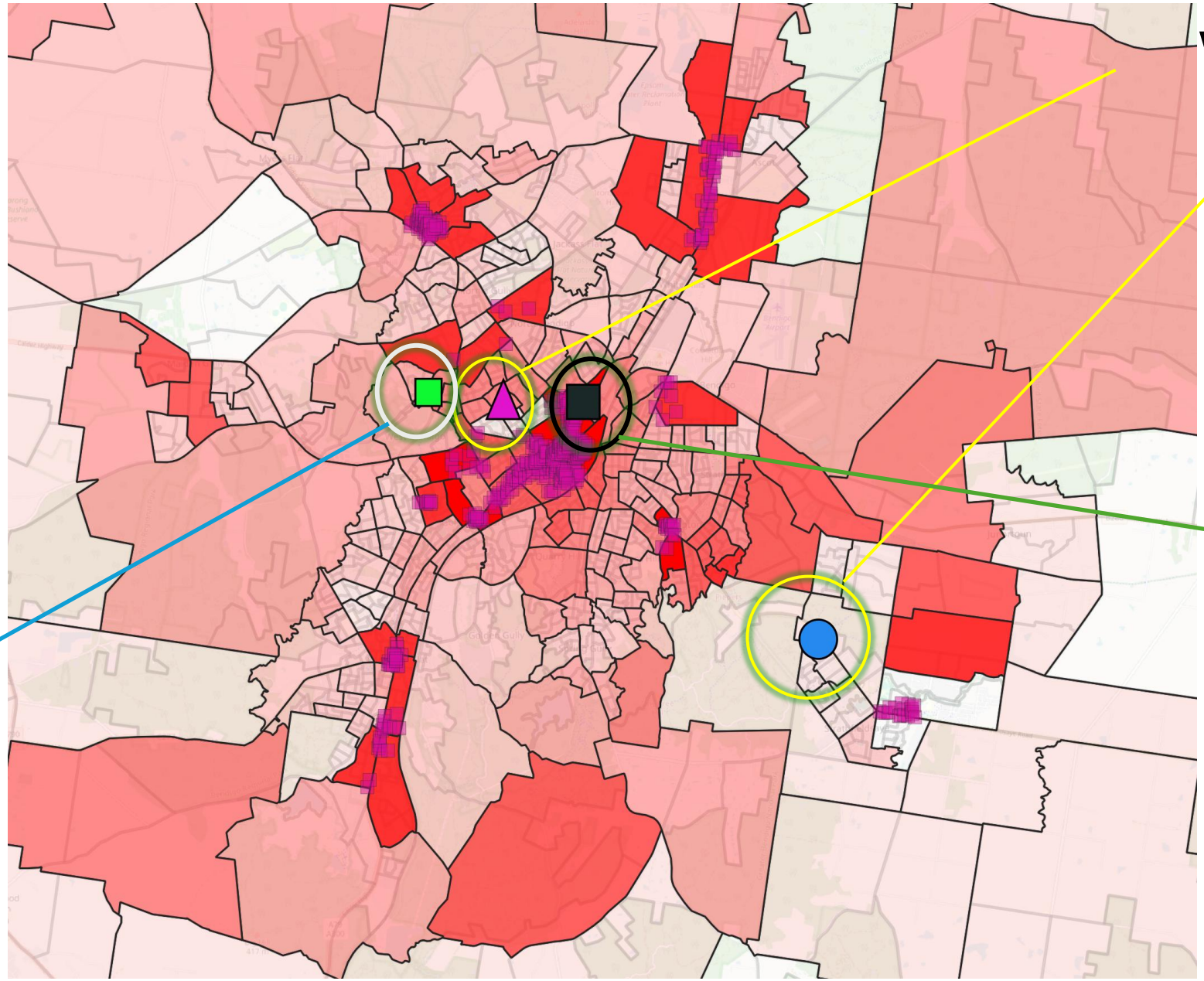

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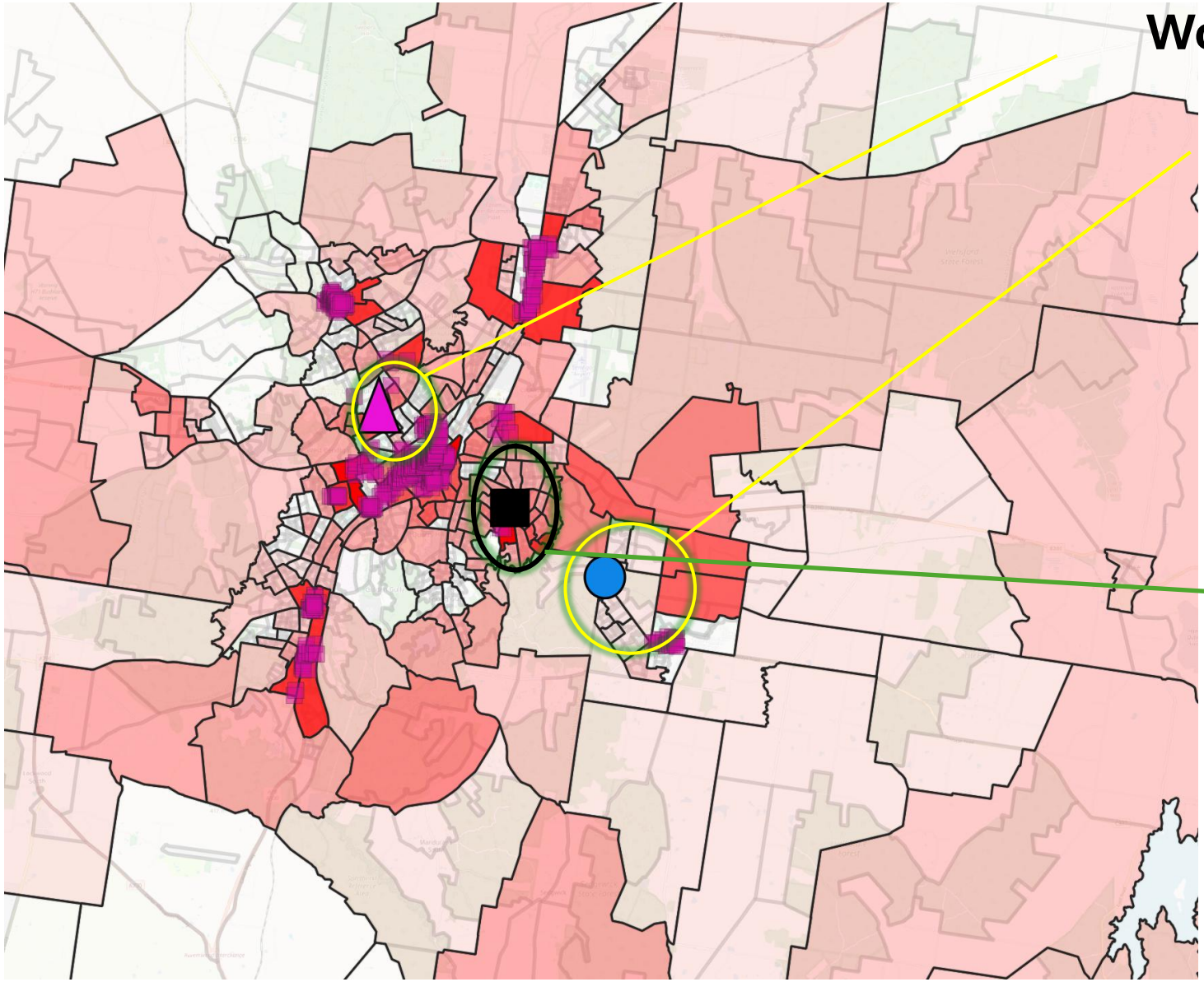

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1	Pickup/Dropoff/Deliver	34	35	NA	commercial
1	Home	35	48	20201102408	home

Final locations

Id	Activity	StartBin	EndBin	SA1	LocationType
1	Home	1	16	20201102408	home
1	Other	16	17	20201101836	park
1	Shopping	17	18	20201101835	commercial
1	Work	18	34	20201101816	work
1	Pickup/Dropoff/Deliver	34	35	20201102027	commercial
1	Home	35	48	20201102408	home

Key findings

- Using a multi-step assignment approach is beneficial for regional cities due to the limited availability of data.
- The methodology for education assignment with capacity constraints for schools, demonstrates robust performance in a dispersed, low-density setting and is transferable to other regional cities.
- The work location assignment approach is replicable in areas where the travel to work data is available, which can also be generated using the available work OD matrices.
- The multi-step assignment for work and education produced trip-distance distributions that closely match observed census and VISTA data for both SA1→SA1 and SA3→SA3 flows.
- Applying a dynamic gravity model for secondary (leisure/shopping) trips to capture location-choice probabilities.

Thank you!

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