Supplementary Material

1. Maximize attendance location-allocation method

This content summarizes the description of the Maximize Attendance location-allocation type (ArcGIS, 2023; Cooper, 1964).

Maximize Attendance chooses facilities such that as much demand weight as possible is allocated to facilities while assuming the demand weight decreases with distance. The demand points, represented by pie charts in this graphic (figure 1), show how much of their total demand is captured by the facility.

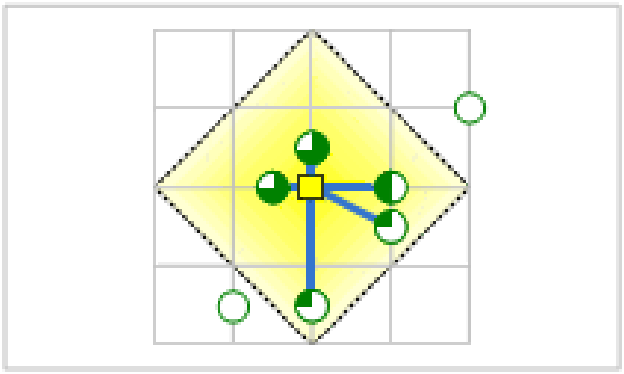

Figure 1 – Demand allocation in maximize attendance location-allocation type

Source: (ArcGIS, 2023)

Public transit bus stops are often chosen with the help of Maximize Attendance. Maximize Attendance assumes that the farther people have to travel to reach a facility, the less likely they are to use it. This is reflected in how the amount of demand allocated to facilities diminishes with distance. We specify the distance decay with the impedance transformation (see table 1 in the main paper).

1.1 Impedance Cutoff

Impedance Cutoff specifies the maximum impedance at which a demand point can be allocated to a facility. The maximum impedance is measured by the least-cost path along the network. If a demand point is outside the cutoff, it is left unallocated. This property might be used to model the maximum distance that people are willing to travel to a transit station, which is represented in our study by catchment areas (see table 1 in the main paper).

1.2 Impedance Transformation

This sets the equation for transforming the network cost between facilities and demand points. This property, coupled with the Impedance Parameter, specifies how severely the network impedance between facilities and demand points influences the solver's choice of facilities.

Applying a transformation can equalize the overall distances that demand points must travel to reach their nearest facility.

Accurately fitting an impedance transformation and parameter to describe priorities or model the behavior of demand points requires careful study, including research on topics like the Huff model and distance decay. The first step, however, is understanding how costs are transformed. In the following list of transformation options (table 1), d refers to demand points and f, facilities. So $impedance_{df}$ is the shortest-path network impedance between demand point d and facility f, and $cost_{df}$ is the transformed network impedance between the facility and demand point. Lambda (λ) denotes the impedance parameter.

Table 1 – Location-allocation impedance transformation functions

Impedance transformation	Description
Linear	$cost_{df} = \lambda * impedance_{df}$
Power	$cost_{df} = impedance_{df}^{\lambda}$
Exponential	$cost_{df} = e^{(\lambda * impedancedf)}$

In the linear impedance transformation, the impedance parameter is always internally set to one, since changing the value of a parameter on a linear transformation doesn't affect the solver's results. On the other hand, exponential transformations are commonly used in conjunction with an impedance cutoff.

The following list describes how the Maximize Attendance problem handles demand:

- Demand outside the impedance cutoff of all facilities is not allocated to any facility.
- When a demand point is inside the impedance cutoff of one facility, its demand weight is partially allocated according to the cutoff and impedance transformation. The demand points in the graphic above have pie charts to represent the ratio of their total demand weight that was captured by the chosen facility.
- The weight of a demand point covered by more than one facility's impedance cutoff is allocated only to the nearest facility.

2. Parameter values and scoring results

Selected Station	Proximity to future rail interchanges			Connection to other public transport modes			Link to surroundings			Social equity			Shared mobility infrastructure			Total HSS
	Measure (m)	Score	Weight	Measure	Score	Weight	Measure (m)	Score	Weight	Measure (%)	Score	Weight	Measure	Score	Weight	
Glen Waverley	1,406	2	0.3	Bus only	0	0.3	579	0	0.2	48%	1	0.1	Both	0	0.1	2.2
Clayton	5,154	0	0.3	Bus only	1	0.3	1412	3	0.2	53%	1	0.1	Shared micro-mobility only	2	0.1	2
Cheltenham	6,726	0	0.3	Bus only	1	0.3	1182	1	0.2	36%	1	0.1	Shared micro-mobility only	0	0.1	1.9
Huntingdale	6,924	0	0.3	Bus only	0	0.3	300	3	0.2	34%	1	0.1	None	1	0.1	1.9
Coburg	7,806	0	0.3	Bus only	2	0.3	290	2	0.2	44%	0	0.1	Both	1	0.1	1.6
Newmarket	3,239	0	0.3	Tram only	0	0.3	425	2	0.2	40%	1	0.1	Shared micro-mobility only	0	0.1	1.5
Rosanna	2,518	1	0.3	Bus only	1	0.3	441	1	0.2	41%	1	0.1	Shared micro-mobility only	2	0.1	1.5
Collingwood	6,933	0	0.3	Bus only	1	0.3	1,344	3	0.2	27%	1	0.1	Car-sharing only	0	0.1	1.5
Moreland	0	3	0.3	Bus and tram	1	0.3	1,089	0	0.2	37%	2	0.1	Car-sharing only	0	0.1	1.5
Glenferrie	4,648	0	0.3	Tram only	1	0.3	537	3	0.2	55%	1	0.1	None	0	0.1	1.4
Box Hill	3,587	0	0.3	Bus only	1	0.3	3,286	1	0.2	56%	1	0.1	None	0	0.1	1.4
Lalor	0	3	0.3	Bus only	1	0.3	5,295	2	0.2	52%	1	0.1	None	2	0.1	1.4
Sunshine	0	3	0.3	Bus only	1	0.3	2,688	2	0.2	37%	2	0.1	None	2	0.1	1.3
Royal Park	3,087	1	0.3	Bus and tram	1	0.3	1,819	3	0.2	20%	1	0.1	Shared micro-mobility only	3	0.1	1.3
Anstey	599	2	0.3	Bus only	1	0.3	578	2	0.2	34%	1	0.1	Shared micro-mobility only	1	0.1	1.2
Jacana	13,659	0	0.3	None	1	0.3	1,339	2	0.2	33%	1	0.1	Car-sharing only	2	0.1	1.2
Middle Brighton	3,898	0	0.3	Bus only	0	0.3	774	2	0.2	30%	1	0.1	Shared micro-mobility only	0	0.1	1.2
Springvale	4,767	0	0.3	Bus only	0	0.3	575	3	0.2	49%	1	0.1	Shared micro-mobility only	0	0.1	1.2
Windsor	2,972	1	0.3	Tram only	1	0.3	639	1	0.2	22%	1	0.1	None	1	0.1	1.2
Balaclava	5,007	0	0.3	Tram only	2	0.3	93	2	0.2	20%	1	0.1	Car-sharing only	0	0.1	1.1
Blackburn	8,781	0	0.3	Bus only	1	0.3	2,355	2	0.2	34%	1	0.1	Shared micro-mobility only	2	0.1	1.1
Flemington Bridge	6,929	0	0.3	Tram only	1	0.3	883	2	0.2	33%	1	0.1	None	0	0.1	1.1
Mount Waverley	0	3	0.3	Bus only	1	0.3	996	3	0.2	37%	1	0.1	None	3	0.1	1.1
Preston	4,450	0	0.3	Bus only	2	0.3	932	3	0.2	38%	2	0.1	None	0	0.1	1.1
Boronia	5,648	0	0.3	Bus only	1	0.3	484	2	0.2	44%	1	0.1	None	0	0.1	1
Brunswick	2,943	1	0.3	Bus only	1	0.3	207	1	0.2	31%	1	0.1	None	0	0.1	1
Noble Park	0	3	0.3	Bus only	1	0.3	564	3	0.2	45%	1	0.1	None	0	0.1	1
Nunawading	1,381	2	0.3	Bus only	0	0.3	360	2	0.2	36%	1	0.1	None	1	0.1	1

Cranbourne	4,136	0	0.3	Bus only	0	0.3	921	2	0.2	36%	1	0.1	Shared micro-mobility only	0	0.1	1
Fairfield	7,427	0	0.3	Bus only	1	0.3	1,666	2	0.2	32%	2	0.1	Car-sharing only	0	0.1	1
Gardenvale	2,481	1	0.3	Bus only	1	0.3	1,114	1	0.2	26%	1	0.1	Shared micro-mobility only	0	0.1	1
Leawarra	1,706	1	0.3	None	0	0.3	229	0	0.2	58%	1	0.1	Shared micro-mobility only	0	0.1	1
Murrumbeena	0	3	0.3	Bus only	1	0.3	1069	0	0.2	29%	2	0.1	Shared micro-mobility only	0	0.1	1
Hughesdale	5,012	0	0.3	Bus only	0	0.3	892	3	0.2	27%	2	0.1	None	2	0.1	0.9
Keon Park	7,676	0	0.3	Bus only	1	0.3	2,293	3	0.2	35%	1	0.1	None	2	0.1	0.9
Keilor Plains	3,912	0	0.3	Bus only	1	0.3	1,160	1	0.2	57%	1	0.1	None	0	0.1	0.9
Ascot Vale	4,426	0	0.3	None	3	0.3	740	2	0.2	35%	1	0.1	Car-sharing only	1	0.1	0.8
Ormond	3,028	1	0.3	Bus only	1	0.3	1,801	2	0.2	40%	1	0.1	Shared micro-mobility only	0	0.1	0.8
South Morang	3,848	0	0.3	Bus only	1	0.3	1,682	2	0.2	36%	1	0.1	Shared micro-mobility only	2	0.1	0.8
Glen Iris	9,280	0	0.3	Bus only	1	0.3	1,440	0	0.2	31%	1	0.1	None	0	0.1	0.8
Hampton	5,914	0	0.3	Bus only	2	0.3	1,124	3	0.2	32%	1	0.1	None	2	0.1	0.8
Werribee	3,914	0	0.3	Bus only	1	0.3	1,580	3	0.2	26%	1	0.1	None	0	0.1	0.8
East Malvern	4,739	0	0.3	None	1	0.3	312	3	0.2	32%	1	0.1	None	0	0.1	0.7
Patterson	3,461	0	0.3	None	0	0.3	668	1	0.2	33%	1	0.1	None	0	0.1	0.7
Albion	5,586	0	0.3	None	1	0.3	3,089	1	0.2	43%	1	0.1	None	2	0.1	0.7
Thomastown	3,502	0	0.3	Bus only	0	0.3	3,733	2	0.2	45%	1	0.1	None	0	0.1	0.7
Sandown Park	4,902	0	0.3	None	0	0.3	1,278	3	0.2	53%	1	0.1	None	0	0.1	0.6
Armadale	2,485	1	0.3	Bus only	1	0.3	1,655	2	0.2	27%	1	0.1	None	0	0.1	0.6
Canterbury	8,519	0	0.3	Bus only	1	0.3	1,672	1	0.2	37%	1	0.1	None	0	0.1	0.6
Moorabbin	1,647	1	0.3	Bus only	1	0.3	1,656	3	0.2	38%	1	0.1	None	2	0.1	0.6
Ripponlea	4,214	0	0.3	Bus only	3	0.3	1,616	1	0.2	25%	0	0.1	None	2	0.1	0.6
Upfield	5,128	0	0.3	Bus only	0	0.3	4,140	2	0.2	15%	2	0.1	None	0	0.1	0.6
Westall	4,772	0	0.3	None	1	0.3	1,853	1	0.2	36%	1	0.1	None	2	0.1	0.6
Bell	3,996	0	0.3	None	1	0.3	1,087	3	0.2	37%	1	0.1	None	2	0.1	0.5
Croxton	0	3	0.3	None	1	0.3	941	0	0.2	31%	1	0.1	None	0	0.1	0.5
Jewell	1,628	1	0.3	None	1	0.3	976	0	0.2	37%	1	0.1	None	0	0.1	0.5
Parkdale	4,301	0	0.3	None	0	0.3	1,197	1	0.2	40%	1	0.1	None	2	0.1	0.5
Thornbury	3,046	1	0.3	None	1	0.3	1,838	0	0.2	33%	0	0.1	Shared micro-mobility only	0	0.1	0.5
Laburnum	5,509	0	0.3	None	1	0.3	3,178	0	0.2	34%	1	0.1	None	0	0.1	0.4
Narre Warren	10,579	0	0.3	Bus only	1	0.3	2,684	2	0.2	44%	1	0.1	None	0	0.1	0.4
Watsonia	2,222	1	0.3	Bus only	0	0.3	2,916	1	0.2	37%	1	0.1	None	0	0.1	0.4
Oak Park	6,318	0	0.3	None	2	0.3	1,756	3	0.2	29%	0	0.1	None	0	0.1	0.3

Reference:

ArcGIS. (2023). *Location-Allocation Types*. https://desktop.arcgis.com/en/arcmap/latest/extensions/network-analyst/location-allocation.htm

Cooper, L. (1964). Heuristic Methods for Location-Allocation Problems. *SIAM Review*, *6*(1), 37-53. https://doi.org/10.1137/1006005