APPENDIX

According to the assumption of the OPS model [1], when an individual at location i makes a choice for location j, the probability of location j being selected is

$$Q_{ij} = \int_0^\infty \mathrm{Pr}_{m_i+s_{ij}}(z)\mathrm{Pr}_{m_j}(>z)\mathrm{d}z, \tag{1}$$

where m_i is the number of opportunities at location i, and s_{ij} is the number of intervening opportunities (*i.e.*, the sum of the number of opportunities at all locations at a shorter distance to i than j [2]). z is a random variable with a continuous distribution $p(z)$ representing the benefit of opportunities, $\mathrm{Pr}_{m_i+s_{ij}}(z)$ is the probability that the maximum benefit obtained after $m_i + s_{ij}$ sampling is exactly z, and $\mathrm{Pr}_{m_j}(>z)$ is the probability that the maximum benefit obtained after m_j samplings is greater than z.

Since $\mathrm{Pr}_x(<z) = p(<z)^x$, we can obtain

$$\mathrm{Pr}_x(z) = \frac{\mathrm{dPr}_x(<z)}{\mathrm{d}z} = xp(<z)^{x-1}\frac{\mathrm{d}p(<z)}{\mathrm{d}z}. \tag{2}$$

Substituting eq. (2) in eq. (1), we obtain

$$\begin{aligned} Q_{ij} &= \int_0^\infty (m_i+s_{ij})p(<z)^{m_i+s_{ij}-1}\frac{\mathrm{d}p(<z)}{\mathrm{d}z}[1-p(<z)^{m_j}]\mathrm{d}z \\ &= (m_i+s_{ij})\int_0^1 [p(<z)^{s_{ij}+m_i-1} - p(<z)^{m_j+s_{ij}+m_i-1}]\mathrm{d}p(<z) \\ &= (m_i+s_{ij})(\frac{p(<z)^{s_{ij}+m_i}}{s_{ij}+m_i}\Big|_0^1 - \frac{p(<z)^{m_j+s_{ij}+m_i}}{m_j+s_{ij}+m_i}\Big|_0^1) \\ &= (m_i+s_{ij})(\frac{1}{s_{ij}+m_i} - \frac{1}{m_j+s_{ij}+m_i}) \\ &= \frac{m_j}{m_i+s_{ij}+m_j}. \end{aligned} \tag{3}$$

[1] Liu, E. and Yan, X. (2019). New parameter-free mobility model: Opportunity priority selection model. Physica A 526, 121023

[2] Stouffer, S. A. (1940). Intervening opportunities: a theory relating mobility and distance. Am. Sociol. Rev. 5, 845-867