

Appendix A. The method of creating land use type

The data for each type of POI were aggregated at the hexagon level. Then, we generated the land use type for each hexagon based on the following Equations:

$$F_{ij} = \frac{n_{ij}}{N_i} \quad (2)$$

$$S_{ij} = \frac{F_{ij}}{\sum_{i=1}^7 F_{ij}} \quad (3)$$

where i represents the POI type; j is the individual hexagon; n denotes the number of POI type i within hexagon j ; N is the sum of POI i in a city; F_{ij} represents the frequency density of POI i for hexagon j in the city; S signifies the share of frequency density of POI i in hexagon j . If every $S_{ij} = 0$, land use for hexagon j is “no value”; if every $0 < S_{ij} < 50\%$, land use for hexagon j is “mixed-use”; if any $S_{ij} > 50\%$, land use for hexagon j is the single-use i .

This method gives the share of POI type i in a hexagon a weight of $1/N_i$, which represents the relative importance of POI type i . For instance, there are typically many more restaurants in a city than there are tourist attractions. Therefore, for a hexagon with a single tourist attraction and several restaurants, it may be reasonable to define this hexagon as a tourism hexagon rather than a commercial hexagon unless the number of restaurants is extremely high.