

Lecture

HUMAN GEOGRAPHY

Topic: Spatial Interaction and Gravity Model

By

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Spatial Interaction

SPATIAL INTERACTION IS A dynamic flow process from one location to another. It is a general concept that may refer to the movement of human beings such as intraurban commuters or intercontinental migrants, but may also refer to traffic in goods such as raw materials or to flows of intangibles such as information.

OR

Interaction between two places in terms of flow of good and services from Place A to Place B.

Three factors are necessary for a spatial interaction to occur:

- **Complementarity.** There must be a supply and a demand between the interacting locations. A residential zone is complementary to an employment zone because the first is supplying workers while the second is supplying jobs. The same can be said concerning the complementarity between a store and its customers and between an industry and its suppliers (movements of freight). An economic system is based on a large array of complementary activities.
- **Intervening opportunity (lack of).** Refers to a location that may offer a better alternative as a point of origin or as a point of destination. For instance, in order to have an interaction of a customer to a store, there must not be a closer store that offers a similar array of goods. Otherwise, the customer will likely patronize the closer store and the initial interaction will not take place.
- **Transferability.** Mobility must be supported by transport infrastructures, implying that the origin and the destination must be linked. Costs to overcome distance must not be higher than the benefits of the related interaction, even if there is complementarity and no alternative opportunity.

The Gravity Model

The gravity model is the most common formulation of the spatial interaction method. It is named as such because it uses a similar formulation than Newton's law of gravity. Gravity like representations have been applied in a wide variety of contexts, such as migration, commodity flows, traffic flows, commuting, and evaluating boundaries between market areas. Accordingly, the attraction between two objects is **proportional to their mass and inversely proportional to their respective distance**. Consequently, the general formulation of spatial interactions can be adapted to reflect this basic assumption to form the **elementary formulation** of the gravity model:

$$T_{ij} = k \frac{P_i P_j}{d_{ij}}$$

- P_i and P_j : Importance of the location of origin and the location of destination.
- d_{ij} : Distance between the location of origin and the location of destination.
- k is a proportionality constant related to the rate of the event. For instance, if the same system of spatial interactions is considered, the value of k will be higher if interactions were considered for a year compared to the value of k for one week.

Thus, spatial interactions between locations i and j are proportional to their respective importance divided by their distance. The gravity model can be extended to include several calibration parameters:

$$T_{ij} = k \frac{P_i^\lambda P_j^\alpha}{d_{ij}^\beta}$$

- P , d and k refer to the variables previously discussed.
- β (beta) : A parameter of transport friction related to the efficiency of the transport system between two locations. This friction is rarely linear as the further the movement the greater the friction of distance. For instance, two locations serviced by a highway will have a lower beta index than if they were serviced by a regular road.
- λ (lambda) : Potential to generate movements (emissivity). For movements of people, lambda is often related to an overall level of welfare. For instance, it is logical to infer that for retailing flows, a location having higher income levels will generate more movements (customers).
- α (alpha) : Potential to attract movements (attractiveness). Related to the nature of economic activities at the destination. For instance, a centre having important commercial activities will attract more movements.