

CIE4801 Transportation and spatial modelling

Exam questions spatial modelling

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17/4/13

Accessibility I (1 / 2)

Accessibility plays an important role in land use (spatial) modeling. Accessibility can be measured in several different ways. One measure is the potential accessibility.

a) Formulate a potential accessibility measure and define all the variables.

The models proposed by Hansen (1959) and by Lowry (1964) explicitly take accessibility measures into account.

b) Describe for both the Hansen model and the Lowry model how accessibility is affecting the location decisions of users.

Accessibility I (1 / 2)

a)
$$A_i = \sum_j M_j f(c_{ij})$$

where A_i is the (origin-based) accessibility of zone i , M_j is the potential of zone j (e.g., number of inhabitants, employers, shops, etc), c_{ij} is the travel time/cost from zone i to zone j , and f is a decreasing function, for example $f(c_{ij}) = \exp(-c_{ij})$

b) In the Hansen model, accessibility affects the location where residents will live. The more accessible a location is to jobs, the more likely residents will move to that location.

In the Lowry model, the residential location is affected by the accessibility to total employment, while service employment is affected by the attraction of service employment, which is defined in terms of accessibility.

Accessibility I (2/2)

When households or firms decide to move, they have to choose between different locations to move to.

c) What is usually the most important aspect (or attribute) when choosing a new location? Explain your answer.

c) The distance from the current location (of the residential place, firm/employer location) is typically the most important attribute. In general, residents search for a house in the neighborhood of their current residential location, and employers typically search for a new firm location that is not too far away from the current location.

Accessibility II (1 / 3)

Accessibility has important implications for location decisions of users (households and firms) and therefore influences activities.

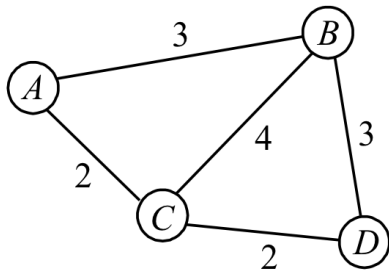
a) Give a definition of accessibility.

The extent to which the land-use/transport system enables persons or goods to reach activities or destinations by means of transport modes.

[origin-based formulation, can also be written destination-based in which persons or goods from other places can reach the zone under consideration]

Accessibility II (2/3)

Consider the following network with four zones (*A* through *D*), each having a certain potential (e.g., jobs, residents, activities, etc.), and with given distances between the zones given in the figure. Assume that the intrazonal distances are all equal to 1.



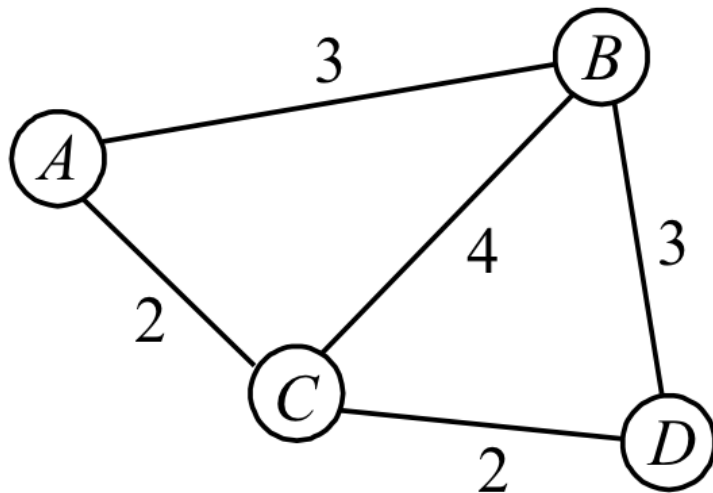
Zone	Potential
<i>A</i>	200
<i>B</i>	100
<i>C</i>	400
<i>D</i>	250

b) Mathematically formulate a suitable accessibility measure which takes the zonal potentials and the distances between the zones into account.

$$A_i = \sum_j P_j F(c_{ij}), \text{ with e.g. } F(c_{ij}) = 1 / c_{ij}$$

Accessibility II (3/3)

c) Determine for this network the ranking of the zones from most accessible to least accessible, based on your measure defined in (b) (intrazonal distance=1)



Zone	Potential
<i>A</i>	200
<i>B</i>	100
<i>C</i>	400
<i>D</i>	250

Accessibility II (3 / 3)

$$A_1 = 200 / 1 + 100 / 3 + 400 / 2 + 250 / 4 = 496$$

$$A_2 = 200 / 3 + 100 / 1 + 400 / 4 + 250 / 3 = 350$$

$$A_3 = 200 / 2 + 100 / 4 + 400 / 1 + 250 / 2 = 650$$

$$A_4 = 200 / 4 + 100 / 3 + 400 / 2 + 250 / 1 = 533$$

Therefore, the ranking from most accessible zone to least accessible zone is: zone 3, zone 4, zone 1, zone 2.

Classical models (1 / 2)

The disaggregate micro-economic model by Von Thünen describes how the production size of a certain good is determined.

a) How do the transportation costs impact upon the production size in the model by Von Thünen?

Goods that are produced have to be brought to a central market place, with a certain transportation cost. The further away these goods are produced, the larger the transportation costs. At some distance, it is no longer beneficial to produce goods, the surplus will be zero, hence limiting the production size.

Classical models (2/2)

The aggregate models proposed by Hansen and by Lowry explicitly take accessibility measures into account.

b) How does accessibility impact upon the residential location choice in the model by Hansen?

c) How does accessibility impact upon the service employment location choice in the model by Lowry?

Residents are assumed to prefer to be close to jobs, hence an origin-based definition of accessibility is used, stating how close a certain zone is to jobs in the current or other zones. Residents will thereby live in more accessible zones.

Firms are assumed to prefer to be close to service firms, hence a destination-based definition of accessibility is used, stating how close a certain zone is to service firms in the current or other zones.

LUT-models (1 / 2)

Integrated land use – transportation models describe the two-way interaction between land-use and transport. The two types of models therefore interact, in which different actors (also called decision makers or agents) are involved.

a) Which actors can be distinguished? And which kind of choices do these actors make?

households: choosing to move and choosing a residential location

firms: employment level and location (plus decision to move)

developers: real-estate development

government: infrastructure and land use policies

LUT-model (2/2)

b. Which of the following 10 processes are described within the transport system, which ones in the land use system, and which ones are usually exogenous to the model?

- T • route choice
- L • real-estate development
- L • job changes
- E • demographic changes
- T • destination choice
- E • infrastructure investments
- L • moving to a new house
- T • buying a car
- T • using a car
- E • tax rates