BREAKING POINT ANALYSIS

By: ***Dr. Sayanti Poddar***

Asutosh College

FUNCTIONAL REGIONS

- A functional region is a territorial unit resulting from the organisation of social and economic relations in that its boundaries do not reflect geographical particularities or historical events. It is thus a functional sub-division of territories

- Functional regions are often organized around a central point which is also called node.

- The concept of functional region provides a way to examine the linkages and flows that create interdependence among people.

- Functional regions are defined by their organizational structure. They are also called nodal regions because they usually revolve around a focal center, such as the downtown core of an urban region or the local service area surrounding a library or post office or shopping mall (Dunford, 2009).

DELINEATION OF FUNCTIONAL REGIONS

Delineation of Functional Regions is done by using any of the 2 most widely used methods: These are:

- Flow Analysis
- Gravitational Analysis

Flow Analysis Method – Functional Region Delineation

- Flow analysis builds up functional regions on the basis of the direction and intensity of flows between the dominant centre and surrounding satellites.
- Each flow will show decreasing intensity as it becomes more distant from the main centre and increasing intensity as it approaches another centre.
- The boundary of the sphere of influence of the dominant centre will be where the flow intensity at a minimum.
- When the flow significantly drops that means interaction/origin's influence drops. In terms of distance, in a particular direction, there is the influence of the node and there onwards it drops.
- This gives cut off points.
- Tentative delineation is done.

- **Features of Flow Analysis Method**
- Builds up flows on the basis of the direction and intensity flows between the dominant centre and surrounding satellites.
- Flows may be of several types: economic (road, rail, shopping or commuting); social (such as flow of students or patients); political (flow of govt. expenditure); information (newspapers, telephone calls), etc.
- Graph theory: measures the relationship (economic, social, etc.) between selected group of centres on the basis of flows between the centres. The no. of telephone calls is the usual flow criteria.
- The flows are plotted in matrix form, from which primary and secondary flows into and out of each centre can be identified.

The flows may be of several types

Economic – cargo or passenger, road or rail

Purpose – shopping or commuting

Social – flow of students or hospital patients

Political – flow of govt. Expenditure

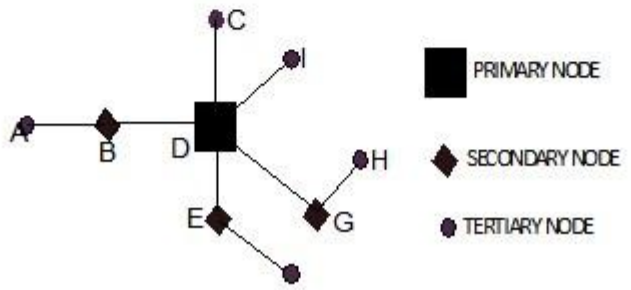
Information- telegrams, newspapers and telephone calls.

Illustrative example using Flow Analysis Method

TELEPHONE CALLS ('000 PER DAY) TO CENTRE

TELEPHONE CALLS ('000 PER DAY) FROM CENTRE

	A	B	C	D	E	F	G	H	I	TOTAL
A		40		20						60
B	10			60						70
C				30					10	30
D		60			40					100
E				30		10				40
F					20		10			30
G				50				20		70
H				20			30			50
I			10	40						50
TOTAL	10	100	10	250	60	10	40	20	10	



The no. of telephone calls is taken as the flow criteria. The flows are plotted in matrix form, from which the primary and secondary flows into and out of each centre can be identified. The resulting hierarchy of nodes can plotted as a simple network, providing an insight into the form and extent of functional relationships within an area. Here D is the major centre, with B.E and G subsidiary centres.

Gravitational Analysis Method

- It is concerned with the theoretical forces of attraction between centres rather than actual flows. The gravity model assumes that the interaction between two centres is directly proportional to the 'mass' of the centres and inversely proportional to 'distance' between the centres.
- 'Mass' can be population, employment, income, expenditure and retail turnover.
- Distance can be in physical terms (km), time, price, and intervening opportunities.
- In mathematical notation f = k (m1 * m2)/d
- Where f is the force of attraction between two settlements, m1 and m2 are masses of the two settlements and d is the distance between them. K is a constant.

- **Features of Gravitational Analysis Method**
- It is concerned with the theoretical forces of attraction between centres rather than the actual flows.
- This model assumes that the interaction between two centres is directly proportional to the 'mass' of centres and inversely proportional to the 'distance' between them.
- 'Mass' is represented by variables like population, employment, income, expenditure and retail turnover.
- 'Distance' is represented in physical terms (miles), time, price and intervening opportunities.
- Mathematically
- By calculating the potential for the centres, lines illustrating relative attractiveness, spheres of influence of various centres can be plotted on a map.
- From such lines, functional regions can be identified.

- **<u>Concept of Demographic or Gravitational Potential</u>**
- The demographic potential at centre 'i' caused by a mass centre j (jvi), is defined as
- $ivj = k (mj)/dij$
- By calculating potential for the centres in a study area, contour lines of equal potential can be plotted on a map, illustrating the relative attractiveness, spheres of influence, of the various centres. From such lines, functional regions can be identified.

Reilly's Law of Retail Gravitation

- In 1931, William J. Reilly was inspired by the law of gravity to create an application of the gravity model to measure retail trade between two cities.
- His work and theory, ***The Law of Retail Gravitation***, allows us to draw trade area boundaries around cities using the distance between the cities and the population of each city.
- Reilly realized that the larger a city, the larger a trade area it would have and thus it would draw from a larger hinterland around the city.
- Two cities of equal size have a trade area boundary midway between the two cities.
- When cities are of unequal size, the boundary lies closer to the smaller city, giving the larger city a larger trade area.
- Reilly called the boundary between two trade areas the breaking point (BP). On that line, exactly half the population shops at either of the two cities.
- The formula is used between two cities to find the BP between the two. The distance between the two cities is divided by one plus the result of dividing the population of city B by the population of city A.
- The resulting BP is the distance from city A to the 50% boundary of the trade area.
- One can determine the complete trade area of a city by determining the BP between multiple cities or centres.
- Of course, Reilly's law presumes that the cities are on a flat plain without any rivers, freeways, political boundaries, consumer preferences, or mountains to modify an individual's progress toward a city.

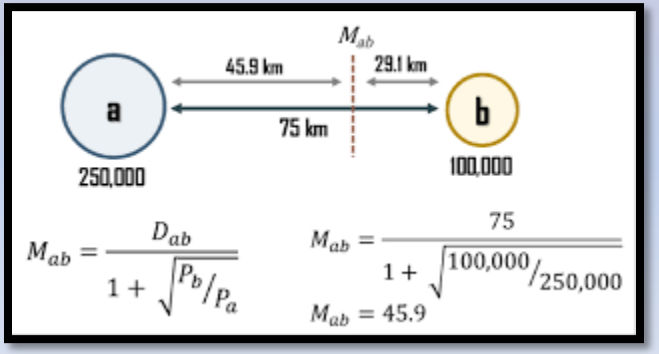
BREAKING POINT ANALYSIS

The theoretical position of the margin of an urban field can be calculated by using a technique known as breaking point theory. This is a simple variation on the standard gravity model.

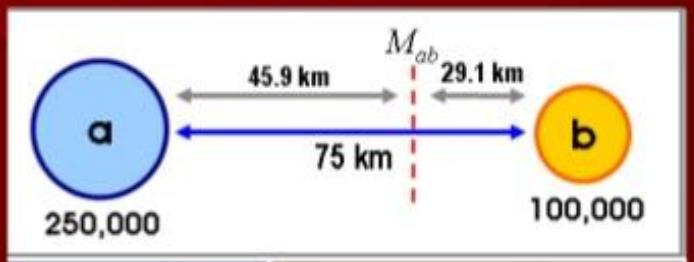
The breaking point between two towns divides the people who will travel to one town from those who will travel to another town for similar services. If enough breaking points can be established around a town, its theoretical urban field can be delimited in that way.

$$BP = \frac{\text{distance between city a and b}}{1 + \sqrt{\frac{\text{pop. b}}{\text{pop. a}}}}$$

BP is distance from city a to breaking point



Breaking Points
Reilly's Gravitation Model Applied



$$M_{ab} = \frac{D_{ab}}{1 + \sqrt{P_b / P_a}}$$

$$M_{ab} = \frac{75}{1 + \sqrt{100{,}000 / 250{,}000}}$$

$$M_{ab} = 45.9$$

Explanation of Equation

M_{ab} = Distance of breaking point from Town B

D_{ab} = Distance between Town A & B

P_a = Population of Town A

P_b = Population of Town B

- Gravitational models say: along a route between Point A and Point B there will be a **breaking point**
- People on left side of the breaking point would shop in Town A, while people on right side of it would shop in Town B
- Operates on assumption that larger towns attract more people → **logical behavior**
- See attachment for applied examples

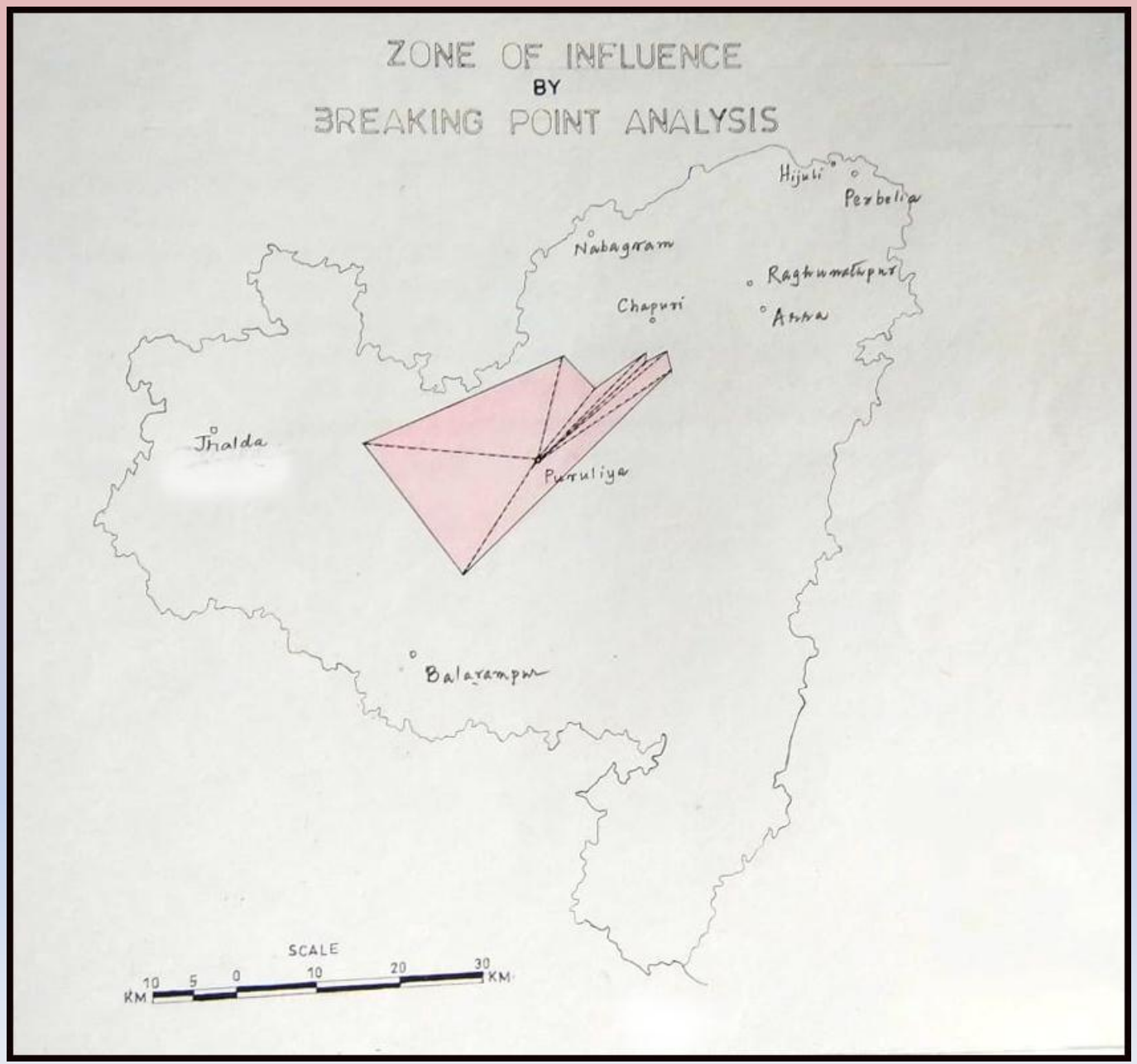

ZONE OF INFLUENCE
BY
BREAKING POINT ANALYSIS
Hijuli
Pezbelia
Nabagram
Raghunathpur
Chapuri
Arsha
Jhalda
Purulia
Balarampur
SCALE
10 5 0 10 20 30
KM
KM

Table for the Calculation of Zone of Influence
by
Breaking Point Analysis of Puruliya Town,2001

Name of Railway Station	Total Population (2001)	Distance in km from Puruliya	Distance in cm from Puruliya	Breaking Point Distance in cm
Puruliya	113766	-		
Balarampur	21824	17.75	4.2	2.92
Raghunathpur	21812	21.58	5.6	3.89
Arra	19911	20.63	5.2	3.67
Jhalda	17870	21.86	5.5	3.94
Chapari	7242	12.08	3.0	2.40
Hijuli	6856	19.44	4.9	3.93
Perbelia	6036	18.77	4.7	3.82
Nabagram	5642	12.93	3.2	2.62

Zone of Influence
by
Breaking Point Analysis of Barddhaman Town,2011

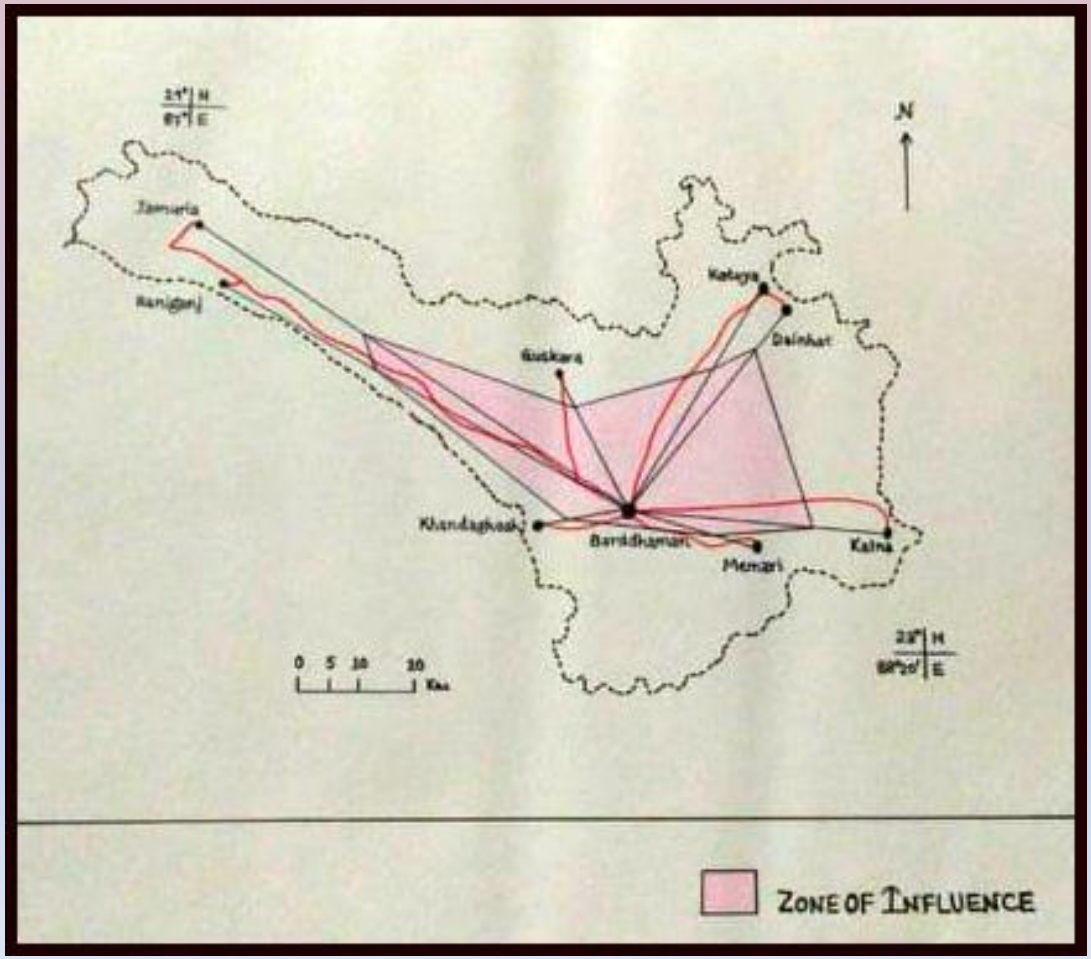


Table for the Calculation of Zone of Influence by Breaking Point Analysis of Barddhaman Town, 2011

Name of Town	Population	Distance from Barddhaman in cm	Breaking Point Distance in cm
Barddhaman	285602	-	-
Memari	36207	2.3	1.70
Kalna	52182	5.0	3.50
Dainhat	22597	5.0	3.90
Katowa	71589	4.7	3.13
Guskara	31867	2.9	2.18
Jamuria	129484	10.2	6.10
Ranigunj	111116	8.9	5.48
Khandaghosh	170331	2.0	1.13