Delineation of Functional Region
(by Law of Retail Gravitation and Breaking-Point analysis)

GEO-A CC4-P (Regional Planning)

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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 (kms), 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 centers rather than the actual flows.
- This model assumes that the interaction between two centers is directly proportional to the 'mass' of centers 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.

- By calculating the potential for the centers, lines illustrating relative attractiveness, spheres of influence of various centers can be plotted on a map.
- From such lines, functional regions can be identified

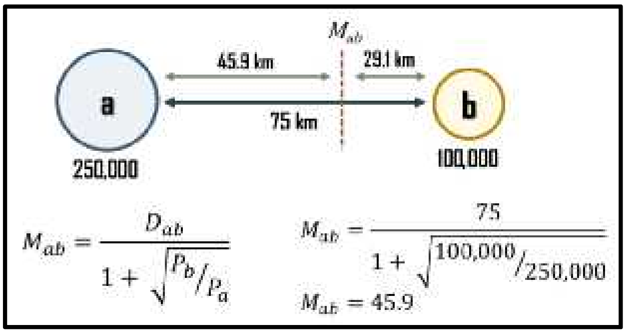
Reilly's Law of Retail Gravitation: In 1931, William J. Reilly was inspired by the law of gravity to create an application of the gravity model to measure retail trade between two cities. His work and theory, *The Law of Retail Gravitation*, allows us to draw trade area boundaries around cities using the distance between the cities and the population of each city. According to Reilly's "law," customers are willing to travel longer distances to larger retail centers given the higher attraction they present to customers. In Reilly's formulation, the attractiveness of the retail center becomes the analogy of size (mass) in the physical law of gravity.

The law presumes the geography of the area is flat without any rivers, roads or mountains to alter a consumer's decision of where to travel to buy goods. It also assumes consumers are otherwise indifferent between the actual cities. In analogy with Newton's law of gravitation, the point of indifference is the point at which the "attractiveness" of the two retail centres (postulated to be proportional to their size and inversely proportional to the square of the distance to them) is equal:

History of the Theory: 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 centers. 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.

$$D_{BP} = \frac{\text{Distance between City a and b}}{1 + \sqrt{\frac{\text{population b}}{\text{population a}}}}$$

Note: D_{BP} is the distance from City "a" to the Breaking Point.



P.D. Converse's Breaking-Point analysis: Reilly's Law has several limitations. Perhaps the most significant of these is the use of population as a "surrogate measure of the number and quality of retail stores" in a trade area (Sheth, Gardner, and Garrett 1988). Yet no one would make a serious attempt to extend, revise, or refute Reilly's original work until P.D. Converse in 1949. Converse's New Law and the Breaking-Point Model. P.D. Converse took Reilly's idea of the breaking-point and expanded it. In a concisely written article for the Journal of Marketing, Converse first introduces a formula for determining "the boundaries of a trading center's trade area" (1949, p. 379):

$$\text{Breaking Point, miles from } B = \frac{\text{Miles between } A \text{ and } B}{1 + \sqrt{\frac{\text{Population of } A}{\text{Population of } B.}}}$$

The Breaking-Point Model and the revision to Reilly's Law provides the platform for Converse's "New Law of Retail Gravitation" (1949). Converse defines his New Law in the following terms: “a trading center and a town in or near its trade area divide the trade of the town approximately in direct proportion to the populations of the two towns and inversely as the squares of the distance factors, using 4 as the distance factor of the home town” (1949). Like Reilly’s Law, this new Law relies upon two simple variables, population and distance, but it has certain advantages over Reilly’s formula. According to Converse, the new Law “can be applied to satellite towns or other towns inside the trade area of a larger town”. Furthermore, “it gives an approximate measure of how the trade is divided without making a survey” (Converse 1949). Converse’s first formula makes it possible for retailers to approximate a town’s trade area “in a very few minutes, without any field work” (1949). All a retailer needs to determine the boundaries is a highway map and population figures.

Despite its aforementioned benefits, Converse’s New Law has many limitations. In the article, Converse acknowledges that its predictive capacity is compromised when town a is much larger than town b. Furthermore, Converse determined the distance factor solely from “shopping goods” and “fashion goods” data (1949). The generalizability of the inertia-distance factor is thus questionable. Does it hold for different categories of retailers? And what about possible confounding variables that Reilly’s Law also ignores, such as traffic, available parking space, and the quality and costs of the retailer’s products? Unfortunately, these questions remain unanswered in Converse’s revision.