

THE GRAVITY MODEL

The gravity model, as social scientists refer to the modified law of gravitation, takes into account the population size of two places and their distance. Since larger places attract people, ideas, and commodities more than smaller places and places closer together have a greater attraction, the gravity model incorporates these two features.

The relative strength of a bond between two places is determined by multiplying the population of city A by the population of city B and then dividing the product by the distance between the two cities squared.

Thus, if we compare the bond between the New York and Los Angeles metropolitan areas, we first multiply their 1998 populations (20,124,377 and 15,781,273, respectively) to get 317,588,287,391,921 and then we divide that number by the distance (2462 miles) squared (6,061,444). The result is 52,394,823. We can shorten our math by reducing the numbers to the millions place - 20.12 times 15.78 equals 317.5 and then divide by 6 with a result of 52.9.

Now, let's try two metropolitan areas a bit closer - El Paso (Texas) and Tucson (Arizona). We multiply their populations (703,127 and 790,755) to get 556,001,190,885 and then we divide that number by the distance (263 miles) squared (69,169) and the result is 8,038,300. Therefore, the bond between New York and Los Angeles is greater than that of El Paso and Tucson!

How about El Paso and Los Angeles? They're 712 miles apart, 2.7 times farther than El Paso and Tucson! Well, Los Angeles is so large that it provides a huge gravitational force for El Paso. Their relative force is 21,888,491, a surprising 2.7 times greater than the gravitational force between El Paso and Tucson! (The repetition of 2.7 is simply a coincidence.)

While the gravity model was created to anticipate migration between cities (and we can expect that more people migrate between LA and NYC than between El Paso and Tucson), it can also be used to anticipate the traffic between two places, the number of telephone calls, the transportation of goods and mail, and other types of movement between places. The gravity model can also be used to compare the gravitational attraction between two continents, two countries, two states, two counties, or even two neighborhoods within the same city.

Some prefer to use the functional distance between cities instead of the actual distance. The functional distance can be the driving distance or can even be flight time between cities.

The gravity model was expanded by William J. Reilly in 1931 into Reilly's law of retail gravitation to calculate the breaking point between two places where customers will be drawn to one or another of two competing commercial centers.

Opponents of the gravity model explain that it can not be confirmed scientifically, that it's only based on observation. They also state that the gravity model is an unfair method of predicting movement because it's biased toward historic ties and toward the largest population centers. Thus, it can be used to perpetuate the status quo.