Modeling Economic Geography

Comps Project Description

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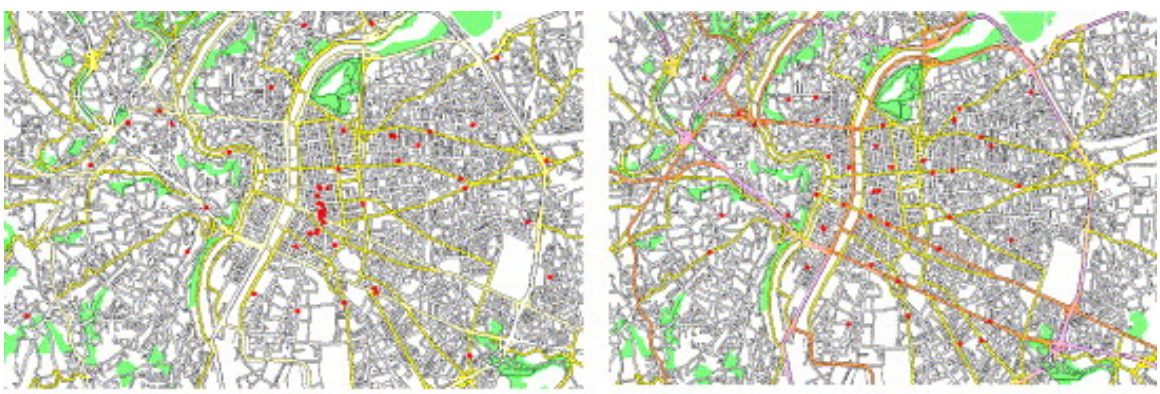
What is Economic Geography?

Let's start with an example. If you were to open a sandwich shop aimed primarily at college students in Northfield, where would you put it? Perhaps, thinking that people will likely eat at the sandwich shop closest to where they live, you might want to put it far away from Hogan Brothers, say, across the Cannon. On the other hand, you might notice that downtown Northfield generates a lot of foot traffic, and aim to locate yourself on Division St. You might even reason that people looking for a sandwich are likely to go to Hogan Brothers, and so locating yourself adjacent to Hogan Brothers may be like free advertising.

It is evident that there are competing attractive forces (which we call agglomeration forces) and repulsive forces (which we call dispersion forces) among businesses in the same industry. Empirically, the relative strengths of these forces vary by industry, leading to wildly different retailer distributions. The image below compares the locations (in red) of motorbike sellers (on the left) and savings banks (on the right) in Lyon. Why do they look so different?



(a) (b)

Economic geography is the study of where retailers, as well as other economic entities (such as people) choose to locate themselves. The field is complex because the agglomeration and dispersion forces are interlinked, leading to many interesting mathematical models which employ tools from diverse mathematical areas including differential equations, probability, game theory, topology, and numerical modeling. Through the course of this project we will study a variety of well known models in economic geography, and we will do our best to extend these models and, if we are daring, invent our own. In what follows, I'll give an overview of two flavors of models we will study.

Two Region Models

In two region models, the economy is abstracted into two regions, such as the two sides of the Cannon. It is important to these models that there be some obstacle to movement of people and/or goods between the regions (such has having to walk across a bridge), because otherwise the regions will effectively be one big region. These models then strive to capture the agglomeration and dispersion forces mathematically, and find the equilibrium distributions between the two regions.

You can convince yourself that the two regions each being identical is always an equilibrium for symmetry reasons. If the dispersion forces totally dominate the agglomeration forces, this will be the unique stable equilibrium. On the other hand, if agglomeration forces totally dominate dispersion forces, this equilibrium will be unstable, and the forces will push as all economic activity towards one region. Most interestingly, if the two forces "balance" properly, one may end up with an equilibrium where economic activity is only partially skewed towards one region, such as has happened in Northfield. This is known as the core-periphery outcome. Despite their seeming simplicity, these models exhibit complex mathematical behaviors, such as multiple equilbria.

Lattice Models

A new and exciting kind of model are the lattice based models, which attempts to simulate the distribution of retail outlets in 2-dimensional space. The (not necessarily attainable) goal of these models is to find some set of simple assumptions that lead to an analytically tractable model that produces the fractal-like behavior we see with retailer locations in real life. As we study the existing models (both computationally and analytically) we'll see why meeting this goal is so difficult, and do our best to make our own contributions!

Prerequisites

There are no prerequisites for this project, but some skills that might be helpful include a knowledge of differential equations, statistics, economics, or programming.

What if I Want to Know More?

If you have any questions please feel free to come by my office in Laird 15-D, or email me at tocchipint@carleton.edu. If you are interested in a very readable treatise on the issues addressed here, I recommend the introduction of Fujita and Thisse's **Economics of Agglomeration**, which can easily be found by google. If you're interested in seeing the mathematical side of the lattice based models, I recommend looking up the article *Aggregation of retail stores* by Jensen, Boisson, and Larralde (also freely available to you).