**Assignment 2**

**John Hopkins University – Computational Modeling for Policy and Security Analysis**

This paper will walk through the Hotelling Law model (Ottino, Stonedahl, Wilensky, 2009) available in the NetLogo model library. The Hotelling Law model is a representation of Hotelling’s Law (Hotelling, 1929), which posits that in some markets, competitors will become similar to each other in order to increase their market share. Hotelling demonstrated this in his paper by imaging two businesses (A and B), where on could re-locate (B) and the other could not (A), and the only way customers differentiated between the two was on their distance from the business. In this example, business B would locate as close to A as possible in order to maximize the number of customers it was closer to. The Hotelling Law model reimagines Hotelling’s demonstration by allowing the businesses to move in two-dimensional space, change their prices, and allowing more than 2 businesses.

The Hotelling Law model generates “stores” using “turtles” in NetLogo. The number of stores generated is selected by the user using a slider. At setup, the stores are randomly generated on an available patch, assigned a unique random color, and (if applicable) assigned a price of 10. The model uses NetLogo patches as “customers” – each patch is a customer, and at setup each customer chooses the store that minimizes the distance from the customer to the store plus the price of the store (if applicable). Each customer is assigned a color that is a couple shades lighter than the color of its preferred store.

Each turn, every store examines its current patch, and every patch that is one unit away on the x-axis, or one unit away on the y-axis from its current patch to determine which patch would win it the most customers. It then chooses this patch, and moves there (if necessary). After the best patch has been decided, each store examines its current price, and the prices 1 unit more and 1 unit less to determine which price would win maximize its revenue. It chooses the best price, and adjust its price (if necessary). When making this determination the store not only considers whether customers will be gained or lost, but also the amount of revenue gained or lost by the change in price. This process is done in a random order, since NetLogo keeps agentsets in random order. Once all of this has been worked out by the stores, the customers choose their store based on which one minimizes the distance from the customer to the store plus the price of the store based on the new locations and prices.

The Hotelling model also has a chooser input that allows the user to select the rules of the model. The rules affect what actions the stores can take. If “moving-only” is selected, then stores cannot change their prices, and can only move their location. Conversely, if “pricing-only” is selected, then stores may not move their location, they can only change their prices. If “normal” is selected, then stores may move location, and change their prices. In all scenarios customers still choose the store based on the minimum distance plus price, but in the “moving-only” scenario the price is fixed for every store at 10.

The Hotelling model has one final choose input that allows the user to select the dimensions of the model. The user can either select “line” or “plane”. If “line” is selected, then only patches with x = 0 are initialized, in effect creating a one-dimensional line that the stores and customers exist on. If “plane” is selected, then all patches are set-up, creating a two-dimensional space.

**References**

Ottino, B., Stonedahl, F. and Wilensky, U. (2009). NetLogo Hotelling’s Law model. <http://ccl.northwestern.edu/netlogo/models/Hotelling>’sLaw. Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL.

Hotelling, Harold. (1929). “Stability in Competition.” The Economic Journal 39.153: 41 -57. (Stable URL: <https://www.jstor.org/stable/2224214>).