Progress Tracker

An Agent-Based Model of Urban Economics:

Evaluating Emergence & Evolution

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| **Agents** | **Feature** | **Explanation** | **Issues** | **Status** | **Version** |
| Landlords | Build Land Area | Landlords placed at random on map in setup, travel random directions around map claiming free space. |  | Fixed. | V1.01 |
|  |  | Cellular Automata | Very slow loading | Fixed: Uses standard method to create patch until certain percentage, then uses cellular automata to fill in remaining space around the patches. | V1.05 |
|  | Colouration/ Ownership |  | When creating their own land area, if there was a single patch left within their land they had to travel around at random to find it. | Fixed: If all 4 neighbours (NSEW) were belonging to the same landlord, it will change. | V1.04 |
|  | Land Costs | Assigned to patches | Not assigning land costs correctly | Fixed | V1.03 |
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|  |  |  |  | Extend: The further a piece of land is from the landlord, the higher the land cost of the patch. |  |
| Firms | Wage output | Randomised number for the wage gap based on the number of firms. | Overlapping firms. |  | V1.05 |
|  |  | Wages of firms can no longer be duplicates. | Better demonstrates the emergence. | Complete | V1.1 |
|  | Place within Radius of City |  |  | Fixed: “in-radius” – each firm claims the space around them so they are unable to stack. | V1.03 |
|  |  |  | Extend to support multiple firms | Complete | V1.04 |
|  |  |  |  | Extend: When the radius is decreased below the limit that allows all firms to be placed within it, reduce the maximum amount of firms on parameter slider. |  |
| People | Love of Variety |  |  | Complete | V1.02 |
|  | Searching for new locations | Ten places selected and costs compared. |  | Complete | V1.05 |
|  | Bidding | Sealed Bidding  Each person bases their bid price on their LOV and their budget and “submits” it where they are compared and the highest bid wins. | This was an extension to the model. | Removed | (V1.05) |
|  | Ownership | Ownership of the selected places was needed to compare the 10 to each other. | When they have selected a place to move to out of the ten patches, take ownership. | Bidding removed, ownership of patch when searching added. | V1.06 |
|  | Comparing Patches |  | Calculations producing numbers too large for net logo. | People comparing patches often attempted to check places that exceeded their budget. | V1.04 |
|  |  |  | Fixing: Distance calculation to compare distances and then calculate costs. | Balancing was wrong so one side of the calculation was always out of proportion. | V1.04 |
|  |  | Balancing of the variables in reference to goals on paper is important for viewing the movement of people. | Limited movement | Fixed: Balancing the numbers used |  |
|  |  | Plotting for how many People have the perfect patch for themselves. |  | Complete | V1.06 |
|  | Personal Bubble | Used in the density calculation to create radii around the people |  | Complete | V1.07 |
|  |  |  | Running Slowly | Fixed: People searching for patches specific to certain parameters slowed the simulation down. Adding the patch-set with these parameters to a global variable fixed this. |  |
|  |  |  |  | Extend: Frugality and Favouritism – Personal Preference over spending on different items. |  |
|  |  |  |  | Extend: Display Radii |  |
| Calculations | Budget | Y is the budget: this is a Person’s wage after any commute cost has been subtracted. | People spending more than wage would allow. | Fixed | V1.02 |
|  | Product Cost | PG is the price of goods and PL is the price of land/density. |  | Complete | V1.02 |
|  | Goods Cost | The total cost of the good PG is a function of its non-spatial base cost pg, the distance it needs to move (d), and the delivery cost to ship it over a unit of distance (c). | Calculation breaks when called. Calculations producing numbers too large for net logo. | Fixed: Balanced numbers to fix our model size. | V1.07 |
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|  | Land Cost |  | Dropping to 0 when run. | Fixed | V1.03 |
|  |  |  | Emergence not showing, heavily bias towards cheaper land. | Fixed: stopping point reached when parameters were adjusted. | V1.06 |
|  |  |  | Landlords changing their land cost is unbalanced; causing people to constantly change patch. | Fixing: lowering landlord parameters to slow the land cost change. | V1.1 |
|  | Utility Cost |  | Drops to zero in very few ticks. | Fixed | V1.05 |
|  | Commute Cost | In the paper this is always set to zero but is suggested in experiments to change it. This has been adapted this model in order for it to be changed when running tests. | When raised above zero, the model does not run correctly. | Fixed: Commute Cost \* Patch is added. | V1.05 |
|  | Density Cost | Density can be interchanged with land cost in the calculations. | When assigned to patched, would not calculate distances properly. | Fixed: People have ownership. | V1.1 |
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### Experiments in Reference Paper

See below for standard elements

*Spatial equilibrium from density cost and Landlords*

Modelled on one firm

After 250 iterations

“People’s consumption of land dropping towards the centre: they are finding the utility-maximising option is to squeeze into less land per Person; land costs rise towards the centre of the settlement.”

A similar (though not identical) pattern emerges via density cost also, purely through the choices made by People responding to density.

These include all of the key variables and will be the first tests carried out on our model. Swapping out *Land* costs for *Density* costs.

*Spatial morphology: reaction to cost changes*

“What drives agent location choice to produce stable emergent equilibria?”

This section looks at how *People* in the model respond to changes in costs, as reflected in settlement size.

To avoid any agent’s ‘locking-in’, each time an increment is made the model must be fully restarted.

*The impact of differences in wealth and preferences*

Giving People exogenous differences in wealth very clearly illustrates the different effect of spatial versus non-spatial costs.

Four different wealth points so that the richest *People* are four times wealthier than the poorest.

In the paper they demonstrate a bidding system, based upon ABM (Account-Based Marketing) models. When two or more agents pick the same piece of land and consequently bid for rental rights.

*Analysis of two and three Person decisions*

*NOT MODELLED IN PAPER*

This is a mathematical model in the paper but should enable a basis for us to test our agent based model around.

It includes communication between agents in order to “decide” how to share land and commute costs between each other.

“Economically, the impact of People's choices on proximity costs cause externalities for others: if ‘my’ location decision is before others, it will change land or density costs for them with no compensation being made (Button, 2010, p. 161)”

Giving People exogenous differences in wealth very clearly illustrates the different effect of spatial versus non-spatial costs.

-Proximity costs

### Additional Experiments

Don’t forget references\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

**oligopolists**

set up graph to track the movement of people

Focus on love of variety- peoples Preferences over things/ frugality

How much a person wants vs how much they are willing to spend (adjustable slider?)

Multiple firms

Utility low density high

“greedy landlord” – (adjusting desired net stock or error margin)

-personality of different landlords

References

Look at -------

Dhanaanjay K. Gode and Shyam Sunder. 1993. Allocative Efficiency of Markets with Zero-Intelligence Traders: Market as a Partial Substitute for Individual Rationality. The Journal of Political Economy. 101 (Feb. 1993). 119-137.



