

An ABM of Residential Development: Testing the Influence of risk Attitudes on Land Configuration

Sample Application

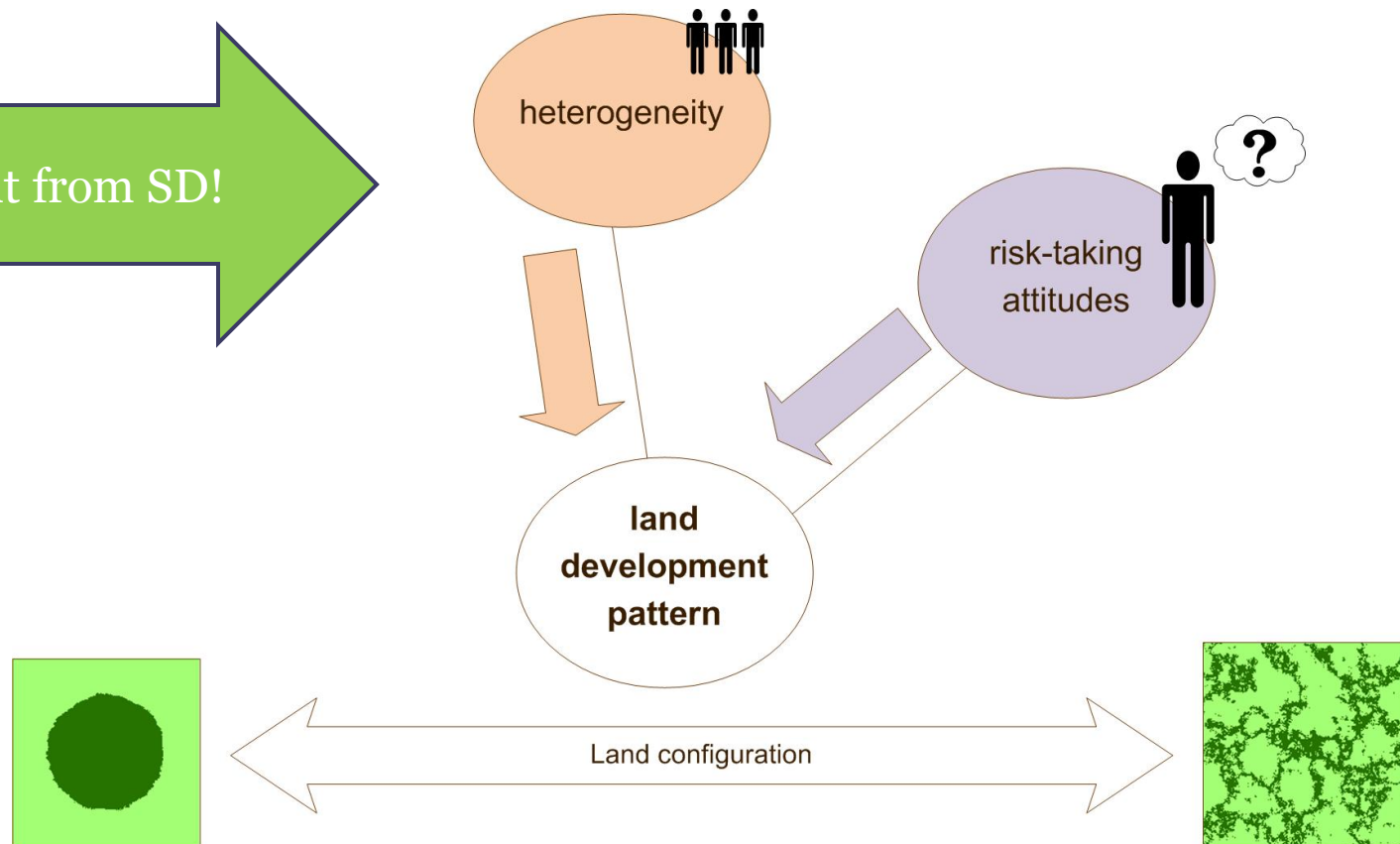


Why bother?

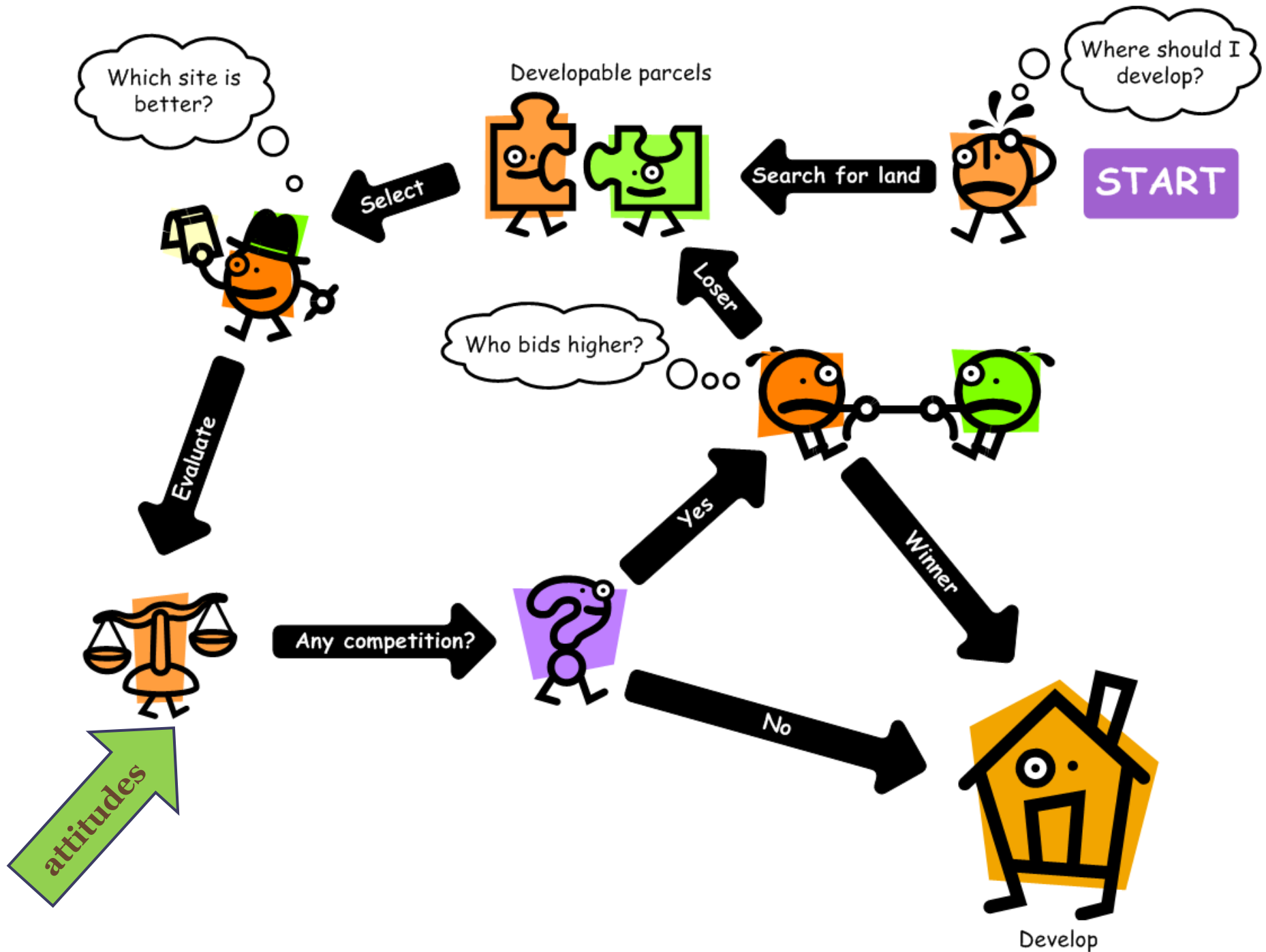


Research Problem

What is the relationship between selected risk-explicit decision making attitudes and the resultant land development pattern?



Attitude - **strategy for decision-making guided by perception,**
feelings AND evaluations associated with choice
Agents - developers



Utility

- Benefit attached to a particular choice among a range of choices
- Given a set of opportunities O_i that are available for agent A:
 - O_i has some level of utility $U(A, O_i)$
 - Where U belongs to $[0.0, 1.0]$
- Traditionally referred to as utility maximizing (rational decision making)

Rational Actor Paradigm

Every agent:

- Posses the same complete knowledge about the choices
- Assigns the same “best” utility to a given option
- Has infinite computing capacity (‘hyperrlational’)
- Does not change its decision making mechanisms over time
- Is ‘representative’ (average Joe) **but it is not a realistic** representation of an actual human being

Limited (Bounded) Rationality

- The perception of utility varies from individual to individual

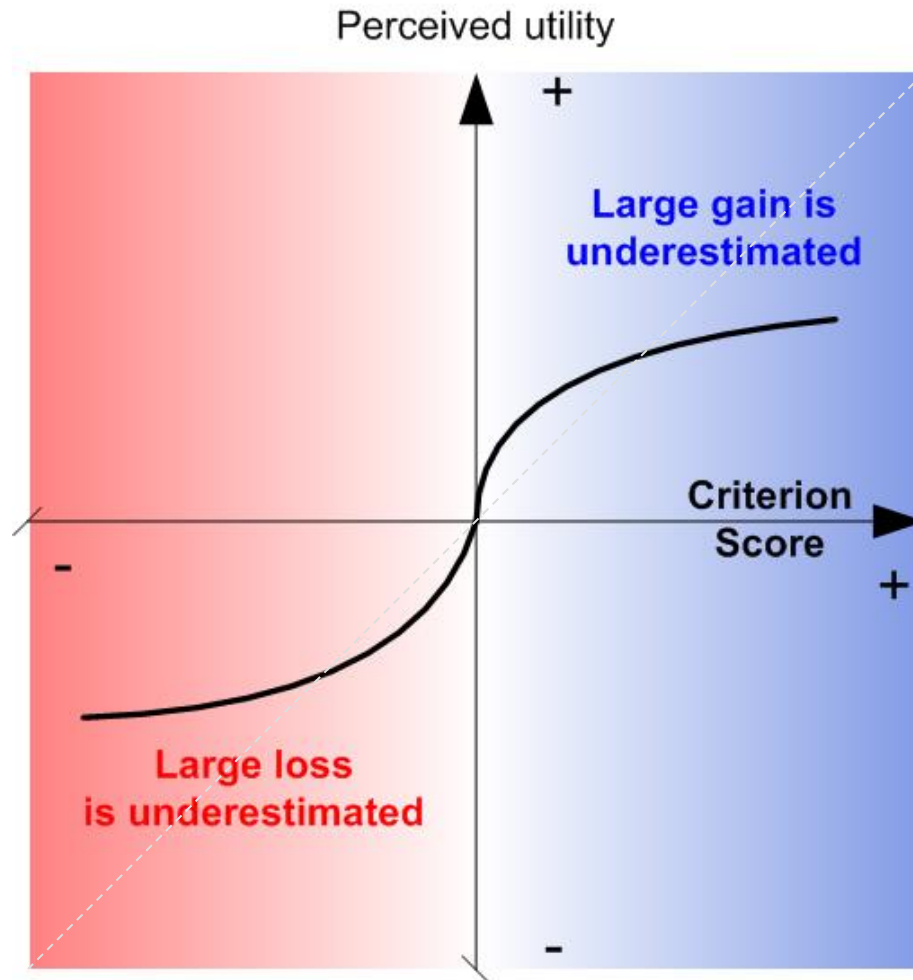
Agent:

- Has incomplete knowledge (unequal and unfair access to information -asymmetry)
- Is restricted by its capabilities (imperfect behavior, different reactions to the same conditions)

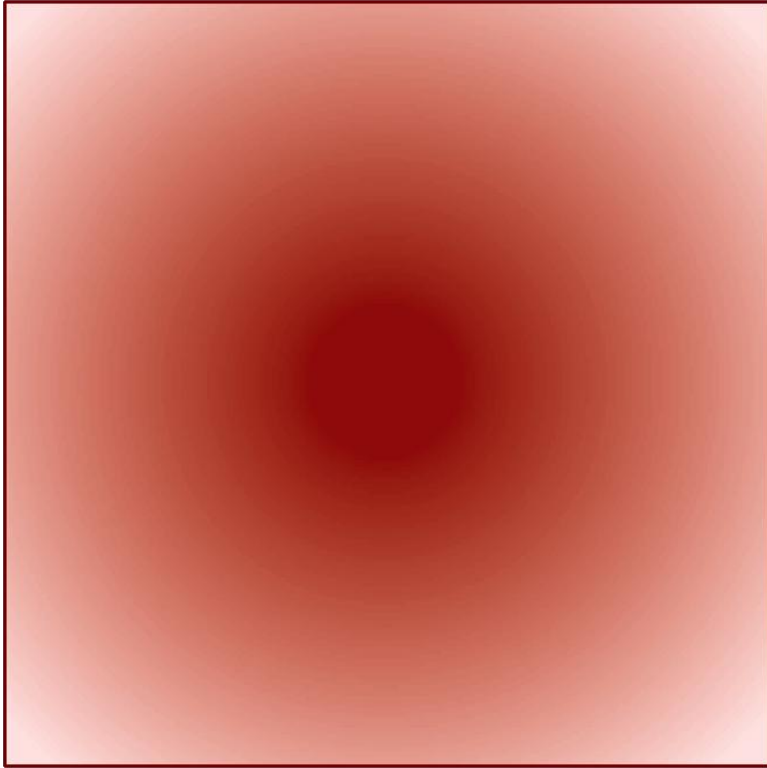
Attitude Utility Functions

Rich

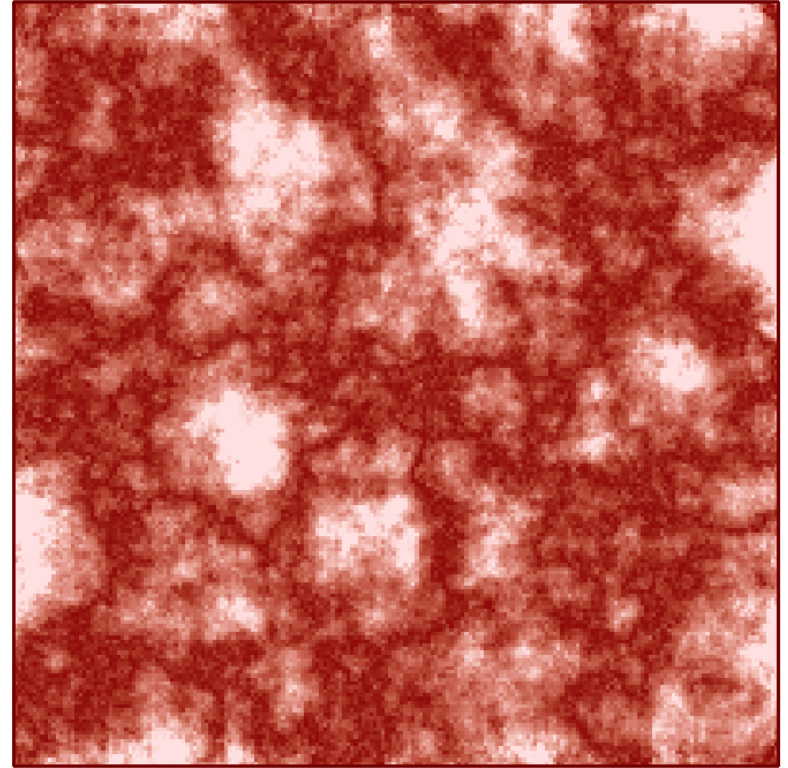
Risk Taking : Risk Averse



Input Data




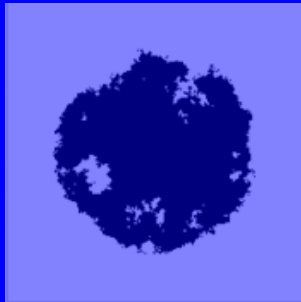
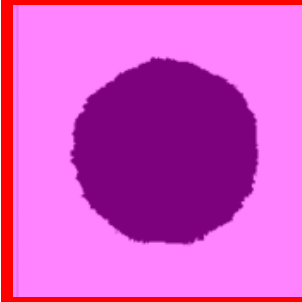

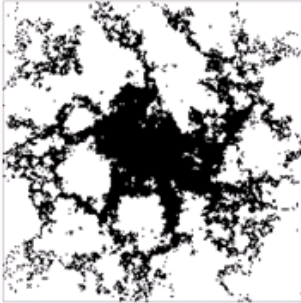
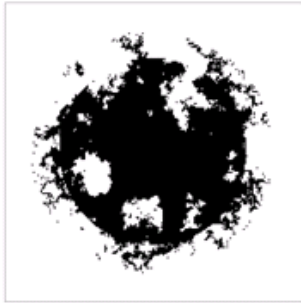
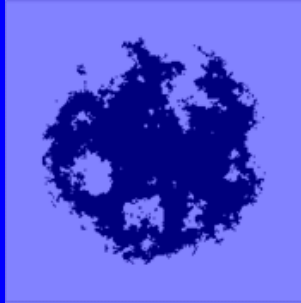
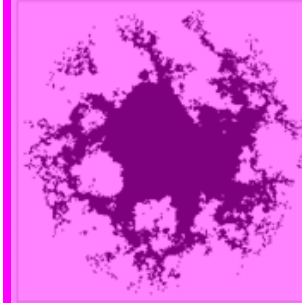
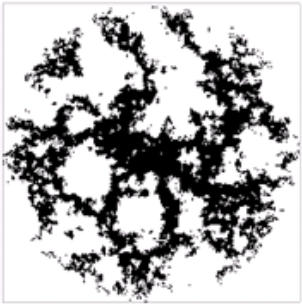
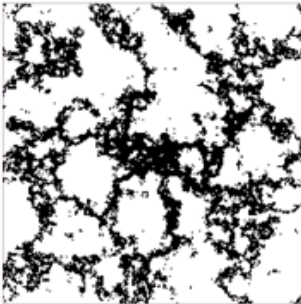
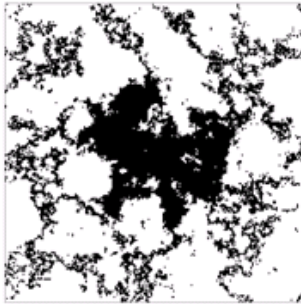
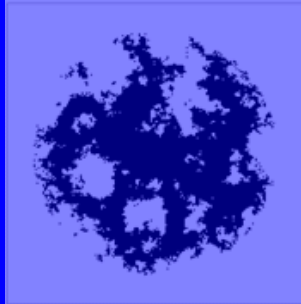
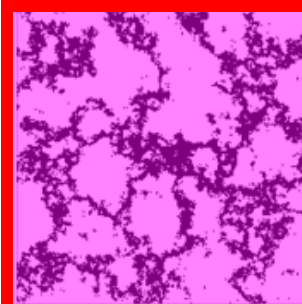


Attractiveness



Price

Results: Attitude to Risk vs. Land Pattern

price	unbiased	reckless	cautious	poor	rich
0.25					
0.50					
0.75					

Assignment

- Use the *model_devABM* to perform experiments aimed at analyzing the impact of:
 - Heterogeneous attitudes to risk
 - Preferences for land characteristics, and
 - Development feedback (economic vs. ecological) to the environment

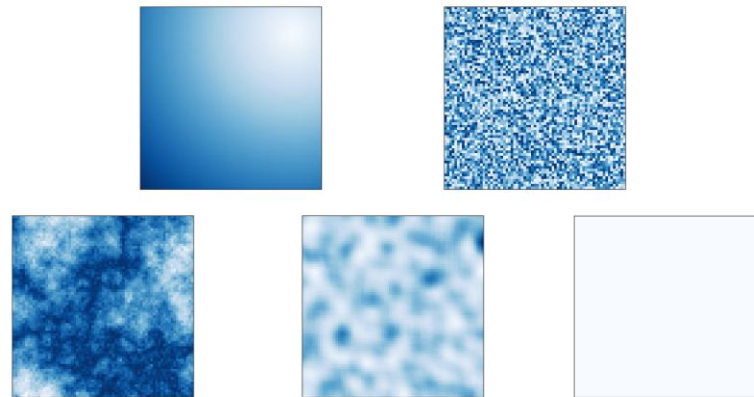
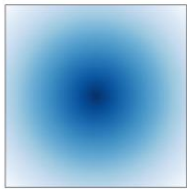
on the resulting (emergent) land development configurations.

Your objective is to:

- simulate residential encroachment into pristine environment
- perform a few simulations with variable spatial input maps, different agent preferences and attitudes, and various feedback intensities
- observe how the constantly changing environment affects later settlement decisions:
 - Land use pattern (spatial output)
 - Agent dissatisfaction (aspatial output)

Data and Assumptions

- Two types of spatial layers (decision criteria):
 - Land value
 - Scenic beauty
- There are 3 agents with variable preferences and different attitudes to risk



Data and Assumptions

- After each simulation about 20% of developable land is converted
- Development is distributed evenly among agents and among time steps.
- The model is deterministic and thus the agents have full knowledge of the current developable locations.
- In this version of the model, new buildup impacts the surroundings of the developed area. Two **feedback parameters are introduced**: increase in land value and decrease in scenic beauty. Both feedbacks can vary within the range [0.0, 0.1]. These two parameters relate to the environment, not the agents.

Sample questions for experiments

- What is the influence of risk attitudes combined with agent preferences on land use pattern (clustered, dispersed)?
- What is the influence of risk attitudes combined with developers' competition on land use pattern?
- Does attitude heterogeneity influence the pattern?

Sample questions for experiments

- Do the AUFs impact outcome patterns when we use only one criterion (e.g. land value)? Explain.
- What is the impact of different input maps on output pattern?
- What is the impact of feedbacks on output pattern?
- How do agents affect agent dissatisfaction due to loss of investment?

Interface

```
C:\Python26\python.exe
ABM-inputs-2010-02-28T16-07-15.txt saved in
G:\narika\courses\XXXHEM\lectures\L7_utilities\model_devABM\re
07-15
completed: 14.3 %
completed: 28.6 %
completed: 42.9 %
completed: 57.1 %
completed: 71.4 %
completed: 85.7 %
completed: 100.0 %
Saved G:\narika\courses\XXXHEM\lectures\L7_utilities\model_dev
28T16-07-15\2010-02-28T16-07-15_output_stats.csv
FINISHED; You can run the model with different inputs
```

74 Agent-Based Model of Residential Development Input

ilities/model_devABM/data/land_vale.asc Land value file Open

odel_devABM/data/scenic_beauty_base.asc Scenic beauty file Open

Preference for land value

Agent [1] 0.35

0.00 0.25 0.50 0.75 1.00

Agent [2] 0.25

0.00 0.25 0.50 0.75 1.00

Agent [3] 0.25

0.00 0.25 0.50 0.75 1.00

Attitude to risk

Agent [1] CAUTIOUS

Agent [2] CAUTIOUS

Agent [3] POOR

Feedbacks

Decrease beauty 0.000

0.000 0.025 0.050 0.075 0.100

Increase value 0.010

0.000 0.025 0.050 0.075 0.100

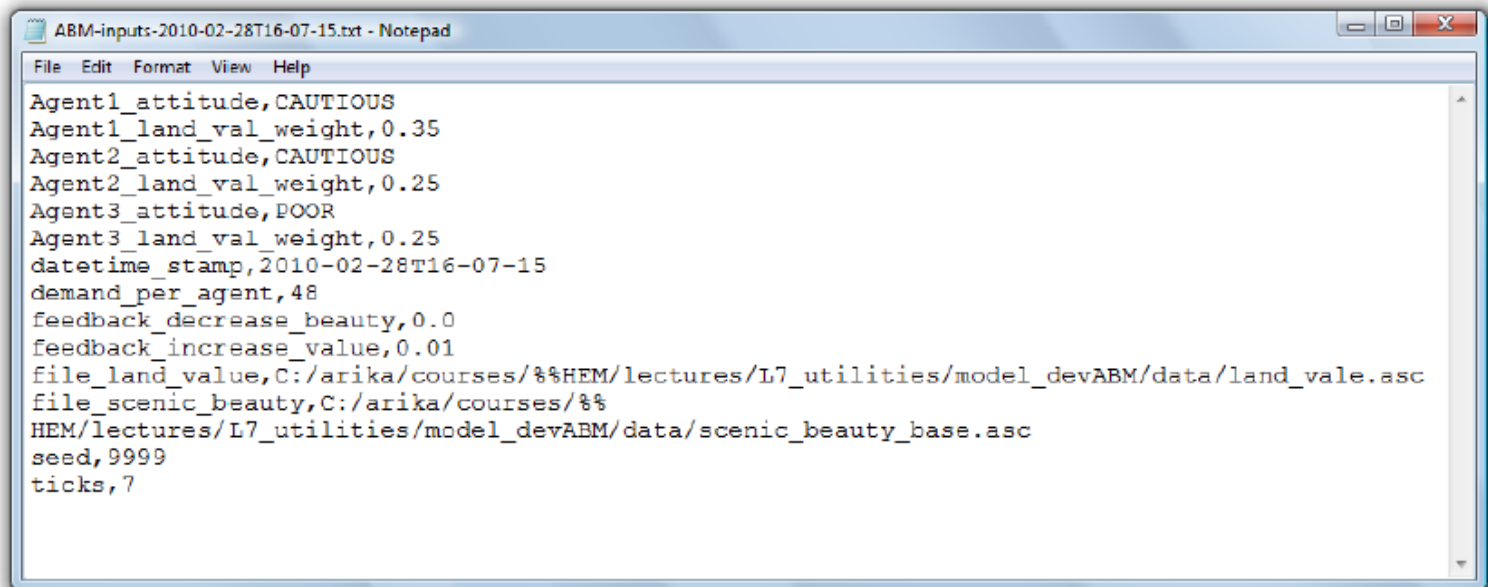
Model

Number of ticks 7

Random seed 9999

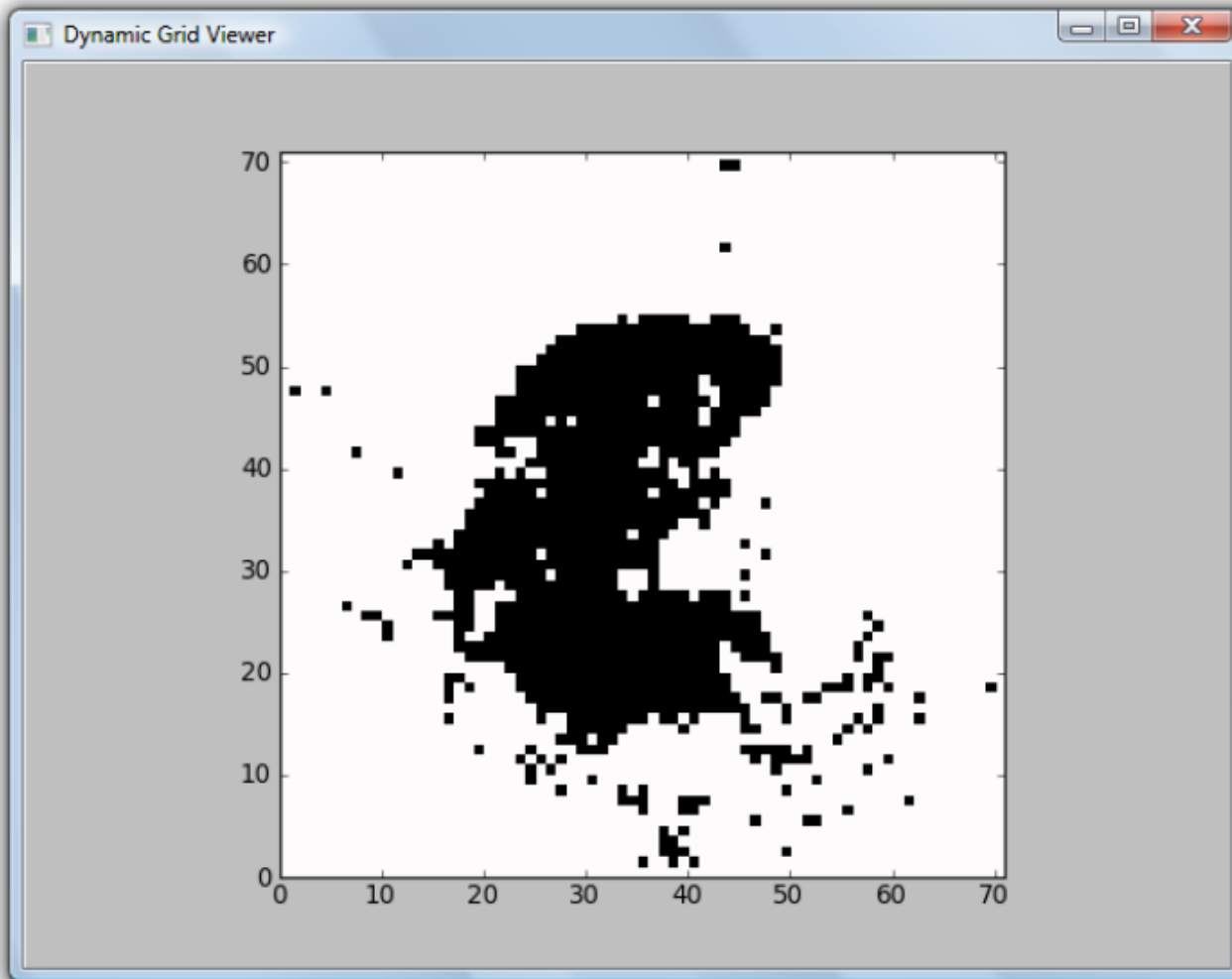
Execute ABM Quit

Parameters File

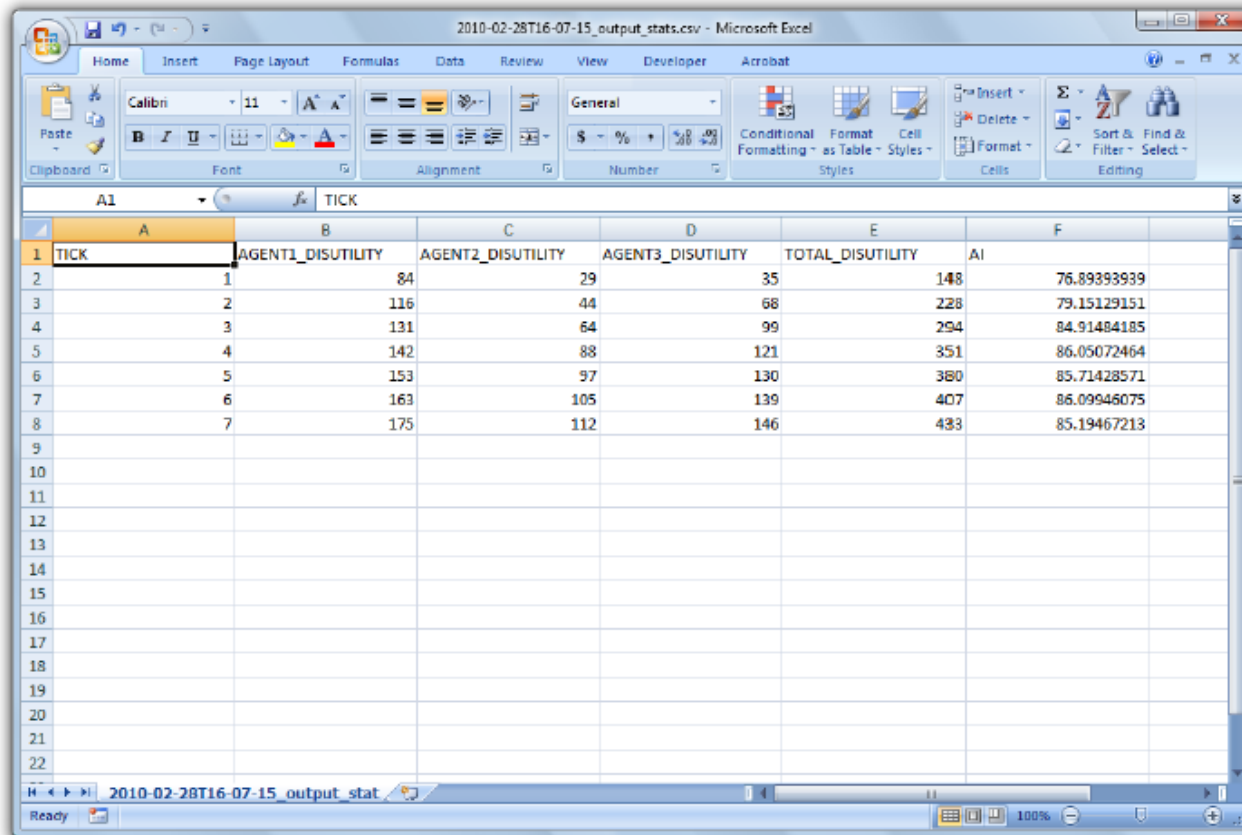
A screenshot of a Notepad window titled "ABM-inputs-2010-02-28T16-07-15.txt - Notepad". The window contains a list of parameters for an Agent-Based Modeling (ABM) simulation, each on a new line. The parameters include agent-specific attributes (attitude, land value weight), global simulation settings (datetime stamp, demand per agent, feedback values), and file paths for land value and scenic beauty data. The text is as follows:

```
Agent1_attitude,CAUTIOUS
Agent1_land_val_weight,0.35
Agent2_attitude,CAUTIOUS
Agent2_land_val_weight,0.25
Agent3_attitude,POOR
Agent3_land_val_weight,0.25
datetime_stamp,2010-02-28T16-07-15
demand_per_agent,48
feedback_decrease_beauty,0.0
feedback_increase_value,0.01
file_land_value,C:/arika/courses/%%HEM/lectures/L7_utilities/model_devABM/data/land_vale.asc
file_scenic_beauty,C:/arika/courses/%%
HEM/lectures/L7_utilities/model_devABM/data/scenic_beauty_base.asc
seed,9999
ticks,7
```

Results - Maps



Output Stats



A screenshot of a Microsoft Excel window titled "2010-02-28T16-07-15_output_stats.csv - Microsoft Excel". The ribbon shows the "Home" tab with various formatting options. The spreadsheet contains a table with 6 columns: A (TICK), B (AGENT1_DISUTILITY), C (AGENT2_DISUTILITY), D (AGENT3_DISUTILITY), E (TOTAL_DISUTILITY), and F (AI). The data is organized into rows, with the first row (row 1) serving as the header. Rows 2 through 8 contain numerical data, while rows 9 through 22 are empty. The status bar at the bottom indicates "Ready" and "100%" zoom.

	A	B	C	D	E	F
1	TICK	AGENT1_DISUTILITY	AGENT2_DISUTILITY	AGENT3_DISUTILITY	TOTAL_DISUTILITY	AI
2	1	84	29	35	148	76.89393939
3	2	116	44	68	228	79.15129151
4	3	131	64	99	294	84.91484185
5	4	142	88	121	351	86.05072464
6	5	153	97	130	380	85.71428571
7	6	163	105	139	407	86.09946075
8	7	175	112	146	433	85.19467213
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