

Your First Model

EES 4760/5760

Agent-Based and Individual-Based Computational Modeling

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Homework

Homework:

- In the mushroom hunt, were there always 80 red patches?
- Any questions about modified mushroom hunt model?
- Let's talk about ODD exercise.

Writing a model from an ODD

- Questions about writing a model from Butterfly ODD?
- Were there things the ODD was unclear about?

Butterfly Model

Download the model

- Download butterfly model from ees4760.jgilligan.org/models/class_05/butterfly_model_class_5.nlogo
 - Or go to the “Downloads” page on the class web site ees4760.jgilligan.org, click on “5. Butterfly Models” and download the “Basic Butterfly Model”

Enhancing the Butterfly model

- Put a slider for q
 - In the “Code” page:
 - Remove q from the global variables
 - Remove the initialization of q from `to setup`
- Add patches-own variable to indicate whether it was visited.

```
patches-own
[
  elevation
  visited? ; question mark means it's a true/false variable
]

to setup
  ...
  ask patches [
    set visited? false
  ]
  ...
end
```

- Add turtles-own variable to remember the patch where it started.

Enhancing the Butterfly model

- Put a slider for q
- Add patches-own variable to indicate whether it was visited.
- Add turtles-own variable to remember the patch where it started.
- Set the number of butterflies to 50.
- Stop butterfly from moving if it's at the top of a hill.
 - How can you tell whether it's on the top?

Enhancing the Butterfly model

- Write a reporter for corridor width

$$\text{Corridor width} = \frac{\# \text{ patches visited}}{\text{distance from start}}$$

- Put an **observer** on the interface
- Define a reporter:

```
to-report corridor-width  
  let wid ... ; calculate corridor  
width  
  report wid  
end
```

Behaviorspace

Running Experiments: BehaviorSpace

- Vary any parameter that has a control on the model's interface
- Writes output to `.csv` spreadsheet file
 - Four options:
 1. Spreadsheet (1 row per variable, each run and step is a column)
 2. Table (1 row per step, each variable is a column)
 3. Statistics
 4. Lists (only useful if you also choose spreadsheet or table)
- Note: Data written in spreadsheet or table might be out of order.

Behaviorspace Table Format

	A	B	C	D
1	BehaviorSpace results (NetLogo 6.4.0) Table version 2.0			
2	enhanced_butterfly_model_class_5.nlogo			
3	vary-q-all-steps			
4	09/03/2024 21:47:41:586 -0500			
5	min-pxcor	max-pxcor	min-pycor	max-pycor
6	0	149	0	149
7	[run number]	q	[step]	corridor-width
8	3	0	0	35.35533906
9	3	0	1	41.01515439
10	15	0	0	35.35533906
11	13	0	0	35.35533906
12	10	0	0	35.35533906
13	14	0	0	35.35533906
14	3	0	2	49.51907135
15	2	0	0	35.35533906

Behaviorspace Spreadsheet Format

	A	B	C	D	E	F	G	H	I
1	BehaviorSpace results (NetLogo 6.4.0) Spreadsheet version 2.0								
2	enhanced_butterfly_model_class_5.nlogo								
3	vary-q-all-steps								
4	09/03/2024 21:48:10:612 -0500								
5	min-pxcor	max-pxcor	min-pycor	max-pycor					
6	0	149	0	149					
7	[run number]	1	1	2	2	3	3	4	4
8	q	0	0	0	0	0	0	0	0
9	[reporter]	[step]	corridor-width	[step]	corridor-width	[step]	corridor-width	[step]	corridor-width
10	[final]	999	423.4725	999	438.6560	999	421.6216	999	418.1058
11	[min]	0	35.3553	0	35.3553	0	35.3553	0	35.3553
12	[max]	999	424.0267	999	438.9208	999	421.8210	999	418.3716
13	[mean]	499.5	300.8170	499.5	303.9720	499.5	302.6952	499.5	300.0260
14	[total steps]	999	999	999	999	999	999	999	999
15									
16	[all run data]	[step]	corridor-width	[step]	corridor-width	[step]	corridor-width	[step]	corridor-width
17		0	35.3553	0	35.3553	0	35.3553	0	35.3553
18		1	40.0116	1	40.6208	1	41.0152	1	39.9840
19		2	47.1075	2	47.1339	2	49.5191	2	50.3201
20		3	49.0780	3	49.6450	3	48.9961	3	52.1140
21		4	50.7408	4	51.5005	4	49.7353	4	55.5346
22		5	49.0910	5	52.4445	5	50.0928	5	55.9192
23		6	51.0026	6	54.4283	6	54.3610	6	59.1715
24		7	51.2436	7	59.8473	7	58.3433	7	61.3543
25		8	54.9979	8	59.8388	8	60.3152	8	62.3758
26		9	58.8774	9	60.6895	9	61.9538	9	64.0257
27		10	60.4508	10	60.4804	10	63.6785	10	63.8910

Behaviorspace Stats Format

	A	B	C	D
1	BehaviorSpace results (NetLogo 6.4.0)		Stats version 2.0	
2	enhanced_butterfly_model_class_5.nlogo			
3	vary-q-all-steps			
4	09/03/2024 21:48:11:511 -0500			
5	min-pxcor	max-pxcor	min-pycor	max-pycor
6	0	149	0	149
7	q	[step]	(mean) corridor-width	(std) corridor-width
8	0	0	35.3553	0.0000
9	0	1	40.3559	0.4474
10	0	2	47.8396	1.3203
11	0	3	48.7062	1.7825
12	0	4	51.2488	2.2297
13	0	5	53.2222	2.3226
14	0	6	56.0615	2.3681
15	0	7	58.0982	2.2659

Analyzing Behaviorspace Output

- Behaviorspace output format is annoying
 - Each line is some tick of some run
 - How to organize, and average over runs?
 - The new *stats* output helps with this, tough
- analyzeBehaviorspace app
 - https://ees4760.jgilligan.org/analyze_behaviorspace
 - Or install on your own computer using R
 - Instructions at <https://github.com/jonathan-g/analyzeBehaviorspace>
 - After installing:

```
library(analyzeBehaviorspace)
launch_abs()
```

Emergence

Emergence

- A tricky concept.
- Joshua Epstein in *Growing Artificial Societies*: “stable macroscopic patterns arising from the local interaction of agents.”
- Epstein ten years later: “I have always been uncomfortable with the vagueness and occasional mysticism surrounding this word.”
- Epstein now prefers to talk about “*Generative Social Science*”

