

## 11.2 Agents of Interaction: Steering a Dangerous Course

### *AgentSheets* Quick Review Questions

*Introduction to Computational Science:  
Modeling and Simulation for the Sciences, 2<sup>nd</sup> Edition*

Angela B. Shiflet and George W. Shiflet  
Wofford College

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### Agent-Based Modeling

- Quick Review Question 1** Indicate to which each of the following applies, cellular automaton (CA) simulations, agent-based (AB) simulations, or both:
- a. Autonomous, decision-making entity has a state and behaviors
  - b. Grid cell has state and transition rules specify next state
  - c. Relationship with neighbors determines next state
  - d. Can use grid
  - e. For each time step, iteration is over each grid cell
  - f. For each time step, iteration is over each autonomous, decision-making entity
  - g. Local interactions can cause global change

*Compose all the following answers in AgentSheets:*

### Model Environment

- Quick Review Question 2** Write the *WHEN-CREATING-NEW-AGENT* method for initialization of a *Farm* agent.

### Agents and Their States

- Quick Review Question 3** Write the *WHEN-CREATING-NEW-AGENT* method for initialization of a *Cattle* agent and the associated *countSIRM* method.

### Agent Behaviors

- Quick Review Question 4** Write cattle *WHILE-RUNNING* method, which is the cattle scheduler method.

- Quick Review Question 5** Write cattle *sir* method.

- Quick Review Question 6** Write cattle *sirAbattoir* method.
- Quick Review Question 7** Write cattle *inFarm* method.
- Quick Review Question 8** Write cattle *farm2Sale* method.
- Quick Review Question 9** Write cattle *inSaleBarn1* method.
- Quick Review Question 10** Write cattle *moveInSalebarn* method.
- Quick Review Question 11** Write cattle *inStocker* method.
- Quick Review Question 12** Write cattle *inFeedlot* method.

### Model Refinement

- Quick Review Question 13** Write the *SimulationDriver*'s *WHILE-RUNNING* method.
- Quick Review Question 14** Write cattle *initInfected* method.

### Answers to Quick Review Questions

1. a. AB      b. CA      c. both      d. both  
e. CA      f. AB      g. both



2.

#### ▼ WHEN-CREATING-NEW-AGENT ()



*Procedure to initialize a Farm agent possibly to have a Cattle agent on top*

*Number of rules: 1*

**If**

SEE (  ,  ), and  
%-CHANCE ( @INIT\_CATTLE\_PROBABILITY\*100 )

**Then**

NEW (  ,  )

3.

### ▾ WHEN-CREATING-NEW-AGENT ()


*Procedure to initialize new calf with a random weight between 60 and 100 pounds, to establish the days sick to be 0 for an infected calf, and to establish various category counters*

*Number of rules: 2*

**If**

SEE (  ,  )


**Then**

SET (weight , to , 60+random(41.0)), and  
SET (daysSick , to , 0), and  
MAKE (  , countSIRM)

**If**

SEE-A (  , Cattle)

**Then**


SET (weight , to , 60+random(41.0)), and  
MAKE (  , countSIRM)

### ▾ ON (countSIR)

*Procedure to update numSusceptible, numInfected, numRecovered, cumulativeInfected, and numCattle after addition of a new beef cow*

*Number of rules: 4*


**If**

SEE (  ,  )

**Then**

SET (@numSusceptible , to , @numSusceptible + 1), and  
SET (@numCattle , to , @numCattle + 1)

**If**

SEE (  ,  )

**Then**

SET (@numFarm , to , @numFarm+ 1)

**If**

SEE (  ,  )

**Then**

SET (@numInfected , to , @numInfected + 1), and  
SET (@cumulativeInfected , to , @cumulativeInfected + 1), and  
SET (@numCattle , to , @numCattle + 1)

**If**

SEE (  ,  )

**Then**

SET (@numRecovered , to , @numRecovered + 1), and  
SET (@numCattle , to , @numCattle + 1)



4.

## ▼WHILE-RUNNING ()

*Cattle Driver of Simulation**Number of rules: 7***If**

STACKED-A (immediately above , a , Farm), and  
 IS (weight , < , 600)



**Then**

MAKE (  , sir), and  
 MAKE (  , inFarm)

**If**

STACKED-A (immediately above , a , Farm)



**Then**

MAKE (  , sir), and  
 MAKE (  , farm2Sale)

**If**

IS (weight , < , 900), and  
 STACKED-A (somewhere above , a , Salebarn)



**Then**

MAKE (  , sir), and  
 MAKE (  , inSaleBarn1)

**If**

STACKED-A (immediately above , a , Stocker)



**Then**

MAKE (  , sir), and  
 MAKE (  , inStocker)

**If**

IS (weight , >= , 900), and  
 STACKED-A (somewhere above , a , Salebarn)



**Then**

MAKE (  , sir), and  
 MAKE (  , inSaleBarn2)

**If**

STACKED-A (somewhere above , a , Feedlot)





**Then**

MAKE (  , sir), and  
 MAKE (  , inFeedlot)

**If**

STACKED-A (somewhere above , a , Slaughterhouse)

**Then**

MOVE (  ), and  
 MAKE (  , sirAbattoir), and  
 CHANGE (  ,  )

5.

ON (sir)

*Procedure to advance an infected beef cow's illness, possibly to recovery, and determine if a susceptible cattle agent becomes sick*

Number of rules: 3

If

```
SEE ( [ ] , [ ] ), and
IS (daysSick , > , @INFECTIOUS_PERIOD)
```

Then

```
CHANGE ( [ ] , [ ] ), and
SET (daysSick , to , 0), and
SET (@numInfected , to , @numInfected - 1), and
SET (@numRecovered , to , @numRecovered + 1)
```

If

```
SEE ( [ ] , [ ] )
```

Then

```
SET (daysSick , to , daysSick + 0.25)
```

If

```
SEE ( [ ] , [ ] ), and
NEXT-TO ( >= , 1 , [ ] ), and
%-CHANCE (@INFECTION_PROBABILITY * 100)
```

Then

```
CHANGE ( [ ] , [ ] ), and
SET (@numSusceptible , to , @numSusceptible - 1), and
SET (@numInfected , to , @numInfected + 1), and
SET (@cumulativeInfected , to , @cumulativeInfected + 1), and
SET (daysSick , to , 0)
```

6.

ON (sirAbattoir)

*Procedure to adjust appropriate system variables when a beef cow is slaughtered*

Number of rules: 3

If

```
SEE ( [ ] , [ ] )
```

Then

```
SET (@numSusceptible , to , @numSusceptible - 1)
```

If

```
SEE ( [ ] , [ ] )
```

Then

```
SET (@numInfected , to , @numInfected - 1)
```

If

```
SEE ( [ ] , [ ] )
```

Then

```
SET (@numRecovered , to , @numRecovered - 1)
```

7.

▼ON (inFarm)

*Cattle agent's behavior on a Farm tile*

Number of rules: 1

If

no condition

Then

MOVE-RANDOM-ON (■), and  
 SET (weight , to , weight + 0.5 + random(0.25))

8.

▼ON (farm2Sale)

*Cattle agent's behavior in moving from Farm tiles to SaleBarn tiles*

Number of rules: 6

If

SEE (⬇️, ■)

Then

MOVE (⬇️)

If

SEE (⬇️, ↘️)

Then

MOVE (↘️)

If

SEE (➡️, ↘️)

Then

MOVE (➡️)

If

SEE (⬇️, ↙️)

Then

MOVE (↙️)

If

SEE (➡️, ↙️)

Then

MOVE (➡️)

If



SEE (⬇️, ■)

Then

MOVE (⬇️), and  
 SET (timeInSale , to , 1 + random(5))

9.

## ▼ON (inSaleBarn1)

*Cattle agent's behavior when in sale barn for the first time**Number of rules: 2***If**`IS (timeInSale , > , 8)`**Then**`MOVE (  )`**If**`no condition`**Then**`SET (timeInSale , to , timeInSale + 1), and``MAKE (  , moveInSaleBarn)`



10.

## ▼ON (moveInSaleBarn)

*Procedure for a cattle agent's random movement in a sale barn**Number of rules: 4***If**`NEXT-TO (> , 0 , )`**Then**`MOVE-RANDOM-ON ( )`**If**`NEXT-TO (> , 0 , )`**Then**`MOVE-RANDOM-ON ( )`**If**`NEXT-TO (> , 0 , )`**Then**`MOVE-RANDOM-ON ( )`**If**`NEXT-TO (> , 0 , )`**Then**`MOVE-RANDOM-ON ( )`





11.

## ▼ ON (inStocker)

*Procedure for a cattle agent's behavior in stocker**Number of rules: 3***If**`IS (weight , >= , 900), and``SEE (  ,  )`**Then**`MOVE (  )`**If**`IS (weight , >= , 900), and``SEE (  ,  )`**Then**`MOVE (  ), and``SET (time2InSale , to , 1 + random(5))`**If**`no condition`**Then**`MOVE-RANDOM-ON (  ), and``SET (weight , to , weight + 0.4 + random(0.2))`

12.

## ▼ON (inFeedlot)

*Procedure for a cattle agent's behavior in feedlot**Number of rules: 5***If**`IS (weight , >= , 1300)`**Then**`MOVE (  )`**If**`SEE (  ,  )`**Then**`MOVE (  ), and  
SET (weight , to , weight + 0.5 + random(0.5))`**If**`SEE (  ,  )`**Then**`MOVE (  ), and  
SET (weight , to , weight + 0.5 + random(0.5))`**If**`SEE (  ,  )`**Then**`MOVE (  ), and  
SET (weight , to , weight + 0.5 + random(0.5))`**If**`no condition`**Then**`SET (weight , to , weight + 0.5 + random(0.5))`





13.

## ▼WHILE-RUNNING ()

*Driver of simulation**Number of rules: 4***If**`IS (phase , = , 0)`**Then**`BROADCAST (Farm , randomCattle), and  
SET (phase , to , 1)`**If**`IS (phase , = , 1), and  
IS (@numInfected , = , 0)`**Then**`BROADCAST (Cattle , initInfected)`**If**`IS (phase , = , 1)`**Then**`SET (phase , to , 2)`**If**`IS (phase , = , 2)`**Then**`BROADCAST (Cattle , cattleBehave)`

14.

## ▼ON (initInfected)

*Method to change Cattle agent to InfectedCattle agent with probability 1/numCattle**Number of rules: 1***If**`SEE (  ,  ), and  
IS (@numSusceptible , = , @numCattle), and  
%-CHANCE (100/@numCattle)`**Then**`CHANGE (  ,  ), and  
SET (@numSusceptible , to , @numSusceptible - 1), and  
SET (@numInfected , to , 1), and  
SET (@cumulativeInfected , to , 1)`