Agri-Terrorism

New Mexico
Supercomputing Challenge
Final Report
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Table of Contents

Introduction

Our project this year is on epidemiology. We are trying to find out how fast different diseases in livestock spread, how they can be prevented, and how they would affect you as the consumer. Some of the diseases we will be modeling are foot and mouth, anthrax, and mad cow. These diseases would have a devastating affect on our economy if an outbreak did occur. Even though precautions are taken, some of the diseases are unnoticeable for a period of time and could be spread throughout a large area of the southwest before it is identified.

We plan to model our problem with the computer language StarLogo. We will be using StarLogo because it is an easy to learn, agent based, free computer model. We will have infected and healthy individuals interacting and the variables will manipulate include probability of infection, speed of disease progress, rate of animal interactions.

We have collected information on the three diseases, and have learned the variables of the diseases that would affect our computer modeling. We have worked on a model and are slowly progressing.

We expect to find out how the diseases spread, and how to stop them. This project has an unlimited area of research and has many possibilities especially since the diseases that we continue to battle are always adapting to the vaccine and antibiotics that we treat them with.

Description

Our project is on the spread of diseases through a feedlot, or sale barn, and through the southwest. Because there are many various diseases we will concentrate on mainly three. The diseases are foot and mouth, mad cow, and anthrax. We are using these diseases because they are caused by different things and spread differently. New Mexico would be devastated by such an outbreak because our economy is based off of agriculture. We have a major influence on most of the livestock through out the southwest. New Mexico is especially vulnerable to such an attack because of our proximity to the Mexican border, and the amount of livestock we import.

We started out conducting research and finding out about different diseases, and attempting to make a simple model. To simulate the different diseases we will change the variables to fit the disease that we are trying to model. We have found out that anthrax is a bacterial disease that is not as contagious in a living animal, although the disease is spread from when an animal comes in contact with an animal killed from anthrax. Spores of anthrax can live in the ground for years and can spread from a spot where a dead animal was. The only way to kill the spores is to burn them. Out breaks of anthrax are relatively common, because of the fact that the spores will live in the ground for several years.

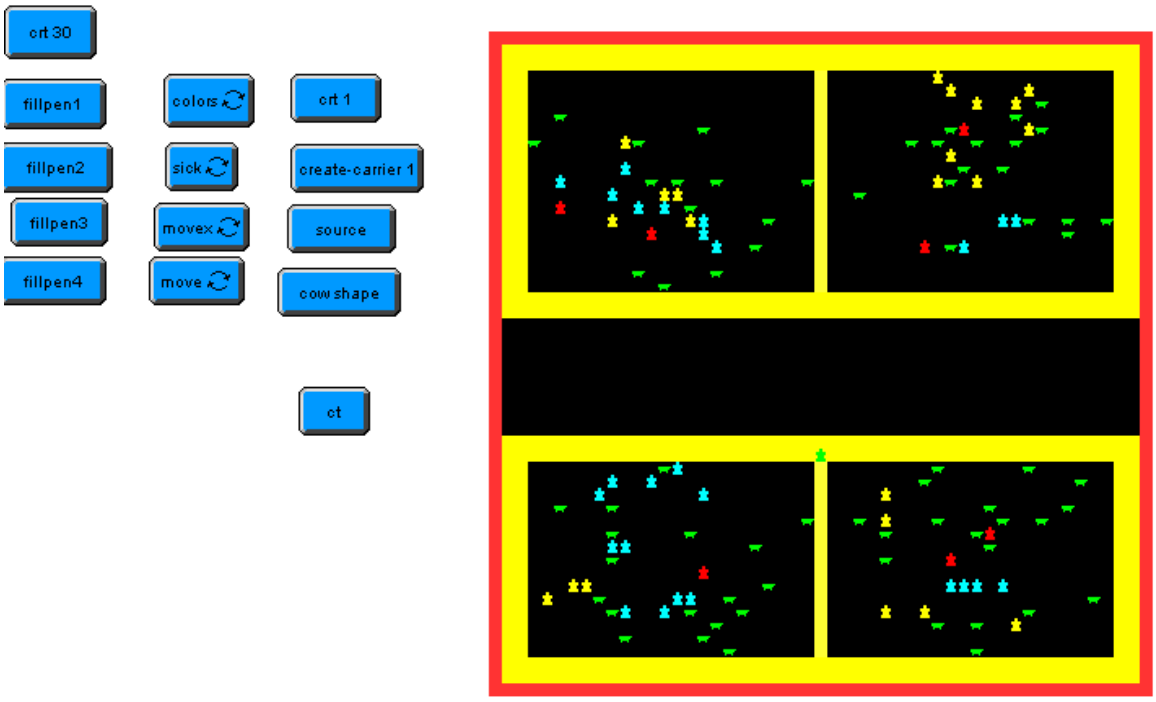
Foot and mouth disease is a viral infection that is very contagious. Most wildlife is susceptible to foot and mouth. The animals usually die, not from the disease, but from the myocarditis (inflammation of the heart) that is a side effect. Human infection is rare, although foot and mouth was eradicated from the U.S. in 1929. There are several strains of foot and mouth, so vaccines have to be specialized. An outbreak of Foot and Mouth Disease in Great Britain in 2001 cost producers billions of dollars.

Mad cow (Bovine Spongiform Encephalopathy, BSE) is neither a viral nor a bacterial infection, but is caused by abnormal proteins, or prions that eat away the animals brain tissue. The only way to get mad cow is to eat the protein. Because there is very little known about mad cow, any tools used on an animal that is suspected of having it have to be thrown away. Because the proteins are only in the central nervous system there is no appreciable risk of humans being infected.

Right now the main prevention system in feed yards, dairies, and sale barns is training employees to watch for the diseases, keep track of all vehicles that enter the property. If there is a case of a disease, a judge can make a disaster declaration stopping all traffic in the area. All animals in the feed yard or sale barn will be killed and all movement of livestock will stop.

In addition to research, we have made computer models of a disease spreading, using StarLogo as our computer language. First we made feed pens for our agents then we put an infected agent in a pen and ran the program to see how fast the disease will spread. We ran into many problems such as all agents spontaneously getting sick and getting better. The agents also would cross the computer fences. We also made a map of New Mexico and neighboring states to determine how fast the disease will spread through out the southwest area. We have not progressed very far with this part of our programming yet.

The following is a screen shot of our model:



An example of our code is in the appendix.
Our map is in the appendix.

Results

Our program only has the basic components of a disease model. Our research provided us with information with what is happening in a feed yard, the different diseases and their variables, and how these diseases are currently being dealt with. So far our research has provided more of the information that we wanted to know than a computer model. Although such research does not take the place of a running model that would show us spreading patterns in a feedlot or the southwest, we hope to accomplish these goals next year. The practice we had modeling the spread of a disease will be valuable help to continue this project next year.

The computer languages we have used are StarLogo, Power Point, and Microsoft Word. We used Power Point for our presentation, and Microsoft Word for all of our reports and interims.

Conclusion

From this project we can conclude that we are at risk of an outbreak, intentional or not. We found out that we do not need to worry about certain diseases like mad cow because it is virtually impossible to spread the disease in a pen of animals. Foot and mouth disease is currently eradicated from the U.S., although there is a risk of having an epidemic of it in the U.S., humans are rarely infected by it. Although anthrax does pose a potential risk of infecting our food supply and causing an epidemic, we have been dealing with it for years and know how to deal with it before it spreads in epidemic proportions. The main effect of a large outbreak of these diseases would be on the economy. The cost of having to deal with an outbreak is very expensive, but most of the loss would be in the amount of livestock that would have to be killed. If an outbreak were to happen in a certain area all the livestock would have to be killed in the surrounding area. If anything was accomplished in this project, I hope that we have laid to rest any fears that you may have had in the past about these diseases.

Our basic model was able to show these following facts:

- The faster the death rates the slower the spread of the disease.
- The slower the death rates the faster the spread of the disease.
- The more contagious the disease is, the faster it spreads.
- The less contagious the disease is, the slower it spreads.

Software

The computer languages we have used are StarLogo, Power Point, and Microsoft Word. We used Power Point for our presentation, and Microsoft Word for all of our reports and interims. We are using StarLogo to model our project. We used StarLogo because it is easy to use, readily available, and is an agent-based model that can be used to see how individuals will react.

Recommendations

In future projects I hope to expand on this project and get a successful model running to see how a disease spreads in a certain area. I might attempt to make an economic model of such a scenario in the future. We didn't get the model results that we were expecting because we were not able to get the model running.

Acknowledgments

I would like to thank Robin Woods for sponsoring our project

I would like to thank Ben Weinheimer, Vice President of the Texas Cattle Feeders Association, for giving us valuable information about what is happening in the feed yards right now.

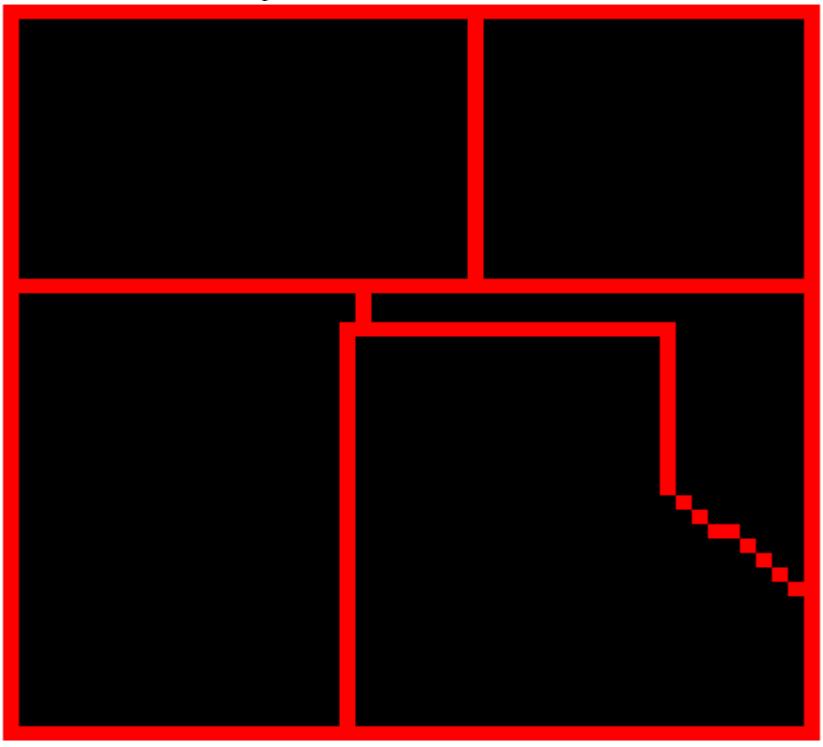
I would also like to thank Mrs. Raulie and Mr. Daugherty for helping us with our programming and getting us to work on our project.

Bibliography

http://www.oie.int
http://www.cgfi.org
Wikipedia, the free encyclopedia
Robin Woods, public health scientist III and Mass Spectrometry Supervisor/Technical Lead in the Newborn Screening Division
Ben Weinheimer, Vice President of the Texas Cattle Feeders Association

Appendix

This is our map:



An example of our code:

```
turtles-own [ health ]
set variable [ health = 0 ]

to fillpen1
  if xcor = 0 [ setc green  setxy -11 14 ]
end

to fillpen2
  if xcor = 0 [ setc green  setxy 12 15 ]
end

to fillpen3
  if xcor = 0 [ setc green  setxy -11 -15 ]
end

to fillpen4
  if xcor = 0 [ setc green  setxy 12 -14 ]
end

to move
  if pc-ahead = yellow [rt 180 - random 45 ]
  fd 1
end

to movex
  if xcor = 2 [rt 180]
  if pc-ahead = yellow [rt 180 - random 45 ]
  fd 1 rt random 360
end

to colors
  if health = 0 [ set color green ]
  if health = 1 [ set color lime ]
  if health = 2 [ set color turquoise ]
  if health = 3 [ set color cyan ]
  if health = 4 [ set color sky ]
  if health = 5 [ set color yellow ]
  if health = 6 [ set color orange]
  if health = 7 [ set color brown ]
  if health = 8 [ set color magenta ]
  if health = 9 [ set color pink ]
  if health = 10 [ set color red ]
end

to sick
  if health > 0 [grab one-of-turtles-here [ set health-of partner health + .1 ]]
  if health > 10 [ die ]
  if health > 0 [ set health health + .1 ] colors
end
```