North American Animal Disease SpreadModel

Disease Characteristics

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- Uses slides from presentations by:
  - Mark A. Schoenbaum
  - Neil Harvey
  - Francisco Zagmutt Vergara
- Additional material from
  - Neil Harvey, Aaron Reeves
  - Other colleagues
- As well as my own

Disease Characteristics

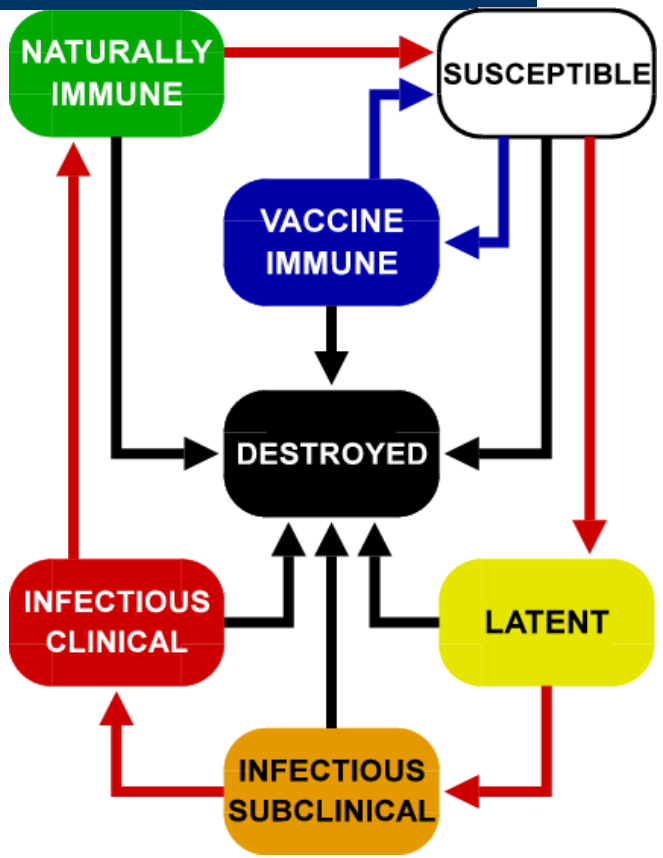
- What are disease characteristics in NAADSM?
- How does NAADSM use them?
- What are the input parameters?
- Example
- Concerns

What are disease characteristics?

- States of disease progression in which a unit (herd or flock) may exist
- Disease states in NAADSM:
  - Latent,
  - Infectious Subclinical,
  - Infectious Clinical,
  - Immune,
  - Vaccine Immune
- User-developed probability density functions entered that describe the duration of each state on a UNIT basis (not an animal!)
- Within-herd spread adjustment optional

Basics of disease states

- Each unit has a state
- 3 actions can change states:
  - Infect
  - Vaccinate
  - Destroy
- Infection and vaccination set in motion a “natural progression” through states

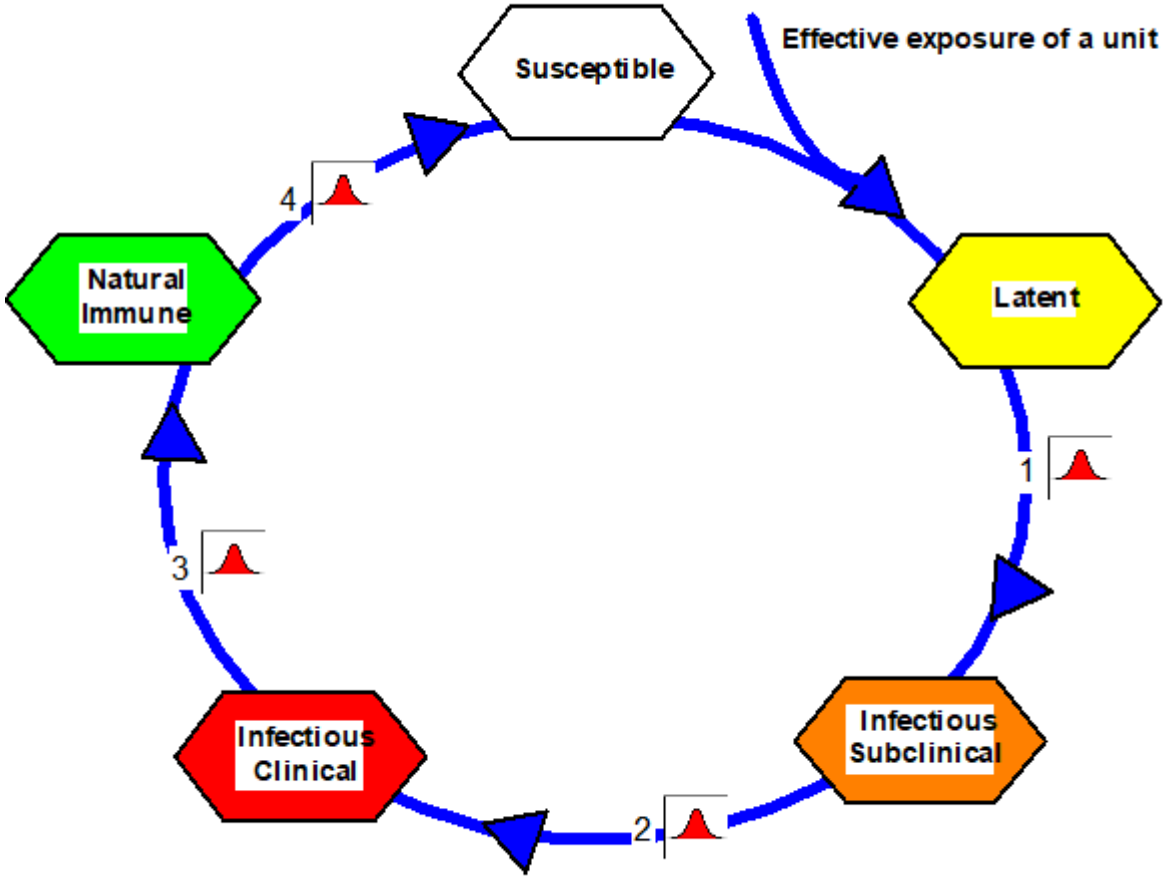


Discussed later…

- Vaccine immunity characteristics entered in another area
  - when vaccination is set up
- Destruction entered elsewhere too
- Not disease characteristics

Progression of an infection

Parameter-specified time intervals fitting into infection cycle



With-in unit prevalence

- An optional add-on to disease states
- Affects disease transmission

How does NAADSM use disease characteristics?

- Controls who can get infected, and how
- Controls who can spread infection, and how
- Affects how infection can be spread
- Affects when detection can occur
- Susceptible herds can be infected via any route
- Immune and Vaccine Immune herds cannot spread infection or be infected by other herds

How does NAADSM use disease characteristics?

- Transmission via direct contact can occur if infected unit is Latent, Infectious Subclinical or Infectious Clinical
- Transmission of disease via indirect contact can occur if infected unit is either Infectious Subclinical or Infectious Clinical
- Transmission via airborne dispersion can occur when infected unit is Infectious Subclinical or Infectious Clinical

How does NAADSM use disease characteristics?

- Detection occurs ONLY when unit is Infectious Clinical

Disease Parameters:

1. Latent period (days) 
2. Infectious subclinical period (days) 
3. Infectious clinical period (days) 
4. Natural immune period (days) 
5. Prevalence (0-1) vs. Time 

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*  Indicates a probability function
*  Indicates a relationship (*x*-*y*) chart

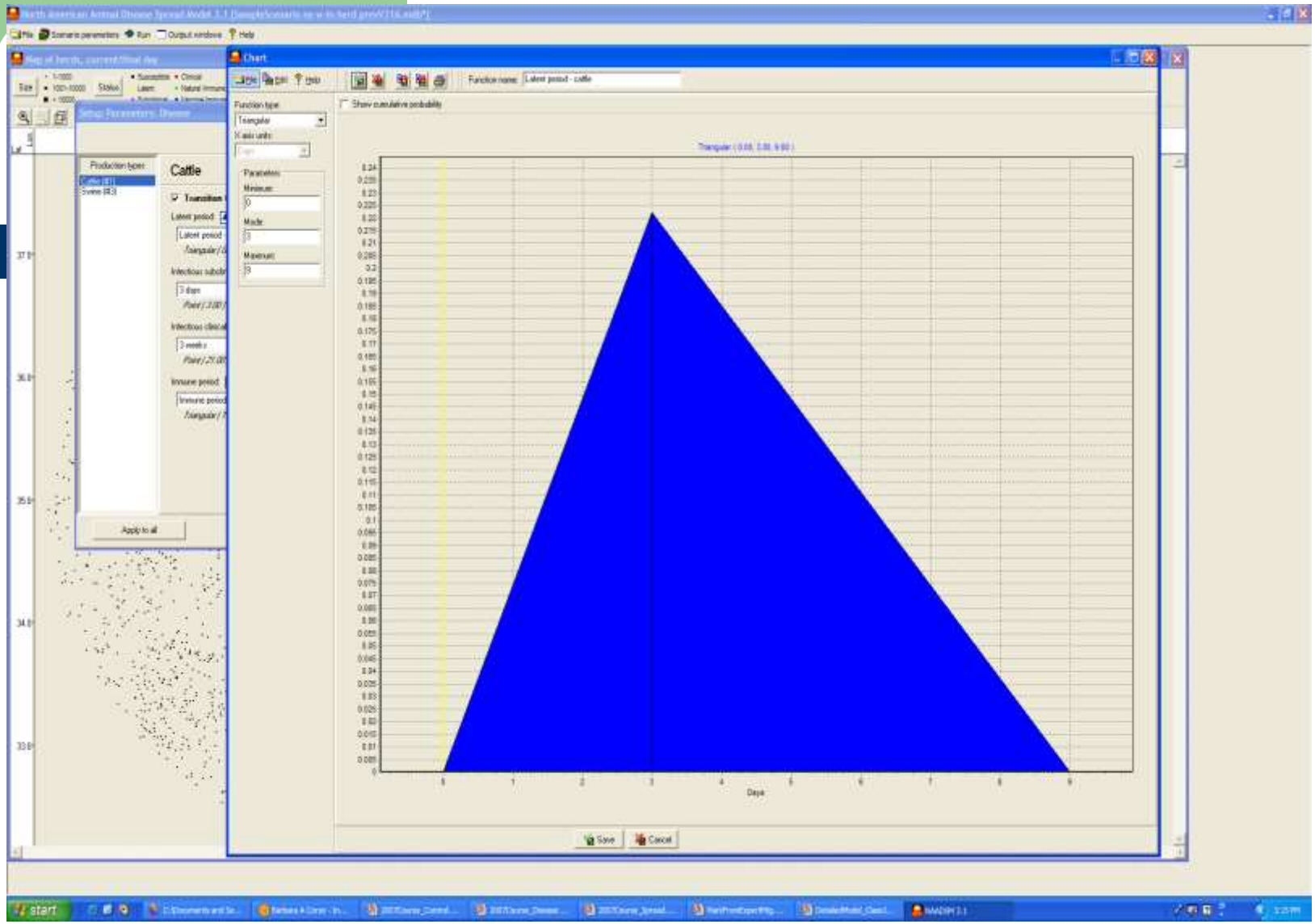


Chart
Function name: Latent period - cattle
Function type
Triangular
Show cumulative probability
Parameters
Minimum:
0
Mode:
3
Maximum:
9
Triangular (0.00, 3.00, 9.00)
Days
Save
Cancel
Production types
Cattle
Apply to all

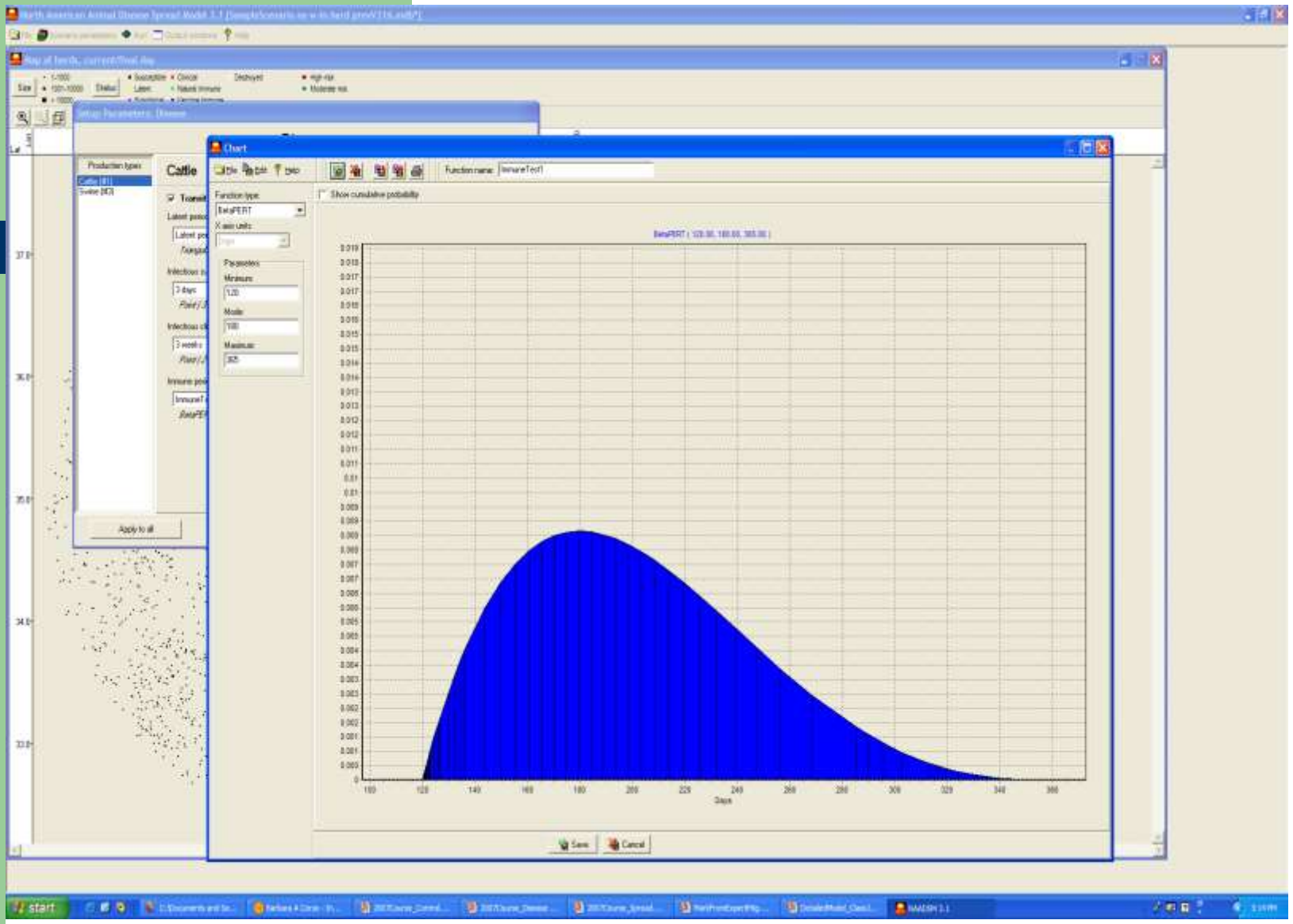


Chart
Cattle
Apply to all
Save
Cancel

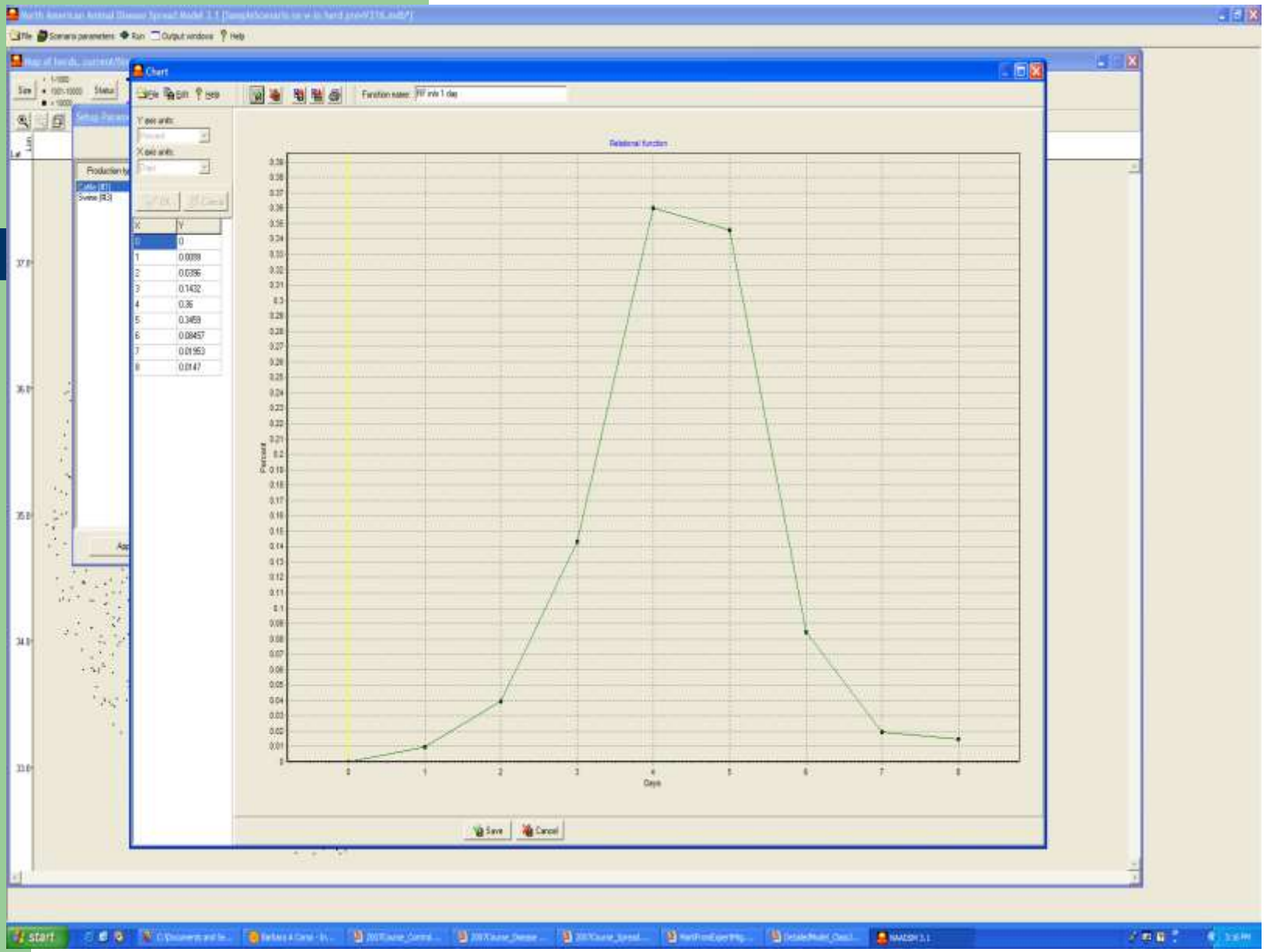
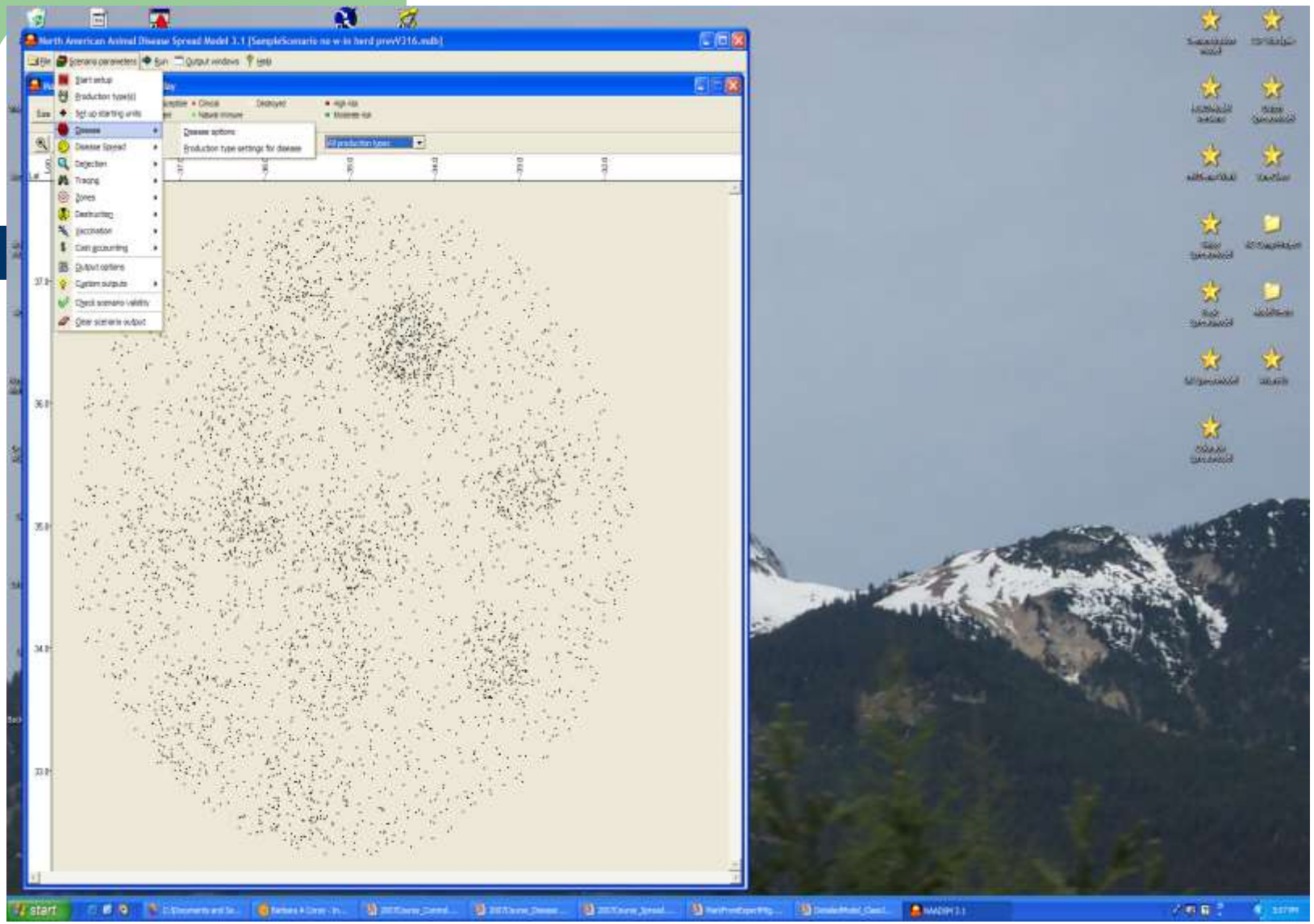
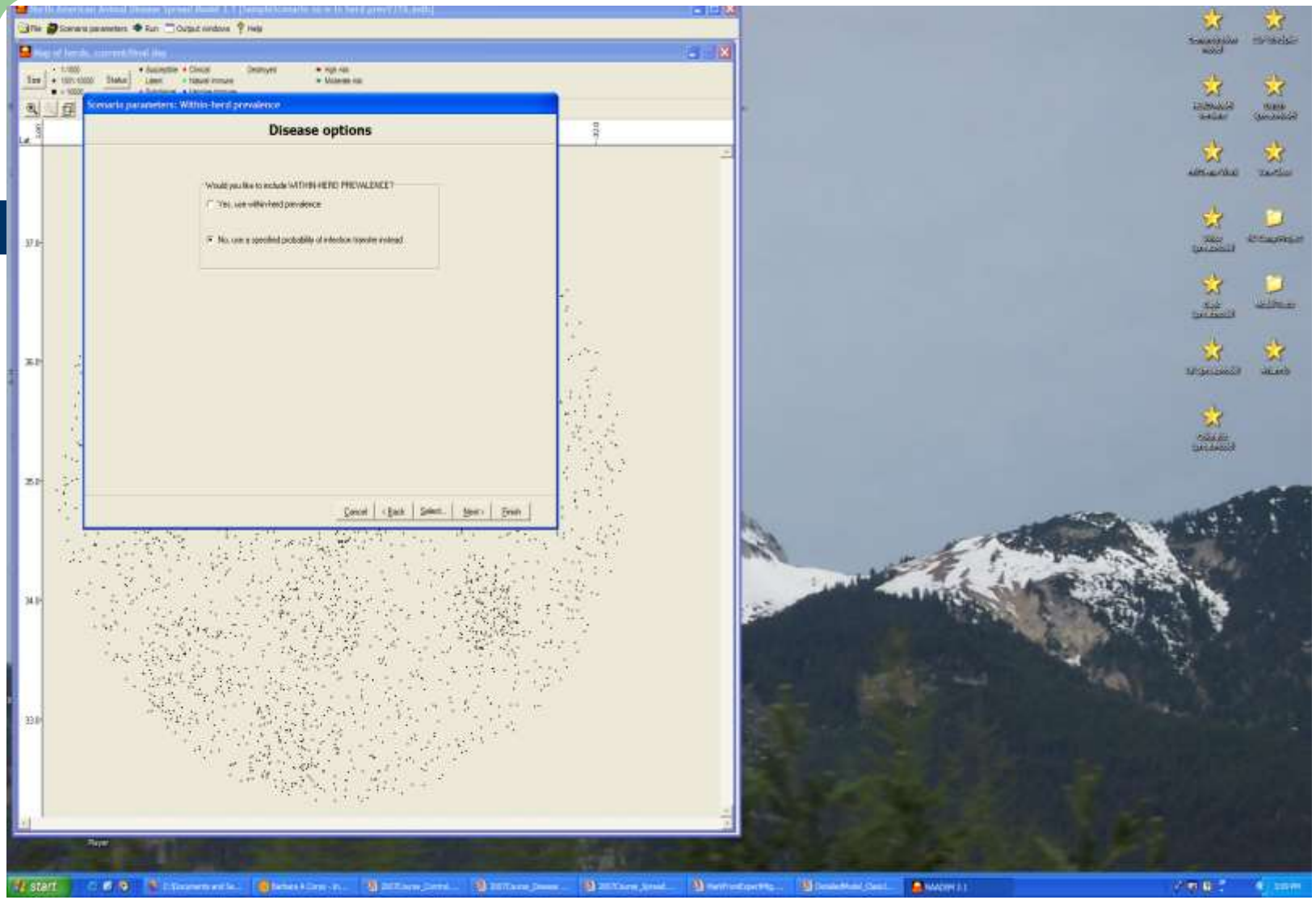


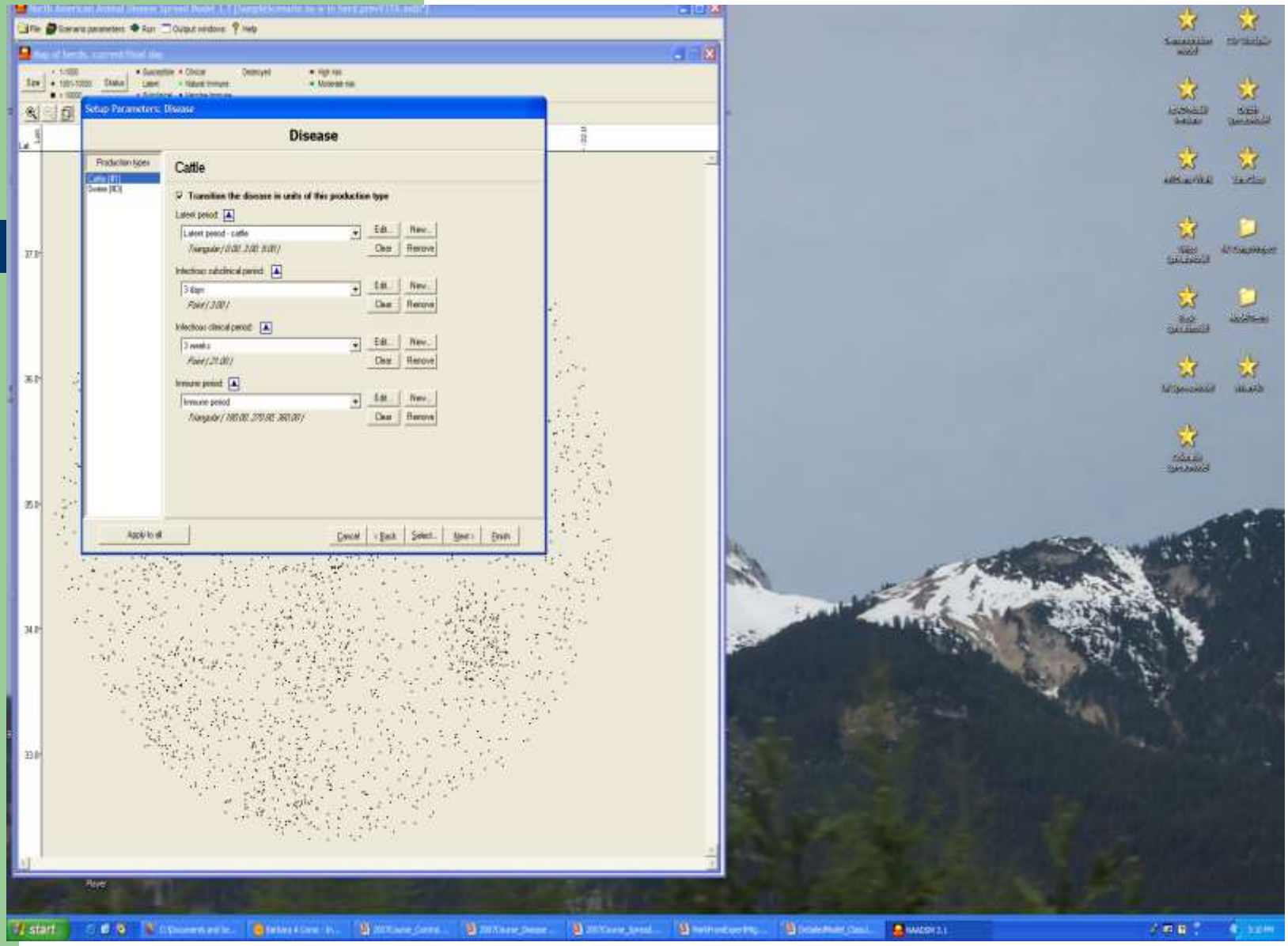
Chart
Relational function
Percent
Days
Save
Cancel

How do you enter characteristics?

- Setup Parameters: Disease
- Enter values for each species in the model
- Enter value for each state that exists
- Can enter 0 to skip a state
- Numerous functions allowed: Fixed Value (point), Uniform, Triangular, BetaPERT, Piecewise
- Can import piecewise from another package

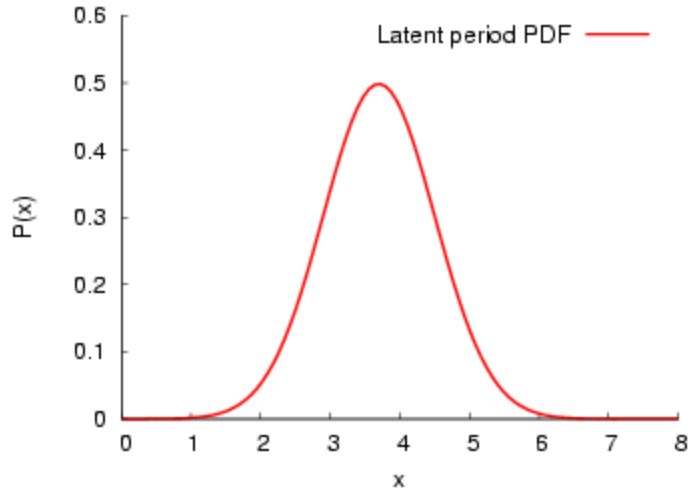

North American Animal Disease Spread Model 3.1
Scenario parameters
Run
Output windows
Help
Start setup
Production type(s)
Set up starting units
Disease
Disease Spread
Detection
Tracing
Zones
Destruction
Vaccination
Cost accounting
Output options
Custom outputs
Check scenario validity
Clear scenario output
Disease options
Production type settings for disease
start


Scenario parameters: Within-herd prevalence
Disease options
Would you like to include WITHIN-HERD PREVALENCE?
Yes, use within-herd prevalence
No, use a specified probability of infection transfer instead
Cancel
< Back
Select...
Next >
Finish
start

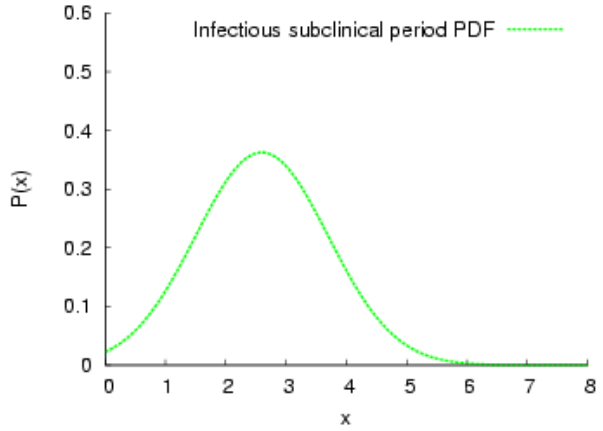

Setup Parameters: Disease
Disease
Production types
Cattle
Transition the disease in units of this production type
Latent period
Infectious subclinical period
Infectious clinical period
Immune period
Apply to all
Cancel
< Back
Select...
Next >
Finish

Example: Input Disease Characteristic parameters

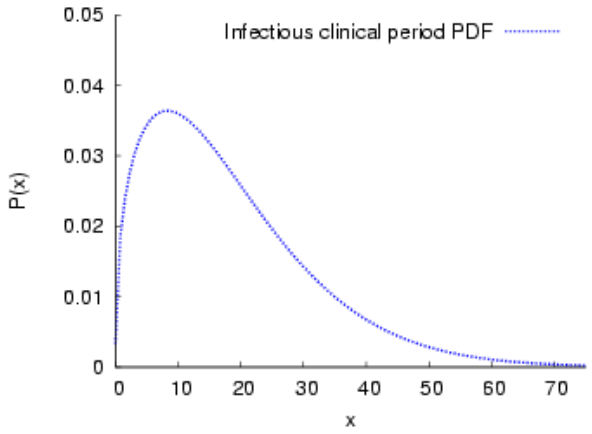
- Latent Period = normal (3.7, 0.8)



- Infectious subclinical period = normal (2.6, 1.1)



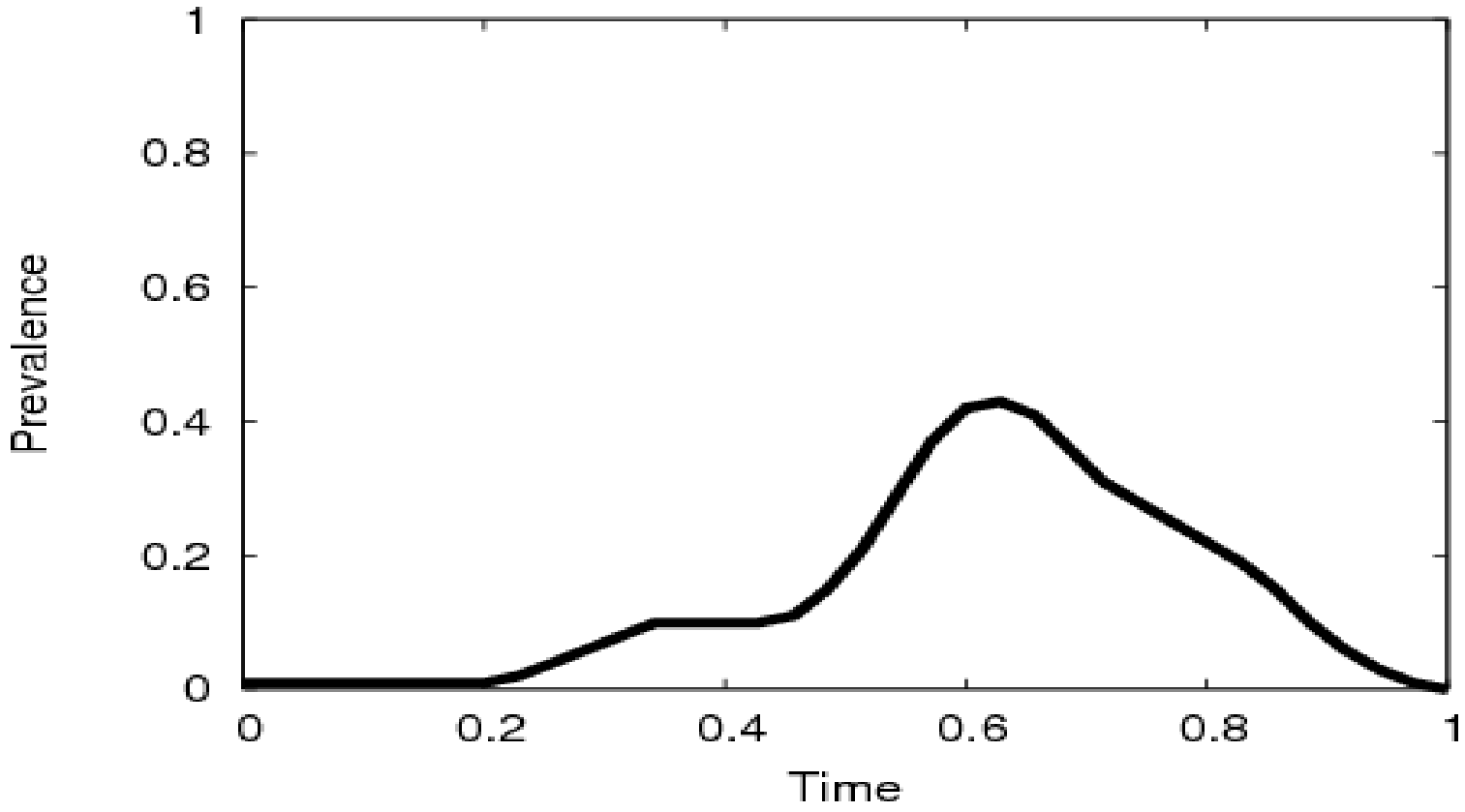
- Infectious clinical period = Weibull (1.4, 20.2)



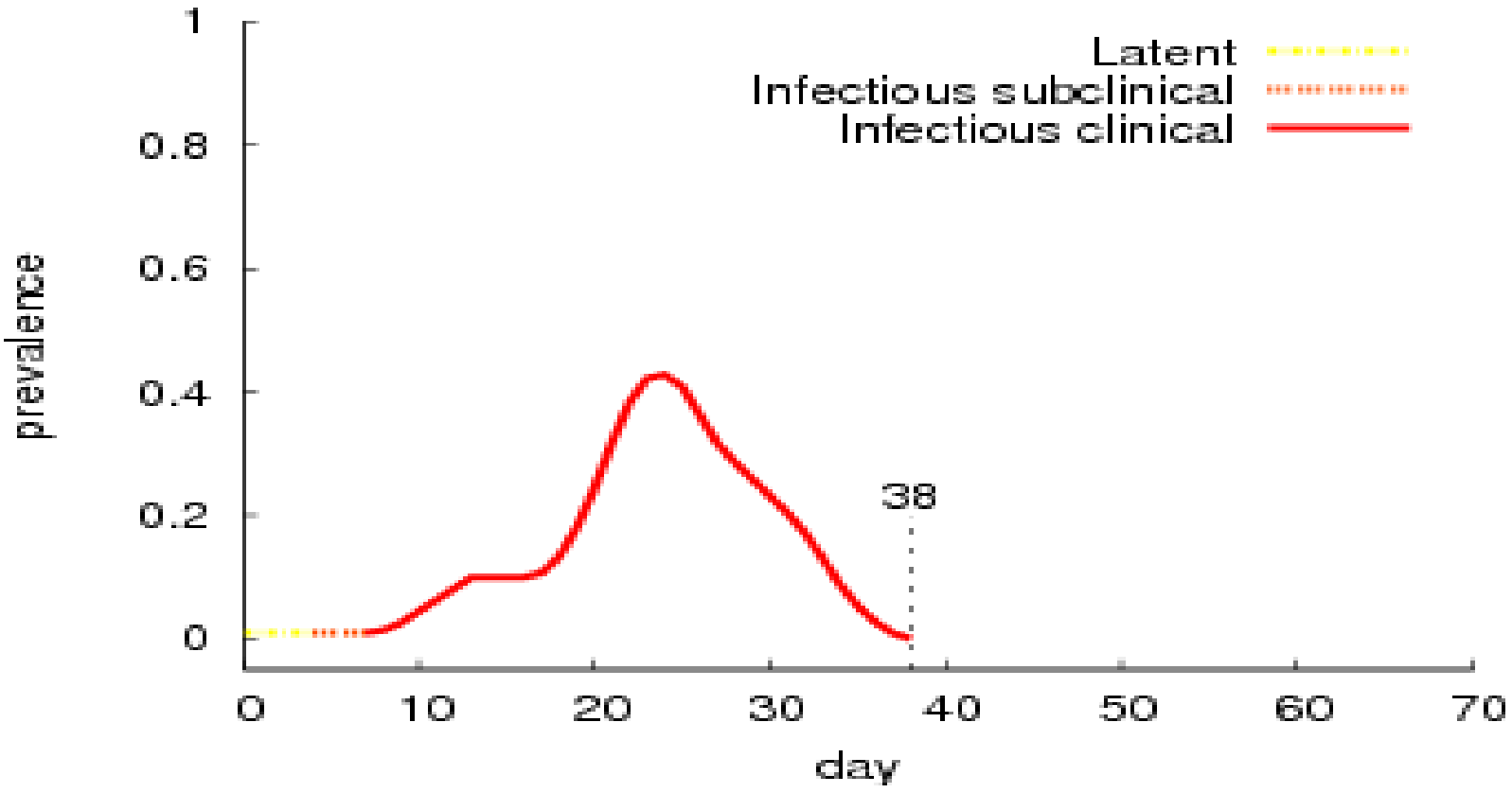
- Three different units become infected
- To determine duration of disease states we sample from our input distributions three times
- Results of three samplings
  - Latent = 4, Inf SubC = 3, Clin = 31 (38 days total)
  - 5, 1, 15 (21 days total)
  - 3, 1, 63 (67 days total)

- Without the within-unit option, NAADSM assumes that the entire premises is in the determined state for that period of time
- How does within unit prevalence adjustment change that?
- Combination of state information and the within-unit curve

Sample within-unit curve

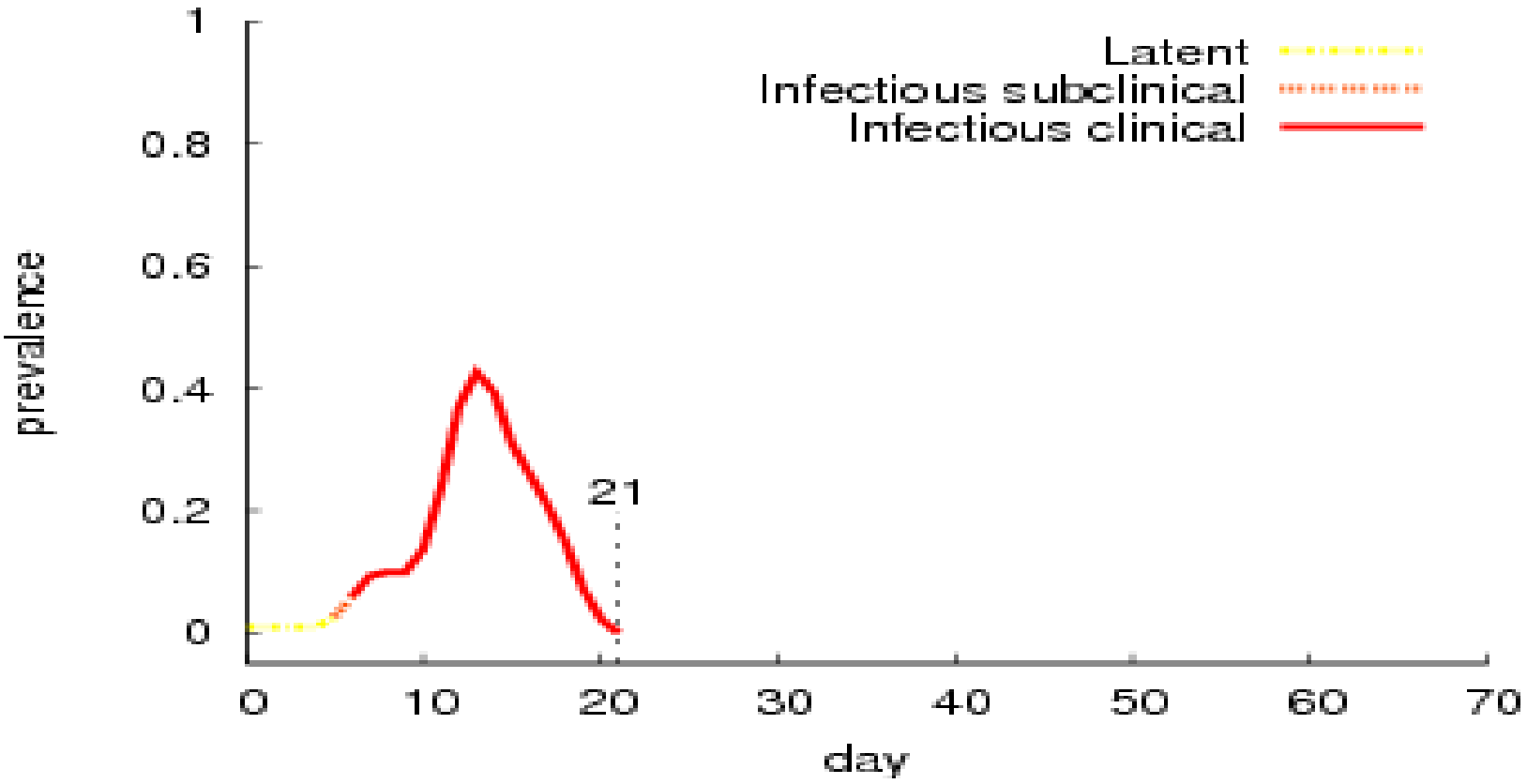


For unit with 38 day “sick” period
(4, 3, 31)

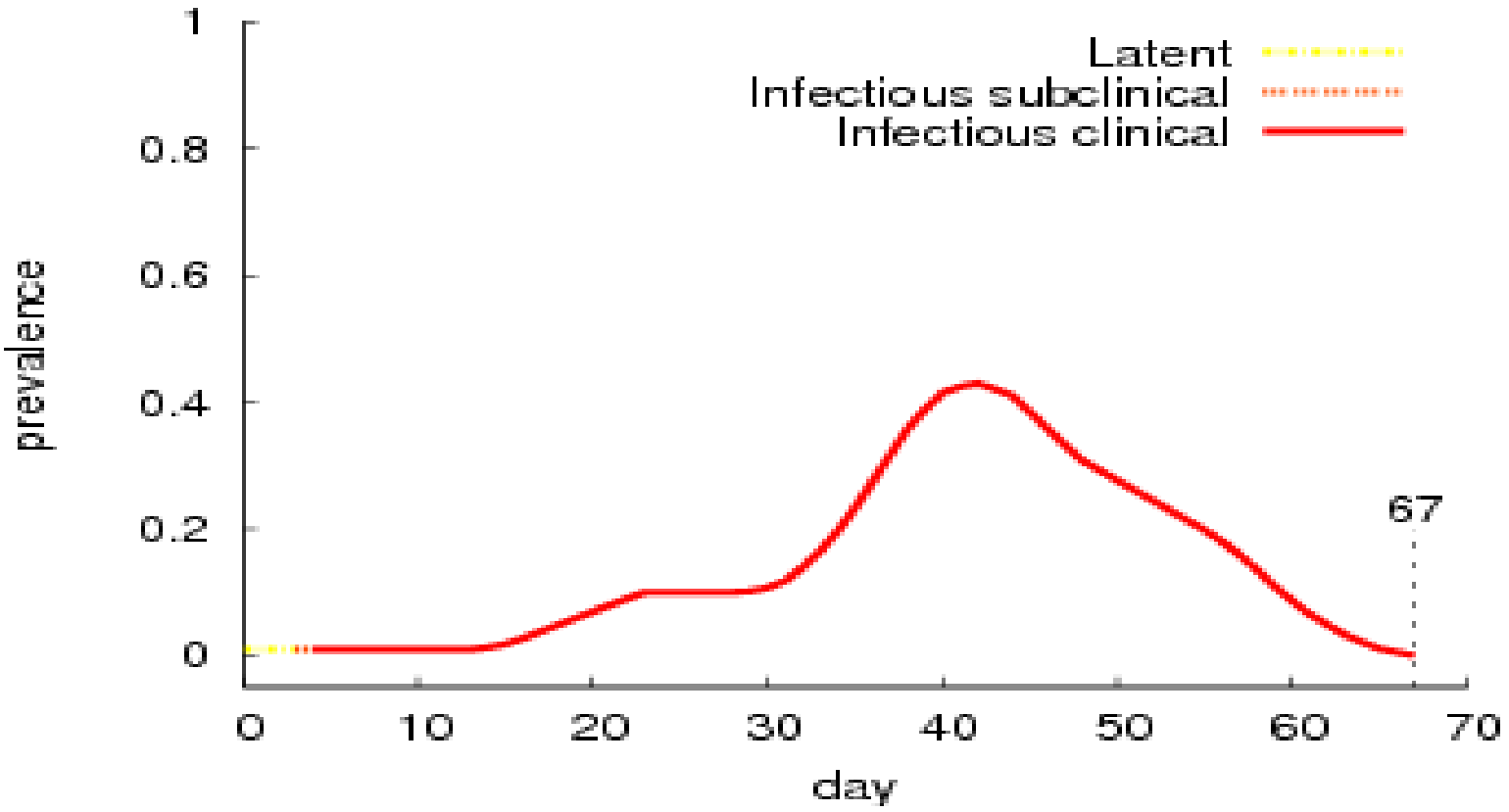


For unit with 21 day period

(5, 1, 15)



For unit with 67 day period
(3, 1, 63)



Concerns

- How do you decide what the input parameters should be?
- Interactions in the model

Questions?