Infectious Disease Models

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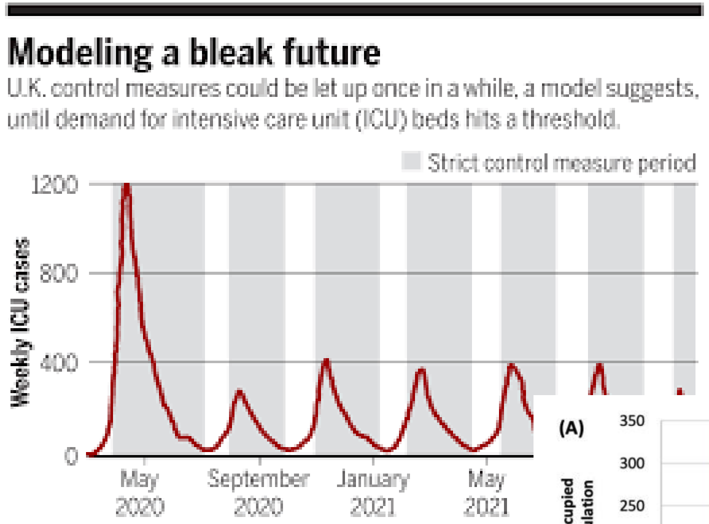
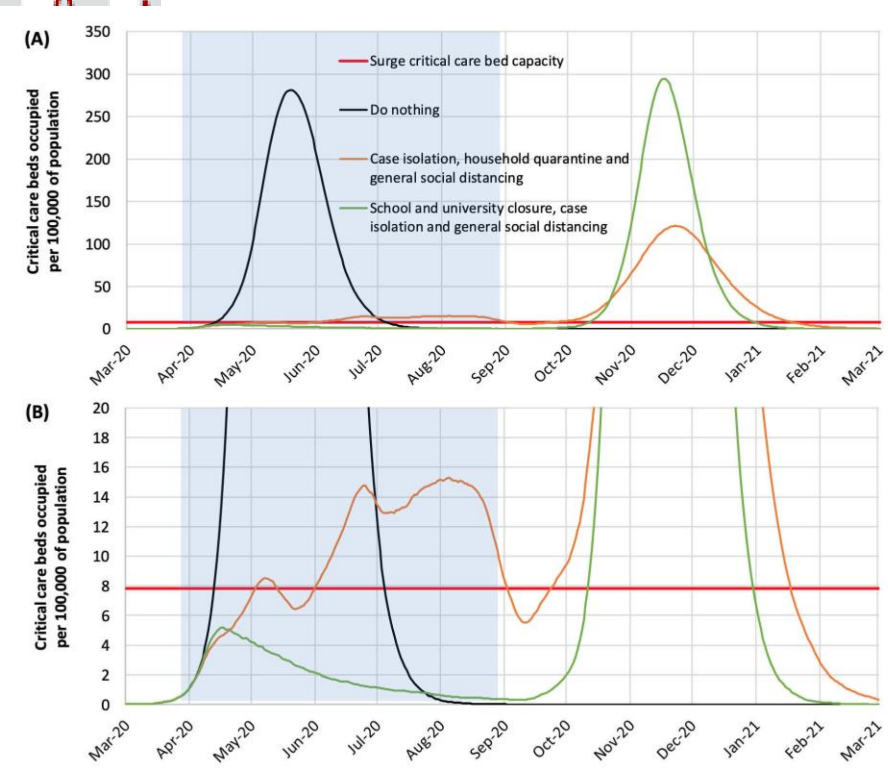
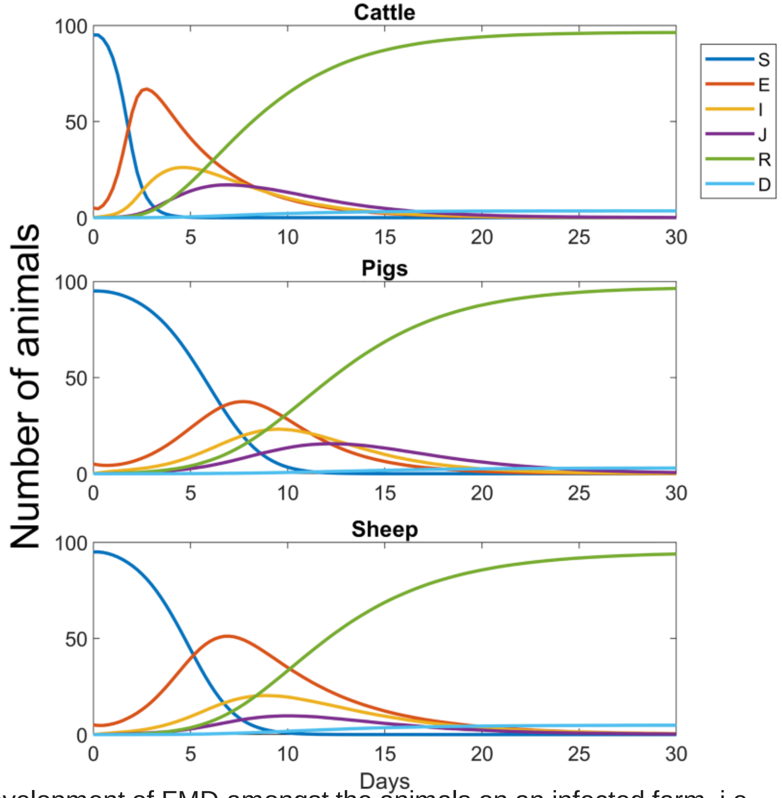
Infectious disease models provide information that can be used to understand transmission and compare controls options.





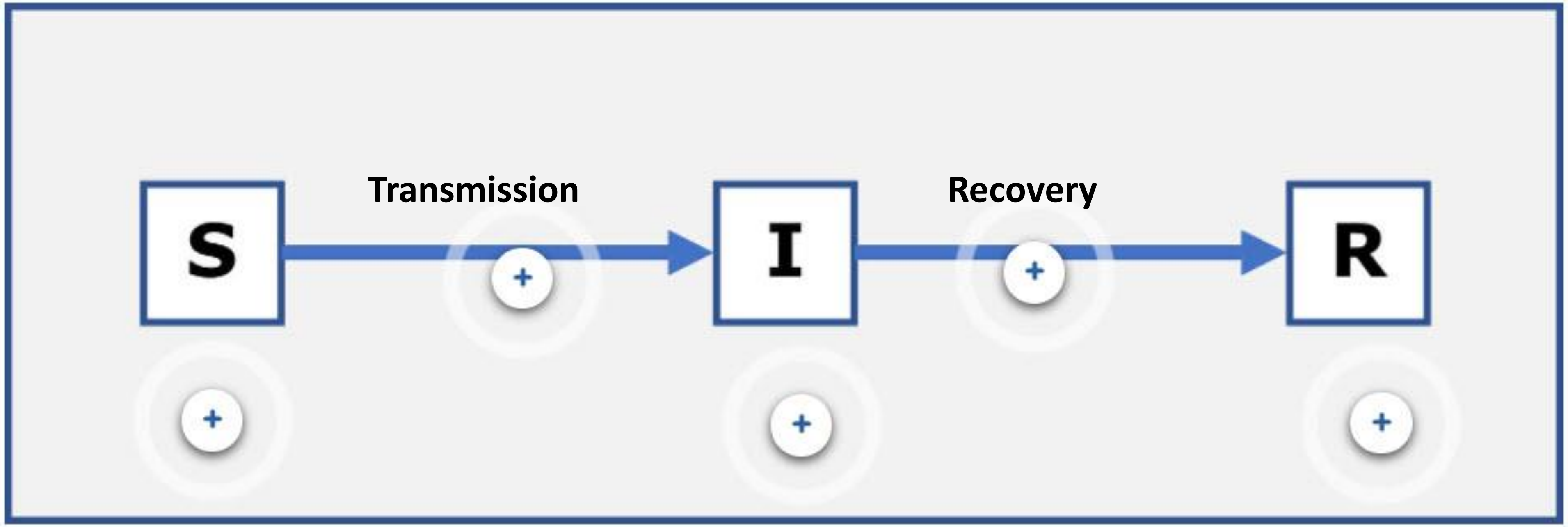


The development of FMD amongst the animals on an infected farm, i.e. intrafarm disease spread. The disease is initiated with 5 infected and 95 uninfected animals in all cases. The disease develop quickest in the case with cattle and slowest for pigs.

Review Module 1

Infectious Disease Models

- Use mathematics to describe transmission and evaluate controls



Infectious Disease Models

- Transmission is determined by:
  - Contact Rate
  - Probability of transmission
  - Level of infection (i.e. what proportion of contacts will be with infectious animals)
- Recovery is determined by the duration an animal is infectious

Stochastic Process = Chance

- Imagine rolling a die the probability of rolling a six would be 1/6
- Probability theory says if we roll the die six times we should expect to have one 6
- But will we?
- No because of chance

Infectious Disease Model

- To sum up the key concepts:
    - SIR models classify animals according to their current status (e.g. susceptible, infectious and recovered)
    - We use mathematical formulas to determine how many animals will be susceptible, infectious, and recovered each day.
    - SIR models have parameters that are fixed for a given scenario but can vary among scenarios.
    - We can include chance and when we do it is called a stochastic model

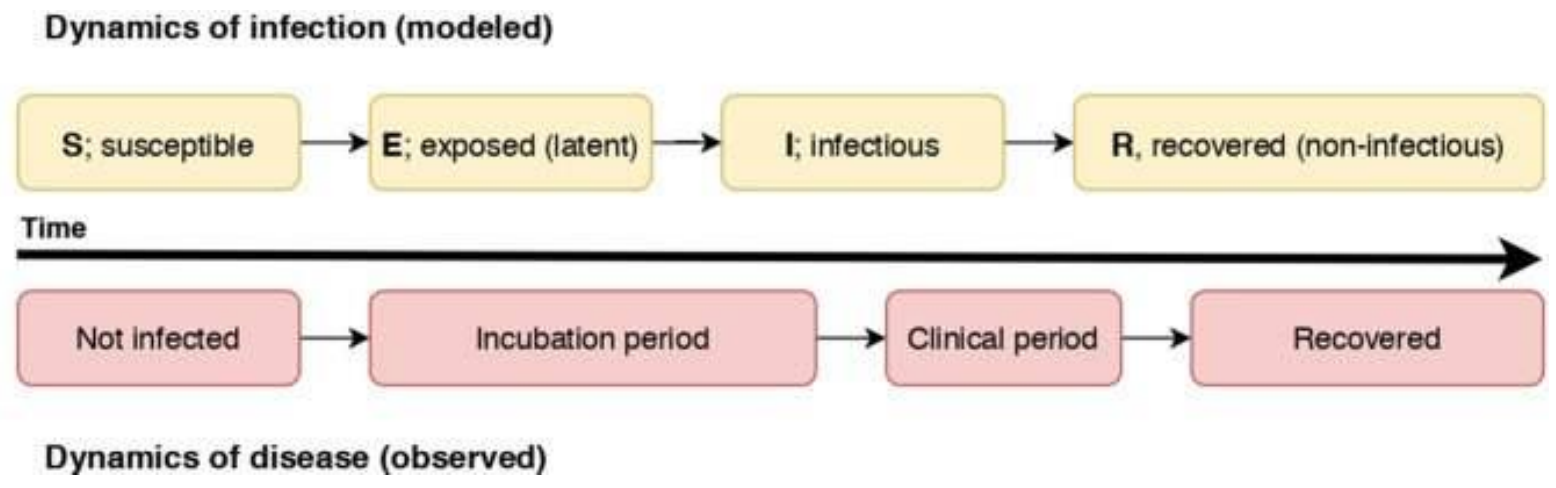
Review Module 2

Terminology

- <u>Unit of interest</u>
  - Are we interested in an individual animal or a group (e.g. farm, flock), or region
- <u>Dynamic</u>
  - The model includes time
- <u>Homogeneous v's heterogenous contacts</u>
  - Homogeneous = all units (e.g. animals or farms) have the same contract patterns
  - Heterogenous = we allow for different contact patterns for different types of units.

Terminology

- <u>Disease states</u>
  - Disease spread models represent the progression of the units of interest through different disease states. For instance, susceptible (S), infectious (I), and recovered (R).



Terminology

- <u>Individual-based model</u>
  - When we use an individual-based model each individual unit is followed separately to see what happens. In the HPAI scenario that means we would be following all 100,000 flocks of poultry.

What to do before programming a model

1. Define the purpose:

   Involves identifying the question or questions to be answered, the system to be modelled, and the outputs to track

2. Identify the unit of interest

   When modelling spread of an outbreak in a country or region we then to focus on the farm

3. Identify what is known about the disease and population to be modelled.

4. Determine the model type

Collating information

- The distribution of disease is determined by:
  - Dynamics of the underlying population (e.g. movement patterns between farms, types of farms)
  - Disease transmission

Type of model

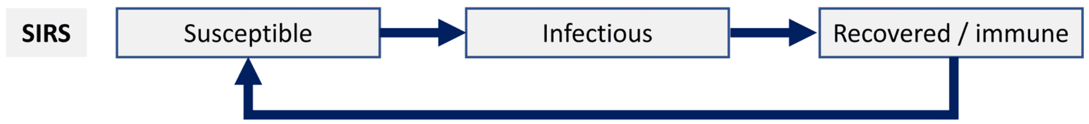
Comprises of two parts:

- How do you want to conceptualise the model?
- Will you create a deterministic or stochastic model?

Conceptualising the model

Susceptible-Infectious-Susceptible

Susceptible-Infectious-Recovered/Immune-Susceptible

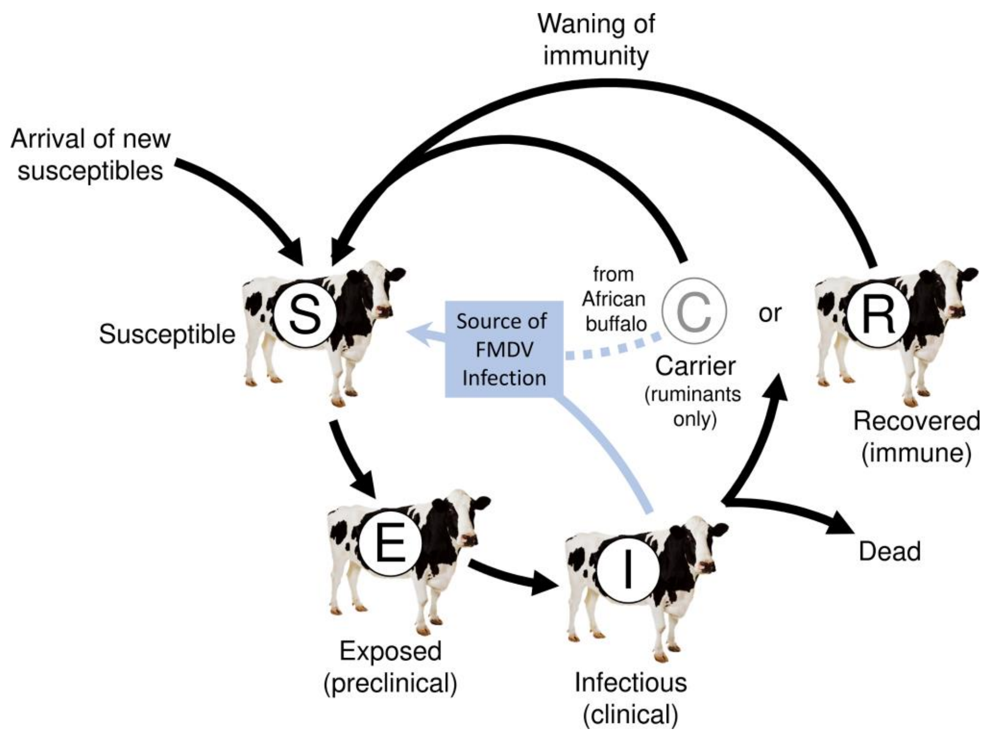


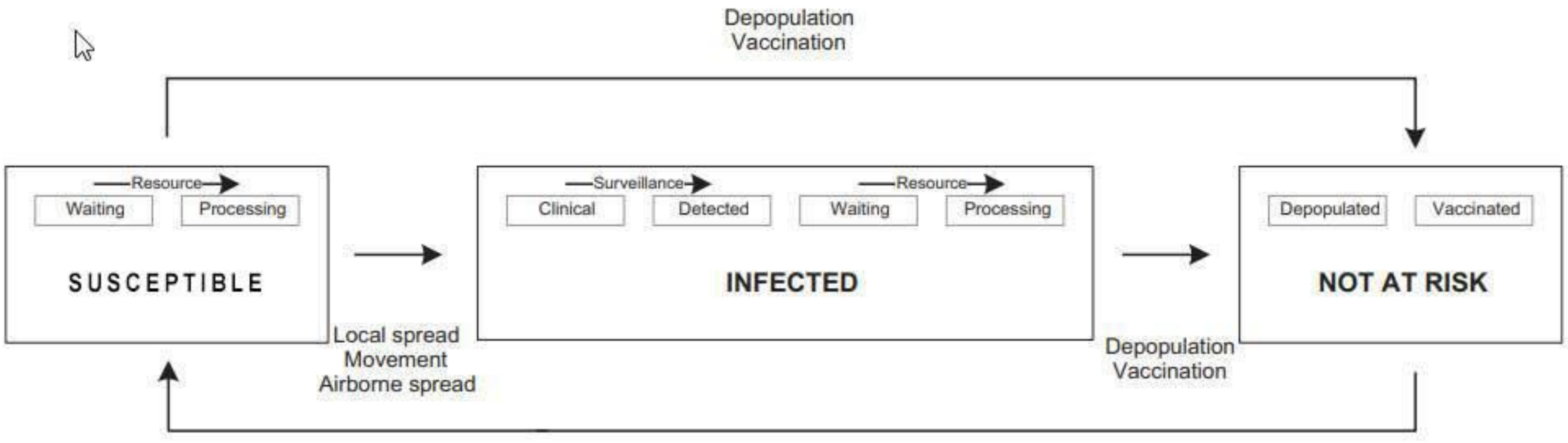
Conceptualising the model

Susceptible-Exposed-Infectious-Recovered-Susceptible

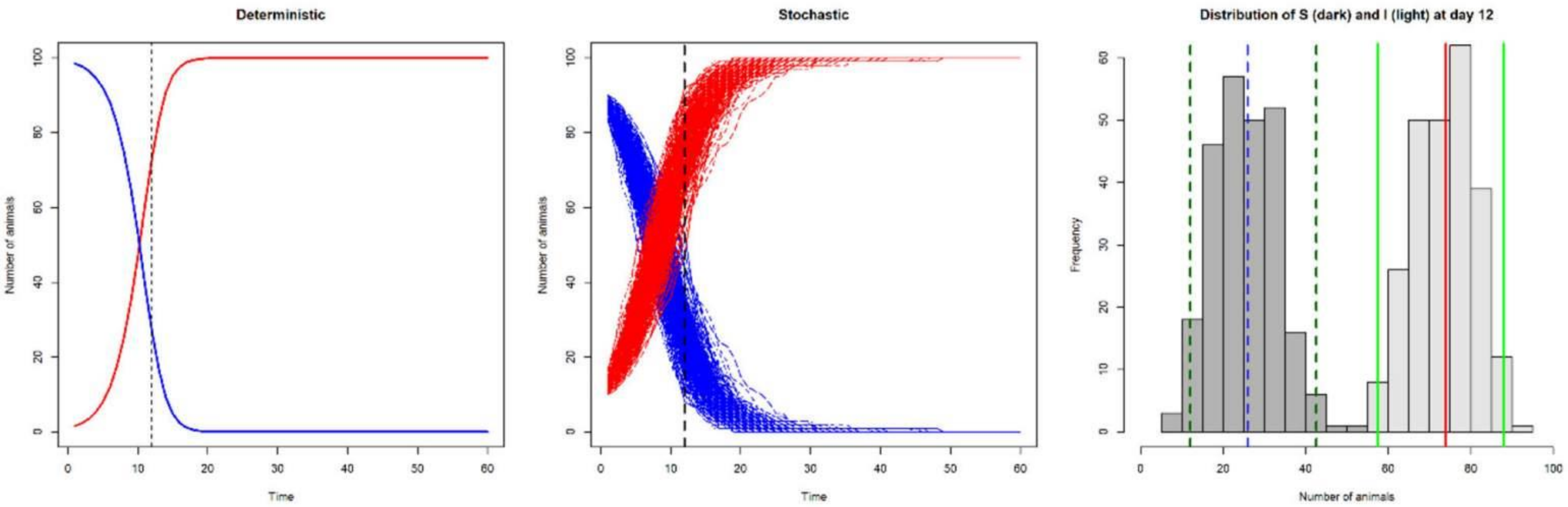
Conceptualising the model

- We are not limited to standard formats





Deterministic V Stochastic



Key difference is that for each day we have multiple possible values.

Conclusion

1. Define the purpose:

2. Identify the unit of interest

3. Identify what is known about the disease and population to be modelled.

4. Determine the model type

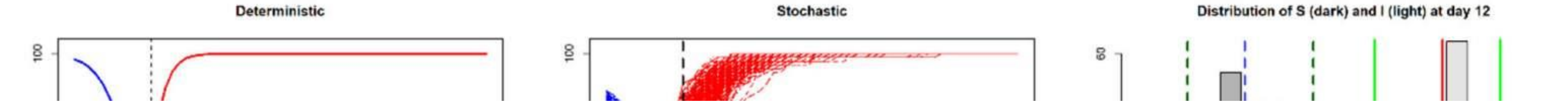
Breakout rooms

Naomi's Breakout Rooms

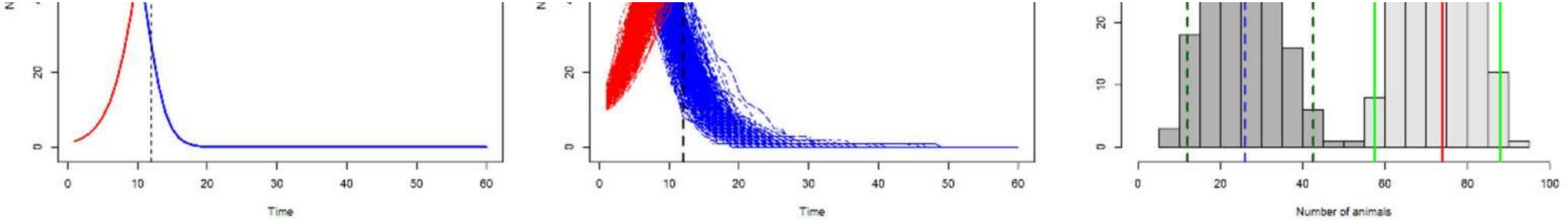
Mentimeter link:
https://www.menti.com/svac1t1aqf

Coming next

Coming next week



If there are many possible answers how do we decide what to do?



Key difference is that for each day we have multiple possible values.