Key premises for disease transmission in movement networks

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How to define “key premises" in an animal movement network?
Some proposals:

- Number of premises affected
- Maximum number of infected animals at any time
- Final outbreak size at end of simulation run
- Number of outbreaks where each of the premises were involved

Or maybe epidemic potential?

- epidemic: infections increase, 5+ premises
- large epidemic: infections increase, 20+ premises
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Movements between Scottish premises (excl. births, deaths, to SHs)
Data

- Cattle Tracing System (CTS)
- 1 Sep – 31 Oct 2013
- 9,482 Scottish premises (county >= 66)
- 145,237 cattle at start

- 1,542 premises with no between movements (9,067 cattle)
- Exits: deaths, exports and moves to slaughter
- Entries: births, imports
Simulation model

Compartmental model (animal-level, per premises):

Source: http://siminf.org/
Premises ranked in top 30
(according to potential for a large epidemic outbreak)

96 Agricultural holdings

Large epidemic potential: 18–43% probability

In case of an epidemic outbreak:
- Premises affected (median): 29
- Outbreak size at 28 days (median): 127 animals
What would happen if there is an infected animal on the single premises most likely to cause an epidemic outbreak?
Some insights

- Node involvement correlated with eigenvector centrality, but not with outbreak size or epidemic potential
- Much variability between premises w.r.t. epidemic potential
- SimInf framework is fast—useful for quick response in real outbreak
Future work

- Consistency of “key status” over time
- Rankings for slower moving diseases
- Different compartmental model types
  (incl. environmental contamination and spatial spread)
- Multi-species models
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