



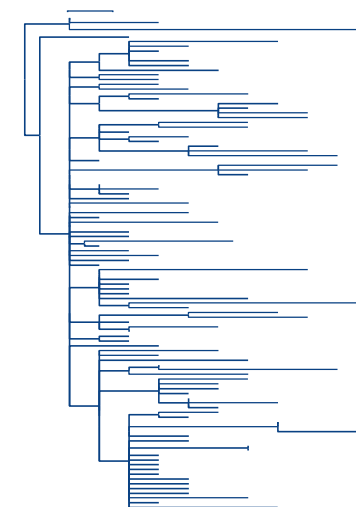
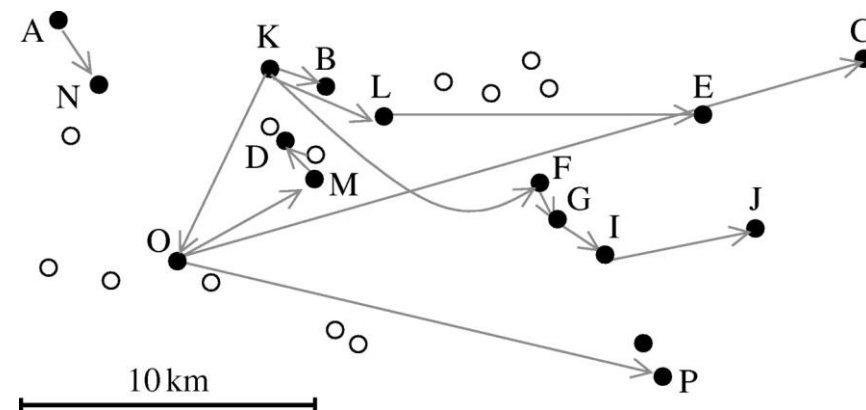
Melbourne Veterinary School
Faculty of Veterinary and Agricultural Sciences

Outbreak reconstruction, parameter inference and simulation

Simon Firestone¹, Saritha Kodikara

¹ Melbourne Veterinary School, The University of Melbourne

² Royal Melbourne Institute of Technology University





Introductions

Workshop aims/objectives

- Introduce Bayesian outbreak reconstruction models
- A gentle introduction to Bayesianism and R
- Familiarise with uses and limitations of these models
- Get everyone's hands dirty inferring and simulating outbreaks with BORIS

Timetable and exploring the course materials / R and packages, other software installation

Key answerable modelling questions



Timetable




Time	Instructor	Format	Details
0930 - 1000	SF, SK	Discussion	<u>Introductions, workshop aims and objectives</u> Discussion of 'key answerable modelling questions' in outbreaks.
1000 - 1045	SF	Presentation	<u>Overview of key tools and approaches for outbreak reconstruction, inference and simulation.</u> A Frequentist approach to outbreak reconstruction (Cottam) Bayesian inference and approaches Outbreak simulation Comparison of the accuracy of outbreak reconstruction algorithms Extension of the best model into BORIS
1045 - 1100			Morning tea.
1100 - 1300	SF, SK	Practical	<u>How to reconstruct an outbreak and make inferences with BORIS.</u>
1300 - 1400			Lunch.
1400 - 1530	SF, SK	Practical	<u>How to forwards simulate with BORIS.</u>
1530 - 1600			Afternoon tea.
1600 - 1630	SF, SK	Discussion	<u>Wrap-up.</u>

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Timetable
Software
Data
Documents
Web sites

Outbreak reconstruction, parameter inference and simulation - new tools

Australian Government Department of Agriculture, Canberra
26 November 2019

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[Simon Firestone](#)
Faculty of Veterinary and Agricultural Sciences
The University of Melbourne
Parkville, Victoria 3010, Australia

[Saritha Kodikara](#)
School of Science, Mathematical Sciences
RMIT University
Melbourne, Victoria 3001, Australia



Software

R, RStudio

R packages: BORIS, readxl, rgdal, ape

Tracer

MEGA



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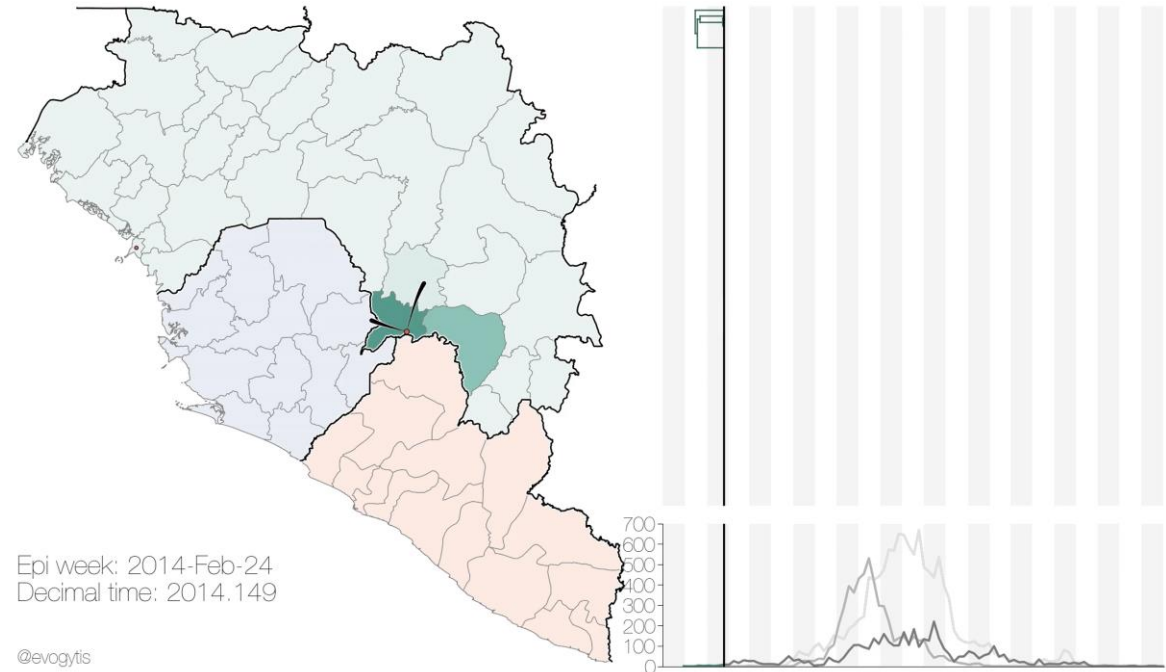
Key answerable modelling questions

Key questions (answerable?)

2014 Ebola outbreak in West Africa: transmission network model

What, where, when, how and why?

- How big will it be?
- How much will it cost?
- How did it get in?
- What is the best control option?
- ...
- Over to you



Source: Gytis Dudas, University of Washington, Seattle <https://youtu.be/j4Ut4krp8GQ>

Key questions: Models that infer who infected whom

Bayesian outbreak reconstruction/inferential models:

- Use available 'observed' data to provide inference of key parts of the rest of the picture.
Data = genomic and epidemiological (field collected and census/holding data)
- Can be used to reconstruct a past outbreak (improve understanding) or '**now-cast**': predict the present
- Primary inference is of the transmission network, i.e., **who infected whom?**
- Also infer **other parameters** included in the model (such as spatial spread characteristics, key epidemiological parameters, the timing of events, and therefore how key individuals were infected). These can subsequently be used in forward simulations.
- Ultimately help work out if the observed picture makes sense. **Are we missing some key infected individuals/farms? Where should we be targeting further surveillance and control resources.**



Key questions: Models that infer who infected whom

Bayesian outbreak reconstruction/inferential models:

- Also infer **other parameters** included in the model / **data-augment**:
 - spatial spread characteristics
 - key epidemiological parameters (R_0 , transmission rates, latent, incubation periods)
 - the timing of key events, and therefore how key individuals were infectedThese can subsequently be used in forward simulations.

- Ultimately help work out if the observed picture makes sense.

Are we missing some key infected individuals/farms?

Where should we be targeting further surveillance and control resources?

