

Practical II

Monday/Tuesday, 30/31 January 2023, 2pm – 5pm

Department of Biology, University of Oxford

Demonstrators/Instructors



Sumali, (she/her)

Main research: Equity in disease transmission and statistical inference



Rhys, (he/him)

Main research: Genomic epidemiology and sampling biases

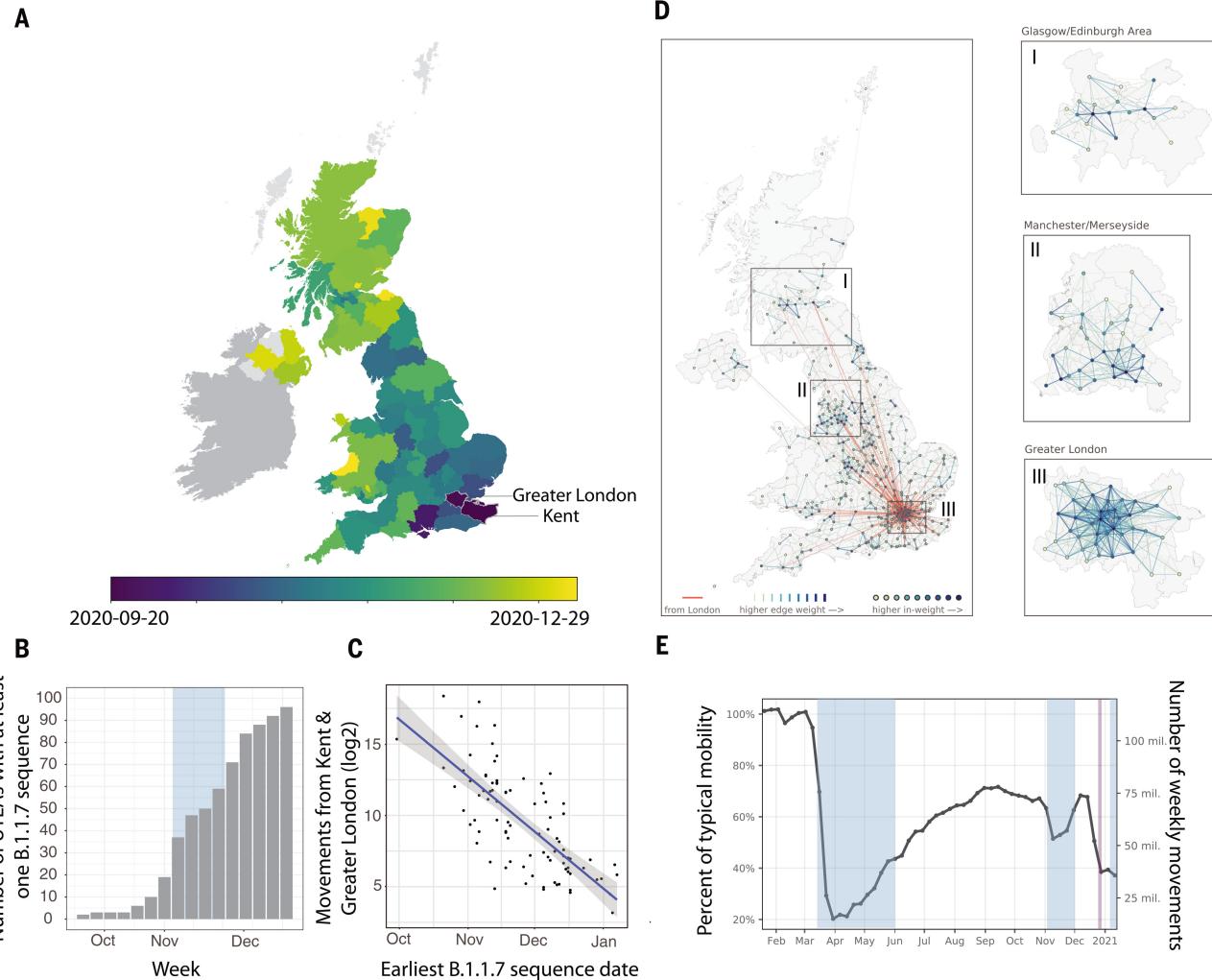


Moritz, (he/him)

Main research: Spatio-temporal dynamics of infectious diseases

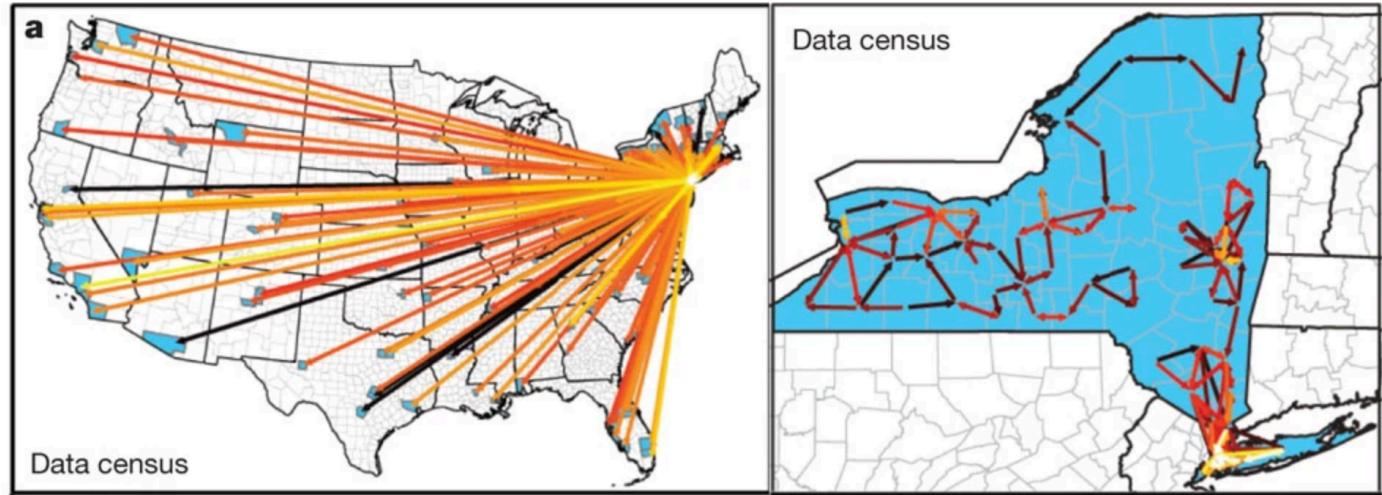
What are we learning today?

- Spatio-temporal dynamics of plant and infectious diseases
- How to fit multiple models to data and evaluate which ones explain the data best (for plant diseases)
- Differences between human mobility driven dispersal vs. continuous diffusion
- How to incorporate spatial structure in epidemic models (flu again)



Models of human mobility

- Infectious diseases spread along human movement networks
- Challenge: how do we represent human movement in ID models?
- The gravity model

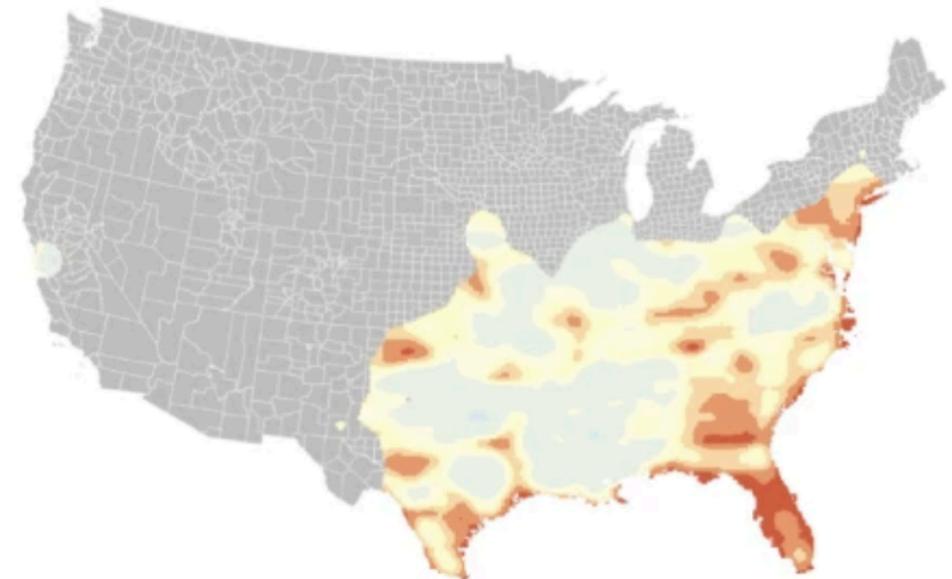


Simini et al. 2017 Nature

$$T_{ij} = \frac{m_i^\alpha n_j^\beta}{f(r_{ij})}$$

Examples of continuous diffusion

- Aedes albopictus dispersal in the US



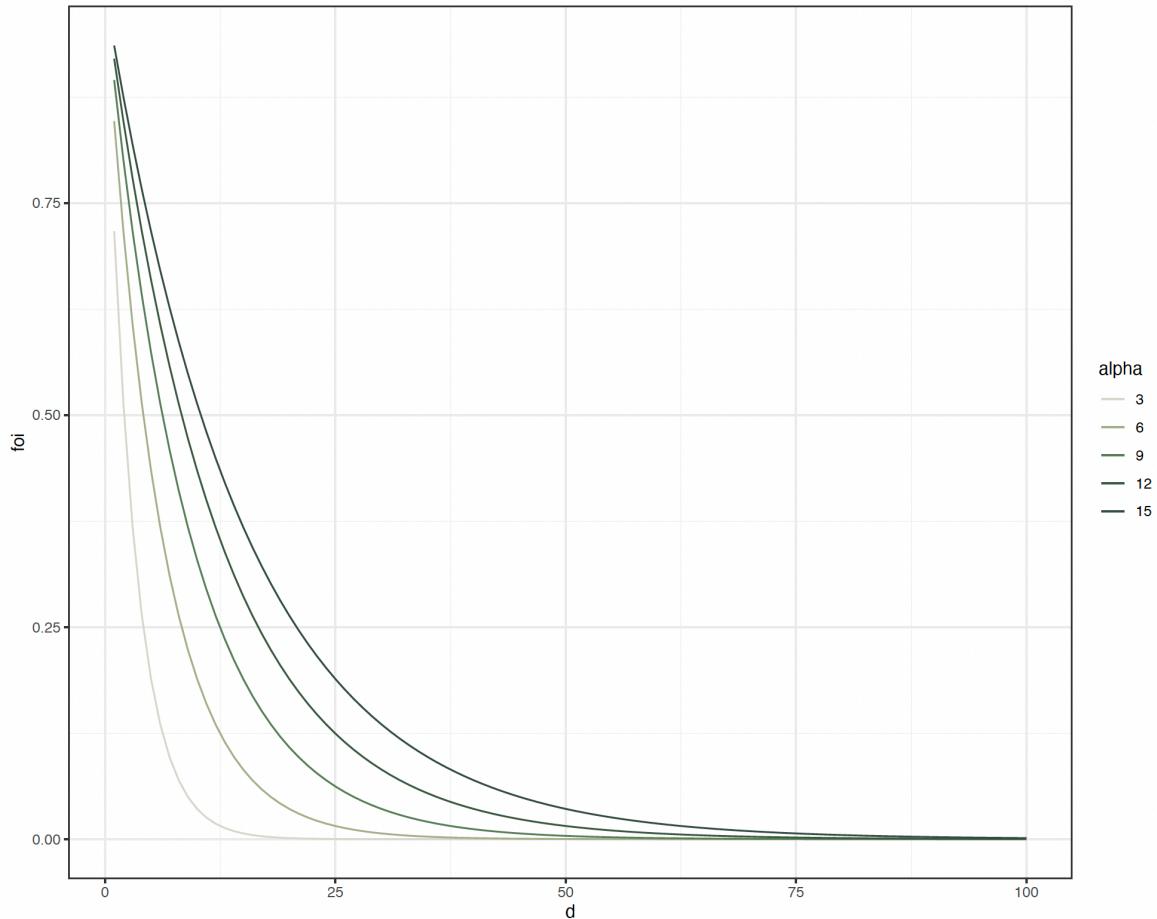
Kraemer et al. 2019 Nat. Microbiology

https://en.wikipedia.org/wiki/Aedes_albopictus

Spatial force of invasion

$$\propto \sum_j z_j \exp(-d_{ij}/a)$$

```
#####
a = seq(1,20, length = 1001)
llik = rep(NA, length(a))
for(i in 1:length(a)){
  foi = apply(exp(-dst/a[i])*filipendula$y94, 2, sum)
  lfit = glm(y95~foi, family = binomial(),
             data = filipendula)
  llik[i] = lfit$deviance/2
}
```



R-Markdown (again)

- Please create your own R-Markdown

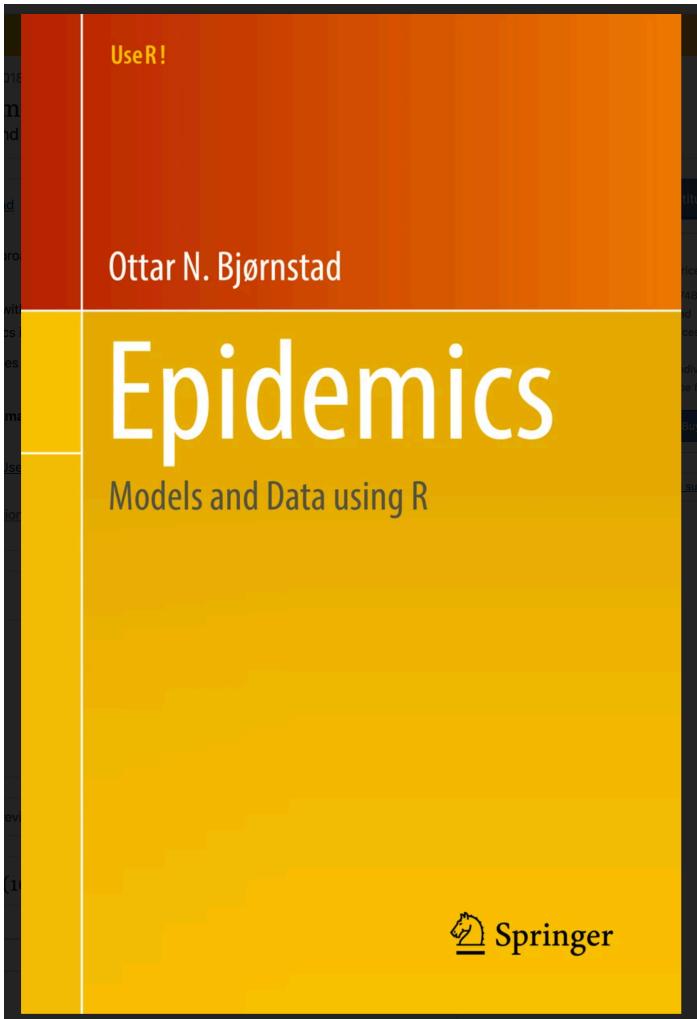
The screenshot displays the R Markdown website. At the top, there's a navigation bar with links for "Get Started", "Gallery", "Formats", "Articles", "Book", "References", and a search icon. Below the navigation, there's a large image showing various R Markdown documents and plots, including a map of New Zealand and a volcano contour plot. To the right of the image, the text "Analyze. Share. Reproduce." is displayed, followed by "Your data tells a story. Tell it with R Markdown. Turn your analyses into high quality documents, reports, presentations and dashboards." Below this, a section titled "R Markdown documents are fully reproducible." contains text about using the notebook interface to weave narrative text and code. At the bottom, a screenshot of an RStudio interface shows a code editor with R code and a plot of Mangungu Whau Volcano.

R Markdown documents are fully reproducible. Use a productive [notebook interface](#) to weave together narrative text and code to produce elegantly formatted output. Use [multiple languages](#) including R, Python, and SQL.

```
1 # Using Terrain Colors
2
3 library(raster)
4
5 v <- raster("Mangungu_Whau.tif")
6 vcol <- terrain.colors(100)
7
8 # Using Heat Colors
9
10 p <- plot(v, col=vcol, zlim=c(0, 100), add=TRUE, col="brown")
11 contour(x, y, vcol, levels=seq(0, 100, 10), add=TRUE, col="brown")
12
13 vcol <- heat.colors(100)
14
15 contour(x, y, vcol, levels=seq(0, 100, 10), add=TRUE, col="brown")
16
17 # Using Natural Earth Colors
18 vcol <- colorRampPalette(c("black", "brown"))
19
20 contour(x, y, vcol, levels=seq(0, 100, 10), add=TRUE, col="brown")
21 contour(x, y, vcol, levels=seq(0, 100, 10), add=TRUE, col="brown")
22
23 vcol <- topo.colors(100)
24
25 contour(x, y, vcol, levels=seq(0, 100, 10), add=TRUE, col="brown")
26
27 vcol <- magma.colors(100)
28
29 contour(x, y, vcol, levels=seq(0, 100, 10), add=TRUE, col="brown")
30
31 vcol <- RdYlBu.colors(100)
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33 contour(x, y, vcol, levels=seq(0, 100, 10), add=TRUE, col="brown")
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35 vcol <- RdYlGn.colors(100)
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98
99 vcol <- RdYlGn.colors(100)
100
101 contour(x, y, vcol, levels=seq(0, 100, 10), add=TRUE, col="brown")
```

<https://rmarkdown.rstudio.com/>

Some further readings



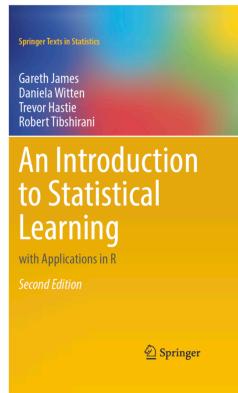
Winner of the 2014 Eric Ziegel award from Technometrics.

As the scale and scope of data collection continue to increase across virtually all fields, statistical learning has become a critical toolkit for anyone who wishes to understand data. *An Introduction to Statistical Learning* provides a broad and less technical treatment of key topics in statistical learning. Each chapter includes an R lab. This book is appropriate for anyone who wishes to use contemporary tools for data analysis.

The book has been translated into Chinese, Italian, Japanese, Korean, Mongolian, Russian and Vietnamese.

The First Edition topics include:

- Sparse methods for classification and regression
 - Decision trees
 - Boosting
 - Support vector machines
 - Clustering
- The Second Edition adds:
- Deep learning
 - Survival analysis
 - Multiple testing
 - Naive Bayes and generalized linear models
 - Bayesian additive regression trees
 - Matrix completion



<https://link.springer.com/book/10.1007/978-3-319-97487-3>

<https://www.statlearning.com/>