A Comparative Study of Techniques for Estimation and Inference of Nonlinear Stochastic Time Series

---

Dexter Barrows, B.Sc.

Masters Thesis Defence
McMaster University
April 2016

1. Framing
2. Hamiltonian HMCMC
3. Iterated Filtering 2
4. Model Fitting
5. Forecasting Frameworks
6. S-maps & Seasonal Outbreaks
7. Spatiotemporal Epidemics
8. Parallelism & Future Directions

Framing

Some stuff about forecasting being important …
… and lacking a “gold standard”

Hamiltonian MCMC

2

It’s cooooolllllll…. it has physiiiiicccsssssss

Iterated Filtering 2

3

Didn’t we skip a step????

Model Fitting

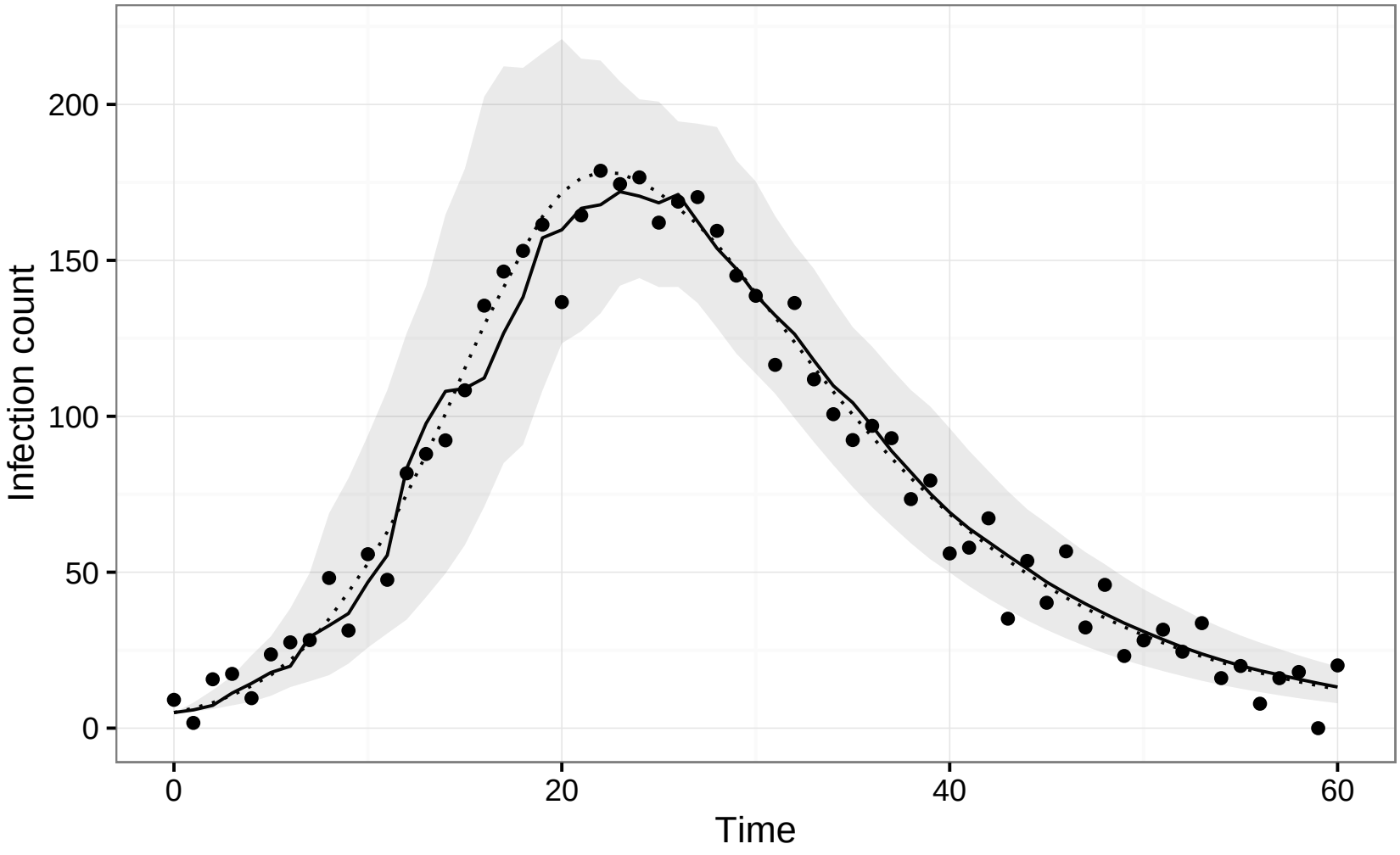
4

Stochastic SIR Model

$$\frac{dS}{dt} = -\beta SI$$
$$\frac{dI}{dt} = \beta SI - \gamma I$$
$$\frac{dR}{dt} = \gamma I$$

$$+$$

$$\beta_{i+1} = \exp\left[\beta_i + \eta\left(\bar{\beta} - \beta_i\right) + \mathcal{N}(0, \sigma_{proc})\right]$$


Infection count
200
150
100
50
0
0
20
40
60
Time

Mmmmm, Kernels

Forecasting Frameworks

5

Fuzzy bootstrapping

S-maps & Seasonal Outbreaks

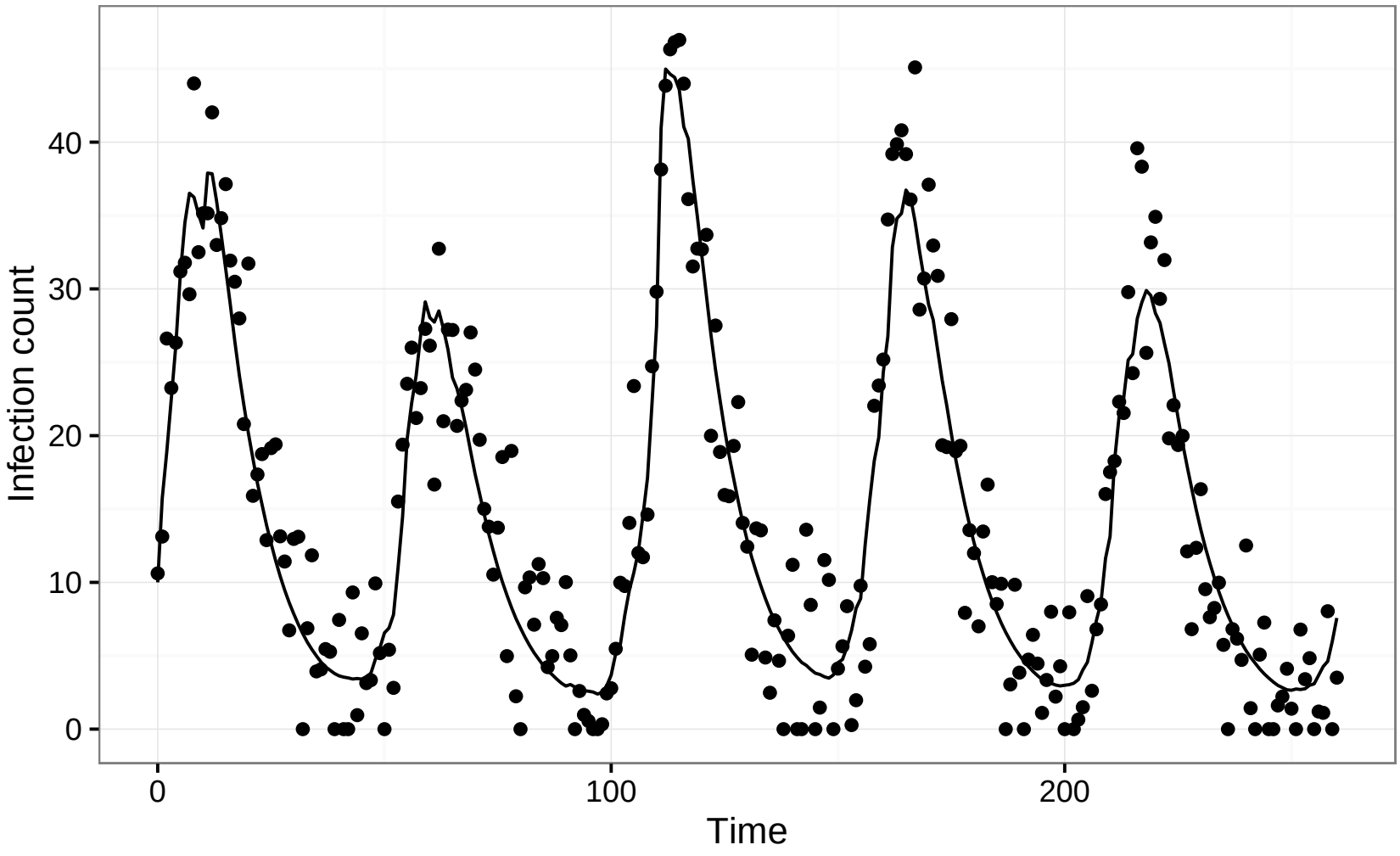
6

Stochastic SIRS Model

$$\frac{dS}{dt} = -\beta SI + \alpha R$$
$$\frac{dI}{dt} = \beta SI - \gamma I$$
$$\frac{dR}{dt} = \gamma I - \alpha R$$

$$+$$

$$\beta_{i+1} = \exp\left[\beta_i + \eta\left(\bar{\beta} - \beta_i\right) + \mathcal{N}(0, \sigma_{proc})\right]$$


Infection count
40
30
20
10
0
0
100
200
Time

Sugihara in the hizzy, knowahtimsaying????

7

Spatiotemporal Epidemics

If you liked it then you should have put a ring on it

Parallelism & Future Directions

More than Moore