Unpaired Homogeneous General Stochastic Epidemic Inference

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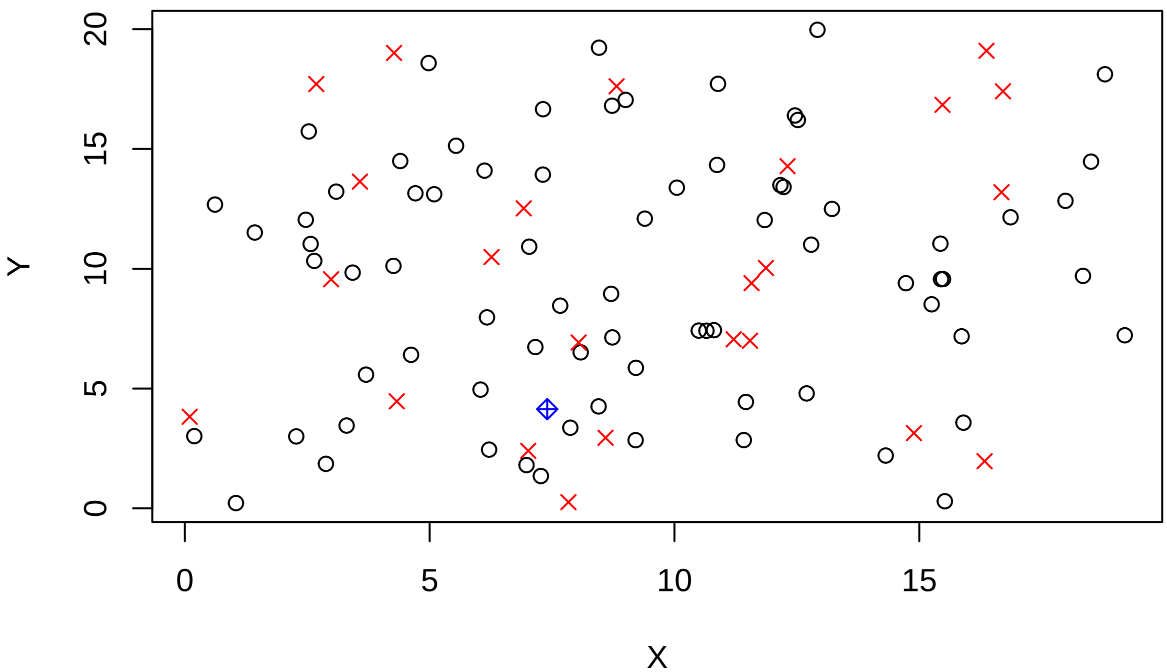
Load in the epidemic

The epidemic we have simulated has a modal number of infected individuals as roughly 25% of the population



Component functions of the MCMC algorithm

The likelihood / posterior

Thus we can now bring the two parts together and calculate the log-likelihood (more accurately the log-posterior for the infection times);

Metropolis-Hastings Acceptance Probability

The MCMC algorithm

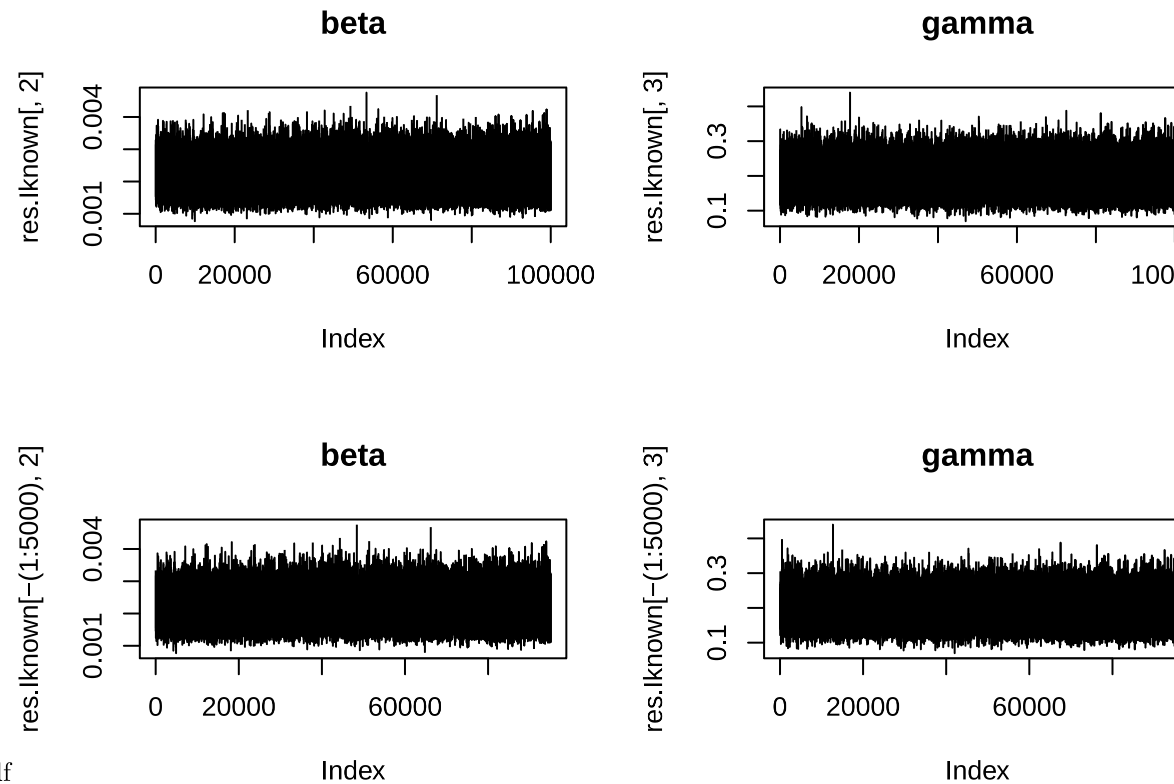
Assuming we know the true infection times, we can remove the Metropolis-Hastings step and reduce the algorithm down to just a Gibbs sampler.

As is more often the case, when the infection times are unknown we use MH methods

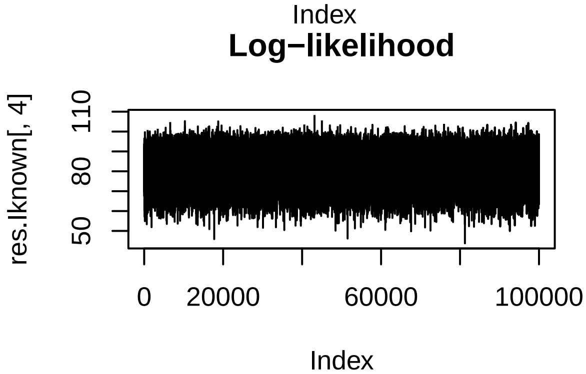
Making inference (Infection times known)

```
## Time difference of 2.142539 mins
```

```
##      sample            beta              gamma              llh
##  Min.   :  5001   Min.   :0.000771   Min.   :0.06978   Min.   : 43.77
##  1st Qu.: 28751   1st Qu.:0.001868   1st Qu.:0.16713   1st Qu.: 76.63
##  Median : 52500   Median :0.002146   Median :0.19150   Median : 81.61
##  Mean   : 52500   Mean   :0.002176   Mean   :0.19386   Mean   : 81.28
##  3rd Qu.: 76250   3rd Qu.:0.002452   3rd Qu.:0.21779   3rd Qu.: 86.26
##  Max.   :100000   Max.   :0.004754   Max.   :0.43951   Max.   :108.33
```



the results I known-1.pdf



the results I known-2.pdf

The algorithm estimates the mean, median, and quartiles of β to be 0.0021763 (0.0018677, 0.0021458, 0.0024525) compared to the true value of $\beta = 0.003$, with an effective sample size of 101202. It estimates the mean, median, and quartiles of γ to be 0.1938643 (0.1671271, 0.1915016, 0.2177905) compared to the true values of $\gamma = 0.23$, with an effective sample size of 96643.

Making inference (Infection times unknown)

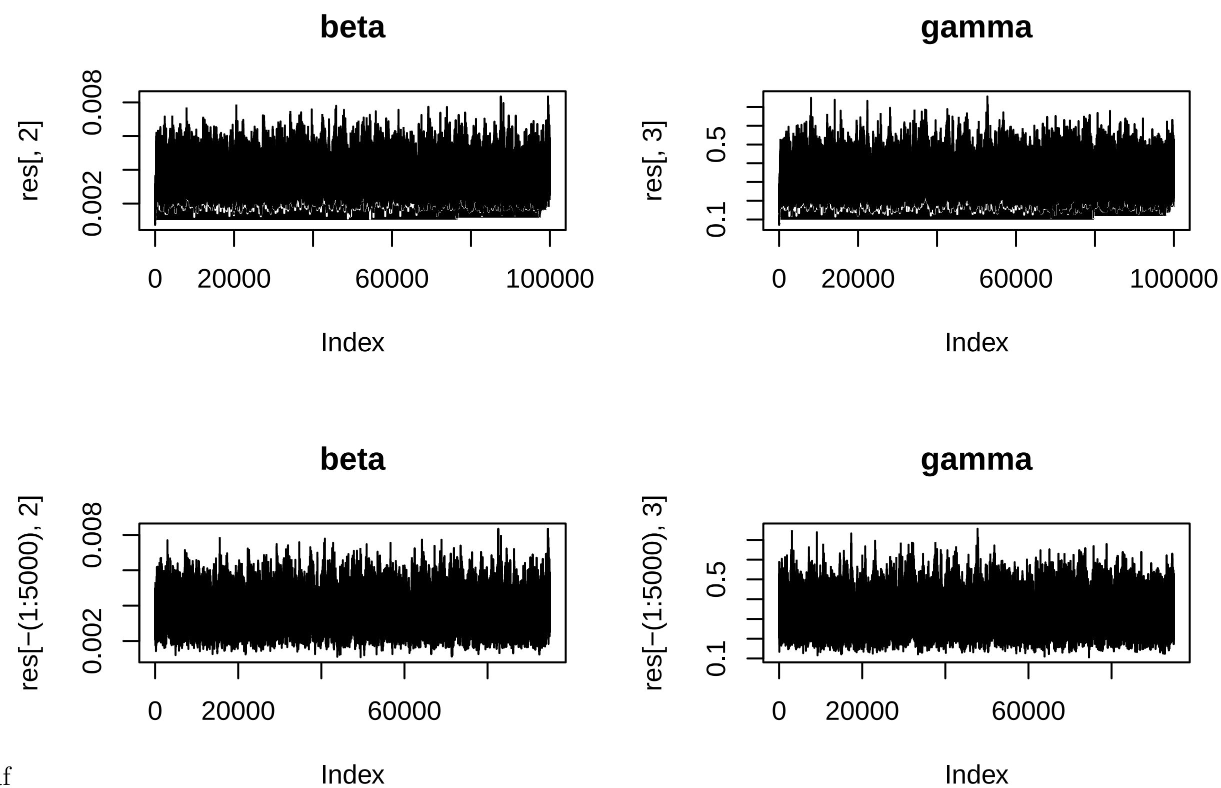
Using our simulated epidemic from earlier, we will now apply our MCMC algorithm in an effort to make inference and recover the parameters.

```
## [1] "initialised"
```

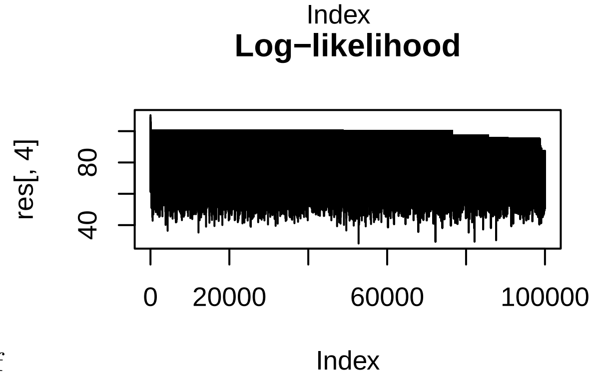
```
## Time difference of 5.398044 mins
```

```
## [1] 0.15361
```

```
##      sample            beta              gamma             llh        
##  Min.   :  5001   Min.   :0.001081   Min.   :0.1063   Min.   : 28.25  
##  1st Qu.: 28751   1st Qu.:0.002963   1st Qu.:0.2678   1st Qu.: 64.95  
##  Median : 52500   Median :0.003486   Median :0.3144   Median : 70.30  
##  Mean   : 52500   Mean   :0.003558   Mean   :0.3208   Mean   : 70.06  
##  3rd Qu.: 76250   3rd Qu.:0.004074   3rd Qu.:0.3671   3rd Qu.: 75.40  
##  Max.   :100000   Max.   :0.008355   Max.   :0.7568   Max.   :100.31  
```



the results-1.pdf



the results-2.pdf

The algorithm estimates the mean, median, and quartiles of β to be 0.0035577 (0.0029626, 0.0034858, 0.0040742) compared to the true value of $\beta = 0.003$, with an effective sample size of 1699. It estimates the mean, median, and quartiles of γ to be 0.3207641 (0.2677693, 0.3143977, 0.3670952) compared to the true values of $\gamma = 0.23$, with an effective sample size of 1636.