**Supporting materials**

**Appendix A.** Data employed in this study. There are 337 lower tier local authorities reporting daily COVID-19 cases across 759 day. All data assembled in this study are included as supplementary information. This data was compiled from a range of publicly available sources as noted in the manuscript. They are provided as the following files: Regions.csv and COVID19Cases.csv.

**Appendix B.** All R code is available to replicate all the methods in this study along with the results obtained in the COVID-19 example. All R-scripts to assemble and analysis the data are included as supplementary information. This has been provided as BGLRModel.R, BNRModel.R, SNRModel.R, timeseriesResults.R, and GLDIllustrations.R.

**Appendix C.** Gelman and Rubin’s convergence diagnostics.

|  |  |
| --- | --- |
| **(a)** |  |
|  | $$β\_{0}$$ |
|  |  |
| **(b)** |  |
|  | $$β\_{1}$$ |
|  |  |
| **(c)** |  |
|  | $$β\_{0}^{'}$$ |
|  |  |
| **(d)** |  |
|  | $$β\_{1}^{'}$$ |
|  |  |
| **(e)** |  |
|  | $$α$$ |
|  |  |

**Figure S1.** Daily Gelman and Rubin’s R statistic over 20000 iterations for the parameter vector $ψ$ for the COVID-19 daily data set. Values less than 1.1 (represented by the horizonal solid red line) suggest that the MCMC chains converge.