

Supplement

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Code is available at: <https://github.com/epiforecasts/model-structure-evaluation>.

1 Model characteristics

Table 1: Model characteristics contributing to the European COVID-19 Forecast Hub, by method used, number of countries targeted, and number of forecasts contributed.

| Model | Method | Country Targets | Case forecasts | Death forecasts |
|-------------------------------|------------------|-----------------|----------------|-----------------|
| AMM-EpiInvert | Statistical | Multi-country | 2788 (1.3%) | |
| CovidMetrics-epiBATS | Statistical | Single-country | 343 (0.2%) | |
| DSMPG-bayes | Semi-mechanistic | Multi-country | 760 (0.4%) | |
| EuroCOVIDhub-baseline | Statistical | Multi-country | 13082 (6.3%) | 13040 (6.3%) |
| FIAS_FZJ-Epi1Ger | Mechanistic | Single-country | 264 (0.1%) | 264 (0.1%) |
| GoeWroc-BaseBayes | Semi-mechanistic | Single-country | 12 (0%) | |
| HZI-AgeExtendedSEIR | Mechanistic | Single-country | 382 (0.2%) | 382 (0.2%) |
| ICM-agentModel | Agent-based | Single-country | 334 (0.2%) | 334 (0.2%) |
| IEM_Health-CovidProject | Mechanistic | Multi-country | 7710 (3.7%) | 7708 (3.7%) |
| ILM-EKF | Semi-mechanistic | Multi-country | 11998 (5.8%) | 11961 (5.8%) |
| ITWW-county_repro | Semi-mechanistic | Single-country | 650 (0.3%) | 600 (0.3%) |
| Imperial-DeCa | Semi-mechanistic | Multi-country | | 571 (0.3%) |
| Imperial-RtI0 | Semi-mechanistic | Multi-country | | 571 (0.3%) |
| Imperial-sbkp | Semi-mechanistic | Multi-country | | 571 (0.3%) |
| JBUD-HMXK | Mechanistic | Multi-country | 1324 (0.6%) | 1324 (0.6%) |
| KITmetricslab-bivar_branching | Statistical | Single-country | 8 (0%) | |
| Karlen-pypm | Mechanistic | Multi-country | 3208 (1.5%) | 3186 (1.5%) |
| LANL-GrowthRate | Semi-mechanistic | Multi-country | 3692 (1.8%) | 3696 (1.8%) |
| LeipzigIMISE-SECIR | Mechanistic | Single-country | 16 (0%) | 16 (0%) |
| MIMUW-StochSEIR | Mechanistic | Single-country | 76 (0%) | 76 (0%) |
| MIT_CovidAnalytics-DELPHI | Mechanistic | Single-country | 348 (0.2%) | 500 (0.2%) |
| MOCOS-agent1 | Agent-based | Single-country | 386 (0.2%) | 386 (0.2%) |
| MUNI-ARIMA | Statistical | Multi-country | 10979 (5.3%) | 11314 (5.4%) |
| MUNI-LaggedRegARIMA | Statistical | Multi-country | | 736 (0.4%) |
| MUNI-VAR | Statistical | Multi-country | 976 (0.5%) | 976 (0.5%) |
| MUNI_DMS-SEIAR | Mechanistic | Single-country | 224 (0.1%) | 200 (0.1%) |
| PL_GRedlarski-DistrictsSum | Mechanistic | Single-country | 378 (0.2%) | |
| RobertWalraven-ESG | Statistical | Multi-country | 9190 (4.4%) | 10465 (5%) |
| SDSC_ISG-TrendModel | Statistical | Multi-country | 1756 (0.8%) | 1744 (0.8%) |
| UB-BSLCoV | Statistical | Single-country | 96 (0%) | 96 (0%) |
| UC3M-EpiGraph | Agent-based | Single-country | 94 (0%) | |
| ULZF-SEIRC19SI | Mechanistic | Single-country | 249 (0.1%) | 249 (0.1%) |
| UMass-MechBayes | Mechanistic | Multi-country | | 5948 (2.9%) |
| UMass-SemiMech | Semi-mechanistic | Multi-country | 1888 (0.9%) | 1904 (0.9%) |
| UNED-PreCoV2 | Statistical | Single-country | 147 (0.1%) | 147 (0.1%) |
| UNIPV-BayesINGARCHX | Statistical | Multi-country | 426 (0.2%) | |
| USC-SIkJalpha | Mechanistic | Multi-country | 12900 (6.2%) | 12688 (6.1%) |
| UpgUmibUsi-MultiBayes | Semi-mechanistic | Single-country | 99 (0%) | 99 (0%) |
| bisop-seirfilter | Mechanistic | Single-country | 32 (0%) | 32 (0%) |
| bisop-seirfilterlite | Mechanistic | Multi-country | 336 (0.2%) | 336 (0.2%) |
| epiMOX-SUIHTER | Mechanistic | Single-country | 134 (0.1%) | 134 (0.1%) |
| epiforecasts-EpiExpert | Qualitative | Multi-country | 945 (0.5%) | 948 (0.5%) |
| epiforecasts-EpiExpert_Rt | Qualitative | Multi-country | 404 (0.2%) | 404 (0.2%) |
| epiforecasts-EpiExpert_direct | Qualitative | Multi-country | 394 (0.2%) | 392 (0.2%) |
| epiforecasts-EpiNow2 | Semi-mechanistic | Multi-country | 8843 (4.3%) | 7721 (3.7%) |
| epiforecasts-weeklygrowth | Statistical | Multi-country | 5971 (2.9%) | |
| itwm-dSEIR | Mechanistic | Single-country | 406 (0.2%) | 406 (0.2%) |
| prolix-euclidean | Semi-mechanistic | Multi-country | 800 (0.4%) | 800 (0.4%) |

2 Distribution of model scores

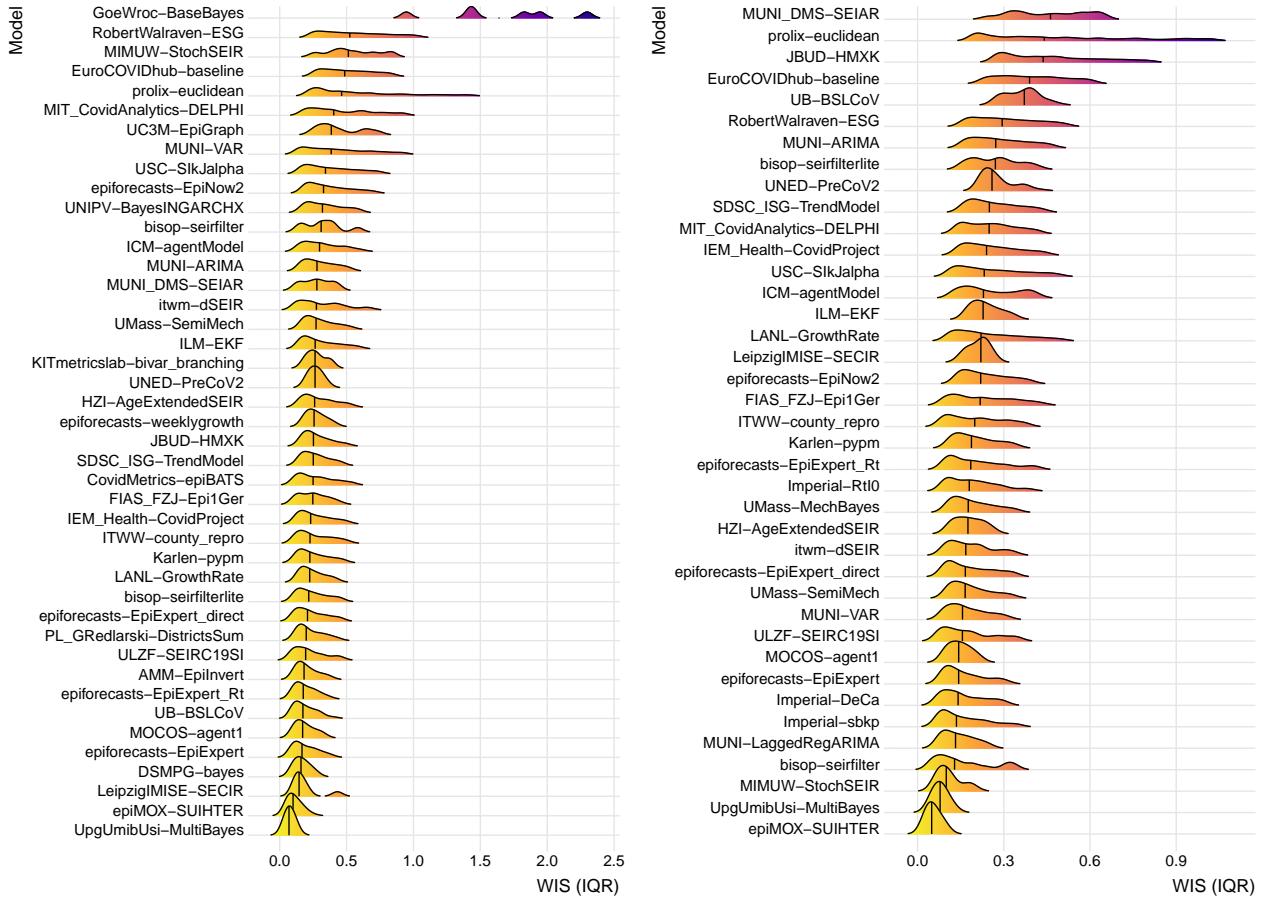


Figure 1: Distribution of forecast scores for each contributing model. Each distribution shows the interquartile range and median (vertical line) of interval scores across forecasts made by each model, with lower interval score indicating better predictive accuracy. Each model forecast for a different combination of targets, with some models contributing very few forecasts, meaning that forecast scores are not directly comparable.

3 Trend identification

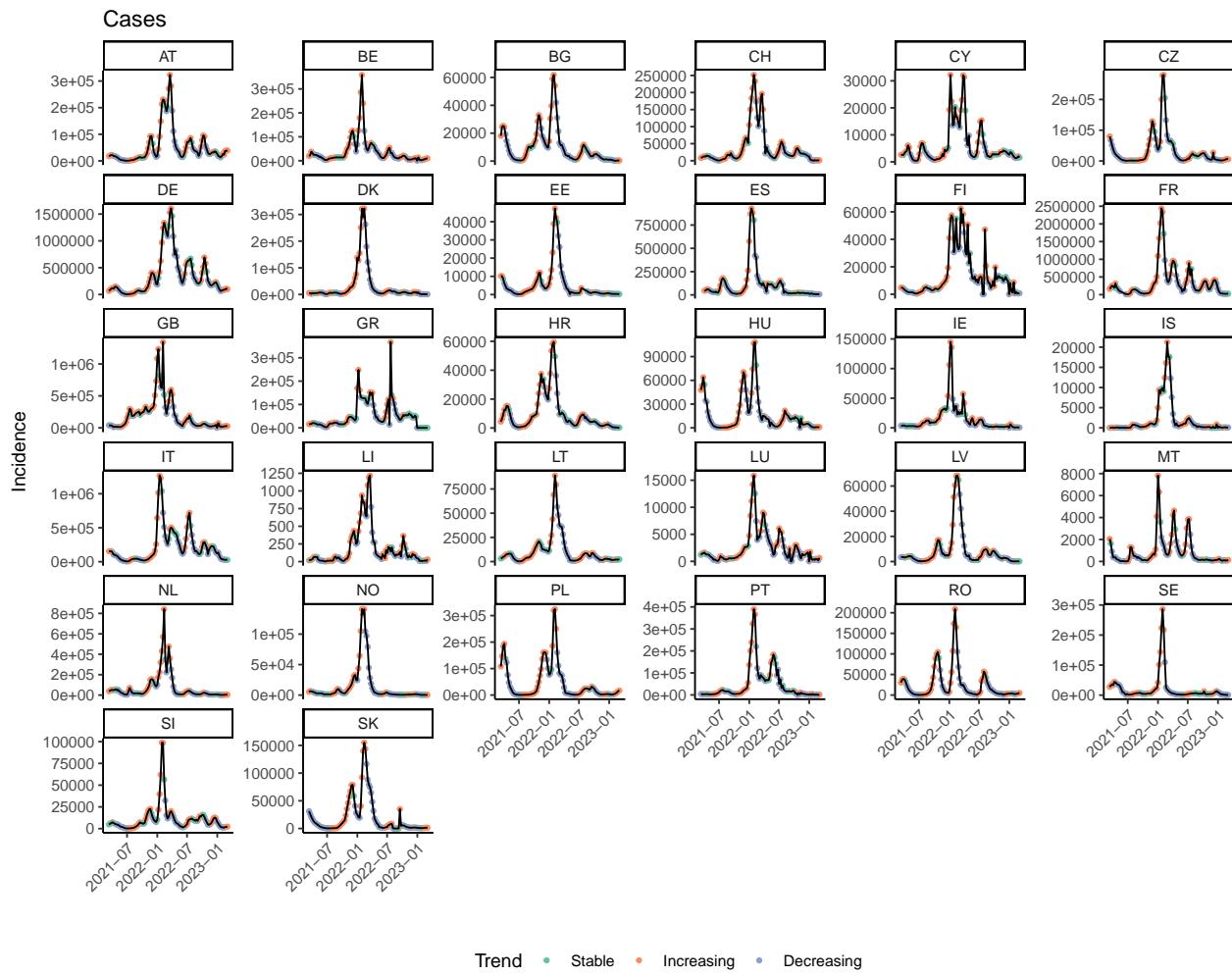


Figure 2: Trends (cases)

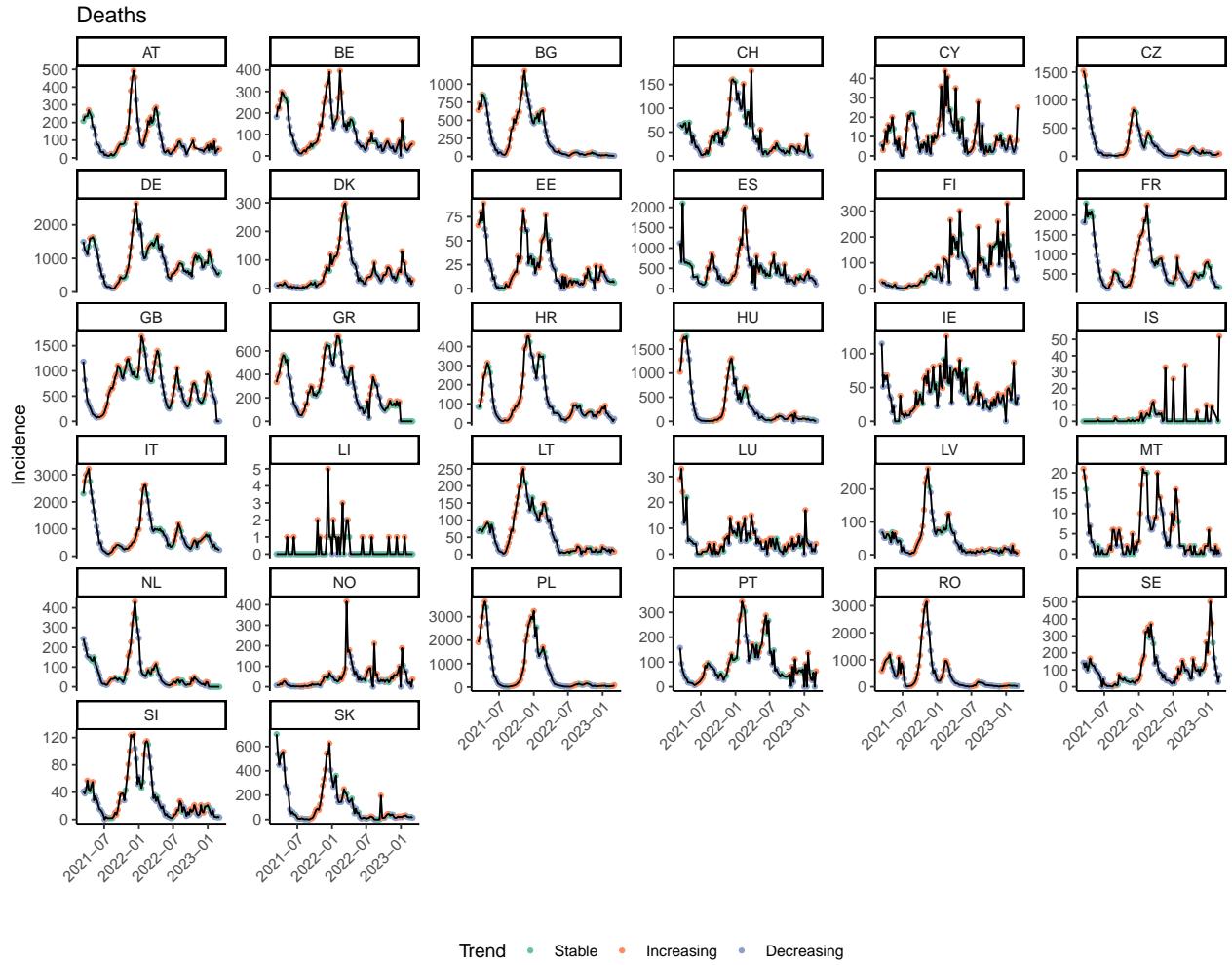


Figure 3: Trends (deaths)

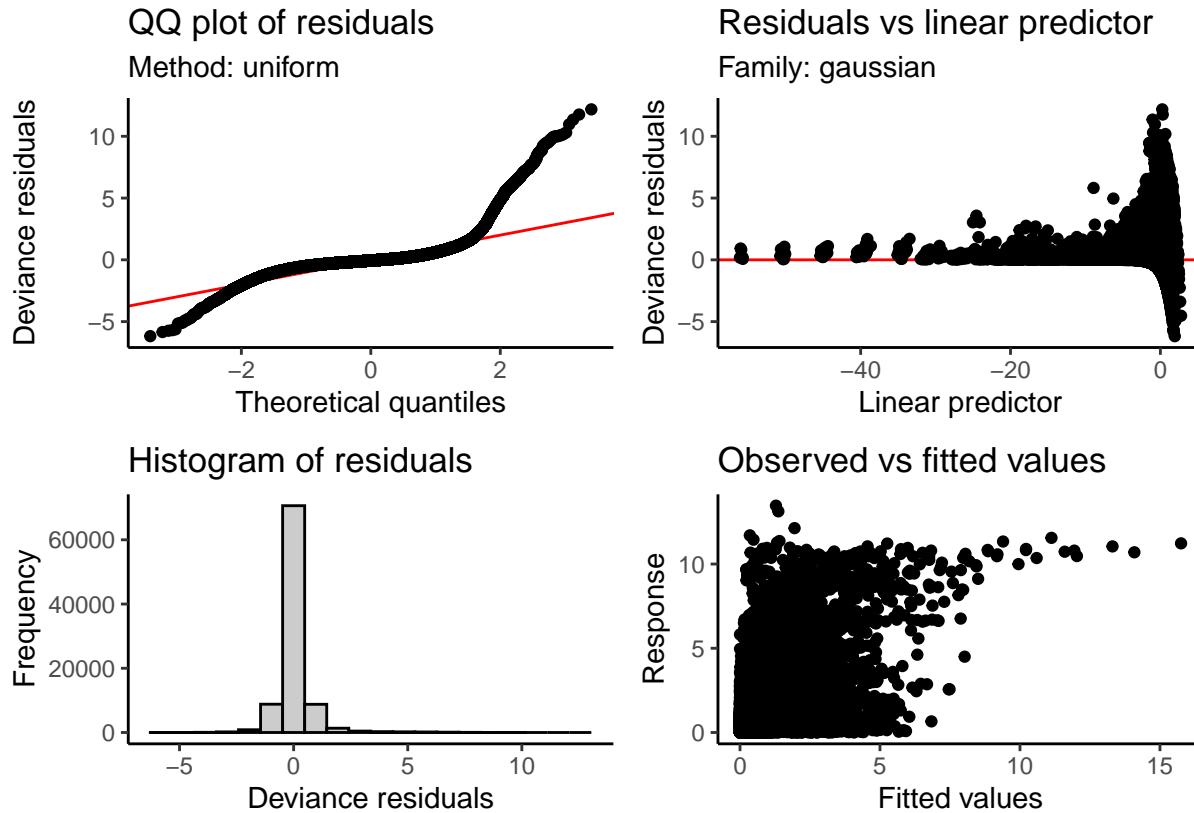
4 Model fitting

4.1 Model formula

$\sim \text{wis}, s(\text{Method}, \text{bs} = "re") + s(\text{CountryTargets}, \text{bs} = "re") + s(\text{Trend}, \text{bs} = "re") + s(\text{location}, \text{bs} = "re") + s(\text{time}, \text{by} = \text{location}) + s(\text{Horizon}, k = 3, \text{by} = \text{Model}) + s(\text{Model}, \text{bs} = "re")$

4.2 Model diagnostics

4.2.1 Cases



4.2.2 Deaths

