Reproducibility Award Approach Description

Required files for an entry to be eligible for the Reproducibility Award:

- Zip file containing:
    1. the completed Reproducibility Award approach description
    2. complete documented code files

Approach 4 (Entry 4)

Please provide a detailed description of the approach used to calculate the point estimates for the selected countries. The description should contain (1) the data processing steps, (2) the methods and models used, (3) references to the scientific papers/sources that present the methods and models used, and (4) the time it took to calculate the point estimates.

Bear in mind that the approach will also be evaluated by its originality, interpretability, simplicity and quality of assumptions.

The fourth entry is based on an STLM ("Seasonal and Trend decomposition using Loess".) model. In the following I explain the STLM model used to calculate the point estimate and give an indication on the duration it took to arrive at the nowcast. STLM models are univariate, meaning they are designed to forecast a single time series variable. Hence, there is no data processing step here.

The license for the method used is the GPL-3 license:
https://cran.r-project.org/web/licenses/GPL-3

1. Data processing steps

STLM models are univariate, meaning they are designed to forecast a single time series variable. Hence, there is no data processing step here. Note:

- We nowcast the Overnight Stays in logs and calculate the level in the end.
- Due to strong turbulences during the pandemic we exclude March 2020 to February 2022 from the estimation sample.

2. Methods and Models

STLM stands for "Seasonal and Trend decomposition using Loess". It is a time series decomposition method that uses local regression (Loess) to estimate the trend and seasonal

components of a time series. The main idea behind the model is to decompose a time series into its different components, such as the trend, seasonal, and remainder components.

The decomposition is done using a method called "Loess", which stands for "Locally Estimated Scatterplot Smoothing". Loess is a non-parametric regression method that fits a smooth curve to a scatterplot of the data using a locally weighted linear regression. This means that the model estimates the underlying trend and seasonal components by fitting a separate smooth curve to different subsets of the data.

After decomposing the time series into its components, the model can then be used to forecast future values by extrapolating the trend and seasonal components. The remainder component is typically assumed to be noise or random fluctuations around the trend and seasonal components.

One of the advantages of the STLM model is that it can handle time series with multiple seasonalities or complex seasonal patterns. Additionally, it can be used to model and forecast non-linear trends, such as exponential or logarithmic trends.

The STLM method involves the following steps:

- Decompose the time series into seasonal, trend, and remainder components using a local regression (Loess) approach.
- Fit a separate ARIMA model to the remainder component to capture any remaining temporal dependence in the data.
- Combine the seasonal, trend, and ARIMA components to produce a final forecast.

3. References

Taylor, S.J., & Letham, B. (2018). "Forecasting at Scale". The American Statistician, 72(1), 37-45. https://doi.org/10.1080/00031305.2017.1380080

Hyndman, R.J., & Khandakar, Y. (2008). "Automatic Time Series Forecasting: The Forecast Package for R". Journal of Statistical Software, 26(3), 1-22. https://www.jstatsoft.org/article/view/v027i03/v27i03.pdf

Cleveland, R.B., Cleveland, W.S., McRae, J.E., & Terpenning, I. (1990). "STL: A Seasonal-Trend Decomposition Procedure Based on Loess". Journal of Official Statistics, 6(1), 3-73. https://www.wessa.net/download/stl.pdf

4. Computing time

Point estimate per country: approx. 10 sec

5. Notes

The code to reproduce the results for this entry is run together with the other 4 entries, so the replication files are the same for all 5 approaches (The code for the other 4 entries has been removed for the publication though).

Similarities/differences to State-of-the-Art techniques (optional)

Please provide a list of similarities and differences between the approach and the state-of-the-art techniques.

Differences:

- STLM models are based on a decomposition approach, where the time series is decomposed into its components, such as trend, seasonality, and residuals, and each component is modeled separately. State-of-the-art models, on the other hand, often use more complex algorithms that do not require this decomposition step.
- STLM models are generally considered to be simpler and more transparent than some state-of-the-art models, which can be more complex and opaque.
- State-of-the-art models often use machine learning techniques, such as deep learning, to model complex relationships in the data. STLM models, on the other hand, are typically based on statistical methods such as ARIMA or ETS.
- STLM models are often used for shorter-term forecasting, while state-of-the-art models are often used for longer-term forecasting or more complex applications.

List of Data Sources with Descriptions

For each country, list the data sources (and their description) that were used to calculate the point estimates for the selected country. Please use the template below to provide the information for each source. **If multiple data sources were used, please copy paste the template below and fill it in.**

Bear in mind that the data sources will also be evaluated based on its openness, availability, coverage and consistency.

The approach used to estimate the nowcast for entry 4 is completely univariate. Therefore, no additional data has been used.

Hardware Specifications

Please describe the hardware specifications of the machines that were used to calculate the point estimates.

Machine 1

CPUs	Intel Xeon 4210 (8 cores)
GPUs	0
TPUs	0
Disk space	200 MB

Short description of the team and all team members – area of expertise (optional)

Please provide a description of the team, all team members, their area of expertise and contact information.

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