Modeling COVID-19 Spread with Mobility Patterns: A Dynamic SIR Model Perspective

Farshad Jafarpour
Life Data Epidemiology
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Outline

1 Introduction

2 Model

3 Country Analysis

4 Apple Index Mobility

5 Infection Growth Rate

6 Pearson Correlation: R(t) vs mobility

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Introduction

- Aim:. Investigating the relationship between mobility patterns, as measured by Apple's mobility index, and the dynamics of the epidemic

- Model: Time Evolution SIR Model

- Indicators: R_t across different countries and correlation with mobility

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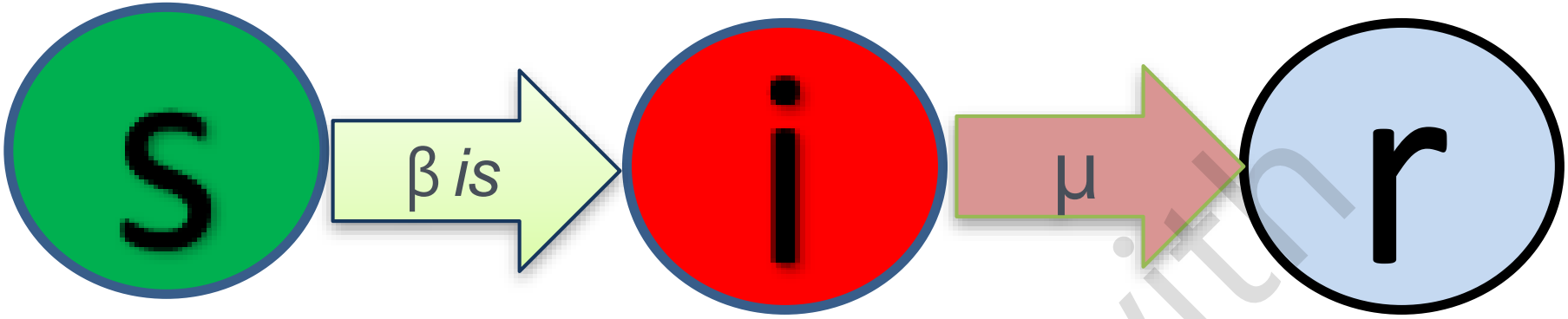
Compartmental model

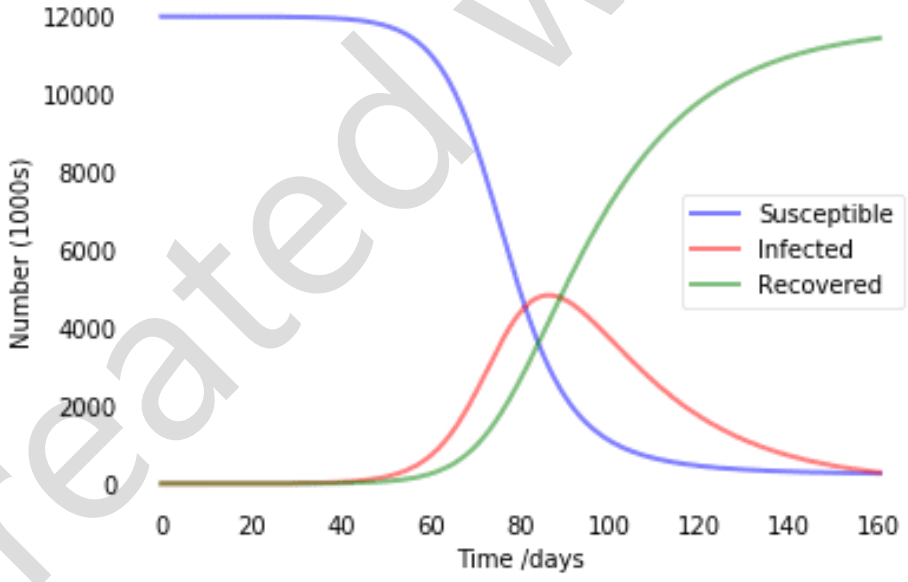


Differential equations:

$$\dot{s} = -\beta\, is$$

$$\dot{i} = \beta\, is - \mu$$

$$\dot{r} = \mu i$$



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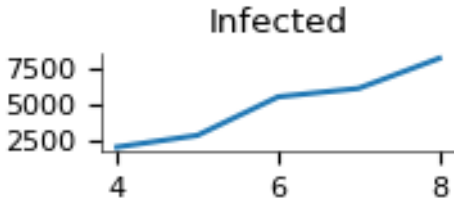
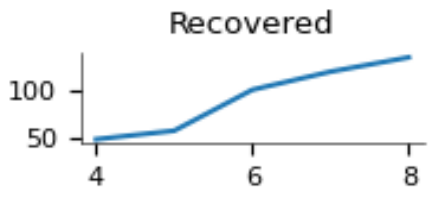
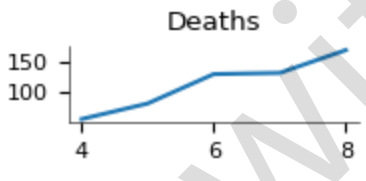
Country Analysis (Iran)

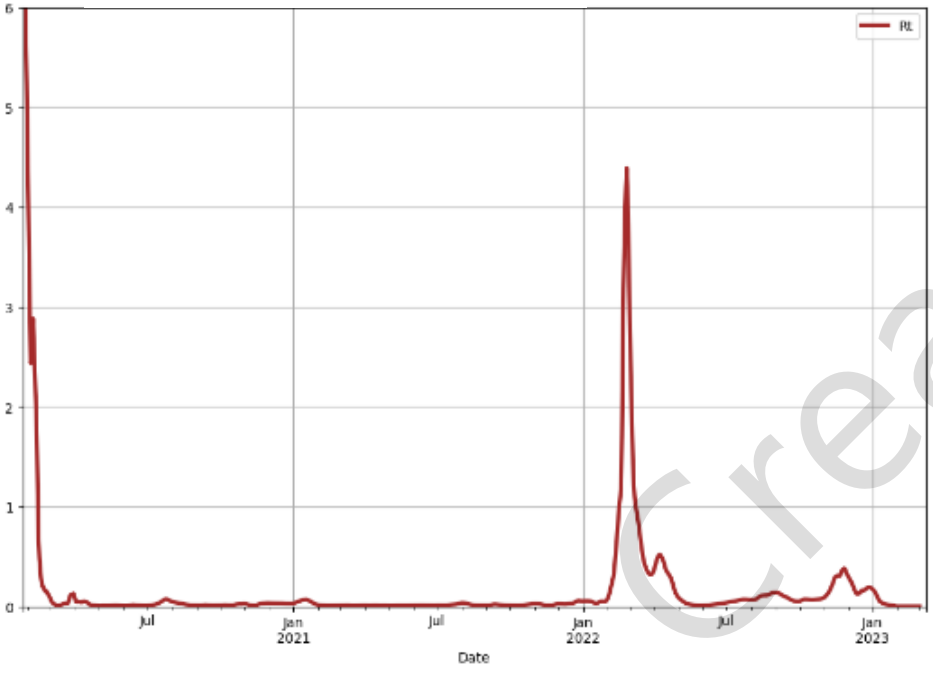
performs TD-SIR fitting for R(t) calculations. It returns enriched country frame and population

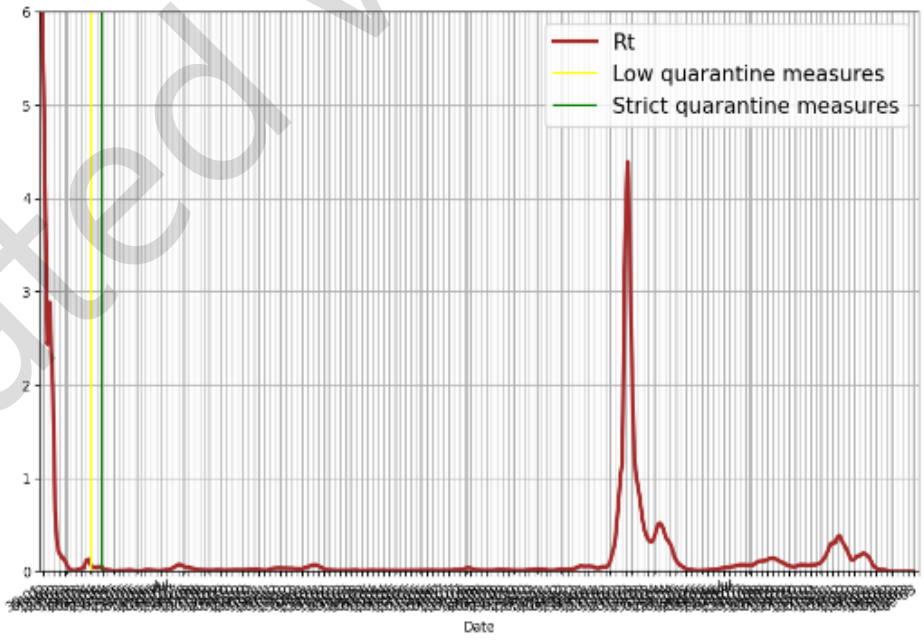
A couple of specific dates are also highlighted .











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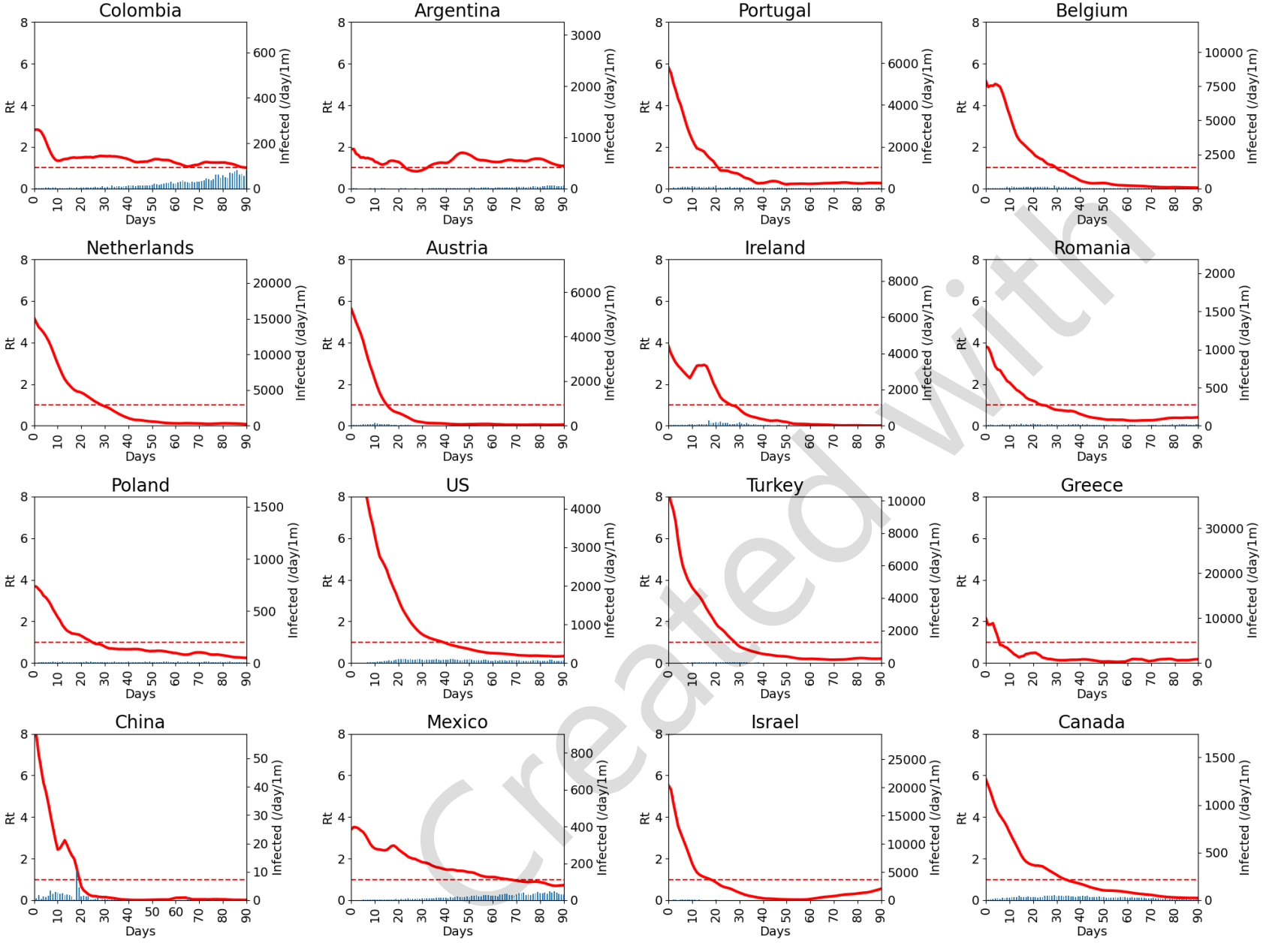
Country analysis



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Country analysis

The R(t) values for different countries indicate the time-varying effective reproduction number of the virus in each country.

Countries with higher R(t) values at a given time, such as Portugal, Belgium, Netherlands, Austria, and China, indicate a higher potential for the virus to spread rapidly during that specific period.

Countries with lower R(t) values at a given time, such as Greece and Argentina, indicate a relatively lower potential for rapid spread during that specific period.

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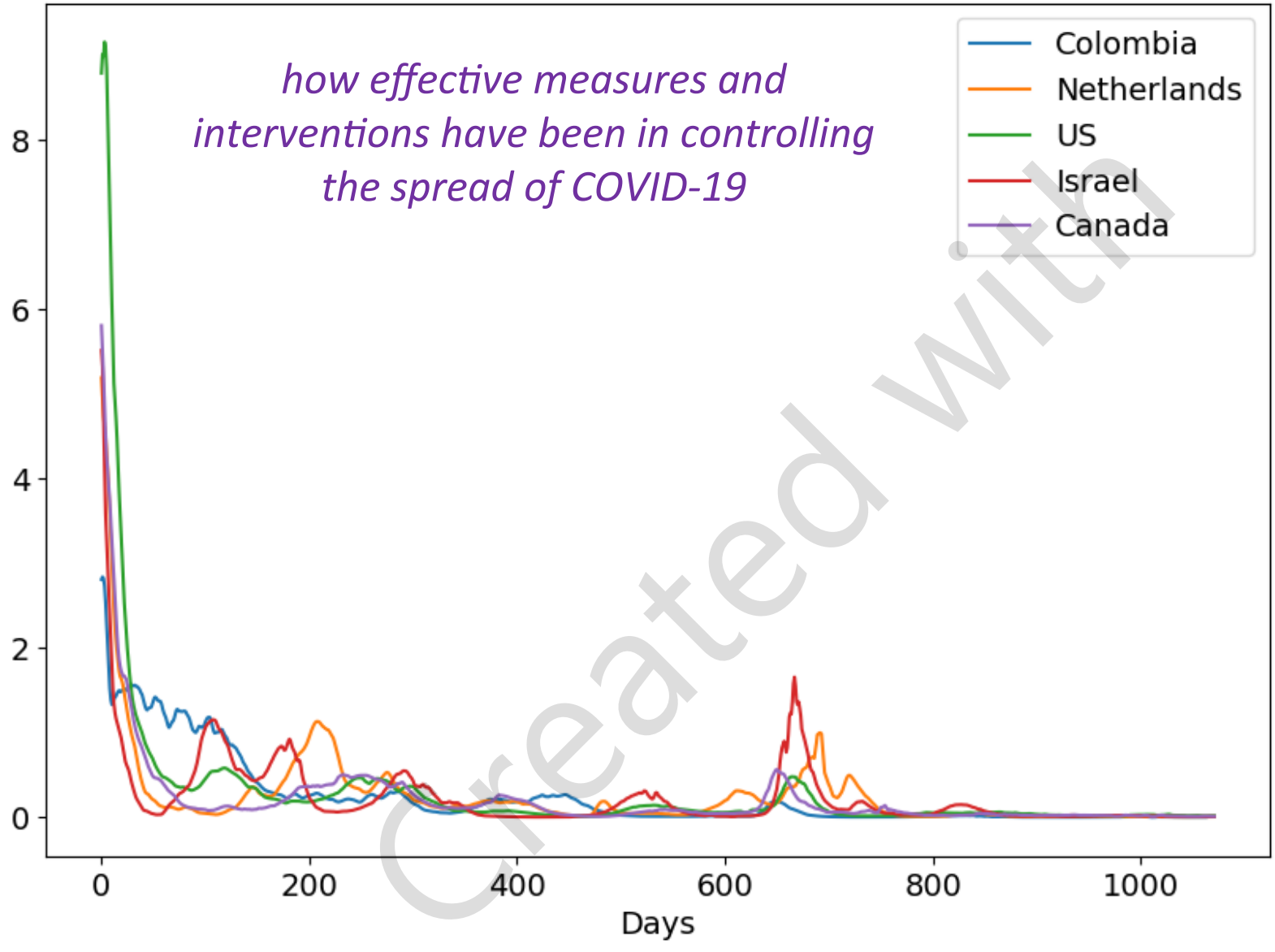
Comparing R(t) in one plot



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What's Apple mobility index is trying

The R(t) values fluctuate over time, indicating changes in the spread of the virus in each country.

The Apple Index provides an additional perspective on the relationship between mobility and the transmission of the virus.

the rolling average of the Apple Mobility Index:
1)smooth out short-term fluctuations and obtain a trend of mobility changes over time.

2)This average provides a more stable representation of the overall mobility patterns in a given country.

how mobility behaviors have been changing and might correlate with the rate of virus spread

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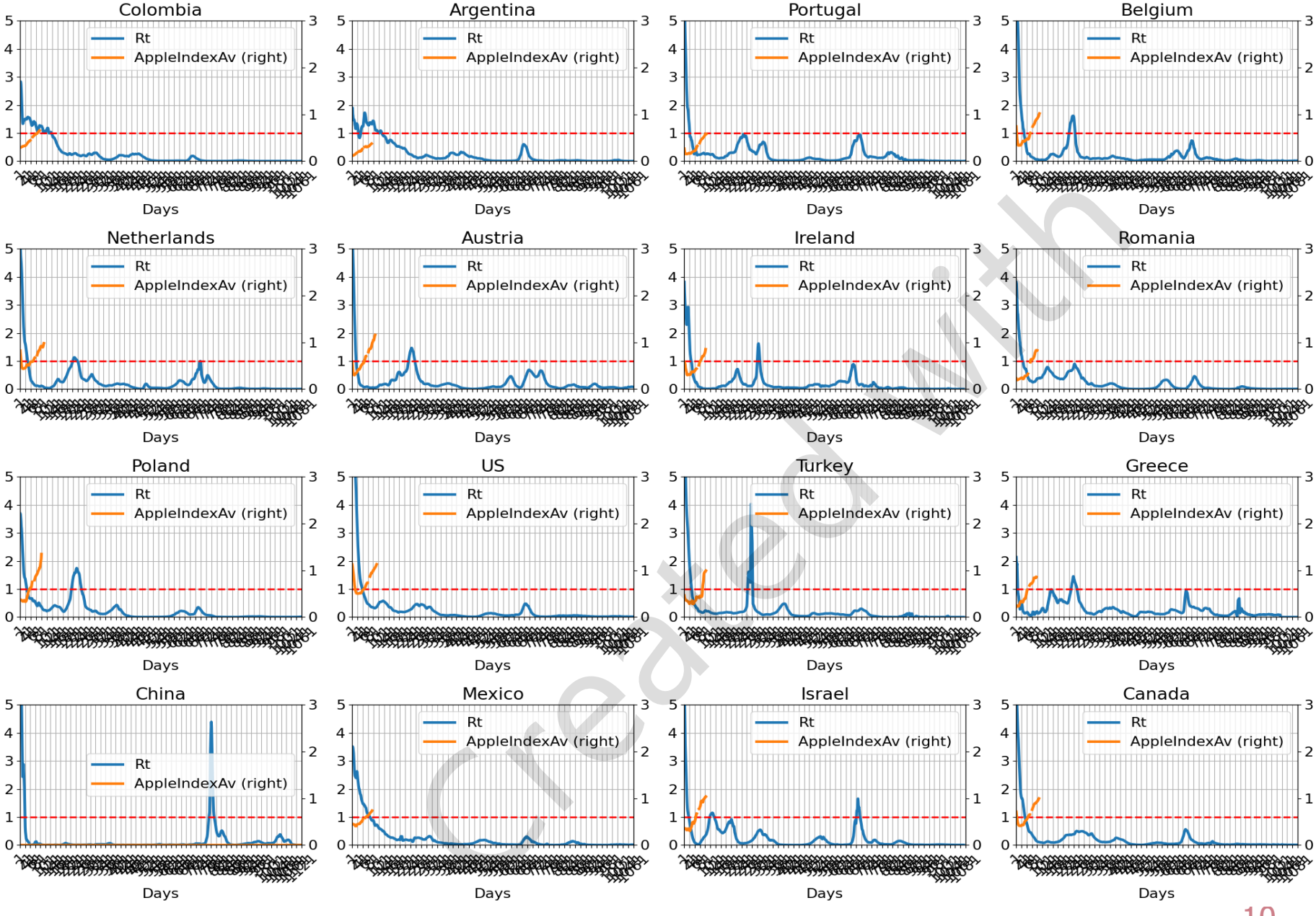
What's Apple mobility index is trying



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Infection Growth Rate

Positive values indicate an increasing rate of spread, suggesting a higher risk of transmission.

Negative values indicate a decreasing rate of spread, suggesting a lower risk of transmission.

The Apple Mobility Index provides an indication of changes in mobility patterns in each country.

Changes in mobility may impact the rate of virus transmission by influencing contact rates and potential exposure.

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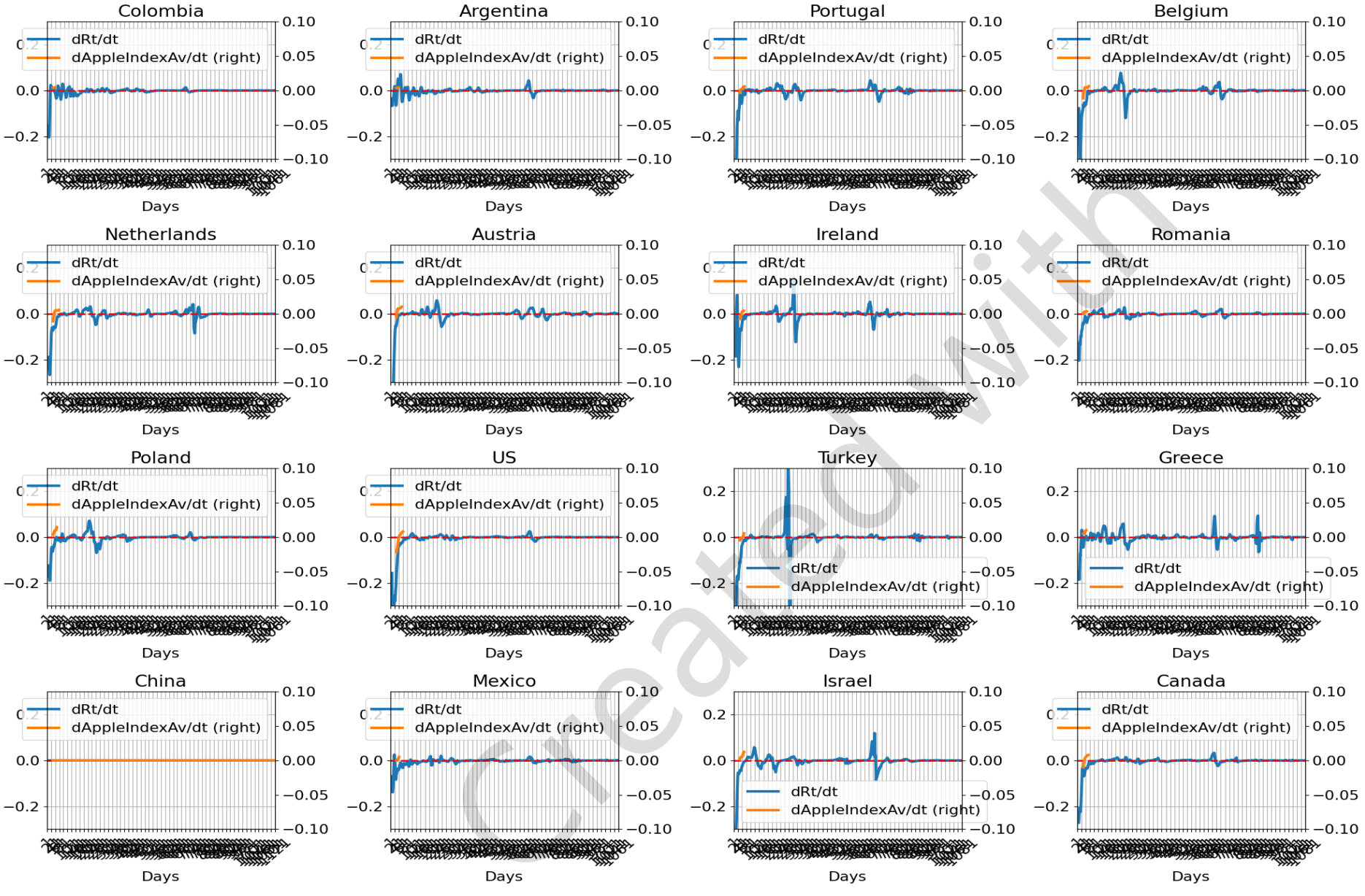
Infection Growth Rate



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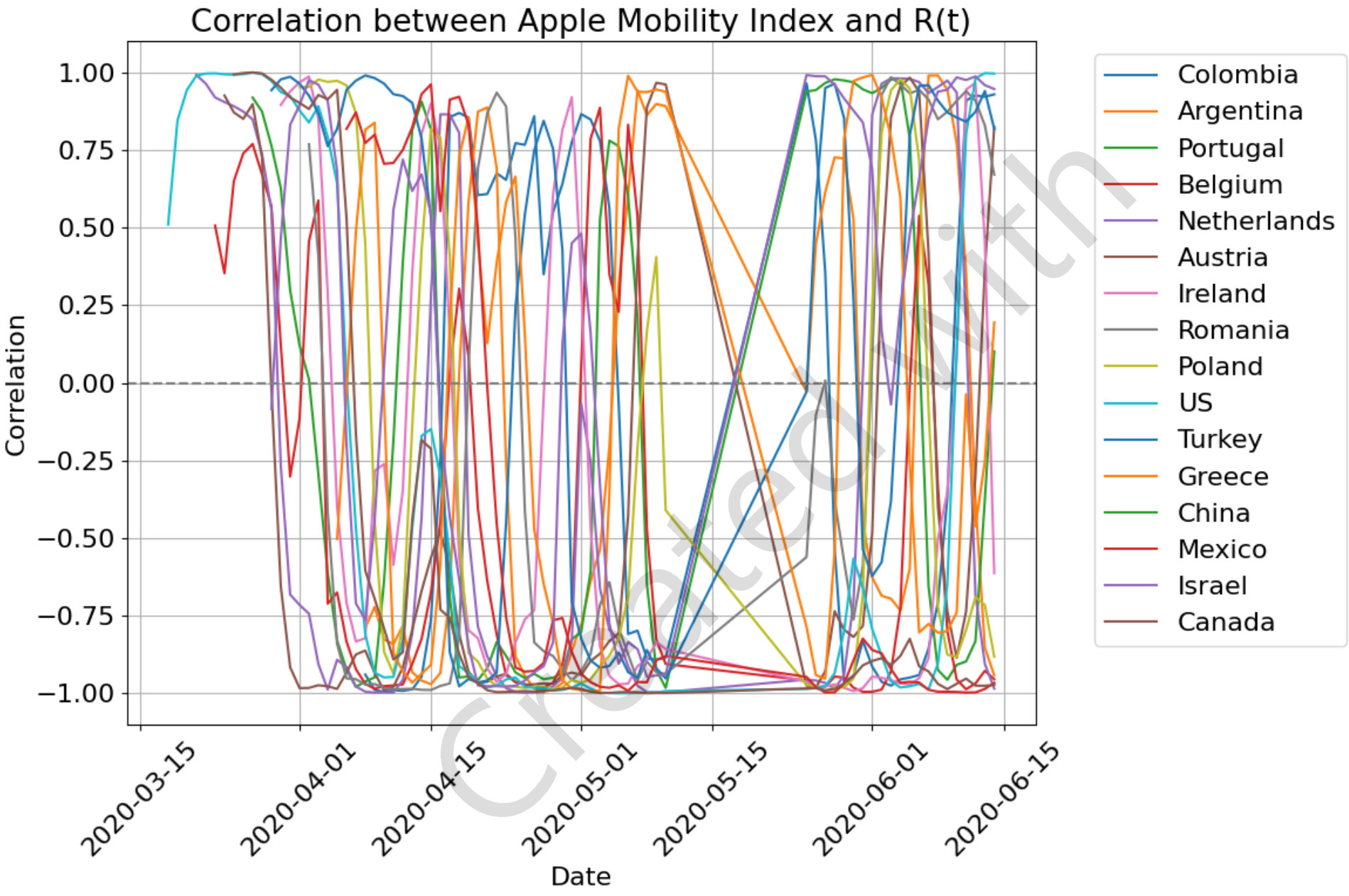
Pearson Correlation



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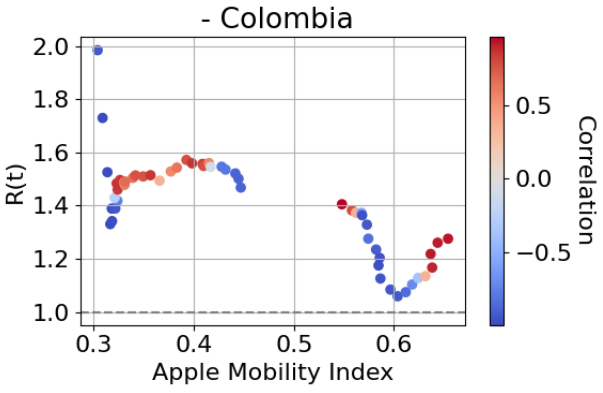

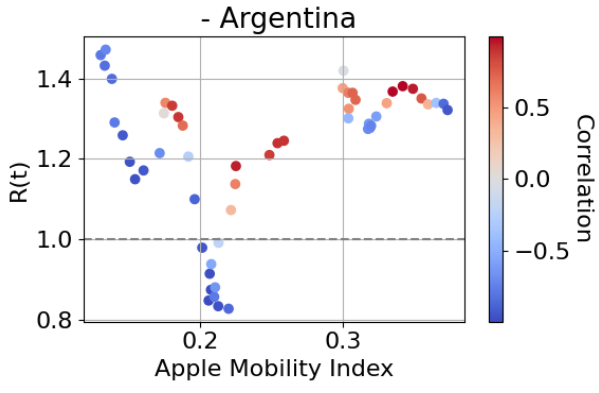

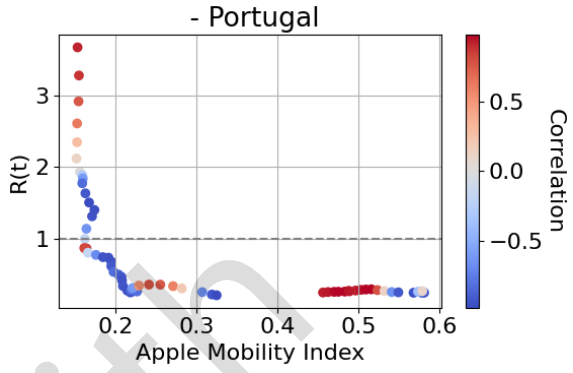

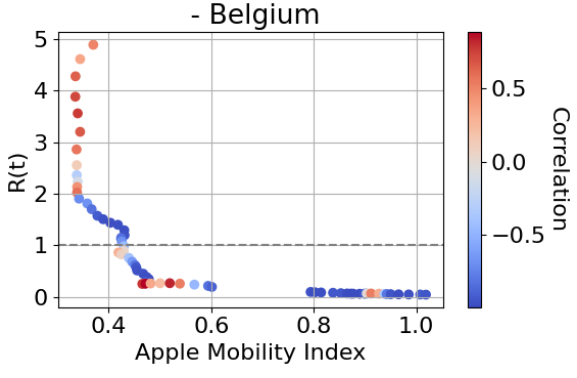

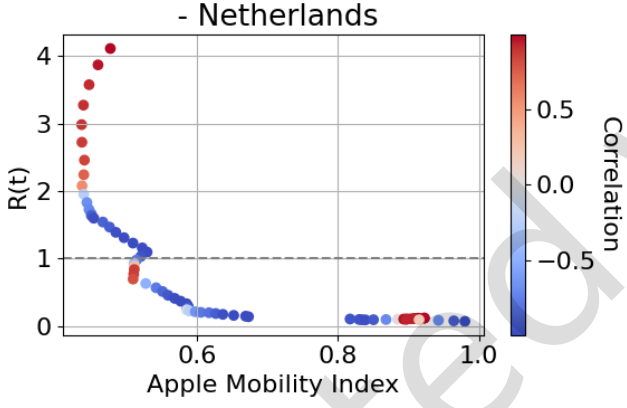

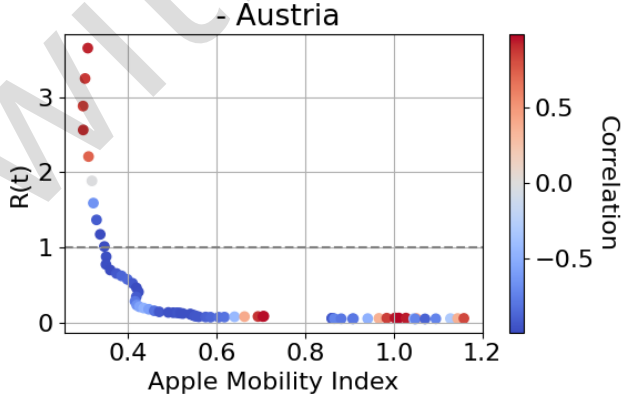

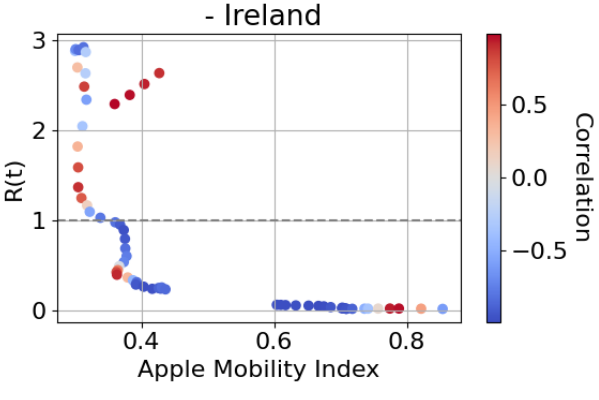

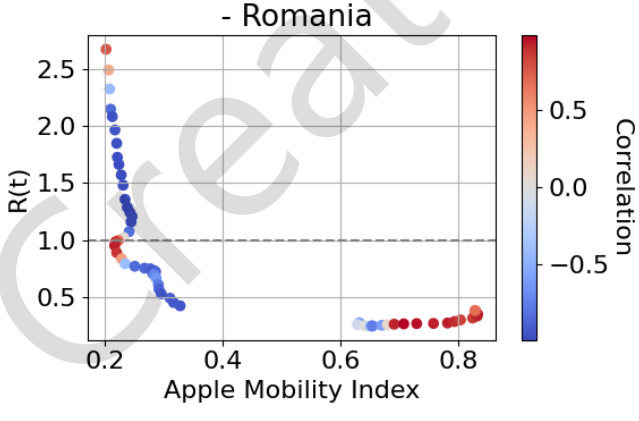

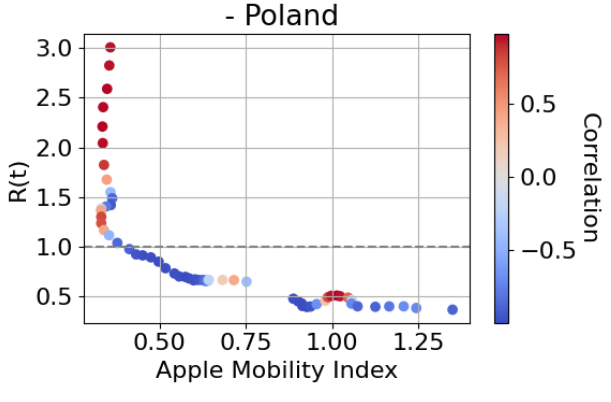

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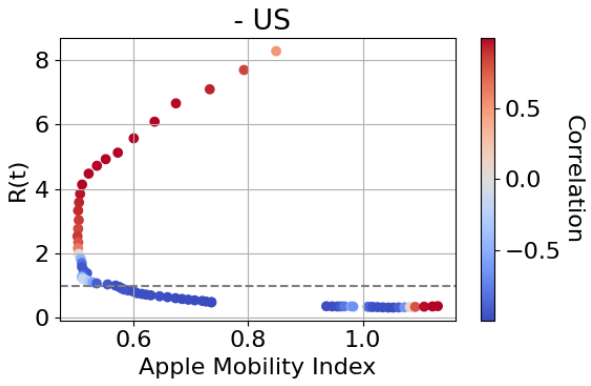
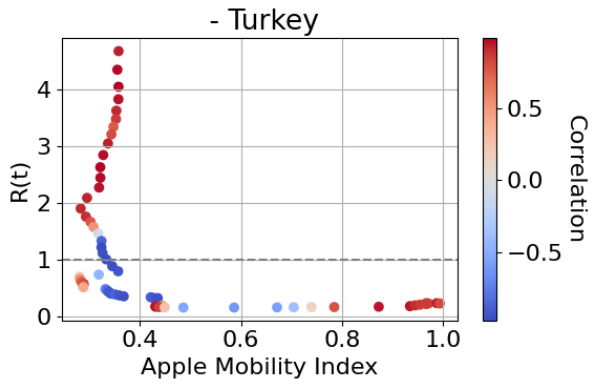
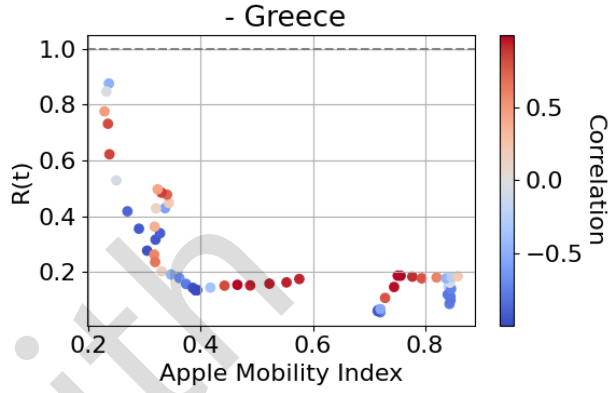
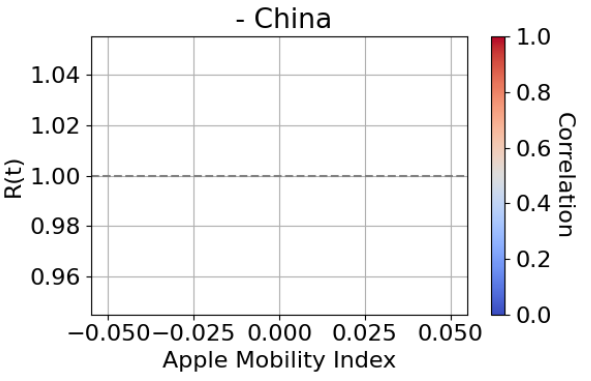
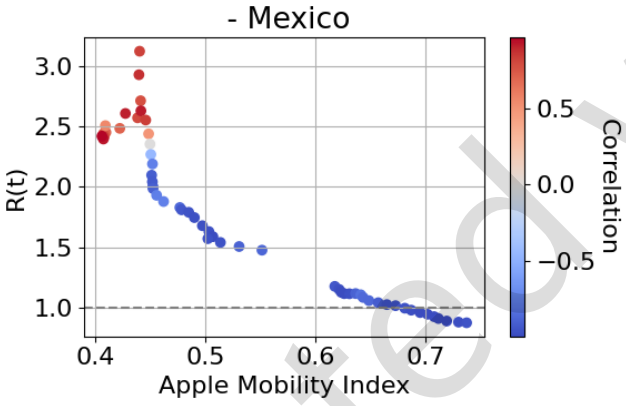
Pearson Correlation

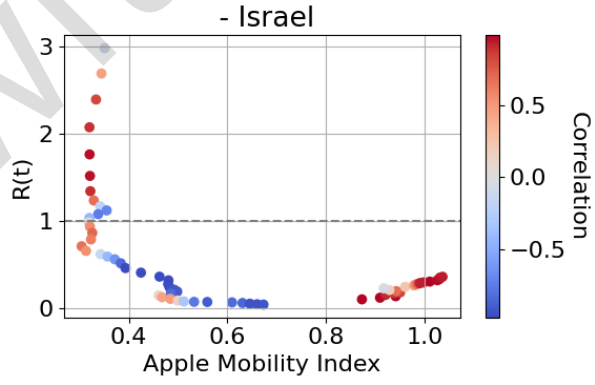


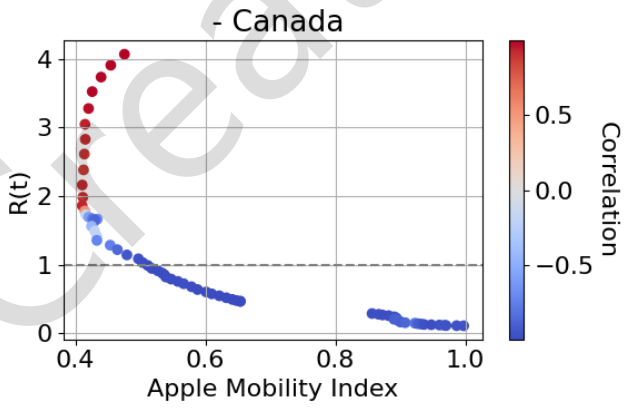












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Conclusion

Utilized the SIR model and Apple Mobility Index to analyze COVID-19 spread.

Revealed insights into epidemic severity, quarantine measures, and mobility impact.

R(t) diagrams demonstrated effectiveness of containment strategies.

Apple Mobility Index highlighted the relationship between mobility and transmission.

Findings contribute to understanding and guiding public health interventions.

Enhances control and mitigation strategies for COVID-19.

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Refrences

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DOI: 10.1109/TNSE.2020.3024723

2) https://github.com/CSSEGISandData/COVID-19

3) Global dynamics of SIR model with switched transmission rate
https://link.springer.com/article/10.1007/s00285-019-01460-2

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