A Study on The Effectiveness of Lock-down Measures to Control The Spread of COVID-19

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Abstract

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1. Introduction

In December 2019, a zoonotic coronavirus, similar to SARS coronavirus and MERS coronavirus outbreak occurred in Wuhan, China [1]. Afterwards, the virus has been named as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), and disease caused by the virus has been named coronavirus disease 2019 (COVID-19). Since then the ongoing pandemic has infected more 6 million people and has caused 300 thousand deaths worldwide .

Initial estimate of R_0, and mortality rate.

Non availability of treatment paradigm and any defense mechanism like vaccination.

Treatment requiring ventilation for long time - requirement was to reduce pressure on healthcare system - SIR modeling forecast

Option available for policymakers was to issue wide scale lock-down / home stay orders, social distancing measures, closing down non-essential

Led to - what are the impacts and losses

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Motivate the requirements for analyzing effectiveness of lock-down. What were the benefits? Reducing burden on healthcare system, saving loss of life, and reducing R_0 by breaking transmission chain.

How can we measure these benefits and compare with the economic losses?

1.1. Our contribution

Defining how to measure these benefits.

Tools for measuring them.

Data - Data Source - Dims [infected, fatal, recovered, No of tests]

Difficulty in assessing: different level of compliance, different cultural practices - hidden variables

1.2. Related Works

Other modeling approaches. SIR-F, DCM, Agent, Hybrid - not post fact A/B testing tools.

1.3. Tools

$m - RSC$ [2, 3], Trend analysis,

2. The setup

3. Results

India - 4 stages of lock-down - effect of each stages - results on prediction by Synthetic control

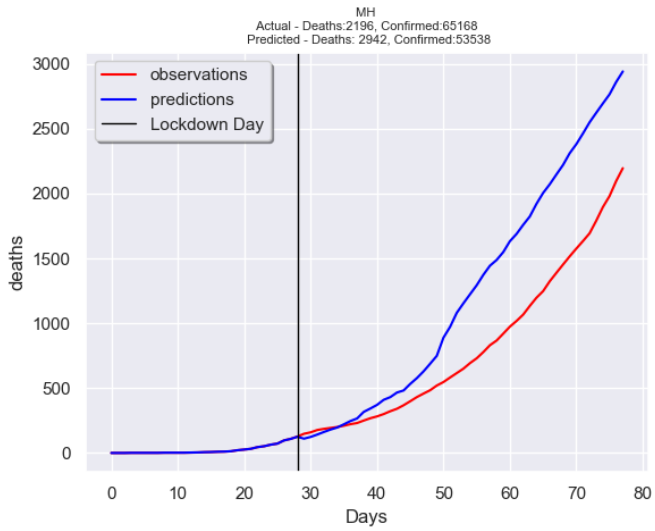
Singapore - recurrence - change in projection on those dates

US - compare prediction models data vs. Synthetic control projection vs actual by state by start and end of lock-down dates (what are the control group in each cases)

AU NZ South K

Sweden

Measured results.



4. Discussion

5. Concluding Remarks

References

[1] Y. Liu, A. A. Gayle, A. Wilder-Smith, J. Rocklöv, The reproductive number of covid-19 is higher compared to sars coronavirus, Journal of Travel Medicine 27 (2). doi:10.1093/jtm/taaa021.
URL `https://doi.org/10.1093/jtm/taaa021`

[2] A. Abadie, A. Diamond, J. Hainmueller, Synthetic control methods for comparative case studies: Estimating the effect of california's tobacco control program, Journal of the American Statistical Association 105 (490) (2010) 493–505. doi:10.1198/jasa.2009.ap08746.

[3] M. Amjad, D. Shah, D. Shen, Robust synthetic control, Journal of Machine Learning Research 19 (22) (2018) 1–51.
URL `http://jmlr.org/papers/v19/17-777.html`