Evaluation of South Korean NPI against COVID-19

Effectiveness of Non-Pharmaceutical Interventions

By R_0 & R_t computation

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Abstract

- What is NPI?
  - **Non-Pharmaceutical Interventions** are actions individuals, communities, and nations could take in order to prevent, retain, or alleviate pandemic besides any medical treatments.
- Examples?
  - Suppression
  - Mitigation
- South Korea?
- How?
  - Daily Trend of R_t: Effective Reproduction Number
  - Monthly Trend of Mortality

Date	NPI	Policy Level	Phase	Notation	Group #	Closing Hour	ES & MS	HS	office	social event	miltary
03/22/2020	suppression	3	1	3_1	N/I	N/I	2/3 of all	2/3 of all	Flex	N/A	allowed
11/01/2021	mitigation	N/A	N/A	N/A	4	21	N/A	N/A	N/A	N/A	N/A

Methods & Models

- Deriving R_0
  - Next Generation Method

$$|F \cdot V^{-1}| = R_0 = \frac{\beta}{\gamma}$$

  - Deterministic Model : Growth rate (Jeong, 2020)

$$i(t) = i_0 \exp(rt) \quad \hat{r} = \arg min_r \left[\sum_{t=0}^{T} |i_t^{Data} - i(t)|^2\right] = \arg min_r \left[\sum_{t=0}^{T} |i_t^{Data} - i_0 \exp(rt)|^2\right]$$

- Deriving R_t
  - R package : estimate_Rt()

```
sk_Rt = estimate_Rt(
  seoul_covid_daily,
  …
  config = list(mean_si=5.195, std_si=0.83))
```

  - Bayes rule & Gaussian distribution (Bettencourt & Ribero)

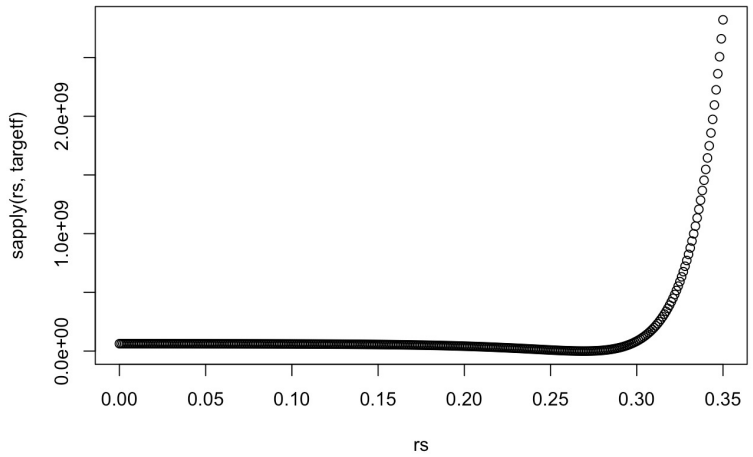
$$P(k|R_t) = \frac{\lambda^k e^{-\lambda}}{k!}$$

- Mortality
  - Covid-19 Mortality / General Mortality * 10 (Monthly)

Visualization & Results

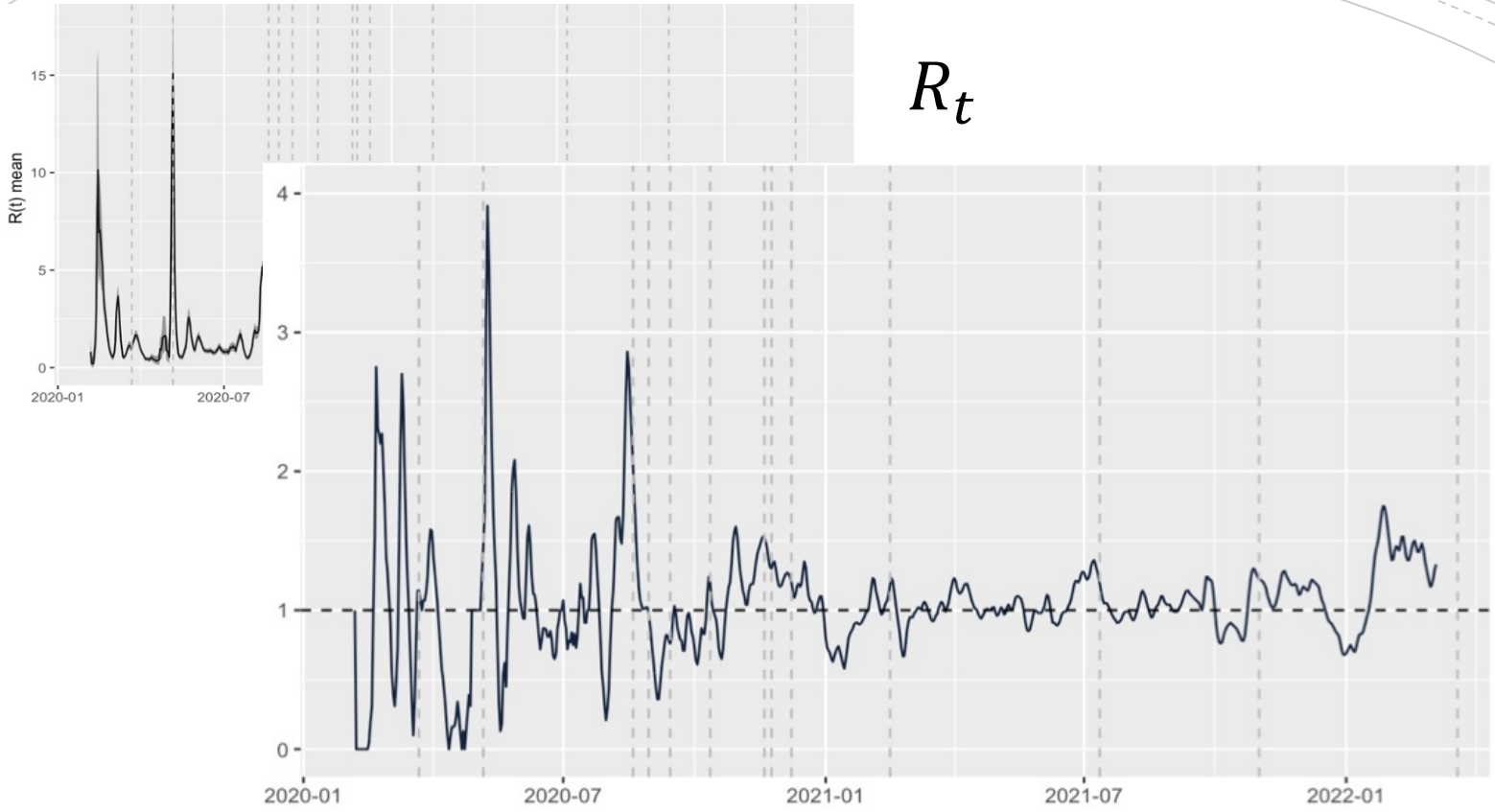
2020/02/14~2020/03/13

```
i <- dt$i[24:52]
t <- c(0:28)
i0 <- 1
targetf <- function(r) sum(i - i0*exp(r*t))^2
rs <- seq(0,0.35,0.001)
plot(rs, sapply(rs, targetf))
```

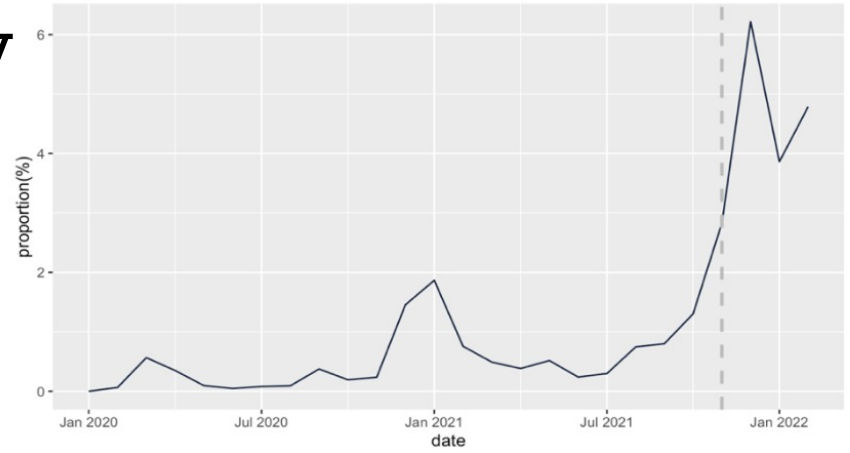


$$R_0 = 3.79$$

R_t



Mortality



Discussion & Future note

- Thumbs up for Suppression
- Question mark for Mitigation
- R_0
  - Plausible but can be more accurate
  - "The World is Stochastic"
- R_t
  - As for trend? Plausible. As for number? Not sure
  - Better assumptions, better dataset (i.e. Heterogeneity)
- Mortality
  - Look for better model!!!
  - Extreme generalization (larger scope of mortality data)