

Computational analysis of effective vaccination model of Covid-19

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Agenda

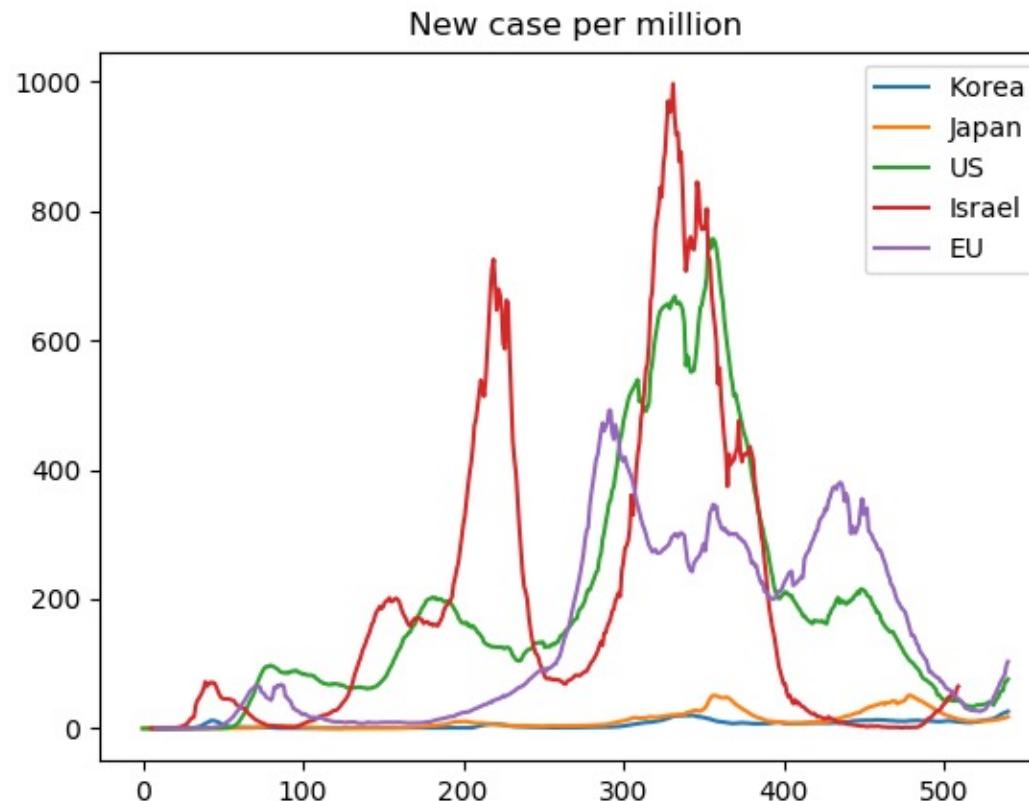
- Project flow
- Data visualization
- Data analysis
- SIR model
- Conclusion and Limitation

Project flow

- Data collection
- Data visualization
- Data analysis
- SIR model

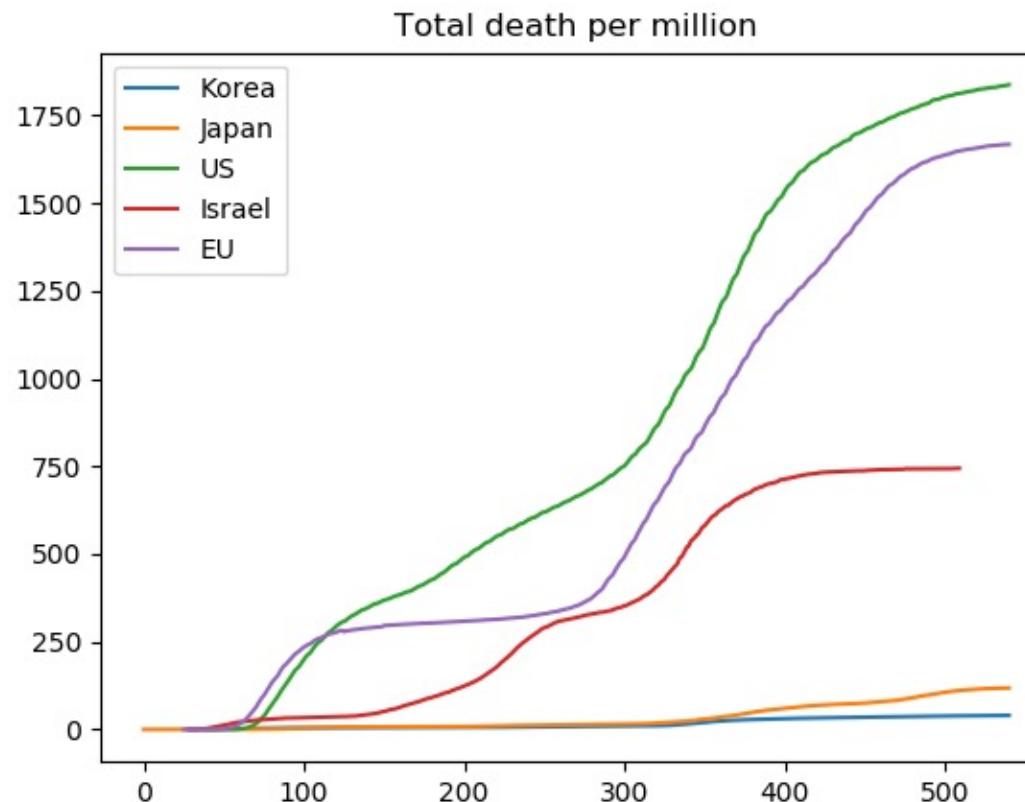
Data visualization 01

● New cases per million



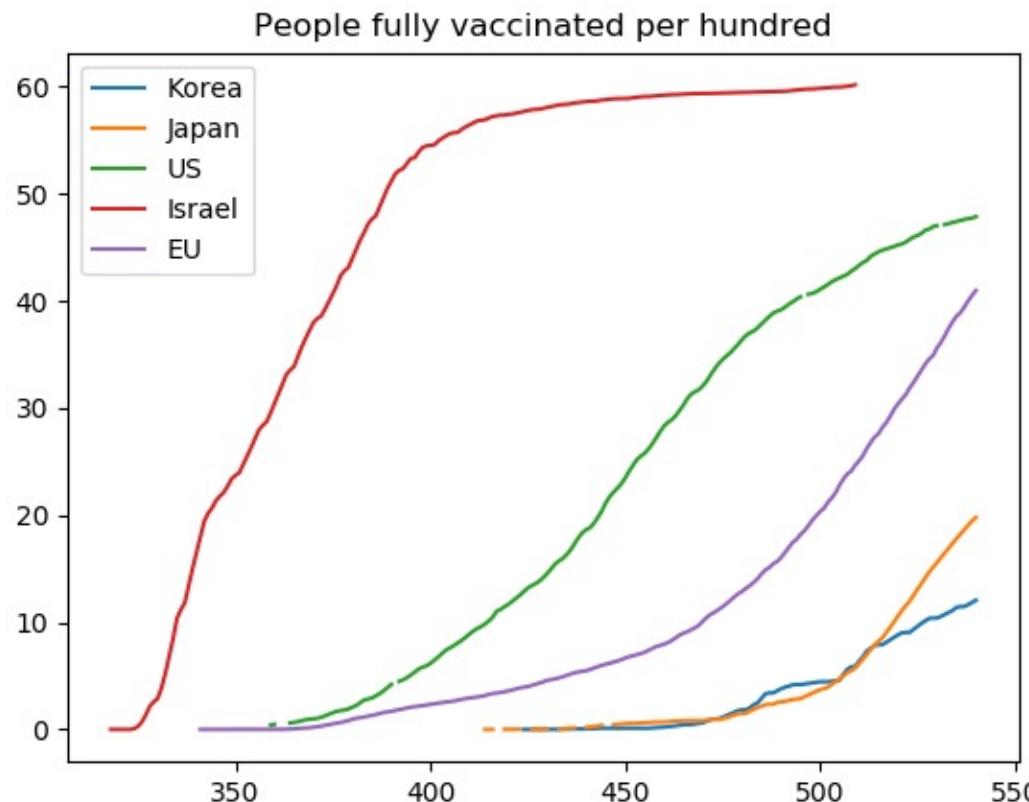
Data visualization 02

● Total death per million



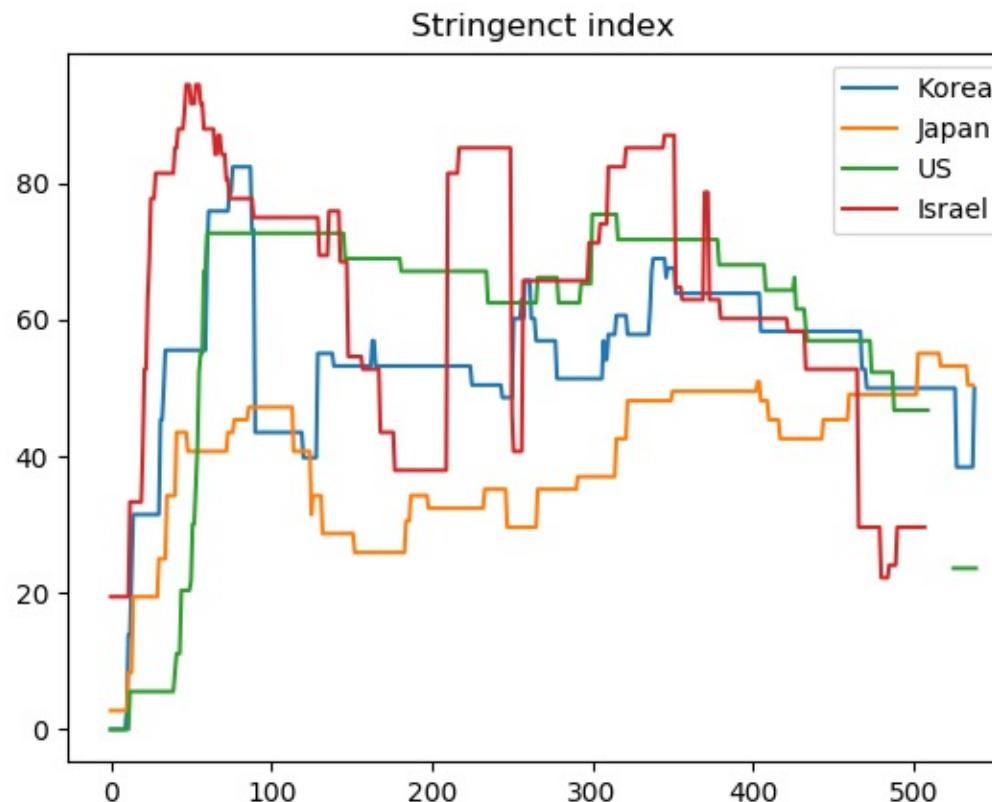
Data visualization 03

● Fully vaccinated people per hundred



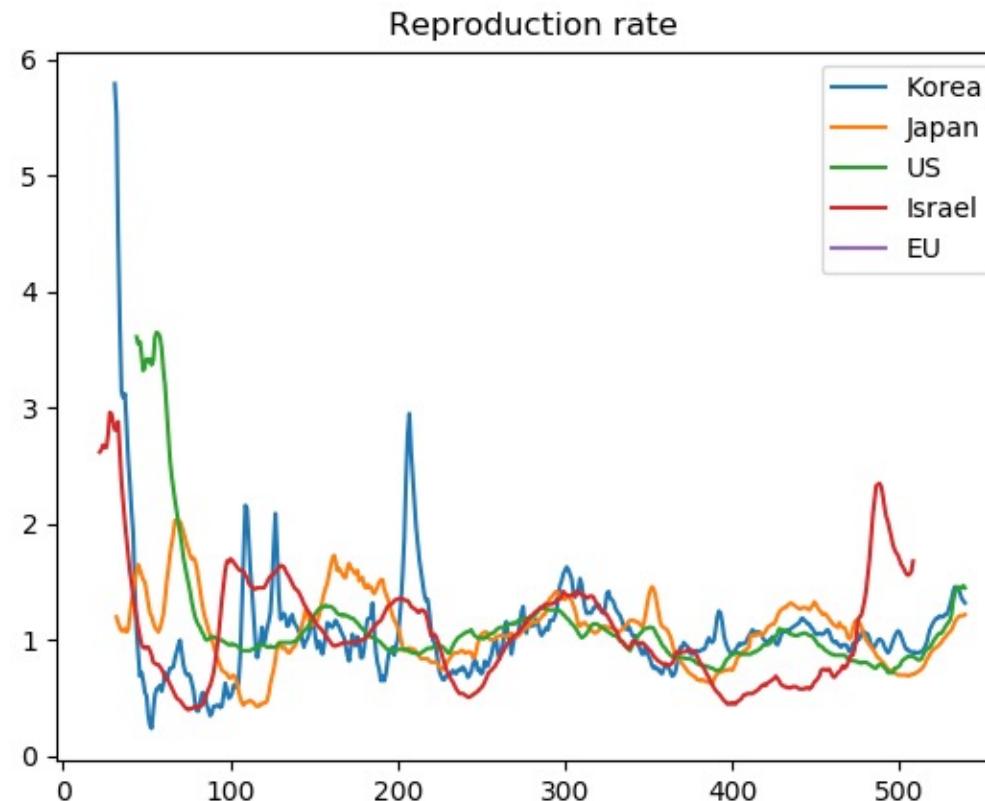
Data visualization 04

● Stringency index



Data visualization 05

● Reproduction rate



Data analysis 01

● Data analysis - South Korea

Correlations						
		new_vaccinations	total_vaccinations	stringency_index	reproduction_rate	new_cases
new_vaccinations	Pearson Correlation	1	.377**	-.274**	-.329**	.048
	Sig. (2-tailed)		<.001	.001	<.001	.578
	N	138	138	136	137	138
total_vaccinations	Pearson Correlation	.377**	1	-.835**	.427**	.531**
	Sig. (2-tailed)	<.001		<.001	<.001	<.001
	N	138	139	137	138	139
stringency_index	Pearson Correlation	-.274**	-.835**	1	-.236**	.199**
	Sig. (2-tailed)	.001	<.001		<.001	<.001
	N	136	137	539	508	537
reproduction_rate	Pearson Correlation	-.329**	.427**	-.236**	1	.124**
	Sig. (2-tailed)	<.001	<.001	<.001		.005
	N	137	138	508	509	509
new_cases	Pearson Correlation	.048	.531**	.199**	.124**	1
	Sig. (2-tailed)	.578	<.001	<.001	.005	
	N	138	139	537	509	539

**. Correlation is significant at the 0.01 level (2-tailed).

Data analysis 02

● Data analysis - Japan

Correlations						
		new_vaccinations	total_vaccinations	stringency_index	reproduction_rate	new_cases
new_vaccinations	Pearson Correlation	1	.885**	.812**	-.467**	-.408**
	Sig. (2-tailed)		<.001	<.001	<.001	<.001
	N	121	121	118	120	121
total_vaccinations	Pearson Correlation	.885**	1	.724**	-.178*	-.308**
	Sig. (2-tailed)	<.001		<.001	.043	<.001
	N	121	131	128	130	131
stringency_index	Pearson Correlation	.812**	.724**	1	-.328**	.535**
	Sig. (2-tailed)	<.001	<.001		<.001	<.001
	N	118	128	538	506	538
reproduction_rate	Pearson Correlation	-.467**	-.178*	-.328**	1	-.019
	Sig. (2-tailed)	<.001	.043	<.001		.668
	N	120	130	506	508	508
new_cases	Pearson Correlation	-.408**	-.308**	.535**	-.019	1
	Sig. (2-tailed)	<.001	<.001	<.001	.668	
	N	121	131	538	508	541

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Data analysis 03

● Data analysis - US

Correlations						
		new_vaccinations	total_vaccinations	stringency_index	reproduction_rate	new_cases
new_vaccinations	Pearson Correlation	1	-.113	.184*	-.045	-.117
	Sig. (2-tailed)		.133	.019	.547	.118
	N	179	179	163	178	179
total_vaccinations	Pearson Correlation	-.113	1	-.895**	.152*	-.804**
	Sig. (2-tailed)	.133		<.001	.036	<.001
	N	179	191	175	190	191
stringency_index	Pearson Correlation	.184*	-.895**	1	-.322**	.454**
	Sig. (2-tailed)	.019	<.001		<.001	<.001
	N	163	175	525	481	525
reproduction_rate	Pearson Correlation	-.045	.152*	-.322**	1	-.192**
	Sig. (2-tailed)	.547	.036	<.001		<.001
	N	178	190	481	496	496
new_cases	Pearson Correlation	-.117	-.804**	.454**	-.192**	1
	Sig. (2-tailed)	.118	<.001	<.001	<.001	
	N	179	191	525	496	541

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Data analysis 04

● Data analysis - Israel

Correlations						
		new_vaccinations	total_vaccinations	stringency_index	reproduction_rate	new_cases
new_vaccinations	Pearson Correlation	1	-.663**	.661**	-.004	.800**
	Sig. (2-tailed)		<.001	<.001	.958	<.001
	N	207	207	205	206	207
total_vaccinations	Pearson Correlation	-.663**	1	-.774**	-.193**	-.825**
	Sig. (2-tailed)	<.001		<.001	.005	<.001
	N	207	208	206	207	208
stringency_index	Pearson Correlation	.661**	-.774**	1	-.101*	.332**
	Sig. (2-tailed)	<.001	<.001		.025	<.001
	N	205	206	508	486	508
reproduction_rate	Pearson Correlation	-.004	-.193**	-.101*	1	.007
	Sig. (2-tailed)	.958	.005	.025		.880
	N	206	207	486	487	487
new_cases	Pearson Correlation	.800**	-.825**	.332**	.007	1
	Sig. (2-tailed)	<.001	<.001	<.001	.880	
	N	207	208	508	487	510

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Data analysis 05

● Data analysis - EU

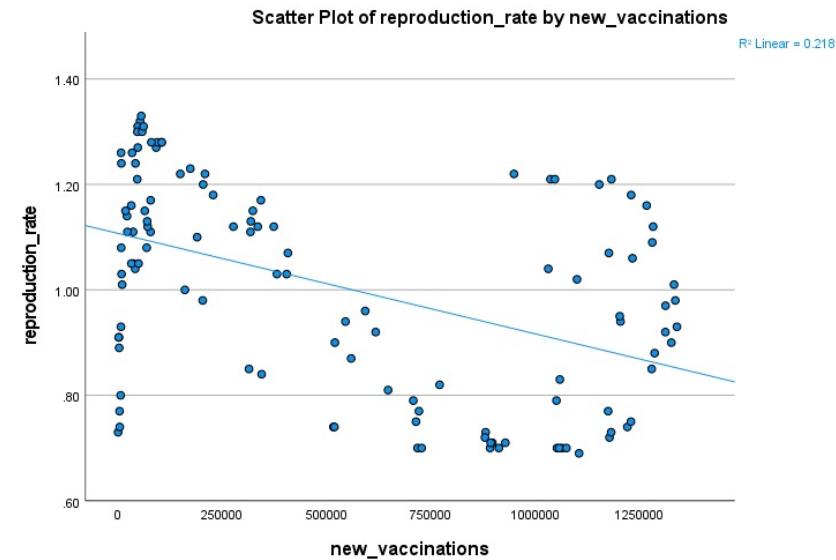
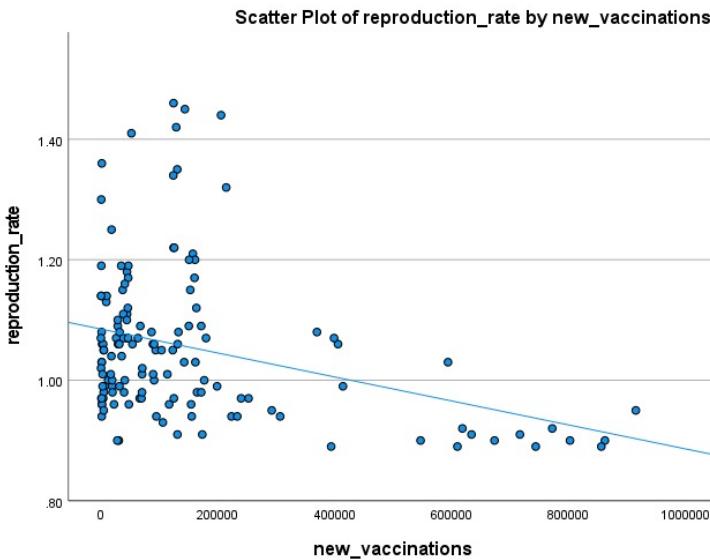
Correlations

		new_vaccinations	total_vaccinations	new_cases
new_vaccinations	Pearson Correlation	1	.861**	-.579**
total_vaccinations	Pearson Correlation	.861**	1	-.737**
new_cases	Pearson Correlation	-.579**	-.737**	1
N		208	208	208
N		208	211	211
N		208	211	541

**. Correlation is significant at the 0.01 level (2-tailed).

Data analysis 06

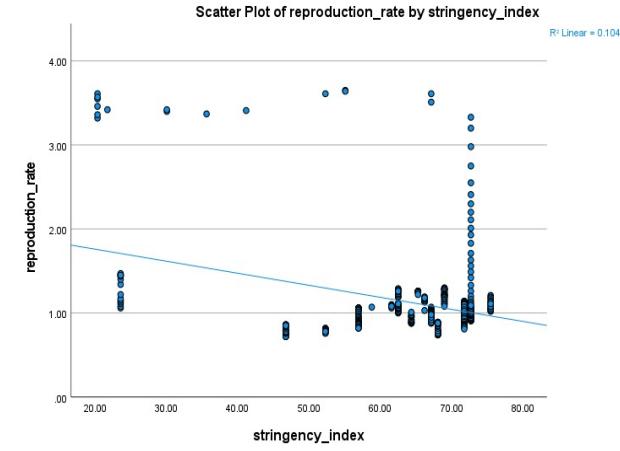
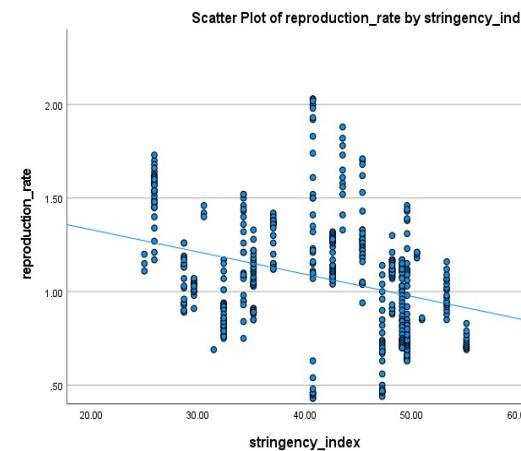
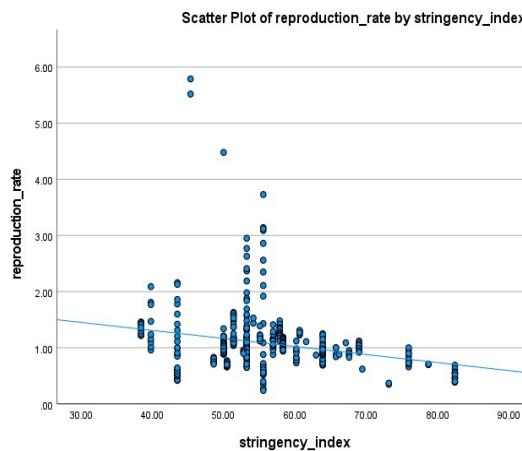
● Discussion 01 (New vaccination & Reproduction rate)



- Negative correlation between new vaccination (vaccination speed) and reproduction rate have been observed in data of Korea (-.329) and Japan(-.467)

Data analysis 07

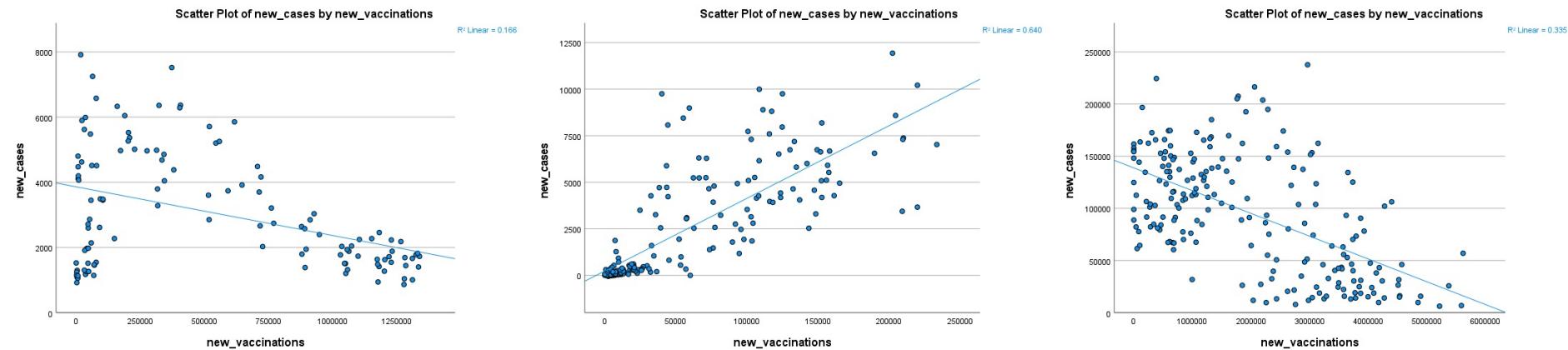
● Discussion 02 (Stringency index & Reproduction rate)



- Negative correlation between stringency index and reproduction rate have been observed in data of Korea (-.236), Japan(-.328) and US(-.322)

Data analysis 08

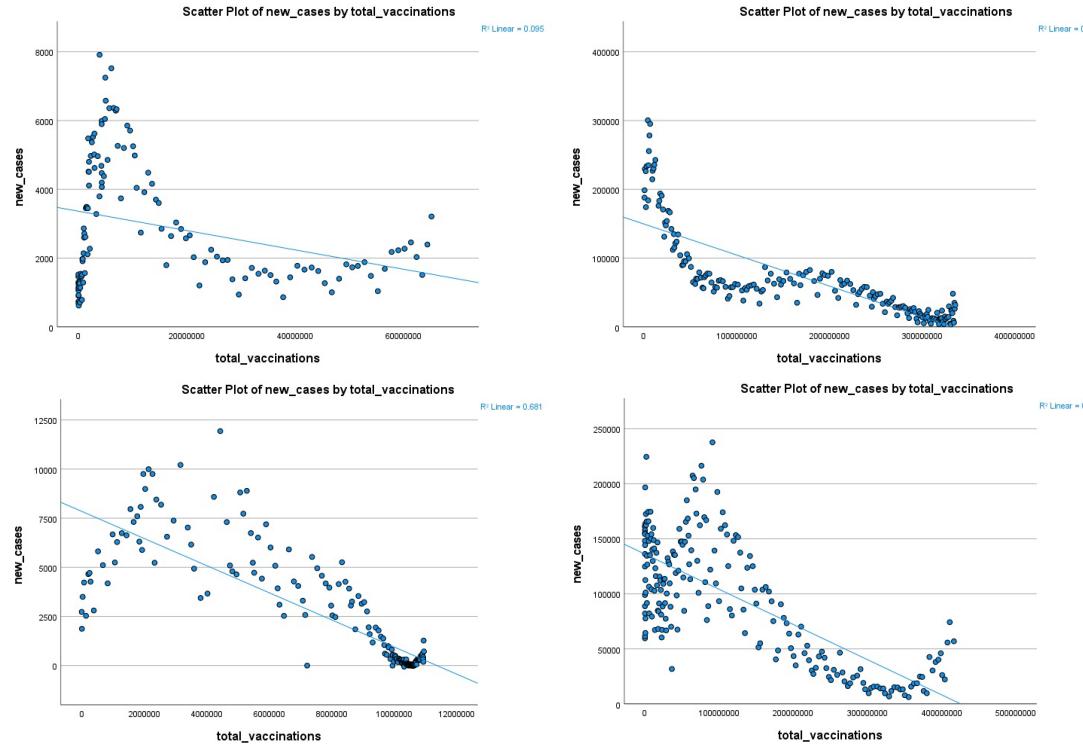
● Discussion 03 (New Vaccination & New cases)



- Both positive and negative correlation was observed between vaccination speed and new cases, with number of Japan(-.408), Israel(.800), and EU(-.579)

Data analysis 09

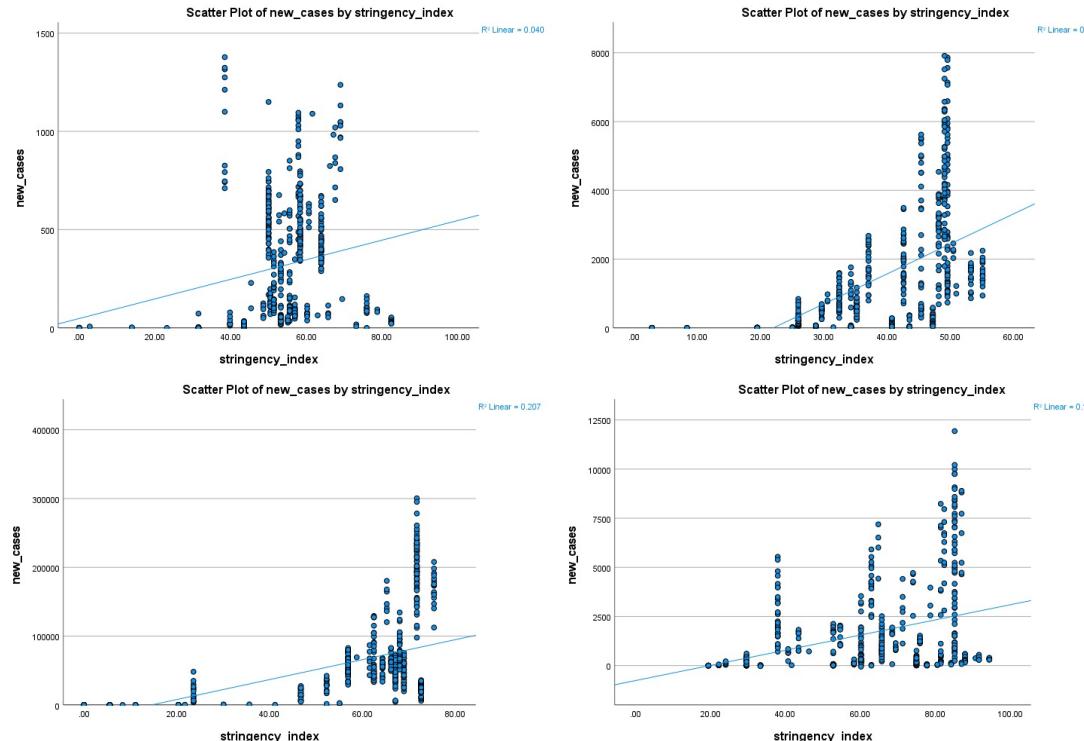
● Discussion 04 (Total Vaccination & New cases)



- Mainly negative correlation was observed between total vaccination and new cases, with number of Japan(-.308), US(-.804), Israel(-.825), and EU(-.737)

Data analysis 10

● Discussion 05 (Stringency index & New cases)



- Positive correlation was observed between all stringency index and new cases among our data, with number of Korea(.199), Japan(.535), US(.454), and Israel(.332)

SIR Model 01

● SIR-V Model (epidemiological model)

- Susceptible
 - Population – Confirmed – Vaccinated
- Infected
 - Confirmed – Recovered – Fatal
- Recovered
 - Recovered + Fatal
- Vaccinated
 - Vaccinated

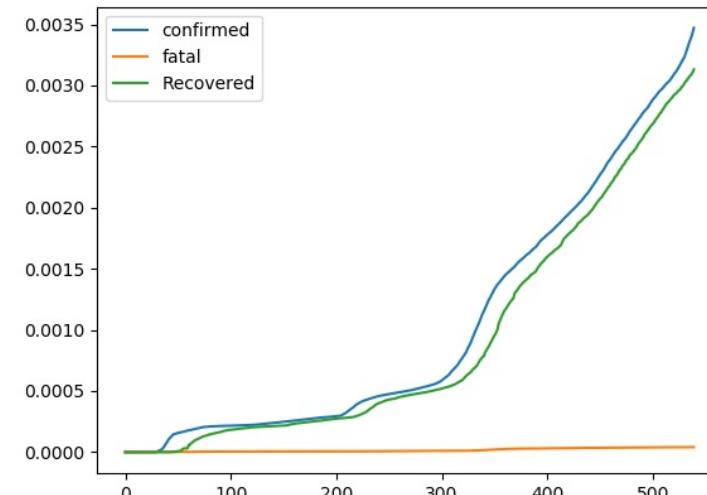
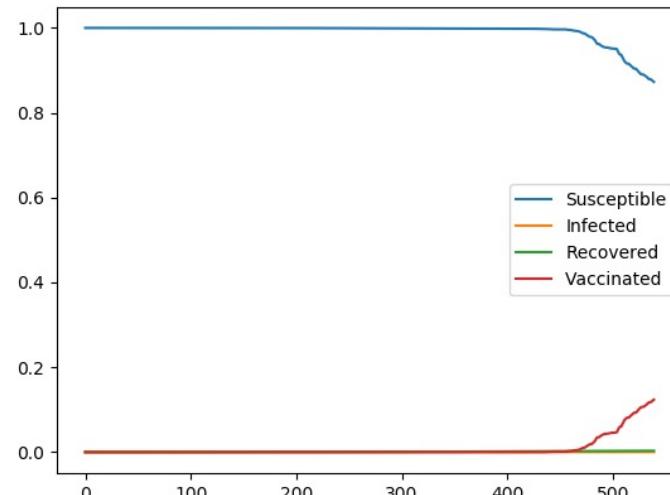
SIR Model 02

● SIR-V Model (epidemiological model)

- Susceptible (S)
 - $S'(t) = -\beta SI - \nu V$
- Infected (I)
 - $I'(t) = +\beta SI - \gamma I$
- Recovered (R)
 - $R'(t) = \gamma I$
- Vaccinated (V)
 - $V'(t) = \nu V$

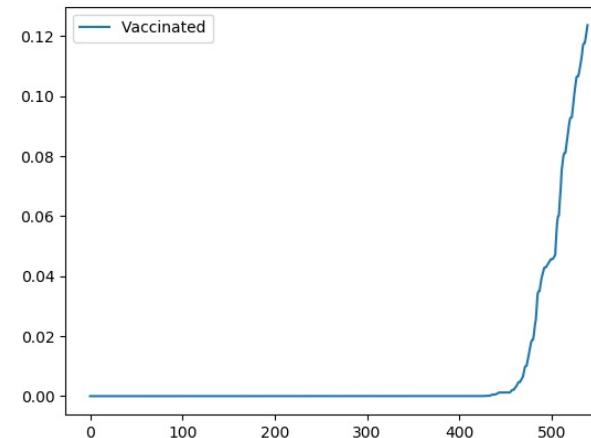
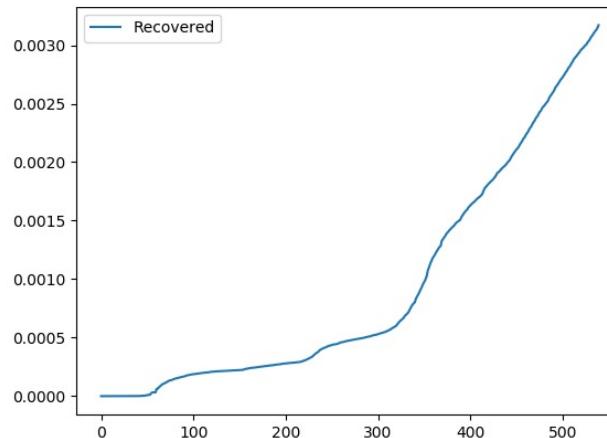
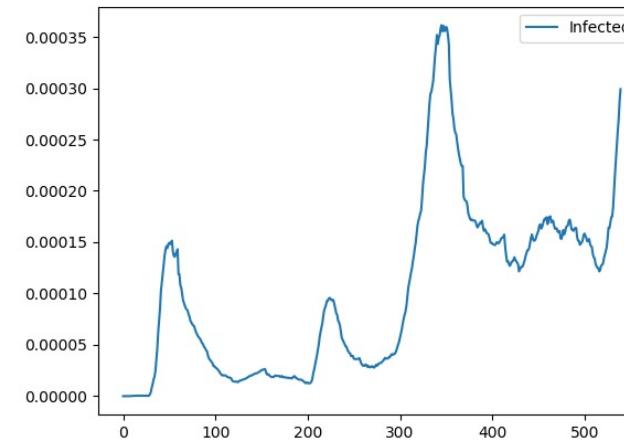
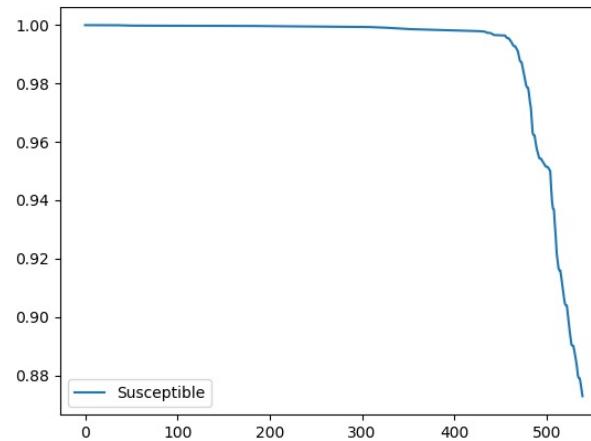
SIR Model 03

● SIR-V Model – South Korea



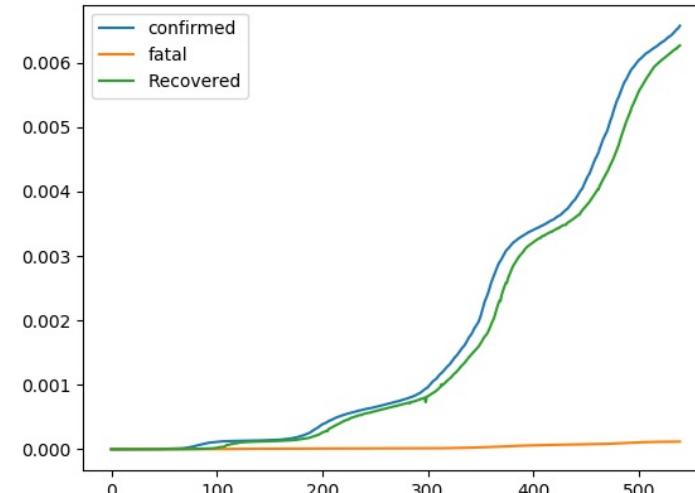
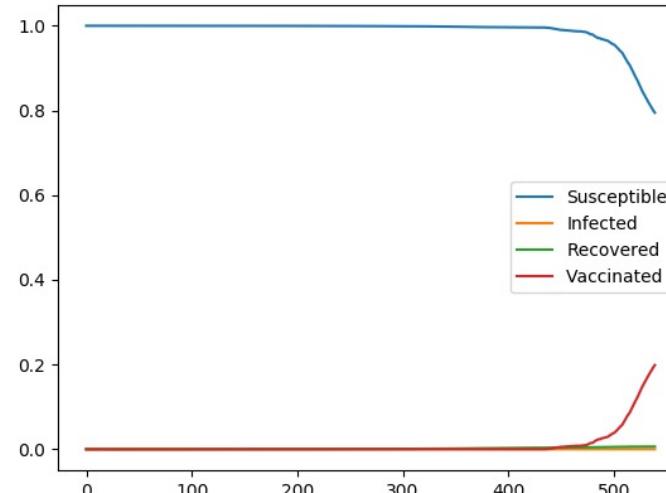
SIR Model 04

● SIR-V Model – South Korea



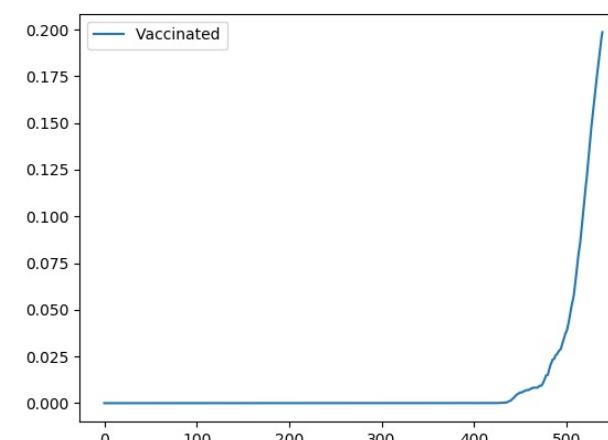
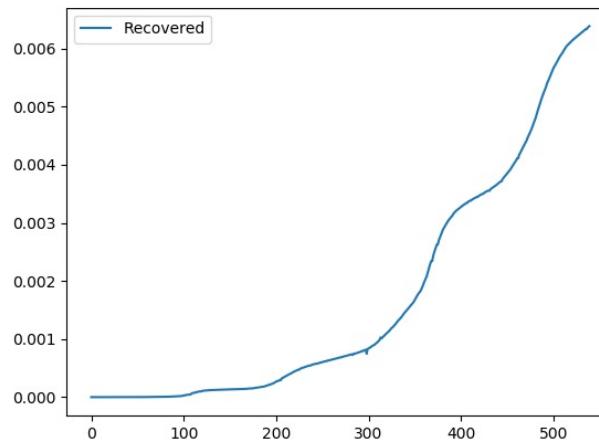
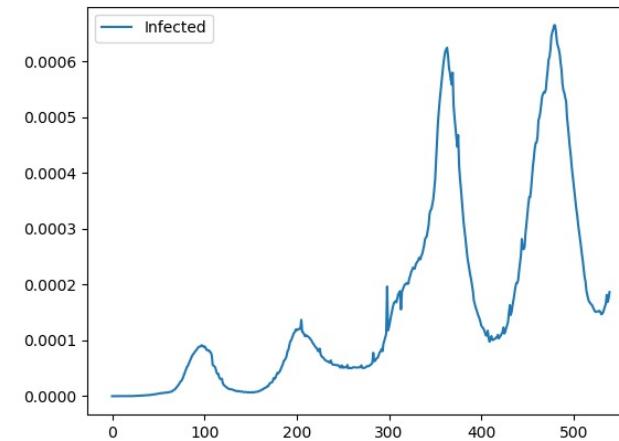
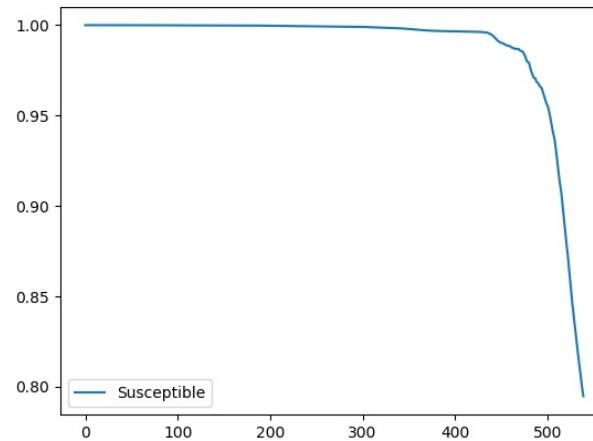
SIR Model 05

● SIR-V Model – Japan



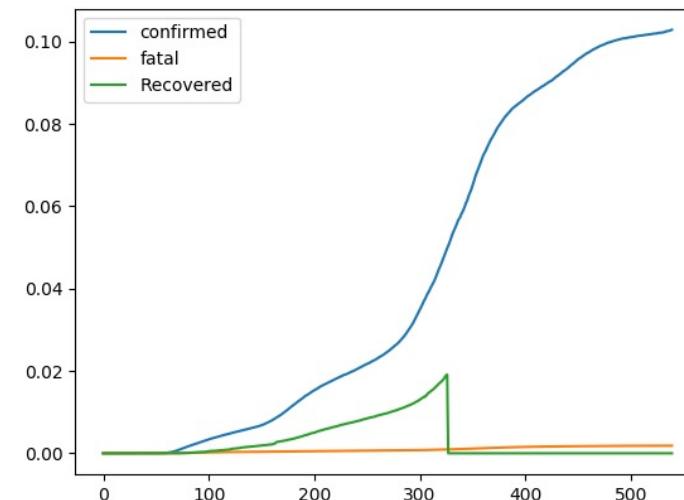
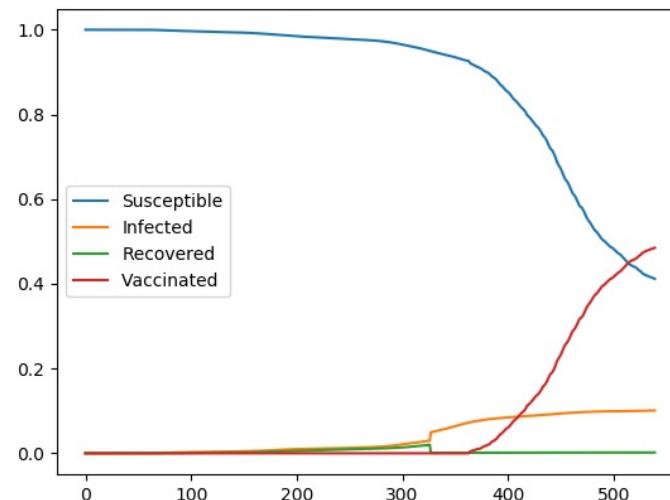
SIR Model 06

● SIR-V Model – Japan



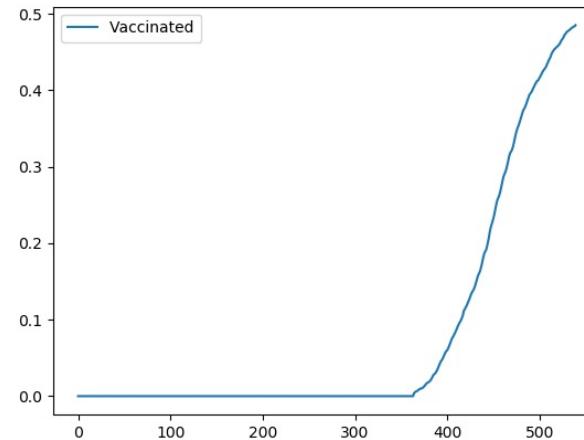
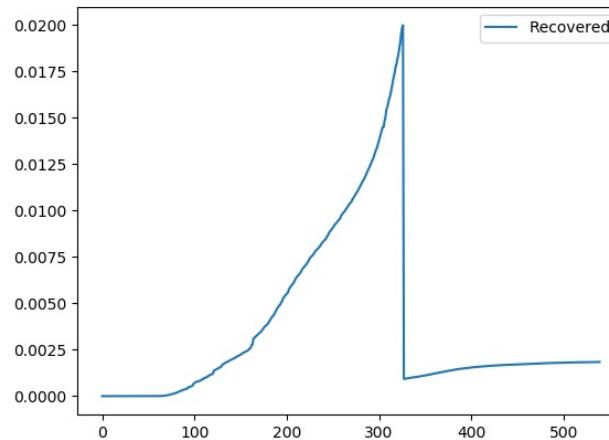
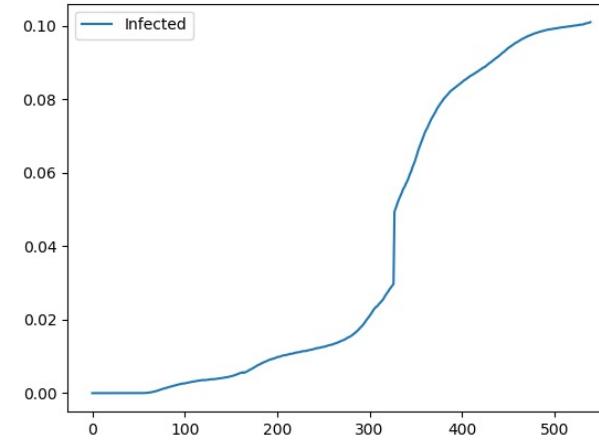
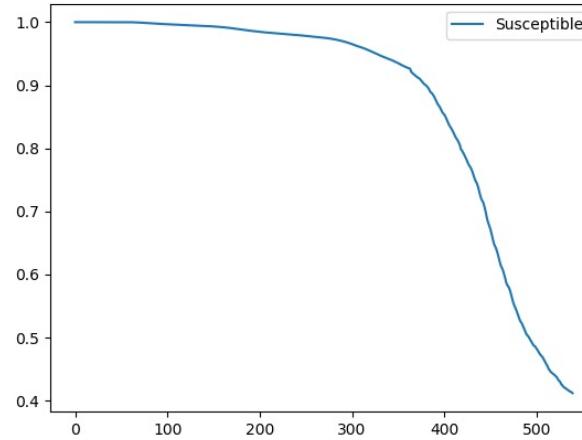
SIR Model 07

● SIR-V Model – US



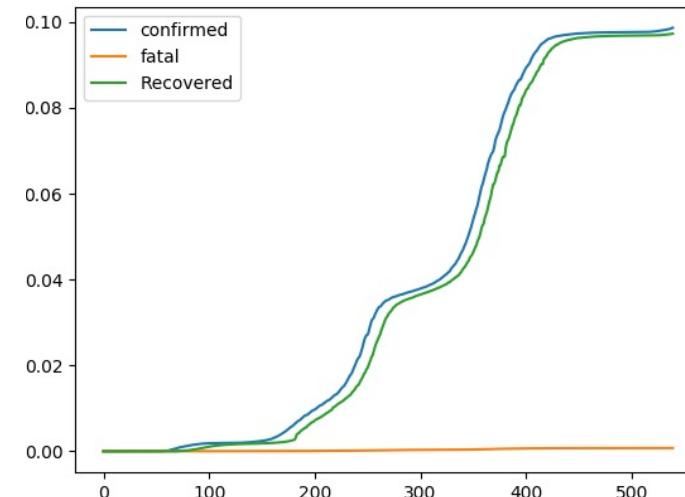
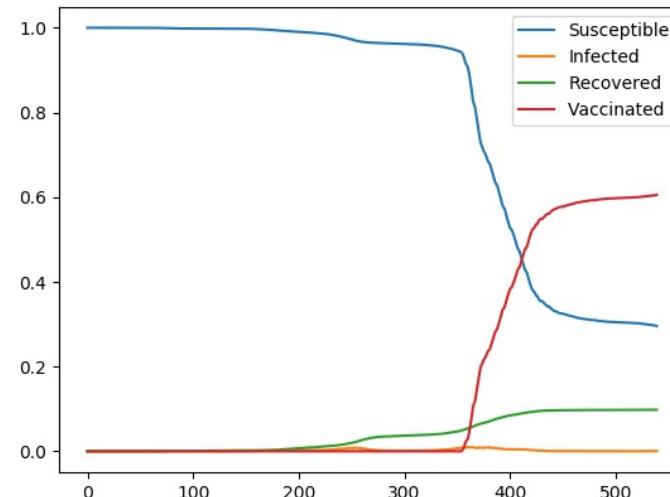
SIR Model 08

● SIR-V Model – US



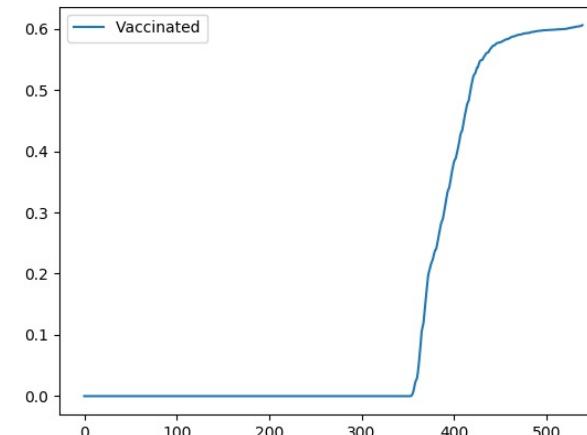
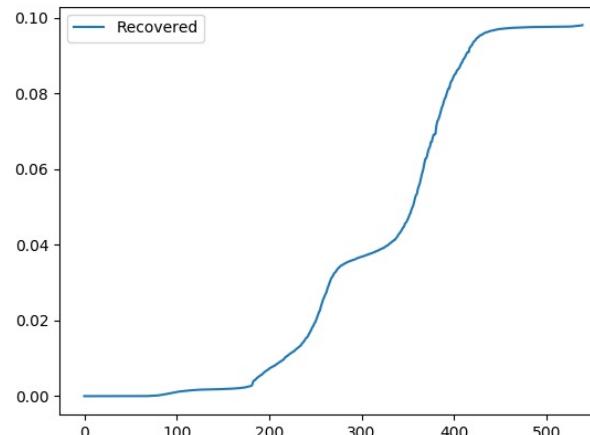
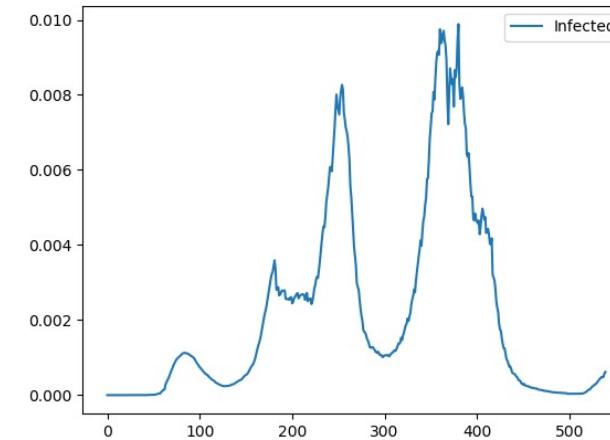
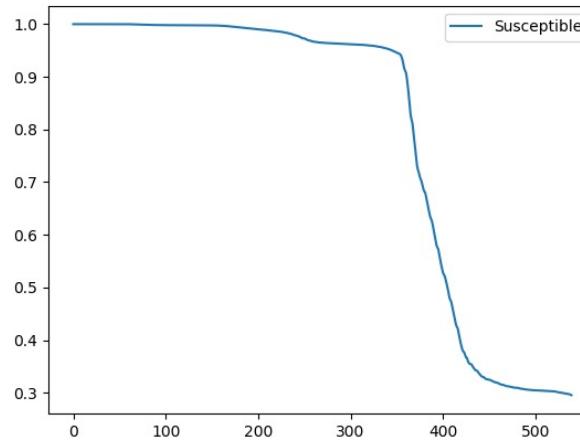
SIR Model 09

● SIR-V Model – Israel



SIR Model 10

● SIR-V Model – Israel



Conclusion & Limitation

- Data analysis was limited to only few countries therefore, it is rather hard to generalize the calculated result. Furthermore, pandemic such as Covid 19 can be determined based on various factors. Since this study focused on only some of the variables it holds errors.
- SIR model was limited only to the data provided by open source. Therefore, each of the variable holds errors. Prediction model based on machine learning could been used to elaborate more to the topic of SIR model.

Thank you

- Q & A -

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