SIR Model - Mass Tests

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January 27, 2021

Overview

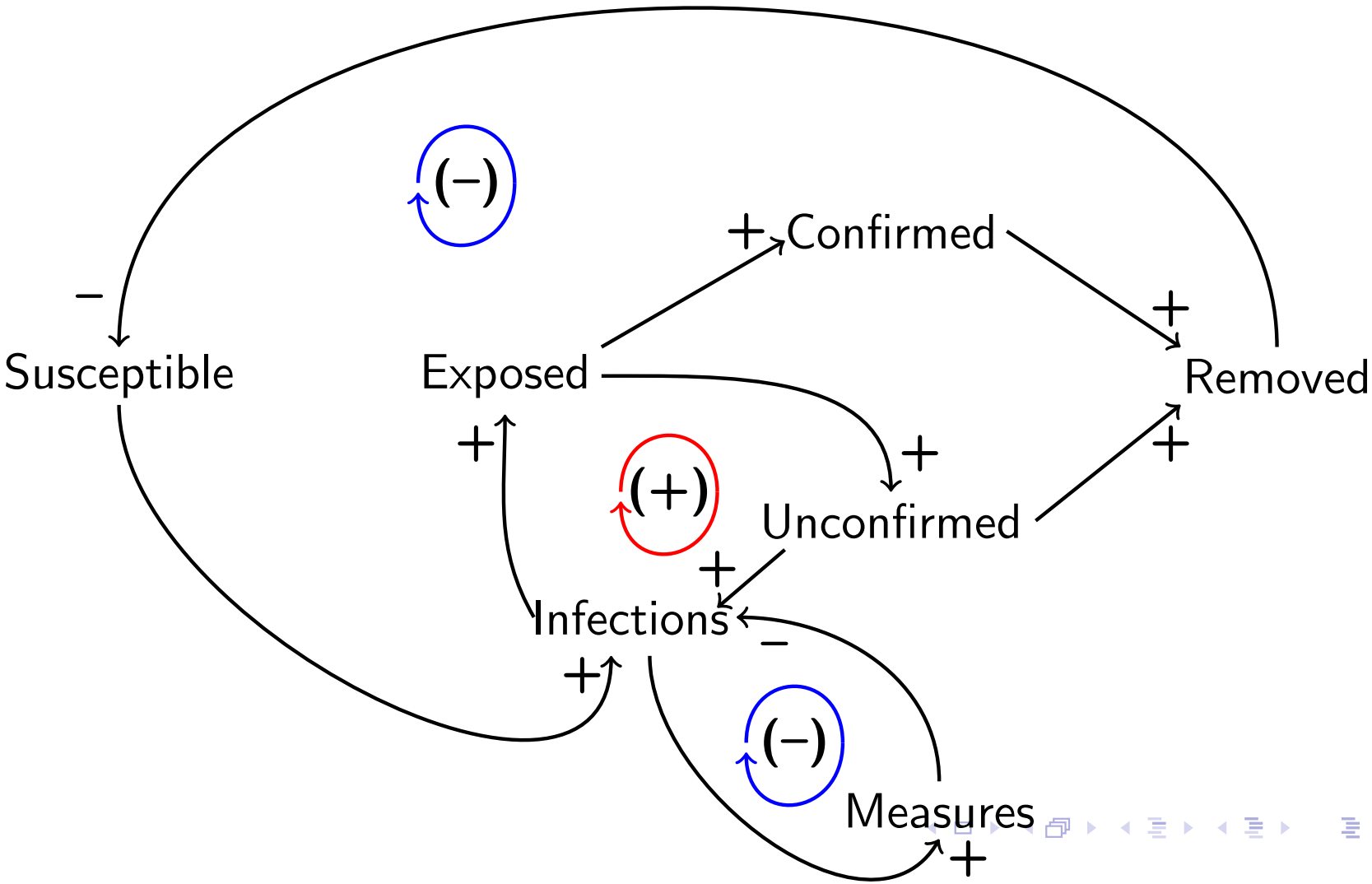
Motivation

- Covid-19 plaguing the world
- Nationwide mass tests in winter
- Goal: reduce number of unconfirmed cases
- Alternative to lockdown measures

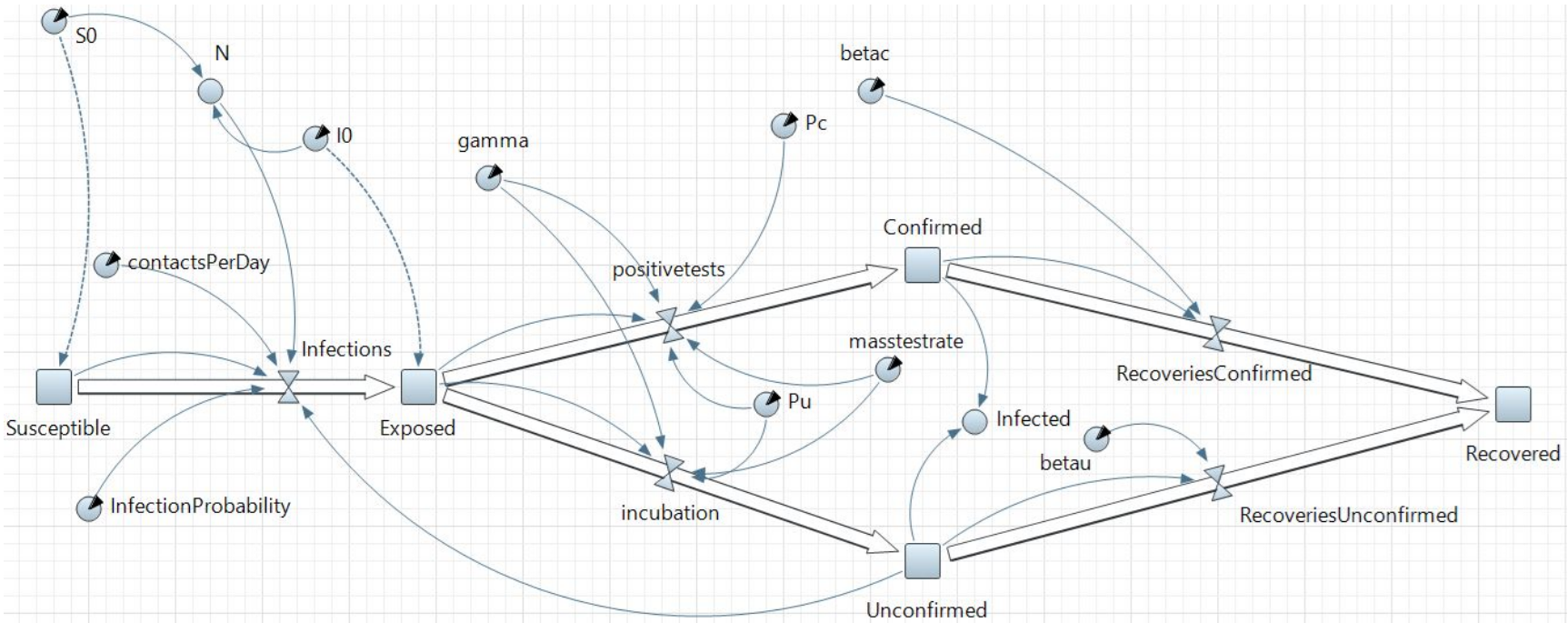
Model Description

- SIR - Susceptible-Infectious-Recovered
- Compartment Exposed: freshly infected but not yet infectious - SEIR Model
- Split Infectious into Confirmed and Unconfirmed
- Only Unconfirmed contribute to infections
- Recovered people do not contribute anymore

Causal Loop Diagram



AnyLogic Implementation



Parameters

α

infection probability in case of contact

c

contacts per day per person

γ

latency rate for moving from Exposed to Confirmed or Unconfirmed

$p_d, p_u : p_d + p_u = 1$

chance of being transferred to detected or undetected compartment, respecitvely

β_d, β_u

recovery rates for detected and undetected persons

Masstests and Lockdown

Masstests:

- A portion of people move directly from the Unconfirmed to the Confirmed compartmet
- The flow from the Exposed compartmet is changed accordingly for the duration
- Occur cyclically

A lockdown occurs:

- When a certain number of people are infected (Confirmed + Unconfirmed, „Dunkelziffer“)
- Lockdown measures reduce number of contacts
- Lift of lockdown in two steps - „Lockdown light“

Additional Assumptions

Some assumptions were made to make a better fit with the real data:

- Less cases for first lockdown
- Stricter first lockdown - more people follow the rules
- Infection-Probability lower in summer
- Model time: Start of Pandemic - about 1 year in the future, assuming no vaccinations!

Lockdown numbers

Nr. Infected	-	$\geq 45,000$	$\leq 10,000$	$\leq 5,000$
contacts per Day	14	2	6	9

Table: Numbers for first lockdown

Nr. Infected	-	$\geq 115,000$	$\leq 30,000$	$\leq 20,000$
contacts per Day	9	3	6	9

Table: Numbers for other lockdowns

Here the $-$ column means number of contacts per day before the respective lockdown.

Results

	30 days	21 days	14 days	7 days
35% participation	199	170	154	48
50% participation	174	151	91	11
70% participation	147	77	11	8
90% participation	67	7	7	6

Table: Days of lockdown with different participation rate and interval between masstests

To compare: without any masstests at all the number of days in lockdown would be 243.

The End