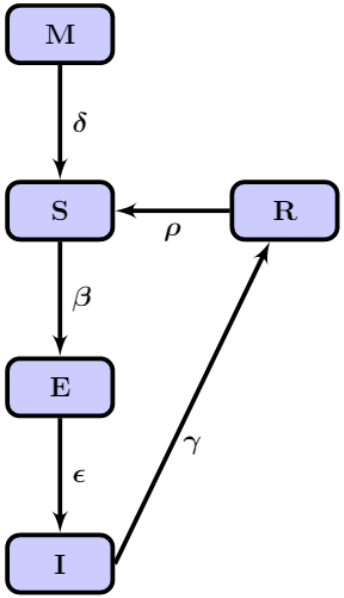
MSEIRS Model

Vaibhav Amit Patel - 201401222
Tanmay Patel - 201401409

Model



Parameter	Explanation	Value
B	Birth rate per day	10
δ	Passive immune becomes susceptible rate	0.005 (200 days)
μ_1	Death rate	0.002
μ_2	Death rate for infecteds and exposed	0.007
β	A susceptible meets an infected at contact rate of 10 it can go in latent period with probability 0.06	0.6
ϵ	Quarantined becomes infected	0.071 (14 days)
γ	Infected gets recovered	0.0667 (15 days)
ρ	Recovered becomes susceptible again	0.001 (1000 days)

TABLE I. **Parameters used in the simulation**

Model

$$\frac{dM}{dt} = B - (\delta - \mu_1)M$$

$$\frac{dS}{dt} = B + \delta M - \frac{\beta SI}{N} - \mu_1 S + \rho R$$

$$\frac{dE}{dt} = \frac{\beta SI}{N} - (\epsilon + \mu_2)E$$

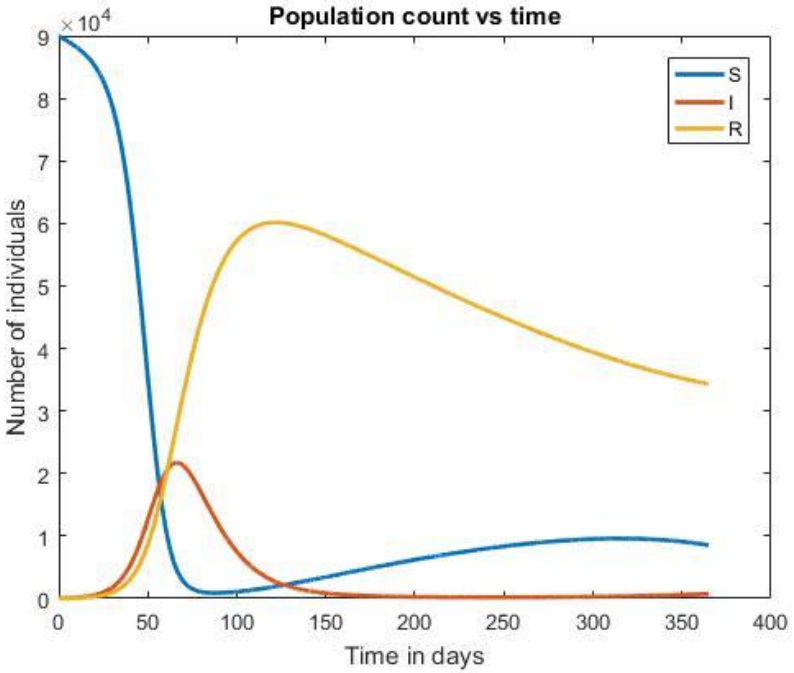
$$\frac{dI}{dt} = \epsilon E - (\gamma + \mu_2)I$$

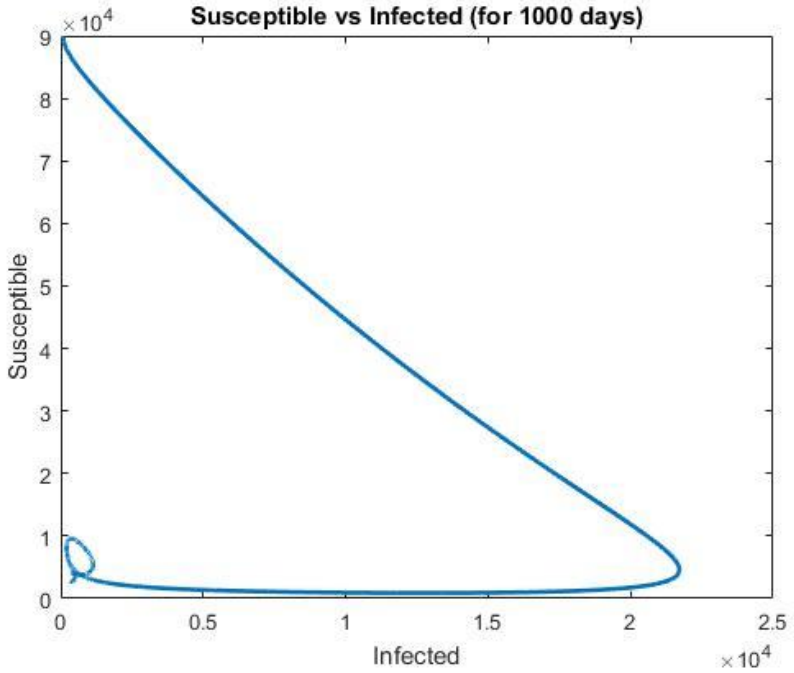
$$\frac{dR}{dt} = \gamma I - (\mu_1 + \rho)R$$

Parameter	Explanation	Value
B	Birth rate per day	10
δ	Passive immune becomes susceptible rate	0.005 (200 days)
μ_1	Death rate	0.002
μ_2	Death rate for infecteds and exposed	0.007
β	A susceptible meets an infected at contact rate of 10 it can go in latent period with probability 0.06	0.6
ϵ	Quarantined becomes infected	0.071 (14 days)
γ	Infected gets recovered	0.0667 (15 days)
ρ	Recovered becomes susceptible again	0.001 (1000 days)

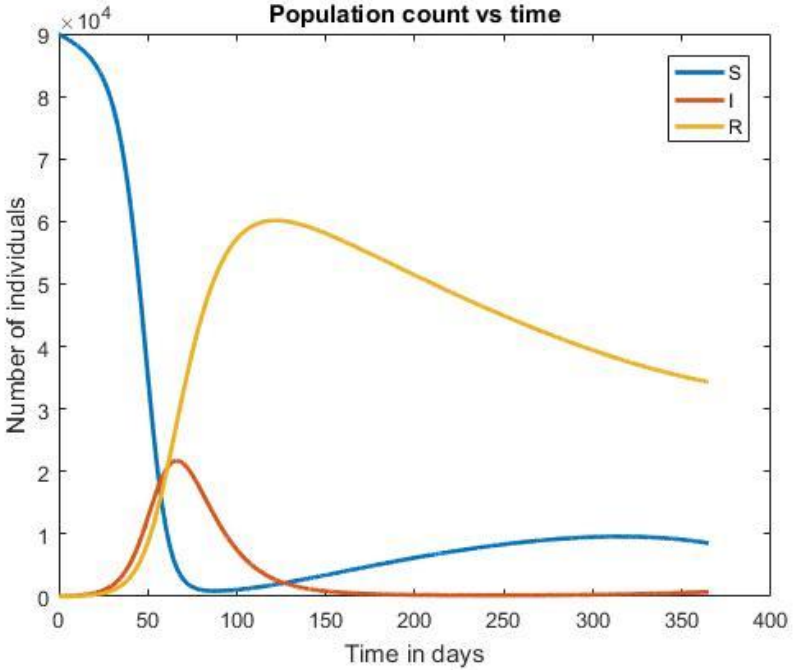
TABLE I. **Parameters used in the simulation**

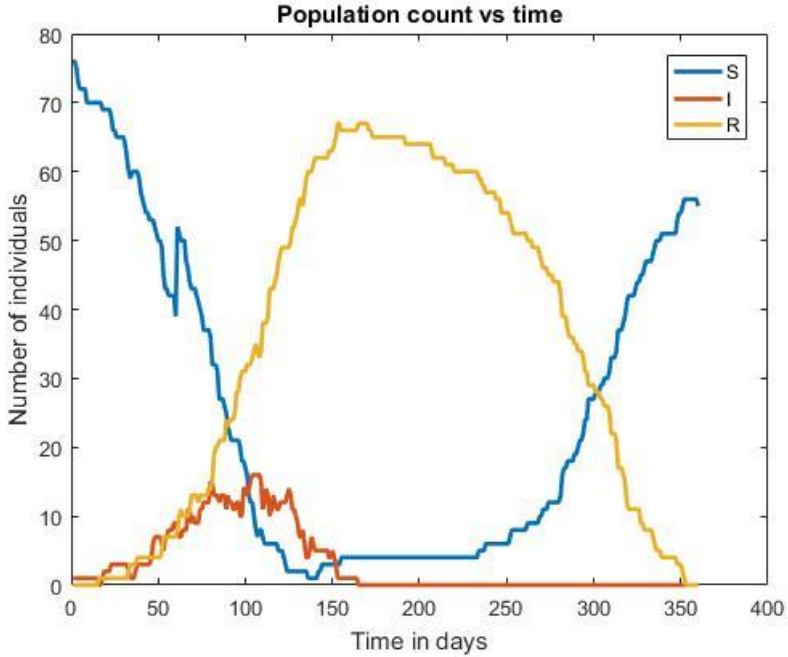
Deterministic approach simulation result





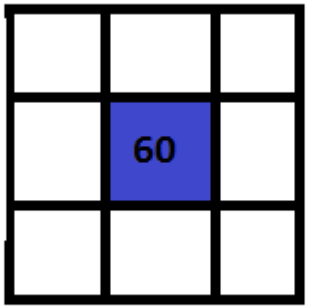
Comparison


Population count vs time
×10^4
Number of individuals
Time in days
S
I
R

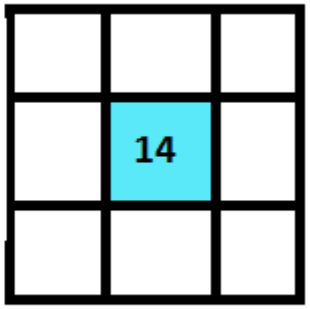

Population count vs time
Number of individuals
Time in days
S
I
R

Modeling using cellular automaton - rules

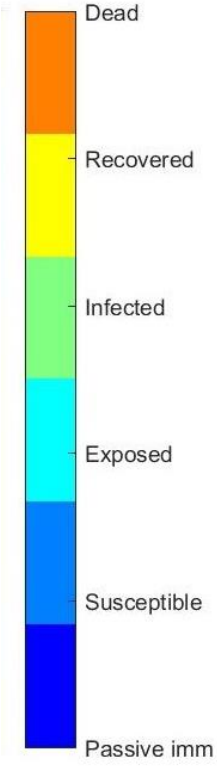
Interaction term



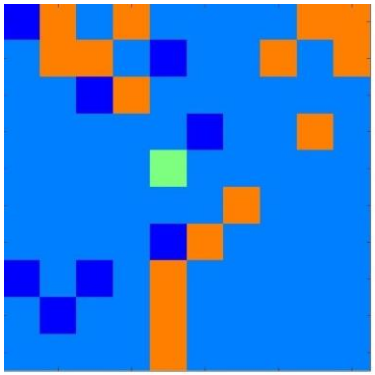
Time stamp, MSEIRS



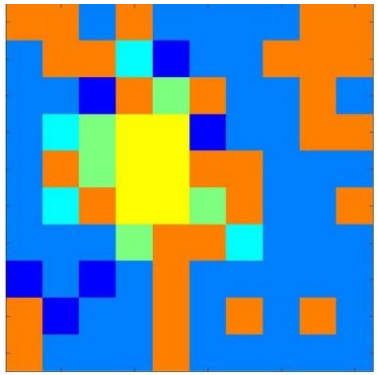
Latent period



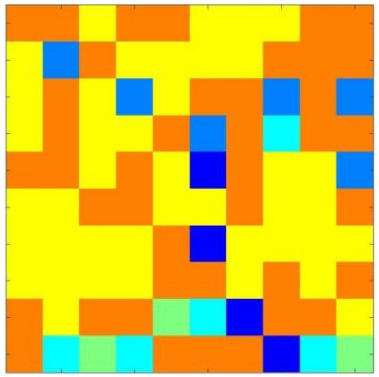
Modeling using cellular automaton



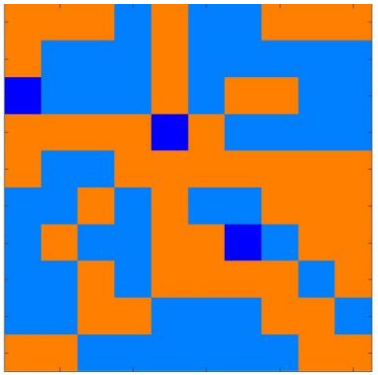
Step-1



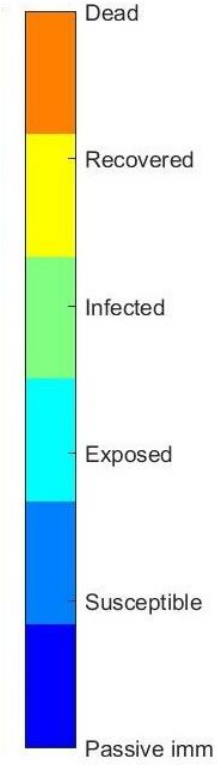
Step-51



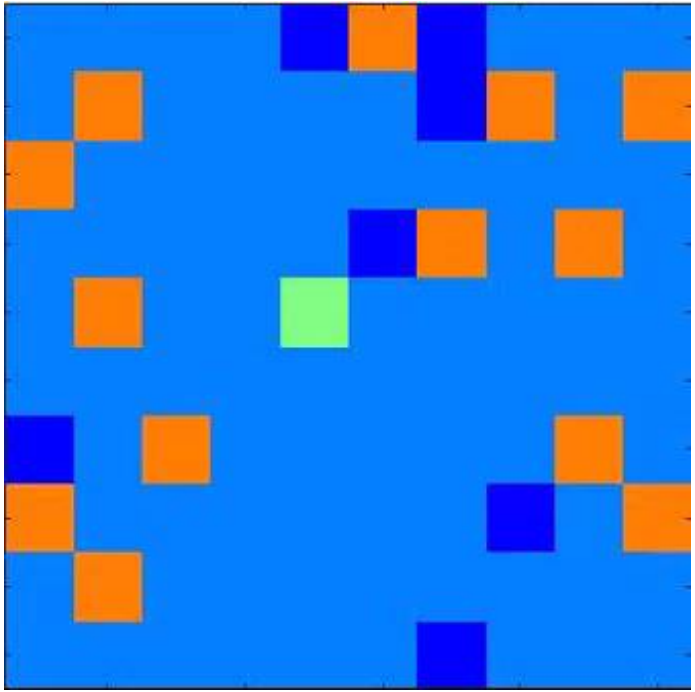
Step-151

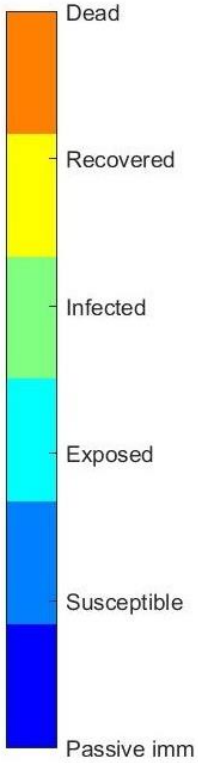


Step-401



Modeling using cellular automaton





Summary and Conclusion

- Modeling with MSEIRS model.
- The deterministic approach
- The cellular automaton approach
- Some things which do not depend on the local property, but depend on the overall number of people in the study, can not be included in the cellular automaton
- The rules for the automaton were good enough to produce almost the same results as in the deterministic model.

Thank you