Model Description

The COVID-19 transmission dynamics can be described by the following ordinary differential equations (ODEs). The total population (N) is divided in to five compartments: susceptible (S), exposed (E), infectious (I), confirmed and isolated (C), and recovered (R)

$$\frac{dS}{dt} = -\beta(t)\frac{SI}{N}$$

$$\frac{dE}{dt} = \beta(t)\frac{SI}{N} - \kappa E,$$

$$\frac{dI}{dt} = \kappa E - \alpha I,$$

$$\frac{dC}{dt} = \alpha I - \gamma C,$$

$$\frac{dR}{dt} = (1 - f)\gamma C,$$

where $N = S + E + I + C + R$.

An individual in susceptible group is moved to the exposed group by transmission from the infectious individuals. The time dependent function $\beta(t)$ represents the transmission rate affected by the government policy. According to the social distancing level the transmission rate is changed. The number of transmitted individuals is represented by the term $\beta(t)\frac{SI}{N}$. The exposed individuals are moved to the infectious individuals. The parameter κ indicates rate of progression from exposed to infectious. The infectious individuals are confirmed and isolated. The confirmation rate (or isolation rate) is represented by a parameter α. The term αI indicates the daily number of reported cases and $\int_0^t \alpha I\, dt$ is the number of cumulated cases. The time dependent function $I(t)$ indicates the number of prevalence at time t. The infectious individuals are recovered at a rate of γ. The parameter f means fatality rate of the COVID-19 disease $(0 \le f \le 1)$.