

What is R? A graph drawer's perspective

R is one of the most important epidemic parameters that governments are trying to keep below one. But what it is exactly? Can we express it in graph drawing terminology?

Epidemic definitions

R_0 (pronounced R naught):

Basic reproduction number:

Average number of secondary infections per typical case without interventions and the entire population susceptible

R_t (Or R as often used in practice):

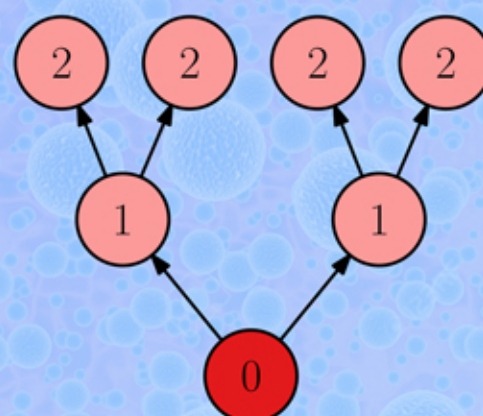
Effective reproduction number:

Average number of secondary infections per typical case

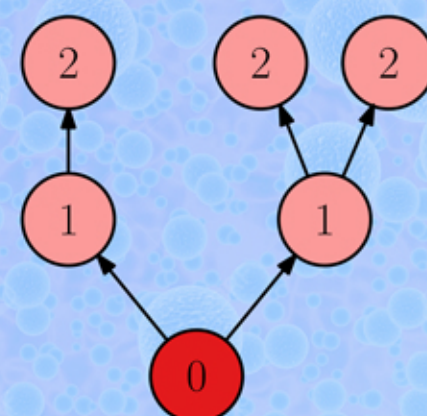
$R_t = 1$



$R_t = 2$



$R_t = ?$

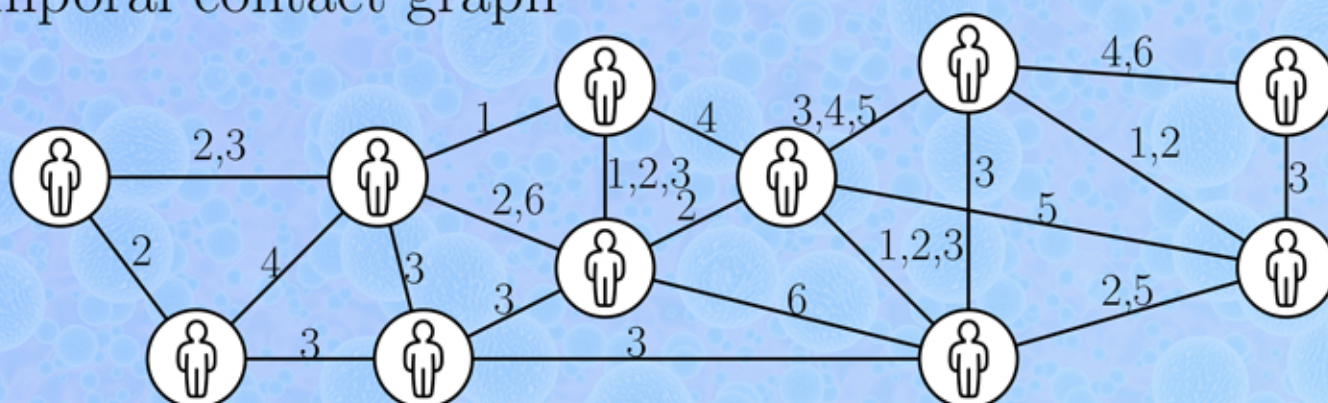


Each level in the tree is one generation

Temporal contact graph

Nodes are people

Edges are contacts between people at a point in time



Time of contact shown on edge

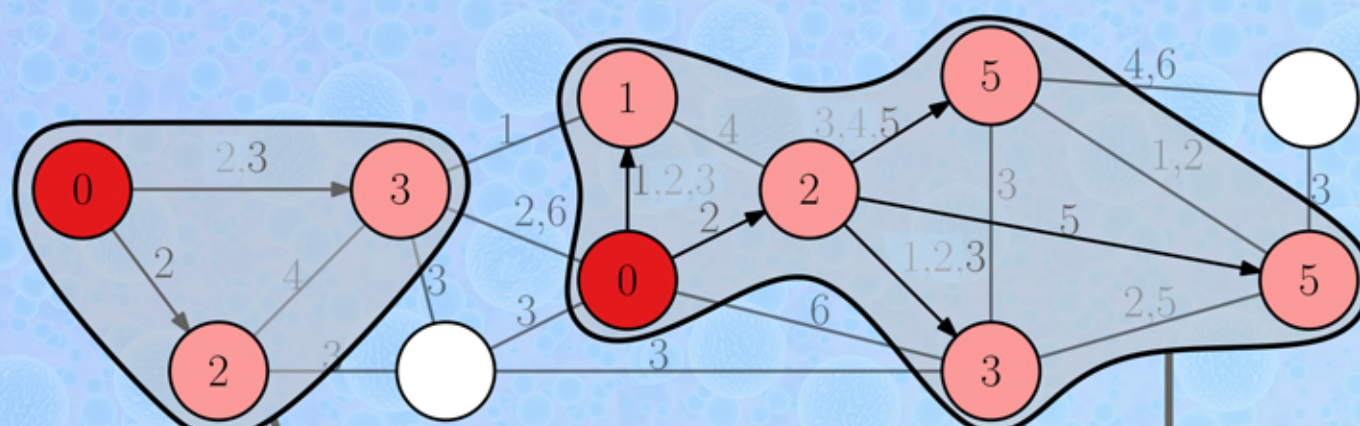
Index case

Exposed

Large uncertainties in the data

- Missing edges
- Unknown directionality
- Time of exposure estimated

Disease spreads throughout the graph



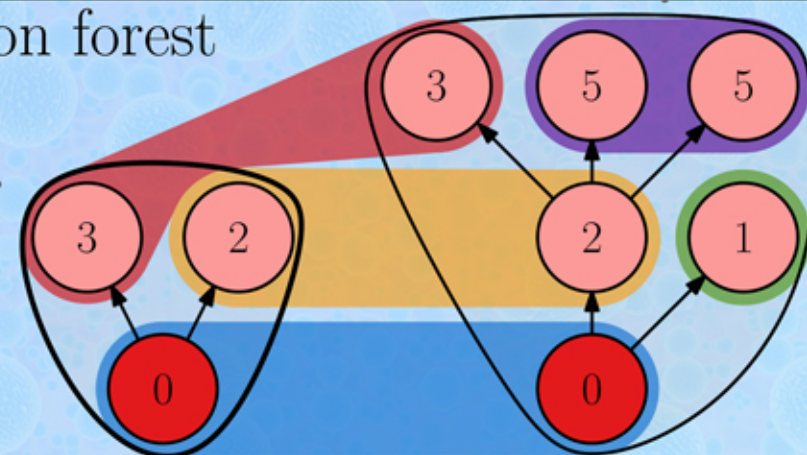
Time of exposure shown inside node

Generate temporal infection forest

Color bands indicate nodes exposed at the same time

Large forest of small trees due to:

- Missing or asymptomatic cases
- Missing transmission edges



Calculate R_t

Y_t = Set of nodes exposed at time t

X_t = Set of children of Y_t

$$R_t^* = \begin{cases} 0 & \text{for } |Y_t| = 0 \\ \frac{|X_t|}{|Y_t|} & \text{otherwise} \end{cases}$$

R_t is usually R_t^* averaged over 7 days

t	0	1	2	3	4	5	6
Y_t							
X_t							
R_t^*	$\frac{4}{2}=2$	$\frac{0}{1}=0$	$\frac{3}{2}=1.5$	$\frac{0}{2}=0$	0	$\frac{0}{2}=0$	0

$$R_t = (2 + 0 + 1.5 + 0 + 0 + 0 + 0) / 7 = 0.5$$