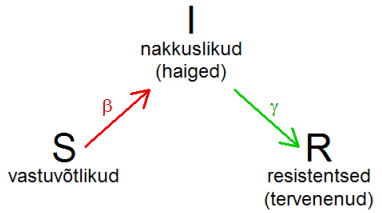
Nakkushaigustest

Mudelid

SIR mudel



diskreetse ajaga SIR mudel

$$S_{t+1} = S_t - \beta \cdot I_t S_t / N$$
$$I_{t+1} = I_t + \beta \cdot I_t S_t / N - \gamma \cdot I_t$$
$$R_{t+1} = R_t + \gamma \cdot I_t$$

pideva ajaga SIR-mudel

$$\frac{dS(t)}{dt} = -\beta \cdot I(t) S(t) / N$$
$$\frac{dI(t)}{dt} = \beta \cdot I(t) S(t) / N - \gamma \cdot I(t)$$
$$\frac{dR(t)}{dt} = \gamma \cdot I(t)$$

$$R_0 = \beta / \gamma$$

R-i abil...

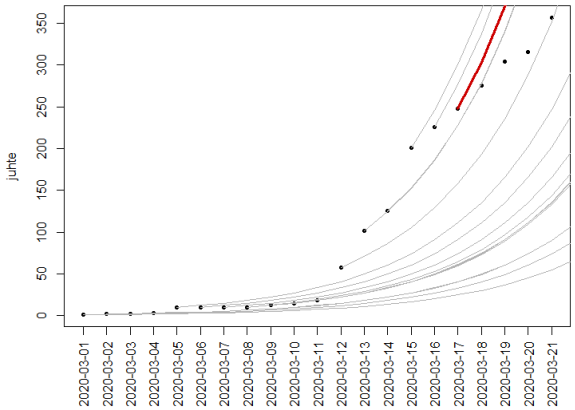
```
algvaartused=c(S=1328000, I=15, R=0)
ajad=0:7
parameetrid = list(beeta = 0.32541)
tulemus = lsoda (algvaartused, ajad, sir_mudel, parameetrid)
```

```
require(deSolve)

# SIR model
sir_mudel = function (aeg, seisund, parameetrid)
{
  S = seisund[1]        # susceptibles / vastuvõtlikud
  I = seisund[2]        # infectious / haigestunud
  R = seisund[3]        # recovered / resistentsed

  N=S+I+R

  with ( parameetrid,
         {
           gamma = 1/8

           # Arvuta tuletised
           dS = (-beeta * S * I/N)
           dI = (beeta * S * I/N) - (gamma * I)
           dR = (gamma * I)

           # kombineerime tulemused
           results = c(dS, dI, dR)
              return(list(results))
         })}
```

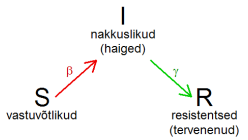
	time	S	I	R
1	0	1328000	15.00000	0.000000
2	1	1327995	18.32848	2.076086
3	2	1327988	22.39550	4.612851
4	3	1327980	27.36494	7.712513
5	4	1327970	33.43699	11.499968
6	5	1327958	40.85628	16.127823
7	6	1327943	49.92167	21.782549
8	7	1327925	60.99827	28.691939

Kui parameetreid tuleb hinnata...

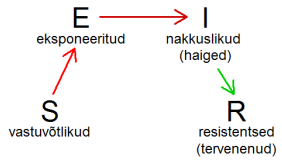
```
f=function(par, tegelik){

  parameetrid = list(beeta = exp(par[1]), gamma = exp(par[2]))
  algvaartused=c(S=762, I=1, R=0)
  ajad=0:(length(tegelik)-1)

  tulem0 = lsoda (algvaartused, ajad, sir_mudel, parameetrid)

  return(sum((tulem0[,3]-tegelik)**2))
}

tulem=optim(log(c(2, 0.5)), f, tegelik=I_tegelik)

# Parameetrite hinnangud:
exp(tulem$par)
```

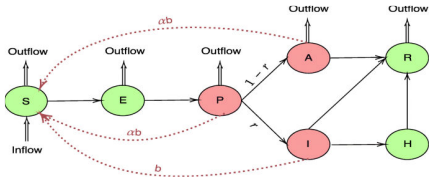


SIR; SEIR; SIS; MSEIR; ...



- SIR: S -> I -> R
- SEIR: S -> Exposed -> I -> R
- SIS: S -> I -> S
- MSEIR Maternal -> S -> E -> I -> R





SEIR

$$\frac{dS(t)}{dt} = -\beta \cdot I(t)S(t)/N$$

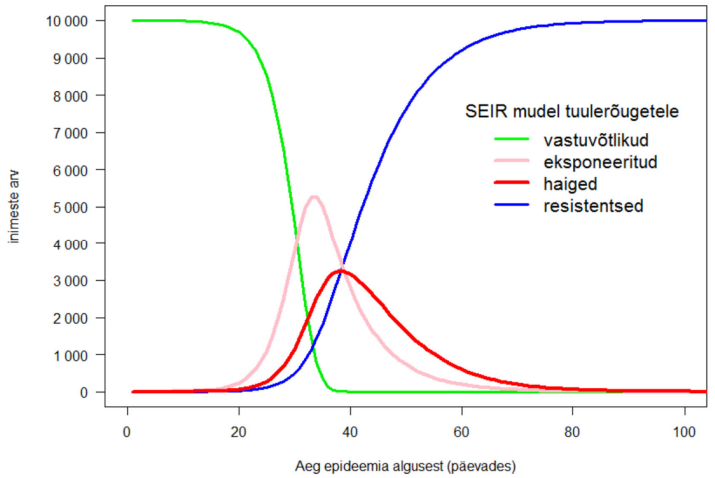
$$\frac{dE(t)}{dt} = +\beta \cdot I(t)S(t)/N - \alpha E(t)$$

$$\frac{dI(t)}{dt} = +\alpha E(t) - \gamma \cdot I(t)$$

$$\frac{dR(t)}{dt} = +\gamma \cdot I(t)$$

$$R_0 = \beta/\gamma$$

SEIR



Stohhastilised mudelid