DYNAMIC DISEASE SPREADING MODELS

WHAT TO PREDICT? NO. OF NEW CASES PER DAY (RKI FALLZAHLEN)

INTEGER? → PARTICLE BASED

POPULATION-BASED MODELLING

SUSCEPTIBLE ($80 \cdot 10^6$ FOR GERM.)

N = TOTAL NO OF PEOPLE

$15974 = I_{meas,new} \in \mathbb{R}$

β, γ TIME CONST.

DIFFERENTIAL EQ.

$$\frac{d}{dt} S = -(\beta \cdot I/_N \cdot S)$$

$$\dot{I} = +(\beta \cdot I/_N \cdot S) - \gamma \cdot I$$

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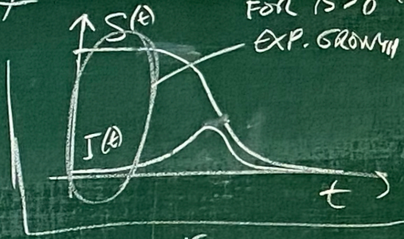
SIMPLEST MODEL: TWO STATES $S(t)$, $I(t)$

TWO PARAMETERS $\beta(t)$, $\gamma \approx$ CONST. IN TIME

$\beta(t)$: DEPENDING ON RULES & BEHAVIOUR (AIM: MAKE β SMALL!)

FOR $\beta > \gamma$ CONST. EXP. GROWTH



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

$$\frac{d\,I(t)}{dt} = +\beta(t) \cdot \frac{I(t)}{N} \cdot S(t) - \gamma \cdot I(t)$$

(N = TOTAL NO OF PEOPLE IN GERMANY $S(t) + I(t) + R(t) = N$)

MEASUREMENT?

$$I_{new,meas} = \beta \frac{I \cdot S}{N} \cdot T_{DAY} \cdot \eta$$

η: FRACTION OF TESTED INF. PEOPLE $0 < \eta < 1$

$R = e^{\frac{r}{\gamma}}$

"$R = e^{r \cdot T}$"

$T \approx$ DURATION OF INFECTION

$$\dot{I} = I \cdot \left(\beta \cdot \frac{S}{N} - \gamma\right) = r$$

r: TIME CONSTANT $[r] = \frac{1}{s}$

$r > 0$: GROWTH
$r < 0$: DECLINE