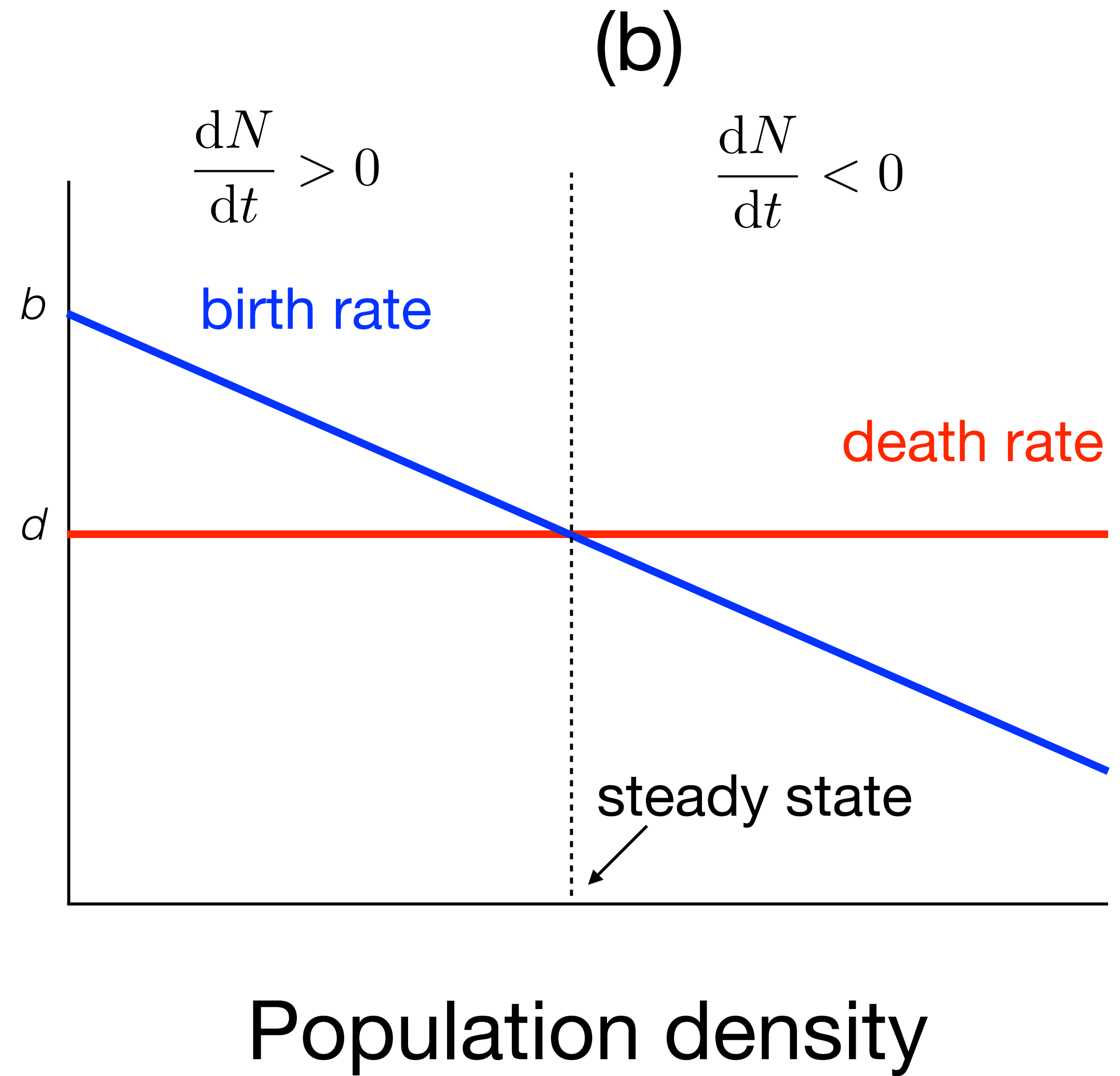
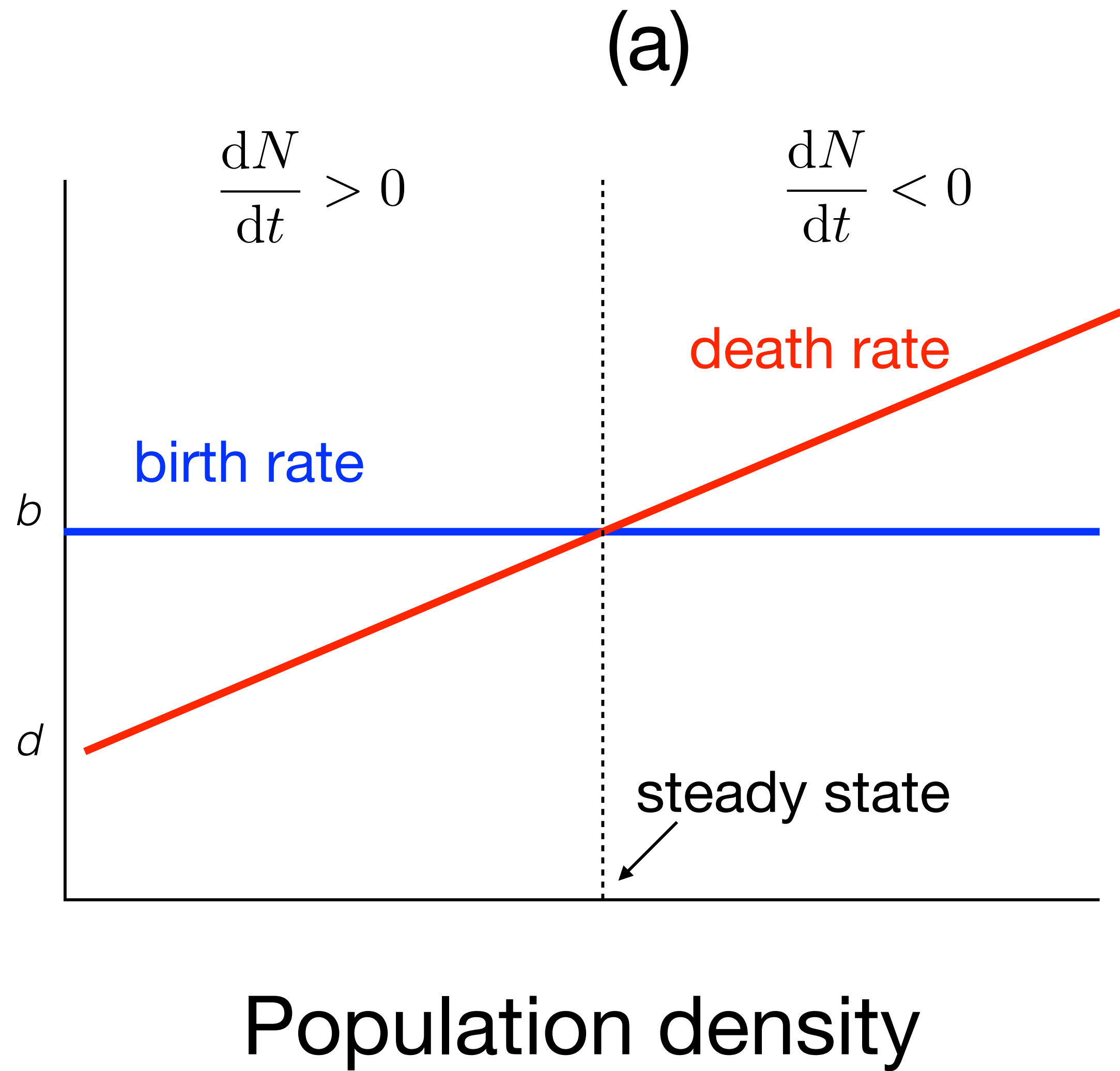
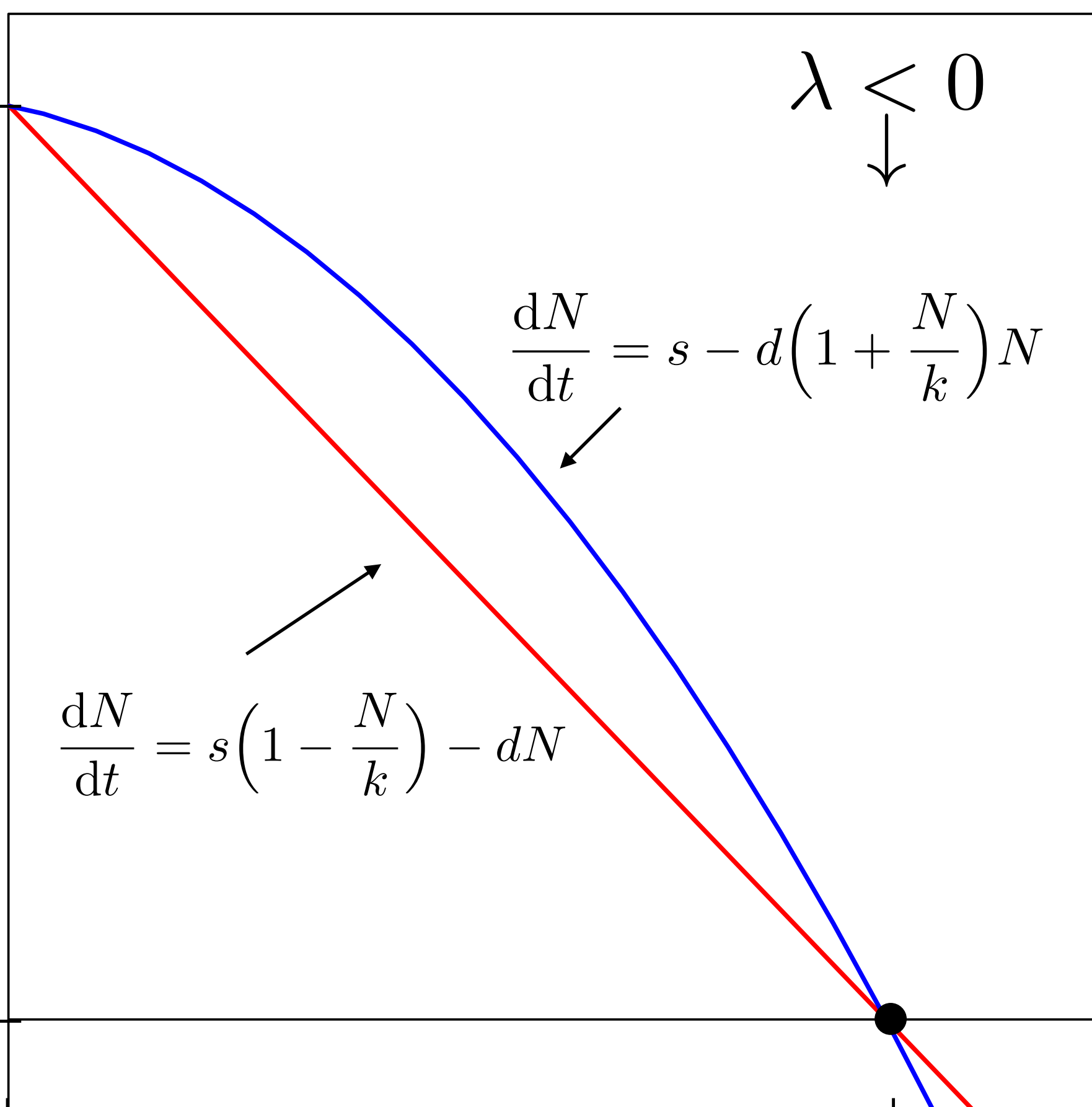
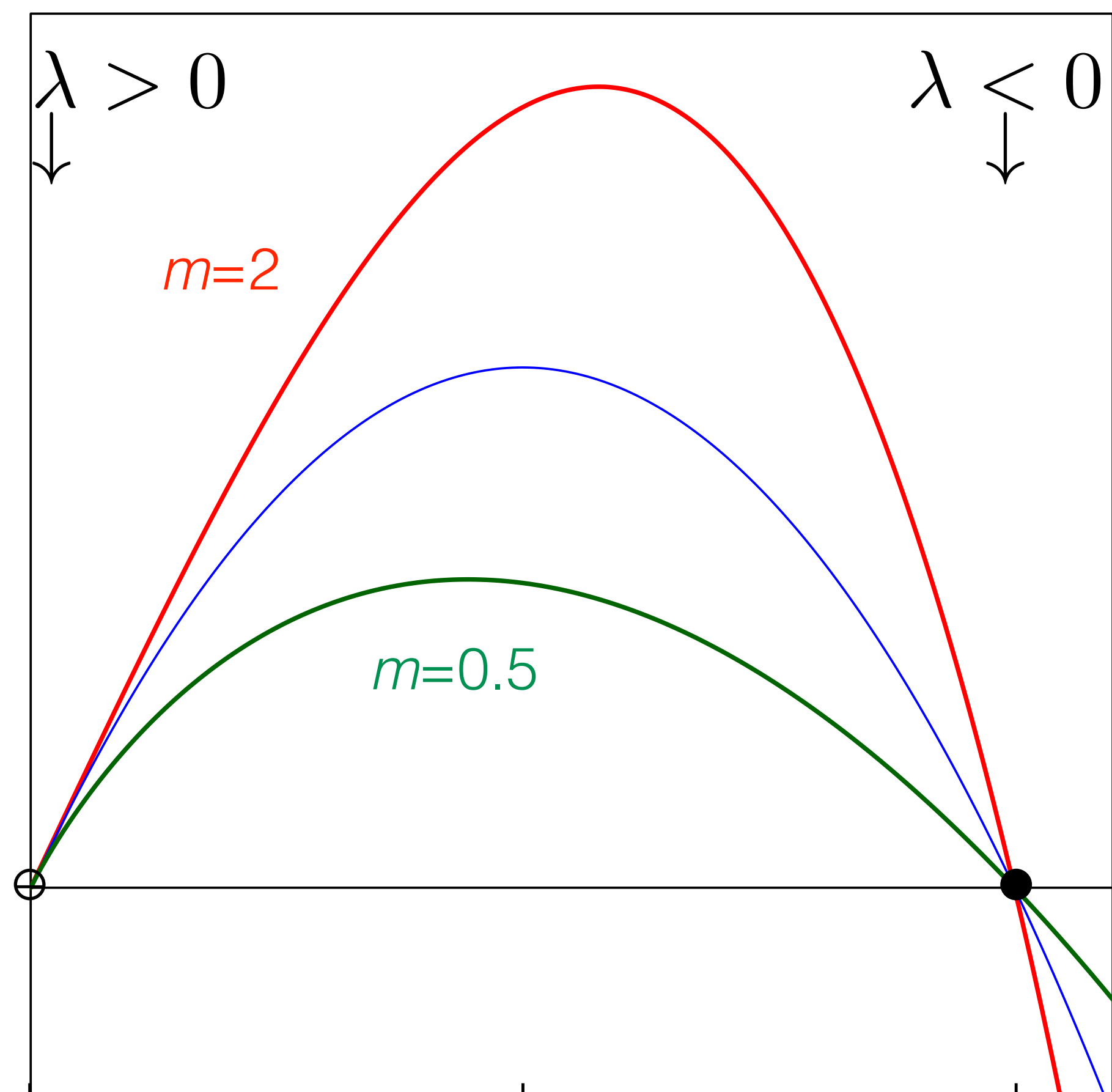


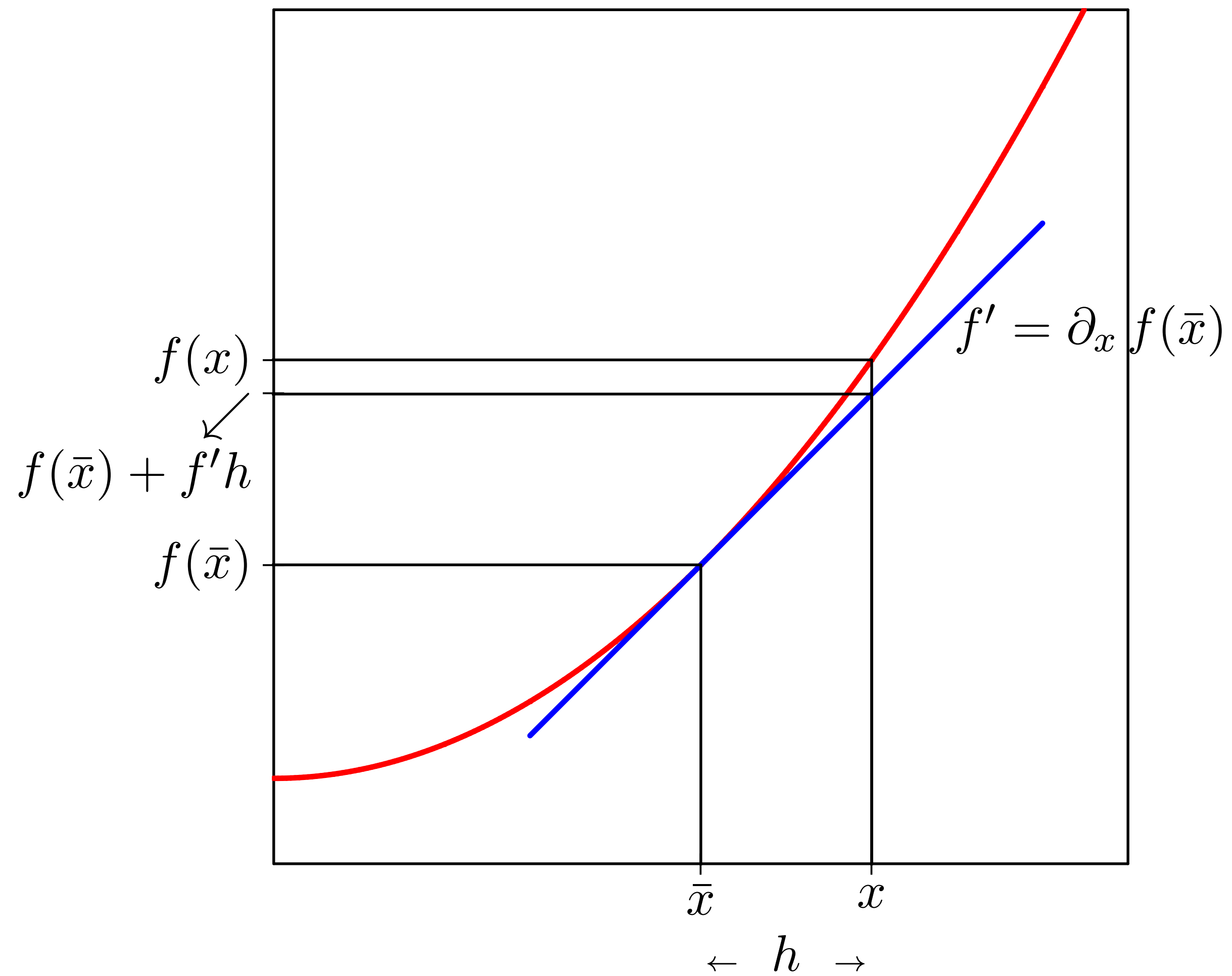
Chapter 4: Stability and return time

Per capita birth or death rate



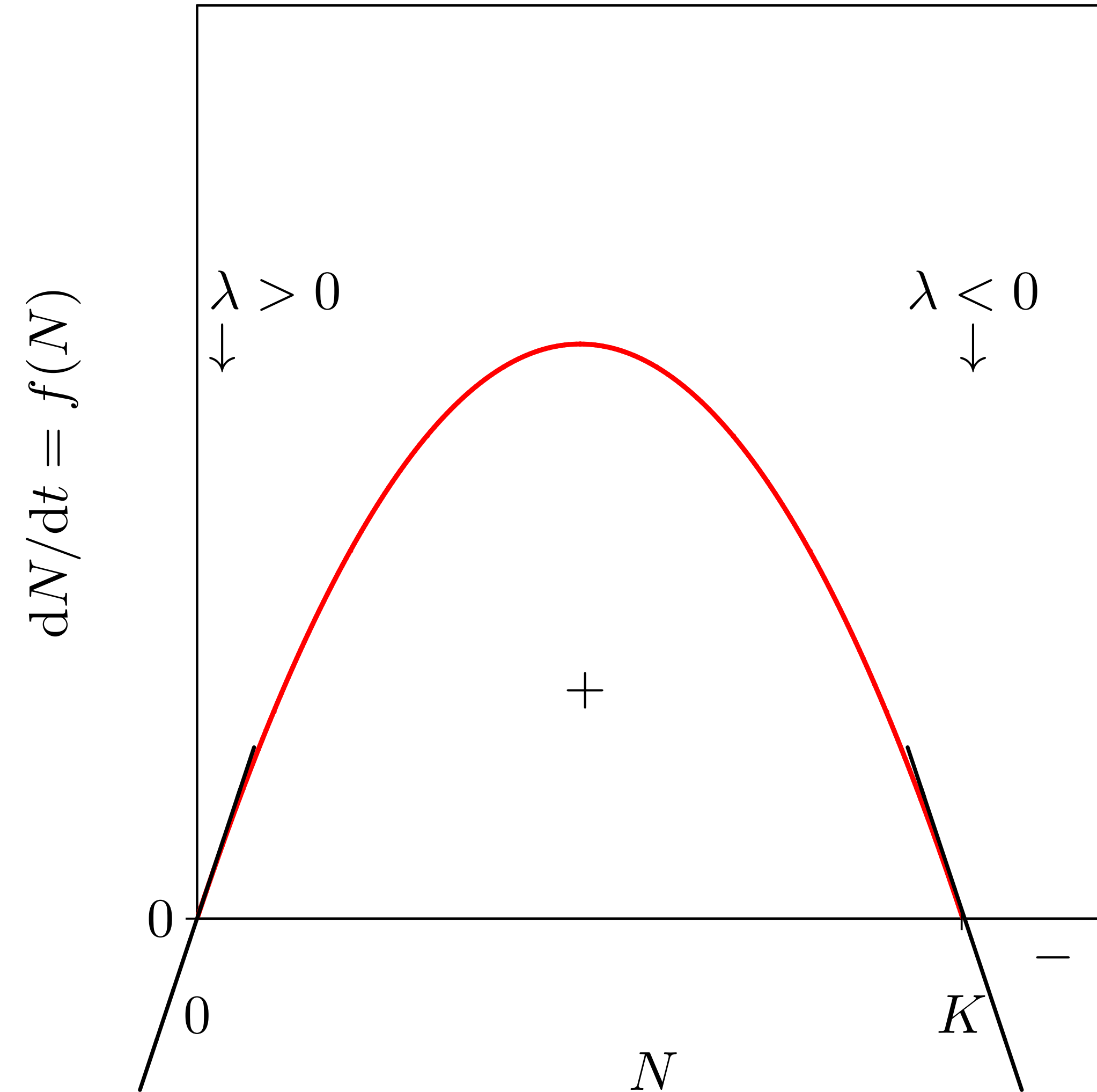


Linearization



$$f(x) \simeq f(\bar{x}) + \partial_x f(\bar{x}) (x - \bar{x})$$

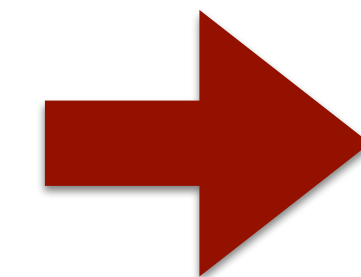
Stability and Return time



$$h(t) = h(0)e^{\lambda t}$$

$$\frac{dN}{dt} = f(N) \simeq f(\bar{N}) + \partial_N f(\bar{N}) (N - \bar{N}) = 0 + \lambda h ,$$

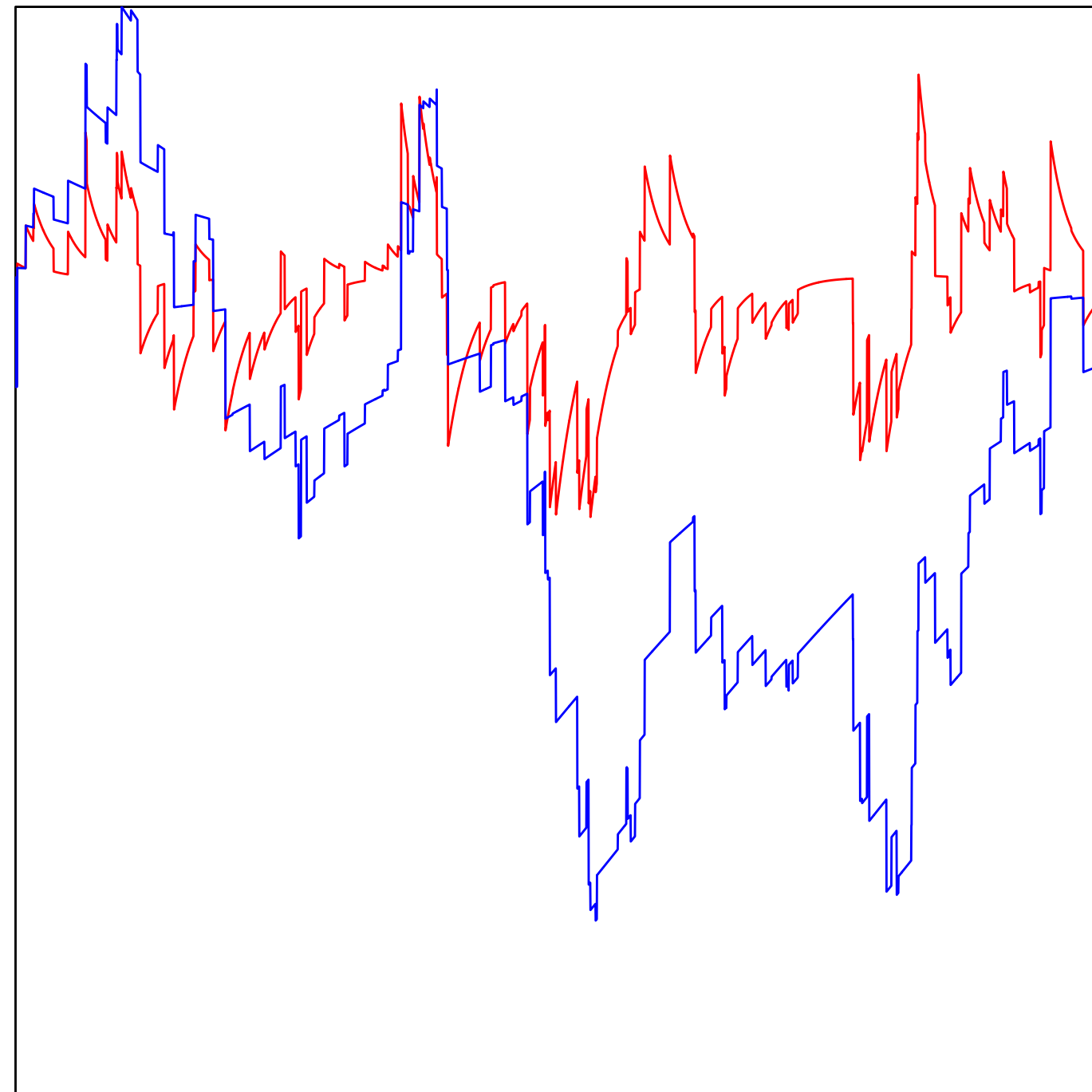
$$\frac{dN}{dt} = \frac{dN}{dt} - \frac{d\bar{N}}{dt} = \frac{d(N - \bar{N})}{dt} = \frac{dh}{dt} ,$$



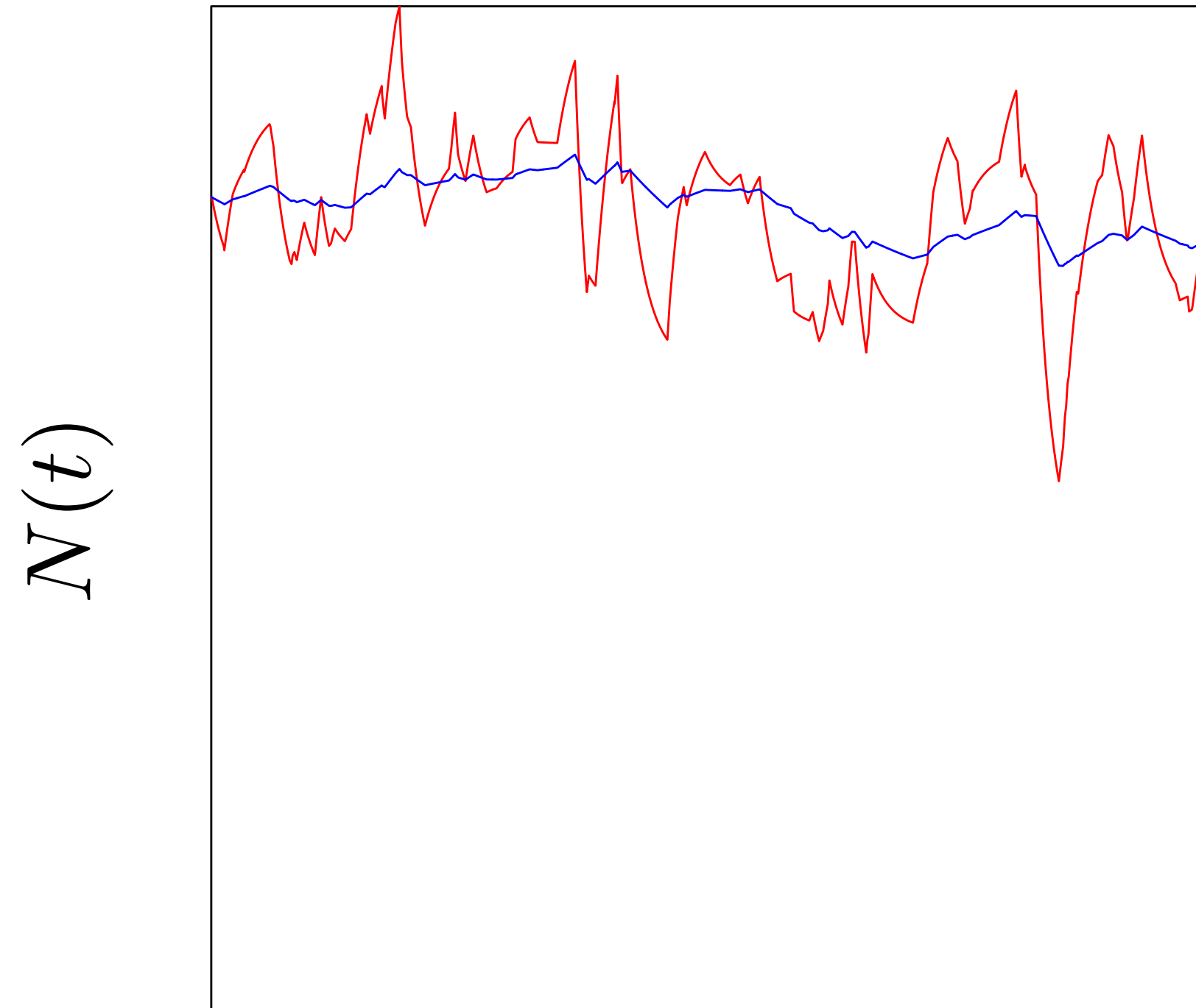
$$\frac{dh}{dt} = \lambda h$$

Return time $T_R = -\frac{1}{\lambda}$

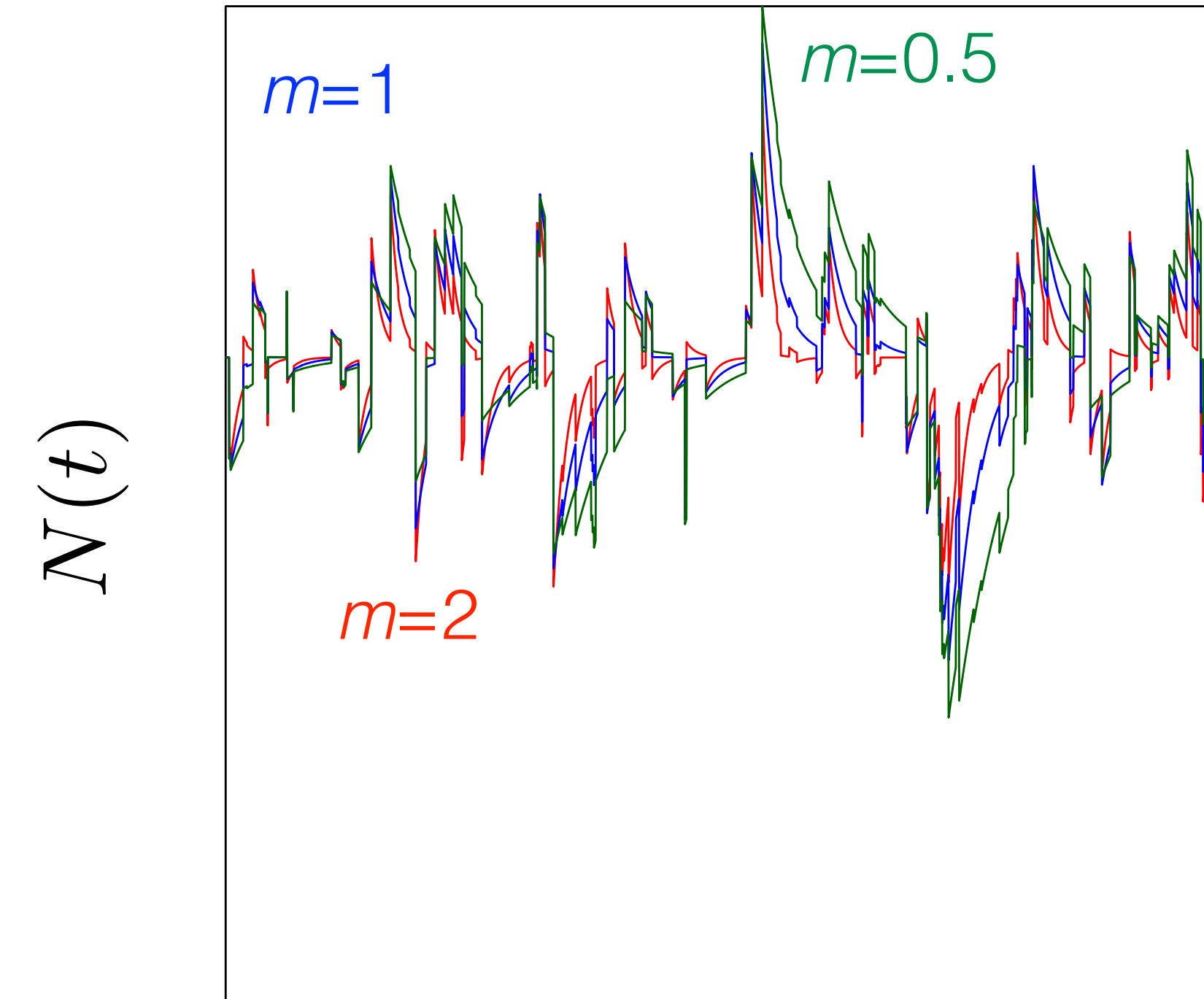
(a)



(b)



(c)



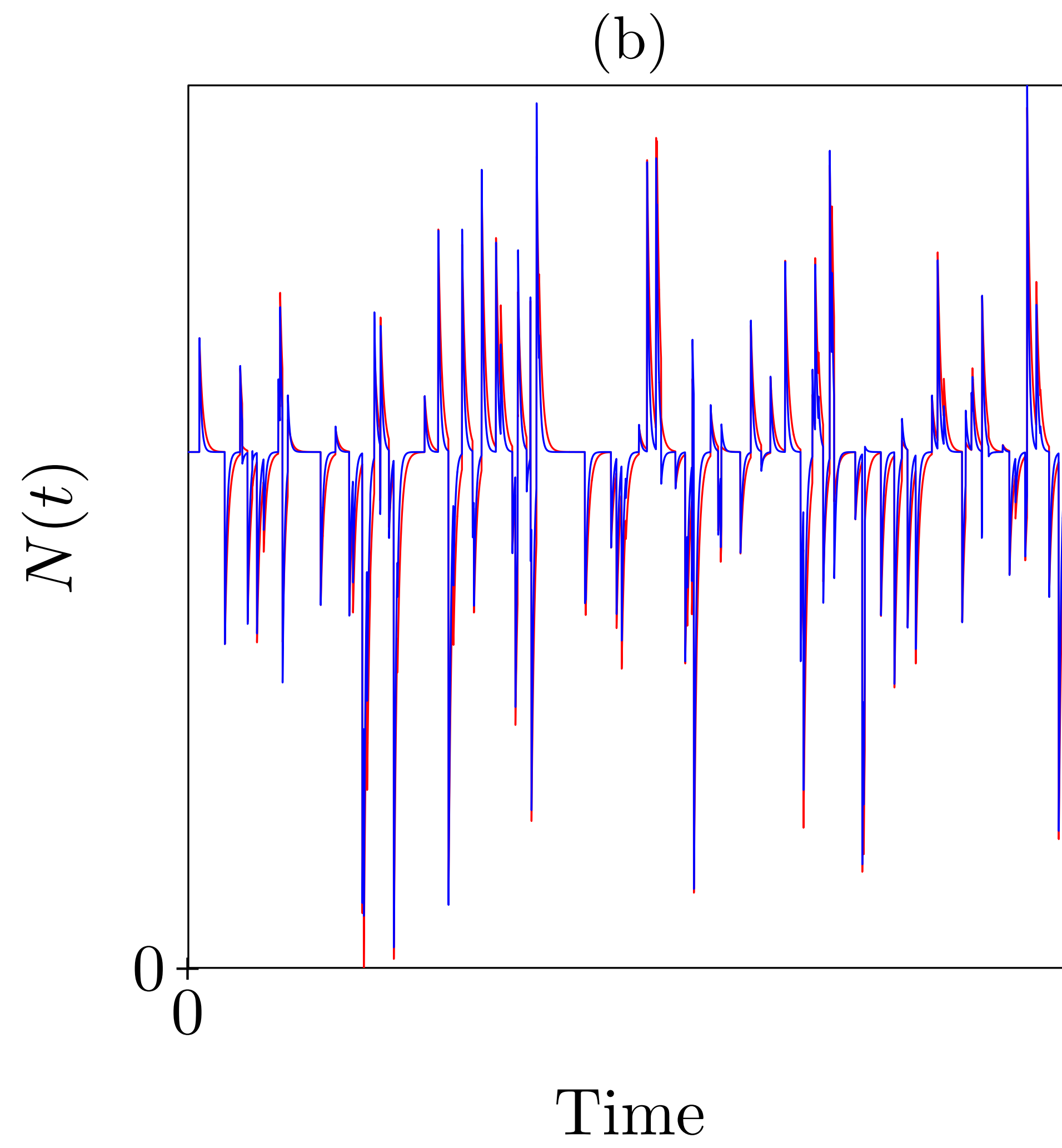
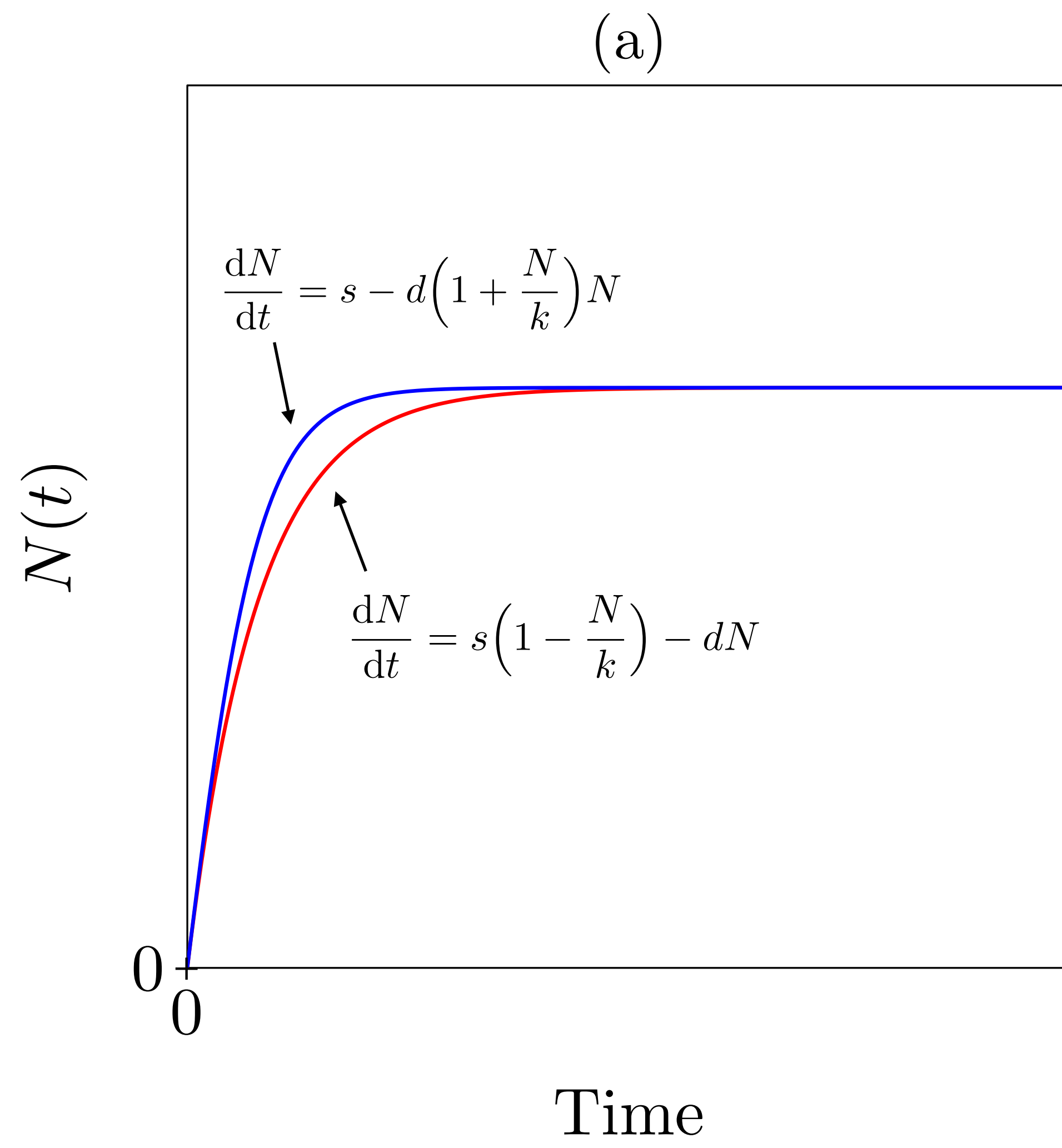
Time

$$\frac{dN}{dt} = rN(1 - N/K)$$

Time

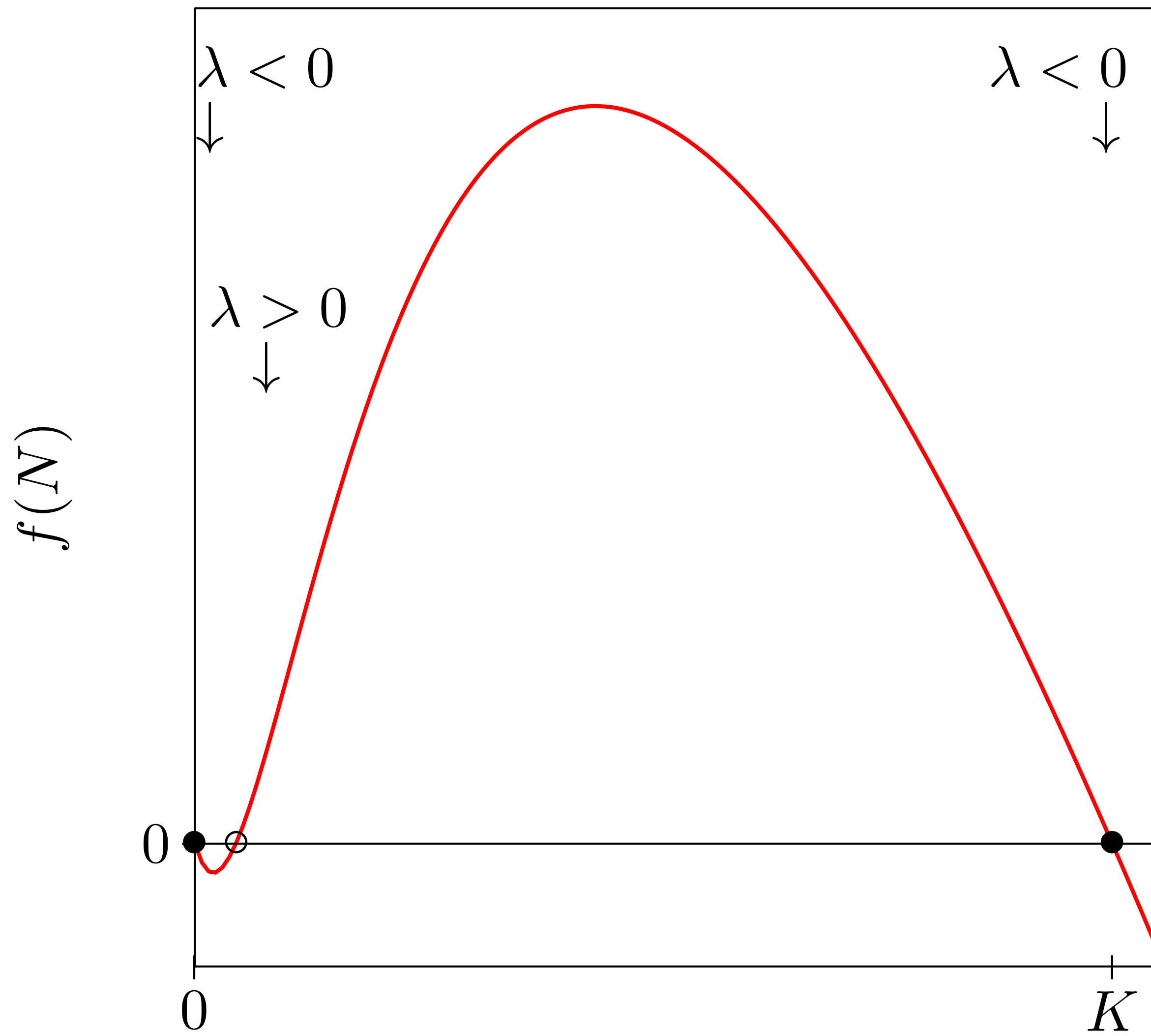
$$\frac{dN}{dt} = rN(1 - [N/K]^m)$$

Time



Basins of attraction

(a)



(b)

