Glenn

1. Sample "universe" to get all $\bar{\lambda}$ and σ^2_λ

2. Simulate 200 yr trajectory
Diffusion model of random λ's with that fixed $\bar{\lambda}$ and σ^2_λ for trajectory

3. Do retrospective on 1st 25 yr with observation error imposed.

Density Dependence Option

Ricker

$$N_{t+1} = N_t e^{\alpha - \beta N_t}$$

Small N_t: $N_{t+1} = N_t e^{\alpha}$

When N_t: $N_t = \frac{\alpha}{\beta}$

$N_{t+1} = N_t$

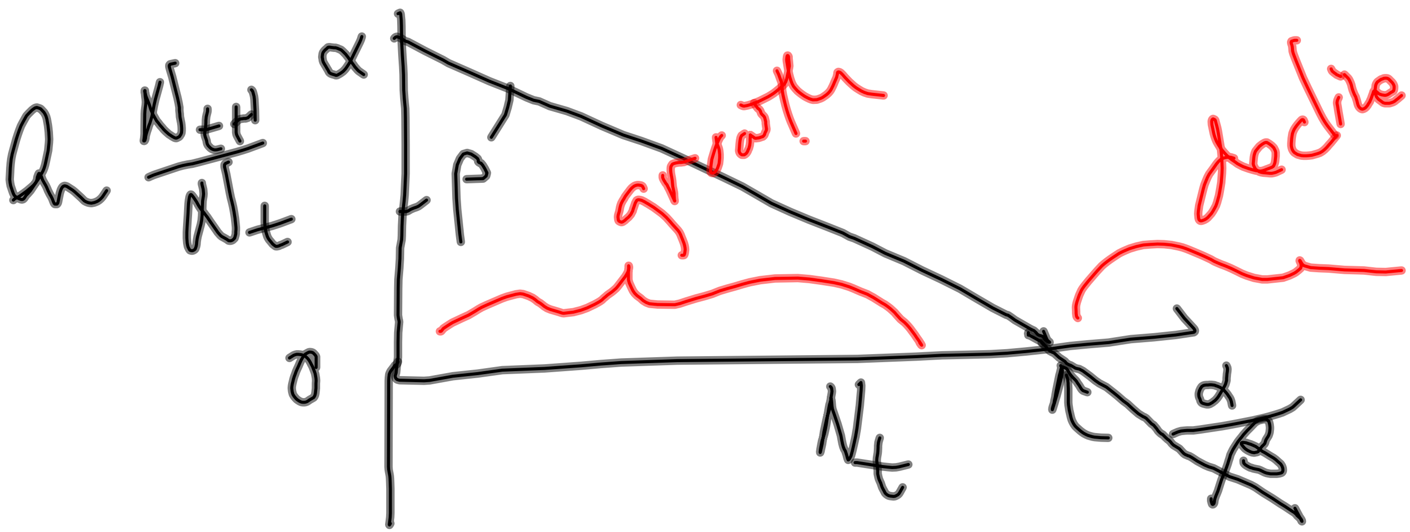
When $N_t > \frac{\alpha}{\beta}$:

$N_{t+1} < N_t$

$$\ln N_{t+1} = \ln N_t + \alpha - \beta N_t$$

$$\ln N_{t+1} - \ln N_t = \alpha - \beta N_t$$

$$\ln \frac{N_{t+1}}{N_t} = \alpha - \beta N_t$$

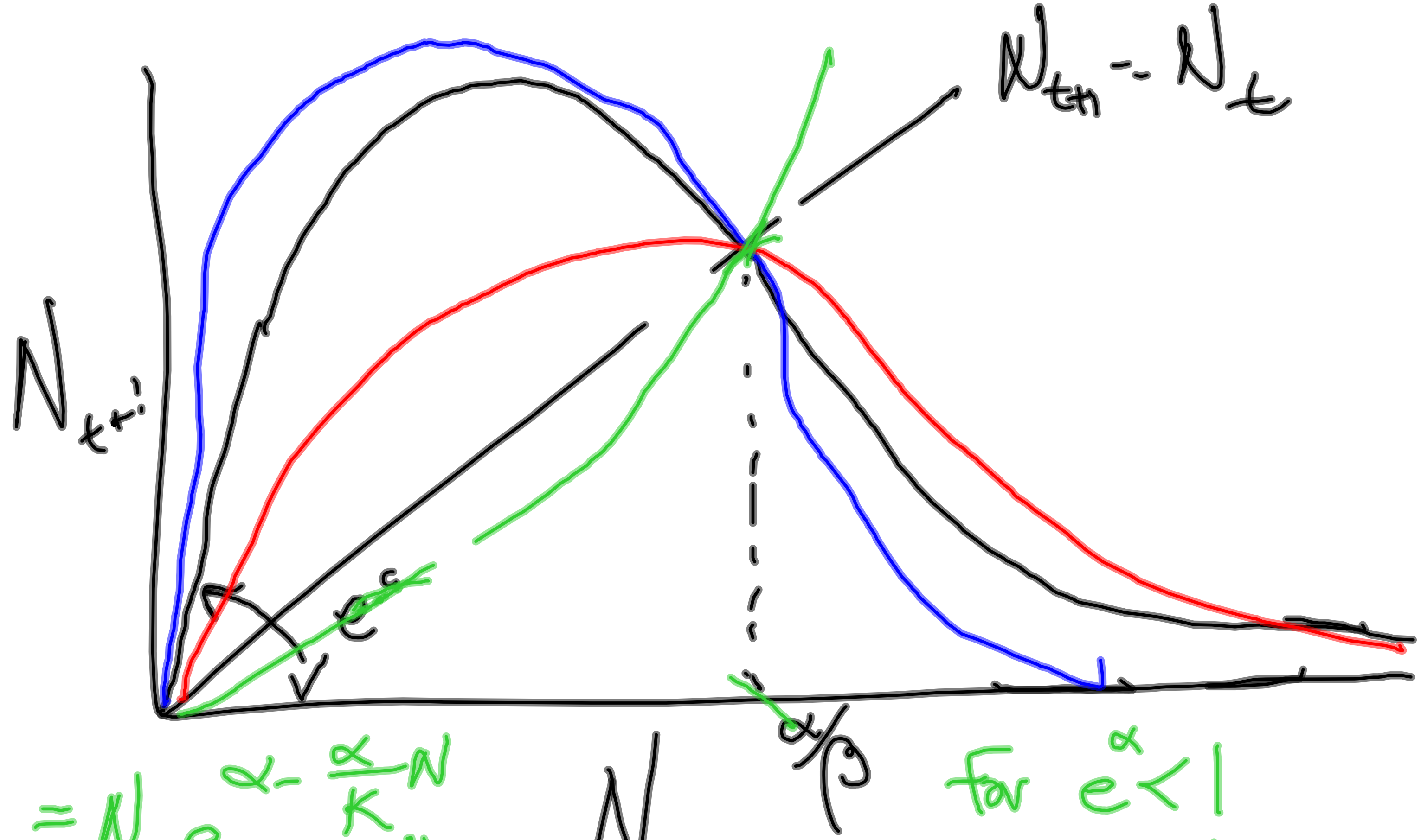


Each population has its own $\bar{\alpha}$ and σ^2_α and K

which is time constant.

At each time step sample $\alpha_t \sim \text{lognormal}(\bar{\alpha}, \sigma^2_\alpha)$

and $\beta_t = \frac{\alpha_t}{K}$



$$N_{t+1} = N_t e^{\alpha - \frac{\alpha}{K} N} = N_t e^{\alpha\left(1 - \frac{N}{K}\right)}$$

for $e^{\alpha} < 1$

$$K = \frac{\alpha}{\beta}$$

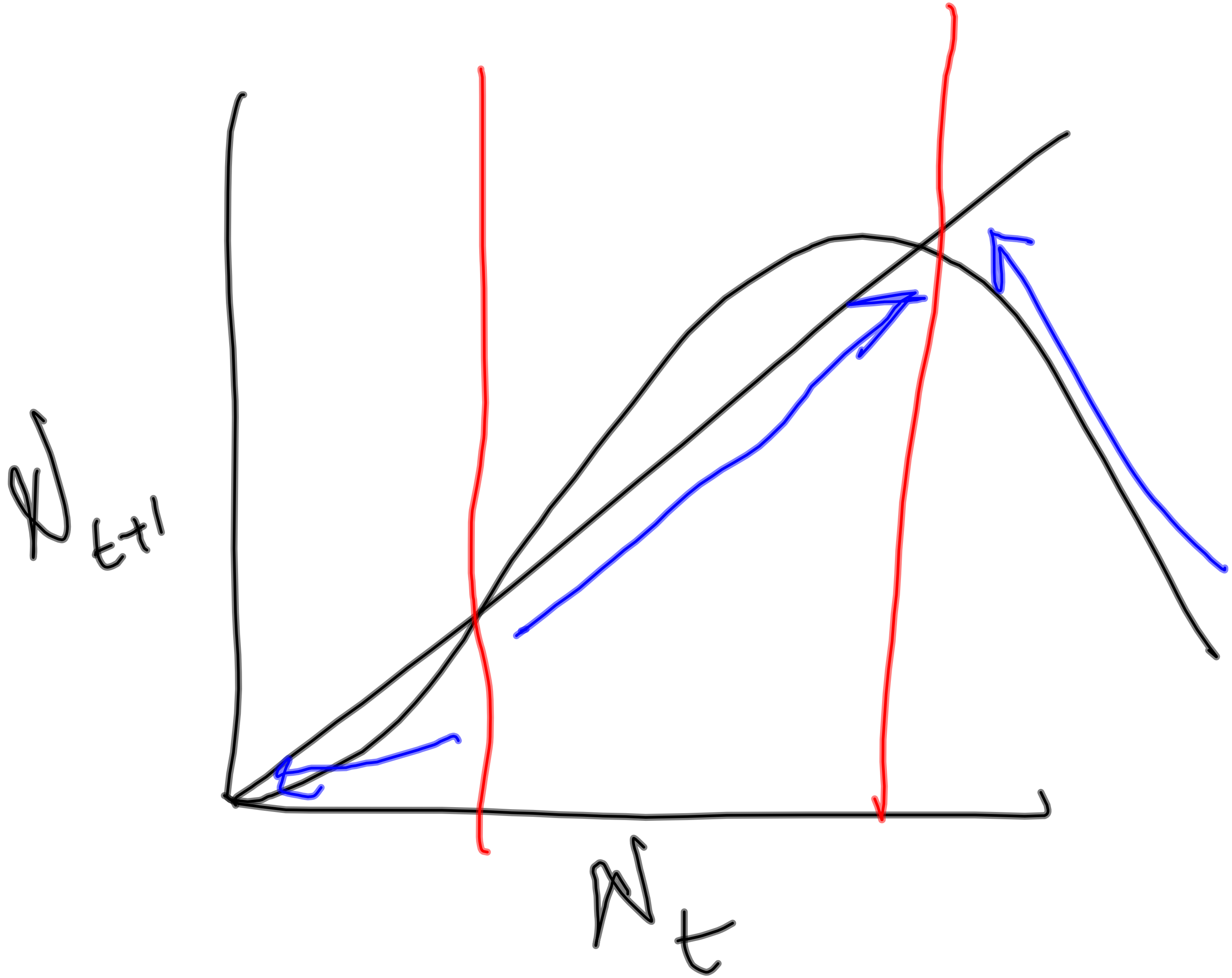
$$\beta = \frac{\alpha}{K}$$

$$N_{t+1} = N_t e^{\alpha - \beta N_t}$$

Actually sample λ
From log normal

calculating $\alpha = \ln \lambda$
allowing $\alpha < 0$

allowing $\beta < 0$



N_{t+1}
N_t