Malthusian law:

\[ \dot{x} = k x \quad \text{hence} \quad x(t) = C e^{kt} \]

with \( C = x(0) \)

\( t \): time in years, beginning in 1980 with \( t = 0 \)

We get \( k \) from the measurement in 1987 (\( t = 7 \))

\[ \frac{x(7)}{3000} = \frac{x(0)}{1000} e^{7k} \quad \Rightarrow \quad 7k = \ln 3 \]

In 2004, we have \( t = 24 \)

\[ x(24) = 1000 \cdot e^{24k} = 1000 \cdot \left( \frac{e^{7k} e^{17k}}{3} \right)^{24/7} = 1000 \cdot 3^{24/7} \approx 43200 \]

(a higher precision would probably be unrealistic, when we try to count fish; maybe this precision is already overdone)

Analogous to \#9:

\[ 300 e^{10k} = 1500 \quad \Rightarrow \quad k = \frac{1}{10} \ln 5 \]

In 2004, we have \( t = 34 \)

\[ 300 e^{24k} = 300 \cdot e^{2.4 \ln 5} = 300 \cdot 5^{2.4} \approx 24000 \]

\[ x(0) = 7 \quad \text{(in units of 10^6 tons)} \]

\[ \dot{x} = 2x - 15 \]

\[ x(t) = \frac{15}{2} - \frac{1}{2} e^{2t} \]

If \( t_0 = \frac{1}{2} \ln 15 \), \( x(t_0) = 0 \), that is, the population has vanished after \( \frac{1}{2} \ln 15 \approx 1.35 \) years

If we want \( \dot{x} = 2x - R \), \( R \) unknown fishing rate such that \( x(t) \equiv 7 \) is a sol'n, we need (plug sol'n into eqn, then solve for \( R \))

\[ R = 14 \]