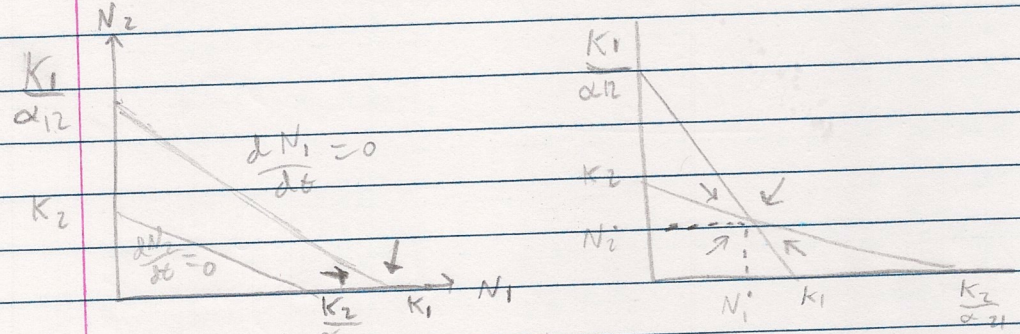
7.1 $\frac{dN_1}{dt} = r_1 N_1 (1 - a_{11} N_1 - a_{12} N_2) - m N_i$

$\frac{dN_2}{dt} = r_2 N_2 (1 - a_{22} N_2 - a_{21} N_1) - m N_i$




species 1 wins

coexistance

7.2 a) $0 = m_1 P_1 (1 - P) - e P$

$e P = m_1 P_1 (1 - P_1)$

$\frac{e P_1}{m_1 P_1} = 1 - P \rightarrow \frac{e}{m_1} - 1 = -P \Rightarrow \boxed{P_1 = 1 - \frac{e_1}{m_1}}$

In order to have positive equilibrium, extinction rate must be low while colonization rate must be high.

b) $0 = m_2 P_2 (1 - P_1 - P_2) m_1 P_1 P_2 - e P_2$

$0 = m_2 P_2 - m_2 P_2 P_1 - m_2 P_2^2 - m_1 P_1 P_2 - e P_2$

$0 = m_2 P_2 - m_2 P_2 (1 - \frac{e_1}{m_1}) - m_2 P_2^2 - (1 - \frac{e_1}{m_1}) m_1 P_2 - e P_2$

$0 = P_2 (m_2 - m_2 (1 - \frac{e_1}{m_1}) - m_2 P_2 - (1 - \frac{e}{m}) m_1 P_2 - e P_2$

$0 = P_2 (m_2 - m_2 + \frac{e m_2}{m_1} - m_2 P_2 - m_1 + e_1 - e_1$

$\frac{0}{P_2} = P_2 (\frac{e m_2}{m_1} - m_2 P_2 - m_1)$

$0 = \frac{e m_2}{m_1} - m_2 P_2 - m_1$

$m_2 P_2 = \frac{e m_2}{m_1} - m_1$

$\boxed{P_2 = \frac{e}{m_1} - \frac{m_1}{m_2}}$

Both colonization rates would have to nearly the same, but also larger than the extinction rate.