Expected frequency of altruists in the population

$$\mathbb{E}[\bar{X}] = \nu + \delta \ \nu(1-\nu) \ \frac{1-\mu}{\mu} \ (1-Q_{\text{out}}) \ \times$$

$$\Bigg(-c - (b-c)\left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d-1)}\right)$$

$$+ \ \frac{Q_{\text{in}} - Q_{\text{out}}}{1-Q_{\text{out}}} \left[\ b - (b-c)\,(n-1) \left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d-1)}\right) \ \right] \Bigg)$$

Expected frequency of altruists in the population

Mutation-drift equilibrium

$$\mathbb{E}[\bar{X}] = \nu + \delta \; \nu(1-\nu) \; \frac{1-\mu}{\mu} \; (1 - Q_{\text{out}}) \; \times$$

$$\Bigg(-c \; - (b-c) \left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d - 1)} \right)$$

$$+ \; \frac{Q_{\text{in}} - Q_{\text{out}}}{1 - Q_{\text{out}}} \left[\; b \; - (b-c)\,(n-1) \left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d - 1)} \right) \right] \Bigg)$$

Expected frequency of altruists in the population

Mutation-drift equilibrium

Selection strength

$$\mathbb{E}[\bar{X}] = \nu + \delta\, \nu(1-\nu)\, \frac{1-\mu}{\mu}\, (1-Q_{\text{out}}) \times$$
$$\left(-c - (b-c)\left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d-1)}\right)\right.$$
$$\left. + \frac{Q_{\text{in}} - Q_{\text{out}}}{1-Q_{\text{out}}} \left[b - (b-c)\,(n-1)\left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d-1)}\right) \right] \right)$$

Expected frequency of altruists in the population

Mutation-drift equilibrium

Selection strength

~~Population variance~~
Variance in the state of one site

$$
\mathbb{E}[\bar{X}] = \nu + \delta\, \nu(1-\nu)\, \frac{1-\mu}{\mu}\, (1 - Q_{\text{out}}) \times
$$

$$
\Bigg(-c - (b-c)\left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d - 1)}\right)
$$

$$
+ \frac{Q_{\text{in}} - Q_{\text{out}}}{1 - Q_{\text{out}}} \left[b - (b-c)\,(n-1) \left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d - 1)}\right) \right] \Bigg)
$$

Expected frequency of altruists in the population

Mutation-drift equilibrium

Selection strength

~~Population variance~~
Variance in the state of one site

$$\mathbb{E}[\bar{X}] = \nu + \delta\, \nu(1-\nu)\, \frac{1-\mu}{\mu}\, (1 - Q_{\mathrm{out}}) \times$$

$$\Bigg(-c - (b-c)\left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d - 1)}\right) - \mathcal{C}$$

$$+ \frac{Q_{\mathrm{in}} - Q_{\mathrm{out}}}{1 - Q_{\mathrm{out}}} \left[b - (b-c)\,(n-1) \left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d - 1)}\right) \right] \Bigg)$$

Expected frequency of altruists in the population

Mutation-drift equilibrium

Selection strength

~~Population variance~~

Variance in the state of one site

$$\mathbb{E}[\bar{X}] = \nu + \delta\, \nu(1-\nu)\, \frac{1-\mu}{\mu}\, (1-Q_{\text{out}}) \times$$

$$\left(\underbrace{-c \,-(b-c)\left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d-1)}\right)}_{-\mathcal{C}} \right.$$

$$\left. + \frac{Q_{\text{in}} - Q_{\text{out}}}{1-Q_{\text{out}}} \left[\underbrace{b \,-(b-c)\,(n-1)\left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d-1)}\right)}_{\mathcal{B}} \right] \right)$$

Expected frequency of altruists in the population

Mutation-drift equilibrium

Selection strength

~~Population variance~~
Variance in the state of one site

$$\mathbb{E}[\bar{X}] = \nu + \delta\, \nu(1-\nu)\, \frac{1-\mu}{\mu}\, (1 - Q_{\mathrm{out}}) \times$$

$$\left(-c - (b-c)\left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d - 1)}\right) \; -\mathcal{C} \right.$$

$$\left. + \underbrace{\frac{Q_{\mathrm{in}} - Q_{\mathrm{out}}}{1 - Q_{\mathrm{out}}}}_{R} \left[\underbrace{b - (b-c)\,(n-1)\left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d - 1)}\right)}_{\mathcal{B}} \right] \right)$$

Expected frequency of altruists in the population

Mutation-drift equilibrium

Selection strength

~~Population variance~~
Variance in the state of one site

$$\mathbb{E}[\bar{X}] = \nu + \delta \, \nu(1-\nu) \, \frac{1-\mu}{\mu} \, (1 - Q_{\text{out}}) \times$$

$$\left(\underbrace{-c - (b-c)\left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d-1)}\right)}_{-\mathcal{C}} + \underbrace{\frac{Q_{\text{in}} - Q_{\text{out}}}{1 - Q_{\text{out}}}}_{R} \left[\underbrace{b - (b-c)\,(n-1)\left(\frac{(1-m)^2}{n} + \frac{m^2}{n\,(N_d-1)}\right)}_{\mathcal{B}} \right] \right)$$