

$$\frac{dx}{dt} = x(f - \phi) \quad x \in \mathbb{R}^2$$

- everyone is first type
- second type
- a mixed population: no difference between fitness



mutated population

$$x = (x_1, x_2) \quad \epsilon > 0 \quad y = (y_1, y_2)$$

$$x_\epsilon = (x_1 + \epsilon(y_1 - x_1), x_2 + \epsilon(y_2 - x_2))$$

E.S.S.

$x$  is ESS iff  $\bar{\epsilon} > 0$

$$u(x, x_\epsilon) > u(y, x_\epsilon) \quad \forall 0 < \epsilon < \bar{\epsilon}, y$$

$$u(x, y) = x A y^T$$

$$A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

$$(u(x, x_\epsilon) > u(y, x_\epsilon))$$

$$x = (1, 0) \quad x_\epsilon = (1 - \epsilon, \epsilon)$$

$$a(1 - \epsilon) + b\epsilon > c(1 - \epsilon) + d\epsilon$$

$\epsilon$  is small:

$$a > c$$

if  $a = c$

$$b > d$$

The first strategy is ESS

$$a > c$$

$$a = c \quad b > d$$