# ESS and NE

Dr. Vimal Kumar, Assistant Professor of Economics
Indian Institute of Technology Kanpur, vimalk@gmail.com

# Relationship with Nash equilibria

- Nash in the symmetric game

| | S | T |
|---|---|---|
| S | a,a | b,c |
| T | c,b | d,d |

1) In this symmetric game, (S,S) is NE if and only if $a \geq c$

2) $x$ $\quad ax(1-x) + bx > cx(1-x) + dxx$ $\quad x$

$a > c$ -① or $a = c$ & $b > d$

# Relationship with Nash equilibria

(1)

- If strategy S is evolutionary stable, then (S,S) is a Nash equilibrium. Is the converse true?

$a > c$ or $a = c$ & $b > d$

If S is evolutionary stable strategy

$\Rightarrow$ $a \geq c$

(S,S) is a NE.

$6 > 5 \Rightarrow 6 \geq 5$

$5 = 5 \Rightarrow 5 \geq 5$

(2) If (S,S) is a NE then S is ESS $\not\Rightarrow$

$\Downarrow$

$a \geq c$

$a > c$ or $a = c$ & $b > d$

& $a = c$ & $b < d$

| | S | T |
|---|---|---|
| S | 10,10 | 5,10 |
| T | 10,5 | 6,6 |

$\Rightarrow$ (S,S) is a NE

$\Rightarrow a = c$ & $d > b$

# 1:1 Sex Ratio as ESS

- Suppose female births are less common than male.
- A newborn female then has better mating prospects than a newborn male, and therefore can expect to have more offspring.
- Therefore parents genetically disposed to produce females tend to have more than average numbers of grandchildren born to them.
- Therefore the genes for female-producing tendencies spread, and female births become commoner.
- As the 1:1 sex ratio is approached, the advantage associated with producing females dies away.
- The same reasoning holds if males are substituted for females throughout. Therefore 1:1 is the equilibrium ratio.

# Hawk and Dove Game

| | Hawk | Dove |
|---|---|---|
| Hawk | -2,-2 | 6,0 |
| Dove | 0,6 | 3,3 |

- Evolutionary Stable Strategy
- Mixed Strategy