

LECTURE #18

EVOLUTIONARY GAME THEORY.

Individuals (no explicit epistemological
(Players). rationality or CKR).

NO { overt reasoning
or explicit decision
making

Replicator Dynamics:

◦ Individuals exhibit different forms of behavior

◦ Some forms of behavior have the ability to persist.

(while other forms tend to be driven out).

ESS = Evolutionarily Stable Strategies

(98)

Population - n Individuals

Interaction - pair-wise
(pan-mictic)

→ Success depends on fitness.

Forms }
Behaviors } Strategies

Fitness } Payoffs.

Body Size Game

		Beetle 2	
		Small	Large
Beetle 1	Small	5,5	1,8
	Large	8,1	3,3

Large Body \Rightarrow Cost of maintaining metabolic requirements

Interaction \Rightarrow Competition
with each other
for food sources.

(99)

Large size dominates

ESS \rightarrow Large, Large (Similar to
Nash Equilibria).

A beetle's overall fitness

= Average fitness it experiences
from each of its several
pairwise interaction



A strategy is Evolutionarily Stable if
when the whole population using
this strategy, any small group of
INVADERS / MUTANTS using a
different strategy die off
(over multiple generations).

Strategy T invades S at level ϵ ,
 $\epsilon \geq 0$, small positive number.

$1-\epsilon$ fraction uses S

ϵ " uses T.

Beetle Body Size Game

Small = $1-\epsilon$ / Large = ϵ

Small Beetle \rightarrow Pay-off

$$5(1-\epsilon) + 1\epsilon \\ = 5 - 4\epsilon$$

Large Beetle \rightarrow Pay-off

$$8(1-\epsilon) + 3\epsilon \\ = 8 - 5\epsilon$$

100

Small \neq ESS.

$$\text{Large}(1-\epsilon) / \text{Small} = \epsilon$$

Small Beetle \neq

$$\rightarrow \text{Pay-off} = \frac{(1-\epsilon) + 5\epsilon}{8\epsilon + 3} = 1 + 4\epsilon$$

Large Beetle

$$\rightarrow \text{Pay-off} = 3(1-\epsilon) + 8\epsilon = 3 + 5\epsilon$$

Large = ESS

