

A Hawk-Dove Game

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A motivating example: Hawk-Dove Game

- Consider the symmetric Hawk-Dove game.
 - Players: Two indistinguishable individuals
 - Strategies: They both must decide whether to share a resource or demand the resource for themselves.
 - Payoffs: If only one individual demands the resource [play Hawk], then he/she obtains that resource (of value V).
 - If both demand the resource, they fight. Each wins with probability 0.5 (thus obtaining the resource). The loser pays a cost of D (due to injuries incurred). It is assumed that $D > V$.

Hawk-Dove Model: Costs and Benefits of Fighting over Resources

Payoff* to...	...in fights against:	
	hawk 	dove 
hawk 	Hawk wins 50% of fights; is injured in 50% of fights.  Payoff: $(V-D)/2$	Hawk always wins; dove flees.  Payoff: V
dove 	Dove never wins; is never injured.  Payoff: 0	Dove wins 50% of fights; is never injured; wastes time.  Payoff: $V/2-T$

* V = fitness value of winning resources in fight

D = fitness costs of injury

T = fitness costs of wasting time

- Generalized Payoff Matrix with (T=0)

	Hawk	Dove
Hawk	$(V-D)/2, (V-D)/2$	$V, 0$
Dove	$0, V$	$V/2, V/2$

- Let us take $D=10, V=6$

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

Nash Equilibrium

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

Reinterpretation

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

- Animal World
- The Hawk-Dove game explains why aggression is present within population of an animal, but is not always seen.
- Let us say that in a population fraction p are of hawk type and $1-p$ are of dove type.
- On average, in an interaction, a hawk type makes=
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Graph

- For Hawk type: $6-8p$
- For Dove type: $3(1-p)$