Chapter 12.
The Prisoner's Dilemma

- Other Dilemmas
- Repeated Games
- Metagames

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Generic Games

- Guyer and Rappoport cataloged all the simple games
- Generic games
  - occur when actors have the same strategies and pay-offs
  - have two strategies and two players
  - have symmetric pay-offs
- Only sixteen generic games are possible
- Four of these present particular problems . . .

The Prisoner's Dilemma

- A demonstration of the difference between equilibrium and optimality (Dresher and Flood, RAND, 1950)
- Two prisoners, convicted of crime
- What happens if they are given the chance to testify against the other?
- Originally told by Tucker.

Stag Hunt Dilemma

- In the stag hunt, two players can cooperate to hunt a stag
- Or, they can defect to hunt a rabbit by themselves
- If anyone defects the stag gets away!
- Another example -- weekend football league

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Chicken Dilemma

- In the prototypical chicken dilemma two rebellious teens race towards each other in the car
- If one flinches and turns away the other wins
- If neither turns away a bad crash happens and both loose

Deadlock Dilemma

- In the Deadlock dilemma two parties pretend to negotiate
- In reality, neither party wants a solution . . .
- They only want to appear to be compromising

Picture by Sharon Farmer, released in public domain (USGOV)

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Repeated Games

- Can we restore cooperation through repeated interaction?
- An important class of games, only touched upon in your text
- These games are usually based on infinite series, and some discounting of future prospects
- Discounting could happen because of an expectation of breakdown in cooperation (p), or because we discount our future payoffs (δ)

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Infinite Series

Let $X = 1 + \delta + \delta^2 + \ldots$

Note that

$$(1 + \delta + \delta^2 + \ldots) = 1 + \delta\,(1 + \delta + \delta^2 + \ldots)$$

So we can substitute

$$X = 1 + \delta \quad X$$

Rearranging

$$X\,(1 - \delta) = 1$$

Therefore

$$X = 1/\,(1 - \delta)$$

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More Infinite Series

Recognize that $Y = \delta^m + \delta^{m+1} + \delta^{m+2} + \ldots$

is equivalent to

$$Y = \delta^m (1 + \delta + \delta^2 + \ldots)$$

So substituting

$$(1 + \delta + \delta^2 + \ldots) = 1/(1 - \delta)$$

Therefore

$$Y = \delta^m / (1 - \delta)$$

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Grim Trigger

- Calculate the benefits of a defection at time m
- Assume that the other player now retaliates indefinitely.

$\Psi_{defect} =$ (cooperation to m)+(one round of temptation payoff)
+(defection payoff for m+2 onwards)

- Suppose that defection occurs if the discounted value of continued cooperation falls below the value of a single defection

Network Structure Matters

- Wilhite (2005, see below) shows that cooperation is better sustained in certain network structures

Increasing incentive to defect →

	$1 < c < 4/3$	$4/3 < c < 3/2$	$3/2 < c < 2$	$2 < c < 3$
Ring	3-cycle: 87% cooperators	3-cycle: 85% cooperators	stable: 52% cooperators	all defectors
Tree	stable: 73% cooperators	some 2-cycles: 20% cooperators	2-cycles: 42% cooperators	some 2 cycles: 12% cooperators
Grid	stable/2-cycle: 68% cooperators	chaotic: 35% cooperators	long cycle: 22% cooperators	all defectors

Wilhite, A. (2005), "PD Games on Networks," Proceedings of Computational Economics and Finance (CEF), accessed online 19 December at: http://cas.uah.edu/wilhitea/papers/pdgames.pdf

Metagames

- Another “solution” to the prisoner’s dilemma was proposed by Howard (1971).
- Howard advances a set of meta-strategies based on beliefs and expectations
- Others have suggested the ultimate meta-strategy is to “do unto others”
- Howard’s work has now moved into actual mediation and intervention in policy settings
- Other soft operations research techniques will be discussed in a seminar