

Game Theory 1:

The Building Blocks



GAME OF GAINS

The Strategic Mindset

Core Concepts of Strategic Interaction

- **Defining a Game:** In game theory, a "game" is a formal model of any situation where the final outcome depends on the interactive decisions of multiple agents.
- **Interdependence:** A player's payoff (the value, utility, or profit of an outcome) is not determined in a vacuum; it is the direct result of their own actions combined with the actions of every other player.
- **Defining Players:** Players are the independent agents or decision-makers within the game.
- **Assumption of Rationality:** It is assumed that all players are Rational, meaning they possess a consistent set of preferences and will logically select the strategies they believe will maximize their personal utility.

Essential Analytical Assumptions

- **Self-Interest:** Rational players act to achieve the highest possible payoff for themselves, prioritizing their own objectives over the collective or opponent's goals.
- **Perfect Information:** A theoretical state where every player possesses total transparency regarding the game's mechanics.
- **Scope of Knowledge:** Perfect information requires that all participants are fully aware of the rules, the complete list of available strategies, and the exact payoffs associated with every potential combination of moves.

Case Study: The 1914 Christmas Truce

- **The Actors:** Individual battalions on the front lines of WWI served as the independent players.
- **The Strategic Choice:** Each unit faced a daily decision: "Shoot" (Aggressive) or "Not Shoot" (Mutual Restraint).
- **Repeated Play:** While generals viewed the war as a single-shot game, the soldiers realized they were in a Repeated Game with the same opponents.
- **The Shadow of the Future:** Because players knew they would face each other again, the incentive shifted from short-term aggression to long-term survival.
- **Cooperative Equilibrium:** This future-oriented mindset incentivized a "live and let live" system, turning a high-conflict game into one of mutual cooperation.

The Payoff Matrix & Dominance

To analyze simultaneous games—where players move at the same time—we use a Payoff Matrix. This grid maps every possible combination of strategies and their resulting rewards.

Finding the Best Move

- 1. The Underlining Method:** A systematic way to identify "Best Responses." You assume Player A chooses a specific move, then underline Player B's highest payoff in that column. Repeat for all options to see where the interests converge.
- 2. Dominant Strategy:** This is the "Holy Grail" of strategy. A strategy is Dominant if it yields a higher payoff than any other option, regardless of what the opponent does. If you have one, you should always play it.

Case Study: The Cola Wars (Coke vs. Pepsi)

Imagine Coke and Pepsi deciding on advertising budgets. High spending eats into profits, but losing market share is worse.

		Pepsi	
		High	Low
Coke	High	(5,5)	(10,2)
	Low	(2,10)	(8,8)

- **The Logic:** If Pepsi goes High, Coke's best move is High ($5 > 2$). If Pepsi goes Low, Coke's best move is still High ($10 > 8$).
- **The Outcome:** Because "High Ad Spend" is a Dominant Strategy for both, they both spend heavily and earn 5, even though they would both be better off (8, 8) if they both stayed Low. This highlights a "Race to the Bottom."

The Prisoner's Dilemma (PD)

The Cooperation Paradox

- **Definition:** A specific game structure where two rational players may fail to cooperate, even though cooperation would result in a better collective outcome.
- **The Conflict:** Individual rationality (maximizing personal gain) leads to collective irrationality (a worse outcome for the group).

The Payoff Hierarchy

To qualify as a Prisoner's Dilemma, the payoffs must follow this specific order of preference:

1. **Temptation:** You defect while the other cooperates (the best individual outcome).
2. **Reward:** Both players cooperate (the best collective outcome).
3. **Punishment:** Both players defect (the Nash Equilibrium; where players usually end up).
4. **Sucker's Payoff:** You cooperate while the other defects (the worst individual outcome).

Case Study: The 1990s Steroid Era

- **Players:** Professional baseball players.
- **Choices:** "Dope" (Defect) or "Stay Clean" (Cooperate).
- **The Dilemma:**
 - If a player stays clean while others dope, they lose their competitive edge (Sucker's Payoff).
 - If they dope while others stay clean, they become the league leader (Temptation).
- **The Result:** "Doping" became the dominant strategy. Despite the health risks and reputational damage to the sport (punishment), rational individual choices led to a "race to the bottom."