**Definition of game theory :Game theory** is the study of mathematical models of negotiation, conflict and cooperation between individuals, organizations and governments. ... **Game theory** is applied in various areas of study to understand why an individual makes a particular decision and how the decisions made by one individual affect others.

Importance of game theory : **Game theory** attempts to take into consideration the interactions between the participants and their behaviour to study the strategic decision-making between rational individuals. It tries to find out the actions that a “player” should perform which would maximize his chances of success mathematically and logically.

Use of game theory in economics:

Economists use game theory to understand the behavior of firms specifically in regards to [price fixing](https://investinganswers.com/dictionary/p/price-fixing), price wars, [collusion](https://investinganswers.com/dictionary/c/collusion), etc. Game theory gives economists a way to predict outcomes when firms engage in these kinds of behaviour.

A few terms commonly used in the study of game theory:

* **Game**: Any set of circumstances that has a result dependent on the actions of two or more decision-makers (players).

**Features of the game are, i) there should be finite number of player**

**ii) the interest of the player should be conflict iii) each player should know the rules governing the choice of action.**

* **Players**: A strategic decision-maker within the context of the game
* **Strategy**: A complete plan of action a player will take given the set of circumstances that might arise within the game

**Pure strategy**: The pre-determined course of action to be employed by player is known as pure strategy

**Mixed strategy**: In this strategy the player select his course of action in accordance with some probability distribution

* **Payoff**:*T*he payoff is the outcomes of the game due to choosing the different course of action by players. It is the net gain due to the strategy brings to the firm for any given counter strategy.

Examples of Game Theory

There are several "games" that game theory analyzes. Below, we will just briefly describe a few of these.

The Prisoner's Dilemma

The [Prisoner's Dilemma](https://www.investopedia.com/terms/p/prisoners-dilemma.asp) is the most well-known example of game theory. Consider the example of two criminals arrested for a crime. Prosecutors have no hard evidence to convict them. However, to gain a confession, officials remove the prisoners from their solitary cells and question each one in separate chambers. Neither prisoner has the means to communicate with each other. Officials present four deals, often displayed as a 2 x 2 box.

1. If both confess, they will each receive a five-year prison sentence.
2. If Prisoner 1 confesses, but Prisoner 2 does not, Prisoner 1 will get three years and Prisoner 2 will get nine years.
3. If Prisoner 2 confesses, but Prisoner 1 does not, Prisoner 1 will get 10 years, and Prisoner 2 will get two years.
4. If neither confesses, each will serve two years in prison.

The most favorable strategy is to not confess. However, neither is aware of the other's strategy and without certainty that one will not confess, both will likely confess and receive a five-year prison sentence. The Nash equilibrium suggests that in a prisoner's dilemma, both players will make the move that is best for them individually but worse for them collectively.

The expression "[tit for tat](https://www.investopedia.com/terms/t/tit-for-tat.asp)" has been determined to be the optimal strategy for optimizing a prisoner's dilemma. Tit for tat was introduced by Anatol Rapoport, who developed a strategy in which each participant in an iterated prisoner's dilemma follows a course of action consistent with his opponent's previous turn. For example, if provoked, a player subsequently responds with retaliation; if unprovoked, the player cooperates.

## Examples of Game Theory

There are multiple real-life examples for understanding the basic concept of game theory. Let us take up a simple one: Apple and Samsung involved in a ‘game of advertising’. As both firms have a stable market reputation, the advertising costs are a direct drain on the net corporate profits.

If both do not advertise, their profits will remain the same (with many simplistic assumptions, including that there are no other competitors).

But advertising budgets are assigned in both the firms so that they do not lose market share to the competitor (spending on advertising is a good strategy for both irrespective of the decision taken by the competitor).

The same analogy can be comfortably replicated for the US-USSR cold war, in which both the nations seemed to be hell bent on adding more nukes in their arsenal.

Another common example that we see in everyday life is related to public goods: if all the residents of a society decide to become good citizens and decide not to throw trash in the open— the society benefits as a whole (even the property rates might go up!).

But an individual might behave in a rogue way (selfish?) by throwing trash in the open— the cost of cleaning is borne by the whole society. This also extends to the [free-rider problem](http://en.wikipedia.org/wiki/Free_rider_problem) and [tragedy of commons](http://en.wikipedia.org/wiki/Tragedy_of_the_commons).

Game theory has a variety of applications in diverse fields — economics, business, political science, biology, computer science and even philosophy. It has helped and is currently helping strategists of every kind all over the world to better design their environments, to suit their overall needs.

We are constantly ‘in the game’ — our life is impacted by the actions and decisions made by others. And here is a thought that might as well be the ultimate philosophical rhetoric originating from game theory: “We can create a better world by becoming better human beings ourselves”.

* **Zero sum game:** In **game** theory a **zero**-**sum game** is a mathematical representation of a situation in which each participant's gain or loss of utility is exactly balanced by the losses or gains of the utility of the other participants. i.e. loss of player X is equal to the gain of player Y.

 **Payoff Matrix**: A **payoff matrix** is a tool that is used to simplify all of the possible

 outcomes of a strategic decision. It is a visual representation of all the possible

 strategies and all of the possible outcomes in matrix form.

Two Person Zero sum Games (Setting up the Pay-oﬀ Matrix)

Example: Coin Matching Game X and Y play a game. Each one has a coin. They will both show a side of their coin simultaneously. If both show heads, no money will be exchanged. If X shows heads and Y shows tails then Y will give Rs.1 to X. If X shows tails and Y shows heads, then X will pay Rs.1 to Y. If both show tails, then Y will give X Rs.2.

This is a Two person game, the players are X and Y. It is also a zero-sum game. This means that X’s gain is Y’s loss. We can use a 2×2 array or matrix to show all four situations and the results as follows: Colleen

|  |  |
| --- | --- |
| X |  Y |
|  | Head | Tail |
| Head | X pays Rs 0Y pays Rs 0 | X get Rs 1Y pays Rs 1 |
| Tail | X pays Rs 1Y get Rs 1 | X get Rs 2Y pays Rs 2 |

This is called a two-person, zero-sum game because the amount won by each player is equal to the negative of the amount won by the opponent for any given situation. The amount won by either player in any given situation is called the pay-oﬀ for that player. A negative pay-oﬀ denotes a loss of that amount for the player. Since it is a zero-sum game, we can deduce the pay-oﬀ of one player from that of the other, thus we can deduce all of the above information from the pay-oﬀ matrix shown below. The pay-oﬀ matrix for a game shows only the pay-oﬀ for the row player for each scenario.

* **Equilibrium**: The point in a game where both players have made their decisions and an outcome is reached