Agent Based Evolutionary Model of Travel Mode Choice

FADELI Ismail

Ecole Nationale Supérieure de Technologie
Transport and Logistics Engineering Department

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What is Game Theory?

Game theory is a branch of applied mathematics that derives mathematical models to predict the outcome of competitive interactions between two or more rational decision makers. It can be for:

- common interest (coordination game)
- competing interest (rivalry)

Defining games

A game consists of four parts:

- Players

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- Players
- Actions
- Strategies
- Payoffs s_i'

Normal form

A normal form represents a list of what players get on function of their actions.
Example: Prisoner's Dilemma

1/2	Confess	Refuse
Confess	2,2	0,3
Refuse	3,0	1,1

Table: Prisoner's Dilemma

Extensive form

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- Poker

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Nash equilibrium is the profile of actions such that each action is a best response to the other actions, $a =< a_1, ..., a_n >$ is a pure strategy Nash equilibrium if $\forall i, a_i \in BR(a_{-i})$.

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- pure strategy: only one action is played.
- mixed strategy: more than one action is played with positive probability.

Sub-game perfection and Backward Induction

A subgame Nash equilibrium is an equilibrium such that the strategies of players constitute a Nash equilibrium in each subgame of the game. It may be found by backwards induction.

Backward Induction

Backward induction is an iterative process for solving finite extensive form games. First, one determines the optimal strategy of the player who makes the last move of the game. Then, the optimal action of the next to last moving player is determined taking the last player's action as given. The process continues in this way backwards in time until the actions have been determined.

So?

By using simple methods of game theory, we can solve for what would be a confusing array of outcomes in a real-world situation. Using game theory as a tool for analysis can be very helpful in sorting out potentially messy real-world situations, from mergers to product releases.

Evolutionary game theory

Evolutionary game theory was introduced by John Maynard Smith in 1982. The main assumption of evolutionary game theory is that strategies with greater payoffs at a particular time would tend to spread more and thus have better chances of being present in the future.

Methodology

There exists many models for analyzing data of travel mode choice. In this section, three main models that have been dominant are explained briefly:

- logit models
- probit models
- discriminant models

Utility theory

According the utility theory, the utility U_i of alternative mode i is expressed as the sum of a deterministic component V_i and a random component ϵ_i capturing the uncertainty:

$$U_i = V_i + \epsilon_i \tag{1}$$

Agent Based Model

- First item

Insert graphic here

Agent Based Model

- First item
- Second item

Insert graphic here

Agent Based Model

- First item
- Second item
- ...

Insert graphic here