SFP

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1 Game theory applied to transportation systems in smart cities

The game The car pooling system can be modelled as a game in which the organisation and car sharers are competing to maximimize their benefits.

Players Player 1 is the organisation and car sharers are player 2.

Strategies

- Player 1: $X = S_R, S_P$ where S_R is the reward strategy and S_P is the punishment strategy.
- Player 2: $Y = S_C, S_N$ where S_C is the cooperative strategy and S_N is the defection strategy.

Nash Equilibrium using pure strategies S_C is a best response for player 2, player 1's best response is S_R. $A = (S_R, S_C)$ is a Nash Equilibrium.

Nash Equilibrium using mixed strategies Due to the unpredictable behavior of the players in reality, Nash Equilibrium is achieved mixing the strategies $A = (S_R, S_P)$ with $P = (p, 1-p)$ and $B = (S_C, S_N)$ with $P = (q, 1-q)$.

Evolutionary stability in games Evolutionary game theory has set two conditions for a strategy S to be evolutionary stable, where $E(S, T)$ represents the payoff for playing strategy S against strategy T.

- Strict Nash Equilibrium: $E(S,S) > E(T,S)$
- Maynard Smith's second condition: $E(S,S) = E(T,S)$ and $E(S,T) > E(T,T)$

2 Mode Choice Models

Popular Models:

- Probit Models
- Binary Logit Models
- Multinomial Logit Models
- Nested Logit Models
- Ordered Logit Models

2.1 Logit Models

Logit models are used in mode choice models in transportation. Logit models are classified into two main categories namely binary and multinomial logit model.

2.1.1 Binary Logit Models

Simple and Nested Binary Logit models are used when only two choices are available. The examples are presented in figures 1,2.

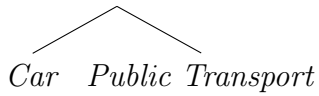

Figure 1: Binary Logit Model

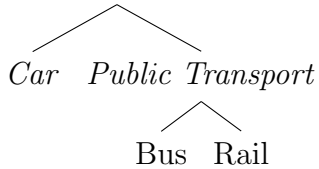

Figure 2: Nested Binary Logit Model

2.1.2 Multinomial Logit Models

Instead of a limited number of choices, multinomial logit models imply a larger set of alternatives. Multinomial Logit Models are categorised into simple and nested multinomial logit models. The examples are presented in figures 3,4.

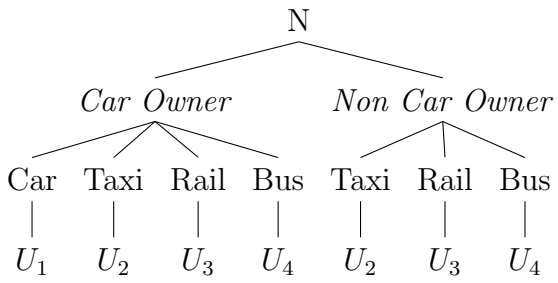

Figure 3: MTO Game