APPLYING GAME THEORY AND TIME SERIES IN SMITH TRAVEL ACCOMMODATION REPORT (STAR)

Xuan TRAN[1]
Global Hospitality and Tourism Management, College of Business
University of West Florida, Pensacola, USA

Ni Putu Kumala DEWI[2]

Zachary JENKINS[2]

Duy TRAN[2]

Ngoc VO[2]

ABSTRACT

Although Smith Travel Accommodations Report (STAR) benchmarks hotel performance against its competitive aggregate and local markets, hotel managers consider STAR as a reference document rather than a strategy model for hotel competition. Recent research report managers prefer less information to use it as clues for a decision rather than more information not to be able to make a decision. It is imperative for hotel managers to use STAR as a clue for the competition. Limited research has focused on techniques to build a clue for STAR as a practice strategy. The present study has built two matrices by STAR indices. After that, game theory strategies were conducted to forecast the outcomes whenever hotel mangers change price. A sample of hotel guests who stayed in seven top hotel destinations in the U.S. during the ten-year period (2005-2015) was selected in the scenario with two assumptions: (1) there are two players in the U.S. meeting business: Player 1 includes hoteliers in Washington DC, Virginia, and Maryland and player 2 includes hoteliers in Orlando, Los Angeles, Chicago, and New York and (2) customers in a hotel of player 1 prefer staying in the hotel of player 1 rather than staying in the hotel of player 2 and vice versa. Findings indicate that two

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[1] Address correspondence to Xuan Tran, Associate Professor, Global Hospitality and Tourism Management, College of Business, University of West Florida, University Parkway, 76/118, Pensacola, FL, USA. E-mail: xtran@uwf.edu
[2] Student of Hospitality Program, University of West Florida

matrices have provided hoteliers with simple clues of different strategies in each month during the year to maximize their revenue.

INTRODUCTION

Failure to appropriately understand game theory in the Smith Travel Accommodations Report (STAR) and time series creates critical issues for pricing strategies in the hotel industry. STAR including 17 tables of hotel occupancy (OCC), revenue per available room (RevPAR), average daily rate (ADR), and indices was used to benchmark hotel performance against its competitive aggregate and local market. The information in STAR is classified into descriptive and static parameters rather than strategic and dynamic clues so that hotel managers are difficult to make decisions. For example, a hotel manager can use the index of average daily rate (ADR) to compare his hotel room rate with his competitor's, to ultimately decide whether to increase or decrease the price in order to maximize his revenue per available room (RevPAR) but he/she does not know what to do next after the response of his/her competitors. Their decisions often separated from the game theory due to its mathematical complication and static numbers in STAR so they are usually risky under uncertainty of the opposing competitors' responses resulting in profit variations.

The STAR report measures each property's market share performance against a self-selected competitive set whereas the game theory explains how people act and react to maximize their benefits under uncertainty through the three main strategies: best responses, dominant strategies, and Nash equilibrium (1950a, 1950b, 1951, 1953). Although both of STAR and game strategies have the same purpose to provide tools for hoteliers to decide their movement in their competition, both of them have no common grounds. As a result, there is a big gap between STAR and game theory strategies.

Camarer and Johnson (1991) explain the reason why experts know so much but predict so badly by the actuarial model. In this model, using the actuarial model with a few clues will help experts make a decision more accurately. Cavojova and Hanak (2014) report that without clues experts will ask for more information and costly due to their intuition.

The question is whether STAR indices can be set up in a few clues such as matrices for hoteliers to forecast a trend using best responses, dominant strategies, or Nash equilibrium in game theory.

In order to answer this question, the present study has set up matrix tables using a sample of hotel guests who stayed in seven top meeting hotel destinations in the U.S. during the ten-year period (2005-2015) in the scenario with two assumptions: (1) there are two players in the U.S. meeting business: Player 1 includes hoteliers in Washington DC, Virginia, and Maryland and player 2 includes hoteliers in Orlando, Los Angeles, Chicago, and New York and (2) customers in a hotel of player 1 prefer staying in the hotel of player 1 rather than staying in the hotel of player 2 and vice versa.

Each player's matrix includes two rows and two columns representing an increase or a decrease in average daily rate of one player called "My property" and the opposing player called "Comp Set" (we borrowed the terms "My Property" and "Comp Set" from STAR). The results shown by RevPAR growth were reported in four quadrants of the matrix. Hotel managers would be able to understand the strategies more clearly in the matrix tables. The purpose of this study is thus to develop the matrices for both players using time series data in STAR for hoteliers to use game theory strategies to forecast their competitive aggregate and local market.

LITERATURE

Game Theory

John von Neumann and Morgenstern (1944, 1947, 1953) developed the game theory to explain how people act and react to maximize their benefits under uncertainty. It involves three fundamental concepts: best response, dominant strategy, and Nash equilibrium defined as follows. The best response is one that earns a player a larger payoff from the opposing player. The dominant strategy is one that earns a player a larger payoff than the opposing player regardless of the response or movement of the opposing player. The Nash equilibrium is the mutual best responses in the sense that each strategy is considered to be an optimal strategy when compared with each other. Game theory is thus mathematical models in which variables of benefits must be maximized.

According to Levine (2016), game theory is combined three economic theories: Decision theory, General Equilibrium theory, and Mechanism Design theories. Decision theory is a theory to explain how a person selects his choice based on his income. General equilibrium theory

is a theory to explain how a buyer selects a seller's product based on the seller's price. Mechanism Design theory is a theory to explain how a seller pays to his employees based on his pricing to buyers. Tversky and Kahneman (1992) developed the Decision theory into prospect theory that explains how a person selects his choice between alternatives based on their risks (happiness or wealth). John Keynes (1936, 2008) developed General Equilibrium theory in a macroeconomics with unemployment and government spending devoted to the equilibrium between supply and demand. Hurwicz and Reiter (2006) developed Mechanism Design theory that explains how a seller and a buyer solves the conflict after they decided to sell or buy regarding their cost, tax, employee's salary, satisfaction and auction.

Game theory is the study of conflict and cooperation, which is primarily used in economics, political science, psychology, logic and biology (Nobel Prize Winners in Game Theory, 2014). The game theory which is the theory of rational choice including patterns of human behaviour in societies reflects the selections of individuals when they attempt to maximize their benefits. Game concepts including best responses, dominant strategies, and Nash equilibriums are applied whenever the actions of the involved agents are interdependent. The concepts of game theory provide a language to formulate and analyse strategic scenarios. Mossetti (2006) reports that the model of a prisoner's dilemma game was applied to measure the social dilemma in sustainable tourism that rests upon the uncoordinated choices of selfish and profit-maximizing players.

In tourism literature, game theory has not been developed. Feeny, Hanna, and McEvoy (1996, p. 187) argue that the tragedy of the overexploitation for recreation land uses between the stronger player and the weaker player is incomplete so that it requires "a richer and more accurate framework". Vail and Hultkrantz (2000) do not believe in the 'cooperative game' that reduces conflicts of owners and tourists among land uses and benefits. Game theory should be considerate to solve the conflicts. Williams (2001) reports that a stable ecosystem could not be considerate for touristic settings because of cultural differences. He suggests a cultural western approach to control sources of undesired change. In this approach, cooperation and conflict would be studied in a game theory; policy priorities have to be shifted from agricultural production to recreational access to the countryside, otherwise public access is reduced to nature settings. Personalizing the value of a landscape

will intensify conflicts over how natural landscapes should be developed and managed.

Another issue in tourism is the time series data that was spurious to blur the benefit relationships between tourists and owners. Buhalis (2000), Uysal, Chen and Williams (2000), Milhalic (2000), Kozak (2001), and Ritchie and Crouch (2000) report that governments commit supportive efforts and funds to enhance their destinations' images and attractiveness levels. The federal government plays a key role by funding necessary to bring competitive destinations and tourism companies into cooperation. Qu, Ennew, & Sinclair (2005), Stokes (2008) and Singh and Hu (2008) examine governments' roles in strengthening destination competitiveness. However, the above researches did not use time series in their framework. Recently, Song, Kim, and Yang (2010) used bias-corrected bootstrap to build and test the elasticity for demand to Hong Kong tourism. Lim, Min and McAleer (2008) used the ARIMAX model to find that Japanese income is elastic for tourism demand in New Zealand.

The two above issues have provided hoteliers with too much information. The hotel managers are experts who prefer less information summarized in some clues for their making a decision. Camerer and Johnson (1991) use actuarial models (i.e., regression equations model) to explain why experts know so much and predict so badly. We can replicate the model below for our application of game theory to hotelier's decision making in Figure 1.
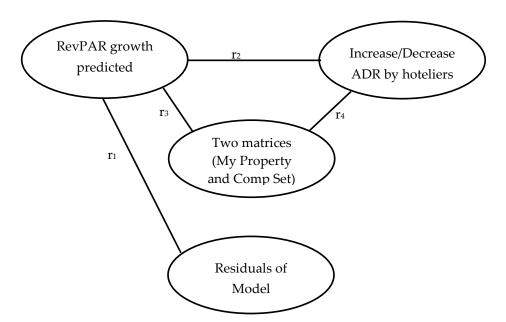

Figure 1. *A Quantitative Language for Describing Hotelier's Decision Performance*

In the above model, r4 > r3 > r2 > r1 are relationships among decisions (Camerer & Johnson, 1991). Hoteliers who make a decision of room rates prefer using the matrices as a clue rather than their own experiences (r4 > r2). Camerer and Johnson (1991) report that full-time radiologists are no better than advanced medical students at detecting lesions in abnormal lungs so that they conclude that in some domains, training, but not professional experience, improves prediction.

The key reason for this is that a professional expert (hotelier) often make a decision by using the configural rule. The configural rule states the impact of one variable on an outcome depends on the level of another variable. In order to avoid the problems, the present study suggest two matrices: one for the hotelier and the other for his competitor set that involves 4-5 other competitive hotels.

The present study is attempting to overcome the two above issues by revising STAR to apply it in hotel operations in order to provide key clues in matrix tables for hoteliers to make a decision in the competition. In this study, the two matrices were set up for two key players: player 1 (Washington DC (DC), Maryland (MA), Virginia (VA)) and player 2 (Orlando (OO), New York (NY), Chicago (CH), and Los Angeles (LA)) to serve one target customers who stayed in hotels for meeting business including customers in the top seven meeting hotel destinations during the 10-year period (2005-2015).

Smith Travel Accommodation Report (STAR)

Smith Travel Research (2016), the largest company specializing in tracking supply and demand for multiple market sectors, provides hotel members with Smith Travel Accommodation Report (STAR) including Average Daily Rate (ADR), Occupancy (OCC), Revenue per available room (RevPAR), and Index in 17 tables. Figure 2 illustrated the Index table.
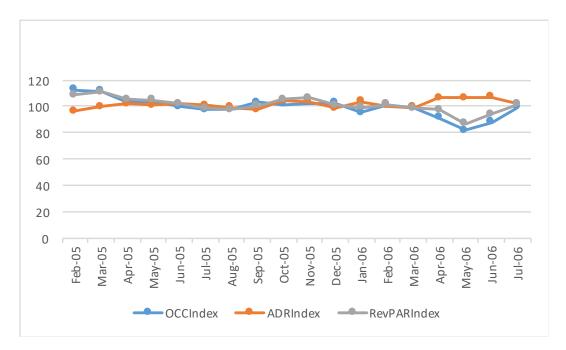
Figure 2. *Summary of the ADR, OCC, and RevPAR between One Property and its Comp Set through Index*

Average Daily Rate (ADR), Revenue per Available Room (RevPAR), Occupancy (OCC), and Index

The four concepts are often used to measure the effectiveness of hotel management. Supply is measured by the number of room nights available during the year. Demand is measured by the number of room nights sold during the year. Revenue is measured by the total room sales during the year. From the Demand, Supply, and Revenue, hoteliers operate their business based on ADR, OCC, and RevPAR. ADR is the ratio between Revenue and Demand. OCC is the ratio between Demand and Supply. RevPAR is the ratio between Revenue and Supply. Index is the ratio of between one player's parameter and the opposing player's parameter; for example, RevPAR index of player 1 is the RevPAR of player 1 divided by the player 2's RevPAR.

In the STAR, a decision maker can position his hotel property's strengths among other three or four competitors called competitive set through pricing. At first, STAR provides decision makers with general hotel market information such as supply (the number of segment rooms in the market times the number of days in the period), demand (the number of rooms sold in the market during the period), and revenue (total room revenue generated from the sale of rooms). Based on the information, a

hotel manager is able to either measure his own operations in the past through per cent change (This Year – Last Year)/Last Year) or compare his hotel's occupancy, average daily rate, and revenue per available room with the ones of his competitive set through index during the period of time.

The present study developed a simple game theory model based on STAR. That is, two players in the game theory are "my property" (a specific hotel market) and the "comp set" (the average of four other destination markets competing against the specific hotel market). The specific hotel market's strategy is any of the options he can select in a setting where the result depends not only on his own actions but on the action of others. The strategy is thus a complete algorithm for playing the game.

The algorithm design in the strategic game includes six components:

1. Set of players: Two players in game theory are the hoteliers in Washington DC, Maryland, and Virginia (Player 1) market and the competitive set including the hoteliers in Orlando, New York, Los Angeles, and Chicago (Player 2).

2. Action sets: An action set A_i for a player i is defined as the set of strategies available to player i. In the present study, every player has two choices either to increase or decrease room rate. If we represent increase by I and decrease by D, then

   $A_i = \{I,D\}$ i=1,2

3. Strategy Profile: In a general N-player game, the strategy profile A is defined as
   $A = (a_1, a_2, ..., a_n)$

   Where a_i belongs to A_i

   In this study, we have two players: A_1 is DC-MD-VA and A_2 is OO-NY-LA-CH.

4. Action profile:
   In the case of this study, there are four possible action profiles B_1, B_2, B_3, and B_4 measured by ADR.

   $B_1 = \{I,I\}$
   $B_2 = \{I,D\}$

$B_3 = \{D,I\}$

$B_4 = \{D,D\}$

5. Set of Outcome:

Superset of action profiles is called Set of Outcome (Set O). In the case of this study, the set O is defined as

$O = \{B_1, B_2, B_3, B_4\}$

Where $B_1, B_2, B_3,$ and B_4 are defined above.

6. Payoff of players. In the study, every hotel destination player in the competition corresponding to an action profile has some payoff measured by RevPAR associated with it.

For player i, this is denoted by $U_i(a_i, a_{-i})$

Where a_i = strategy of player i

a_{-i} = strategy of other players except i

Therefore, the payoff for DC-MD-VA hotel destination in the case of various action profiles was U_{1i} (I,I), U_{2i} (I,D), U_{3i}(D,I), and U_{4i}(D,D). Similarly, we can find payoff for OO-NY-LA-CH was U_{i1} (I,I), U_{i2} (I,D), U_{i3} (D,I) and U_{i4} (D,D).

Time Series Analysis

The Smith Travel Accommodations Report program tracks and delivers monthly, weekly and daily data of ADR, OCC, RevPAR, and Index to hotel partners. The data are co-integrated due to time trend, seasonal, and irregularity issues so that they might mislead the results of relationships or forecasting. In order to eliminate the spurious problems, we need to use time series analysis methods to verify the findings from regressions. For example, Figure 3 indicates effects of the percent change of ADR of DC-MD-VA and its comp set on its RevPAR index as follows:

Indexrevpar = 0.89 - .92*ADRCompGrowth (p<.05)-1.99*ADRDCGrowth (p=.38)

In the model, the independent variable ADRDCGrowth was not a significant predictor. When adding the time trend, one of the time series tools, to this model to eliminate the spurious problem of this model, the independent variable ADRDCGrowth became a significant predictor.

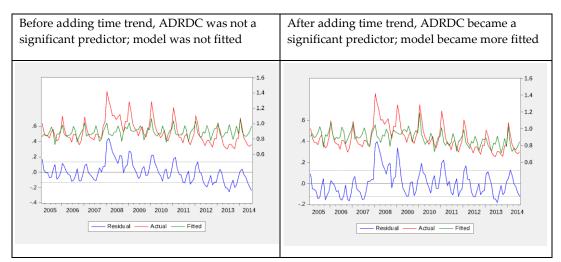Indexrevpar = 1.01 -0.91*ADRcompgrowth -7.3*ADRDCGrowth (p<.005) + @trend

Before adding time trend, ADRDC was not a significant predictor; model was not fitted	After adding time trend, ADRDC became a significant predictor; model became more fitted

Figure 3. *Time Series Method (Time Trend) Changed The Model*

Therefore, the present study has changed the data into log and used the moving average method to attain the stationary status of the data. Figure 4 indicates that ADR, RevPAR, and Indices are stationary without spurious issues.
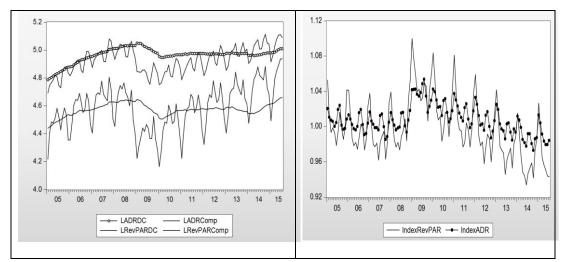

Figure 4. *ADR, RevPAR, and Indices in log of DC-MD-VA and OO-NY-LA-CH*

In order to improve the function of STAR besides reducing spurious data through log and moving average, the present study set up

matrix tables between two players. Each player's matrix includes two rows and two columns representing an increase or a decrease in average daily rate of one player and the opposing player. The results shown by RevPAR growth were reported in four quadrants of the matrix. Hotel managers would be able to understand the strategies more clearly in the matrix tables to forecast best responses, dominant strategies, or Nash equilibrium. The study then tested the values in four quadrants of the matrix as follows:

Null Hypothesis 1: There would be no changes in RevPAR of both players when one player increases ADR in response to the opposing player's increase in ADR.

Null Hypothesis 2: There would be no changes in RevPAR of both players when one player decreases ADR in response to the opposing player's increase in ADR.

Null Hypothesis 3: There would be no changes in RevPAR of both players when one player increases ADR in response to the opposing player's decrease in ADR.

Null Hypothesis 4: There would be no changes in RevPAR of both players when one player decreases ADR in response to the opposing player's decrease in ADR.

METHOD

Sample

The study sample is the customers at the player 1's and player 2's hotels. Data were collected from Smith Travel Research (STR) for the hotel guests staying in player 1's hotels (Washington DC- Virginia – Maryland) and in player 2's hotels (Orlando, New York, Los Angeles, and Chicago) during the 10-year period (2005-2015). The main reason to select the seven hotel destinations in the U.S. because they are the top destinations for meeting planners (except Las Vegas since its data was not available from STR). In the game design for this study, we assume that the hotel guests in the seven hotel destinations during the 10-year period are able to switch their staying either in player 1's hotels or in player 2' hotels.

Matrix

There are two matrices for two players. The matrix of each player includes two rows and two columns representing an increase or a decrease in ADR of one player and the opposing player. The results shown by RevPAR growth were reported in four quadrants of the matrix. If the value of RevPAR in one quadrant is higher than the ones in any other quadrants, there will be the best response for one player. If the values of the RevPAR in one column or one row are higher than the ones in the other column or row, there will be the dominant strategy for one player. If the RevPAR values of both players are higher than the ones in any other quadrants, there will be the Nash equilibrium for both players.

Data

The monthly data of ADR, RevPAR, and OCC of the two players collected from Smith Travel Research during the 10-year period (2005-2015) were transferred into Log to eliminate the spurious issues from time series data. The monthly indices for ADR and RevPAR of each player were calculated by dividing one player's by the opposing player's for each month. Then the per cent changes of the four indices (two indices RevPAR and ADR for each player) were calculated by dividing the difference of each month between two-year period by the same month in the previous year to measure the growth rate of each parameter.

Four dummy variables of ADR were set up for each month to represent (1) Player 1's ADR increase and Player 2's ADR increase, (2) Player 1's ADR increase and Player 2's ADR decrease, (3) Player 1's ADR decrease and Player 2's ADR increase, and (4) Player 1's ADR decrease and Player 2's ADR decrease. Then multiply RevPAR percent change of each player by one of the four dummies. Finally, average the values of each month during 10-year period. As a result, in each month from January to December there were 8 variables in two matrices representing RevPAR per cent change of two players in four cases: (1) Player 1 increased ADR and player 2 increased ADR, (1) (2) player 1 increased ADR and player 2 decreased ADR, (3) player 1 decreased ADR and player 2 increased ADR, and (4) player 1 decreased ADR and player 2 decreased ADR. For example, findings in January indicate the averages of the products among the dummy variables and the RevPAR of player 1 and player 2 (Figure 5) as follows:

The payoff for player 1 was as follows:

U_{1i} (I,I) = 0.36
U_{2i} (I,D) = -0.01
U_{3i}(D,I) = 0.58
U_{4i}(D,D) = 0.14

Similarly, we can find payoff for player 2 was

U_{i1} (I,I) = 0.49
U_{i2} (I,D) = -0.20
U_{i3} (D,I) = 0.77
U_{i4} (D,D) = 0.30

Player1/Player2	Increase ADR	Decrease ADR
Increase ADR	0.36/0.49	(0.01)/(0.2)
Decrease ADR	0.58/0.77	0.14/0.30

C is a Nash equilibrium representing highest RevPAR growth for both players
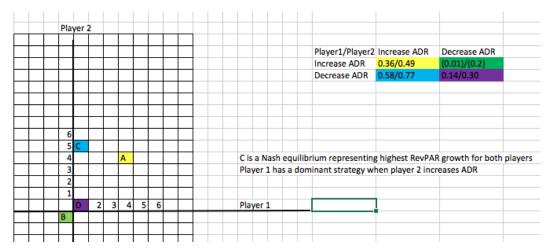Player 1 has a dominant strategy when player 2 increases ADR

Figure 5. *Positioning the Strategies of both Players in Increasing RevPAR in January*

ANOVA was conducted to find significant differences between RevPAR percent change before and after ADRs were changed. All differences were significant ($p < 0.05$).

RESULTS

The matrices of two players showed that the RevPAR percent change in each month significantly changed when there were an increase/decrease of ADR from two players. The four null hypotheses were rejected. Our research hypotheses were supported. There were different strategies for each player to maximize their own benefits in each month. The pricing

game between player 1 and player 2 involves the players acting individually rationally; choosing outcomes that are their own best interest. Each market's "Pay-off" in this study was the value of increasing their revenue per available room (RevPAR). The game is either a zero-sum (winner/loser) or a non-zero-sum (win-win). A win-win game is designed in the Nash equilibrium that both players can profit in a variety of ways. Player 1 and player 2 in a win-win game will position their market share in developing RevPAR in an integrative result. In contrast, a zero-sum game illustrated in best responses or dominant strategies is a game in which a player's gains (or losses) of RevPAR are balanced by the losses (or gains) of the RevPAR of the other player. Player 1 and player 2 in a zero-sum game will distribute the pie of hotel receipts in a distributive result.

The following are 12 matrix tables with suggesting strategies of game theory for 12 months in a year between the two players: player 1 and player 2.

Table 1. *Two Matrices of Player 1 and Player 2 Combination in January*

Player 1\ Player 2	ADR Increase	ADR Decrease
ADR Increase	0.36 \ 0.49	(0.01) \ (0.20)
ADR Decrease	0.58 \ 0.77	0.14 \ 0.30

Comments:

1.1. The third quadrant [0.58\0.77] is a Nash equilibrium because it is the place where both players receive highest payoff. That is, when Player 1 decreases ADR and Player 2 increases ADR, both will get highest payoff.

1.2. The first column [0.36\0.49 and 0.58\0.77] is a dominant strategy for player 2 because no matter what player 1 increases or decreases the price, player 2 always get higher payoff.

Table 2. *Two Matrices of Player 1 and Player 2 Combination in February*

Player 1\ Player 2	ADR Increase	ADR Decrease
ADR Increase	0.61 \ 0.57	(0.14) \ (0.31)
ADR Decrease	0.31 \ 0.65	0.25 \ 0.33

Comments:

2. The first quadrant [0.61\0.57] and the third quadrant [0.31\0.65] is the best responses for player 1 and player 2, respectively because it is the place where each player receives highest payoff. That is, when Player 2 increases ADR and the best response for Player 1 is to increase ADR. When player 1 decreases ADR, the best response for player 2 is to increase ADR.

Table 3. *Two Matrices of Player 1 and Player 2 Combination in March*

Player 1\ Player 2	ADR Increase	ADR Decrease
ADR Increase	0.59 \ 0.57	(0.15) \ (0.25)
ADR Decrease	0.32 \ 0.80	0.26 \ 0.36

Comments:

3. The first quadrant [0.59\0.57] and the third quadrant [0.32\0.80] are the best responses for player 1 and player 2, respectively because they are the places where each player receives highest payoff. That is, when Player 2 increases ADR and the best response for Player 1 is to increase ADR. When player 1 decreases ADR, the best response for player 2 is to increase ADR.

Table 4. *Two Matrices of Player 1 and Player 2 Combination in April*

Player 1\ Player 2	ADR Increase	ADR Decrease
ADR Increase	0.54 \ 0.57	(0.15) \ (0.24)
ADR Decrease	0.37 \ 0.88	0.25 \ 0.43

Comments:

4.1. The first quadrant [0.54\0.57] and the third quadrant [0.37\0.88] are the best responses for player 1 and player 2, respectively because they are the places where each player receives highest payoff. That is, when Player 2 increases ADR and the best response for Player 1 is to increases ADR. When player 1 decreases ADR, the best response for player 2 is to increase ADR.

4.2. The first column [0.54\0.57 and 0.37\0.88] is a dominant strategy for player 2 because no matter what player 1 increases or decreases the price, player 2 always get higher payoff.

Table 5. *Two Matrices of Player 1 and Player 2 Combination in May*

Player 1\ Player 2	ADR Increase	ADR Decrease
ADR Increase	0.49 \ 0.56	(0.14) \ (0.24)
ADR Decrease	0.41 \ 0.85	0.26 \ 0.44

Comments:

5.1. The first quadrant [0.49\0.56] and the third quadrant [0.41\0.85] are the best responses for player 1 and player 2, respectively because they are the places where each player receives highest payoff. That is, when Player 2 increases ADR and the best response for Player 1 is to increases ADR. When player 1 decreases ADR, the best response for player 2 is to increase ADR.

5.2. The first column [0.49\0.56 and 0.41\0.85] is a dominant strategy for player 2 because no matter what player 1 increases or decreases the price, player 2 always get higher payoff.

Table 6. *Two Matrices of Player 1 and Player 2 Combination in June*

Player 1\ Player 2	ADR Increase	ADR Decrease
ADR Increase	0.35 \ 0.57	0.21 \ (0.23)
ADR Decrease	0.41 \ 0.92	0.06 \ 0.44

Comments:

6.1. The third quadrant [0.41\0.92] is a Nash equilibrium because it is the place where both players receive highest payoff. That is, when Player 1 decreases ADR and Player 2 increases ADR, both will get highest payoff.

6.2. The first column [0.35\0.57 and 0.41\0.92] is a dominant strategy for player 2 because no matter what player 1 increases or decreases the price, player 2 always get higher payoff.

Table 7. *Two Matrices of Player 1 and Player 2 Combination in July*

Player 1\ Player 2	ADR Increase	ADR Decrease
ADR Increase	0.37 \ 0.70	(0.04 \ 0.28)
ADR Decrease	0.49 \ 1.05	0.27 \ 0.62

Comments:

7.1. The third quadrant [0.49\1.05] is a Nash equilibrium because it is the place where both players receive highest payoff. That is, when Player 1 decreases ADR and Player 2 increases ADR, both will get highest payoff.

7.2. The first column [0.37\0.70 and 0.49\1.05] is a dominant strategy for player 2 because no matter what player 1 increases or decreases the price, player 2 always get higher payoff.

Table 8. *Two Matrices of Player 1 and Player 2 Combination in August*

Player 1\ Player 2	ADR Increase	ADR Decrease
ADR Increase	0.17 \ 0.59	(0.06 \ 0.33)
ADR Decrease	0.29 \ 0.98	0.09 \ 0.52

Comments:

8.1. The third quadrant [0.29\0.98] is a Nash equilibrium because it is the place where both players receive highest payoff. That is, when Player 2 increases ADR and Player 1 decreases ADR, both will get highest payoff.

8.2. The first column [0.17\0.59 and 0.29\0.98] is a dominant strategy for player 2 because no matter what player 1 increases or decreases the price, player 2 always get higher payoff.

Table 9. *Two Matrices of Player 1 and Player 2 Combination in September*

Player 1\ Player 2	ADR Increase	ADR Decrease
ADR Increase	0.18 \ 0.47	(0.05) \ 0.07)
ADR Decrease	0.30 \ 0.76	0.01 \ 0.25

Comments:

9.1. The third quadrant [0.30\0.76] is a Nash equilibrium because it is the place where both players receive highest payoff. That is, when Player 2 decreases ADR and Player 1 increases ADR, both will get highest payoff.

9.2. The first column [0.18\0.47 and 0.30\0.76] is a dominant strategy for player 2 because no matter what player 1 increases or decreases the price, player 2 always get higher payoff.

Table 10. *Two Matrices of Player 1 and Player 2 Combination in October*

Player 1\ Player 2	ADR Increase	ADR Decrease
ADR Increase	0.18 \ 0.48	(0.16) \ (0.33)
ADR Decrease	0.34 \ 0.82	0.18 \ 0.48

Comments:

10.1. The third quadrant [0.34\0.82] is a Nash equilibrium because it is the place where both players receive highest payoff. That is, when Player 2 decreases ADR and Player 1 increases ADR, both will get highest payoff.

10.2. The first column [0.18\0.48 and 0.34\0.82] is a dominant strategy for player 2 because no matter what player 1 increases or decreases the price, player 2 always get higher payoff.

Table 11. *Two Matrices of Player 1 and Player 2 Combination in November*

Player 1\ Player 2	ADR Increase	ADR Decrease
ADR Increase	0.17 \ 0.35	(0.20) \ (0.40)
ADR Decrease	0.37 \ 0.75	0.17 \ 0.35

Comments:

11.1. The third quadrant [0.37\0.75] is a Nash equilibrium because it is the place where both players receive highest payoff. That is, when Player 2 decreases ADR and Player 1 increases ADR, both will get highest payoff.

11.2. The first column [0.17\0.35 and 0.37\0.75] is a dominant strategy for player 2 because no matter what player 1 increases or decreases the price, player 2 always get higher payoff.

Table 12. *Two Matrices of Player 1 and Player 2 Combination in December*

Player 1\ Player 2	ADR Increase	ADR Decrease
ADR Increase	0.16 \ 0.43	(0.03) \ (0.18)
ADR Decrease	0.35 \ 0.73	0.00 \ 0.30

Comments:

12.1. The third quadrant [0.35\0.73] is a Nash equilibrium because it is the place where both players receive highest payoff. That is, when Player 2 decreases ADR and Player 1 increases ADR, both will get highest payoff.

12.2. The first column [0.16\0.43 and 0.35\0.73] is a dominant strategy for player 2 because no matter what player 1 increases or decreases the price, player 2 always get higher payoff.

DISCUSSION

In the above 12 matrices combinations for 12 months, there were two kinds of games: the win-win games in April, May, June, July, August, September, October, November, December, and January and the zero-sum games in February and March.

In the win-win game in April, May, June, July, August, September, October, November, December, and January, there was a Nash equilibrium where both players receive highest payoff. It is when player 2 decreases ADR and player 1 increases ADR, both will get highest payoff. In the peak season from April to January the meeting business in Orlando, New York, Los Angeles, and Chicago have a dominant strategy to increase their hotel room rates no matter what Washington DC, Virginia and Maryland increase or decrease their room rates. However, the meeting business in the U.S. will be most profitable when hotels in Washington DC, Virginia, and Maryland decrease room rates.

In the zero-sum game in the off seasons in February and March, there were best responses for both players: when Player 2 increases ADR

and the best response for Player 1 is to increases ADR. When player 1 decreases ADR, the best response for player 2 is to increase ADR. In the off-season of meeting business in the U.S. (February and March) when Orlando, New York, Los Angeles, and Chicago increase ADR, the best response for Washington DC, Virginia and Maryland is to increase ADR. The best response for Orlando, New York, Los Angeles, and Chicago is to increase ADR when Washington DC, Virginia, and Maryland decrease ADR.

CONCLUSIONS AND IMPLICATIONS

The results indicate that situational manipulations, such as setting up matrices affect information search more than preferred cognitive style (STAR indices). It implies that examining hotel strategies in context-specific tasks; i.e., using matrix tables in this case for hoteliers plays a crucial role in searching for information when making a decision. Hanak, Sirota, & Juanchich (2013) mention that experts only use more valid clues. Camerer and Johnson (1991) suggest utilizing more previous knowledge to form a kind of diagnostic reasoning that match the clues in a specific case would ask experts to search only for information relevant to the problem at hand. That is, STAR report should add more matrix for hoteliers for their solutions at hand.

This study has contributed to Smith Travel Accommodations Report (STAR) when it added two matrices because the matrix tables help hotel managers consider game theory and time series methods in using STAR to make a decision for hotel competition. Therefore, it has bridged the gap between STAR and strategy practice. Implications are two matrices have provided hoteliers with simple clues of different strategies in each month during the year to maximize their revenue.

The two kinds of game (zero-sum and win-win) are actually being played between the two players in the scenario during the 10-year period (2005-2015) in the meeting business scenario. Two limitations of this study are (1) the overriding assumption that the hotel guests in both players did not want to switch hotels but in fact, they would and (2) the hotel meeting market in the U.S. did cover only seven destinations but there are more than meeting destinations in the U.S.. However, despite the limitations, the game findings create a benchmark for future meeting policy in the U.S.. The contribution of game theory will provide future perspectives for

hotel managers in analysing STAR with matrices as well as potential game theory applications within hotel arenas.

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