



Analyses of Students Choice of Public and Private Institution in Nigeria Using Game Theory BY

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Abstract

The factors influencing students' decisions to attend private or public universities in Nigeria were examined using the minimax principle of two players playing zero sum games. In order to gather the necessary data, questionnaires were distributed to the target population of sampled public and private higher education institutions across the six geopolitical zones, taking into account the 23 factors that were identified as influencing people's decisions between public and private schools. In a two-player zero-sum game, the acquired data were analyzed using the minimax theorem. The best approach and the game's worth were identified. The approach's results revealed that the game's value was 127 (saddle point), indicating that it was favorable to public schools and indicating that the majority of pupils preferred public schools. The saddle point here implies that people like public schools because they are less expensive, but private schools owe their patronage to their conducive learning environment. This suggests that students' decisions to enrol in university in Nigeria are significantly influenced by the cost of tuition and a positive learning environment. Additionally, the results of the Academic Staff Union of University's (ASUU) industrial strike action are being used by prospective students to choose private universities over public universities.

Keywords: Minimax Principle; geopolitical zones; two-person zero-sum game; saddle point.

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1. Introduction

Nigeria is a developing nation, and education is essential to boosting GDP, gender equality, peace, health, stability, and eradicating poverty.

Education plays a significant role in reducing poverty because it raises a nation's GDP and aids in decision-making during times of conflict.

In Nigeria, schools are primarily divided into two categories: public schools, which are supported by the federal or state government, and private schools, which receive funding from a variety of sources such as private grants, school tuition, and endowments.

The University of Ibadan, Covenant University, University of Lagos, UNN, and Ahmadu Bello University are some of the best institutions in Nigeria, according to [1]. Other top institutions are UNN and Ahmadu Bello University.

A person selects a university depending on a number of variables.

Without a doubt, there are many private universities that only enroll a small number of pupils. This is influenced by a numerous variables, such as the public's opinion of educational quality, the cost of tuition, and the accessibility of facilities and infrastructure[2]. According to [3], one key consideration while selecting a university is the environment that promotes learning.

Numerous studies have been made into the elements that influence college and university choices made by students for their higher education such as in[4,5].

[6] listed educational factors (in the family: education style, in school: teacher recommendations and career guidance), information factors (open, exhibitions, mass media), economic factors (study fee, career prospects), and other factors as factors that influence the interest of prospective students in choosing tertiary institutions (geographical location, ranking, personal and demographic).

Personal preference tops list of preferences in [7] because it naturally has the greatest impact on university choice since students largely rely on their thoughts and preferences.

Six factors were highlighted in the work of [8] as being taken into account by students when weighing their university preferences. Location and accessibility of the university, suitability of the courses, academic standing, type of institution, and, last but not least, parental and high school counselor recommendations. They used a hypothetical model to compile a list of preferences, and the results showed that course appropriateness was the top priority. [9] utilized adaptive conjoint analysis, a type of conjoint analysis, to investigate Western Australian students' preferences for universities. Course suitability is the most sought preference criteria, followed by academic reputation, job possibilities, and teaching quality, according to the research, which examined ten aspects

Cost/benefit, closeness to home, teaching quality, placements, influences from family and friends, university amenities, and financial aid are the main factors influencing the choice of college or university, according to [10].

Using multiple regression analysis, [11] determined the crucial elements that have the greatest influence on parents' decisions regarding the pre-school for their children.

[12] used education fees, promotions, brand image, motivation, and student decision as criteria to determine the elements that influence students' decisions while selecting private colleges in Medan. They used quota sampling to acquire the sample, which was obtained through surveys, questionnaires, and interviews. They then used factor analyses with regression weights and confirmatory factor analysis to examine the data (CFA). The findings of their study showed that students' decisions to attend private colleges in Medan are positively and significantly influenced by the cost of education, promotions, brand image, motivation, and facilities.

Using quota sampling in the selection procedures, [13] looked into the factors that affect Malaysian students' decisions on which school to attend. The outcome demonstrated that a student's decision is significantly influenced by the costs, site advertising, method, and physical proof.

In his research, [14] used mean analysis and MANOVA to identify the characteristics that influence students' choice of institution. He was of the opinion that these factors may change depending on the students' backgrounds and the variety of available study alternatives. His findings showed that the majority of students prioritize degree recognition over academic performance, careers after graduation, and a practical approach to learning.

[15] found that using a sampling survey approach and survey questionnaires, "future employment prospects," "teaching quality," "staff expertise," and "course content" were significant selection criteria for Vietnamese students' choice of school.

By using a logistic main component analysis, [16] analyze the factors influencing students' decisions from a survey conducted at 23 Italian educational institutions. Results showed that a number of factors worked together to influence students' choice, with geographical closeness, local job opportunities, university reputation, and accessibility competing with one another.

In Akwa Ibom State, [17] used a cross-sectional descriptive study and a purposive sample technique to obtain data on patients' preferences for healthcare institutions that provide high-quality care. Numerous variables were taken into account, and a two-person zero sum game theory strategy was used. The outcome demonstrates that the game's value, $v = 330$, indicates that it is in the public hospital's favor. The findings also indicated that patients chose public hospitals with a probability of one (1) due to service costs, whereas private hospitals ascribed their preferences to healthcare providers' attitudes with a probability of one (1).

A two person zero sum game strategy was used by [18] to examine people's choices for academic intent in India. Ten factors were found. The approach's results demonstrated that people prefer public schools more due to the

higher expense of education, whereas those who attend private schools credit their preferences to the amenities those schools offer.

The goal of this research is to discover the variables that determines students' decisions regarding enrolment in higher education institutions in Nigeria. Using a two-player zero sum game, the reactions to the parameters will be gathered and analyzed.

2. Materials and methods

The data for this study was gathered from the four best private and public institutions in each of Nigeria's six geographical zones in 2022, according to webometrics with the exception of the North West, which has just two private universities.

The North Central Public Institutions considered are: Federal University of Technology Minna, University of Jos , University of Ilorin, and Kwara State University whereas that of North Central Private Institution are African University of Science and Technology Abuja , Baze University Kuchigoro, Nile University of Nigeria (Nigeria Turkish Nile University), and Veritas University.

North West Public Institution includes Ahmadu Bello University, Bayero University Kano , Federal University Dutse Jigawa State, and Usmanu Danfodiyo University Sokoto.

Skyline University Nigeria, and Al-Qualam University Katsina are the only Private Institution in North West. North East Public Institution are University of Maiduguri, Abubakar Tafawa Balewa University Bauchi, Federal University Kashere Gombe State, and Gombe State University Gombe whereas American University of Nigeria, PEN Resource University Gombe, Al-Ansar University Maiduguri, Borno, and American University of Nigeria, Yola are the North East Private Institution.

South West Public institution includes University of Ibadan, Obafemi Awolowo University, University of Lagos , and Federal University of Technology Akure.

South West Private institution are Covenant University Ota, Landmark University, Redeemer's University, and Joseph Ayo Babalola University

South South Public Institution are University of Port Harcourt, 2. University of Calabar, 3. University of Uyo 4. Federal University of Petroleum Resources Effurun whereas South South Private institution, Igbinedion University Okada, 2. Edo University Iyamho, 3. Benson Idahosa University 4. Novena University Ogume,

South East Public Institution are University of Nigeria, Nsukka, Nnamdi Azikiwe University, Awka

Federal University of Technology, Owerri, and Micheal Okpara University of Agriculture,

South East Private institution includes Madonna University, Okija , Caritas University, Amorji Nike Enugu, Godfrey Okoye University Enugu, and Tansian University, Umunaya

A three-month survey was carried out to gather high-quality data that reflected the opinions of the pupils. Students and employees from private and public institutions who gave their agreement and were present on school grounds during the research work were given questionnaires. To make sure the questionnaire was suitable for its intended use, it underwent validation. Prior to distribution, the questionnaire was piloted with 25 students to get their opinion on how clear the items were. The technique of purposeful sampling was adopted.

The researcher divided the students' responses (respondents) into public and private institutions in order to use the Two Persons Zero Sum Game. Public institutions stand in for player A, who plays the row position, while private institutions represent player B, who plays the column position. Out of the 23,000 questionnaires distributed, 17,456 responses were found, resulting to a response measure of 75.8%. Out of the 12,000 questionnaires given across 24 public institutions (500 each), 8467 were retrieved, or 70.6%, with 29.4% of the surveys (3533) not returned. Additionally, 8989 questionnaires—or 81.7%—of the 11,000 that were delivered to 22 private colleges (500 each) were recovered, while 18.3% (or 3533) were not.

The questionnaire has sections for demographic information (gender, age, university and location, current student level) and evaluation questions for the elements that influenced respondents' decisions on which university to attend. In section three's table, the responses for the criteria taken into consideration are shown.

2.1 Two-person zero-sum Game

Two-person zero-sum Game consists of two players, each with a unique set of strategies. The objective of one player is to maximize her payment, whereas the objective of the opposing player is to decrease this payoff. This suggests that one player's gain is another's loss (payoff). Each player's reward is determined by her decision, as well as by the other player's decision.

A two-person game is referred to as a zero-sum game if the total payouts to each player remain the same regardless of the game's outcome. Each payoff vector's terms must, in order word, add up to the same sum for each payoff vector. Another name for it is a constant-sum game.

In particular, a game with only two players, such as player A and player B, is referred to as a two-person zero sum game if player A's benefit is equal to player B's loss, making the sum total zero.

The payoffs (gains or losses) can be displayed as a payoff matrix when participants choose their specific strategy. Due to the zero sum nature of the game, one player's gain is another's loss, and vice versa. Assume A and B each have m and n strategies, respectively.

Consider the following payoff matrix.

Player B's strategies

$$\begin{array}{c}
 \text{Player A's strategies} \\
 A_1 \\
 A_2 \\
 \vdots \\
 A_m
 \end{array}
 \begin{array}{c}
 B_1 \quad B_2 \quad \dots \quad B_n \\
 \left[\begin{array}{cccc}
 a_{11} & a_{12} & \dots & a_{1n} \\
 a_{21} & a_{22} & \dots & a_{2n} \\
 \vdots & \vdots & \dots & \vdots \\
 a_{m1} & a_{m2} & \dots & a_{mn}
 \end{array} \right]
 \end{array}$$

Figure 1: A pay off matrix.

Player A wishes to achieve the largest payment a_{ij} while player B will make every effort to get the smallest value a_{ij} . Should Player B win and Player A lose, then it becomes $(- a_{ij})$.

2.2 Assumptions for two-person zero sum game

There are only a limited number of options available to each player. There are instances when each player will have the identical set of options. Alternatively, each player may have a specific course of action that is unavailable to the other player, even if some options are open to both players. Player A tries to get as much as possible for himself. Player B makes an effort to limit his own losses. Prior to the play, each players make their decisions independently without consulting one another. To prevent one player gaining from direct experience of the decision made by the opposing player, the decisions are made and announced simultaneously. The two participants are aware of the potential rewards for themselves and their opponents.

2.3 Minimax and Maximin Principles

The fundamental issue with playing games is that each player must choose an optimal strategy without being aware of their opponent's approach. The goal of game theory is to determine how these players should choose their individual strategies in order to maximize their payoffs. The minimax-maximin principle is a term used to describe such a decision-making criterion. This rule ensures that the optimum approach is chosen for both players in games of pure strategy.

The payoff $\min a_{ij}$, which is the minimum of the i^{th} row components in the payoff matrix, is gained by player A, for instance, if he selects his i^{th} strategy. Given that his objective is to maximize his payout, he can choose method I to do so, which will result in a payment that is greater than $\max \min a_{ij}$. $1 \leq i \leq m$ $1 \leq j \leq n$. Similar to player A, player B can decide on the j^{th} column elements to limit his loss to the maximum and minimum of a_{ij} . $1 \leq j \leq n$ $1 \leq i \leq m$

The game is considered to have a saddle point (equilibrium point) if the maximin value for one player equals the minimax value for another player, i.e. $\max \min a_{ij} (1 \leq i \leq m \ 1 \leq j \leq n) = V = \min \max a_{ij} (1 \leq j \leq n \ 1 \leq i \leq m)$. The related tactics are therefore referred to as optimal strategies. They must be equal if there are two or more saddle points.

The value of the game is defined as the payout, or V , at an equilibrium point. In the long run, the participants can determine the best tactics. The game is considered fair if $V=0$.

2.4 Data collection

The data collected on the twenty three factors considered on the students choice of institutions are summarized in Table 1 below.

Table 1: Responses on the factors that influence students choice of institutions.

Factors	Public institution (a _i)	Private institution (b _j)
1 Technology	350	120
2 Post-School Benefits	131	100
3 English Proficiency	150	306
4 And Facilities Such As Hygiene Scholarships	200	99
5 Campus Location	140	200
6 The Academic Curriculum Program	269	126
7 Friends influence	457	137
8 Cost	2054	274
9 Campus Size	203	101
10 Proximity To Home	303	78
11 Teaching Quality/Quality Of Education	557	390
12 Teachers Qualification	578	120
13 Influences From Parents	713	817
14 Facilities Of University	498	140
15 Admission Process	285	1011
16 Accountability	503	602
17 University Ranking	142	11
18 Extra-Curricular Activity	109	348
19 Carier prospect	239	152
20 Conduceive learning Environment	208	1927
21 Safety	112	842
22 School reputation	202	106
23 Industrial strike action by ASUU	64	982
TOTAL	8467	8989

In this case the matrix becomes a 23 * 23 matrix given in figure 2.

A=

$a_{1,1}$	$a_{1,2}$	$a_{1,3}$	$a_{1,4}$	$a_{1,5}$	$a_{1,6}$	$a_{1,7}$	$a_{1,8}$	$a_{1,9}$	$a_{1,10}$	$a_{1,11}$	$a_{1,12}$	$a_{1,13}$	$a_{1,14}$	$a_{1,15}$	$a_{1,16}$	$a_{1,17}$	$a_{1,18}$	$a_{1,19}$	$a_{1,20}$	$a_{1,21}$	$a_{1,22}$	$a_{1,23}$
$a_{2,1}$	$a_{2,2}$	$a_{2,3}$	$a_{2,4}$	$a_{2,5}$	$a_{2,6}$	$a_{2,7}$	$a_{2,8}$	$a_{2,9}$	$a_{2,10}$	$a_{2,11}$	$a_{2,12}$	$a_{2,13}$	$a_{2,14}$	$a_{2,15}$	$a_{2,16}$	$a_{2,17}$	$a_{2,18}$	$a_{2,19}$	$a_{2,20}$	$a_{2,21}$	$a_{2,22}$	$a_{2,23}$
$a_{3,1}$	$a_{3,2}$	$a_{3,3}$	$a_{3,4}$	$a_{3,5}$	$a_{3,6}$	$a_{3,7}$	$a_{3,8}$	$a_{3,9}$	$a_{3,10}$	$a_{3,11}$	$a_{3,12}$	$a_{3,13}$	$a_{3,14}$	$a_{3,15}$	$a_{3,16}$	$a_{3,17}$	$a_{3,18}$	$a_{3,19}$	$a_{3,20}$	$a_{3,21}$	$a_{3,22}$	$a_{3,23}$
$a_{4,1}$	$a_{4,2}$	$a_{4,3}$	$a_{4,4}$	$a_{4,5}$	$a_{4,6}$	$a_{4,7}$	$a_{4,8}$	$a_{4,9}$	$a_{4,10}$	$a_{4,11}$	$a_{4,12}$	$a_{4,13}$	$a_{4,14}$	$a_{4,15}$	$a_{4,16}$	$a_{4,17}$	$a_{4,18}$	$a_{4,19}$	$a_{4,20}$	$a_{4,21}$	$a_{4,22}$	$a_{4,23}$
$a_{5,1}$	$a_{5,2}$	$a_{5,3}$	$a_{5,4}$	$a_{5,5}$	$a_{5,6}$	$a_{5,7}$	$a_{5,8}$	$a_{5,9}$	$a_{5,10}$	$a_{5,11}$	$a_{5,12}$	$a_{5,13}$	$a_{5,14}$	$a_{5,15}$	$a_{5,16}$	$a_{5,17}$	$a_{5,18}$	$a_{5,19}$	$a_{5,20}$	$a_{5,21}$	$a_{5,22}$	$a_{5,23}$
$a_{6,1}$	$a_{6,2}$	$a_{6,3}$	$a_{6,4}$	$a_{6,5}$	$a_{6,6}$	$a_{6,7}$	$a_{6,8}$	$a_{6,9}$	$a_{6,10}$	$a_{6,11}$	$a_{6,12}$	$a_{6,13}$	$a_{6,14}$	$a_{6,15}$	$a_{6,16}$	$a_{6,17}$	$a_{6,18}$	$a_{6,19}$	$a_{6,20}$	$a_{6,21}$	$a_{6,22}$	$a_{6,23}$
$a_{7,1}$	$a_{7,2}$	$a_{7,3}$	$a_{7,4}$	$a_{7,5}$	$a_{7,6}$	$a_{7,7}$	$a_{7,8}$	$a_{7,9}$	$a_{7,10}$	$a_{7,11}$	$a_{7,12}$	$a_{7,13}$	$a_{7,14}$	$a_{7,15}$	$a_{7,16}$	$a_{7,17}$	$a_{7,18}$	$a_{7,19}$	$a_{7,20}$	$a_{7,21}$	$a_{7,22}$	$a_{7,23}$
$a_{8,1}$	$a_{8,2}$	$a_{8,3}$	$a_{8,4}$	$a_{8,5}$	$a_{8,6}$	$a_{8,7}$	$a_{8,8}$	$a_{8,9}$	$a_{8,10}$	$a_{8,11}$	$a_{8,12}$	$a_{8,13}$	$a_{8,14}$	$a_{8,15}$	$a_{8,16}$	$a_{8,17}$	$a_{8,18}$	$a_{8,19}$	$a_{8,20}$	$a_{8,21}$	$a_{8,22}$	$a_{8,23}$
$a_{9,1}$	$a_{9,2}$	$a_{9,3}$	$a_{9,4}$	$a_{9,5}$	$a_{9,6}$	$a_{9,7}$	$a_{9,8}$	$a_{9,9}$	$a_{9,10}$	$a_{9,11}$	$a_{9,12}$	$a_{9,13}$	$a_{9,14}$	$a_{9,15}$	$a_{9,16}$	$a_{9,17}$	$a_{9,18}$	$a_{9,19}$	$a_{9,20}$	$a_{9,21}$	$a_{9,22}$	$a_{9,23}$
$a_{10,1}$	$a_{10,2}$	$a_{10,3}$	$a_{10,4}$	$a_{10,5}$	$a_{10,6}$	$a_{10,7}$	$a_{10,8}$	$a_{10,9}$	$a_{10,10}$	$a_{10,11}$	$a_{10,12}$	$a_{10,13}$	$a_{10,14}$	$a_{10,15}$	$a_{10,16}$	$a_{10,17}$	$a_{10,18}$	$a_{10,19}$	$a_{10,20}$	$a_{10,21}$	$a_{10,22}$	$a_{10,23}$
$a_{11,1}$	$a_{11,2}$	$a_{11,3}$	$a_{11,4}$	$a_{11,5}$	$a_{11,6}$	$a_{11,7}$	$a_{11,8}$	$a_{11,9}$	$a_{11,10}$	$a_{11,11}$	$a_{11,12}$	$a_{11,13}$	$a_{11,14}$	$a_{11,15}$	$a_{11,16}$	$a_{11,17}$	$a_{11,18}$	$a_{11,19}$	$a_{11,20}$	$a_{11,21}$	$a_{11,22}$	$a_{11,23}$
$a_{12,1}$	$a_{12,2}$	$a_{12,3}$	$a_{12,4}$	$a_{12,5}$	$a_{12,6}$	$a_{12,7}$	$a_{12,8}$	$a_{12,9}$	$a_{12,10}$	$a_{12,11}$	$a_{12,12}$	$a_{12,13}$	$a_{12,14}$	$a_{12,15}$	$a_{12,16}$	$a_{12,17}$	$a_{12,18}$	$a_{12,19}$	$a_{12,20}$	$a_{12,21}$	$a_{12,22}$	$a_{12,23}$
$a_{13,1}$	$a_{13,2}$	$a_{13,3}$	$a_{13,4}$	$a_{13,5}$	$a_{13,6}$	$a_{13,7}$	$a_{13,8}$	$a_{13,9}$	$a_{13,10}$	$a_{13,11}$	$a_{13,12}$	$a_{13,13}$	$a_{13,14}$	$a_{13,15}$	$a_{13,16}$	$a_{13,17}$	$a_{13,18}$	$a_{13,19}$	$a_{13,20}$	$a_{13,21}$	$a_{13,22}$	$a_{13,23}$
$a_{14,1}$	$a_{14,2}$	$a_{14,3}$	$a_{14,4}$	$a_{14,5}$	$a_{14,6}$	$a_{14,7}$	$a_{14,8}$	$a_{14,9}$	$a_{14,10}$	$a_{14,11}$	$a_{14,12}$	$a_{14,13}$	$a_{14,14}$	$a_{14,15}$	$a_{14,16}$	$a_{14,17}$	$a_{14,18}$	$a_{14,19}$	$a_{14,20}$	$a_{14,21}$	$a_{14,22}$	$a_{14,23}$
$a_{15,1}$	$a_{15,2}$	$a_{15,3}$	$a_{15,4}$	$a_{15,5}$	$a_{15,6}$	$a_{15,7}$	$a_{15,8}$	$a_{15,9}$	$a_{15,10}$	$a_{15,11}$	$a_{15,12}$	$a_{15,13}$	$a_{15,14}$	$a_{15,15}$	$a_{15,16}$	$a_{15,17}$	$a_{15,18}$	$a_{15,19}$	$a_{15,20}$	$a_{15,21}$	$a_{15,22}$	$a_{15,23}$
$a_{16,1}$	$a_{16,2}$	$a_{16,3}$	$a_{16,4}$	$a_{16,5}$	$a_{16,6}$	$a_{16,7}$	$a_{16,8}$	$a_{16,9}$	$a_{16,10}$	$a_{16,11}$	$a_{16,12}$	$a_{16,13}$	$a_{16,14}$	$a_{16,15}$	$a_{16,16}$	$a_{16,17}$	$a_{16,18}$	$a_{16,19}$	$a_{16,20}$	$a_{16,21}$	$a_{16,22}$	$a_{16,23}$
$a_{17,1}$	$a_{17,2}$	$a_{17,3}$	$a_{17,4}$	$a_{17,5}$	$a_{17,6}$	$a_{17,7}$	$a_{17,8}$	$a_{17,9}$	$a_{17,10}$	$a_{17,11}$	$a_{17,12}$	$a_{17,13}$	$a_{17,14}$	$a_{17,15}$	$a_{17,16}$	$a_{17,17}$	$a_{17,18}$	$a_{17,19}$	$a_{17,20}$	$a_{17,21}$	$a_{17,22}$	$a_{17,23}$
$a_{18,1}$	$a_{18,2}$	$a_{18,3}$	$a_{18,4}$	$a_{18,5}$	$a_{18,6}$	$a_{18,7}$	$a_{18,8}$	$a_{18,9}$	$a_{18,10}$	$a_{18,11}$	$a_{18,12}$	$a_{18,13}$	$a_{18,14}$	$a_{18,15}$	$a_{18,16}$	$a_{18,17}$	$a_{18,18}$	$a_{18,19}$	$a_{18,20}$	$a_{18,21}$	$a_{18,22}$	$a_{18,23}$
$a_{19,1}$	$a_{19,2}$	$a_{19,3}$	$a_{19,4}$	$a_{19,5}$	$a_{19,6}$	$a_{19,7}$	$a_{19,8}$	$a_{19,9}$	$a_{19,10}$	$a_{19,11}$	$a_{19,12}$	$a_{19,13}$	$a_{19,14}$	$a_{19,15}$	$a_{19,16}$	$a_{19,17}$	$a_{19,18}$	$a_{19,19}$	$a_{19,20}$	$a_{19,21}$	$a_{19,22}$	$a_{19,23}$
$a_{20,1}$	$a_{20,2}$	$a_{20,3}$	$a_{20,4}$	$a_{20,5}$	$a_{20,6}$	$a_{20,7}$	$a_{20,8}$	$a_{20,9}$	$a_{20,10}$	$a_{20,11}$	$a_{20,12}$	$a_{20,13}$	$a_{20,14}$	$a_{20,15}$	$a_{20,16}$	$a_{20,17}$	$a_{20,18}$	$a_{20,19}$	$a_{20,20}$	$a_{20,21}$	$a_{20,22}$	$a_{20,23}$
$a_{21,1}$	$a_{21,2}$	$a_{21,3}$	$a_{21,4}$	$a_{21,5}$	$a_{21,6}$	$a_{21,7}$	$a_{21,8}$	$a_{21,9}$	$a_{21,10}$	$a_{21,11}$	$a_{21,12}$	$a_{21,13}$	$a_{21,14}$	$a_{21,15}$	$a_{21,16}$	$a_{21,17}$	$a_{21,18}$	$a_{21,19}$	$a_{21,20}$	$a_{21,21}$	$a_{21,22}$	$a_{21,23}$
$a_{22,1}$	$a_{22,2}$	$a_{22,3}$	$a_{22,4}$	$a_{22,5}$	$a_{22,6}$	$a_{22,7}$	$a_{22,8}$	$a_{22,9}$	$a_{22,10}$	$a_{22,11}$	$a_{22,12}$	$a_{22,13}$	$a_{22,14}$	$a_{22,15}$	$a_{22,16}$	$a_{22,17}$	$a_{22,18}$	$a_{22,19}$	$a_{22,20}$	$a_{22,21}$	$a_{22,22}$	$a_{22,23}$
$a_{23,1}$	$a_{23,2}$	$a_{23,3}$	$a_{23,4}$	$a_{23,5}$	$a_{23,6}$	$a_{23,7}$	$a_{23,8}$	$a_{23,9}$	$a_{23,10}$	$a_{23,11}$	$a_{23,12}$	$a_{23,13}$	$a_{23,14}$	$a_{23,15}$	$a_{23,16}$	$a_{23,17}$	$a_{23,18}$	$a_{23,19}$	$a_{23,20}$	$a_{23,21}$	$a_{23,22}$	$a_{23,23}$

Figure2: pay of matrix of the institution choice.

a_i = students choice of public institution due to factor i, $i=1, \dots 23$

a_j = students choice of private institution due to factor j, $j=1, \dots 23$

From table 1, the pay of matrix is generated using $a_i - b_j : j=1, \dots 23$ for each row.

That is :

Row i= $a_i - b_j : j=1, \dots 23$

Row 1= $a_1 - b_j : j=1, \dots 23$

Row 1= $a_2 - b_j : j=1, \dots 23$

Row 1= $a_3 - b_j : j=1, \dots 23$

.

.

.

Row 1= $a_i - b_j : j=1, \dots 23$

This gives;

A=

$$\begin{matrix} & \text{Player B} \\ & b_1 & b_2 & b_3 & b_4 & b_5 & b_6 & b_7 & b_8 & \dots & b_{23} \\ \left[\begin{matrix} (a_1 - b_1) & (a_1 - b_2) & (a_1 - b_3) & (a_1 - b_4) & (a_1 - b_5) & (a_1 - b_6) & (a_1 - b_7) & (a_1 - b_8) & \dots & (a_1 - b_{23}) \\ (a_2 - b_1) & (a_2 - b_2) & (a_2 - b_3) & (a_2 - b_4) & (a_2 - b_5) & (a_2 - b_6) & (a_2 - b_7) & (a_2 - b_8) & \dots & (a_2 - b_{23}) \\ (a_3 - b_1) & (a_3 - b_2) & (a_3 - b_3) & (a_3 - b_4) & (a_3 - b_5) & (a_3 - b_6) & (a_3 - b_7) & (a_3 - b_8) & \dots & (a_3 - b_{23}) \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ (a_{23} - b_1) & (a_{23} - b_2) & (a_{23} - b_3) & (a_{23} - b_4) & (a_{23} - b_5) & (a_{23} - b_6) & (a_{23} - b_7) & (a_{23} - b_8) & \dots & (a_{23} - b_{23}) \end{matrix} \right] \end{matrix}$$

Figure 3: Pay of matrix resulting from Table 1.

Substituting the values give that the payoff matrix is

230	250	44	250	150	224	213	76	247	272	-40	230	467	210	-661	252	339	2	198	-1927	-492	244	-632
11	31	-175	32	-69	5	-6	-143	30	53	-259	11	-686	-9	-188	-471	120	-217	-21	-1796	-711	25	-851
30	50	-156	51	-50	24	-13	-142	49	72	-240	30	-667	10	-861	-452	139	-198	-2	-1777	-692	44	-829
80	100	-106	101	0	74	63	-74	99	122	-190	80	-617	60	-811	-402	189	-148	48	-1727	-642	94	782
20	40	-166	41	-60	14	3	-134	37	61	-250	20	-677	0	-871	-462	129	-208	-12	-1787	-708	34	-842
149	169	-37	170	69	143	132	-5	168	191	-121	149	-548	129	-742	-333	258	-79	117	-1658	-573	164	-713
337	357	151	358	257	331	320	183	356	379	67	337	-360	317	-554	-145	446	109	305	-1470	-385	351	-525
1934	1954	1748	1955	1854	1928	1917	1780	1953	1976	1664	1934	1237	1914	1043	1452	2043	1706	1902	127	1212	1948	1072
83	103	-103	104	3	77	66	-71	102	125	-187	83	-614	63	-808	-399	192	-145	51	-1724	-1639	97	-779
183	203	-3	204	103	177	166	29	202	225	-87	183	-514	163	-708	-299	292	-45	151	-1624	-539	197	-679
437	457	251	458	357	431	420	283	456	479	167	437	-260	417	-454	-45	546	209	405	-1370	-285	451	-425
458	478	272	479	378	452	441	304	477	500	188	458	-239	438	-433	-24	567	230	426	-1349	-264	472	-404
593	813	407	614	513	587	576	439	612	635	323	593	-104	573	-298	111	702	365	561	-1214	-129	607	-269
378	398	192	399	298	374	361	222	397	420	108	378	-319	358	-513	-104	487	150	346	-1429	-344	392	-848
165	185	-21	186	85	159	148	11	184	207	-105	165	-532	145	-726	-317	274	-63	133	-1642	-557	179	-697
383	403	197	404	303	377	366	229	402	425	113	383	-314	368	-508	-99	492	155	351	-1424	-339	397	-479
22	42	-164	43	-53	16	5	-132	41	64	-248	22	-675	2	-869	-460	131	-206	-10	-1785	-700	36	-840
-11	9	-197	10	-91	-17	-28	-165	8	31	-281	-11	-708	-31	-902	-493	98	-239	-43	-1818	-733	3	-873
119	139	-67	140	39	113	102	-35	138	161	-151	119	-578	99	-772	-363	228	-108	87	-1688	-603	133	-743
88	108	-98	109	8	82	71	-66	107	130	-182	88	-609	68	-803	-394	197	-140	56	-1719	-634	102	-774
-8	12	-194	13	-88	-14	-25	-162	11	34	-278	-8	-705	-28	-899	-490	101	-236	-40	-1815	-730	6	-870
82	102	-104	103	2	76	65	-72	101	124	-188	82	-615	62	-809	-400	191	-146	50	-1725	-640	96	-780
-56	-36	-242	-35	-136	-62	-73	-210	-37	-14	-326	-56	-753	-76	-947	-538	53	-284	-88	-1863	-778	-42	-918

Figure 4: Pay of matrix resulting from Figure 3 after substituting the values for a and b.

Thus applying Minimax and Maximin Principles shows that

$$\text{Row min} = \begin{pmatrix} -1577 \\ -1796 \\ -1777 \\ -1727 \\ -1787 \\ -1658 \\ -1470 \\ 27 \\ -1724 \\ -1624 \\ -1370 \\ -1349 \\ -1214 \\ -1429 \\ -1642 \\ -1424 \\ -1784 \\ -1818 \\ -1688 \\ -1719 \\ -1815 \\ -1725 \\ -1863 \end{pmatrix}$$

Colum max =

$$(1938 \ 1954 \ 1748 \ 1955 \ 1854 \ 1928 \ 1917 \ 1780 \ 1953 \ 1976 \ 1664 \ 1934 \ 1234 \ 1914 \ 1043 \ 1452 \ 2043 \ 1706 \ 1902 \ 127 \ 1212 \ 1948 \ 1072)$$

Min of maximum = **127**

3. Results

From the analyses done using minimax principle, the game shows that the value is 127 which indicates that player A which is public University choice wins the competition under the cost strategy since the value is above zero, whereas the player B which is public University lost the competition but minimizes its loss using Conducive learning Environment.

This implies that people choose to study in public institutions due to cost of education whereas people choose private institution due to Conducive learning Environment. In other words, private institutions has better learning environment than public schools but very expensive in acquiring knowledge.

4. Conclusion

The study is on the peoples preferences between public and private institution in Nigeria.

Samples of four private and public institutions from each of the six geopolitical zones were selected for this research. Data collected from the twenty four factors considered through the use of questionnaire were analyzed using minimax principle of Two-Persons zero sum Game. The results show that amongst several reasons for choice of institutions, majority of students prefers Public schools due to little or no cost of education whereas private institution is preferred due to the conducive learning Environment.

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