Application of Game Theory in the Nigerian Electoral System

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Abstract: - In this paper, we carry out a study on the application of game theory in the Nigerian electoral system. The data for the study was collected from the official publication of INEC results for six major political parties in the February 25th, 2023 presidential election in Nigeria. In the competitive game, each political party and INEC used mixed strategies in the game. The political parties compete for the electorates' vote while INEC regulates the game. INEC has six strategies and political parties also have six strategies which they apply in various proportions to outweigh the other. Therefore, for any of the political parties to be successful in the election, she must apply: party structure up to 19.54%; manifesto up to 20.18%; campaign up to 19.05%; people's perception of the political party up to 20.26%; vote from electorate up to 19.54% and acceptable candidate up to 1.43% of the time respectively. For INEC to effectively perform her statutory responsibility, she must apply: electoral law up to 18.71%; electoral guidelines up to 19.99%; prosecuting electoral offenders up to 16.87%; cancelling elections up to 23.14%; inconclusive elections up to 19.19%; declaration of results up to 2.10% of the time respectively and the value of the game was 1.5337

Key-Words: - Game theory, Electoral system, Strategies, Game value, Linear programming

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1 Introduction

A game is an interaction of two decision-makers with defined rules and regulations that each player must observe and at the end of the game each player either gains or suffers a loss, see [1]. The reward could either be gains or losses. Mixed strategies are the probability of applying each of the strategies over a given number of times. Game theory is an independent body of knowledge that has applications across disciplines such as mathematics, Biology, Economics, and anything that involves competition and rationality, see [2]. Most of these games have only one winner after playing and hence a two-person zero-sum game where a loss to one is a gain to the other. Our interest is in competitive games and this description is an example of a competitive game. Other situations can be formulated as games; therefore, we see a game as an abstraction that defines the description of a strategic situation. The major interest of players in a game is to maximize their payoffs or minimize their losses as the case may be. The owner of the game always plays to maximize payoff while the defender plays to minimize losses. The defender would concentrate on her smallest possible payoff instead of being careless and making a loss. In this case, the players are said to be playing their pure strategies, and the game is expected to have a saddle point which incidentally corresponds to the value of the game. But if this idea of playing pure strategy fails, then each player should look for dominating and dominated strategies. It is advisable to adopt a dominance rule. For instance, the dominance rule states that a defender of the game should choose the minimum row as a dominating row and discard the maximum row as a dominated row because he/she wants to minimize losses. On the contrary, the dominance rule for the owner of the game states that the player will choose the maximum column as a dominating column and discard the minimum column as a dominated column as he/she wants to maximize profit [3].

Life is an expression of Game theory in all respects because it involves competition. In this paper, we are interested in the Nigerian electoral system as a game and the players are the Independent Electoral Commission and the political parties; in this case, we have two intelligent players. The Independent National Electoral Commission (INEC) owns the game. He plays along the columns of the game matrix and plays the minimax criterion to maximize her profit. At the same time, the political parties are the defenders who also compete among themselves and INEC. They play along the rows of the matrix and play maximin criterion to minimize her losses. Among the political parties, each of these players competes for the electorates and their votes. INEC regulates the activities of the political parties. These set of standards are called the strategies. The INEC strategies that she applies against political parties are: 1. Electoral laws, 2. Electoral guidelines, 3. Cancelation of the result of some erring pooling boots, 4. Declaring an election Inconclusive, 5. Disqualification of candidates in the case of irregularities or falsification and 6. Declaration of election result. That is, INEC has six strategies to apply to maintain law and order. Again, political parties have six strategies such as 1. Party structures, 2. Manifestoes, 3. Campaign, 4. Good perception of their political parties, 5. Vote from electorates, 6. Presentation of an acceptable candidate for general election; therefore, political parties have six strategies also.

INEC applies the electoral law to regulate the activities of the political parties and the party candidates. It is expected that the political parties and their candidate should comply with the electoral law, any deviation could lead to disqualification of the candidate or nullification of an election. The electoral guideline is a set of rules of engagement. The electoral umpire sets out these rules to guide the conduct of the election and make it known to both the political parties and the electorates. The electoral body has the power to cancel any electoral process that does not follow the electoral law or guidelines, but the umpire has limited power over this. If the election result was announced in compliance with the electoral law and there was disagreement between political parties, the electoral body or the political party or the

candidate can refer the matter to court for adjudication. Again, the electoral body can declare an election inconclusive depending on the set-out rules from the electoral law. The electoral body has the power to disqualify a candidate based on non-compliance with the electoral laws and guidelines. Finally, the electoral body is saddled with the responsibility to declare the result of the election and return whoever satisfies the requirement of the law elected. These set-out parameters are called the strategies which the electoral body uses to play the game and it is within the discretion of INEC to determine the proportion of time to use each of the strategies. The votes from the electorates form the cost matrix upon which the competition is based. The manifestoes of each political party sell them to the electorates. Electorates will always look for a political party that has their interest at heart and who captures most of their expectations in the manifestoes. In other words, manifestoes are a marketing strategy that sells the political parties to the electorates. In recent times, we have seen that political structure plays a pivotal role, not only in monitoring the election but grassroots mobilization. A structure-less political party may win an election but will be rigged out because there would be few or no ones in some areas to protect the interest of the political party. Campaigns are the most effective marketing strategies of political parties. During the campaign, the political parties make their intentions known to the electorates, make some promises, etc, that will make the electorates vote for them in the general election. The perception or public image of the political parties to the electorates is another important factor to the political parties. Every political party wants to have a good image before the electorate. The image makers of political parties, mostly their spokesperson, try to create this good image about their political parties. The ultimate goal is the vote of the electorates and to gain legitimacy from the people. Though these things do not move as smoothly as they should in Nigeria, yet, we are assuming that electoral umpires are just and should do their work without fear or favour. The proper combination of these factors in a given proportion will give a political party a lead in an election.

In this study, we apply game theory in the Nigerian electoral system to determine the various strategies INEC would apply in determining electoral success in Nigeria and also the various strategies political parties would apply to win the election; the (probability) proportion of the time each of the strategies would be applied by each player and the value of the game. This paper aims to apply game theory in the Nigerian electoral system and the objectives are:

To model the electoral process as a competitive game problem, where INEC and Political parties are the players.

1. To obtain the value of the game

2. To determine the strategies adopted by the electoral body (INEC).

3. To determine the strategies adopted by the political parties.

2 Literature Review

The mathematical foundation of the Theory of Competitive Games was laid by von Neumann [4] and it was through the collaboration of von Neumann and Morgenstern that economists learned of this tool for analysing economic problems. The history of the adaptation and development of game theory was traced to [5, 6] even though the mathematical and general foundation of the body of knowledge was attributed to [1]. In reality, some people always expect the worst but this is not in isolation from rationality. Because he is conscious of not losing to his opponent, he always anticipates the opponent's move, see [7]. But Nash Equilibrium is a point where each player maintains a balance in the game, it is a point where each of the players is playing his pure strategy and this point is the value of the game, see [8]. Game theory is the application of real-life scenarios to solve practical problems. It has diverse applications across disciplines, see [9]. In dynamic games with mixed strategies, dominance plays a negligible impact. Hence, each player plays his mixed strategies at a given proportion of time to

win over his opponent [10]. Game is a subset of applied mathematics with an application aspect of statistics known as decision theory. It involves two players which could be described as intelligent and rational players, see [11]. Previously, Game theory was seen as a concept that cannot be quantified in solving a real-life problem, see [12]. Game theory is as real as life itself and it is quantifiable. Its application cuts across almost every activity in life. According to some researchers, the academic performance of students involves two major players; the lecturers trying to defend the integrity of the process and the students whose interests are to graduate with good classes at all costs. This is a two-person zero-sum game where each is trying to bring the best strategies to outweigh the other and a loss for one is a gain to the other. Students and lecturers are in constant competition on who gets what in their academic performance. The lecturers try to protect the integrity of their institutions by maintaining a high level of standard and reputation for their institutions while the students try at all costs to make good grade points. Both the lecturers and the students employ different strategies to achieve this [1]. Other researchers applied Game theory to model a cyber-security problem. Their work was concerned with a two-person zero-sum game with multiple strategies for a cyber-security attack line in a DoS/DDoS scenario. In this case, the network provider (defender) competes with the attacker (illegal users). The defender of the game tries as much as possible to protect the bandwidth from the attacker, whose interest is to attack the bandwidth, thereby causing a denial of service (DoS). If the attack originated from more than one node, it implies that the attack is distributed DoS [13]. Game theory provides the tools for modelling the interaction between two rational competitors, see [14]. Some researchers demonstrated the application of Game theory in the Werewolf game, see [15]. Still on the practical application of Game theory,[16] used Game theory to model construction work, also, there are so many other applications of Game theory.

Game theory [`7] has been used to show how Bitcoin transactions and blockchains work in real scenarios. It was observed that the Bitcoin miners are in rational competition with one another to outweigh the other for a reward. The application of game theory cuts across many activities in life, provided there is a competition or collaboration, an aspect of game theory must be involved. Since a gain to one is a loss to the other, the game theory involved is a zero-sum game. The application of games finds space in solving various economic problems [18] that require decision-making at various stages. The ability to cope with business and various economic challenges is dependent on rationality, knowing that the competitors (opponents) are also intelligent. A decision-maker must bear in mind that it is either he wins or loses value to the opponents who are competing with him.

The authors [19] buttressed the application and theoretical aspects of game theory as a complex mathematical theory that aids in decision-making. They noted that game theory is associated with competition and rational decision-making. The conflict situation where players adopt all known strategies to win is a game problem where a loss to one is a gain to the other. The authors observed that the conflicts cut across social, political, and economic spheres of life; and players in a game include political parties, governments, firms or businesses, prison inmates and professional sports franchises, etc. However, our interest in this paper is to apply game theory in politics. Game theory was applied between doctors and patients [20] where each is competing with the other for a common interest. The doctors have different strategies such as maintaining ethical standards, commitment to duty in other to save lives, malpractices to make money, and other unethical standards to cut corners, etc., the patients on the other hand have their counter strategies to defy the doctors' ingenuity and in all there has to be an equilibrium which is the value of the game. Depending on the side one is looking at it, game

theory provides solutions to rational decision problems.

In a related development, a wonderful review work was done by [21], where details on game theory were given and a comparison of the popularity of game theory and entrepreneurship was made using different journal indexing databases such as EBSCO, Google Scholar, etc., and the review showed that game theory was more popular than the entrepreneurship. This indicates the popularity and application of game theory in different fields of life. The author observed that government decisions and policies could be modelled using game theory for optimal performance. The reviewed work shows that the application and popularity of game theory are on the increase. Again, similar work was done by [22], where a bibliometric analysis of game theory was carried out to compare the popularity of game theory concerning energy and natural resources. The research was based on published works on these areas with a special interest in WOS (Web of Science) indexing. The result showed that game theory ranks highest in popularity, followed by environment and green innovation technology. Therefore, game theory is gaining very much ground in recent years as more people discover its application in solving decision-related problems. In this paper, our interest is to apply game theory in the Nigeria electoral system where the players are the political parties and the Independent National Electoral Commission (INEC).

3 Materials and Methods

3.1 Nature of Data for the Study

The nature of data for this study is secondary data published by INEC on the performance of the six most popular political parties in the Nigerian presidential election of February 25, 2023.

3.2 Population of the Study

The population of the study cut across the entire population of adult Nigerians who took part in the February 25, 2023 presidential election in Nigeria. The concern of this study is on the eight registered political parties that took part in the presidential election.

3.3 Sample Size

We are concerned with the presidential election results of February 25, 2023, and our specific focus is on the six most popular political parties in the election namely: All Progressive Congress (APC), Peoples Democratic Party (PDP), Labour Party (LP), New Nigerian Peoples Party (NNPP), All Progressive Grand Alliance (APGA) and Action Alliance (AA). Their actual respective votes according to the official publication of INEC will be used for the study.

3.3 Method of Data Analysis

In finding solutions to game theory problems, there are about four methods that can be used. The first is to look for saddle points if the players are playing a pure strategy, basically when the game is static, but in this case, it will be impossible for political parties to apply a pure strategy in a dynamic game like this. Hence, since the game is dynamic, both INEC and political parties will use a mixed strategy to play the game. In this case, we observed that pure strategy and arithmetic methods naturally fail. Secondly, we considered a solution by dominance. In this case, each political party is trying to minimize losses by playing the minimum rows and considering the maximum row as a dominated row while the minimum row is a dominating row. But this game is large and not only that no row entirely dominates the other, we observed that no available strategy should be ignored, otherwise, the political party will inflict self-injuries on itself. On the other hand, INEC is the owner of the game and stands to lose nothing provided it plays its statutory role. INEC is funded by the government of Nigeria and therefore not in any way losing financial value but as a player in the game, she plays along the column of the cost matrix and the dominant role

for her is to play the maximum column as a dominating column and eliminate the minimum column as a dominated column and finally play to maximize her profit, and also play minimax criterion to achieve maximum benefit from the game. The political parties play maximin criterion to minimize their losses. To INEC, all the strategies are important, apart from the fact that none of the columns entirely dominate the other, all the strategies need to be upheld. In this case, the dominance rule fails, hence, the arithmetic method has naturally failed. The third method of solution is the matrix method and we found that the column and row oddments of the cost matrix are not the same and hence the arithmetic method fails also. At this juncture, we apply the linear programming method which is the general solution to the game problem. Every two-person zero-sum game is equivalent to a linear programming problem [1]. This finding allowed for the easy calculation of the optimal strategies for any mxn matrix game using the Simplex / Dual Simplex method.

3.4 Assumptions of the Model

The following are the assumptions that guided us in the development of the Game model:

1. The cost matrix does not have a saddle point

2. No row or column dominates the other.

3. Column oddment is not equal to row oddment.

4. Each player has a mixed strategy to adopt.

Table 1. Layout of the Cost Matrix

Political Parties	INEC					
	A	**B**	**C**	**D**	**E**	**F**
K	X_{ka}	X_{kb}	X_{kc}	X_{kd}	X_{ke}	X_{kf}
L	X_{la}	X_{lb}	X_{lc}	X_{ld}	X_{le}	X_{lf}
M	X_{ma}	X_{mb}	X_{mc}	X_{md}	X_{me}	X_{mf}
N	X_{na}	X_{nb}	X_{nc}	X_{nd}	X_{ne}	X_{nf}
O	X_{oa}	X_{ob}	X_{oc}	X_{od}	X_{oe}	X_{of}
P	X_{pa}	X_{pb}	X_{pc}	X_{pd}	X_{pe}	X_{pf}

INEC has six (6) strategies a, . . . , f and Political Parties has six (6) strategies k, . . . , p. Table 1 is explained as follows:

INEC

The six INEC strategies are:

a = Electoral law

b = Electoral guideline

c = Prosecuting electoral offenders

d = Cancelling election

e = Inconclusive election

f = Declaration of electoral result

Political Parties

The six Political parties' strategies are:

k = Party structure

l = Manifestoes

m = Campaign

n = People's perception of the political party

o = Vote from the electorate

p = Acceptable candidate in the general election

Cost Matrix

The values of the cost matrix X_{ka}, $X_{kb, \ldots}$, X_{pe}, X_{pf}, X_{pf} represent the proportion of votes as a result of the combination of the strategies.

Column allocation of Cost Matrix:

APC = column a

PDP = column b

LP = column c

ANPP = column d

APGA = column e

AA = column f

Table 2. Weights of Party Strategies

Characteristics	Weight
k = Party structure	0.21
l = Manifestoes	0.13
m = Campaign	0.2
n = People's perception of party	0.12
o = Vote from the electorate	0.23
p = Acceptable candidate	0.11
Total	1

Source: Researchers, 2023

3.5 The Game model

From the political party's point of view, the interest is to minimize losses which are associated with the strategies to be adopted. However, minimization of the losses (1/V) is the same as maximization of the inverse of the losses due to strategies, subject to the respective cost constraints. Hence, we have;

$$\text{Maximize Z} = \left(\frac{1}{\frac{1}{v}}\right) = \sum_{j=1}^{6} \text{Cx}_j \quad (1)$$

$$\text{Subject to } \sum_{i=1}^{6}\sum_{j=1}^{6} x_{\text{ij}} \leq v \quad (2)$$

Where

$$Z = k + l + \ldots + p = 1 \text{ (sum of probability)} \quad (3)$$

v = value of the game, ie. the constraint (4)

Formulating the problem, we have;

$$\text{Maximize} Z = \frac{k}{v} + \frac{l}{v} + \ldots + \frac{p}{v} \quad (5)$$

$$\text{Max Z} = Y_1 + \ldots + Y_6 + 0\text{S}_1 + \ldots + 0\text{S}_n \quad (6)$$

$$\text{where Y}_j = \frac{y_j}{v} \Rightarrow y_j = \text{v.} \quad (7)$$

Subject to

$$Y_1 + \ldots + Y_6 + S_1 = 1 \quad (8)$$

$$\vdots$$

$$Y_1 + \ldots + Y_6 + S_6 = 1$$

Where S_j is the augmented slack variables that form the starting solution

The value of the game V is

$$V = \frac{1}{\left(\frac{1}{v}*\right)} = \frac{1}{Z} \quad (9)$$

Where Z is the optimal objective function.

From equation (7), the strategies for political parties are:

$$y_j = \text{v.Y}_1 + \ldots + \text{v.Y}_6 \quad (10)$$

From the duality theory, the strategies for INEC are:

$$x_j = \text{v.X}_1 + \ldots + \text{v.X}_6 \quad (11)$$

Where $x_j > 0, = X_{j,} > 0, y_i > 0,\ S_{j,} > 0$

4 Data Presentation and Analysis

4.1 Data Presentation

In Table 3, we present the number of votes obtained by each political party, and in Table 4, we present the breakdown of the votes from each political party based on the six strategies, see Appendix 1. In Appendix 2, we present the tabular solution to the game problem.

4.2 Data Analysis

Let the value of the game to political parties (A) be V

From INEC's (B) point of view, she will play to minimize V.

Applying equation (2), we have

A1: $1846893y_1 + 1466749y_2 +$

$$1281322y_3 + 314301y_4 + 259605y_5 + 232281y_6 \leq V$$

A2: $1143314y_1 + 907988y_2 + 793199y_3 + 194567y_4 + 160708y_5 + 143793y_6 \leq V$

A3: $1758945y_1 + 1396904y_2 + 1220307y_3 + 299334y_4 + 247243y_5 + 221220y_6 \leq V$

A4: $105536y_1 + 838142y_2 + 732184y_3 + 179601y_4 + 148346y_5 + 132732y_6 \leq V$

A5: $202287y_1 + 1606440y_2 + 1403352y_3 + 344234y_4 + 284330y_5 + 254404y_6 \leq V$

A6: $967420y_1 + 768297y_2 + 761169y_3 + 164634y_4 + 135983y_5 + 121672y_6 \leq V$

From equation (3), we have

$$y_1 + y_2 + y_3 + y_4 + y_5 + y_6 = 1$$

$$y_1, y_2, y_3, y_4, y_5, y_6 \geq 0$$

$$1846893\frac{y_1}{V} + 1466749\frac{y_2}{V} + 1281322\frac{y_3}{V} + 314301\frac{y_4}{V} + 259605\frac{y_5}{V} + 232281\frac{y_6}{V} \leq 1$$

$$1143314\frac{y_1}{V} + 907988\frac{y_2}{V} + 793199\frac{y_3}{V} + 194567\frac{y_4}{V} + 160708\frac{y_5}{V} + 143793\frac{y_6}{V} \leq 1$$

$$1758945\frac{y_1}{V} + 1396904\frac{y_2}{V} + 1220307\frac{y_3}{V} + 299334\frac{y_4}{V} + 247243\frac{y_5}{V} + 221220\frac{y_6}{V} \leq 1$$

$$105536\frac{y_1}{V} + 838142\frac{y_2}{V} + 732184\frac{y_3}{V} + 179601\frac{y_4}{V} + 148346\frac{y_5}{V} + 132732\frac{y_6}{V} \leq 1$$

$$202287\frac{y_1}{V} + 1606440\frac{y_2}{V} + 1403352\frac{y_3}{V} + 344234\frac{y_4}{V} + 284330\frac{y_5}{V} + 254404\frac{y_6}{V} \leq 1$$

$$967420\frac{y_1}{V} + 768297\frac{y_2}{V} + 761169\frac{y_3}{V} + 164634\frac{y_4}{V} + 135983\frac{y_5}{V} + 121672\frac{y_6}{V} \leq 1$$

From equation (5), we have

$$\frac{y_1}{V} + \frac{y_2}{V} + \frac{y_3}{V} + \frac{y_4}{V} + \frac{y_5}{V} + \frac{y_6}{V} = \frac{1}{V}$$

From equation (7),

Let $\frac{y_i}{V} = Y_j$; then we have,

$$1846893Y_1 + 1466749Y_2 + 1281322Y_3 + 314301Y_4 + 259605Y_5 + 232281Y_6 \leq 1$$

$$1143314Y_1 + 907988Y_2 + 793199Y_3 + 194567Y_4 + 160708Y_5 + 143793Y_6 \leq 1$$

$$1758945Y_1 + 1396904Y_2 + 1220307Y_3 + 299334Y_4 + 247243Y_5 + 221220Y_6 \leq 1$$

$$105536Y_1 + 838142Y_2 + 732184Y_3 + 179601Y_4 + 148346Y_5 + 132732Y_6 \leq 1$$

$$202287Y_1 + 1606440Y_2 + 1403352Y_3 + 344234Y_4 + 284330Y_5 + 254404Y_6 \leq 1$$

$$967420Y_1 + 768297Y_2 + 761169Y_3 + 164634Y_4 + 135983Y_5 + 121672Y_6 \leq 1$$

$$Y_1 + Y_2 + Y_3 + Y_4 + Y_5 + Y_6 = \frac{1}{V}$$

Augmenting the slack variables, from equation (6), we have

Maximize $Z \quad -Y_1 - Y_2 - Y_3 - Y_4 - Y_5 - Y_6 + 0S_1 + 0S_2 + 0S_3 + 0S_4 + 0S_5 + 0S_6 = 0$

From equation (8), we have,

Subject to

$$1846893Y_1 + 1466749Y_2 + 1281322Y_3 + 314301Y_4 + 259605Y_5 + 232281Y_6 + S_1 = 1$$

$$1143314Y_1 + 907988Y_2 + 793199Y_3 + 194567Y_4 + 160708Y_5 + 143793Y_6 + S_2 = 1$$

$$1758945Y_1 + 1396904Y_2 + 1220307Y_3 + 299334Y_4 + 247243Y_5 + 221220Y_6 + S_3 = 1$$

$$105536Y_1 + 838142Y_2 + 732184Y_3 + 179601Y_4 + 148346Y_5 + 132732Y_6 + S_4 = 1$$

$$202287Y_1 + 1606440Y_2 + 1403352Y_3 + 344234Y_4 + 284330Y_5 + 254404Y_6 + S_5 = 1$$

$$967420Y_1 + 768297Y_2 + 761169Y_3 + 164634Y_4 + 135983Y_5 + 121672Y_6 + S_6 = 1$$

$$Y_1,Y_2,Y_3,Y_4,Y_5,Y_6,S_1,S_2,S_3,S_4,S_5,S_6 \geq 0$$

$$V = \frac{1}{\left(\frac{1}{v}*\right)} = 1.5337$$

From equation (10), the strategies for political parties are;

$$y_j = V.Y_1 + \ldots + V.Y_6$$

$$(y_1,y_2,y_3,y_4,y_5,y_6) = (0.1954;\ 0.2018;\ 0.1905;\ 0.2026;\ 0.1954;\ 0.0143)$$

From equation (11), the strategies for INEC are;

$$x_i = V.X_1 + \ldots + V.X_6$$

$$(x_1,x_2,x_3,x_4,x_5,x_6) = (0.1871;\ 0.1999;\ 0.1687;\ 0.2314;\ 0.1919;\ 0.0210)$$

5. Discussion and Recommendation

5.1. Discussion

From the last tableau, see Appendix 2, we observed that the optimal objective function, which was to maximize the inverse of the value of the game, was 0.652. We know that player A's interest was to minimize losses (1/V), which was the same as maximizing the inverse of (1/V). Therefore, the value of the game is 1.5337. Again, the strategies for the political parties are the primal decision variables which were represented by y_i's, and the strategies for INEC which were the dual decision variables were represented by x_i's. These decision variables are the strategies, see the summary of parties' and INEC's strategies in Appendix 3. Both players applied their mixed strategies in various proportions. We should note that the mixed strategies are the probabilities of applying each strategy over a given proportion of time. The application of mixed strategies keeps the opponent guessing on which strategy should be used. Mixed strategy has an advantage over pure strategy because each player has multiple choices of which strategy to choose, while pure strategy uses only one strategy. A complex system such as Nigeria's electoral system and politicking requires mixed strategies which were exactly applied by each player to win the election. We also noticed from Appendix 3 that the sum of the strategies for both political parties and INEC is unity (that is, one) respectively. This corresponds to the law of probability which states that the sum of probabilities of an event is one.

From the parties' and INEC's strategy summary table in Appendix 3, we interpret as follows: The value of each probability determines the magnitude of application of each strategy by INEC and political parties. Therefore, for any of the political parties to be successful in the election, she must apply: party structure up to 19.54% of the time; manifesto up to 20.18% of the time; campaign up to 19.05% of the time; people's perception of the political party up to 20.26% of the time; vote from electorate up to 19.54% of the time and acceptable candidate up

to 1.43% of the time. On the other hand, for INEC to effectively perform her statutory responsibility, she must apply electoral law up to 18.71% of the time; electoral guidelines up to 19.99% of the time; prosecute electoral offenders up to 16.87% of the time; cancel election up to 23.14% of the time, inconclusive election up to 19.19% of the time and declaration of results up to 2.10% of the time. The above is also interpreted as the amount of time and effort needed to be devoted to each of these strategies. The political parties and INEC combine these strategies in different proportions to beat their opponents.

5.2. Conclusion

In this paper, we carry out a study on the application of game theory in the Nigerian electoral system. In the competitive game, each player, political parties, and INEC play more than one strategy and hence, they adopt mixed strategies. The advantage of playing a mixed strategy is that the players keep guessing what the next move of the opponent would be. The political parties compete for the electorate's vote while INEC regulates the game. INEC has six strategies and political parties also have six strategies that they apply in various proportions. The data for the study was collected from the official publication of INEC results from six major political parties in the February 25th presidential election in Nigeria. The total vote for each political party was used to generate the cost matrix alongside the weighted strategies. Each political party was assigned a column in the cost matrix and the weights on each strategy were applied to generate the game (cost) matrix. From this study, we conclude that there is a need to adopt the scientific method (Game theory) in our electoral system for optimal performance against the current haphazard, rigging, and imposition of candidates who cannot naturally win elections. There should be further study in this area of application of game theory in the electoral system but in a slightly different direction. Since there is cooperation among members of each political party, more work should be done on cooperative game theory in conjunction with the zero-sum game which we considered in this paper because cooperative game or a combination of both could provide a better model for the electoral system.

5.3. Recommendations

From this research, we recommend that:

(1). Game theory should be adopted and applied by political parties for optimal benefits. (2). The electoral body should adopt and apply game theory to maintain its integrity and give legitimacy to whoever wins the election.

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Conflict of Interest

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Appendix 1

Table3. Total votes obtained by each political party in the presidential election, 2023

	POLITICAL PARTIES					
	APC	PDP	LP	ANPP	APGA	AA
VOTES OBTAINED	8,794,726	6,984,520	6,101,533	1,496,671	1,236,215	1,106,102

Source: em.m.wikipedia.org; 2023 Nigerian presidential election.

Table 4. The proportion of votes obtained by each political party based on Table 2&3

	INEC (B)					
PARTIES (A)	a(1)	b(2)	c(3)	d(4)	e(5)	f(6)
k(1)	1846893	1466749	1281322	314301	259605	232281
l(2)	1143314	907988	793199	194567	160708	143793
m(3)	1758945	1396904	1220307	299334	247243	221220
n(4)	1055367	838142	732184	179601	148346	132732
0(5)	2022787	1606440	1403352	344234	284330	254404
p(6)	967420	768297	671169	164634	135983	121672
TOTAL	**8794726**	**6984520**	**6101533**	**1496671**	**1236215**	**1106102**

Source: Researchers, 2023

Appendix 2

Solving the resulting Linear programming problem using the simplex method, we have,

BASIC	Z	Y1	Y2	Y3	Y4	Y5	Y6	S1	S2	S3	S4	S5	S6	RHS
Z	1	-1	-1	-1	-1	-1	-1	0	0	0	0	0	0	0
S1	0	1846893	1466749	1281322	314301	259605	232281	1	0	0	0	0	0	1
S2	0	1143314	907988	793199	194567	160708	143793	0	1	0	0	0	0	1
S3	0	1758945	1396904	1220307	299334	247243	221220	0	0	1	0	0	0	1
S4	0	1055367	838142	732184	179601	148346	132732	0	0	0	1	0	0	1
S5	0	2022787	1606440	1403352	344234	284330	254404	0	0	0	0	1	0	1
S6	0	967420	768297	671169	164634	135983	121672	0	0	0	0	0	1	1

There are six iterations involved to arrive at the optimal tableau; hence, the final tableau is

Basic	Z	Y1	Y2	Y3	Y4	Y5	Y6	S1	S2	S3	S4	S5	S6	RHS
Z	1	0	0	0	0	0	0	-0.1220	-0.1304	-0.1100	0.1509	0.1251	0.0136	0.652
Y5	0	0	0	0	0	1	0	-0.5836	-1.1276	0.6263	0.5281	0.690	-0.710	-0.1274
Y4	0	0	0	0	1	0	0	-0.251	1.1171	-1.1209	1.5842	-0.431	0.371	0.1321
Y3	0	0	0	1	0	0	0	-0.6673	-0.7553	1.2527	0.0561	-0.121	0.0805	-0.1242
Y2	0	0	1	0	0	0	0	-0.3346	1.4895	-0.4945	0.1123	-0.242	0.1609	0.1316
Y1	0	1	0	0	0	0	0	0.9163	-0.6276	-0.3736	-0.472	0.190	-0.210	-0.1274
Y6	0	0	0	0	0	0	1	-0.5001	-0.5001	-4.4E-06	7.5E-06	0.5001	0.5001	0.0093

Appendix 3.

Summary of Parties' and INEC's strategies

Party's Strategies	yi	INEC's Strategies	xi
k = Party structure (y_1)	0.1954	a = Electoral law (x_1)	0.1871
l = Manifestoes (y_2)	0.2018	b = Electoral guideline (x_2)	0.1999
m = Campaign (y_3)	0.1905	c = Prosecuting electoral offenders (x_3)	0.1687
n = People's perception (y_4)	0.2026	d = Cancelling election (x_4)	0.2314
o = Vote from the electorate (y_5)	0.1954	e = Inconclusive election (x_5)	0.1919
p = Acceptable candidate (y_6)	0.0143	f = Declaration of electoral result (x_6)	0.021
Total	1	Total	1