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Mathematical analysis of the possibility of zero political competition between major political parties in Nigeria-a fall out from 2023 presidential election using Nash equilibrium

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Abstract

In this paper, the concept of Nash Equilibrium will be used to examine the Political Competition between Major Political Parties in 2023 Presidential Election. An x-ray of the Mathematical Analysis of the Possibility of Zero Political Competition between Major Political Parties in Nigeria using Nash Equilibrium will be discussed using 2023 Presidential Election as a major focus. The essence of a successful credible election devoid of rancor and post-election violence cannot be under-estimated as it guarantees the citizens the right to enjoy the dividend of democracy and creates a platform for a peaceful transition from one democratic dispensation to another. Data collection that aided this work was sourced through previous works, interviews, and from the website of the Independent National Electoral Commission (INEC), the electoral umpire that has the responsibility of conducting elections in Nigeria.

Keywords: Election, electoral competition, prisoner's dilemma, non-cooperative games, pure strategy, Nash equilibrium

1. Introduction

The formal process of selecting a person for public office or of accepting or rejecting a political proposition is by voting. It is important to distinguish between the form and the substance of elections. In some cases, electoral forms are present but the substance of an election is missing, as when voters do not have a free and genuine choice between atleast two alternatives ^[1].

2. Literature Review

An election is an act of choosing or selecting candidates who will represent the people of a country in the parliament and other positions in government. An election is also said to be a contest between competing political parties or groups for government power ^[2].

The formal model of political competition almost ubiquitously employed by students of political economy is one in which political parties play no role. The model introduced by ^[3] over forty years ago, portrays a competition between candidates, whose sole motivation for engaging in politics is to enjoy the power and perquisites of office holding.

The Modern-day definition of game theory can be put something like this - Game theory is the study of the ways in which interacting choices of economic agents produce outcomes with respect to the preferences (or utilities) of those agents, where the outcomes in question might have been intended by none of the agents. It is the study of how to mathematically determine the best strategy for given condition in order to optimize the outcome. It is the theory of how optimal strategies are formulated in times of conflict ^[4].

Game theory uses mathematics to express its idea formally. However, most game theoretical ideas are not inherently mathematical through a mathematics formation makes it easy to define concepts precisely, verify the consistency of ideas, and explore the implications of assumptions ^[5]. The Modern Mathematical approach of game theory is generally attributed to ^[6] and ^[7].

A question of priority was raised by Frechet's suggestion that several "Zur Theories der Gesellacha Fisspielle" by ^[8] in the early 20's really made grounds for game theory. The theories were then published with comments by Frechet and ^[6]. A game is defined as a competitive situation among persons or groups called players that is conducted under a prescribed set of rules with known pay offs. The rules defined the elementary activities or moves but each player knows the moves available to the other players. The outcomes depend on the combination of strategies by the players ^[9].

Nash equilibrium on the other hand is a stable outcome in game theory where each player has chosen the best possible strategy, given the strategies of the other players and no player can improve their outcome by unilaterally changing their own strategy. In essence, everyone is satisfied with their choice, and no one has an incentive to deviate from it, even though the collective outcome isn't necessarily the best possible for the group. A famous example is the Prisoner's Dilemma, where both Prisoner's confessing is a Nash equilibrium even though both would have been better off staying silent.

According to ^[17], the purpose of study in game theory is game. The players involved in a game are arranged in their preferences, their information, the strategic actions available to them, and how these influence the outcome. A high level description of a game specifies only what payoffs each individual or group can obtain by assistance of members.

Game theory allows researchers to study strategic decision-making situations in accounting contexts. It helps to capture the interdependencies and strategic interactions among various stakeholders, such as managers, auditors, investors and regulators. By modeling these interactions, game theory enhances understanding of the factors that influence decision-making and the outcomes that result from different strategies ^[18].

3. Related Works

An American Mathematician, ^[10] came up with the Nash theory which stated 'a situation in which a player will continue with their chosen strategy, having no incentive to deviate from it, after taking into consideration the opponents strategy (GAMES THEORY - NASH EQUILIBRIUM AND ITS APPLICATION 2015b). One of the greatest developments in society was the creation of non-cooperative game theory by ^[11]. Given the set of candidates $k = (1, \dots, k)$ ^[12] describes each voter submits a ballot, which is a vector of k components. An electoral system is then defined by the set of possible ballots that each voter can submit and by the election rule that given the ballots cast, select the winner from the set k .

Voting decisions are at the heart of democratic societies, as they shape the composition of governments and determine the policies that govern our lives.

However, the choices individuals make at the ballot box are influenced by a myriad of factors that impact their decision-making process ^[13].

Given a set of suspects, ^[14] in his work "Application of Games Theory to Crime Investigation of Suspects (A Case Study of Delta State Police Divisional Headquarters, Abraka) used the strategies of interview/questioning and interrogation of suspects to obtain confessions from which led to a systematic increase in suspects making positive confessions to various crimes, administering justice speedily and a strong avenue for prison decongestion.

In another vain, ^[15] through his work "An understudy of the Political Competition Between the Major Political Parties in 2023 Governorship Election in Delta State, Nigeria Using Nash

Equilibrium". Show how the use of Strategies of Effective Media Dissemination and Grassroot Campaign Network as pivotal parameter that ensured landslide victory of PDP (Peoples Democratic Party) over APC (All Progressive Congress). While looking at the habits of animals, ^[16] in "An x-ray of the Competitive and Co-operative Habits of Wildlife Animals using Game Theoretic Approach in Ovu-Inland, Delta State, Nigeria" said to minimize loss in wildlife, both the competitive and co-operative animals will choose from either strategies and there is no geometric increase in either cooperative or competitive habits in wildlife animals in Ovu-Inland which accounts for a saddle point situation which implies the game has no value as there is no predictable outcome with all wildlife animals acting in their own-rational best interest.

4. Materials and Methods

This work uses the Prisoner's Dilemma Method, a situation where two bank robbers have been arrested and are being interrogated in separate rooms. The authorities have no other witnesses, and can only prove the case against them if they can convince at least one of the robbers to betray their accomplice and testify to the crime. Each suspects has the choice to cooperate with their accomplice and remain silent or to defect from the gang and testify for the persecution. If they both co-operate and remain silent, then the authorities will only be able to convict them on a lesser charge, resulting in one year in jail for each. If one testifies and the other does not, then the one who testifies will go free and other will get five years. However, if both testify against the other, each will get three years in jail for being partly responsible for the robbery.

Sources of data collection was gotten from the 2023 Presidential Election as released by the Independent Electoral Commission of Nigeria (INEC) and Google Scholars in related field.

3.1 Two-Person Zero Sum and Non-Zero Sum Games

In zero-sum games total benefit to all players in the game, for every combination of strategies always to zero (or more unfortunately put, a player benefits only at the expense of others). Many games studied by game theorist (including the Prisoner's Dilemma) are non-zero sum games, because some outcomes have no results or less than zero.

Informally, in non-zero games, a gain by one player does not necessarily correspond with a loss of another.

Table 1: Matrix of pay-offs

Player I/Player II	Y ₁	Y ₂	- - -	Y _n
X ₁	a ₁₁	a ₁₂	- - -	a _{1n}
X ₂	a ₂₁	a ₂₂	- - -	a _{2n}
I	I			
I	I			
I	I			
X _n	a _{n1}	a _{n2}	- - -	a _{nn1}

Table 1 gives the amount a_{ij} by player I from player II. If player I plays with i th pure strategy, X_i the player II plays his j th pure strategy Y_j . Thus, the matrix of pay-off (game) of player I are the positive entries while the matrix of the pay-offs (game) of player II are the negative entries of the above matrix. From this paper, the result of the 2023 Presidential Election will be examined critically and the strategies used by the political actors will be reviewed.

This work will also show how the major political Shenanigans use the strategies of Arrest of opposition party members and

vote buying as well as effective grass root campaign network and media dissemination. Three table will be considered, table 2 showing the results of the 2023 Presidential Election, table 3 showing the strategies employed by the aspirants and table 4 showing the pay-off matrix. Next, we obtain the algebra of the game and draw the conclusion from the results obtained.

3.2 The Algebra of the Game

Table 2: Results of the 2023 Presidential Election Released by INEC

S/N	States	APC	LP	PDP
1	Ekiti	201,494	11,397	89,554
2	Osun	343,945	23,283	354,366
3	Kwara	263,572	31,116	136,909
4	Ondo	369,924	4,405	115,463
5	Ogun	341,554	85,829	123,831
6	Oyo	449,884	99,110	182,977
7	Yobe	151,459	2,406	198,567
8	Enugu	4,772	428,640	15,749
9	Lagos	572,606	582,454	75,750
10	Gombe	146,977	26,160	319,123
11	Jigawa	421,390	1,889	386,587
12	Adamawa	182,881	105,648	417,611
13	Katsina	482,283	6,376	489,045
14	Nasarawa	172,922	191,361	147,093
15	Niger	375,183	80,452	284,898
16	Benue	310,468	308,372	130,081
17	F.C.T. Abuja	90,902	281,717	74,194
18	Akwa-Ibom	160,620	132,683	214,012
19	Edo	144,471	331,163	89,585
20	Abia	8,914	327,095	22,675
21	Kogi	240,751	56,217	145,104
22	Bauchi	316,694	27,373	426,607
23	Plateau	307,195	466,272	243,808
24	Bayelsa	42,572	49,975	68,818
25	Kaduna	399,292	294,494	554,360
26	Kebbi	246,088	10,682	285,175
27	Kano	517,341	28,513	131,716
28	Zamfara	298,396	1,660	193,978
29	Sokoto	285,444	6,568	288,679
30	Cross-River	130,520	179,917	95,425
31	Delta	90,183	341,866	161,600
32	Ebonyi	42,402	259,738	13,503
33	Anambra	5,111	584,621	9,036
34	Taraba	135,165	146,315	189,017
35	Borno	252,282	7,205	190,921
36	Rivers	231,591	175,071	88,468
37	Imo	66,406	360,495	30,234
38	Results	8,830,673	6,058,538	6,984,519

Table 3: Shows the strategies of Arrest of Opposition/Vote buying and effective grassroots campaign/media dissemination

APC	PDP		
		B1	B2
	A1	6	3
	A2	2	4
	A3	6	4

Table 4: Pay-off matrix

APC	PDP			
		B1	B2	Row minima
	A1	6	3	3
	A2	2	4	2
	A3	6	4	4
	Column maxima	6	4	
	Minimax		4	

Saddle point => Maximin = Minimax = 4

Taking inequalities across columns

$$6x_1 + 2x_2 + 6x_3 \leq g$$

$$3x_1 + 4x_2 + 4x_3 \leq g$$

$$x_1 + x_2 = 1 \text{ (Expectation of non-zero sum game)}$$

Taking inequalities across rows

$$6y_1 + 3y_2 \geq g$$

$$2y_1 + 4y_2 \geq g$$

$$6y_1 + 4y_2 \geq g$$

$$y_1 + y_2 = 1 \text{ (Expectation of non-zero sum game)}$$

$$y_2 = 1 - y_1$$

$$\Rightarrow 6y_1 + 3y_2 \geq g$$

$$6y_1 + 3(1 - y_1) \geq g$$

$$6y_1 + 3 - 3y_1 \geq g$$

$$6y_1 - 3y_1 + 3 \geq g$$

$$3y_1 + 3 \geq g$$

$$\Rightarrow 2y_1 + 4y_2 \geq g$$

$$2y_1 + 4(1 - y_1) \geq g$$

$$2y_1 + 4 - 4y_1 \geq g$$

$$4 + 2y_1 - 4y_1 \geq g$$

$$4 - 2y_1 \geq g$$

$$\Rightarrow 6y_1 + 4y_2 \geq g$$

$$6y_1 + 4(1 - y_1) \geq g$$

$$6y_1 + 4 - 4y_1 \geq g$$

$$6y_1 - 4y_1 + 4 \geq g$$

$$2y_1 + 4 \geq g$$

$$A_1: \text{ If } y_1 = 0, g = 3$$

$$g = 0, y_1 = \frac{-3}{3} = -1$$

$$A_2: \text{ If } y_1 = 0, g = 4$$

$$g = 0, y_1 = \frac{-4}{-2} = 2$$

$$A_3: \text{ If } y_1 = 0, g = 4$$

$$g = 0, y_1 = \frac{-4}{2} = -2$$

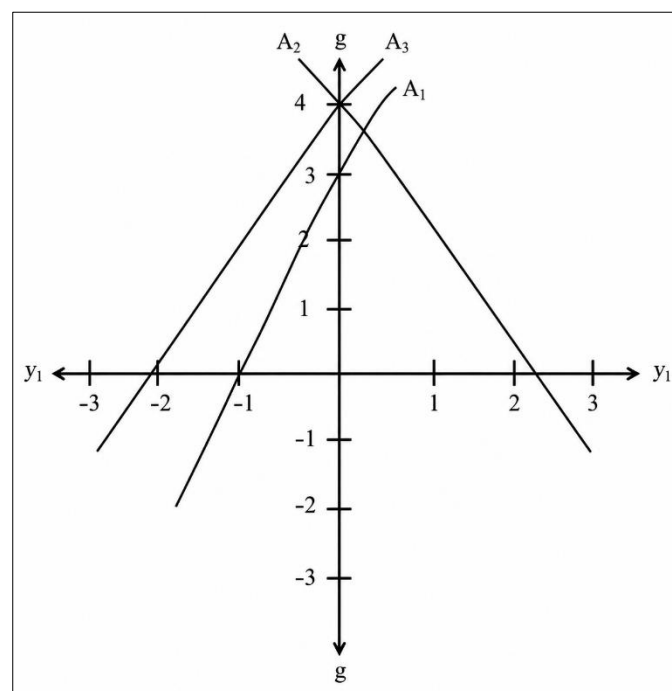


Fig 1: Graph showing the various strategies employed during the 2023 Presidential Election

From above inequalities across row

$$6x_1 + 2x_2 + 6x_3 \leq g$$

$$3x_1 + 4x_2 + 4x_3 \leq g$$

Let $g = 4$ and $x_1 = 0$, we have;

$$2x_2 + 6x_3 = 4 \dots\dots\dots (1) \times 2$$

$$4x_2 + 4x_3 = 4 \dots\dots\dots (2) \times 1$$

$$4x_2 + 12x_3 = 8 \dots\dots\dots (3)$$

$$4x_2 + 4x_3 = 4 \dots\dots\dots (2)$$

$$(3) - (2): 8x_3 = 4$$

$$x_3 = \frac{4}{8}$$

$$x_3 = \frac{1}{2}$$

Substitute $x_3 = \frac{1}{2}$ into (1)

$$2x_2 + 6x_3 = 4$$

$$2x_2 + 6 \times \frac{1}{2} = 4$$

$$2x_2 + 3 = 4$$

$$2x_2 = 4 - 3$$

$$2x_2 = 1$$

$$x_2 = \frac{1}{2}$$

Discussion of Results

Using table X4, observe the pay-off possesses a saddle point (i.e. Maximin = Minimax = 4). APC will try to minimize its greatest loss in order to get more votes than other parties. It can only do this by choosing between strategies A_2 and A_3 . The greatest loss that can befall APC if it chooses A_2 is 2, which occurs when PDP chooses B_2 , implying a decrease in effective grassroots campaign. In the same vein, if APC chooses strategy A_3 , its greatest loss will be 4, which occurs when PDP chooses B_2 implying an increase in arrest of opposition party. In a bid to minimize losses during election, APC will choose strategy A_3 , thus limiting its greatest loss to 4, which coincidentally is the saddle point. Using mixture of strategies A_2 (effective grassroots campaign) $\frac{1}{2}$ th of the time and A_3 (Arrest of opposition party/vote buying) $\frac{1}{2}$ th of the time, we obtain the best combination of balanced strategy where APC emerged victorious in the last 2023 Presidential Election in Nigeria.

4. Conclusion

Notice from table X4, that there is a significant increase in the strategies of effective grassroots campaign and arrest of opposition/vote buying which was the major reason for APC victory over other parties in the last 2023 Presidential Election. Also observe that apart from the saddle point (Maximin = Minimax = 4), notice that applying either strategies yields same result (i.e. $A_2 = A_3 = \frac{1}{2}$ th of time) which implies that since either of these strategies paid off in making APC victorious, similar strategies be repeated in their quest to retain power in subsequent Presidential election.

Finally, in view of the evidence provided from prior conclusion, it is established that employing effective grassroots campaign and arrest of strong party opposition/vote buying are best strategies adopted by APC that ensured their victory over PDP and other parties in the last 2023 Presidential election which have been brought to limelight.

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