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Game Theory Approach: Profit Calculation in Business

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Abstract: Business is back bone of transaction between buyer and supplier firms. Evolution of internet has helped customers to do shopping online 24X7 using online shopping portal, this lead to categorization of e-commerce into B2C, B2B, C2C etc. Identifying the authentic manufacturer and suppliers is difficult as the online transactions are carried on. There are so many ways for finding out the authentic stackeholder. Here in this paper two stages have been made in first stage a game theory concept is used to identify authentic suppliers the manufacturer can choose for finding the reliable supplier's using Extensive decision tree with perfect information as decision metrics. In second stage after filtering the suppliers again Stackelberg model is used for analysis of profit and selecting suppliers who will gain huge profit. Overall, a comprehensive framework for analyzing the profitability of businesses using game theory principles. It can help manufacturer make informed decisions about their strategies and provide insights into the competitive landscape of the market.

Keywords: Extensive decision tree, Manufacturer, Stackelberg model, Supplier firms.

I. Introduction

Business firms, also known as companies or corporations, are organizations that engage in commercial, industrial, or professional activities with the aim of generating profit. These entities may be privately owned, publicly traded, or state-owned. Business firms can vary greatly in size, from small startups to multinational conglomerates with operations in multiple countries. The primary objective of business firms is to generate revenue by providing goods or services that meet the needs of their target market. They do this by developing products, services, or solutions that are valuable, unique, and relevant to their customers. Business firms must also manage their resources efficiently to ensure that they can deliver their products or services at a competitive price point. Business firms are typically structured as a hierarchy, with a board of directors at the top, followed by executive management, middle management, and front-line employees. The board of directors sets the strategic direction of the company and oversees the executive management team, who are responsible for the day-to-day operations of the business. Business firms also have various departments that are responsible for different aspects of the business, such as finance, marketing, human resources, and operations. These departments work together to ensure that the company is functioning effectively and efficiently.

Game Theory aids in the comprehension of scenarios involving decision-makers due to its potential in creating behavioral models can become a tool used in the area of formulating or redesigning logistic strategies of supply chains. Game theory involves a significant part of decision making process under uncertainty conditions. Nash equilibrium is a concept in game theory that describes a stable state of a game where no player can improve their payoff by unilaterally changing their strategy, given that all other players keep their strategies unchanged. In other words, it is a situation where each player's strategy is optimal, given the strategies of the other players to understand the concept of Nash equilibrium, let us first define a few terms. A game is a situation where two or more players interact with each other, and each player's payoff depends on the strategies they choose and the strategies chosen by the other players. A strategy is a plan of action that a player chooses to achieve their objective in the game.

Stackelberg equilibrium can be found using backward induction, which involves working backwards from the end of the game to determine the optimal strategies of each player. The leader's optimal strategy is determined by assuming that the follower will choose their best response to the leader's action. The follower's best response, in turn, is determined by assuming that the leader will choose their optimal strategy. There are limitations to the Stackelberg equilibrium concept. One limitation is that it assumes that both players have perfect information about each other's preferences and strategies, which may not be the case in real-world situations. Another limitation is that it assumes that the leader is able to commit to their chosen action, which may not always be feasible.

Paper is organized in the following manner introduction in Section I, Literature Survey in Section II, System design in Section III followed by Result Analysis in Section IV.

II. Literature Survey

"A game-theory based model for analyzing e-marketplace competition", in this authors Jianya Zheng and Weigang focuses on the Bertrand model, which is a game-theory model that assumes sellers compete by setting prices for their products. The model assumes that customers always choose the cheapest option available, and if two or more sellers offer the same product at the same price, they split the market share evenly [1]. The paper discusses the assumptions of the Bertrand model, including the assumption that sellers have perfect information about each other's prices and costs. It also discusses the prediction of the Bertrand model, which is that in a perfectly competitive market, sellers will set prices equal to their marginal cost. The paper then discusses the strategic behavior that sellers can engage in to gain an advantage over their competitors. This includes undercutting their competitors' prices, differentiating their products, and coordinating with other sellers in the market [1]. The paper also discusses game-theory models that can be used to analyze e-marketplace competition, including the Cournot model and the Hotelling model. The paper concludes by emphasizing the importance of game theory in analyzing e-marketplace competition. By understanding the incentives and behaviors of competitors, sellers can develop effective pricing and marketing strategies to gain a competitive advantage in the market [1]. The paper also notes that while game theory provides a powerful framework for analysis, it is important to keep in mind the limitations and assumptions of these models when applying them to real-world situations.

"Stakeholder power in e-business adoption with a game theory perspective", in this author Barbara Roberts adopted the e-business technologies is a complex process that involves multiple stakeholders with different levels of power and influence. This paper presents a game-theory based model to analyze the power dynamics among stakeholders in the e-business adoption process. The model considers three types of stakeholders: the firm, the customers, and the competitors [2]. The firm has the power to adopt e-business technologies, which can provide benefits such as cost savings and improved customer service. However, the adoption of these technologies can also have negative consequences, such as reduced customer loyalty and increased competition. Customers also have power in the e-business adoption process, as they can choose to adopt or reject e-business technologies [2]. They may be reluctant to adopt these technologies if they perceive them as difficult to use or if they are concerned about privacy and security issues. Competitors also have power in the e-business adoption process, as they can respond to the firm's adoption of e-business technologies by adopting similar technologies or by offering alternative products or services. The game-theory model analyzes the strategic interactions among these stakeholders and identifies the conditions under which the firm is most likely to adopt e-business technologies. The analysis considers factors such as the costs and benefits of adoption, the level of competition in the market, and the preferences and power of the stake holders.

“Analysis on Pirate Game from the perspective of experimental economics and game theory”, in this author Yunjia Huang uses Pirate Game. The Pirate Game is a classic game theoretic problem that is often used in the study of bargaining and cooperation. In this game, a group of pirates must decide how to divide a fixed amount of treasure. However, if a majority of pirates do not agree with the distribution, then the pirate proposing the distribution will be thrown overboard and the next pirate in line will propose a new distribution [3]. The game continues until a proposal is accepted. This paper aims to analyze the Pirate Game from the perspective of experimental economics and game theory. Experimental economics is a branch of economics that uses controlled experiments to test economic theories, while game theory is a branch of mathematics that studies strategic decision- making in situations of conflict and cooperation [3]. The authors conducted a series of laboratory experiments to study the behavior of participants playing the Pirate Game. They found that, on average, the pirates in the game were able to reach a fair distribution of the treasure, even though the outcome was not always optimal from a game theoretic perspective.

“Nash Equilibria of 2-Player Finite Simultaneous Move Games”, in this authors Qianqin Chen, Ruiqiu Ou and Jianmei Yang titled this paper where Nash Equilibria of 2-Player Finite Simultaneous Move Games is a seminal work in game theory, published by John Nash in 1950 [4]. It lays out the basic concepts of Nash equilibrium, which has become one of the most important ideas in game theory and has applications in many fields, including economics, political science, and biology. The paper begins with a definition of a game, which is essentially a set of rules that govern the behavior of two or more players. Nash then introduces the concept of a strategy, which is a plan of action that a player can take in the game [4]. This defines a pure strategy as a single action that a player can take, and a mixed strategy as a probability distribution over the set of pure strategies. Nash then defines the concept of a Nash equilibrium, which is a set of strategies, one for each player, such that no player can improve their outcome by unilaterally changing their strategy. In other words, each player is playing the best response to the other player’s strategy. Nash shows that every finite game has at least one Nash equilibrium, and provides a proof of this result [4]. The paper then goes on to provide several examples of games and their Nash equilibrium. These include the prisoner’s dilemma, the battle of the sexes, and the matching pennies game. In each case, Nash shows how to find the Nash equilibrium and discusses the implications of the equilibrium for the players.

“Nash Equilibrium Seeking with Infinitely-Many Players”, Paul Frihauf, Miroslav Krstic, and Tamer Basar, The concept of Nash equilibrium has been an important tool in game theory for understanding the behavior of multiple decision makers. However, much of the work on Nash equilibrium has focused on the case of finitely-many players. In this paper, the authors extend the theory of Nash equilibrium to the case of infinitely-many players. The authors begin by introducing a model of a game with an infinite number of players, where each player chooses a real number as their strategy [6]. They then define the notion of a Nash equilibrium in this setting, which is a set of strategies such that no player can improve their payoff by unilaterally changing their strategy. The authors then prove some key results about Nash equilibria in this setting. In particular, they show that if a game has a Nash equilibrium, then it has infinitely-many Nash equilibria [6]. They also prove a version of the folk theorem, which states that any payoff vector that is achievable in a repeated game can be achieved as a Nash equilibrium in a one-shot game. Next, the authors consider the problem of finding a Nash equilibrium in a game with infinitely-many players. They propose a modification of the best-response dynamics, where players repeatedly update their strategies to improve their payoff. They show that this modified dynamics converges to a Nash equilibrium under certain conditions on the game. Finally, the authors apply their theory to the case of oligopoly competition, where a small number of firms compete in a market [6]. They show that their results provide a new way of analyzing competition in such markets, which can lead to new insights into the behavior of firms and the market outcomes. Overall, this paper provides a rigorous and comprehensive analysis of Nash equilibrium in the case of infinitely-many players. The authors' results have important implications for a wide range of fields, from economics to computer science to biology.

"Numerical Method for Finding a Static Stackelberg-Nash Equilibrium: The case of Favorable Followers", in this authors S. Moya and A. Poznyak uses Stackelberg-Nash equilibrium. Stackelberg-Nash equilibrium is a concept in game theory that describes a scenario in which a player, known as the leader, chooses their strategy first, and then the followers, known as the followers, choose their strategies accordingly to maximize their payoffs. The paper focuses on the scenario where the followers have a favorable outcome if they match the leader's strategy. The authors extend the FFSNE algorithm to the case of games with multiple followers, and they demonstrate its effectiveness in several numerical examples [5]. The authors propose a numerical algorithm for computing the Stackelberg-Nash equilibrium in games with favorable followers, which they call the "Follower- Favorable Stackelberg-Nash Equilibrium" (FFSNE) algorithm. The algorithm consists of two main steps: the first step involves finding the leader's best response function to the follower's strategy, while the second step involves finding the follower's best response function to the leader's strategy [5]. The authors then show that the FFSNE algorithm is computationally efficient and demonstrate its effectiveness in several numerical examples [5]. They also compare the FFSNE algorithm to other existing numerical methods for computing Stackelberg-Nash equilibrium and show that it outperforms them in terms of convergence speed and accuracy.

"Stackelberg-equilibrium of pricing and inventory decisions in a supply chain", Anwar Mahmood, The paper proposes a model for analyzing pricing and inventory decisions in a supply chain. The paper focuses on a two-level supply chain consisting of a single supplier and a single retailer [7]. The supplier is assumed to have complete information about the demand and production costs, while the retailer has limited information about the demand. The paper develops a Stackelberg game model to analyze the interaction between the supplier and the retailer [7]. The supplier is assumed to be the leader, who first sets the wholesale price and the production quantity. The retailer, who is the follower, then decides on the retail price and the order quantity. The paper considers two different scenarios: one where the retailer has a fixed order quantity and one where the retailer can vary the order quantity [7]. The paper shows that in both scenarios, the Stackelberg equilibrium exists, and the supplier's optimal wholesale price and production quantity depend on the retailer's order quantity and the market demand. The paper also shows that the Stackelberg equilibrium can lead to a win-win situation for both the supplier and the retailer, where both parties can achieve higher profits compared to a situation where they act independently [7]. The paper further extends the model to include inventory decisions by the retailer. In this extended model, the retailer is assumed to face a fixed ordering cost and a holding cost for excess inventory. The paper shows that the Stackelberg equilibrium in this extended model exists and the optimal decisions of both the supplier and the retailer depend on the market demand and the inventory cost parameters. The paper concludes by highlighting the importance of coordination between the supplier and the retailer in a supply chain. The model proposed in the paper can help the parties to coordinate their decisions and achieve higher profits. The model can also be extended to more complex supply chain structures and can be used to analyze different scenarios and decision-making situations.

III. System Design

This section presents the proposed system and implementation details of the Profit Calculation of Business Firms using Game Theory.

A. Proposed System

The system design of profit analysis model is shown in the Fig. 1.

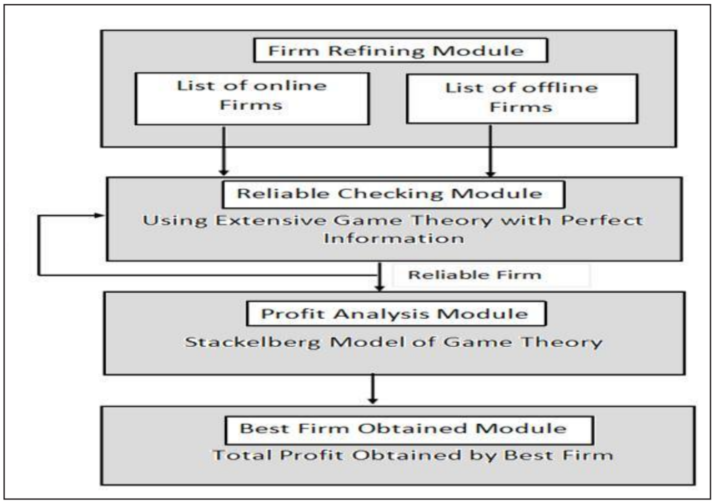


Fig. 1: System Design of Profit Analysis Mode

This model consists of four different modules namely, firm refining module, reliable checking module, profit analysis module and best firm obtained module.

Firm Refining Module: This module checks for the different firms which are involved in doing business both online and offline. The active firms who sale the product in short duration of time are short listed. The list of online firms, list of offline firms and list of manufacturers are obtained from this module.

Reliable Checking Module: In this module, reliability of the online and offline firms is checked using extensive game theory with perfect information.

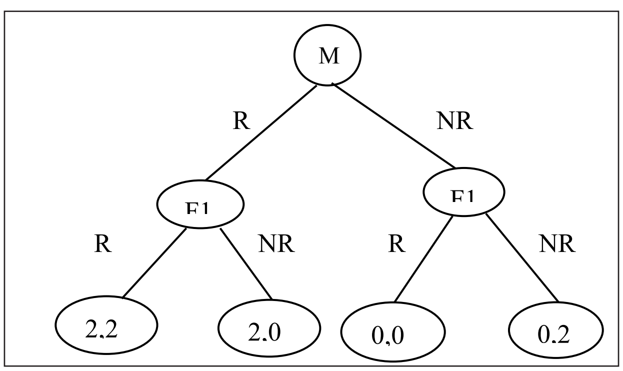


Fig. 2: Extensive Decision Tree with Perfect Information

The Fig. 2 shows two players involved in doing business online. One player is manufacturer represented as "M". The other is business firm1 identified as F1. The manufacturer actively participates in the game. The manufacturer has two moves, reliable represented as 'R' and not-reliable represented as 'NR'. The player becomes active after the manufacturer decides which action to chose. The business firm F1 has two strategies to choose. The strategies are reliable and non-reliable. The values (2,2) , (2,0), (0,0), and (0,2) are called payoff values. The strategy that has been selected by manufacturers is R. The supplier also selects R. Their payoff is (2,2), For the strategy (R, NR) the payoff is (2,0), For the strategy (NR, NR) the payoff is (0,0) and for the strategy (NR, R) the payoff is (0, 2). The business firm F1 has two strategies to choose. The strategies are reliable and non-reliable. The values (2,2), (2,0), (0,0), and (0,2) are called payoff values. Unlike dominant strategy, the Nash equilibrium doesn't always lead to the most optimal outcome. It just means that an individual chooses the best strategy based on the information they have. The strategies are reliable and non-reliable.

F1 \ M	R	NR
R	2,2	2,0
NR	0,2	0,0

Fig. 3: Payoff Matrix to Check Reliability

Profit Analysis Module: In this module, Stackelberg model is used to find out the profit**.** The Stackelberg model is a leadership model that allows the firm dominant to set its price first. Subsequently, the follower firms optimize their production and cost. It was formulated by Heinrich Von Stackelberg in 1934. Let us assume a market with three players – A, B, and C. If A is the dominant force, it will set the product's price first. After that, firms B and C will follow the price set and adjust their production basis supply and demand patterns accordingly.

The first two scenarios will result in an equilibrium condition after a time-lapse where the profit maximization functions will serve as the determinants. In case 3, a warfare situation will occur as equilibrium will be difficult to establish. Therefore, it can be expected such a loggerhead stance can only be eliminated if there is a collision or failure of the weaker firm leading to a monopoly in the market. Finally, in case 4, the profit maximization expectations will not hold, and they must revise. That gives rise to the Cournot condition.

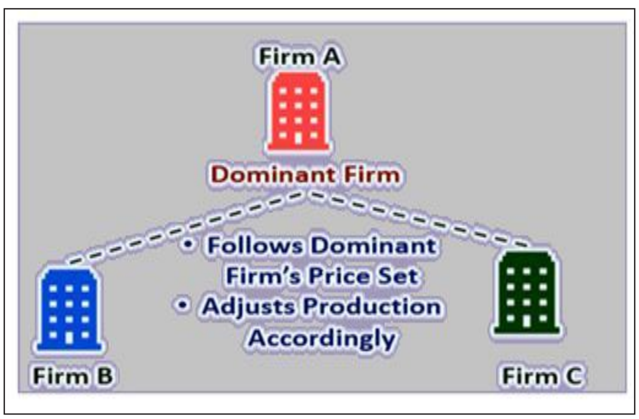


Fig. 4: Stackelberg Model

B. Assumptions in Stackelberg

A duopolistic can sufficiently recognize market competition based on the Cournot model. Each firm aims to maximize its profits based on the expectation that the decisions of its competitors will not be affected by its output. It assumes perfect information for all players in the market. Note: An underlying assumption with the Cournot model is that the operating firms cannot collude and must seek to maximize profits based on their rivals' decisions. However, models such as Stackelberg, Cournot, and Bertrand have assumptions that do not always hold in real markets. While one firm may follow Stackelberg's principles, the other might not.

The following steps can help solve a basic problem based on the Stackelberg model:

- Write the demand function for the market.
- Write the cost functions for both firms A and B in the market.
- The individual reaction functions in the duopoly are found by taking the partial derivates of the profit function.
- Assume firm A as a leader, and obtain the profit maximization equation for firm A, substituting firm B's profit function in firm A equation.
- Solve for firm B as being the follower.

The following circumstances are possible if two firms, A and B, participate in a duopolist competition:

- Firm A chooses to be the leader, and B wants to be the follower.
- Firm B chooses to be the leader, and A wants to be the follower.
- Both A and B want to be the leaders.
- Both A and B choose to be followers.

Stackelberg's model remains an important strategic model in economics. This model is useful to a firm when it realizes profitability prospects under the first-mover advantage concept. A practical instance where leaders show commitment to the first move is capacity expansion. It is assumed that one cannot undo the action. In principle, Stackelberg's strategy is important where the first mover, the leader, acts irrespective of the follower's movement.

C. Manually Profit Calculation using Stackelberg Model for Two Firms

Consider MC=4

P=10000/2(QA +QB)

Calculation for Firm "B" :

$MAX\ QB \Rightarrow PQB - MC*QB$

$MAX\ QB \Rightarrow (100 - 2QA - 2QB)QB - 4QB$

$MAX\ QB \Rightarrow 100QB - 2QAQB - 2QB2 - 4QB$

$MAX\ QB \Rightarrow 96QB - 2QAQB - 2QB2 = 0$

Differentiate W.R.T. QB

$\partial\pi/\partial QB\ ,\ 96 - 2QA - 4QB = 0$

$4QB = 96 - 2QA$

$QB = 96/4 - 2/4\ QA$

$QB = 24 - 1/2\ QA$ --------------------------(1)

Calculation for Firm "A" :

$MAX\ QA \Rightarrow PQA - MC*QA$

$MAX\ QA \Rightarrow (100 - 2QA - 2QB)QA - 4QA$

$MAX\ QA \Rightarrow (100 - 2QA - 2[24 - 1/2QA]\ QA - 4\ QA)$

$MAX\ QA \Rightarrow (100 - 2QA - 48 + QA)\ QA - 4QA$

$MAX\ QA \Rightarrow (100 - 2QA - 48 + QA)\ QA - 4QA$

$MAX\ QA \Rightarrow (52 - 2QA + QA)\ QA - 4QA$

$MAX\ QA \Rightarrow (52 - 2QA2) - 4QA$

$48QA - QA2 = 0$

Differentiate W.R.T. QA

$\partial\pi/\partial QB\ ,\ 48QA - QA2 = 0$

$48 - 2QA = 0$

$QA = 48/2$

$QA = 24$ ---------------------------(2)

Substitute eqn (2) in eqn (1)

$QB = 24 - 24/2$

$QB = 12$

Substitute QA & QB values in P

$P = 100 - 2(24 + 12)$

$P = 100 - 2(36)$

$P = 100 - 72$

$P=28$

Best Firm Obtained Module: This module gives the total profit obtained by the two best firms who are reliable. Farther they manufacture the products together to earn the profit.

The Fig. 5 shown above is the Usecase diagram for proposed system. It provides detail and clear description about the Proposed System. Considering the two actors which are represented by stick diagram, namely Business Firm1 and Business Firm2. The rectangle box is termed as system which consists of n number of usecase.

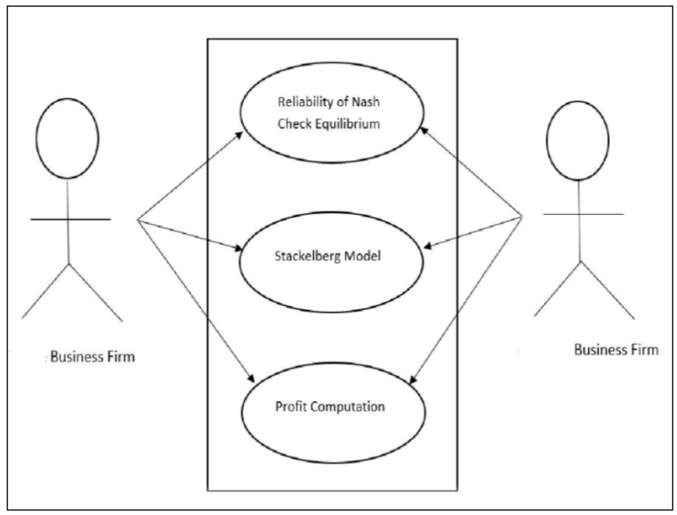


Fig. 5: Usecase Model of Business Firms

According to this model this have three usecase has been used, they are Reliability of Nash, Stackelberg Model, Profit Computation.

- *Reliability of Nash Equilibrium:* Nash equilibrium helps to find the reliable firms among the set of firms.
- *Stackelberg Model:* Stackelberg is used to compute the profit among the reliable firms which is obtained by applying Nash equilibrium.
- *Profit Computation:* By considering the two major firm, can obtain the highest profitable firm. Hence this firm is selected by manufacturers.

D. Implementation

Algorithm:

```
1.Import Random module
2.While(I<n)
   a)Selection of Manufacturer,Firm1 and Firm2
   b)Reliability checking module using extensible decision    tree with perfect Information
   i)If(a>=c and a>=e and a>=g and b>=d and b>=f and      b>=h)
         1)print PAYOFF matrix
         2)Print Manufacturer ID,Firm1 ID,Firm2 ID are satisfied     by Nash equilibrium
         3)Profit calculation from Stackelberg Model
               a) Selection of maximum cost required to   manufacture product.
               b) Print Firm1 ID and calculate the following for quantity of product manufactured by Firm1
               Quantity of products manufactured byFirm1(Qa)=(10000-maximum cost)/4
              Print Qa
               c) Print Firm2 ID and calculate the following for quantity of product manufactured by Firm2
               Quantity of products manufactured by Firm2(Qb)=((10000- maximum cost)/4)-(0.5*Qa)
              Print Qb
              d) Calculating Proft
                   Total Profit=10000-2*(Qa+Qb)
   else
     Print Payoff Matrix
     Print Manufacturer,Firm1 and Firm2 are not satisfied by Nash  Equillibrium
```

Alogrithm 1: Filtering of Unreliable Stakeholder using Game Theory

IV. Result Analysis

This section gives information of output obtained; same is represented in the form of snapshot.

A. Snapshots of User Interface

Login Page

Fig. 6 shows the login page for the proposed system. Technology used is HTML, CSS and JavaScript .Login page consists of two login options namely Admin login and Manufacturer login. Here the Admin and Manufacturer should enter name and password to get logged in.

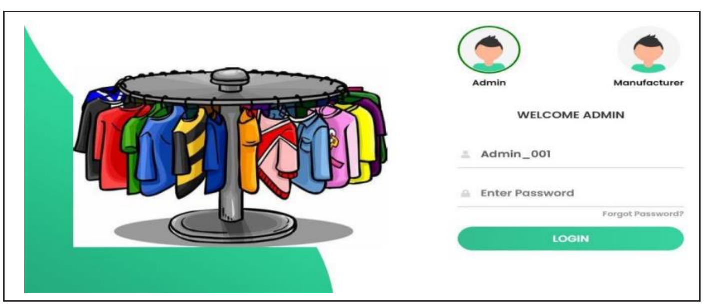


Fig. 6: Login Page

Admin Login

Fig. 7 shows the list of manufacturers. They include Saree, Sassy Skirts, Denim hits, Floral prints and Jumpsuit manufacturers.

Sassy Skirts

Manufacturer_ID	Manufacturer	Type
2	Leher Men's Designers	Sassy Skirts
7	PRASHANTH MENS FASHION	Sassy Skirts
12	Sudeep garments	Sassy Skirts
17	Vinod Textiles	Sassy Skirts
22	Shyli Readymade Handloom Products.	Sassy Skirts
27	tirupur export garments	Sassy Skirts

Fig. 7: Admin Login

List of Saree Manufacturers

Fig. 8 shows the list of Saree Manufacturers among the firms is obtain by clicking on Saree manufacturer option. The table consists of Manufacturer_ID, Manufacturer and Type.

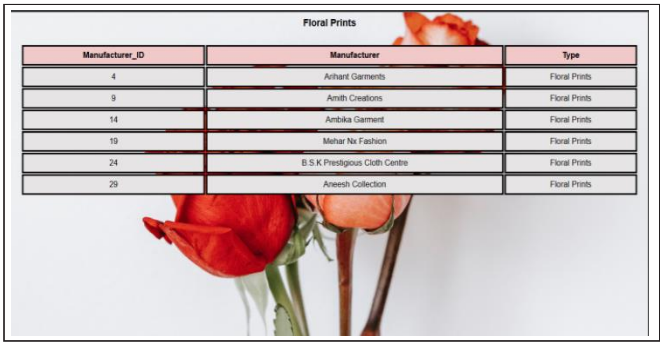
Saree

Manufacturer_ID	Manufacturer	Type
1	Tiruppur clothing wholesalers	Saree
6	SHREE GOKUL HOSIERY	Saree
11	LOOT FAB	Saree
16	Vinod Textiles	Saree
21	Sunnex Tailors	Saree
26	S M S CREATION	Saree

Fig. 8: Saree Manufacturer List

List of Foral Prints Manufacturers

Fig. 9 shows the list of Floral Prints Manufacturers among the firms is obtain by clicking on Floral Prints manufacturer option. The table consist of Manfacturer_ID, Manufacturer and Type.



Floral Prints

Manufacturer_ID	Manufacturer	Type
4	Arihant Garments	Floral Prints
9	Amith Creations	Floral Prints
14	Ambika Garment	Floral Prints
19	Mehar Nx Fashion	Floral Prints
24	B.S.K Prestigious Cloth Centre	Floral Prints
29	Aneesh Collection	Floral Prints

Fig. 9: List of Floral Print Manufacturer

List of Jump Suit Manufacturer

Fig. 10 shows the list of Jumpsuit Manufacturers among the firms is obtain by clicking on Jumpsuit manufacturer option. The table consist of manufacturers ID, Manufacturer name and type.

JumpSuits

M Manufacturers	Manufacturer	Type
5	Muruli stitching centre	Jumpsuit
10	M/s Venus attire	Jumpsuit
15	H K G N Kids Wear	Jumpsuit
20	Shahi Exports Pvt Ltd	Jumpsuit
25	Varshini Garments And Fashions	Jumpsuit
30	Anand Apparels	Jumpsuit

Fig. 10: List of Jumpsuit Manufacturers

Manufacturer Login

Fig. 11 shows Manufacturer Login. It includes firm1 and firm2 datasets.

Fig. 11: Manufacturer Login

List of Firm1 and Firm2

Table I and Table II shows list details of the information sold by the Firm1 and Firm2. It includes information about names of the Firms, Price, Color and Type. In the column name, firms name are mentioned, price consist of price, followed for color and type of product they sell.

TABLE I: FIRM1 PRODUCT SELLING DETAILS

F1	Name	Price	Color	Type
1	Inweave	5899	Orange	Saree
2	Anubhulee	4899	Navy Blue	Sassy Skirt
3	Nayo	3699	Red	Denim Kurta
4	Ahika	1350	Black	Saree
5	Libas	2050	Grey	Ethnic wear

TABLE II: FIRM2 PRODUCT SELLING DETAILS

F2	Name	Price	Color	Type
1	Mehar Nx Fashion	5899	Orange	Saree
2	Varshni Garments and Fashions	4899	Navy Blue	Sassy Skirt
3	Prashanth Mens Fashion	3699	Red	Denim Kurta
4	Vinod Textiles	1350	Black	Saree
5	Gopi Textiles	2050	Grey	Ethnic wear

B. Test Cases

Test Cases are divided into two cases. These cases are discussed below.

Case 1: Checking for Reliable Firm using Nash Equilibrium

Table III shows the reliability list obtained after applying Nash Equilibrium. It consists of Manufacturer_ID, Manufacturer_Name, Firm1_ID,Firm1_Name, Firm2_ID, Firm2_Name and Nash Equilibrium.

For example, consider Manufacturer_ID 8, Manufacturer_Name Amith Creations, with Firm1_ID as 20, Firm1_Name as Libas, Firm2_ID as 7, Firm2_Name as Anouk has satisfied the Nash Equilibrium.

For example, consider Manufacturer_ID 11, Manufacturer_Name Leher Men's Designers, with Firm1_ID as 10, Firm1_Name as indi inside, Firm2_ID as 9, Firm2_Name as Kalini has not satisfied the Nash Equilibrium.

Table III: Reliability List Obtained from Nash Equilibrium

Manufacturer_ID	Manufacturer_ Name	Firm1_Id	Firm1- Name	Firm2_ID	Firm_2 Name	Nash equilibrium
8	Amith Creations	20	Libas	7	Anouk	Satisfied
28	Anand Apparels	8	Louis	10	Indi INSIDE	Satisfied
11	Leher Men's Designers	10	Indi INSIDE	9	Kalini	Not Satisfied
26	Shri Mahalaxmi Agencies	25	Basacrafts	19	Sangria	Satisfied
27	Aneesh Collection	23	Myshka	8	Louis	Satisfied

Case 2: Profit Obtained by Joint Venture using Stackelberg Model

Table IV shows the profit by both firms selling the product manufactured by the Manufacturer obtained after applying Stackelberg Model. It consists of Manufacturer_ID, Manufacturer_Name, Firm 1_ID, Firm 1_Name, Firm 2 _ID , Firm2_Name and Profit.

For example, consider Manufacturer_ID 19, Manufacturer_Name Mehar Nx Fashion, with Firm 1_ID as 27, Firm1_Name as Libas, Firm 2_ID as 16, Firm 2_Name as Divyank has profit of 6189.25 rupees.

Consider Manufacturer_ID 16, Manufacturer_Name Vinod Textiles, with Firm1_ID as 2, Firm1_Name as Anubhutee, Firm 2_ID as 29, Firm 2_Name as Anouk has profit of 4802.5 rupees.

Table IV: Profit Obtained from Stackelberg Model

Manufacturer_ ID	Manufacturer_Name	Firm1_Id	Firm1- Name	Firm2_ID	Firm_2 Name	Profit in Lakhs
19	Mehar Nx Fashion	27	Libas	16	Divyank	6189.24
25	Varshini Garments and Fashions	11	Varanga	25	Busan	6039.25
19	Mehar Nx Fashion	16	Seoul	17	Libas	5642.5
11	Loot Fab	27	Libas	1	Kvsfab	5179.75
16	Vinod Textiles	2	Anubhutee	29	Anouk	4802.5

V. Conclusion

The use of game theory in calculating the profit of business firms provides a comprehensive framework for understanding the competitive dynamics of the industry. Game theory models can help firms make strategic decisions by considering their actions in relation to the actions of competitors. By identifying the different strategies available to them and their competitors, firms can make informed decisions that maximize their profits. Through game theory analysis, firms can identify their optimal profit strategy. The Nash equilibrium concept in game theory can help firms determine the best strategy to adopt, given the actions of their competitors. In essence, game theory analysis can help firms anticipate the actions of their competitors and prepare for them accordingly. Overall, game theory provides a useful tool for analyzing the profit of business firms, and it can help firms make better-informed decisions. However, it is important to note that game theory models are based on certain assumptions, and they may not always accurately reflect the complexities of the real world. Nonetheless, game theory provides a solid foundation for firms to analyze their profit and make strategic decisions.

Future Enhancement

Present work calculates the profit only for clothing but we can make this project further enhanced by applying the same strategies and methods for automobiles and many other applications.

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