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Analyzing the hyperlocal delivery business model using operations research techniques

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ABSTRACT

The hyper-local delivery industry is on the rise in India due to firms trying to capture the biggest share in the market by promising the fastest delivery in the industry. Through this research paper, we have tried to analyze the impact of the Assignment problem in a way to increase employee efficiency and optimize business operations via time minimization. With the use of these tools, companies can optimize their delivery time which they could have overlooked due to human error. After going through different research, we came to the conclusion that they address the problem by taking only one constraint into account, so to counter this we came up with a solution using multiple constraints that are actually faced by companies. Our findings demonstrate that operations research methodologies can assist hyper-local delivery platforms in making decisions about how to assign their employees to pick up or drop the package in the least amount of time possible.

Keywords: *Hyper-local delivery industry, Operations Research Application, Assignment Problem*

1. INTRODUCTION

The market of the hyperlocal delivery system is valued at an estimate of $1,324.2 billion in the year 2019 and by 2027, is projected to reach $3,634.3 billion, at a CAGR of 17.9% (ReportLinker, 2020). Hyperlocal delivery companies offer delivery of services and products which can be supplied in the restricted geographic place in minimal duration. Hyperlocal offerings include shipping of products and offerings; for instance, shipping of products consists of food, grocery, drugs, furniture, digital items (Kamble & Deshmukh, 2020).

The sudden rise in urbanization, changes in consumer behavior, and improving lifestyle are some of the factors which have led to the growth of hyperlocal delivery systems in India. Many e-commerce giants are planning to acquire these hyperlocal delivery startups so that they can reduce their transportation costs and minimize their delivery times (Kamble & Deshmukh, 2020).

There are companies like Dunzo, Burzo, Xpressbees, and many more, so it has become important for each company to increase its market share and compete with its competitors in the most economical way. It has become important for every company to gain customer loyalty because any customer would prefer to order from companies that provide services to them at the cheapest rates, rather than sticking to any particular company (Kamble & Deshmukh, 2020).

The OR technique we have used in our research paper is assignment problem or AP. It refers to the analysis of how to assign objects to objects in the best possible way. It thus means that we are assigning a number of resources to the same number of activities as it will reduce the total cost of allocation to the minimum or increase it to the maximum.

Our topic is to analyze the hyperlocal delivery model using assignment problems. With the help of AP, the hyperlocal delivery company can allocate their delivery boys to deliver orders in the least amount of time and thus minimize the distance for the next order delivery. These methods can be utilized on a lot bigger scope with a huge number of requests on a city-wide level. Companies should focus on increasing employees' efficiency, as it will eventually lead to a decrease in delivery time and therefore lead to an increase in the number of deliveries.

2. LITERATURE REVIEW

With the growth in delivery platforms, research around the area of optimizing delivery services has shot up. We review the OR concepts used to enhance these processes, figure out shortcomings in them with respect to our unique case. We continue our research by diving deeper into the area of assignment problems and understanding their implications in one of the recent industries to have shot up in popularity i.e., the hyperlocal delivery business industry.

The market is currently being dominated by Dunzo which delivers in 8 cities but it has been receiving fierce competition from Swiggy, Grofers, Amazon, and Flipkart that have recently ventured into this segment by starting to deliver groceries and other essentials during the Covid 19 pandemic. The market has effectively grown at a tremendous rate during this pandemic as people were afraid to step out of their houses and so these companies stepped up to fill that vacuum by delivering daily essentials at their doorsteps. These organizations' main source of income comes from the commission rate which they charge to their delivery partners. Pricing is also done via delivery charges according to the distance and surge pricing according to the demand in their locality. Dunzo and Burzo are some of the market leaders in the hyperlocal delivery segment, so they can easily make use of consumer demand and get them to pay surge pricing (Kamble & Deshmukh, 2020).

It has been found from a study by Kung, L.-C., & Zhong, G.-Y. (2017) that consumers have become more price-sensitive and are attracted to offers and discounts. Both of these factors are inter-connected to each other and have a significant impact on consumers' selection of hyperlocal delivery apps like Dunzo, Burzo.

One of the most important tasks for any hyper-local delivery business is scheduling. Scheduling is the process of allocating resources over a period of time in order to complete a set of tasks. In such a competitive environment, scheduling helps the business efficiently plan the delivery of their orders and allocate it to delivery personnel that can deliver them in the shortest time duration (Goel, Jain, Singhal, Jhunjhunwala, & Doshi, 2018). In the hyperlocal delivery business, the shortest delivery time is one of its greatest aspects and also sometimes their unique selling point. With the increasing competition in hyperlocal delivery, companies have to be working efficiently to reduce their delivery time and also offer the lowest or competitive prices to attract customers and maintain relevant market share.

A research paper by R.E. Stary & I.A. Valentine (1971), elucidates the importance of operations research in delivery systems in order to keep costs to a minimum and perform tasks in the shortest time frame possible, in order to do so the linear programming approach has been utilized. However, this approach requires constant data in terms of constraint and data input, which cannot be guaranteed in the delivery service model as the pickup and drop location will keep changing from customer to customer and cannot be predetermined.

Research on attended home delivery systems discusses that it is imperative for customers to be present during the delivery for perishable or expensive goods that cannot be left unattended (Agatz, Campbell, Fleischmann, & Savels, 2008). This leads to increased costs since deliveries will have to be done on the basis of time slots. Retail distribution management research showed that Attended Home Deliveries that were divided into one hour-long time slots had a cost of transportation that was larger than unattended deliveries by 2.7 times (Punakivi M, Saranen J 2001). This theory isn't relevant as the services provided are on demand and are executed on an almost real-time basis.

Studies by Golden, B., Raghavan, S., Wasil, E. (2008), and Eksioglu, B., Vural, A., Reisman, A., (2009) as well as Dumitrescu, I., Ropke, S., Cordeau, J.-F., Laporte, G., (2010) show how vehicle routing problems can be used to optimize vehicle routes from a primary location to supply known demands of customers subject to constraints of transport capacity. The traveling salesman problem can also be described in this category which discusses a pickup-delivery system where a single pickup corresponds to one drop off a deeper dive into this study extends to multiple traveling salesman problem that examines the usage of integer, multi-objective optimization model, this helps to minimize the distance traveled in total and while ensuring working times of the traveling salesmen stays balanced (Bektas, T. 2006, Kergosien, 2009).

A survey on pickup and delivery problems classified problems into 2 categories, first, one dealing with goods transport from the storehouse to linehaul customers and from backhaul customers to the storehouse this is expounded as Vehicle Routing Problems with Backhauls. The second category deals with the transportation of goods between pickup and delivery points. (Parragh, 2008). These problems take into account the usage of multiple or single vehicle transportations and cover a larger distance.

The most relevant research done with respect to our topic is on the pickup and delivery problem (PDP) (Parragh, 2008). It is a subset of the routing problem in which objects and people have to be transported from different origins to different destinations. There are three categories under PDP: (1) Many-to-many where multiple origins and destinations are involved eg. repositioning of inventory between different retail outlets (2) One-to-many-to-one, eg. delivery of beverages to consumers and collection of empty cans and bottles (3) One-to-one where transportation is made from one origin to one destination. While this theory is relevant it isn't accurate enough for our case as the hyperlocal delivery model deals with small geographical areas (Bektas, T. 2006, Kergosien, 2009).

The above-mentioned OR concepts make unique contributions to optimize the process of delivery and multiple aggregator delivery businesses have utilized these to streamline their operations. But, the focus of our research paper is to understand how hyperlocal delivery businesses like Dunzo & Burzo have optimized their operations. While they do come under the aggregator delivery business segment what makes them unique is their business model. The hyperlocal business model makes high task completion rate and high employee efficiency the most prominent way of growth as these businesses provide services that have high frequency and low margins.

A study by Sapna Shrimali and Govind Shay Sharrma (2017) reveals how operations research and in particular how assignment problems can be utilized in order to increase the productivity of labor and achieving minimization of costs by optimizing the use of time. This same methodology can be used in the case of hyperlocal delivery business models. As these businesses have multiple delivery personnel in a small area readily available to fulfill a task, allocating the task to the right delivery personnel becomes the obvious way of increasing employee efficiency (Sharrma & Kaushik, 2017). This is why we have based our research on the impact of the Assignment problem to analyze the best way to increase employee efficiency and optimize business operations via time minimization.

3. RESEARCH OBJECTIVES

The objectives of the research paper will be to find answers to the following questions:

1. To understand the use of operation research in the hyperlocal delivery system
2. To analyze the use of assignment problems to increase employee efficiency
3. To elaborate on the use of multiple constraints to optimize the delivery time

4. RESEARCH METHODOLOGY

This research paper is written using secondary data from different sources, which include-

1. Past research papers (16)
2. Articles (6)

A thorough research has been carried out for this research paper. The goal of this study is to determine the necessity for operations research as a result of the vast size at which they operate and the wide range of services they provide. The assignment problem was used to learn how businesses in this industry can deal with a variety of situations in the most time-efficient way possible.

5. ANALYSIS AND FINDINGS

The start of courier services occurred during the 19th-20th century, with light packages being hand-delivered on foot while larger ones were carried by horses in Europe and Asia, camels in Gulf countries, some Asian countries as well as Australia, and in areas of Alaska, Canada, and Australia even dog sleds were used by delivery men to transport parcels and mail (Tanwar, 2018). Since 1817 after the invention of bicycles (Miller, 2021) this economic method was used by most deliverymen to deliver parcels at a swift speed, however back then even express deliveries took around 1-2 days to be delivered due to a lack of appropriate infrastructure, navigation systems, etc.

The modern-day delivery system has achieved immense improvements due to technological progress. Systems like Borzo promise deliveries to any place in Mumbai within 90 minutes (Shreyas Mhambrey, n.d.). This is due to the fact that they have created multiple courier schedules with shifts in order to provide quality service at any time of the day. Deliveries are done via the delivery partners who can get a part-time affiliation with the company within their hyper-locality in order to deliver items either via foot or bike in the least time possible.

The hyperlocal delivery market has also increased employee efficiency drastically through new apps and methods to deliver these goods. Although there are a lot of local players in this industry, it is dominated by two major players, Borzo (previously known as Burzo) and Dunzo. These players are dominating the hyperlocal delivery industry due to their scope of services provided, user-friendliness of the app, marketing strategies, and websites, and they have also gained customers' trust through their policies. This has been done by applying operations research techniques to better their service and satisfy customers. There is a competitive nature between the companies as all of them do the same work. People will always choose the ones who are faster and more efficient. The companies which have a shorter delivery time which can be found out using OR will be more popular. Today these delivery apps use AI and other strategies like business tie-ups to optimize their apps. These steps have definitely cut out some time from the delivery process regardless of how simple or complicated the delivery process is.(Kashyaap, 2018)

The research papers analyzed have made it clear that the hyper-local delivery business has become a predominant logistics play. Today these delivery apps use AI and other strategies like business tie-ups to optimize their apps. These steps have definitely cut out some time from the delivery process regardless of how simple or complicated the delivery process is. There is enough proof of a direct correlation between customer satisfaction and delivery speed. Organizations like Amazon are to be blamed for setting these kinds of customer expectations which has made real-time delivery the ultimate dream for delivery companies. This research paper aims to understand the impact of assignment problems on improving employee efficiency and in turn business operations. It has been found that if delivery platforms don't act as a convenient, cost-effective intermediary they will most likely lose market share making OR absolutely essential for their survival.

Problem: There are 4 delivery boys in a hyper-local delivery company. Four different customers have placed their orders, so which delivery boy must be selected for which order on the basis of two factors that we have chosen, which are the time and distance of the next order? We have assigned equal weights to the time and distance of the next order respectively. The weights have been assigned to the factors so that the effect of both of them can be encompassed in a single assignment problem as assignment problems are used for single factor problems (data in the following problem is based on assumptions).

Step 1: The given problem is balanced as the number of rows is equal to the number of columns.

Table-1: Constraint 1 Time- Balanced number of rows = number of columns

Time (in minutes)				
Delivery boys	Order 1	Order 2	Order 3	Order 4
1	52	66	58	51
2	50	69	59	56
3	52	51	61	54
4	66	51	59	63

Table-2: Constraint 2 Distance: Balanced number of rows = number of columns

Distance of next order (in km)				
Delivery boys	Order 1	Order 2	Order 3	Order 4
1	6	6	13	15
2	15	14	6	12
3	8	13	6	7
4	10	7	15	11

Step 2: Adding the two matrices and dividing them by the total weights.

Table-3: Adding the two matrices and dividing them by the total weights

Delivery boys	Order 1	Order 2	Order 3	Order 4
1	29.00	36.00	35.50	33.00
2	32.50	41.50	32.50	34.00
3	30.00	32.00	33.50	30.50
4	38.00	29.00	37.00	37.00

Step 3: Row Minima (Subtracting the minimum number in the row from all numbers in the row)

Table-4: Row Minima

Delivery boys	Order 1	Order 2	Order 3	Order 4
1	0.00	7.00	6.50	4.00
2	0.00	9.00	0.00	1.50
3	0.00	2.00	3.50	0.50
4	9.00	0.00	8.00	8.00

Step 4: Column minima (Subtracting the minimum number in the column from all numbers in the column)

Table-5: Column Minima

Delivery boys	Order 1	Order 2	Order 3	Order 4
1	0	7	6.5	3.5
2	0	9	0	1

3	0	2	3.5	0
4	9	0	8	7.5

Step 5: The most efficient way to deliver orders in the least amount of time and minimum distance for the next order is -

Table-6: Assignments

Delivery boys	Order Assignment	Time (Minutes)	Distance of next order (Kms)
1	Order 1	52	6
2	Order 3	59	6
3	Order 4	54	7
4	Order 2	51	7

Step 6: Observation and Findings

Using the assignment problem technique, the hyperlocal delivery company can effectively allocate their delivery boys to deliver orders in the least amount of time and also minimize the distance for the next order delivery. These methods can be utilized on a lot bigger scope with a huge number of requests on a city-wide level.

On top of this, hyperlocal delivery apps can make use of data, run it through AI systems to pinpoint areas of high order probability. This way they can instruct the delivery personnel to be in certain areas during certain times of the day thereby reducing the time and distance values that would be entered in the assignment problem system to assign orders.

6. RECOMMENDATIONS

In certain situations, cost could be given more preference rather than time or distance where people don't mind waiting for a few days in order to pay the least amount of delivery fee in that case weighted assignment problems will be very useful. The findings can be more multidimensional if there is a way to assign problems using more factors such as an extra commission for express delivery. The same technique can be applied by food delivery apps as well where people can order from multiple restaurants (example: starters, main course, and dessert can be ordered from three different places) and weights can be given according to their preference of which meal they want to eat first, assignment problem can then be used to allocate delivery guys more efficiently.

7. LIMITATIONS

The use of operations research doesn't factor in unforeseen circumstances such as accidents, route blockage, etc. The data used in the example sum is based on assumptions due to the insufficiency of primary data. Since secondary data referred to has been accumulated from various other research papers some of our analysis and conclusions could have been influenced by those papers. Also, there could be implicit bias due to the reference of other sources while writing the paper.

8. CONCLUSION

Due to rising customer expectations, the need to make close to real-time delivery has become essential for the survival of delivery companies, especially Hyperlocal delivery companies that have small delivery consignments. Organizations have used various OR tools and AI applications to optimize their processes but, through this research paper, we have tried to understand how companies can make better choices when they have multiple options to choose from for the fulfillment of a task. This research paper uses assignment problems to help delivery companies make the best possible choices while taking into account all possible major constraints they might face. As seen in the hypothetical numerical solution above, we have made use of weights such as time and distance between 2 consecutive orders to get the most accurate answers. This system can not only be used by hyperlocal delivery businesses but other logistical businesses. This is made possible by the flexibility in our application with the use of weights which can be changed according to the business scenario a particular company operates in. Companies which use OR will be able to strike a balance between employee efficiency and high market share.

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