A Real Life Feasibility Analysis in a Delivery Service System

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ABSTRACT

Online food ordering is an emerging field in recent years in the restaurant industry. The availability of this platform provides customers with convenient food shopping and restaurants with increased productivity and order accuracy. Feed Me Cyprus (FMC) is an online food ordering application, that has been in progress since the beginning, now it is considering to start the delivery service by itself. For this purpose, the feasibility of establishing the own distribution network for a real-life service system which is FMC was analyzed in this research. Two strategies have been developed, one with considering the restaurants separately and the other with grouping restaurants according to their locations. All related data and information are obtained from several resources and the problem was formulated as a mixed-integer programming model. The developed model was used to find the expected annual profit of FMC for all alternative scenarios. Both of the strategies, by trying different service prices: 6, 7,…,10 Turkish lira (TL) and delivery units were profitable. The second strategy is developed to increase the utilization of the delivery units and the expected profit of FMC by combining restaurants in groups based on their locations. By applying a comparison between the results of the two strategies, the second one was more profitable. In this way, some useful information and guiding comments for FMC are obtained by implementing several economic analyses based on the found numerical results of the second strategy. Except for some cases in price 6 TL, the results for the rest of the prices in economic analyses were acceptable based on their net profit and payback period.

Keywords: Feasibility analysis, Distribution, Online food delivery, Economic analysis, Mixed-integer programming

ÖZ

İnternet üzerinden yemek siparişi vermek son yıllarda restorant sektöründe gelişen bir alandır. Bu platformun kullanılabilirliği, müşterilere olan uygun yiyecek alışverişi ve restoranlara daha fazla üretkenlik ve sipariş doğruluğu sağlar. Feed Me Cyprus (FMC) şirketi de bunlardan biridir. Kurulduğundan beri restorantlara internet üzerinden sipariş verme hizmeti sağlayan bu şirket son zamanlarda kendi dağıtım ekibini oluşturarak siparişlerin müşterilere dağıtımını da kendisi yapmayı planlamaktadır. Bu amaçla, FMC olan gerçek bir hizmet sistemi için kendi dağıtım ağını kurmanın olabilirliğiyle bu araştırmada analiz edilmiştir. Bu kapsamda birinde restorantların ayrı ayrı düşünüldüğü diğerinde gruplar halinde konumlarına göre düşünüldüğü iki strateji ele alınmıştır. İhtiyaç duyulan veri ve bilgiler çeşitli kaynaklardan elde edilmiş ve problem bir karma tamsayılı programlama modeli olarak formülize edilmiştir. Geliştirilen model kullanılarak ele alınan tüm senaryolar için FMC şirketinin olabilir yıllık karı bulunmuştur. Her iki strateji de farklı hizmet fiyatlarını: 6, 7,…, 10 Türk lirası (TL) ve teslimat birimleri deneyerek karlıydı. İkinci strateji dağıtım birimlerinin kullanım oranlarını ve FMC şirketinin olabilir karını artırmak üzere geliştirilmiştir. İki stratejinin sonuçları arasında bir karşılaştırma uygulayarak, ikincisi daha karlı olduğunu fark ettik. Bu şekilde, ikinci stratejinin bulunan sayısal sonuçlarına dayalı çeşitli ekonomik analizler yapılarak FMC şirketi için bazı yararlı bilgiler ve yol gösterici çıkarımlarda bulunulmuştur. 6 TL fiyatındaki bazı durumlar dışında, ekonomik analizlerde kalan fiyatların sonuçları net kar ve geri ödeme sürelerine göre kabul edilebilirdi.

Anahtar Kelimeler: Olabilirlik analizi, Dağıtım, Çevrimiçi yemek teslimatı, Finansal analiz, Karma tamsayılı programlama

To My Mother

For her pure love, affection, encouragement, and support, without her, I would be nothing

My Father

For earning an honest living and for supporting and encouraging me to be the Best

My Sister Sona, and My Brother Mohammad

And To My Beloved Friend Elham

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LIST OF SYMBOLS AND ABBREVIATIONS

FMC	Feed Me Cyprus
TL	Turkish Lira
EV	Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
LCA	Life Cycle Assessment
APIs	Application Programming Interfaces
SNS	Social Network Services
LVDC	Low Voltage Direct Current
KEPCO	Korean Electric Power Corporation
MVAC	Medium-Voltage Alternating Current
SIEM	Security Information and Event Management
BWPT	Bi-directional Wireless Power Transfer
QDWPT	Quasi-Dynamic
G2V	Grid-to-Vehicle
V2G	Vehicle-to-Grid
BEV	Battery Electric Vehicles
Kwh	Kilowatt Hour
GIS	Geographical Information System
LBS	Location Based System
ESTs	Energy Storage Technologies
EPS	Electric Power System
CAES	Compressed Air Energy Storage
PHS	Pumped Hydro Storage
FDA	Food Delivery Application
U&G	Uses and gratifications
OFD	Online Food Delivery

FD	Food Delivery

Chapter 1

INTRODUCTION

With the development of technology all around the world, we can see its rising effect on people`s daily life. In this way, everyone`s usage of it in order to save up in energy especially time has been increased and received a lot of importance. People tend to shop and order online due to its convenience. There are intense competition and a challenging environment between online business firms to serve the best service at the lowest cost. There are different fields of activities like transportation, clothes and grocery shopping, food ordering, etc.

Online food ordering has been growing significantly in recent years, especially among younger generations. Lots of companies started to work in this field. They try to do their job in the best quality and draw more attention to customers. It facilitates customer access to lots of restaurants. It is faster, productive, and more convenient for both sides. Restaurants receive more orders in a shorter period. One of these online food ordering companies is Feed Me Cyprus (FMC).

1.1 Feed Me Cyprus

FMC is an online food ordering application that has been operating in North Cyprus. It started working first in Famagusta in September 2017, then Nicosia in April 2018, and Kyrenia in April 2019. Online marketing as Feed Me Market has been started since September 2020 in Famagusta. It started with several restaurants in Nicosia, Famagusta, and Kyrenia; and now is continuously spreading in the remaining areas of

North Cyprus, as well as welcoming new restaurants in the three big cities to their system. FMC made a contract with these restaurants and they provide their menu in the application. A customer can easily order any food from any of these restaurants that prefer, in this process customer:

- Register with his/her phone number
- Select the restaurant of his/her preference
- Add the products she/he wants
- Enter his/her address and submit the order.

After that, the restaurant will confirm the order, prepare it, and deliver it to the customer`s address.

FMC owners were considering doing the delivery job and launch their own delivery fleet. Is it possible and is it worth investing in such a business or not?! For the proper answer, they needed help and some academic work on the feasibility of this real-life situation.

In order to make a correct decision, in this study, we analyzed several cases. We considered different prices and situations in detail. In the end, FMC has to decide by itself whether it is beneficial enough to take responsibility and launch the delivery service or not?!

In this research, information and data were collected about orders from FMC application like customer and restaurant’s addresses, their average distance, average daily orders and deliveries of restaurants, type, and the average number of motorcycles that restaurants use for their daily deliveries, it`s relevant and necessary information like usage of gas in how many kilometers, costs related to it and deliverymen wages.

Two mathematical scenarios were developed for our study. In each scenario, the five different service prices and their yearly profits for the company were considered.

In the first scenario by considering the restaurant`s average number of daily orders of FMC and the number of needed motorcycles, yearly profit in five different service prices by subtracting specific expenses was calculated. In the second scenario, some changes were applied by considering some restaurants as one restaurant according to their amount of orders and locations in order to earn more profit and use fewer motorcycles. The second scenario was more profitable, in this way to evaluate from an economic point we brought up capital investment, salvage value, the interest rate of 13%, the minimum attractive rate of return of 20%, and 5 years of the planning horizon. In this economic analysis, present value, annual value, internal rate of return, and the payback duration were calculated to provide us broader and comprehensive information about the results of this study.

Here we share definitions of economic terms that were used in our analysis:

1.2 Capital Investment

For the definition of this economic term, Will Kenton mentioned this; “Capital investment is the procurement of money by a company in order to further its business goals and objectives. The term can also refer to a company's acquisition of long-term assets such as real estate, manufacturing plants, and machinery” KENTON (2020a). Here we considered 17000 TL for every motorcycle as a capital investment.

1.3 Salvage Value

This economic term is defined as

> Salvage value is the estimated book value of an asset after depreciation is complete, based on what a company expects to receive in exchange for the

> asset at the end of its useful life. As such, an asset's estimated salvage value is an important component in the calculation of a depreciation schedule. Kenton (2020b).

After asking some motorcycles shop owners, it was considered 8000 TL for the salvage value at the end of five years.

1.4 Interest Rate

Definition of this term in the engineering economy book by Leland Blank

> Interest is the manifestation of the time value of money. Computationally, interest is the difference between an ending amount of money and the beginning amount. If the difference is zero or negative, there is no interest. There are always two perspectives to an amount of interest: interest paid and interest earned. Interest is paid when a person or organization borrowed money (obtained a loan) and repays a larger amount over time. Interest is earned when a person or organization saved, invested, or lent money and obtains a return of a larger amount over time. When interest paid over a specific time unit is expressed as a percentage of the principal, the result is called the interest rate Leland Blank (2011).

It was considered a 13% interest rate according to one of the banks in North Cyprus in December 2020.

1.5 Present Value (PV)

For this economic term, we have this definition

> Present value (PV) is the current value of a future sum of money or stream of cash flows given a specified rate of return. Future cash flows are discounted at the discount rate, and the higher the discount rate, the lower the present value of the future cash flows. Determining the appropriate discount rate is the key to properly valuing future cash flows, whether they be earnings or debt obligations Fernando (2020b).

1.6 Internal Rate of Return (IRR)

This economic term defined as

> The internal rate of return is a metric used in financial analysis to estimate the profitability of potential investments. The internal rate of return is a discount rate that makes the net present value (NPV) of all cash flows equal to zero in a discounted cash flow analysis Fernando (2020a).

1.7 Minimum Attractive Rate of Return (MARR)

In the engineering economy book by Leland was mentioned

> For any investment to be profitable, the investor (corporate or individual) expects to receive more money than the amount of capital invested. In other words, a fair rate of return, or return on investment, must be realizable The Minimum Attractive Rate of Return (MARR) is a reasonable rate of return established for the evaluation and selection of alternatives. A project is not economically viable unless it is expected to return at least the MARR Leland Blank (2011).

Here it was considered 20% for the rate of MARR.

1.8 Payback Period

This economic term defined as

> The payback period refers to the amount of time it takes to recover the cost of an investment. The payback period is the cost of the investment divided by the annual cash flow. The shorter the payback, the more desirable the investment Kagan (2020).

In the following sections, some articles about feasibility analysis in the second chapter were summarized, chapter three is about our collected information during this study, the fourth chapter will be about mathematical models and detailed data about it. Then we provide numerical results in the fifth chapter and in the last chapter we will discuss our conclusions and suggested future studies.

Chapter 2

LITERATURE REVIEW

This paper is about the feasibility analysis of establishing a distribution network for the FMC that is an online food ordering application. Through our research, there were numerous studies about feasibility analysis in different sections as well as some exact researches in the field of online food delivery service. In the following part, some studies were summarized.

Kaldellis (2002) studied a comprehensive time-depending feasibility analysis to make improvements in the credibility of the computational strategies to simulate the economic situation of commercial wind parks in Greece. In the model, the time dependency of the governing parameters was considered and it was based on almost 20-years data from the local market records. The application of the improved computational frame to various cases, about the economic behavior of wind parks launched during 1985–95 in Greece, remarkably promoted the credibility of predictions in comparison with the findings based on time-mean values of the corresponding parameters. Finally, the proposed model in this study explains the development of wind energy applications in Greece during the last 15 years, based on purely economic terms very well.

Cicconi et al. (2012) studied the recent growth of the EV/PHEV market due to the technological improvement of battery systems. The Second Life applications

appropriate for the Li-Ion battery cells was studied that are used for electric powertrains to increase endurable transportation and stay away from the environmental effect that disposal of these kinds of batteries would have. A Life Cycle Assessment (LCA) analysis has been considered to evaluate the usage in terms of environmental effect. The research concluded a positive impact of the Second Life solution on the environmental effect of the Li-Ion cells; furthermore, the gathered information will be beneficial for the Second Life strategies and scheduling within the early design stage.

The feasibility analysis of transportation applications based on application programming interfaces (APIs) of social network services (SNS) was studied by Byon et al. (2013). Some SNS are developing new plans on providing APIs that permit external programmers to access their services and tailor down their personal applications for specific jobs. Transportation applications will benefit from these modern usable data sources. This paper gave suggestions about three important SNS (Facebook, Twitter, and Flickr) transportation applications related to carpooling, traffic condition monitoring, and accident reporting. This research has also revealed that SNSs are very valuable contributors in designing and implementing the idea of the internet of things in the common field of transportation engineering.

A Techno-Economic feasibility analysis on Low voltage direct current (LVDC) distribution system for rural electrification in South Korea was studied by Afamefuna et al. (2014). The study concentrated on the use of LVDC distribution system to replace some of KEPCO's existing traditional medium-voltage alternating current (MVAC) distribution network for rural electrification in South Korea. The researchers Considered whether it will be beneficial or risky from the technical and economic

views. LVDC distribution system was more cost-efficient option with a cost savings for the MVAC system.

Ahmed et al. (2014) did a feasibility analysis for the effect of the reduction of visibility on crash occurrence. Visibility detection systems help to reduce the increased danger of limited-visibility. Bayesian logistic regression was used to link six years (2005–2010) of historical accident information to real-time weather data gathered from eight airports in the State of Florida, roadway specifications and overall traffic parameters. The results of this study indicated that real-time weather information gathered from nearby airports can predict to determine increased danger on highways.

Galle et al. (2015) worked on the feasibility of the transformation of 352 student residences that have become obsolete. In order to offer a piece of useful advice, architectural explorations and life cycle evaluations were done. Through Life Cycle Costing, the beginning costs of distinguished transformation methods, conventional and of course adaptable, were considered. By combined evaluations at an element and building level, it was possible to detect the specific value of the residences' load-bearing structure and the situations under which adaptable building could improve that value. These results allowed us to formulate accurate advice in the beginning stages of the project.

Irfan et al. (2015) studied Cloud computing that is growing recently and has a very important role in the domain of Information Technology. The study presented a feasibility analysis of performing digital forensics via SIEM (Security Information and Event Management) system in the cloud environment. The main work of the research focused on inactive attacks while some active attacks are covered as well and the

forensics analysis gets done while considering the service provider end. The primary analysis presented in this study will prepare a detailed and precise overview of the different artifacts that may be considered for applying an in-depth forensic analysis in the cloud environment using the Security Information and Event Management System.

Wang et al. (2015) evaluated the feasibility analysis of a collaborative platform for delivery fulfillment in a smart city. the objective was to estimate the feasibility of such a platform in Singapore. In the end, the results validated that the collaborative platform as an effective solution to match the delivery demand and supply in an urban environment involving a lot of variable factors without a physical Urban Consolidation Center is needed and necessary.

Mohamed et al. (2017) analyzed, a new bi-directional wireless power transfer (BWPT) charging and discharging concept for its feasibility in integration at traffic signals. Classified as quasi-dynamic WPT (QDWPT), a string of coils was proposed to be fixed under the road surface to give grid-to-vehicle (G2V) and vehicle-to-grid (V2G) services to battery electric vehicles (BEVs) while stopped. For every plan, a comparison has been made over the maximum driving range per drive cycle and range gained for each consumed kwh. We concluded from this study that, QDWPT at traffic signals is a very promising answer to substantially expand the driving limit and operating time for city driving particularly at high charging levels.

According to Siregar et al. (2017), a food delivery system is a type of geographical information system (GIS) that can be performed through a digitation procedure. To make sure that the digitation process of the food delivery system can be performed effectively, the shortest path determination facility and food delivery vehicle tracking

were added. A Star (A*) algorithm for determining the shortest path and location-based system (LBS) programming for moving food delivery vehicle object tracking was used. A system that can be used by food delivery drivers, customers, and administrators in terms of simplifying the food delivery system was generated.

Sreekanth et al. (2019) analyzed the benefits of energy storage technologies (ESTs) for managing the future energy request, by including the case of electric power systems (EPS) in barren areas. Two interactive programs were used in the feasibility analysis that was allowed to evaluate different ESTs about their specifications, costs, benefits, which was performed for the first time in this area. Compressed air energy storage (CAES) was the most important choice followed by pumped hydro storage (PHS) and sodium-sulfur battery, according to the technical and economic valuations of the various ESTs in barren areas.

Ray et al. (2019) studied the different motives leading to the high usage of various FDAs. They worked to find out by developing a psychometrically important and reliable instrument that measures different uses and gratifications (U&G) behind the use of FDAs. Furthermore, the connection between different U&Gs and purposes to use FDAs were investigated. A mixed-method research approach consisting of open-ended essays (qualitative) with 125 FDA users and an online cross-sectional survey with 395 FDA users was applied. Then a U&G theory was applied and found eight major gratifications behind the use of FDA, namely, convenience, societal pressure, customer experience, delivery experience, search of restaurants, quality control, listing, and ease-of-use.

Suhartanto et al. (2019) evaluated the direct effect of food and e-service quality on customer loyalty toward online food delivery (OFD) service and its indirect effect through the intercession of customer satisfaction and remarkable value. by using a survey of 405 OFD service customers from Bandung, Indonesia, and applying variance-based partial least squares to estimate the proposed model, it was confirmed the direct effect of food quality on online loyalty, but not e-service quality. Additionally, the study revealed the partial intercession role of customer satisfaction and remarkable value on the relationship between both food and e-service quality on online loyalty toward OFD services.

Li et al. (2020) studied the advantages of online food delivery (FD) during the global 2020 COVID-19 epidemic. It helped consumer access to prepared meals and enabled food providers to keep operating. The broader impacts of online FD, and what they mean for the stakeholders were involved. From an economic viewpoint, while online FD provides job and sale opportunities, it was criticized for the high charges of restaurants and questionable working conditions for delivery crew. From a social view, online FD has effects on the relationship between consumers and their meal, as well as affecting public health results and traffic systems. Environmental impacts were the high generation of waste and its carbon tracks.

Chapter 3

COLLECTED INFORMATION

The objective of this study is to analyze the feasibility of launching a distribution network for the FMC application. In this way, we need some data and information:

1) Every restaurant`s average daily order of FMC (S_r).
2) How many motorcycles and deliverymen will be needed to distribute the orders (M_r).
3) The average cost for every order.
4) Every deliveryman`s average yearly expenses.

3.1 Restaurants Average Daily Order of FMC (S_r)

To calculate these data, we asked FMC owners to provide us with information about the last two months of the 2019 year`s average daily order from restaurants. We collected the results in table 1 according to that information.

Table 1: Average number of daily orders from restaurants (S_r)

R	S_r	R	Sr	R	Sr	R	Sr	R	Sr
R1	4	R21	1	R41	6	R61	14	R81	3
R2	27	R22	28	R42	26	R62	22	R82	4
R3	5	R23	85	R43	24	R63	13	R83	2
R4	9	R24	1	R44	28	R64	3	R84	7
R5	55	R25	38	R45	13	R65	6	R85	6
R6	11	R26	5	R46	11	R66	4	R86	4
R7	8	R27	34	R47	60	R67	24	R87	3
R8	17	R28	76	R48	11	R68	17	R88	68
R9	5	R29	8	R49	17	R69	61	R89	3
R10	16	R30	18	R50	27	R70	31	R90	22
R11	71	R31	19	R51	26	R71	3		
R12	8	R32	5	R52	62	R72	4		
R13	2	R33	253	R53	3	R73	30		
R14	6	R34	1	R54	2	R74	21		
R15	1	R35	23	R55	6	R75	19		
R16	28	R36	2	R56	8	R76	35		

R17	68	R37	1	R57	32	R77	6		
R18	16	R38	17	R58	6	R78	13		
R19	1	R39	27	R59	4	R79	3		
R20	1	R40	9	R60	19	R80	15		

3.2 Number of Motorcycles for Distribution (M_r)

For getting this information, we have to have the average number of orders a deliveryman can carry out every day. In this way, we selected 27 restaurants by random and asked their managers or supervisors about the daily average number of orders from FMC, phone, or other apps, and the number of motorcycles for performing the delivery operation. The collected information is given below in table 2.

Table 2: Number of deliverymen

Restaurant	Average daily order	Number of deliverymen
R1	71	3
R2	70	2
R3	54	2
R4	35	2
R5	30	3
R6	90	4
R7	60	3
R8	90	4
R9	175	4
R10	55	1
R11	25	1
R12	175	2
R13	200	5
R14	65	2
R15	17.5	2
R16	27.5	1
R17	55	3
R18	225	3
R19	20	1
R20	20	1
R21	30	1
R22	40	1
R23	70	3
R24	70	2
R25	65	2
R26	40	1
R27	7.5	1

All the collected information was considered and the average number of orders per deliverymen in table 3 was calculated.

Table 3: Delivery data

Restaurant	Average daily order	Number of delivery guys	Average per delivery man	Restaurant	Average daily order	Number of delivery guys	Average per delivery man
R1	71	3	24	R16	27.5	1	27.5
R2	70	2	35	R17	55	3	18
R3	54	2	27	R18	225	3	75
R4	35	2	17.5	R19	20	1	20
R5	30	3	10	R20	20	1	20
R6	90	4	22.5	R21	30	1	30
R7	60	3	20	R22	40	1	40
R8	90	4	22.5	R23	70	3	23
R9	175	4	44	R24	70	2	35
R10	55	1	55	R25	65	2	32.5
R11	25	1	25	R26	40	1	40
R12	175	2	87.5	R27	7.5	1	7.5
R13	200	5	40				
R14	65	2	32.5				31.111
R15	17.5	2	9				**31**

We calculated the average number of orders for every motorcycle. In other words, for 27 randomly chosen restaurants we computed 31 orders per day for each motorcycle to be delivered. But in our observation and calculation, there was an average number of daily orders like 40, 44,55, 75, and 87 so we assumed FMC can take an averagely of 36 orders per day. Later, we divided the restaurant`s average daily order of FMC to 36, rounded it up, and computed how many motorcycles will be needed for every restaurant so the delivery job will be done. This information is given in table 4.

3.3 Calculation of Average Fuel Cost

We did some research about the type of motorcycles that are suitable for the delivery job. We asked restaurants, deliverymen, and some motorcycle shops and gathered the following information from each shop.

Table 4: Number of motorcycles (Mr)

R	S_r	M_r	R	S_r	M_r	R	S_r	M_r	R	S_r	M_r	R	S_r	M_r
R1	4	1	R11	71	2	R21	1	1	R31	19	1	R41	6	1
R2	27	1	R12	8	1	R22	28	1	R32	5	1	R42	26	1
R3	5	1	R13	2	1	R23	85	3	R33	253	8	R43	24	1
R4	9	1	R14	6	1	R24	1	1	R34	1	1	R44	28	1
R5	55	2	R15	1	1	R25	38	2	R35	23	1	R45	13	1
R6	11	1	R16	28	1	R26	5	1	R36	2	1	R46	11	1
R7	8	1	R17	68	2	R27	34	1	R37	1	1	R47	60	2
R8	17	1	R18	16	1	R28	76	3	R38	17	1	R48	11	1
R9	5	1	R19	1	1	R29	8	1	R39	27	1	R49	17	1
R10	16	1	R20	1	1	R30	18	1	R40	9	1	R50	27	1
R	**S_r**	**M_r**	**R**	**S_r**	**M_r**	**R**	**S_r**	**M_r**	**R**	**S_r**	**M_r**			
R51	26	1	R61	14	1	R71	3	1	R81	3	1			
R52	62	2	R62	22	1	R72	4	1	R82	4	1			
R53	3	1	R63	13	1	R73	30	1	R83	2	1			
R54	2	1	R64	3	1	R74	21	1	R84	7	1			
R55	6	1	R65	6	1	R75	19	1	R85	6	1			
R56	8	1	R66	4	1	R76	35	1	R86	4	1			
R57	32	1	R67	24	1	R77	6	1	R87	3	1			
R58	6	1	R68	17	1	R78	13	1	R88	68	2			
R59	4	1	R69	61	2	R79	3	1	R89	3	1			
R60	19	1	R70	31	1	R80	15	1	R90	22	1			

3.3.1 NCM Honda Kibris

1) Honda Activa F125: 17500 Turkish Lira (1liter:50 kilometers)
2) Honda spacy Alfa: 19500 TL (1liter: 60 kilometers)

3.3.2 Sim&Er Motor

1) Honda Activa 5G (2020): 16800 TL (metal body, 6 liters: 250 kilometers, normal)
2) Yamaha alpha: 14500 TL (6 liters: 180 kilometers)

3.3.3 Motomax

1) Honda Activa 5G: 16800 TL (1liters: 68 kilometers)

We found out that one type of motorcycle is more common and mostly used here in North Cyprus between restaurants for the delivery process and it was Honda Activa 5G.

3.3.4 Honda Activa 5G Specifications:

Figure 1: Honda Activa 5G

- Mileage: 60 Kmpl
- Engine: 109 CC
- Power: 7.96 PS @ 7500 rpm
- Torque: 9 Nm @ 5500 rpm (*Honda Activa 5G*, 2020)

This motorcycle uses nearly 1-liter gas for every 60 kilometers. By considering traffic, waiting duration in red light, etc. we took approximately 40 kilometers for the consumption of 1-liter gas. And the price of 1-liter gas was 6 TL, so for every kilometer, the gas cost would be 0.15 TL.

Later, we calculated for every order average distance by considering randomly selected 199 orders from FMC. We used Google Earth for this purpose and computed the distance between the customer`s address and the restaurant`s address. Results are given in the following table 5.

Table 5: Distance

Observation	Distance	Observation	Distance	Observation	Distance
1	2.3	28	2.1	55	0.5
2	9.9	29	1.9	56	2
3	2.1	30	1	57	2.8
4	0.4	31	0.75	58	1.6
5	0.11	32	1.8	59	1.7
6	2.3	33	1.9	60	1.3
7	0.2	34	0.7	61	2.2
8	1.3	35	2	62	1.2
9	2.2	36	0.9	63	2.6
10	0.4	37	3	64	0.65
11	0.4	38	2.3	65	2.1
12	1.9	39	0.6	66	0.35
13	0.11	40	1.7	67	0.45
14	0.75	41	1.2	68	2.8
15	0.9	42	1.9	69	0.6
16	2.7	43	2.3	70	3.4
17	0.4	44	3.1	71	1.3
18	0.35	45	1.4	72	1.5
19	0.75	46	1.7	73	1.6
20	2.3	47	2.1	74	1.7
21	1.6	48	1.5	75	2.7
22	1.2	49	3.7	76	0.16
23	2.7	50	0.75	77	1.3
24	1.7	51	1	78	1
25	0.85	52	2.3	79	2.3
26	4.1	53	0.4	80	0.8
27	2.4	54	3.1	81	0.65
82	1.6	122	0.052	162	1
83	1.4	123	0.75	163	1.7
84	1.6	124	2.1	164	0.22
85	1.3	125	0.6	165	1.3
86	1.6	126	0.75	166	0.1
87	0.7	127	2.2	167	2.7
88	4	128	0.051	168	0.65
89	3.3	129	1.1	169	2
90	2.1	130	1.1	170	1.2
91	3.3	131	1.8	171	2.5
92	0.8	132	2.1	172	1.7
93	2.9	133	1.2	173	0.17
94	1.1	134	2	174	0.7
95	5.6	135	0.092	175	1.3
96	3.5	136	0.75	176	2.1
97	1.4	137	2.4	177	2.5
98	1.7	138	0.55	178	1.4
99	1.4	139	0.009	179	1.1
100	0.85	140	0.65	180	2.2
101	2.1	141	1.7	181	1.6
102	0.26	142	1.9	182	0.7
103	1.5	143	0.021	183	2.3
104	1	144	4.2	184	2.7
105	0.7	145	2.4	185	1.4
106	2.9	146	0.45	186	0.5
107	2.1	147	0.75	187	0.28
108	1.8	148	0.75	188	1.1
109	0.85	149	0.75	189	1.4
110	1.6	150	3	190	0.85
111	0.95	151	4.2	191	2.2
112	2.7	152	1.6	192	0.6
113	1.8	153	0.14	193	2.1
114	1.4	154	2.7	194	2.2
115	1.2	155	2.1	195	2.7
116	3.1	156	1	196	1
117	0.65	157	1.8	197	1.3
118	2.3	158	0.5	198	2.4
119	2.5	159	2.1	199	2.2
120	2.2	160	1.9	**323.625**	
121	2.9	161	2	**1.6**	**3.2**

The average distance was computed 3.2≅3.5

Therefore, the average cost of fuel for each order will be: $(6 \div 40) \times 3.5 \cong 0.5$

3.4 Calculation of the Average Constant Yearly Cost for Every Deliveryman

For achieving this information, we needed to know about the salary of a person who works in North Cyprus. We asked some people who work at private companies and KKTC Labor Ministry. Net salary with insurance etc. was approximately 5000 TL. And the average cost of a motorcycle with all traffic insurance, etc. was nearly 2000 TL. So:

$$(5000 \times 12) + 2000 = 62000 \text{ TL/Year}$$

Chapter 4

MATHEMATICAL MODELS

4.1 Problem Definition and Formulation

FMC has a contract with a set of restaurants to receive online orders for them. Each restaurant has several orders received daily via FMC. FMC company wants to get an idea about the expected amount of profit in case of buying motorcycles, employing drivers, and delivering the orders from the restaurants to the customers with a service price. The amount of expected profit is equal to the amount of expected income minus the expected total cost. The expected amount of income is a function of the service price and the amount of the expected delivered orders. Here it is assumed that the restaurants are ready to make a contract and buy this delivery service from the FMC company. The expected amount of orders can be forecasted using past data for each restaurant. But in order to determine the number of the delivered orders a subset of the restaurants that FMC will make a contract should be determined. Similarly, the service price should be determined as a part of the problem. The expected total cost is a function of the delivery distances, fuel oil cost, number of the delivered orders, salaries of the drivers, and expected maintenance-and-repair costs of the motorcycles. Salaries of the drivers, fuel oil cost, average delivery distances, the expected amount of maintenance-and-repair cost for a motorcycle can be determined using past data and some external sources, but determining the number of the delivered orders is a part of the problem. It depends on the restaurants that FMC will make a delivery contract. Also, FMC needs to determine the number of motorcycles and drivers for this job. As

a result, FMC should determine the delivery price, the number of the delivery units (motorcycles and drivers), and a subset of the restaurants to make a contract in order to maximize its expected profit. The sets and the parameters related to the problem are listed below.

R: set of the restaurants.

S_r: Number of the orders that restaurant r receives daily via FMC.

M_r: Number of the motorcycles needed to deliver S_r orders of restaurant r.

Salary: Gross salary of a driver.

MRC: Expected maintenance-and-repair cost of a motorcycle for a year.

FC: Expected fuel oil cost for delivery.

Decision variables are:

P: Delivery price for an order.

K: Number of the motorcycles and the drivers that FMC has.

X_r: 1 if Feed Me makes a contract and deliver the orders of restaurant r, 0 otherwise.

MotSay: Number of motorcycles used for delivery operations.

RestSay: Number of restaurants making the delivery contract with Feed Me.

When P and K are given, the values of the other decision variables can be determined by using the following Mixed Integer Programming Model:

Max TEP = $340(P-FC)\sum_{r\in R} S_rX_r$ - (MRC+ 12×Salary)MotSay

s.t.

$$\text{MotSay} = \sum_{r\in R} M_rX_r \quad (1)$$

$$\text{RestSay} = \sum_{r\in R} X_r \quad (2)$$

$MotSay \leq K$ (3)

$X_r \in \{0,1\}$ $\forall r \in R$ (4)

$MotSay, RestSay \geq 0$ (5)

In this model, the objective function is the maximization of the annual total expected profit. Most of the restaurants work 7 days a week. But some of them do not work on Sundays. Most of them do not work on some national and religion-related holidays/feasts. As a result of these considerations, it is assumed that a restaurant works 340 days a year on average. Constraint (1) computes the number of motorcycles used for the delivery operations based on the restaurant selection decisions. Constraint (2) computes the number of restaurants that FMC can serve. Constraint (3) limits the number of used motorcycles with the number of available motorcycles. Constraint (4) indicates that a restaurant selection decision is a binary decision. Constraint (5) set the domains for the MotSay and RestSay decision variables.

As it is explained above P and K are assumed to be given in this model. We have decided to solve the model for several discrete, realistic P and K values. We have tried all combinations of P=5, 6, …, 10 TL, and K=1, 2, …, $\sum_{r \in R} M_r$. The results are presented in the following chapters.

It was seen that there were motorcycles that were available but not used in many solutions after solving the above problems and interpreting the results. There were motorcycles with very low utilization and there were many restaurants with few orders that do not requires fully loaded motorcycles. After this observation, we have decided to combine restaurants considering their number of orders in order to increase utilization of motorcycles and serve more orders, cover more restaurants, and increase the expected profit. So, in this second scenario, a motorcycle may serve more than one

but few restaurants which are close to each other and combined in the same group. The above model is used in the second scenario too, but S_r and M_r values are updated according to the restaurant combination decisions. Restaurants are combined heuristically considering the closeness between them, their S_r and M_r values, and the number of the combined restaurants.

Chapter 5

NUMERICAL RESULTS

5.1 First Scenario

In our first scenario, we calculated the yearly profit for FMC by considering the average number of daily orders of restaurants for five different service prices. In each price, the number of used motorcycles, the number of contracted restaurants till the maximum number of motorcycles which after that the yearly profit wouldn't change were calculated.

- First, we assumed FMC takes 6 TL for each delivery from restaurants

In this case, the maximum number of used motorcycles was 8 and restaurants was 5. the value of the objective function wouldn't change after 8 motorcycles (table 6). So we considered all the possible situations in this price:

K=1)

It means that FMC can have a contract with one restaurant that is restaurant number 76 by using one motorcycle and earn 3450 TL in a year.

K=2)

It means that FMC can have a contract with one restaurant that is restaurant number 11 by using two motorcycles and earn 8770 TL in a year.

K=3)

In this case, FMC can have a contract with two restaurants that are restaurant number 11 and 76 by using three motorcycles and earn 12220 TL in a year.

K=4)

It means that FMC can have a contract with three restaurants that are restaurants number 11, 27, and 76 by using four motorcycles and earn 13800 TL in a year.

K=5)

It means that FMC can have a contract with three restaurants that are restaurants number 11, 17, and 76 by using five motorcycles and earn 15380 TL in a year.

K=6)

It means that FMC can have a contract with four restaurants that are restaurants number 11, 17, 27, and 76 by using six motorcycles and earn 16960 TL in a year.

K=7)

It means that FMC can have a contract with four restaurants that are restaurants number 11, 17, 76, and 88 by using seven motorcycles and earn 18540 TL in a year.

K=8)

It means that FMC can have a contract with five restaurants that are restaurants number 11, 17, 27, 76, and 88 by using eight motorcycles and earn 20120 TL in a year.

Table 6: $P6_1$

P = 6			
K	**RestSay**	**MotSay**	**Profit**
1	1	1	3450
2	1	2	8770
3	2	3	12220
4	3	4	13800
5	3	5	15380
6	4	6	16960
7	4	7	18540
8	5	8	20120

- Second, our calculations for price=7 TL continued till 28 motorcycles. After this number, the objective value and number of contracted restaurants and used motorcycles didn't change which the yearly profit was 230900 TL with 13 restaurants (table 7).

Table 7: $P7_1$

P = 7							
K	**RestSay**	**MotSay**	**Profit**	**K**	**RestSay**	**MotSay**	**Profit**
1	1	1	15350	15	5	15	163950
2	1	2	32910	16	6	16	177090
3	2	3	48260	17	7	17	185810
4	3	4	61400	18	8	18	192320
5	3	5	74540	19	8	19	198830
6	4	6	87680	20	9	20	205340
7	4	7	100820	21	9	21	209640
8	5	8	113960	22	10	22	216150
9	6	9	122680	23	11	23	220450
10	6	9	122680	24	11	24	224750
11	7	11	135700	25	12	25	229050
12	8	12	142210	26	12	25	229050
13	9	13	146510	27	12	25	229050
14	9	14	153020	28	13	28	230900

- Third, we considered all the possible situations for price = 8 TL. The maximum profit and number of used motorcycles were 614900 TL and 41 for 23 restaurants that FMC can have a contract with (table 8).

Table 8: $P8_1$

P = 8							
K	**RestSay**	**MotSay**	**Profit**	**K**	**RestSay**	**MotSay**	**Profit**
1	1	1	27250	22	10	22	459250
2	1	2	57050	23	11	23	473750
3	2	3	84300	24	11	24	488250
4	3	4	109000	25	12	25	502750
5	3	5	133700	26	12	25	502750
6	4	6	158400	27	12	25	502750
7	4	7	183100	28	13	28	533500
8	5	8	207800	29	14	29	542900
9	6	9	227400	30	15	30	552300
10	7	10	244450	31	16	31	561700
11	7	11	261500	32	16	32	568550
12	8	12	278550	33	17	33	577950
13	8	13	293050	34	18	34	584800
14	4	14	305000	35	19	35	591650
15	5	15	332250	36	20	36	598500
16	6	16	356950	37	21	37	602800
17	7	17	376550	38	22	38	607100
18	8	18	393600	39	22	38	607100
19	8	19	410650	40	22	40	610600
20	9	20	427700	41	23	41	614900
21	9	21	442200				

Table 9: $P9_1$

P = 9							
K	**RestSay**	**MotSay**	**Profit**	**K**	**RestSay**	**MotSay**	**Profit**
1	1	1	39150	13	8	13	439590
2	1	2	81190	14	4	14	461400
3	2	3	120340	15	5	15	500550
4	3	4	156600	16	6	16	536810
5	3	5	192860	17	7	17	567290
6	4	6	229120	18	8	18	594880
7	4	7	265380	19	8	19	622470
8	5	8	301640	20	9	20	650060
9	6	9	332120	21	9	21	674760
10	7	10	359710	22	10	22	702350
11	7	11	387300	23	11	23	727050
12	8	12	414890	24	11	24	751750
25	12	25	776450	36	20	36	975900
26	12	25	776450	37	21	37	989040
27	12	25	776450	38	22	38	1002180
28	13	28	836100	39	21	39	1009540
29	14	29	855020	40	22	40	1022680
30	15	30	873940	41	23	41	1035820
31	16	31	892860	42	24	42	1043180
32	16	32	908890	43	25	43	1050540
33	17	33	927810	44	26	44	1055010
34	18	34	943840	45	27	45	1056590
35	19	35	959870	46	28	46	1058170

- Fourth, with price = 9 TL our calculations continued till 46 motorcycles. In this case, FMC`s yearly profit was 1058170 TL with 28 restaurants (table 9).
- Fifth, for the price = 10 TL FMC`s yearly profit was 1524020 TL. The maximum number of used motorcycles was 47 with 29 contracted restaurants (table 10).

Table 10: $P10_1$

P = 10							
K	**RestSay**	**MotSay**	**Profit**	**K**	**RestSay**	**MotSay**	**Profit**
1	1	1	51050	25	12	25	1050150
2	1	2	105330	26	12	25	1050150
3	2	3	156380	27	12	25	1050150
4	3	4	204200	28	13	28	1138700
5	3	5	252020	29	14	29	1167140
6	4	6	299840	30	15	30	1195580
7	4	7	347660	31	16	31	1224020
8	5	8	395480	32	16	32	1249230
9	6	9	436840	33	17	33	1277670
10	7	10	474970	34	18	34	1302880
11	7	11	513100	35	19	35	1328090
12	8	12	551230	36	20	36	1353300
13	8	13	586130	37	21	37	1375280
14	4	14	617800	38	22	38	1397260
15	5	15	668850	39	21	39	1412780
16	6	16	716670	40	22	40	1434760
17	7	17	758030	41	23	41	1456740
18	8	18	796160	42	24	42	1472260
19	8	19	834290	43	25	43	1487780
20	9	20	872420	44	26	44	1500070
21	9	21	907320	45	27	45	1509130
22	10	22	945450	46	28	46	1518190
23	11	23	980350	47	29	47	1524020
24	11	24	1015250				

5.2 Second Scenario

In our second scenario, first, we decided to divide restaurants into groups according to their location. In this way, we checked their orders again and considered some restaurants that were close together as one restaurant. Then we added up their orders so drivers could accommodate more orders in a single run. In this situation, our total restaurants were 47.

- First, we did calculations for price=6 TL:

In this case, the maximum number of used motorcycles was 19 and restaurants were 13. The value of the objective function wouldn't change after 19 motorcycles (table 11). So we considered all the cases in this price:

K=1)

It means that FMC can have a contract with one restaurant that is restaurant number 68 by using one motorcycle and earn 3450 TL in a year.

K=2)

In the optimal solution of this case, FMC can have a contract with restaurants number 42 and 43 together with two motorcycles and earn 10640 TL in a year.

K=3)

In the optimal solution of this case, FMC can have a contract with restaurants number 42 and 43 together and number 68 by using three motorcycles and earn 14090 TL in a year.

K=4)

In this case, FMC can have a contract with restaurants number 42 and 43 together and number 44,45 and 46 together by using four motorcycles and earn 19410 TL in a year.

K=5)

In this situation, FMC can have a contract with restaurants number 42 and 43 together and number 44,45 and 46 together and number 68 by using five motorcycles and earn 22860 TL in a year.

K=6)

In the optimal solution of this case, FMC can have a contract with restaurants number 1 and 8 together and, number 42 and 43 together, and number 44,45 and 46 together and number 68 by using six motorcycles and earn 26310 TL in a year.

K =7)

In this case, FMC can have a contract with restaurants number 1 and 8 together and, number 34 and 35 together and, number 42 and 43 together and, number 44,45 and 46 together and, number 68 by using seven motorcycles and earn 27890 TL in a year.

K =8)

In this case, FMC can have a contract with restaurants number 1 and 8 together and, number 39 and, number 42 and 43 together and, number 44,45 and 46 together and, number 68 by using eight motorcycles and earn 29470 TL in a year.

K =9)

In this case, FMC can have a contract with restaurants number 1 and 8 together and, number 39 and, number 42 and 43 together and, number 44,45 and 46 together and, number 49 and, number 68 by using nine motorcycles and earn 31050 TL in a year.

K =10)

In this case, FMC can have a contract with restaurants number 1 and 8 together and, number 34 and 35 together and, number 39 and, number 42 and 43 together and, number 44,45 and 46 together and, number 49 and, number 68 by using ten motorcycles and earn 32630 TL in a year.

K =11)

In this case, FMC can have a contract with restaurants number 1 and 8 together and, number 27 and 32 together and, number 34 and 35 together and, number 39 and, number 42 and 43 together and, number 44,45 and 46 together and, number 49 and, number 68 by using eleven motorcycles and earn 34210 TL in a year.

K =12)

In this situation, FMC can have a contract with restaurants number 1 and 8 together and, number 24 and, number 27 and 32 together and, number 34 and 35 together and, number 39 and, number 42 and 43 together and, number 44,45 and 46 together and, number 68 by using twelve motorcycles and earn 35790 TL in a year.

K =13)

For this case, FMC can have a contract with restaurants number 1 and 8 together and, number 24 and, number 27 and 32 together and, number 34 and 35 together and, number 39 and, number 42 and 43 together and, number 44,45 and 46 together and, number 49 and, number 68 by using thirteen motorcycles and earn 37370 TL in a year.

K =14)

In this case, FMC can have a contract with restaurants number 1 and 8 together and, number 24 and, number 27 and 32 together and, number 34 and 35 together and, number 39 and, number 42 and 43 together and, number 44,45 and 46 together and, number 49 and, number47, 48 and 50 together and, number 68 by using fourteen motorcycles and earn 38950 TL in a year.

K =15)

In this case, FMC can have a contract with restaurants number 1 and 8 together and, number 24 and, number 34 and 35 together and, number 39 and, number 42 and 43 together and, number 44,45 and 46 together and, number 49 and, number47, 48 and 50 together and, number 63, 64 and 65 together and, number 68 by using fifteen motorcycles and earn 40530 TL in a year.

K =16)

In this case, FMC can have a contract with restaurants number 1 and 8 together and, number 24 and, number 27 and 32 together and, number 34 and 35 together and, number 39 and, number 42 and 43 together and, number 44,45 and 46 together and, number 49 and, number47, 48 and 50 together and, number 63, 64 and 65 together and, number 68 by using sixteen motorcycles and earn 42110 TL in a year.

K =17)

For this situation, FMC can have a contract with restaurants number 1 and 8 together and, number 24 and, number 27 and 32 together and, number 34 and 35 together and, number 39 and, number 42 and 43 together and, number 44,45 and 46 together and, number 49 and, number47, 48 and 50 together and, number 63, 64 and 65 together and, number 68 and, number 80, 81 and 82 together by using seventeen motorcycles and earn 43690 TL in a year.

K =18)

For this case, FMC can have a contract with restaurants number 1 and 8 together and, number 24 and, number 27 and 32 together and, number 34 and 35 together and, number 39 and, number 42 and 43 together and, number 44,45 and 46 together and,

number 49 and, number47, 48 and 50 together and, number 63, 64 and 65 together and, number 68 and, number 80, 81 and 82 together by using seventeen motorcycles and earn 43690 TL in a year.

K= 19)

In this situation, FMC can have a contract with restaurants number 3 and 6 together and, number 1 and 8 together and, number 24 and, number 27 and 32 together and, number 34 and 35 together and, number 39 and, number 42 and 43 together and, number 44,45 and 46 together and, number 49 and, number47, 48 and 50 together and, number 63, 64 and 65 together and, number 68 and, number 80, 81 and 82 together by using nineteen motorcycles and earn 44980 TL in a year.

Table 11: $P6_2$

P= 6									
K	**BRestSay**	**RestSay**	**MotSay**	**Profit**	**K**	**BRestSay**	**RestSay**	**MotSay**	**Profit**
1	1	1	1	3450	11	14	8	11	34210
2	2	1	2	10640	12	14	8	12	35790
3	3	2	3	14090	13	15	9	13	37370
4	5	2	4	19410	14	18	10	14	38950
5	6	3	5	22860	15	19	10	15	40530
6	8	4	6	26310	16	21	11	16	42110
7	10	5	7	27890	17	24	12	17	43690
8	9	5	8	29470	18	24	12	17	43690
9	10	6	9	31050	19	26	13	19	44980
10	12	7	10	32630					

- Second, our calculations for price=7 TL continued till 46 motorcycles. After this number, the objective value and number of contracted restaurants and used motorcycles didn't change which the yearly profit was 418800 TL with 26 restaurants (table 12).

- Third, we considered all the possible situations for price = 8 TL. The maximum profit and number of used motorcycles were 949400 TL and 50 for 30 restaurants that FMC can have a contract with (table 13).

Table 12: $P7_2$

P = 7									
K	**BRestSay**	**RestSay**	**MotSay**	**Profit**	**K**	**BRestSay**	**RestSay**	**MotSay**	**Profit**
1	1	1	1	15350	24	35	17	24	317570
2	2	1	2	35120	25	35	17	24	317570
3	3	2	3	50470	26	36	18	26	326170
4	5	2	4	68030	27	38	19	27	330470
5	6	3	5	83380	28	29	15	28	341400
6	8	4	6	98730	29	33	16	29	352330
7	10	5	7	111870	30	34	17	30	361050
8	9	5	8	125010	31	35	17	31	371980
9	10	6	9	138150	32	36	18	32	380700
10	12	7	10	151290	33	37	19	33	385000
11	14	8	11	164430	34	37	19	34	389300
12	14	8	12	177570	35	39	20	35	393600
13	15	9	13	190710	36	39	20	36	397900
14	18	10	14	203850	37	41	21	37	402200
15	19	10	15	216990	38	42	22	38	406500
16	21	11	16	230130	39	44	23	39	408590
17	24	12	17	243270	40	47	24	40	410680
18	24	12	18	254200	41	44	23	41	412770
19	26	13	19	267340	42	46	24	42	414860
20	30	14	20	278270	43	49	25	43	416950
21	32	15	21	289200	44	49	25	43	416950
22	32	15	22	297920	45	49	25	43	416950
23	34	16	23	308850	46	50	26	46	418800

Table 13: $P8_2$

P = 8									
K	**BRestSay**	**RestSay**	**MotSay**	**Profit**	**K**	**BRestSay**	**RestSay**	**MotSay**	**Profit**
1	1	1	1	27250	26	36	18	26	624350
2	2	1	2	59600	27	27	14	27	638850
3	3	2	3	86850	28	29	15	28	661000
4	5	2	4	116650	29	33	16	29	683150
5	6	3	5	143900	30	34	17	30	702750
6	8	4	6	171150	31	35	17	31	724900
7	10	5	7	195850	32	36	18	32	744500
8	9	5	8	220550	33	37	19	33	759000
9	10	6	9	245250	34	37	19	34	773500
10	12	7	10	269950	35	39	20	35	788000
11	14	8	11	294650	36	39	20	36	802500
12	14	8	12	319350	37	41	21	37	817000
13	15	9	13	344050	38	42	22	38	831500
14	18	10	14	368750	39	44	23	39	843450
15	19	10	15	393450	40	47	24	40	855400
16	21	11	16	418150	41	44	23	41	867350
17	24	12	17	442850	42	46	24	42	879300
18	24	12	18	465000	43	49	25	43	891250
19	26	13	19	489700	44	49	25	43	891250
20	30	14	20	511850	45	47	25	45	910050
21	32	15	21	534000	46	50	26	46	922000
22	32	15	22	553600	47	51	27	47	931400
23	34	16	23	575750	48	52	28	48	940800
24	35	17	24	595350	49	53	29	49	945100
25	35	17	24	595350	50	56	30	50	949400

- Fourth, with price = 9 TL our calculations continued till 54 motorcycles. In this case, FMC`s yearly profit was 1507200 TL with 34 restaurants (table 14).

Table 14: $P9_2$

P = 9				
K	**BRestSay**	**RestSay**	**MotSay**	**Profit**
1	1	1	1	39150
2	2	1	2	84080
3	3	2	3	123230
4	5	2	4	165270
5	6	3	5	204420
6	8	4	6	243570
7	10	5	7	279830
8	9	5	8	316090
9	10	6	9	352350
10	12	7	10	388610
11	14	8	11	424870
12	14	8	12	461130
13	15	9	13	497390
14	18	10	14	533650
15	19	10	15	569910
16	21	11	16	606170
17	24	12	17	642430
18	24	12	18	675800
19	26	13	19	712060
20	30	14	20	745430
21	32	15	21	778800
22	32	15	22	809280
23	34	16	23	842650
24	35	17	24	873130
25	35	17	24	873130
26	36	18	26	922530
27	27	14	27	947230
28	29	15	28	980600
29	33	16	29	1013970
30	34	17	30	1044450
31	35	17	31	1077820
32	36	18	32	1108300
33	37	19	33	1133000
34	37	19	34	1157700
35	39	20	35	1182400
36	39	20	36	1207100
37	41	21	37	1231800
38	42	22	38	1256500
39	44	23	39	1278310
40	47	24	40	1300120
41	44	23	41	1321930
42	46	24	42	1343740
43	49	25	43	1365550
44	49	25	43	1365550
45	48	25	45	1403390
46	50	26	46	1425200
47	51	27	47	1444120
48	52	28	48	1463040

49	53	29	49	1476180
50	56	30	50	1489320
51	57	31	51	1496680
52	60	32	52	1501150
53	63	33	53	1505620
54	66	34	54	1507200

- Fifth, for the price = 10 TL FMC`s yearly profit was 2090060 TL. The maximum number of used motorcycles was 56 with 35 contracted restaurants (table 15).

Table 15: $P10_2$

P = 10									
K	**BRestSay**	**RestSay**	**MotSay**	**Profit**	**K**	**BRestSay**	**RestSay**	**MotSay**	**Profit**
1	1	1	1	51050	29	33	16	29	1344790
2	2	1	2	108560	30	34	17	30	1386150
3	3	2	3	159610	31	35	17	31	1430740
4	5	2	4	213890	32	36	18	32	1472100
5	6	3	5	264940	33	37	19	33	1507000
6	8	4	6	315990	34	37	19	34	1541900
7	10	5	7	363810	35	39	20	35	1576800
8	9	5	8	411630	36	39	20	36	1611700
9	10	6	9	459450	37	41	21	37	1646600
10	12	7	10	507270	38	42	22	38	1681500
11	14	8	11	555090	39	44	23	39	1713170
12	14	8	12	602910	40	47	24	40	1744840
13	15	9	13	650730	41	44	23	41	1776510
14	18	10	14	698550	42	46	24	42	1808180
15	19	10	15	746370	43	49	25	43	1839850
16	21	11	16	794190	44	49	25	43	1839850
17	24	12	17	842010	45	48	25	45	1896730
18	24	12	18	886600	46	50	26	46	1928400
19	26	13	19	934420	47	51	27	47	1956840
20	30	14	20	979010	48	52	28	48	1985280
21	32	15	21	1023600	49	53	29	49	2007260
22	32	15	22	1064960	50	56	30	50	2029240
23	34	16	23	1109550	51	57	31	51	2044760
24	35	17	24	1150910	52	60	32	52	2057050
25	35	17	24	1150910	53	63	33	53	2069340
26	36	18	26	1220710	54	66	34	54	2078400
27	27	14	27	1255610	55	66	34	55	2081000
28	29	15	28	1300200	56	69	35	56	2090060

5.3 Comparison of Results Between the First and Second Scenario

In the following section, we are going to share the charts and tables of our results in both scenarios in a comparative way:

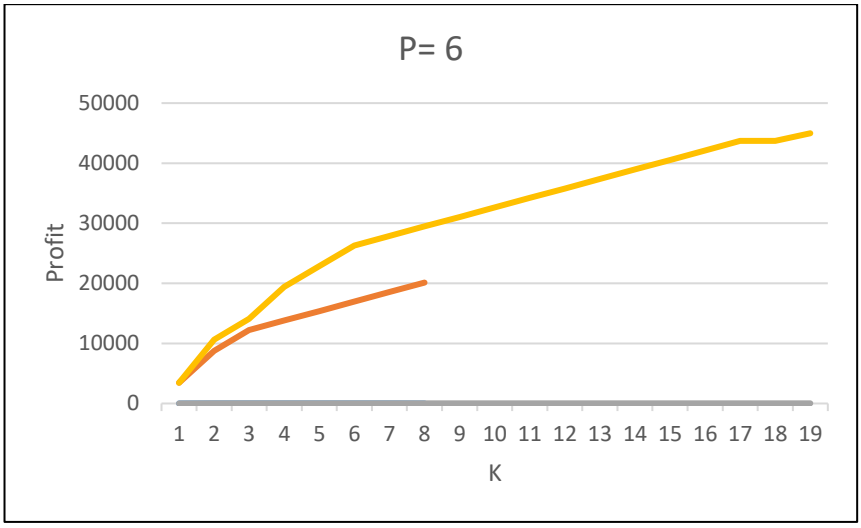

Figure 2: comparison 1

Table 16: Comparison 1

P= 6										
First scenario				**Second scenario**					**Increase in profit**	
K	**RestSay**	**MotSay**	**Profit**	**K**	**BRestSay**	**RestSay**	**MotSay**	**Profit**	**TL**	**%**
1	1	1	3450	1	1	1	1	3450	0	-
2	1	2	8770	2	2	1	2	10640	1870	21.32
3	2	3	12220	3	3	2	3	14090	1870	15.30
4	3	4	13800	4	5	2	4	19410	5610	40.65
5	3	5	15380	5	6	3	5	22860	7480	48.63
6	4	6	16960	6	8	4	6	26310	9350	55.13
7	4	7	18540	7	10	5	7	27890	9350	50.43
8	5	8	20120	8	9	5	8	29470	9350	46.47
9				9	10	6	9	31050		
10				10	12	7	10	32630		
11				11	14	8	11	34210		
12				12	14	8	12	35790		
13				13	15	9	13	37370		
14				14	18	10	14	38950		
15				15	19	10	15	40530		
16				16	21	11	16	42110		
17				17	24	12	17	43690		
18				18	24	12	17	43690		
19				19	26	13	19	44980		

As we observe in both scenarios, the yearly profit increases when we add more motorcycles to the process because deliverymen can carry more orders from restaurants and deliver to the customers. The availability of delivering more orders in

the second scenario is significant. The amount of increase in the cases of K= 2 and K= 3 and in the cases of K= 6, K= 7 and, K= 8 are the same but there is a difference in the percentage of increase. The highest increment belongs to K= 6 with 55.13% and after that to K= 7 with 50.43%.

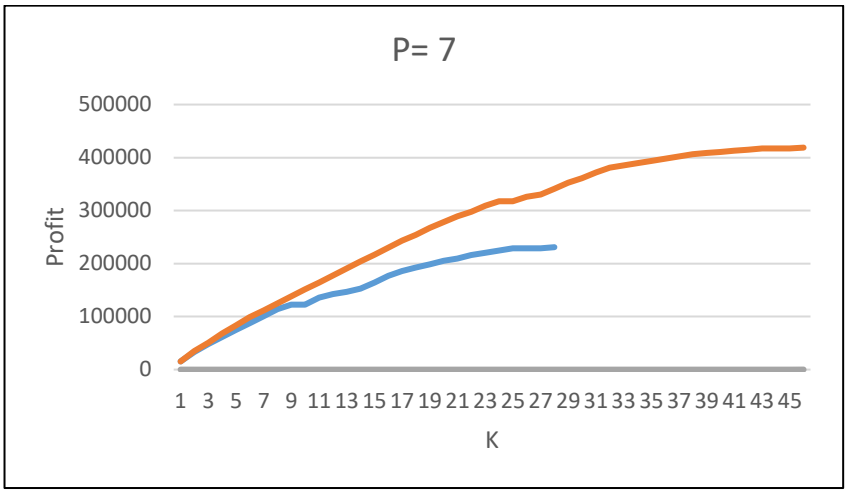

Figure 3: comparison 2

Table 17: Comparison 2

P= 7										
First scenario				**Second scenario**					**Increase in profit**	
K	**RestSay**	**MotSay**	**Profit**	**K**	**BRestSay**	**RestSay**	**MotSay**	**Profit**	**TL**	**%**
1	1	1	15350	**1**	1	1	1	15350	0	0.00
2	1	2	32910	**2**	2	1	2	35120	2210	6.72
3	2	3	48260	**3**	3	2	3	50470	2210	4.58
4	3	4	61400	**4**	5	2	4	68030	6630	10.80
5	3	5	74540	**5**	6	3	5	83380	8840	11.86
6	4	6	87680	**6**	8	4	6	98730	11050	12.60
7	4	7	100820	**7**	10	5	7	111870	11050	10.96
8	5	8	113960	**8**	9	5	8	125010	11050	9.70
9	6	9	122680	**9**	10	6	9	138150	15470	12.61
10	6	9	122680	**10**	12	7	10	151290	28610	23.32
11	7	11	135700	**11**	14	8	11	164430	28730	21.17
12	8	12	142210	**12**	14	8	12	177570	35360	24.86
13	9	13	146510	**13**	15	9	13	190710	44200	30.17
14	9	14	153020	**14**	18	10	14	203850	50830	33.22
15	5	15	163950	**15**	19	10	15	216990	53040	32.35
16	6	16	177090	**16**	21	11	16	230130	53040	29.95
17	7	17	185810	**17**	24	12	17	243270	57460	30.92
18	8	18	192320	**18**	24	12	18	254200	61880	32.18
19	8	19	198830	**19**	26	13	19	267340	68510	34.46

20	9	20	205340	**20**	30	14	20	278270	72930	35.52
21	9	21	209640	**21**	32	15	21	289200	79560	37.95
22	10	22	216150	**22**	32	15	22	297920	81770	37.83
23	11	23	220450	**23**	34	16	23	308850	88400	40.10
24	11	24	224750	**24**	35	17	24	317570	92820	41.30
25	12	25	229050	**25**	35	17	24	317570	88520	38.65
26	12	25	229050	**26**	36	18	26	326170	97120	42.40
27	12	25	229050	**27**	38	19	27	330470	101420	44.28
28	13	28	230900	**28**	29	15	28	341400	110500	47.86
29				**29**	33	16	29	352330		
30				**30**	34	17	30	361050		
31				**31**	35	17	31	371980		
32				**32**	36	18	32	380700		
33				**33**	37	19	33	385000		
34				**34**	37	19	34	389300		
35				**35**	39	20	35	393600		
36				**36**	39	20	36	397900		
37				**37**	41	21	37	402200		
38				**38**	42	22	38	406500		
39				**39**	44	23	39	408590		
40				**40**	47	24	40	410680		
41				**41**	44	23	41	412770		
42				**42**	46	24	42	414860		
43				**43**	49	25	43	416950		
44				**44**	49	25	43	416950		
45				**45**	49	25	43	416950		
46				**46**	50	26	46	418800		

In the comparison of price 7, the highest increment has been observed in K= 28 with a percentage of 47.86%. all 28 motorcycles are used in both scenarios. The numerical difference in some cases is the same but it varies in percentage increase. It is between K= 2 and K= 3 and in the cases K= 6, 7, and 8, and in the cases of K= 15 and K= 16.

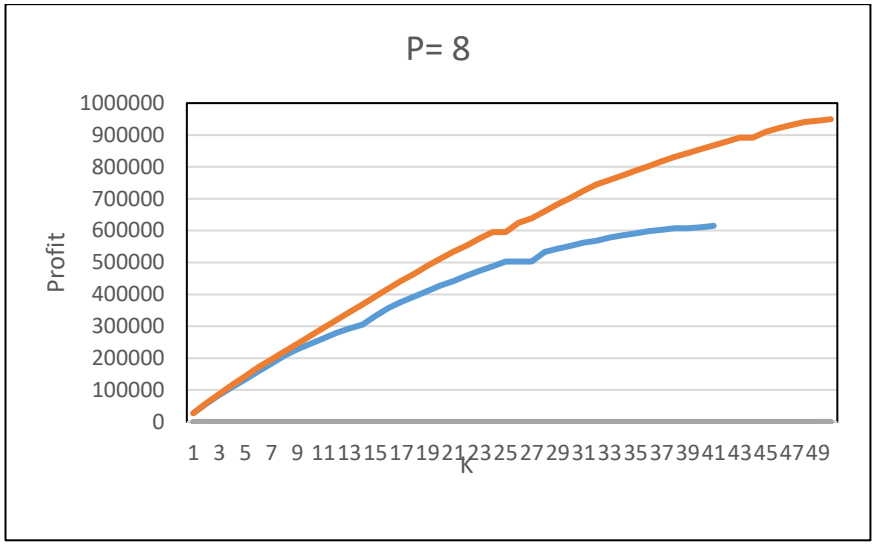

Figure 4: comparison 3

Table 18: Comparison 3

P= 8										
First scenario				**Second scenario**					**Increase in profit**	
K	**RestSay**	**MotSay**	**Profit**	**K**	**BRestSay**	**RestSay**	**MotSay**	**Profit**	**TL**	**%**
1	1	1	27250	**1**	1	1	1	27250	0	0.00
2	1	2	57050	**2**	2	1	2	59600	2550	4.47
3	2	3	84300	**3**	3	2	3	86850	2550	3.02
4	3	4	109000	**4**	5	2	4	116650	7650	7.02
5	3	5	133700	**5**	6	3	5	143900	10200	7.63
6	4	6	158400	**6**	8	4	6	171150	12750	8.05
7	4	7	183100	**7**	10	5	7	195850	12750	6.96
8	5	8	207800	**8**	9	5	8	220550	12750	6.14
9	6	9	227400	**9**	10	6	9	245250	17850	7.85
10	7	10	244450	**10**	12	7	10	269950	25500	10.43
11	7	11	261500	**11**	14	8	11	294650	33150	12.68
12	8	12	278550	**12**	14	8	12	319350	40800	14.65
13	8	13	293050	**13**	15	9	13	344050	51000	17.40
14	4	14	305000	**14**	18	10	14	368750	63750	20.90
15	5	15	332250	**15**	19	10	15	393450	61200	18.42
16	6	16	356950	**16**	21	11	16	418150	61200	17.15
17	7	17	376550	**17**	24	12	17	442850	66300	17.61
18	8	18	393600	**18**	24	12	18	465000	71400	18.14
19	8	19	410650	**19**	26	13	19	489700	79050	19.25
20	9	20	427700	**20**	30	14	20	511850	84150	19.68
21	9	21	442200	**21**	32	15	21	534000	91800	20.76
22	10	22	459250	**22**	32	15	22	553600	94350	20.54
23	11	23	473750	**23**	34	16	23	575750	102000	21.53
24	11	24	488250	**24**	35	17	24	595350	107100	21.94
25	12	25	502750	**25**	35	17	24	595350	92600	18.42
26	12	25	502750	**26**	36	18	26	624350	121600	24.19
27	12	25	502750	**27**	27	14	27	638850	136100	27.07
28	13	28	533500	**28**	29	15	28	661000	127500	23.90
29	14	29	542900	**29**	33	16	29	683150	140250	25.83

30	15	30	552300	**30**	34	17	30	702750	150450	27.24
31	16	31	561700	**31**	35	17	31	724900	163200	29.05
32	16	32	568550	**32**	36	18	32	744500	175950	30.95
33	17	33	577950	**33**	37	19	33	759000	181050	31.33
34	18	34	584800	**34**	37	19	34	773500	188700	32.27
35	19	35	591650	**35**	39	20	35	788000	196350	33.19
36	20	36	598500	**36**	39	20	36	802500	204000	34.09
37	21	37	602800	**37**	41	21	37	817000	214200	35.53
38	22	38	607100	**38**	42	22	38	831500	224400	36.96
39	22	38	607100	**39**	44	23	39	843450	236350	38.93
40	22	40	610600	**40**	47	24	40	855400	244800	40.09
41	23	41	614900	**41**	44	23	41	867350	252450	41.06
42				**42**	46	24	42	879300		
43				**43**	49	25	43	891250		
44				**44**	49	25	43	891250		
45				**45**	47	25	45	910050		
46				**46**	50	26	46	922000		
47				**47**	51	27	47	931400		
48				**48**	52	28	48	940800		
49				**49**	53	29	49	945100		
50				**50**	56	30	50	949400		

In our third comparison, like previous ones the rate of increase differs from case to case and it`s not always additive. The highest increment belongs to the last K which is 41 and all the 41 motorcycles are being used in both scenarios.

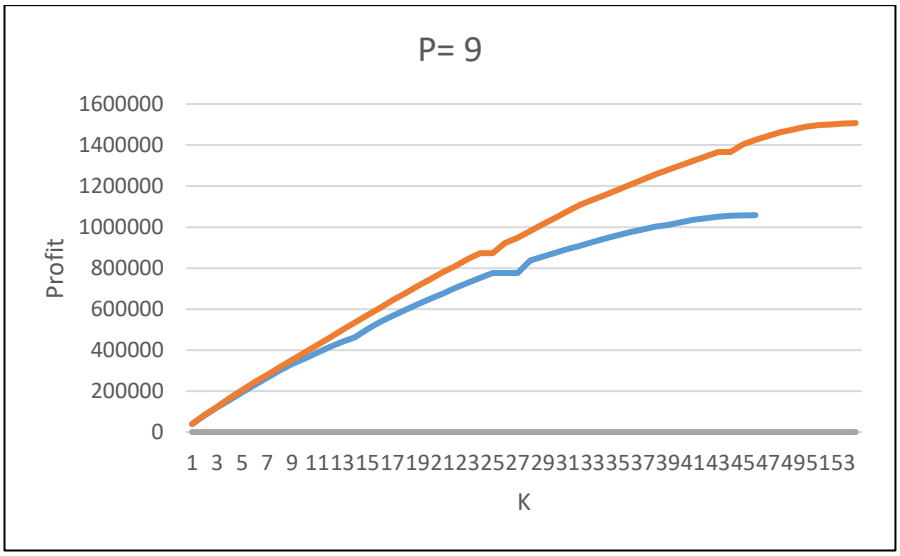

Figure 5: comparison 4

Table 19: Comparison 4

P= 9										
First scenario					Second scenario				Increase in profit	
K	RestSay	MotSay	Profit	K	BRestSay	RestSay	MotSay	Profit	TL	%
1	1	1	39150	**1**	1	1	1	39150	0	0.00
2	1	2	81190	**2**	2	1	2	84080	2890	3.56
3	2	3	120340	**3**	3	2	3	123230	2890	2.40
4	3	4	156600	**4**	5	2	4	165270	8670	5.54
5	3	5	192860	**5**	6	3	5	204420	11560	5.99
6	4	6	229120	**6**	8	4	6	243570	14450	6.31
7	4	7	265380	**7**	10	5	7	279830	14450	5.45
8	5	8	301640	**8**	9	5	8	316090	14450	4.79
9	6	9	332120	**9**	10	6	9	352350	20230	6.09
10	7	10	359710	**10**	12	7	10	388610	28900	8.03
11	7	11	387300	**11**	14	8	11	424870	37570	9.70
12	8	12	414890	**12**	14	8	12	461130	46240	11.15
13	8	13	439590	**13**	15	9	13	497390	57800	13.15
14	4	14	461400	**14**	18	10	14	533650	72250	15.66
15	5	15	500550	**15**	19	10	15	569910	69360	13.86
16	6	16	536810	**16**	21	11	16	606170	69360	12.92
17	7	17	567290	**17**	24	12	17	642430	75140	13.25
18	8	18	594880	**18**	24	12	18	675800	80920	13.60
19	8	19	622470	**19**	26	13	19	712060	89590	14.39
20	9	20	650060	**20**	30	14	20	745430	95370	14.67
21	9	21	674760	**21**	32	15	21	778800	104040	15.42
22	10	22	702350	**22**	32	15	22	809280	106930	15.22
23	11	23	727050	**23**	34	16	23	842650	115600	15.90
24	11	24	751750	**24**	35	17	24	873130	121380	16.15
25	12	25	776450	**25**	35	17	24	873130	96680	12.45
26	12	25	776450	**26**	36	18	26	922530	146080	18.81
27	12	25	776450	**27**	27	14	27	947230	170780	21.99
28	13	28	836100	**28**	29	15	28	980600	144500	17.28
29	14	29	855020	**29**	33	16	29	1013970	158950	18.59
30	15	30	873940	**30**	34	17	30	1044450	170510	19.51
31	16	31	892860	**31**	35	17	31	1077820	184960	20.72
32	16	32	908890	**32**	36	18	32	1108300	199410	21.94
33	17	33	927810	**33**	37	19	33	1133000	205190	22.12
34	18	34	943840	**34**	37	19	34	1157700	213860	22.66
35	19	35	959870	**35**	39	20	35	1182400	222530	23.18
36	20	36	975900	**36**	39	20	36	1207100	231200	23.69
37	21	37	989040	**37**	41	21	37	1231800	242760	24.55
38	22	38	1002180	**38**	42	22	38	1256500	254320	25.38
39	21	39	1009540	**39**	44	23	39	1278310	268770	26.62
40	22	40	1022680	**40**	47	24	40	1300120	277440	27.13
41	23	41	1035820	**41**	44	23	41	1321930	286110	27.62
42	24	42	1043180	**42**	46	24	42	1343740	300560	28.81
43	25	43	1050540	**43**	49	25	43	1365550	315010	29.99
44	26	44	1055010	**44**	49	25	43	1365550	310540	29.43
45	27	45	1056590	**45**	48	25	45	1403390	346800	32.82
46	28	46	1058170	**46**	50	26	46	1425200	367030	34.69
47				**47**	51	27	47	1444120		
48				**48**	52	28	48	1463040		
49				**49**	53	29	49	1476180		
50				**50**	56	30	50	1489320		

51				**51**	57	31	51	1496680		
52				**52**	60	32	52	1501150		
53				**53**	63	33	53	1505620		
54				**54**	66	34	54	1507200		

In this comparison, the highest increment is in the last case with K= 46 and 34.69%. In every situation, there is an increase but the rate varies. Sometimes it is additive but sometimes it is decreasing. When the numerical difference is constant between the cases, the percentage difference is somehow close.

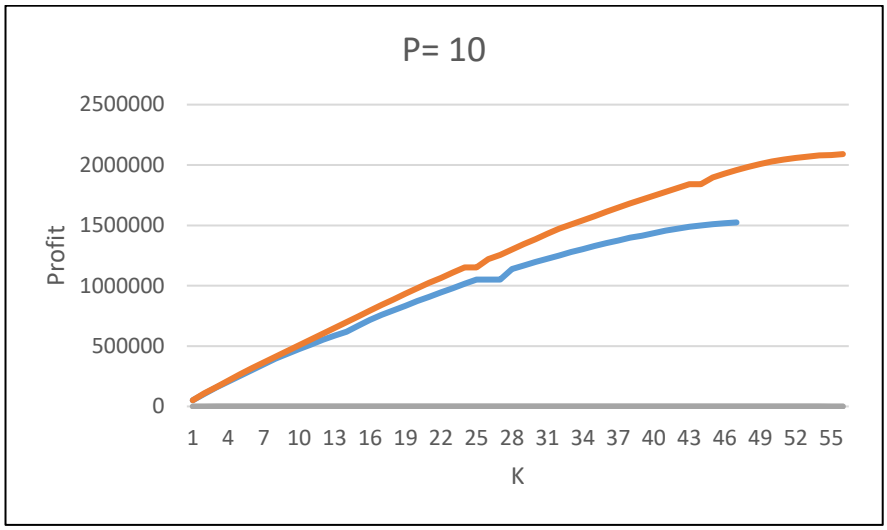

Figure 6: comparison 5

Table 20: Comparison 5

P= 10										
First scenario					**Second scenario**				**Increase in profit**	
K	**RestSay**	**MotSay**	**Profit**	**K**	**BRestSay**	**RestSay**	**MotSay**	**Profit**	**TL**	**%**
1	1	1	51050	**1**	1	1	1	51050	0	0.00
2	1	2	105330	**2**	2	1	2	108560	3230	3.07
3	2	3	156380	**3**	3	2	3	159610	3230	2.07
4	3	4	204200	**4**	5	2	4	213890	9690	4.75
5	3	5	252020	**5**	6	3	5	264940	12920	5.13
6	4	6	299840	**6**	8	4	6	315990	16150	5.39
7	4	7	347660	**7**	10	5	7	363810	16150	4.65
8	5	8	395480	**8**	9	5	8	411630	16150	4.08
9	6	9	436840	**9**	10	6	9	459450	22610	5.18
10	7	10	474970	**10**	12	7	10	507270	32300	6.80

11	7	11	513100	**11**	14	8	11	555090	41990	8.18
12	8	12	551230	**12**	14	8	12	602910	51680	9.38
13	8	13	586130	**13**	15	9	13	650730	64600	11.02
14	4	14	617800	**14**	18	10	14	698550	80750	13.07
15	5	15	668850	**15**	19	10	15	746370	77520	11.59
16	6	16	716670	**16**	21	11	16	794190	77520	10.82
17	7	17	758030	**17**	24	12	17	842010	83980	11.08
18	8	18	796160	**18**	24	12	18	886600	90440	11.36
19	8	19	834290	**19**	26	13	19	934420	100130	12.00
20	9	20	872420	**20**	30	14	20	979010	106590	12.22
21	9	21	907320	**21**	32	15	21	1023600	116280	12.82
22	10	22	945450	**22**	32	15	22	1064960	119510	12.64
23	11	23	980350	**23**	34	16	23	1109550	129200	13.18
24	11	24	1015250	**24**	35	17	24	1150910	135660	13.36
25	12	25	1050150	**25**	35	17	24	1150910	100760	9.59
26	12	25	1050150	**26**	36	18	26	1220710	170560	16.24
27	12	25	1050150	**27**	27	14	27	1255610	205460	19.56
28	13	28	1138700	**28**	29	15	28	1300200	161500	14.18
29	14	29	1167140	**29**	33	16	29	1344790	177650	15.22
30	15	30	1195580	**30**	34	17	30	1386150	190570	15.94
31	16	31	1224020	**31**	35	17	31	1430740	206720	16.89
32	16	32	1249230	**32**	36	18	32	1472100	222870	17.84
33	17	33	1277670	**33**	37	19	33	1507000	229330	17.95
34	18	34	1302880	**34**	37	19	34	1541900	239020	18.35
35	19	35	1328090	**35**	39	20	35	1576800	248710	18.73
36	20	36	1353300	**36**	39	20	36	1611700	258400	19.09
37	21	37	1375280	**37**	41	21	37	1646600	271320	19.73
38	22	38	1397260	**38**	42	22	38	1681500	284240	20.34
39	21	39	1412780	**39**	44	23	39	1713170	300390	21.26
40	22	40	1434760	**40**	47	24	40	1744840	310080	21.61
41	23	41	1456740	**41**	44	23	41	1776510	319770	21.95
42	24	42	1472260	**42**	46	24	42	1808180	335920	22.82
43	25	43	1487780	**43**	49	25	43	1839850	352070	23.66
44	26	44	1500070	**44**	49	25	43	1839850	339780	22.65
45	27	45	1509130	**45**	48	25	45	1896730	387600	25.68
46	28	46	1518190	**46**	50	26	46	1928400	410210	27.02
47	29	47	1524020	**47**	51	27	47	1956840	432820	28.40
48				**48**	52	28	48	1985280		
49				**49**	53	29	49	2007260		
50				**50**	56	30	50	2029240		
51				**51**	57	31	51	2044760		
52				**52**	60	32	52	2057050		
53				**53**	63	33	53	2069340		
54				**54**	66	34	54	2078400		
55				**55**	66	34	55	2081000		
56				**56**	69	35	56	2090060		

In our last comparison, we have 47 cases. K= 47 has the highest increment with 28.40%. all 47 motorcycles will be used for the delivery process. The rate of increase is sometimes additive and sometimes decreasing. The difference is sometimes close together but sometimes not.

5.4 Economic Analysis

Since the second scenario is more profitable we decided to apply an economic analysis. This analysis was performed for all five different service prices during a five-year period. By considering the capital of investment, salvage value after 5 years, the interest rate of 13%, and the minimum attractive rate of return, we calculated present value, annual value, and payback period. The results of this analysis are given as follows.

P=6: As we observed before, by increasing the number of motorcycles the annual profit of FMC company will increase. But in our economic analysis, we can see that after 5 years in only the cases of 2, 3, 4, and 5 motorcycles there will be an acceptable rate of return, and FMC can obtain its initial capital after almost 3 years. Other cases are not acceptable because of their low internal rate and long duration of payback.

Table 21: Economic analysis1 (P=6)

MotSay	Annual Profit (TL)	Capital for the Investment (TL)	Salvage Value after 5 years (TL)	Interest rate (i)	Planning Horizon (Year)	Present Value (TL)	Annual Value (TL)	IRR	MARR	MARR>=IRR	Pay back (Year)
1	3450	-17000	8000	13%	5	-523.47	-148.83	12%	20%	**REJECT**	5.44
2	10640	-34000	16000	13%	5	12107.50	3442.34	25%	20%	ACCEPT	2.61
3	14090	-51000	24000	13%	5	11584.03	3293.51	21%	20%	ACCEPT	3.16
4	19410	-68000	32000	13%	5	17637.78	5014.68	22%	20%	ACCEPT	3.00
5	22860	-85000	40000	13%	5	17114.30	4865.85	20%	20%	ACCEPT	3.29
6	26310	-102000	48000	13%	5	16590.83	4717.01	18%	20%	**REJECT**	3.52
7	27890	-119000	56000	13%	5	9490.14	2698.18	16%	20%	**REJECT**	4.14
8	29470	-136000	64000	13%	5	2389.44	679.35	14%	20%	**REJECT**	4.78
9	31050	-153000	72000	13%	5	-4711.25	-1339.48	12%	20%	**REJECT**	5.44
10	32630	-170000	80000	13%	5	-11811.95	-3358.31	11%	20%	**REJECT**	6.11
11	34210	-187000	88000	13%	5	-18912.64	-5377.14	10%	20%	**REJECT**	6.81
12	35790	-204000	96000	13%	5	-26013.34	-7395.97	9%	20%	**REJECT**	7.54
13	37370	-221000	104000	13%	5	-33114.03	-9414.80	8%	20%	**REJECT**	8.31
14	38950	-238000	112000	13%	5	-40214.73	-11433.63	7%	20%	**REJECT**	9.11
15	40530	-255000	120000	13%	5	-47315.42	-13452.46	7%	20%	**REJECT**	9.96
16	42110	-272000	128000	13%	5	-54416.12	-15471.29	6%	20%	**REJECT**	10.87
17	43690	-289000	136000	13%	5	-61516.81	-17490.13	6%	20%	**REJECT**	11.84
17	43690	-289000	136000	13%	5	-61516.81	-17490.13	6%	20%	**REJECT**	11.84
19	44980	-323000	152000	13%	5	-82295.43	-23397.79	4%	20%	**REJECT**	17.45

After P=6, in all remaining prices, 7, 8, 9, and 10 as we increase the number of motorcycles the yearly profit increases as well, and at the same time, in all the situations the internal rate of return is more than MARR which is 20%. In this way, all the possible cases are acceptable. duration of payback is being decreased as we increase the price and get close to zero.

Table 22: Economic analysis 2 (P=7)

MotSay	Annual Profit (TL)	Capital for the Investment (TL)	Salvage Value after 5 years (TL)	Interest rate (i)	Planning Horizon (Year)	Present Value (TL)	Annual Value (TL)	IRR	MARR	MARR>IRR	Pay back (YEAR)
1	15350	-17000	8000	13%	5	41331.58	11751.17	88%	20%	ACCEPT	0.70
2	35120	-34000	16000	13%	5	98209.32	27922.34	102%	20%	ACCEPT	0.60
3	50470	-51000	24000	13%	5	139540.90	39673.51	97%	20%	ACCEPT	0.63
4	68030	-68000	32000	13%	5	188645.56	53634.68	98%	20%	ACCEPT	0.62
5	83380	-85000	40000	13%	5	229977.14	65385.85	96%	20%	ACCEPT	0.64
6	98730	-102000	48000	13%	5	271308.72	77137.01	95%	20%	ACCEPT	0.65
7	111870	-119000	56000	13%	5	304867.22	86678.18	92%	20%	ACCEPT	0.67
8	125010	-136000	64000	13%	5	338425.72	96219.35	90%	20%	ACCEPT	0.68
9	138150	-153000	72000	13%	5	371984.21	105760.52	88%	20%	ACCEPT	0.70
10	151290	-170000	80000	13%	5	405542.71	115301.69	87%	20%	ACCEPT	0.71
11	164430	-187000	88000	13%	5	439101.21	124842.86	86%	20%	ACCEPT	0.72
12	177570	-204000	96000	13%	5	472659.71	134384.03	85%	20%	ACCEPT	0.73
13	190710	-221000	104000	13%	5	506218.21	143925.20	84%	20%	ACCEPT	0.73
14	203850	-238000	112000	13%	5	539776.71	153466.37	83%	20%	ACCEPT	0.74
15	216990	-255000	120000	13%	5	573335.20	163007.54	83%	20%	ACCEPT	0.75
16	230130	-272000	128000	13%	5	606893.70	172548.71	82%	20%	ACCEPT	0.75
17	243270	-289000	136000	13%	5	640452.20	182089.87	82%	20%	ACCEPT	0.76
18	254200	-306000	144000	13%	5	666237.62	189421.04	81%	20%	ACCEPT	0.77
19	267340	-323000	152000	13%	5	699796.12	198962.21	80%	20%	ACCEPT	0.77
20	278270	-340000	160000	13%	5	725581.53	206293.38	79%	20%	ACCEPT	0.78
21	289200	-357000	168000	13%	5	751366.95	213624.55	79%	20%	ACCEPT	0.79
22	297920	-374000	176000	13%	5	769379.29	218745.72	77%	20%	ACCEPT	0.80
23	308850	-391000	184000	13%	5	795164.70	226076.89	76%	20%	ACCEPT	0.81
24	317570	-408000	192000	13%	5	813177.04	231198.06	75%	20%	ACCEPT	0.83
24	317570	-408000	192000	13%	5	813177.04	231198.06	75%	20%	ACCEPT	0.83
26	326170	-442000	208000	13%	5	818109.39	232600.40	71%	20%	ACCEPT	0.88
27	330470	-459000	216000	13%	5	820575.56	233301.57	69%	20%	ACCEPT	0.90
28	341400	-476000	224000	13%	5	846360.98	240632.74	69%	20%	ACCEPT	0.91
29	352330	-493000	232000	13%	5	872146.40	247963.90	69%	20%	ACCEPT	0.91
30	361050	-510000	240000	13%	5	890158.73	253085.07	68%	20%	ACCEPT	0.92
31	371980	-527000	248000	13%	5	915944.15	260416.24	68%	20%	ACCEPT	0.92
32	380700	-544000	256000	13%	5	933956.48	265537.41	67%	20%	ACCEPT	0.93
33	385000	-561000	264000	13%	5	936422.66	266238.58	66%	20%	ACCEPT	0.95
34	389300	-578000	272000	13%	5	938888.83	266939.75	64%	20%	ACCEPT	0.98
35	393600	-595000	280000	13%	5	941355.01	267640.92	63%	20%	ACCEPT	1.00
36	397900	-612000	288000	13%	5	943821.18	268342.09	62%	20%	ACCEPT	1.02
37	402200	-629000	296000	13%	5	946287.35	269043.26	61%	20%	ACCEPT	1.04
38	406500	-646000	304000	13%	5	948753.53	269744.43	60%	20%	ACCEPT	1.06
39	408590	-663000	312000	13%	5	943446.62	268235.60	58%	20%	ACCEPT	1.08
40	410680	-680000	320000	13%	5	938139.71	266726.76	57%	20%	ACCEPT	1.11
41	412770	-697000	328000	13%	5	932832.81	265217.93	56%	20%	ACCEPT	1.14
42	414860	-714000	336000	13%	5	927525.90	263709.10	54%	20%	ACCEPT	1.16
43	416950	-731000	344000	13%	5	922218.99	262200.27	53%	20%	ACCEPT	1.19
43	416950	-731000	344000	13%	5	922218.99	262200.27	53%	20%	ACCEPT	1.19
43	416950	-731000	344000	13%	5	922218.99	262200.27	53%	20%	ACCEPT	1.19
46	418800	-782000	368000	13%	5	890752.11	253253.78	50%	20%	ACCEPT	1.28

Table 23: Economic analysis 3 (P=8)

MotSay	Annual Profit (TL)	Capital for the Investment (TL)	Salvage Value after 5 years (TL)	Interest rate (i)	Planning Horizon (Year)	Present Value (TL)	Annual Value (TL)	IRR	MARR	MARR>IRR	Pay back (YEAR)
1	27250	-17000	8000	13%	5	83186.63	23651.17	160%	20%	ACCEPT	0.37
2	59600	-34000	16000	13%	5	184311.14	52402.34	175%	20%	ACCEPT	0.34
3	86850	-51000	24000	13%	5	267497.77	76053.51	170%	20%	ACCEPT	0.35
4	116650	-68000	32000	13%	5	359653.34	102254.68	171%	20%	ACCEPT	0.35
5	143900	-85000	40000	13%	5	442839.98	125905.85	169%	20%	ACCEPT	0.35
6	171150	-102000	48000	13%	5	526026.61	149557.01	167%	20%	ACCEPT	0.36
7	195850	-119000	56000	13%	5	600244.30	170658.18	164%	20%	ACCEPT	0.36
8	220550	-136000	64000	13%	5	674461.99	191759.35	161%	20%	ACCEPT	0.37
9	245250	-153000	72000	13%	5	748679.68	212860.52	160%	20%	ACCEPT	0.37
10	269950	-170000	80000	13%	5	822897.37	233961.69	158%	20%	ACCEPT	0.38
11	294650	-187000	88000	13%	5	897115.07	255062.86	157%	20%	ACCEPT	0.38
12	319350	-204000	96000	13%	5	971332.76	276164.03	156%	20%	ACCEPT	0.38
13	344050	-221000	104000	13%	5	1045550.45	297265.20	155%	20%	ACCEPT	0.39
14	368750	-238000	112000	13%	5	1119768.14	318366.37	154%	20%	ACCEPT	0.39
15	393450	-255000	120000	13%	5	1193985.83	339467.54	154%	20%	ACCEPT	0.39
16	418150	-272000	128000	13%	5	1268203.52	360568.71	153%	20%	ACCEPT	0.39
17	442850	-289000	136000	13%	5	1342421.22	381669.87	152%	20%	ACCEPT	0.39
18	465000	-306000	144000	13%	5	1407669.97	400221.04	151%	20%	ACCEPT	0.40
19	489700	-323000	152000	13%	5	1481887.66	421322.21	151%	20%	ACCEPT	0.40
20	511850	-340000	160000	13%	5	1547136.41	439873.38	150%	20%	ACCEPT	0.40
21	534000	-357000	168000	13%	5	1612385.16	458424.55	149%	20%	ACCEPT	0.40
22	553600	-374000	176000	13%	5	1668664.98	474425.72	147%	20%	ACCEPT	0.41
23	575750	-391000	184000	13%	5	1733913.73	492976.89	146%	20%	ACCEPT	0.41
24	595350	-408000	192000	13%	5	1790193.54	508978.06	145%	20%	ACCEPT	0.41
24	595350	-408000	192000	13%	5	1790193.54	508978.06	145%	20%	ACCEPT	0.41
26	624350	-442000	208000	13%	5	1866877.40	530780.40	140%	20%	ACCEPT	0.43
27	638850	-459000	216000	13%	5	1905219.34	541681.57	138%	20%	ACCEPT	0.43
28	661000	-476000	224000	13%	5	1970468.09	560232.74	138%	20%	ACCEPT	0.44
29	683150	-493000	232000	13%	5	2035716.84	578783.90	138%	20%	ACCEPT	0.44
30	702750	-510000	240000	13%	5	2091996.65	594785.07	137%	20%	ACCEPT	0.44
31	724900	-527000	248000	13%	5	2157245.41	613336.24	137%	20%	ACCEPT	0.44
32	744500	-544000	256000	13%	5	2213525.22	629337.41	136%	20%	ACCEPT	0.44
33	759000	-561000	264000	13%	5	2251867.15	640238.58	134%	20%	ACCEPT	0.45
34	773500	-578000	272000	13%	5	2290209.08	651139.75	133%	20%	ACCEPT	0.45
35	788000	-595000	280000	13%	5	2328551.02	662040.92	131%	20%	ACCEPT	0.46
36	802500	-612000	288000	13%	5	2366892.95	672942.09	130%	20%	ACCEPT	0.46
37	817000	-629000	296000	13%	5	2405234.88	683843.26	129%	20%	ACCEPT	0.47
38	831500	-646000	304000	13%	5	2443576.81	694744.43	128%	20%	ACCEPT	0.47
39	843450	-663000	312000	13%	5	2472949.81	703095.60	126%	20%	ACCEPT	0.48
40	855400	-680000	320000	13%	5	2502322.80	711446.76	125%	20%	ACCEPT	0.48
41	867350	-697000	328000	13%	5	2531695.79	719797.93	123%	20%	ACCEPT	0.49
42	879300	-714000	336000	13%	5	2561068.79	728149.10	122%	20%	ACCEPT	0.50
43	891250	-731000	344000	13%	5	2590441.78	736500.27	121%	20%	ACCEPT	0.50
43	891250	-731000	344000	13%	5	2590441.78	736500.27	121%	20%	ACCEPT	0.50
45	910050	-765000	360000	13%	5	2631249.89	748102.61	118%	20%	ACCEPT	0.51
46	922000	-782000	368000	13%	5	2660622.88	756453.78	117%	20%	ACCEPT	0.52
47	931400	-799000	376000	13%	5	2681026.93	762254.95	115%	20%	ACCEPT	0.53
48	940800	-816000	384000	13%	5	2701430.99	768056.12	114%	20%	ACCEPT	0.53
49	945100	-833000	392000	13%	5	2703897.16	768757.29	112%	20%	ACCEPT	0.54
50	949400	-850000	400000	13%	5	2706363.33	769458.46	110%	20%	ACCEPT	0.55

Table 24: Economic analysis 4 (P=9)

MotSay	Annual Profit (TL)	Capital for the Investment (TL)	Salvage Value after 5 years (TL)	Interest rate (i)	Planning Horizon (Year)	Present Value (TL)	Annual Value (TL)	IRR	MARR	MARR>IRR	Pay back (YEAR)
1	39150	-17000	8000	13%	5	125041.68	35551.17	230%	20%	ACCEPT	0.26
2	84080	-34000	16000	13%	5	270412.96	76882.34	247%	20%	ACCEPT	0.24
3	123230	-51000	24000	13%	5	395454.65	112433.51	241%	20%	ACCEPT	0.24
4	165270	-68000	32000	13%	5	530661.13	150874.68	243%	20%	ACCEPT	0.24
5	204420	-85000	40000	13%	5	655702.81	186425.85	240%	20%	ACCEPT	0.24
6	243570	-102000	48000	13%	5	780744.50	221977.01	239%	20%	ACCEPT	0.25
7	279830	-119000	56000	13%	5	895621.38	254638.18	235%	20%	ACCEPT	0.25
8	316090	-136000	64000	13%	5	1010498.27	287299.35	232%	20%	ACCEPT	0.25
9	352350	-153000	72000	13%	5	1125375.15	319960.52	230%	20%	ACCEPT	0.26
10	388610	-170000	80000	13%	5	1240252.04	352621.69	228%	20%	ACCEPT	0.26
11	424870	-187000	88000	13%	5	1355128.92	385282.86	227%	20%	ACCEPT	0.26
12	461130	-204000	96000	13%	5	1470005.81	417944.03	226%	20%	ACCEPT	0.26
13	497390	-221000	104000	13%	5	1584882.69	450605.20	225%	20%	ACCEPT	0.26
14	533650	-238000	112000	13%	5	1699759.58	483266.37	224%	20%	ACCEPT	0.26
15	569910	-255000	120000	13%	5	1814636.46	515927.54	223%	20%	ACCEPT	0.26
16	606170	-272000	128000	13%	5	1929513.35	548588.71	223%	20%	ACCEPT	0.26
17	642430	-289000	136000	13%	5	2044390.23	581249.87	222%	20%	ACCEPT	0.26
18	675800	-306000	144000	13%	5	2149102.32	611021.04	221%	20%	ACCEPT	0.27
19	712060	-323000	152000	13%	5	2263979.20	643682.21	220%	20%	ACCEPT	0.27
20	745430	-340000	160000	13%	5	2368691.29	673453.38	219%	20%	ACCEPT	0.27
21	778800	-357000	168000	13%	5	2473403.38	703224.55	218%	20%	ACCEPT	0.27
22	809280	-374000	176000	13%	5	2567950.66	730105.72	216%	20%	ACCEPT	0.27
23	842650	-391000	184000	13%	5	2672662.75	759876.89	215%	20%	ACCEPT	0.27
24	873130	-408000	192000	13%	5	2767210.04	786758.06	214%	20%	ACCEPT	0.28
24	873130	-408000	192000	13%	5	2767210.04	786758.06	214%	20%	ACCEPT	0.28
26	922530	-442000	208000	13%	5	2915645.42	828960.40	208%	20%	ACCEPT	0.28
27	947230	-459000	216000	13%	5	2989863.11	850061.57	206%	20%	ACCEPT	0.29
28	980600	-476000	224000	13%	5	3094575.20	879832.74	206%	20%	ACCEPT	0.29
29	1013970	-493000	232000	13%	5	3199287.29	909603.90	205%	20%	ACCEPT	0.29
30	1044450	-510000	240000	13%	5	3293834.58	936485.07	204%	20%	ACCEPT	0.29
31	1077820	-527000	248000	13%	5	3398546.66	966256.24	204%	20%	ACCEPT	0.29
32	1108300	-544000	256000	13%	5	3493093.95	993137.41	203%	20%	ACCEPT	0.29
33	1133000	-561000	264000	13%	5	3567311.64	1014238.58	202%	20%	ACCEPT	0.29
34	1157700	-578000	272000	13%	5	3641529.33	1035339.75	200%	20%	ACCEPT	0.30
35	1182400	-595000	280000	13%	5	3715747.03	1056440.92	198%	20%	ACCEPT	0.30
36	1207100	-612000	288000	13%	5	3789964.72	1077542.09	197%	20%	ACCEPT	0.30
37	1231800	-629000	296000	13%	5	3864182.41	1098643.26	195%	20%	ACCEPT	0.30
38	1256500	-646000	304000	13%	5	3938400.10	1119744.43	194%	20%	ACCEPT	0.30
39	1278310	-663000	312000	13%	5	4002452.99	1137955.60	192%	20%	ACCEPT	0.31
40	1300120	-680000	320000	13%	5	4066505.89	1156166.76	191%	20%	ACCEPT	0.31
41	1321930	-697000	328000	13%	5	4130558.78	1174377.93	189%	20%	ACCEPT	0.31
42	1343740	-714000	336000	13%	5	4194611.67	1192589.10	188%	20%	ACCEPT	0.32
43	1365550	-731000	344000	13%	5	4258664.57	1210800.27	186%	20%	ACCEPT	0.32
43	1365550	-731000	344000	13%	5	4258664.57	1210800.27	186%	20%	ACCEPT	0.32
45	1403390	-765000	360000	13%	5	4366440.76	1241442.61	183%	20%	ACCEPT	0.32
46	1425200	-782000	368000	13%	5	4430493.65	1259653.78	182%	20%	ACCEPT	0.33
47	1444120	-799000	376000	13%	5	4484381.75	1274974.95	180%	20%	ACCEPT	0.33
48	1463040	-816000	384000	13%	5	4538269.84	1290296.12	179%	20%	ACCEPT	0.33
49	1476180	-833000	392000	13%	5	4571828.34	1299837.29	177%	20%	ACCEPT	0.34
50	1489320	-850000	400000	13%	5	4605386.84	1309378.46	175%	20%	ACCEPT	0.34
51	1496680	-867000	408000	13%	5	4618615.74	1313139.62	172%	20%	ACCEPT	0.35
52	1501150	-884000	416000	13%	5	4621679.84	1314010.79	169%	20%	ACCEPT	0.35
53	1505620	-901000	424000	13%	5	4624743.94	1314881.96	166%	20%	ACCEPT	0.36
54	1507200	-918000	432000	13%	5	4617643.25	1312863.13	163%	20%	ACCEPT	0.36

Table 25: Economic analysis 5 (P=10)

MotSay	Annual Profit (TL)	Capital for the Investment (TL)	Salvage Value after 5 years (TL)	Interest rate (i)	Planning Horizon (Year)	Present Value (TL)	Annual Value (TL)	IRR	MARR	MARR>IRR	Pay back (YEAR)
1	51050	-17000	8000	13%	5	166896.74	47451.17	300%	20%	ACCEPT	0.19
2	108560	-34000	16000	13%	5	356514.78	101362.34	319%	20%	ACCEPT	0.18
3	159610	-51000	24000	13%	5	523411.52	148813.51	313%	20%	ACCEPT	0.19
4	213890	-68000	32000	13%	5	701668.91	199494.68	314%	20%	ACCEPT	0.18
5	264940	-85000	40000	13%	5	868565.65	246945.85	312%	20%	ACCEPT	0.19
6	315990	-102000	48000	13%	5	1035462.38	294397.01	310%	20%	ACCEPT	0.19
7	363810	-119000	56000	13%	5	1190998.46	338618.18	306%	20%	ACCEPT	0.19
8	411630	-136000	64000	13%	5	1346534.54	382839.35	303%	20%	ACCEPT	0.19
9	459450	-153000	72000	13%	5	1502070.62	427060.52	300%	20%	ACCEPT	0.19
10	507270	-170000	80000	13%	5	1657606.70	471281.69	298%	20%	ACCEPT	0.19
11	555090	-187000	88000	13%	5	1813142.78	515502.86	297%	20%	ACCEPT	0.20
12	602910	-204000	96000	13%	5	1968678.85	559724.03	295%	20%	ACCEPT	0.20
13	650730	-221000	104000	13%	5	2124214.93	603945.20	294%	20%	ACCEPT	0.20
14	698550	-238000	112000	13%	5	2279751.01	648166.37	293%	20%	ACCEPT	0.20
15	746370	-255000	120000	13%	5	2435287.09	692387.54	293%	20%	ACCEPT	0.20
16	794190	-272000	128000	13%	5	2590823.17	736608.71	292%	20%	ACCEPT	0.20
17	842010	-289000	136000	13%	5	2746359.25	780829.87	291%	20%	ACCEPT	0.20
18	886600	-306000	144000	13%	5	2890534.67	821821.04	290%	20%	ACCEPT	0.20
19	934420	-323000	152000	13%	5	3046070.75	866042.21	289%	20%	ACCEPT	0.20
20	979010	-340000	160000	13%	5	3190246.17	907033.38	288%	20%	ACCEPT	0.20
21	1023600	-357000	168000	13%	5	3334421.59	948024.55	287%	20%	ACCEPT	0.20
22	1064960	-374000	176000	13%	5	3467236.35	985785.72	285%	20%	ACCEPT	0.20
23	1109550	-391000	184000	13%	5	3611411.77	1026776.89	284%	20%	ACCEPT	0.21
24	1150910	-408000	192000	13%	5	3744226.54	1064538.06	282%	20%	ACCEPT	0.21
24	1150910	-408000	192000	13%	5	3744226.54	1064538.06	282%	20%	ACCEPT	0.21
26	1220710	-442000	208000	13%	5	3964413.44	1127140.40	276%	20%	ACCEPT	0.21
27	1255610	-459000	216000	13%	5	4074506.89	1158441.57	273%	20%	ACCEPT	0.21
28	1300200	-476000	224000	13%	5	4218682.31	1199432.74	273%	20%	ACCEPT	0.21
29	1344790	-493000	232000	13%	5	4362857.73	1240423.90	273%	20%	ACCEPT	0.21
30	1386150	-510000	240000	13%	5	4495672.50	1278185.07	272%	20%	ACCEPT	0.21
31	1430740	-527000	248000	13%	5	4639847.92	1319176.24	271%	20%	ACCEPT	0.22
32	1472100	-544000	256000	13%	5	4772662.68	1356937.41	270%	20%	ACCEPT	0.22
33	1507000	-561000	264000	13%	5	4882756.13	1388238.58	268%	20%	ACCEPT	0.22
34	1541900	-578000	272000	13%	5	4992849.58	1419539.75	267%	20%	ACCEPT	0.22
35	1576800	-595000	280000	13%	5	5102943.04	1450840.92	265%	20%	ACCEPT	0.22
36	1611700	-612000	288000	13%	5	5213036.49	1482142.09	263%	20%	ACCEPT	0.22
37	1646600	-629000	296000	13%	5	5323129.94	1513443.26	262%	20%	ACCEPT	0.22
38	1681500	-646000	304000	13%	5	5433223.39	1544744.43	260%	20%	ACCEPT	0.22
39	1713170	-663000	312000	13%	5	5531956.18	1572815.60	258%	20%	ACCEPT	0.23
40	1744840	-680000	320000	13%	5	5630688.97	1600886.76	256%	20%	ACCEPT	0.23
41	1776510	-697000	328000	13%	5	5729421.77	1628957.93	255%	20%	ACCEPT	0.23
42	1808180	-714000	336000	13%	5	5828154.56	1657029.10	253%	20%	ACCEPT	0.23
43	1839850	-731000	344000	13%	5	5926887.35	1685100.27	251%	20%	ACCEPT	0.23
43	1839850	-731000	344000	13%	5	5926887.35	1685100.27	251%	20%	ACCEPT	0.23
45	1896730	-765000	360000	13%	5	6101631.63	1734782.61	248%	20%	ACCEPT	0.24
46	1928400	-782000	368000	13%	5	6200364.42	1762853.78	246%	20%	ACCEPT	0.24
47	1956840	-799000	376000	13%	5	6287736.56	1787694.95	245%	20%	ACCEPT	0.24
48	1985280	-816000	384000	13%	5	6375108.69	1812536.12	243%	20%	ACCEPT	0.24
49	2007260	-833000	392000	13%	5	6439759.52	1830917.29	241%	20%	ACCEPT	0.24
50	2029240	-850000	400000	13%	5	6504410.34	1849298.46	238%	20%	ACCEPT	0.25
51	2044760	-867000	408000	13%	5	6546339.85	1861219.62	236%	20%	ACCEPT	0.25
52	2057050	-884000	416000	13%	5	6576908.70	1869910.79	232%	20%	ACCEPT	0.25
53	2069340	-901000	424000	13%	5	6607477.55	1878601.96	229%	20%	ACCEPT	0.26
54	2078400	-918000	432000	13%	5	6626685.75	1884063.13	226%	20%	ACCEPT	0.26
55	2081000	-935000	440000	13%	5	6623172.63	1883064.30	222%	20%	ACCEPT	0.26
56	2090060	-952000	448000	13%	5	6642380.82	1888525.47	219%	20%	ACCEPT	0.27

Chapter 6

CONCLUSION

The number of customers that are eager to order food online through applications than traditional dining is growing day by day. According to this evolving business lots of companies started to work in the field of online food ordering. It has become more efficient for restaurants and more convenient for customers and of course faster for both sides. FMC is one of these companies. It started to operate in 2017 and since then their business is growing. Alongside other apps that are trying to improve their qualities and even offer more facilities to the customers, FMC has decided to take the responsibility of delivery operation by itself and has its own delivery fleet. In this way, to provide a precise job and consider its feasibility in such a process, FMC owners needed to think through carefully and of course an academic help. So in this paper, we studied the feasibility of establishing the own distribution network for FMC. In order to make a valid decision, we needed some necessary information and data to collect. Some data were gathered from FMC such as the number of restaurant's daily orders of FMC, the distance between customers, and the restaurant's addresses. The rest of the data were gathered from randomly chosen restaurants. We asked their managers or supervisors and deliverymen about their average number of daily orders for delivery, how many deliverymen or motorcycles being used for this purpose, and how many orders deliverymen usually take per day. In the following steps of this study, we also asked some motorcycle shop owners about the kind of scooter that is mostly used by restaurants in North Cyprus for delivery operation. Furthermore, to be sure of the

validity of their statements we observed some restaurant`s delivery operations and gathered some useful details. Honda Activa 5G was a popular scooter among restaurants. By looking through the internet and sources mentioned above necessary information about Honda Activa 5G was noted. For finalizing our mathematical scenario and in order to calculate and ensure the maximum profit, some costs had to be eliminated. By considering the number of working days for each deliveryman in a year, the amount of their salary, paid taxes and insurance were subtracted. Additionally, the approximate costs of a motorcycle being used for the delivery process in a year were calculated. We considered five different service prices for our two scenarios. Earning profit by price 5 TL and less for FMC company wasn't possible in our proposed scenarios, so we started with 6 TL and continued till price 10 TL. As we increased the number of motorcycles more orders could be delivered so the profit would increase as well. Then we came up with the idea of decreasing transportation costs and getting more use of motorcycles. In this way, we arranged the restaurants by their locations. In this scenario, each deliveryman takes as much order as he can from not only one restaurant but different restaurants that are close together. This method was more beneficial because deliverymen could take more orders from restaurants. In each price after a certain amount of motorcycles, the profit wouldn't change because it wasn't worth it for the operation to accept orders from restaurants with a low number of orders by considering the cost for motorcycles and deliverymen. Since we didn't consider FMC`s capital of investment in our estimation of annual profit we did an economic analysis for the second scenario because it was more profitable. In this analysis, present and annual value, the interest rate of return, and payback period were calculated for each price. In price 6 TL we only had four acceptable situations but all the cases for the rest of the prices were acceptable and the duration of payback was

getting smaller and close to one year. Both sides should start the job for 6 and 7 TL because in our calculations for prices less than 6 TL there is no gain for FMC and for prices more than 7 TL it seems an expensive and costly process for restaurants. However, we presented our work to FMC owners. Now, it is up to them to discuss and examine these results and use this strategy in their future work.

6.1 Future Study

In this paper, we considered the same prices in our calculations for all of the restaurants. To continue this work and do it in a better way, it can be examined for different prices and contracts with different restaurants. And a survey can be done on the restaurant's feedbacks whether they will be eager to get along with such a process or not.

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