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# A Study into Optimizing the Number of Cashier Employees in Manuel Supermarket


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# Table of Contents

# List of figures

# List of tables

# CHAPTER – 1
# Introduction

## 1.1 Introduction

Nowadays, in a world full of Competitions, organizations and enterprises, especially the companies that need store to sell products, are suffering from the employees shifts and the miss-allocations of their resources. Manual-Al-batarjee branch is one of the enterprises that is suffering from this problem. In this paper, the purpose was mainly to reduce the number of workers in the cashiers, which will logically reduce the salary cost on the company's finances. The tool that will be used in this paper in order to get as much accurate results as possible is "integer linear programming module". After obtaining this study, a full variety of cashier's workers are decreased with keeping the required variety of cashier workers in every shift consummated. This paper starts with introduction, a literature review part which contains previous and similar projects done comparable to this paper. Research methodology will then be discussed in general. Last but not least, results, discussion, conclusion, and references will take place in this paper.

## 1.2 Aims & Objectives

### 1.2.1 Aims:

i. Minimize the overhead cost at supermarket branches.
ii. Decrease the number of cashiers without loss in efficiency.

### 1.2.2 Objectives:

i. Optimizing the number of cashiers in a local Manuel supermarket branch in Jeddah.
ii. Finding best allocation of human resources.

# CHAPTER - 2
# Literature Review

## 2.1 Literature Review

Using integer linear programming and other techniques to optimize the labor scheduling study is not a new thing at all! There are many studies and research papers that have been done in the past years which demonstrate the importance and the impact of a good scheduling system. One of the recent studies that has been made regarding the optimization of scheduling system is “aircraft maintenance workforce scheduling”, the objective of the study is to determine the optimum maintenance workforce schedule for labors, the researchers used integer linear programming to find the optimum working day to satisfy the stakeholder’s interest. This results in $ 100,000 of savings annually. One of the cons of this paper is the worker’s fatigue which is a result of a 7-day work schedule which is considered horrible for such a job! (Alfares, 1997)

Another real-life example on integer linear programming scheduling system is the “staff scheduling and rostering”. Basically, in the past few years, this area has become increasingly important as business become more service focused. The stakeholders must bury in mind the importance of flexible workplace agreement and shift equity along with other key point that should be taken into consideration by the decision makers in the enterprise. “rostering” is basically a process of establishing time schedules for the employees or workers in the enterprise, so as to satisfy the demand of service or goods provided by the organization. This paper was made by the European Journals of operation research. The classification presents the rostering method as variety of modules beginning with the determination of staffing necessities and ending with the specification of the work to be performed, over some time amount, by every individual within the workforce. Integer linear programming was used as a tool! (Cheang et al., 2003)

Cashiers-less go store is the newest feature Amazon used in their stores in the US. The idea behind the cashier-less technology is that customers do not need to pass by a cashier after finishing from shopping. Amazon used some techniques in order to be able to launch such a technology. The only device needed for shopping in Amazon new store is the “cell phone”, the customer just need to download Amazon application and check the product the phone’s camera, after that the items get charged to their Amazon account automatically. The use operation research techniques and simulation models software helped Amazon team to implement such a technology. The place is covered 360 degrees with digital and developed cameras and sensors so as to guarantee the smoothness of process. One of the disadvantages of this technology is that it needs a high budget to be settled from the upper management, plus it also needs a periodic maintenance to ensure that the system is working properly. (The Verge, 2018)

# CHAPTER - 3
# Problem Statement

## 3.1 Problem Statement

Manual supermarket needs to minimize the number of cashier employee and without having a shortage of demand for cashiers in the supermarket. The supermarket located in Jeddah in Al-Batterjee street, it's one of Manual supermarket series. After talking with Ahmed Al Saeat, one of the supervisors in Manual supermarket, he told us the demand in each day. Also, he has two shifts during the day. One starts from 8 am to 4 am, another start from 4 pm to 12 am. The current schedule of cashiers is that each cashier works five days of the week and takes two days off. This problem can be solved by using linear programming techniques to optimize the scheduling for the cashiers in this branch without having a shortage in demand for cashiers.

# CHAPTER - 4
# DATA COLLECTION

## 4.1 Primary/secondary data

The primary data was collected using one of the data-gathering techniques, which is the interview that is the most common method of data-gathering techniques. This technique will help us to collect data from the supervisor who knows the current situation for the system and give us the correct information which will help us to find the optimal solution for this problem. The supervisor who works in Manual supermarket gave us the scheduling for the cashiers, the demand for each day is the following:

*Table (1): The demand for cashiers each day.*

| DAYS OF THE WEEK | SUN | MON | TUES | WED | THURS | FRI | SAT |
|---|---|---|---|---|---|---|---|
| NUMBER OF CASHIERS | 10 | 10 | 10 | 10 | 12 | 18 | 10 |

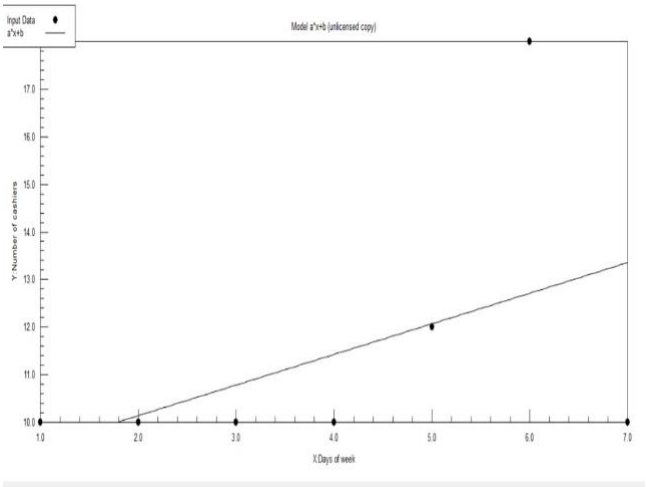


*FIGURE (1): linear regression between days of the week and number of cashiers*

| Statistics | |
|---|---|
| Variable | X:Number of cashiers |
| Number of Points | 7 |
| Missing Points | 0 |
| Maximum Value | 18 |
| Minimum Value | 10 |
| Range | 8 |
| Average | 11.42857143 |
| Standard Deviation | 2.992052966 |

*FIGURE (2): Statistics*

# CHAPTER - 5
# RESULTS AND DISCUSSIONS

## 5.1 Results

### 5.1.1 Formulation

In this section, we formulated the problem by using the linear programming based on the given information and the system requirements to reduce the number of employees in each shift in a way to minimize the cost for the company.

**Decision Variables**

The used decision variables can be described as follows:

$X_{i.j}$ = Number of cashiers who start working I, and their shift start at j.

($i$ = Sunday, Monday, … … Saturday)

(1,2, … … 7)

($j$ = 8 am – 4 pm, 12 pm – 8 pm, 4 pm – 12 am)

(a, b, c)

**Objective Function**

The objective is to minimize the number of cashiers for Manuel supermarket.

$minimize\ Z = xa.1 + xa.2 + xa.3 + xa.4 + xa.5 + xa.6 + xa.7 + xb.1 + xb.2 + xb.3 + xb.4 + xb.5 + xb.6 + xb.7 + xc.1 + xc.2 + xc.3 + xc.4 + xc.5 + xc.6 + xc.7$

## Constraints

The system requirements or constraints to be taken into account while designing the schedule for the cashiers can be summarized as follows.

1- The demand for cashiers each day
2- The employee shouldn't work more than 8 hours per day.
3- Each cashier work for five consecutive working days then he takes two consecutive off days.

**Subject To (constraints);**

$$(a{:}8am{-}4pm)$$

$xa.1 + xa.4 + xa.5 + xa.6 + xa.7 \geq 2$ $(\#\ of\ Cashier\ on\ Sunday)$

$xa.2{+}xa.5{+}xa.6{+}xa.7{+}xa.1{\geq}2$ $(\#ofCashieronMonay)$

$xa.3 + xa.6 + xa.7 + xa.1 + xa.2 \geq 2$ $(\#\ of\ Cashier\ on\ Tuesday)$

$xa.4 + xa.7 + xa.1 + xa.2 + xa.3 \geq 2$ $(\#\ of\ Cashier\ on\ Wednesday)$

$xa.5 + xa.1 + xa.2 + xa.3 + xa.4 \geq 2$ $(\#\ of\ Cashier\ on\ Thursday)$

$xa.6 + xa.2 + xa.3 + xa.4 + xa.5 \geq 4$ $(\#\ of\ Cashier\ on\ Friday)$

$xa.7 + xa.3 + xa.4 + xa.5 + xa.6 \geq 2$ $(\#\ of\ Cashier\ on\ Saturday)$

$$(b{:}12pm{-}8pm)$$

$xb.1{+}xb.4{+}xb.5{+}xb.6{+}xb.7{\geq}2$ $(\#ofCashieronSunday)$

$xb.2{+}xb.5{+}xb.6{+}xb.7{+}xb.1{\geq}2$ $(\#ofCashieronMonay)$

$xb.3{+}xb.6{+}xb.7{+}xb.1{+}xb.2{\geq}2$ $(\#ofCashieronTuesday)$

$xb.4{+}xb.7{+}xb.1{+}xb.2{+}xb.3{\geq}2$ $(\#ofCashieronWednesday)$

$xb.5{+}xb.1{+}xb.2{+}xb.3{+}xb.4{\geq}2$ $(\#ofCashieronThursday)$

$xb.6{+}xb.2{+}xb.3{+}xb.4{+}xb.5{\geq}5$ $(\#ofCashieronFriday)$

$xb.7{+}xb.3{+}xb.4{+}xb.5{+}xb.6{\geq}2$ $(\#ofCashieronSaturday)$

$$(c{:}4pm{-}12am)$$

$xc.1{+}xc.4{+}xc.5{+}xc.6{+}xc.7{\geq}6$ $(\#ofCashieronSunday)$

$xc.2+xc.5+xc.6+xc.7+xc.1 \geq 6$ $(\#ofCashieronMonay)$

$xc.3+xc.6+xc.7+xc.1+xc2 \geq 6$ $(\#ofCashieronTuesday)$

$xc.4+xc.7+xc.1+xc.2+xc.3 \geq 6$ $(\#ofCashieronWednesday)$

$xc.5+xc.1+xc.2+xc.3+xc.4 \geq 8$ $(\#ofCashieronThursday)$

$xc.6+xc.2+xc.3+xc.4+xc.5 \geq 9$ $(\#ofCashieronFriday)$

$xc.7+xc.3+xc.4+xc.5+xc.6 \geq 6$ $(\#ofCashieronSaturday)$

$xi, j \geq 0$ (non negativity constraint)

### 5.1.2 Results

After having the data collected and organized, and the Integer Linear Programming problem formulation is ready, QM software was used to solve the problem. The following two tables and the scale below will conclude the results before and after using the Integer Linear Programing Model.

*Table (2): The New System.*

| Day | Shift | Number of Cashiers |
|---|---|---|
| Sunday | 8AM-4PM | 3 |
| | 12PM-8PM | 5 |
| | 4PM-12AM | 6 |
| Monday | 8AM-4PM | 4 |
| | 12PM-8PM | 5 |
| | 4PM-12AM | 10 |
| Tuesday | 8AM-4PM | 2 |
| | 12PM-8PM | 3 |
| | 4PM-12AM | 7 |
| Wednesday | 8AM-4PM | 4 |
| | 12PM-8PM | 5 |
| | 4PM-12AM | 8 |
| Thursday | 8AM-4PM | 2 |
| | 12PM-8PM | 2 |
| | 4PM-12AM | 10 |
| Friday | 8AM-4PM | 4 |
| | 12PM-8PM | 5 |
| | 4PM-12AM | 10 |
| Saturday | 8AM-4PM | 4 |
| | 12PM-8PM | 5 |
| | 4PM-12AM | 10 |
| Summarize | Three Shifts | 19 Cashiers |

*Table (3): The Old System.*

| Day | Shift | Number of Cashiers |
|---|---|---|
| Sunday | 8AM-4PM | 8 |
| | 4PM-12AM | 11 |
| Monday | 8AM-4PM | 8 |
| | 4PM-12AM | 11 |
| Tuesday | 8AM-4PM | 8 |
| | 4PM-12AM | 11 |
| Wednesday | 8AM-4PM | 8 |
| | 4PM-12AM | 11 |
| Thursday | 8AM-4PM | 14 |
| | 4PM-12AM | 20 |
| Friday | 8AM-4PM | 22 |
| | 4PM-12AM | 22 |
| Saturday | 8AM-4PM | 8 |
| | 4PM-12AM | 12 |
| Summarize | Two Shifts | 29 Cashiers |

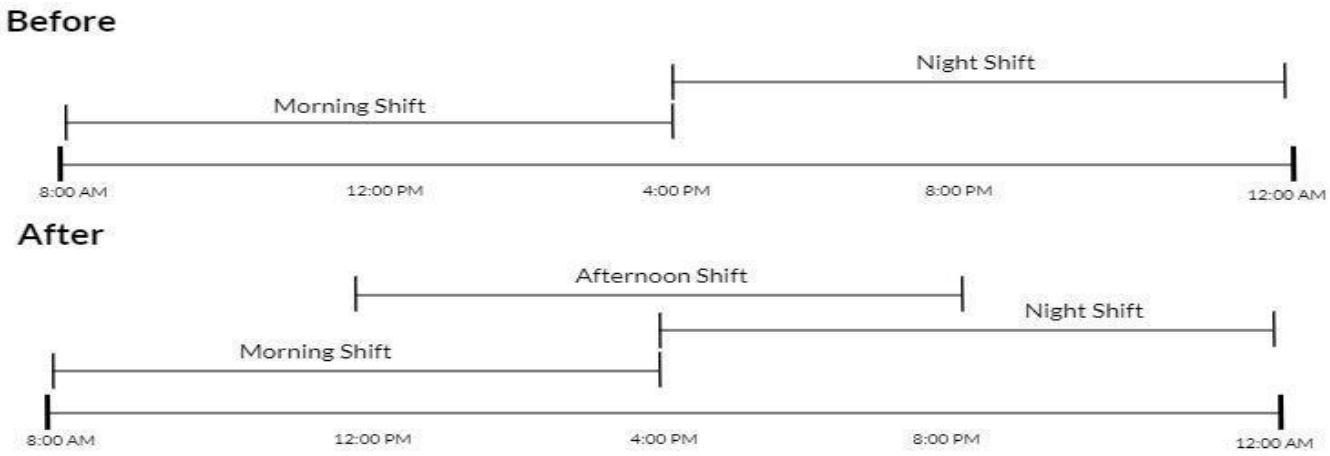


*FIGURE (3): Scales of the new and old shifting system.*

## 5.2 Discussions

As you see in figure 1 the work policy must be changed to have three shifts instead of two. From table 2 it is obvious that the optimal number of cashiers is 19, this means that only 19 cashiers are needed to satisfy both the constraints and the customer demand. Originally, AL-Batrjee branch has 26 to 30 cashiers, this means that if the branch follows the new scheduling policy, the number of cahiers will be minimized to 19. Following this policy will help in reducing the number of cahiers by 11, which will logically save 11 workers' salary each month. An important point to be buried in mind is that the number of cashiers mates change, but the policy not. In order to have a smooth transition between the old and new system, you need training for the targeted employees, in our case cashiers. Before applying the new system all the affected employees must be aware of the new business policies and regulations and have gone throw a training period to slow thing down and make them mentally ready for the future changes that the new system will have on their jobs and duties.

# CHAPTER - 6
# CONCLUSION AND RECOMMENDATION

## 6.1 Recommendations

From the requirement management, the number of cashiers will change one month to the other, one recommendation that we see as a must is developing Job enrichment and Job cycle programs. Let's say for a month the number of cashiers needed is ten and the next month is eight and the month after it is ten, that means that I am going to fire two cashiers in the second month and give them their job back after one month, that is a poor way to manage your employees. Job enrichment and Job cycle programs will solve the problem, we should train our employees to do various tasks and jobs, if we do not need them as cashiers they can work in the inventory or as a shelf organizer, maybe even in the marketing department or HR. We can make them do paperwork or doing a survey and gathering data for us. Bottom line is if we do not need them right now as cashiers, we will need them later, and in the mean, while they should work somewhere else inside the company.

## 6.2 Conclusion

Finally, integer linear programming module was used, which leaded us to find the optimum solution of reducing the number of cashiers' employees in each shift for Manual supermarket, Al-Batarjjee street branch in Jeddah. The old shifting system was costing the company more money, along with the unneeded number of employees. After getting the results, it showed that the optimum number of cashiers' workers is 19. As a result, the number of employees will be reduced from 26-30 to 7-11 employees only! The process followed was getting the optimum solution. First determining the shifts and the number of cashier employees needed in each shift which will be done through scheduling the shifts, then collecting the data needed, and lastly, applying the linear programming module. Finally, these results might give us the boost to go ahead and optimize the number of cashier employees in each shift for this branch.

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