Optimizing Work Schedules for

a Local Pizza Hut

by,

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Summary

The objective of this project was to develop an optimization model that can help Local Pizza Hut to optimize their staff scheduling process. We identified the key factors that affect staffing scheduling and analyzed the existing staffing scheduling techniques. We have developed an optimization model that can consider these factors and generate an optimal staffing schedule.

Pizza Hut has four types of employees, legal restrictions and labor laws that must be considered when scheduling shifts. Servers work four-hour shifts starting at 9AM, 1PM, and 5PM. Managers work an eight-hour shift starting at 10AM, with a one-hour unpaid lunch break. Chefs work two shifts, from 9AM to 3PM and 3PM to 9PM. The minimum number of employees required to provide service during specific hours is provided. The salaries paid by the company to employees are also given.

It is essential to create a schedule that meets the needs of the business while considering the legal requirements and labor laws that must be adhered to. A budget is acquired to work on the project in the coming days. This budget will be used to determine the number of employees needed and the salaries that can be paid. The goal is to create a schedule that is cost-effective and maximizes the efficiency of the manpower available.

It is essential to create a schedule that is fair and equitable to all employees and meets their needs. The schedule must also adhere to the labor laws and legal requirements that must be followed. This project requires a great deal of consideration and thought to ensure that the schedule is effective and efficient.

Introduction

In today's competitive market, effective staffing scheduling is critical for organizations to maximize productivity, minimize costs, and improve overall performance. Staffing scheduling optimization is the process of determining the most efficient staffing levels and work schedules to meet business needs while minimizing labor costs. Effective staffing scheduling requires careful planning and execution, considering factors such as workload, employee availability, skills, preferences, and labor laws. This project report aims to discuss staffing scheduling optimization, its benefits, and how it can be implemented to improve business operations.

Pizza Hut is a popular fast-food chain that serves pizzas, pasta, and other Italian dishes. They're facing staffing issues that affect sales and profit margins. We aimed to create a schedule that complies with labor laws and legal restrictions while meeting staffing requirements and employee preferences. We collected data on the limitations for the number of employees required to provide service to customers throughout the day and analyzed the staffing patterns to develop an optimization model.

Problem

The local Pizza Hut has a staffing problem that results in understaffing on weekends and overstaffing throughout the week, which causes problems with overtime and lower profit margins. The objective is to create a productive schedule that maximizes personnel use while lowering daily expenses. The business employs four different worker categories: servers, bussers, managers, and chefs, each of whom has their own set of shift requirements and regulatory constraints. A table lists the bare minimum of workers needed for each shift to offer customer service. Each employee category receives a varied wage from the company, ranging from $20/hour for bussers to $50/hour for managers. The problem statement calls for the creation of an optimal schedule that complies with regulatory requirements, reduces labor expenses, and ensures adequate staffing levels throughout each shift.

Proposed Solution

Even yet, staffing scheduling is a crucial procedure that entails distributing the labor across various duties and activities to achieve organizational objectives. Demand forecasting, workforce planning, scheduling, and monitoring are a few elements that the staffing scheduling process may include. But, in this project, we emphasize the management of staffing scheduling, which is essential for the nearby Pizza Hut as it can allow them to maximize workforce allocation, lower labor costs, and increase overall productivity.

To implement staffing scheduling optimization, we followed the following steps:

1. Analyze workload patterns: Analyze workload patterns to identify peak and slow periods, which can help determine the optimal number of employees needed at any given time. In this case, it was directly provided to us by the owner of the company.
2. Determine staffing needs: Based on workload patterns, determine the optimal number of employees needed at each time.
3. Develop work schedules: Develop work schedules that align with workload patterns, employee preferences, and labor laws.

Once the schedule is implemented, we could add another possible step for monitoring and adjusting to monitor staffing schedules and adjust as necessary to ensure they continue to meet business needs and improve performance. We further analyze the sensitivity report of the schedule we come up with, so that we understand the possible effects of one aspect to another. The Main Chapter takes us through all the details and technicalities in the report ahead.

Main Chapter

Data Collection

Please be aware that the scenario described above is hypothetical, and no data collection was ***done***. However, in a real-world situation, different techniques might be used to acquire the data needed to answer this issue. One strategy might be to ask the Pizza Hut management for details on the current staffing plan and employee performance. Also, information on local labor laws and regulations relevant to the region in which Pizza Hut operates could be found online or by speaking with legal professionals. The number of clients serviced throughout each shift might be monitored to determine the bare minimum of staff needed. The company's records or industry norms could be used to gather salary data for various employee kinds. These data sources, among others, could be used to build a comprehensive understanding of the current staffing situation and inform the development of an efficient work schedule.

The data that we worked with, is summarized in the table below:

Table 1

Work-shift timings	Number of Employees
9:00 AM to 10:00 AM	5
10:00 AM to 11:00 AM	8
11:00 AM to 12:00 PM	10
12:00 PM to 1:00 PM	10
1:00 PM to 2:00 PM	10
2:00 PM to 3:00 PM	10
3:00 PM to 4:00 PM	8
4:00 PM to 5:00 PM	8
5:00 PM to 6:00 PM	6
6:00 PM to 7:00 PM	10
7:00 PM to 8:00 PM	10
8:00 PM to 9:00 PM	10

Maximum number of Bussers working at each shift	3
Minimum number of Servers working at each shift	4
Minimum number of Managers working	1
Minimum number of Chefs working at each shift	2

Employee salaries would be:

Server: $30/hour

Busser: $20/hour

Manager: $50/hour

Chef: $45/hour

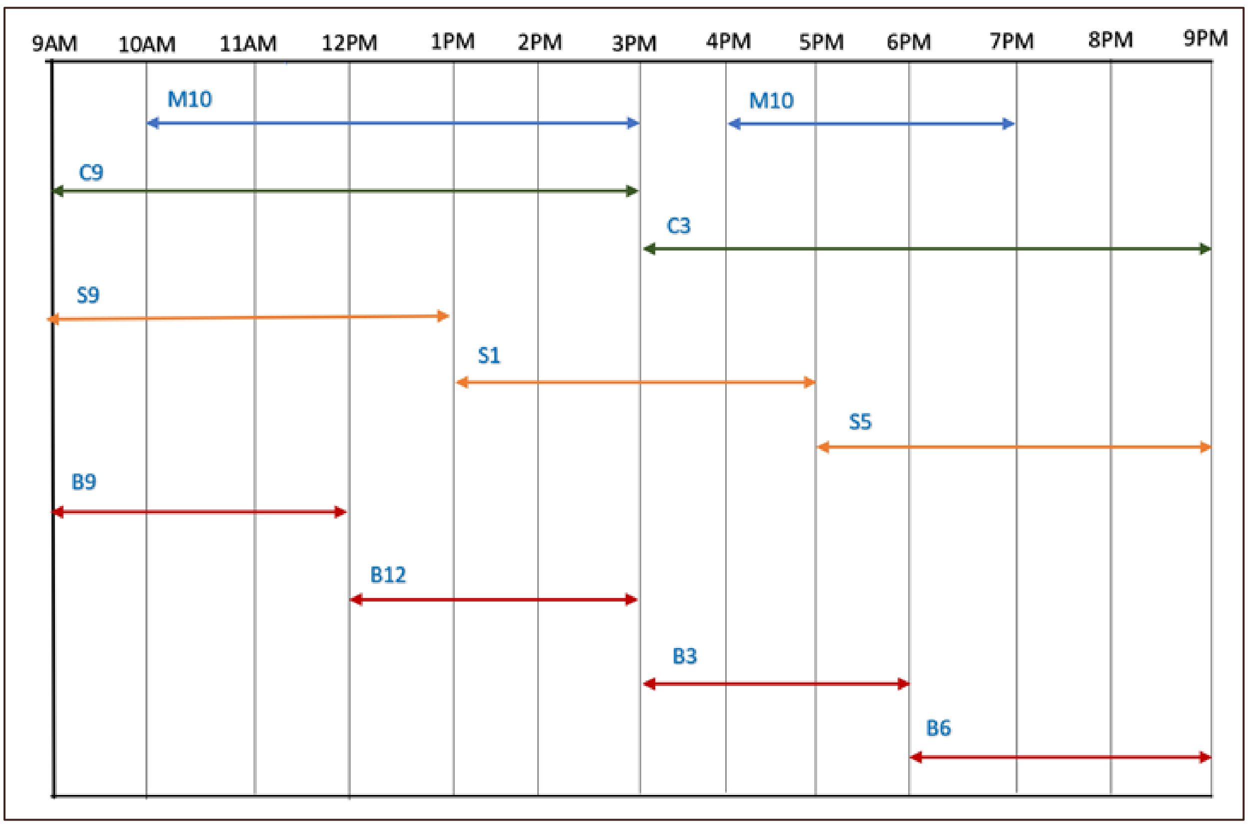
Data Analysis

We analyzed the data to identify staffing patterns and employee preferences. We found that the local Pizza Hut had a higher number of employees on weekdays than on weekends. We also found that the servers worked on a shift basis for four hours, starting at 9 AM, 1 PM, and 5 PM. Managers worked an eight-hour shift, starting at 10 AM and working for five hours, followed by a one-hour un-paid lunch break and then another three-hour shift. Chefs worked in two shifts, starting at 9 AM to 3 PM and 3 PM to 9 PM. At all times, there must be Minimum 4 servers, Minimum 2 chefs and Minimum 1 manager working. Along with the same

We also identified legal restrictions and labor laws that need to be considered when creating a work schedule. The US labor laws allow a maximum of 8 hours per shift.

Daily Scheduling

Figure 1



Optimization Model

To create the best work plan that reduces labor expenses and provides proper staffing levels throughout each shift, an optimization model was constructed for the given scenario. The model considers constraints relating to regulatory requirements, minimum personnel requirements, and labor rules for each shift. To solve the model, linear programming is used, which can offer an ideal solution that satisfies all the requirements and accomplishes the desired goal.

To complete this model, we had the following decision variables:

Table 2

Decision Variables	**Definition**
S9	Number of servers starting at 9AM
S1	Number of servers starting at 1PM
S5	Number of servers starting at 5PM
M10	Number of managers starting at 10AM
B9	Number of bussers starting at 9AM
B12	Number of bussers starting at 12PM
B3	Number of bussers starting at 3PM
B6	Number of bussers starting at 6PM
C9	Number of chefs starting at 9AM
C3	Number of chefs starting at 3PM

For the inputs we had the following:

Table 3

Inputs	**Definition**	**Given Values**
Cs	Daily cost of each server (S1, S5, S9)	$120
Cm	Daily cost of each manager (M10)	$400
Cb	Daily cost of each busser (B3, B6, B9, B12)	$60
Cc	Daily cost of each chef (C3, C9)	$225

Our objective in this study, as stated earlier, is to minimize the daily cost of employees. Here is the objective function:

Table 4

Objective Function	**Definition**
Minimize Daily Cost: **Cs*(S1+S5+S9) + Cm*M10 + Cb*(B3+B6+B9+B12) + Cc*(C3+C9)**	We will minimize the daily cost defined by the cost per day of each employee multiplied by number of employees.

For this model, we will have the following constraints:

Table 5

#	**Constraint**	**Equation**	**Explanation**
1	Minimum number of employees working 9 AM-10 AM >= 5	S9+B9+C9 ≥ 5	We will not allow the number of employees from 9 AM to 10 AM to be below 5.
2	Minimum number of employees working 10 AM-11 AM >= 8	S9+B9+C9 + M10 ≥ 8	We will not allow the number of employees from 10 AM to 11 AM to be below 8.
3	Minimum number of employees working 11 AM-12 PM >= 10	S9+B9+C9 + M10 ≥ 10	We will not allow the number of employees from 11 AM to 12 PM to be below 10.
4	Minimum number of employees working 12 PM-1 PM >= 10	S9+B12+C9+M10 ≥ 10	We will not allow the number of employees from 12PM to 1 PM to be below 10.
5	Minimum number of employees working 1 PM-2 PM >= 10	S1+B12+C9+M10 ≥ 10	We will not allow the number of employees from 1 PM to 2 PM to be below 10.
6	Minimum number of employees working 2PM-3PM >= 10	S1+B12+C9+M10 ≥ 10	We will not allow the number of employees from 2 PM to 3 PM to be below 10.
7	Minimum number of employees working 3 PM-4 PM >= 8	S1+B3+C3 ≥ 8	We will not allow the number of employees from 3 PM to 4 PM to be below 8.
8	Minimum number of employees working 4 PM-5 PM >= 8	S1+B3+C3+M10 ≥ 8	We will not allow the number of employees from 4 PM to 5 PM to be below 8.
9	Minimum number of employees working 5 PM-6 PM >= 6	S5+B3+C3+M10 ≥ 6	We will not allow the number of employees from 5 PM to 6 PM to be below 6.
10	Minimum number of employees working 6 PM-7 PM >= 10	S3+B6+C3+M10 ≥ 10	We will not allow the number of employees from 6 PM to 7 PM to be below 10.
11	Minimum number of employees working 7 PM-8 PM >= 10	S5+B6+C3 ≥ 10	We will not allow the number of employees from 7 PM to 8 PM to be below 10.
12	Minimum number of employees working 8 PM-9 PM >= 10	S5+B6+C3 ≥ 10	We will not allow the number of employees from 8 PM to 9 PM to be below 10.

13	Maximum number of bussers 9 AM - 12 PM <= 3	$B9 \leq 3$	We will not allow the number of bussers from 9 AM to 12 PM to be above 3.
14	Maximum number of bussers 12 PM - 3 PM <= 3	$B12 \leq 3$	We will not allow the number of bussers from 12 PM to 3PM to be above 3.
15	Maximum number of bussers 3 PM - 6 PM <=3	$B3 \leq 3$	We will not allow the number of bussers from 3 PM to 12 PM to be above 3.
16	Maximum number of bussers 6 PM - 9 PM <=3	$B6 \leq 3$	We will not allow the number of bussers from 6 PM to 9 PM to be above 3.
17	Minimum number of servers 9 AM - 1 PM >= 4	$S9 \geq 4$	We will not allow the number of servers from 9 AM to 1 PM to be below 4.
18	Minimum number of servers 1 PM - 5 PM >= 4	$S1 \geq 4$	We will not allow the number of servers from 1 AM to 5 PM to be below 4.
19	Minimum number of servers 5 PM - 9 PM >= 4	$S5 \geq 4$	We will not allow the number of servers from 5 AM to 9 PM to be below 4.
20	Minimum number of managers starting 10 AM >=1	$M10 \geq 1$	We will not allow the number of managers from 10 AM to be below 1.
21	Minimum number of chefs 9 AM - 3 PM >= 2	$C9 \geq 2$	We will not allow the number of chefs from 9 AM to 1 PM to be below 2.
22	Minimum number of chefs 3 PM - 9 PM >= 2	$C3 \geq 2$	We will not allow the number of chefs from 3 PM to 9 PM to be below 2.
23	Non-negativity and integer	S9, S1, S5, M10, B9, B12, B3, B6, C9, C3 $\geq$ 0 and integer	To keep the values non-negative and integer.

Solution Results and Analysis

With our model constructed, we set out to solve the model with Excel's Solver. We used the Simplex Linear Programming function to get our optimized solution. The optimized model is shown in **Figure 2**

Figure 2

Decision Variables:		*Value*	*Cost, $*
Number of Managers, 10 am	M_{10} =	1.00	400.0
Number of Chefs, 9 am	C_9 =	2.00	225.0
Number of Chefs, 3 pm	C_3 =	2.00	225.0
Number of servers, 9 am	S_9 =	4.00	120.0
Number of servers, 1 pm	S_1 =	4.00	120.0
Number of servers, 5 pm	S_5 =	5.00	120.0
Number of bussers, 9 am	B_9 =	3.00	60.0
Number of bussers, 12 pm	B_{12} =	3.00	60.0
Number of bussers, 3 pm	B_3 =	2.00	60.0
Number of bussers, 6 pm	B_6 =	3.00	60.0
		29.00	

Scheduling based on the model decisions:

	9am	*10am*	*11am*	*12pm*	*1pm*	*2pm*	*3pm*	*4pm*	*5pm*	*6pm*	*7pm*	*8pm*	*9pm*
Number of Managers, 10 am		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0			
Number of Chefs, 9 am	2.0	2.0	2.0	2.0	2.0	2.0							
Number of Chefs, 3 pm							2.0	2.0	2.0	2.0	2.0	2.0	
Number of servers, 9 am	4.0	4.0	4.0	4.0									
Number of servers, 1 pm					4.0	4.0	4.0	4.0					
Number of servers, 5 pm									5.0	5.0	5.0	5.0	
Number of bussers, 9 am	3.0	3.0	3.0										
Number of bussers, 12 pm				3.0	3.0	3.0							
Number of bussers, 3 pm							2.0	2.0	2.0				
Number of bussers, 6 pm										3.0	3.0	3.0	

Objective:		
Minimize daily cost, $		3.520.00

Constraints:	*LHS*		*RHS*
Employees at 9AM -10 AM	9.0	>=	5
Employees at 10AM - 11 AM	10.0	>=	8
Employees at 11 AM - 12 PM	10.0	>=	10
Employees at 12PM - 1 PM	10.0	>=	10
Employees 1PM - 2 PM	10.0	>=	10
Employees at 2PM - 3 PM	16.0	>=	10
Employees at 3PM - 4 PM	8.0	>=	8
Employees at 4PM - 5 PM	9.0	>=	8
Employees at 5PM - 6 PM	10.0	>=	6
Employees at 6PM - 7 PM	11.0	>=	10
Employees at 7PM - 8 PM	10.0	>=	10
Employees at 8PM - 9 PM	10.0	>=	10
Maximum no of busser 9 AM - 12 PM	3.0	<=	3
Maximum no of busser 12 PM - 3 PM	3.0	<=	3
Maximum no of busser 3 PM - 6 PM	2.0	<=	3
Maximum no of busser 6 PM - 9 PM	3.0	<=	3
Minimum no of servers 9 AM - 1 PM	4.0	>=	4
Minimum no of servers 1 PM - 5 PM	4.0	>=	4
Minimum no of servers 5 PM - 9 PM	5.0	>=	4
Minimum no of managers starting 10 AM	1.0	>=	1
Minimum no of chefs 9 AM - 3 PM	2.0	>=	2
Minimum no of chefs 3 PM - 9 PM	2.0	>=	2

Figure 2 shows us the optimal solution that meets all constraints with a daily cost of **$3,520.00**.

Running the model using Simplex Linear Programming in Solver generated a favorable and distinct outcome. **Table 6** shows the optimized values of the decision variables.

Table 6

Decision Variables	Number of workers according to the optimal solution
S9	4
S1	4
S5	5
M10	1
B9	3
B12	3
B3	2
B6	3
C9	2
C3	2

Sensitivity Analysis

One Way Analysis

Using solver table for the integer programming model, we study how the optimal daily cost function and the number of employees starting at each hour from 9am to 9pm vary, with changes in the number of employees starting at 9am. The chart is shown below **(Figure 3):**

Figure 3

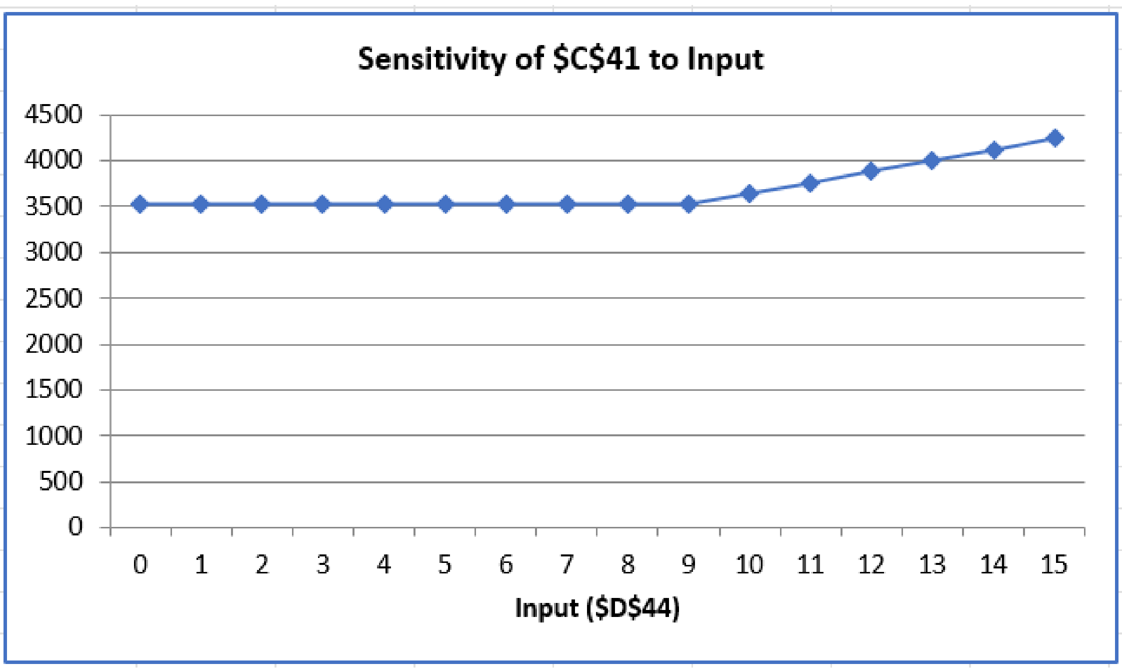
Oneway analysis for Solver model in Question2 worksheet

Input (cell D44) values along side, output cell(s) along top

	C41	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	Data for chart C41
0	3,520.00	1.00	2.00	2.00	4.00	4.00	5.00	3.00	3.00	2.00	3.00	3520
1	3,520.00	1.00	2.00	2.00	4.00	4.00	5.00	3.00	3.00	2.00	3.00	3520
2	3,520.00	1.00	2.00	2.00	4.00	4.00	5.00	3.00	3.00	2.00	3.00	3520
3	3,520.00	1.00	2.00	2.00	4.00	4.00	5.00	3.00	3.00	2.00	3.00	3520
4	3,520.00	1.00	2.00	2.00	4.00	4.00	5.00	3.00	3.00	2.00	3.00	3520
5	3,520.00	1.00	2.00	2.00	4.00	4.00	5.00	3.00	3.00	2.00	3.00	3520
6	3,520.00	1.00	2.00	2.00	4.00	4.00	5.00	3.00	3.00	2.00	3.00	3520
7	3,520.00	1.00	2.00	2.00	4.00	4.00	5.00	3.00	3.00	2.00	3.00	3520
8	3,520.00	1.00	2.00	2.00	4.00	4.00	5.00	3.00	3.00	2.00	3.00	3520
9	3,520.00	1.00	2.00	2.00	4.00	4.00	5.00	3.00	3.00	2.00	3.00	3520
10	3,640.00	1.00	2.00	2.00	5.00	5.00	5.00	3.00	2.00	1.00	3.00	3640
11	3,760.00	1.00	2.00	2.00	6.00	6.00	5.00	3.00	1.00	0.00	3.00	3760
12	3,880.00	1.00	2.00	2.00	7.00	6.00	5.00	3.00	1.00	0.00	3.00	3880
13	4,000.00	1.00	2.00	2.00	8.00	6.00	5.00	3.00	1.00	0.00	3.00	4000
14	4,120.00	1.00	2.00	2.00	9.00	6.00	5.00	3.00	1.00	0.00	3.00	4120
15	4,240.00	1.00	2.00	2.00	10.00	6.00	5.00	3.00	1.00	0.00	3.00	4240

Following line graph represents this table:

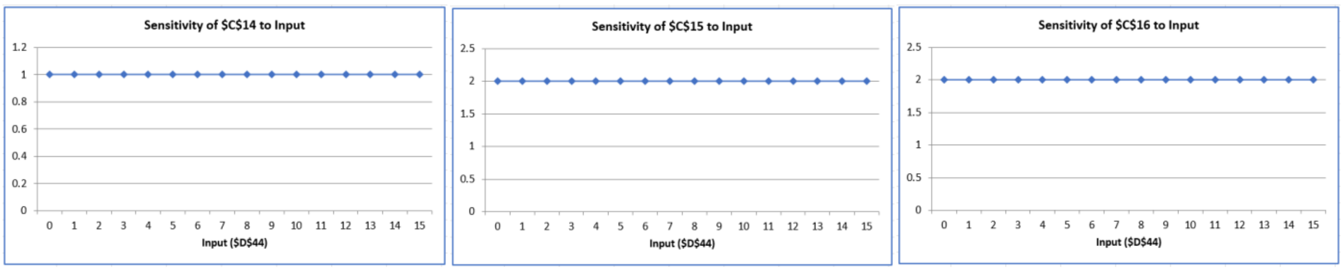
Figure 4



From the chart and graph we can see that objective function (minimum daily cost) is insensitive till number of employees are 9. After that daily cost goes up with every unit increase in number of employees. The line graph below confirms this behavior of the objective function:

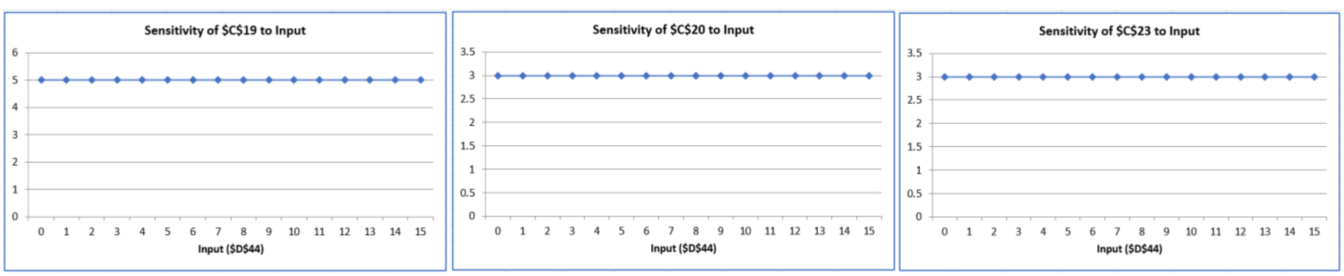
Similarly, we tried to find out the sensitivity of other variables based on the chart and the graph in the Excel sheet. By doing so, we observed that cells C14, C15, and C16 that represent Manager, and two Chef (we call them C9 and C3) are insensitive.

Figure 5



The same is observed with cells C19, C20, and C23 representing Server starting at 5 pm (we call them S5), Busser starting at 9 am (B9) and Busser starting at 6 pm (B6) respectively.

Figure 6

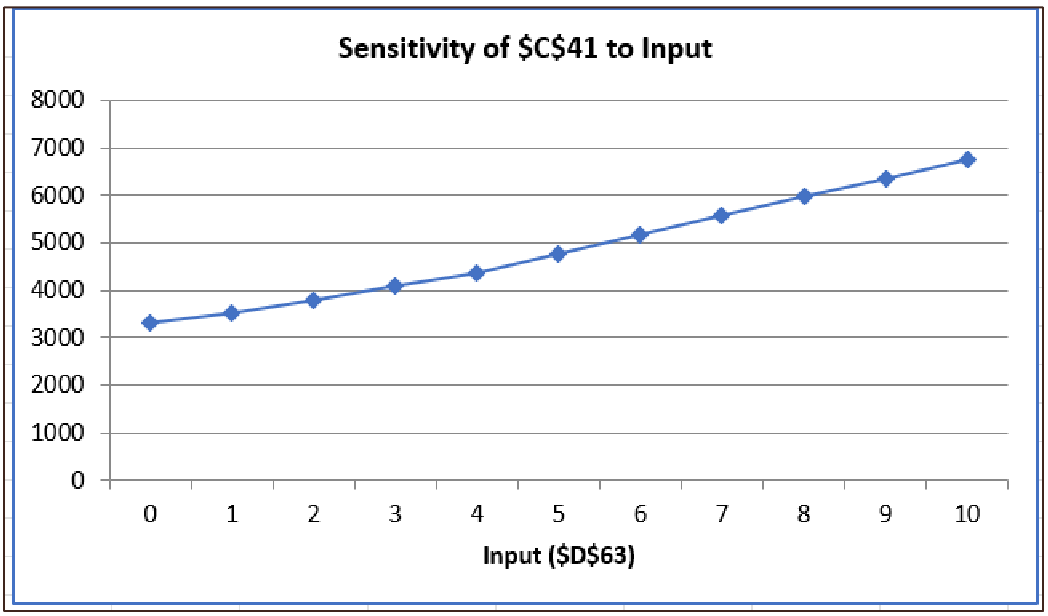


Additionally, we also studied the one-way sensitivity for the number of managers how the optimal daily cost function and the number of employees starting at each hour from 9am to 9pm vary, with changes in the number of employees starting at 9am. The chart and the graph are shown below:

Figure 7

	Oneway analysis for Solver model in Question2 worksheet											
	Input (cell D63) values along side, output cell(s) along top											Data for chart
	C41	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C41
0	3,300.00	0.00	2.00	2.00	5.00	5.00	5.00	3.00	3.00	1.00	3.00	3300
1	3,520.00	1.00	2.00	2.00	4.00	4.00	5.00	3.00	3.00	2.00	3.00	3520
2	3,800.00	2.00	2.00	2.00	4.00	4.00	5.00	2.00	2.00	2.00	3.00	3800
3	4,080.00	3.00	2.00	2.00	4.00	4.00	5.00	1.00	1.00	2.00	3.00	4080
4	4,360.00	4.00	2.00	2.00	4.00	4.00	5.00	0.00	0.00	2.00	3.00	4360
5	4,760.00	5.00	2.00	2.00	4.00	4.00	5.00	0.00	0.00	2.00	3.00	4760
6	5,160.00	6.00	2.00	2.00	4.00	4.00	5.00	0.00	0.00	2.00	3.00	5160
7	5,560.00	7.00	2.00	2.00	4.00	4.00	5.00	0.00	0.00	2.00	3.00	5560
8	5,960.00	8.00	2.00	2.00	4.00	4.00	5.00	0.00	0.00	2.00	3.00	5960
9	6,360.00	9.00	2.00	2.00	4.00	4.00	5.00	0.00	0.00	2.00	3.00	6360
10	6,760.00	10.00	2.00	2.00	4.00	4.00	5.00	0.00	0.00	2.00	3.00	6760

Figure 8



From the graph and the chart, we can see that with every unit increase in number of managers (D63), daily cost will increase.

Numbers of bussers starting 9AM (C_{20}) and 12PM (C_{21}) will go down till number of managers are 3 and then will become 0.

Conclusion

For the given workday shift starting for 9 am to 9 pm and with four categories of employees working in the Local Pizza Hut being Servers, Bussers, Chefs and Managers, along with the given constraints stated in Table 5, we acquired an optimal solution using Excel with Solver which is a schedule of all the employees satisfying all the constraints, limitations, requirements and laws for Pizza Hut to have smooth business operations running throughout the week.

The optimal daily cost is $3520, after scheduling with an efficient scheduled derived in the Excel file submitted along with this Project report. The schedule based on the optimal solution suggests:

- Pizza Hut should schedule 29 employees in total, in varied shifts throughout their workday of 9:00 am to 9:00 pm
- 1 Manager starts working at 10:00 am and their shift ends at 7:00 pm completing their 8-hour shift.
- 2 Chefs start at 9:00 am, other 2 start at 3:00 pm and each Chef completes a 6-hour shift at work
- 13 Servers work through the day, 4 of which start at 9:00 am, other 4 start at 1:00 pm and remaining 5 start working at 5:00 pm, each of them completing their 4-hour shift.
- 11 Bussers, each working 3-hour long shift where 3 bussers start at 9:00 am, 3 start at 12:00 pm, 2 start at 3:00 pm and remaining 3 start at 6:00 pm

In conclusion, improving daily staffing can significantly affect Pizza Hut's success, as well as its productivity, efficiency, and profitability. Businesses may make sure they have the proper people in place to satisfy consumer demand, can minimize overstaffing, can maximize efficiency, and can sustain high levels of productivity by carefully monitoring workload and staffing needs.