NATIONAL UNIVERSITY *of* SINGAPORE

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IE 4290

Introduction to Operations Research

Project Report

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April 5th, 2002

Background

Opened on 31st December 1999, The Cheesecake Cafe was featured on various magazines and TV programs for its relaxed, homelike ambience. Four partners own the establishment.

The setup of the operation is simple and quite informal with little rules. Besides the 4 partners, a pool of 5 part-time waiters run the café and pub most of the time. The second floor is the café, serving popular Italian dishes with an array of drinks and desserts. The décor is nostalgic with many of the two-seater tables remodeled from old-fashioned sewing machines.

The Cheesecake Cafe faces competition from other restaurant/nightspots like The Travel Café and Coffee Express who each have their own unique selling points and who are all within a short walking distance from The Cheesecake Cafe. The Management has to ensure that they schedule their staff such that service is always smoothly delivered in order to stay competitive.

Focus of Project

The opening hours of The Cheesecake Café are as follows:

Operating hours:	Tuesdays – Fridays	3pm – 11pm
	Saturdays/Sundays/Public Holidays	3pm – 1am
	Mondays	Closed

The Cheesecake Cafe has responded with several problems that they have encountered during their 2-year operation of the café. Our group will focus on the scheduling problem of the waiters and the managers to run the café each day. This case report serves as a reference for the Management in their decision-making process.

Problem Description

As a newly established café cum pub in the food & beverage industry, The Cheesecake Cafe emphasizes a lot on providing good service. This is all the more important especially when it is situated in central Singapore where constant, intense competition is faced by The Cheesecake Cafe from its nearby, more well-established entertainment spots. Hence, a good scheduling plan for its waiters will ensure better coordination and service to its customers.

The problem of having insufficient waiters to serve customers has existed since day one of its operation. Customer feedback has revealed that waiters are not always prompt in getting their orders and food is always served slow. This is especially so during weekends and public holidays. Moreover, The Cheesecake Cafe has no proper scheduling for its pool of part-timers. The current practice is that one of the partners in charge will inform

the particular required waiter to report for work only two days before the scheduled day. This has actually created some inconvenience for both the waiter and the person-in-charge, as there are occasions when the waiter might have other commitments that day and is unable to report for work. If that is the case, the person-in-charge will have to call another waiter to stand in. In times when replacements are not available, the lack of waiters will lead to a decreased quality of service, with an increased waiting time and lower customer satisfaction.

In order to solve the above problems, a plan is devised where the determination of the right number of waiters required per day and the scheduling of the waiters and managers can be done one week in advance.

Methodology

For the scheduling problem of waiters, the LP model to get optimal solutions to minimize labor cost will be used. In addition, the scheduling of the managers will be done as well by minimizing the total number of days they have to work per week.

The data required includes the number of part-timers, their wage rate per hour for weekdays, weekends and public holidays, the availability of the part-timers and the managers and the average forecasted data on the customer flow based on past records. The individual wage rates for the part-timers in accordance to their length of service and experience are shown in the table below.

	Wage Rate (per hour)		
Worker	**Weekday**	**Weekend**	**Public Holiday**
1	$6.50	$10.00	$13.00
2	$7.00	$11.00	$14.00
3	$7.50	$11.00	$15.00
4	$7.00	$11.00	$14.00
5	$6.50	$10.00	$13.00

In the formulation of the LP model, T1 is the first shift of Tuesday, T2 the second shift of Tuesday, W1 the first shift of Wednesday and so on.

Let the number of weekday shifts worker m has to perform be x_m.
Let the number of weekend shifts worker m has to perform be y_m.
Let the number of public holiday shifts worker m has to perform be p_m.
Let the number of days manager m has to work be a_m.

Each weekday's shift is 4 hours long and each weekend/public holiday shift is 5 hours long. (Refer to Table 1).

The objective function for the scheduling of workers will be such that

Minimize z = $(6.50 \times 4) x_1 + (10 \times 5) y_1 + (13 \times 5) p_1 +$
$(7.00 \times 4) x_2 + (11 \times 5) y_2 + (14 \times 5) p_2 +$
$(7.50 \times 4) x_3 + (11 \times 5) y_3 + (15 \times 5) p_3 +$
$(7.00 \times 4) x_4 + (11 \times 5) y_4 + (14 \times 5) p_4 +$
$(6.50 \times 4) x_5 + (10 \times 5) y_5 + (13 \times 5) p_5$

The objective function for the scheduling of managers will be such that

Minimize $z = a_1 + a_2 + a_3 + a_4$

Constraints

(1) At the end of every week, the waiters will be required to indicate the shifts they are available for work in the following week. There is flexibility involved in that they do not have to make themselves available on every single shift. This is to be done on a first-come-first-serve basis and that at least 4 waiters have to be available on every shift though they may not be assigned to work duties. (Refer to Table 7).

(2) Every worker must work for at least 4 shifts a week but not more than 6 shifts in a week. This is to ensure that there is fair scheduling for the part-timers so that there will be no occurrence that a particular worker has to work exceptionally more shifts than others. (Refer to Table 4).

Similarly for the managers, they will also have to indicate the days they are free but each manager is required to work for a minimum of two days per week. (Refer to Table 8).

For the workers,
$4 \le x_1 + y_1 + p_1 \le 6$ $4 \le x_2 + y_2 + p_2 \le 6$ $4 \le x_3 + y_3 + p_3 \le 6$
$4 \le x_4 + y_4 + p_4 \le 6$ $4 \le x_5 + y_5 + p_5 \le 6$

$x_m, y_m, p_m \ge 0$

For the managers,
$a_1 \ge 2, a_2 \ge 2, a_3 \ge 2, a_4 \ge 2$

$a_m \ge 0$

(3) To estimate the number of waiters required per day per shift, the number of customers per day have to be determined. It can be done by performing a forecast based on past data. The resulting forecasted number of customers per day will be divided into 2 shifts; 30% for the first shift and 70% for the second. With this, the average number of customers per shift will be obtained. The average number is then divided by the number

of hours in the shift because it is assumed that the customers come and dine in for an average of 1 hour. Therefore the resulting figure will give an estimate of the average number of customers dining in the cafe which has a maximum seating capacity of 50. This figure will be divided with the number of customers to be served by one waiter i.e. the waiter to customer ratio; the resulting figure will be the required number of waiters per shift. The same method is applied to determine the number of managers required per day. (Refer to Table 9).

For the workers,

$x_1 + x_2 + x_3 + x_4 + x_5 + y_1 + y_2 + y_3 + y_4 + y_5 + p_1 + p_2 + p_3 + p_4 + p_5 \geq 30$

For the managers,

$a_1 + a_2 + a_3 + a_4 \geq 9$

Coming back to the LP model, the objective function will be to minimize the total payroll costs for the part-timers. The payroll cost for each part-timer is calculated by multiplying the number of hours worked in the shifts (Table 5) with the wage rate per hour for the shifts. The total payroll is the sum of all part-timers' pay each week. (Refer to Table 6).

On the other hand, there is a different objective function for the scheduling of the managers. For them, it will be to minimize the number of days they have to be on duty so as to give everyone the most off days as possible. (Refer to Table 3).

After developing the spreadsheet, Solver is then activated to provide an optimal solution for the waiters' scheduling, bearing in mind that the assumptions of linearity and non-negativity hold. The optimal results will be displayed in Table 4 whereby '1' means that the waiter is required to work and '0' means otherwise.

Solver is also activated to provide an optimal solution for managers' scheduling, again bearing in mind the assumptions of linearity and non-negativity. The optimal results will be displayed in Table 3 whereby '1' means the manager is required to work that day for both shifts and '0' means no work for that day.

Assumptions

(1) To ensure high level of service, it will be ideal if 1 waiter is available to serve 10 customers. As for the scheduling of the managers, since they will not be directly serving the customers, a ratio of 1 manager to 25 customers will be sufficient. During public holidays, the number of customers will be much higher than usual. The Cheesecake Café's managers estimated that the number of customers coming in on a public holiday is about 20% more than usual. Therefore, it shall be assumed that the percentage increment to be 20%. As the total seating capacity of The Cheesecake Cafe is never constant (due to al fresco seating) and that the main service area is the dining floor, the spreadsheet is designed to cope with the situation on the dining floor. The spreadsheet will give an overestimate of the staff needed if demand exceeds 50 per hour. (Refer to Table 9).

(2) The operating hours have been conveniently divided into 2 equal shifts. There will be 4 hours per shift for the weekdays and 5 hours per shift for the weekends and public holidays to facilitate easier calculation.

(3) The Cheesecake Cafe is usually busier at the later part of the operating hours, which is from 7 pm onwards. Therefore, it is assumed that the number of customers to be served in the first shift will be 30% of the total number of customers for the day while the remaining 70% will be served in the second shift.

Evaluation

The solution on the scheduling of the part-timers and the managers has to be determined by using Solver separately due to different constraints and objective functions involved in each case. Indeed, a feasible solution with all the constraints satisfied can be obtained. All part-timers except one will have to work 6 shifts per week. The other part-timer works only 5 shifts. This happens probably because his wage rate per hour of $7.50 is the highest among all. Since the objective function of this scheduling is to minimize total payroll cost, he will most likely not be scheduled to work. This result comes as no surprise at all.

The forecasted average number of customers per day varies each week based on the previous year's data. Using past data, the forecasted number of customers for each day of the following week is reflected below.

Days of Week	Forecasted no. of customers
Tues	116
Wed	136
Thu	106
Fri	248
Sat	214
Sun	228

In cases where the forecasted number of customers per shift rises to more than 40, the number of waiters required will be 5. This implies that all part-timers have to be available. What happens if there are only 4 part-timers available for that shift? The LP solution will be infeasible since it is not a balanced model. Therefore to rectify this problem, a “Dummy” variable is added to account for the shortage of waiter only. In order to ensure that, an exceptionally high wage rate per hour is allocated to it and that it will be available for work on all shifts.

Conclusion

Scheduling of workers and managers using the Excel can result in cost and time savings for The Cheesecake Cafe. Every aspect of the scheduling can be taken care of and solution is provided within a few clicks on the mouse. No doubts that there are many benefits in using the LP model, there are still some areas that The Cheesecake Cafe has to take note of. The highest paid part-timer will tend to work lesser hours than the others and there is also the problem of having to find a replacement to satisfy the shortage of part-timers.

~ The End ~