IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

DATA ANALYTICS FOR RESHAPING THE RESTAURANT INDUSTRY

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Abstract: Restaurants generate massive amounts of data, which, when utilized properly, may be a treasure trove for a restaurant's success. The next question is what technologies restaurants can use to collect and organize this data so that it can be examined and used to make decisions. Apart from the obvious choices of Python, R, Excel, and Tableau. We saw that numerous approaches and algorithms are used to efficiently solve problems in the field of computer science; we speculated that these techniques and algorithms could be utilized to solve problems in a different field, such as the restaurant industry. Although restaurant data analytics aren't a miracle solution for increasing sales overnight, they can help. Making a lucrative business decision can also be done using a variety of strategies and algorithms.

Index Terms **- Restaurant data analysis, Caching, Pre-emptive SJF, Resource Allocation Graph.**

I. INTRODUCTION

The restaurant business is one of the most competitive industry on the planet. Not only do we need to eat and drink to survive as a species, but people have loved the communal meal experience. Because we enjoy dining out on special events, weekends, and whenever we can, restaurants in villages, towns, and cities all over the world are in high demand. With such growing demands comes a high level of saturation, which means that keeping ahead of the competition is vital if you want to prosper – or perhaps even survive – in the restaurant business.[1] For today's digital world, every piece of data - from wait time to staff performance and menu optimization – could be collected, structured, and presented in a manner that enables a restaurant to evolve and improve on a continuous basis. Restaurant data analysis is the concept of using business intelligence software to determine all of the data related to the restaurant industry and converting it into actionable information that will lead to greater efficiency. Although restaurant data analytics are just not a magic pill that can miraculously increase your sales, they may provide you with detailed and actionable insights that will assist you in making critical business decisions. [2]

II. METHODOLOGY

For analyzing current customer trends and their transactions in the restaurant business and prescribe tips based on the various computer science techniques and algorithms. The steps include:

A) Data Collected: A bunch of data was collected from restaurant, for analysis purpose, which includes columns like Table Number, Number of Males, Number of Females, Total Members, day, Payment Mode, Group Type, and Ordered Items.

B) Processing of Data: After Data collection we prepared the data, where raw data is cleaned up and organized for the following stage of data processing. And finally, we processed above data for interpretation. To find out correct answers related to proposed project.

C) Experimental work Conducted: It is currently time to evaluate the data that has been collected. Information gathering is the first step in analyzing the data; here, we look for patterns, traits, and areas of interest in our data. The next process is data visualization, which is the graphical depiction of data. Visualization tools make it easy to examine and analyze trends, anomalies, and relationships in the data by employing visual elements like charts, graphs, and maps. Here Python, tableau, MS excel were used for data analytics, machine learning, and even design.

III. COMPUTING TECHNIQUES MIRRORING REAL-LIFE INSTANCES

1. COMPUTING TECHNIQUE 1 (REQUEST-RESPONSE MODEL):

Request – Response is a method which can be visualized as this:

Let the waiter 'W' be Servers, customers 'C' be Clients and processing 'P' be chefs.

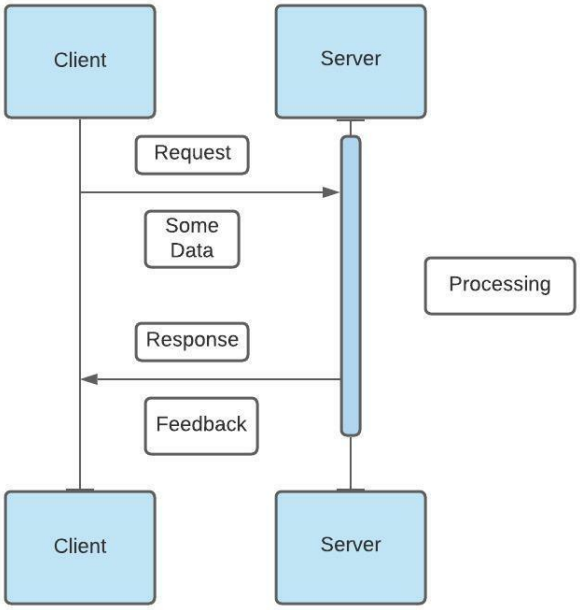


Figure 1: Resquest-Response Model

The client or customer (C) is the requester while the server or waiters (W) are the provider of service which is processed by the chef (P). The request (order) processing is performed by the restaurant chefs, and the results are delivered to the clients in most client-server environments, which is done to increase the rate of performance.

As show in the above Figure 1, when C enters the restaurant, they request (order) items to be delivered by W. W receives the request (order) and passes on to the P(chef). P then prepares the response(order) and gives it to W. W in turn delivers it to C.

Benefits of Request Response model

• It divides the request's processing into many phases.
• It facilitates resource sharing between clients and servers.
• By storing data on each server rather than the client, it lowers data replication [4].

2. COMPUTING TECHNIQUE 2 (PROPERTY OF ABSTRACTION):

Data abstraction is one amongst the foremost essential and necessary feature of object homeward programming in C++. Abstraction suggests that displaying solely essential data and concealment the main points. Knowledge abstraction refers to providing solely essential data regarding the info to the surface world, concealment the background details or implementation.[5]

Abstraction can be visualized in this way:

The menu card simply shows the most crucial ingredients of each food item, obfuscating any superfluous information that can confuse customers. This allows clients to make a semi-confident judgement about what they would like to eat, albeit imperfectly. Abstraction is the process of concealing superfluous features and complications concerning items.

It doesn't care how it's created, what ingredients it's made with, or how long it's been fried for. We can argue, in computer science terms, that unneeded complexity is abstracted away, leaving just relevant features exposed.

3. COMPUTING TECHNIQUE 3 (PROPERTY OF INHERITANCE):

The basic method through which a derived class can inherit the properties of a base class is inheritance. The behavior of the base class is passed down to the derived class. Inheritance ensures that code can be reused. Classes can inherit commonly used state and behavior from other classes thanks to object-oriented programming. The technique by which a class A can inherit properties from a class B is known as inheritance. "A inherits from B," we say. The class B is referred to as the Base class and the class A is called the Derived class or Subclass. A hierarchy is formed by the inheritance of relationships between objects or classes. [6]

Table No. 1: List of different Pastas

Pastas
Pasta A
Pasta B
Pasta C
Pasta D

Table No. 2: List of different Milkshakes

Milkshakes
Milkshake A
Milkshake B
Milkshake C
Milkshake D

Referring the above tables-
So, it wouldn't be wrong to say that here the Base Classes are, as shown in the above Table No. 1 and Table No. 2 :

• Pastas
• Milkshakes

While the items listed under 'Pastas' and 'Milkshakes' can be considered as Derived Classes. Likewise, we can name the menu of a restaurant with a base class and its child class, so that it will be helpful for the customers to know the menu in an easy way. In the above reference we have the base class as Pastas and its children would be different kinds of pastas available in that restaurant.

IV. PRESCRIBED STRATEGIES

The computer science concepts can be used for improving the efficiency of the restaurant efficiency and also for the betterment of restaurant business:

- Caching
- Pre-emptive SJF
- Resource Allocation Graph

(1) ***Caching***: It can be visualized in this way –
Suppose there are various demographic groups (Groups A, B, C) as shown in the below Table No. 3, whose popular choices are known out of this Items group (Item 1, Item 2……, Item 10) then

Table No. 3: Three different demographic groups

Group A	Group B	Group C
Item 1	Item 3	Item 1
Item 2	Item 5	Item 2
Item 5	Item 4	Item 4

So, the chefs can establish an ad-hoc cache in which these items will be prepared earlier than any other items (which aren't included in the group of popular choices of any demographic group.)

Advantages of Caching:

1. Improves performance. [7]
2. Reduces latency. [7]

(2) ***Pre-emptive SJF***: It can be applied and visualized in different cases as shown below, based on Table No. 4:

Table No. 4: Pre-emptive SJF

Process Queue	Burst Time	Arrival Time
P1(Dish 1)	12	4
P2(Dish 2)	4	10
P3(Dish 3)	16	2
P4(Dish 4)	6	0
P5(Dish 5)	8	8

(0) At time = 0, P4 orders Dish 4 to the waiter. So, its execution is started.

Case 0:

(1) At time = 2, P3 orders Dish 3to the waiter. Thus, the burst times of orders of P4 and P3 are compared. Since P4 'wins' the comparison with less burst time, its execution continues while P3 is put in queue.

Case 1:

(2) At time = 4, P1 orders Dish 1 to the waiter. Thus, the burst times of orders of P4, P3 and P1 are compared. Again, P4 is confirmed to have the least burst time. So its execution is resumed while P1 is kept in the waiting queue.

Case 2:

(3) At time = 6, P4's order of Dish 4 is delivered. When the burst times of orders of P1 and P3 are compared, P1 is found to have lesser burst time compared with the latter. Hence its execution starts.

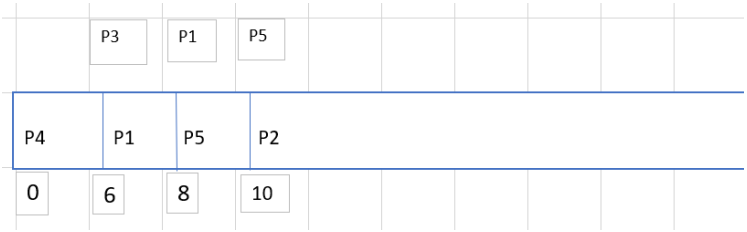
Case 3:

(4) At time = 8, P5 orders Dish 5. Hence the burst times of orders of P1, P3 and P5 are compared. It turns out that P5 'wins' this comparison hence the P1's preparation is stopped(pre-empted) and P5's order is executed.

Case 4:

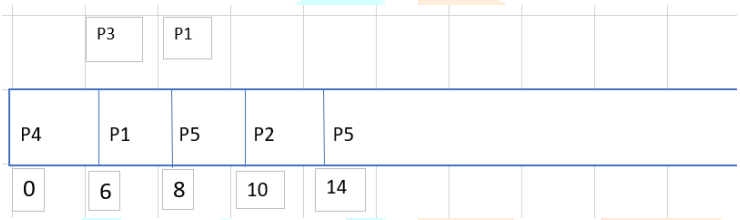
(5) At time = 10, P2 orders Dish 2. Now the burst times of orders of P5, P2, P1, P3 are compared. P2 has the least burst time amongst the other orders. Hence P5 is stored in queue and order of P2 is executed.

Case 5:



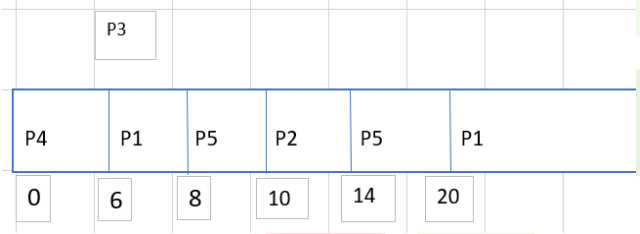
(6) At time = 14, P2's order of Dish 2 is ready and delivered. Subsequently, the burst times of P1, P3 and P5 are compared. Upon checking, its seen that P5 has least burst time. Hence its execution is resumed.

Case 6:



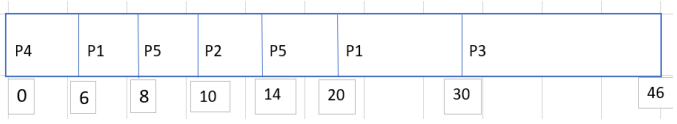
(7) At time = 20, P5's order of Dish 5 is delivered. Afterwards, the burst times of orders of P1 and P3 are compared. We get P1 as the victor after checking the burst times of the remaining two orders. So, the execution of order of P1 is resumed.

Case 7:



(8) At time = 30, P1's order of Dish 1 is delivered. As order of P3 is the only remaining order, its executed in an uninterrupted manner. At time = 46, P3's order of Dish 3 is completed.

Case 8:



Waiting Times for the Processes:
P4 = 6 – 6 =0
P1 = 30 – (12 + 4) = 14
P5 = 20 – (8 + 8) = 4
P2 = 14 – (4 + 10) = 0
P3 = 46 – (16 + 2) = 28

Hence,
Average Waiting Time = (0 + 14 + 4 + 0 + 28)/5 = **9.2**

Advantages of SJF:

(1) When compared to the FIFO (First in First Out) method, it reduces the average waiting time. [8]

(2) A burst time estimate can be derived from the work description for the batch method of long-term scheduling.[8]

(3) ***Resource Allocation Graph*****:** It can be visualized as:

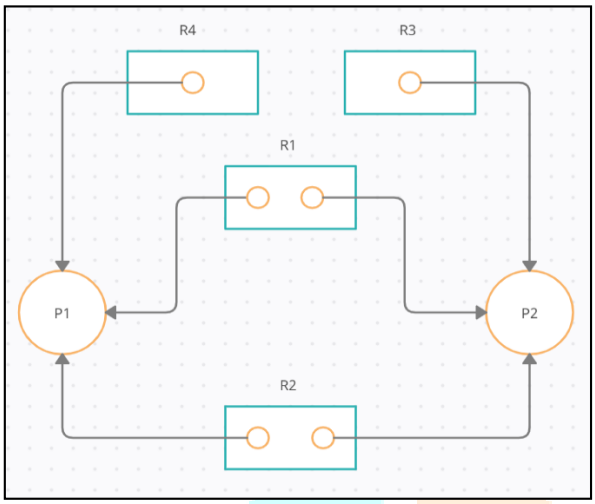


Figure 2: Resourse Allocation Graph

Let us assume that P1 and P2 are two chefs working in a restaurant and these are the following resources which are utilized as ingredients to prepare various dishes:

- R1 – Ingredient 1 (Multiple Instances)
- R2 – Ingredient 2 (Multiple Instances)
- R3 – Ingredient 3 (Single Instance)
- R4 – Ingredient 4 (Single instance)

As shown in Figure 2, we will assume that P1 has been entrusted with the order of Dish 1 whereas P2 has to prepare the order of Dish 2 (Assuming that these dishes can be prepared from these four ingredients for simplicity purposes)

If we observe the resource allocation graph, then we can note the following things:

R4
R1 — one or more instances have been held by P1
R2

Similarly,

R3
R1 — one or more instances have been held by P2
R2

If we construct a request and allocation matrix, then this is obtained:

Processes	Allocation				Request			
	R1	R2	R3	R4	R1	R2	R3	R4
P1	1	1	0	1	0	0	0	0
P2	1	1	1	0	0	0	0	0

Table No. 5: Resource allocation graph

As we can observe that neither P1 nor P2 have requested for any resource. They sometimes require the same resources (R1 and R2), but multiple instances of those resources are available. There is no cycle formed in the graph either. Hence this is a no deadlock situation, and the activities can occur smoothly.

Advantages of Resource Allocation Graph:

- It helps us understand the resource allocation easily via the Resource Allocation Graph. [9]
- Resource Allocation Graph helps us to understand the following main things:[9]

(1) Which resource is required by the process? [9]
(2) How many resources are required by the process? [9]
(3) How many resources are available at the moment? [9]

V. RESULTS AND DISCUSSION

Data analytics is gaining traction thanks to the abundance of data available across restaurant systems. For a restaurant who wants to provide a better experience for his guests while also making a profit, investing in the correct tool is essential. Restaurant data analytics would eventually push his business in the right direction.

To summarize, restaurant analytics can use various data points to help restaurants understand and overcome the problem of "empty tables." A deep dive into the data can also assist restaurateurs in identifying their off-peak hours and running special deals and discounts to fill the tables. For example, if a restaurant does not have customers in the evening (between 4-6 p.m.), he can sell snacks such as garlic bread, tea, burgers, and other items, and offer special deals to young customers (age range less than 25). The restaurant owner would be able to draw more clients during off-peak hours this manner.

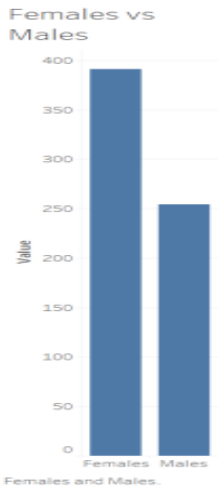


Figure 3: Using Tableau, male v/s female ratio has been determined.

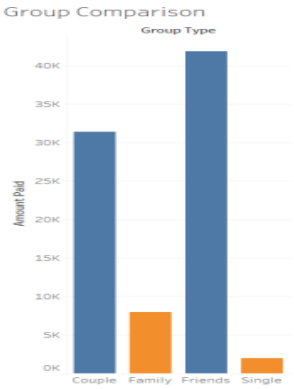


Figure 4: Using Tableau, group wise comparison of the financial collection is depicted.

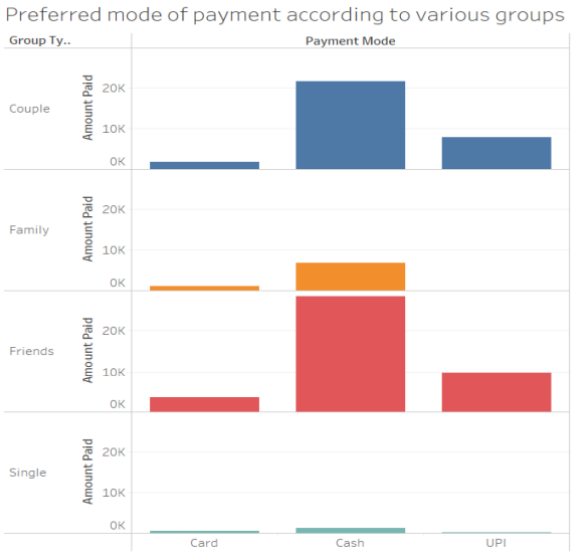


Figure 5: Using Tableau, mode of payment used by customers is compared.

VI. Conclusion & Future Scope

Businesses that take the time to collect and interpret market data have a competitive advantage over their competitors who do not, thanks to today's technology and the insights that come with it. Apart from restaurant statistics, CS approaches and algorithms can help you understand what drives and detracts from your restaurant's profitability. We may improve operations, modify stocks, train personnel, fine-tune menus, and rethink consumer interactions based on these insights.

This was an earnest attempt of visualizing and applying computer science techniques and algorithms for solving various problems pertaining to restaurant industry and for its betterment.

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