

GRAIN

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DSI 39



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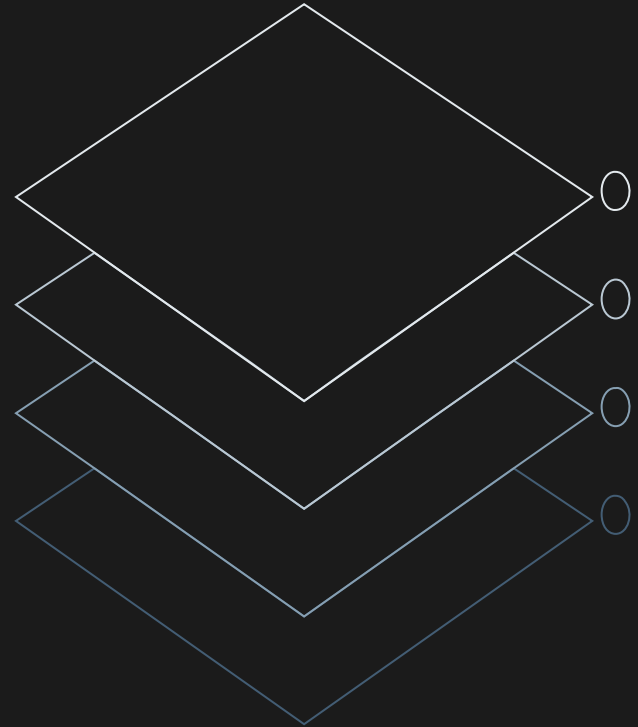
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food catering

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Understanding food catering

01



\$13B

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Size of the F&B market in Singapore



The food catering business is growing post covid

The sales in Singapore's food and beverage (F&B) services sector rose 21.8% year-on-year (YoY) to around \$1b in January 2023, partly due to the celebration of the Chinese New Year by the end of the month.

in place. Food Caterers recorded the largest growth in sales of 135.2%, due mainly to higher demand for both event and in-flight catering with the easing of restrictions on large-

According to [Statista's report on the F&B industry in Singapore](#), the market is expected to generate revenue of S\$13.5bn in 2023, with an annual growth rate of 1.95% (CAGR 2023-2027).

Post covid, the food catering business is recovering and is expected to grow.

Credit

<https://sbr.com.sg/economy/news/fb-sales-218-yoy-in-january>

<https://www.staffany.com/blog/singapore-food-and-beverage-industry/>

<https://www.singstat.gov.sg/-/media/files/news/mrssep2022.ashx#:~:text=Food%20Caterers%20recorded%20the%20largest.scale%20events%20and%20international%20travel>

But there are many challenges

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The competition in this field is immense. The industry has managed to be very competitive and saturated. Like I told you before, the crowd welcomes

Many entrepreneurs have sleepless nights thinking on how to ensure the quality of the food has not been compromised under any circumstances.

One of the biggest challenges faced by businesses in the F&B industry in Singapore is managing costs. Rising costs of raw materials, rent, and labour can put a strain on profitability, especially for small businesses.

Inventory management has always been the biggest challenge and every month the team just tries the best to be more efficient. However, most of this work is done manually. Hence adds up to the investment of time and energy.

With immense competition, food quality and inventory management, it is not easy to survive in this industry.

Credit

<https://rashikadass28.medium.com/5-challenges-faced-by-f-b-industry-in-singapore-1d5c7a5a6d6b>

<https://www.staffany.com/blog/singapore-food-and-beverage-industry/>

Problem Statement

How can we automate some of the processes to save time and energy for Grain?

Given past data, can we forecast demand to efficiently carry out inventory management?

What is the recommended price for customers from different sectors?

Is there a way to automatically assign drivers for deliveries so that only a final check is needed?



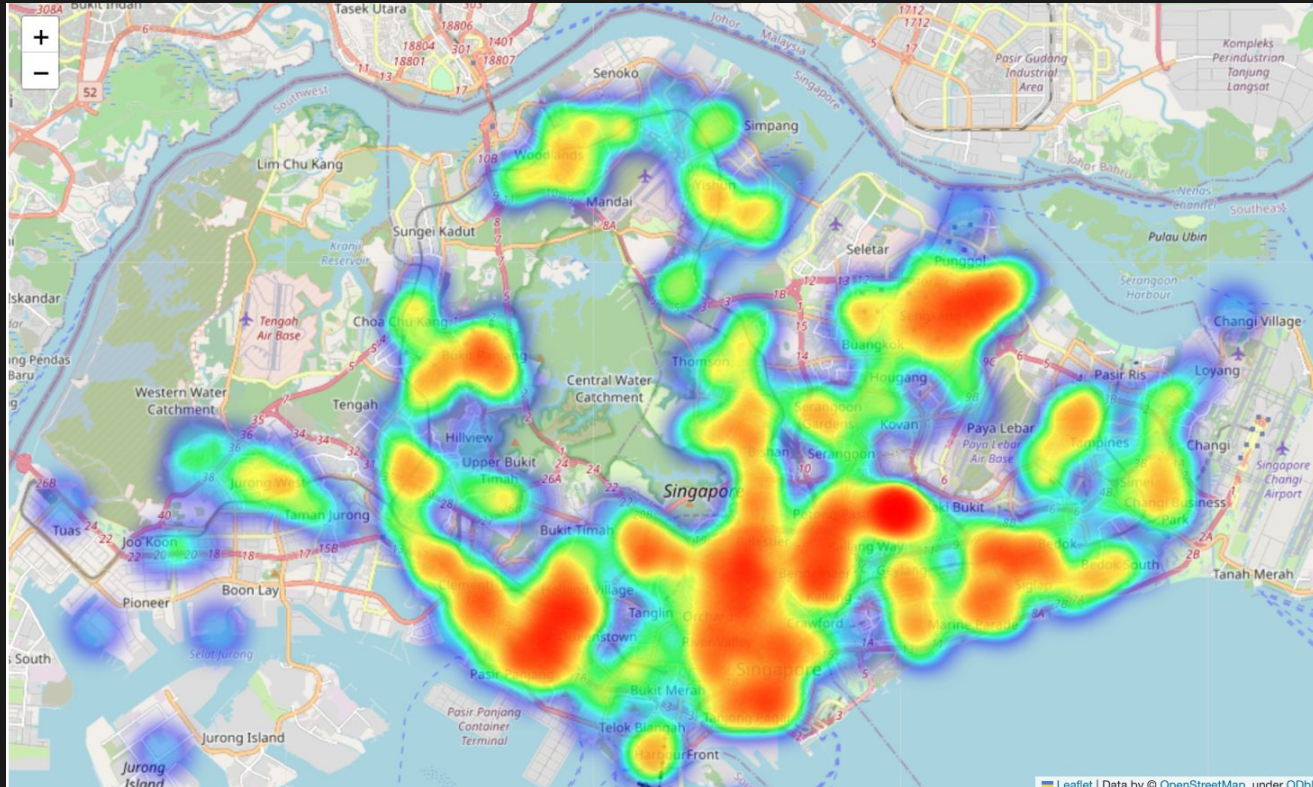


Analysis

02

There are 3 hotspots for deliveries

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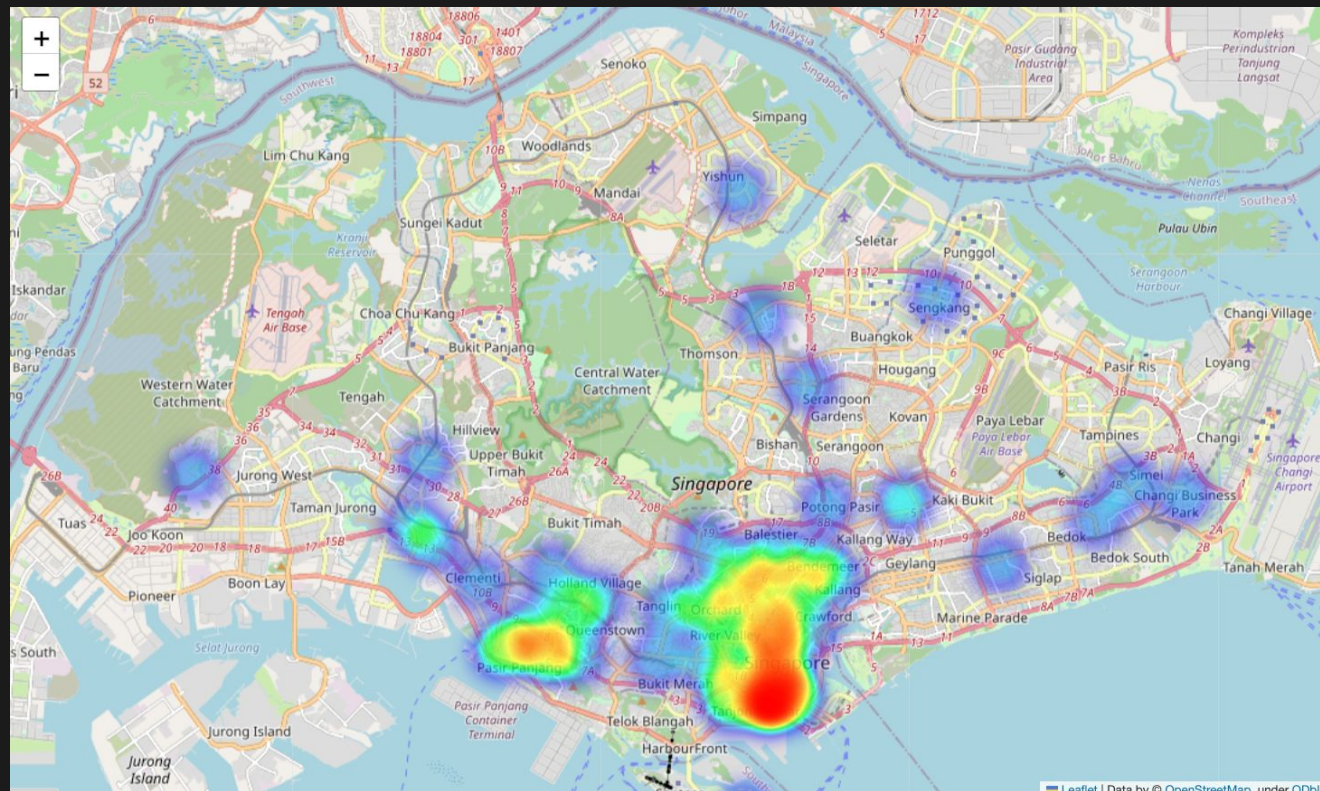


This is the heatmap for the deliveries in the month of December 2022. There seems to be 3 hot spots for deliveries.

1. Central business district (Raffles place mrt)
2. Education district (Kent ridge mrt)
3. Residential district (Sengkang mrt)

Most deliveries go to the central business district

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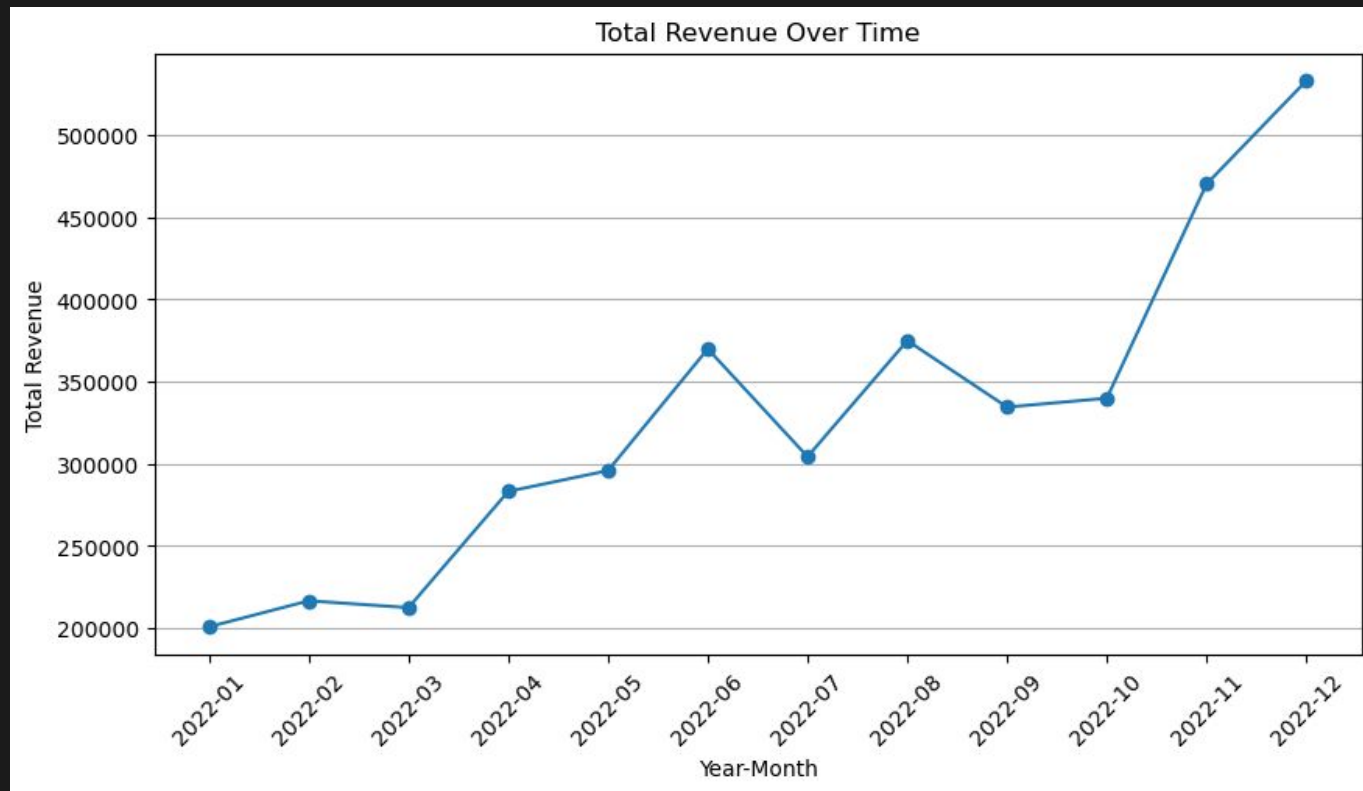


This is the heatmap for the deliveries in the first week of the month of December 2022.

The major hotspot for deliveries is in the central business district.

Revenue has been on the upward trend

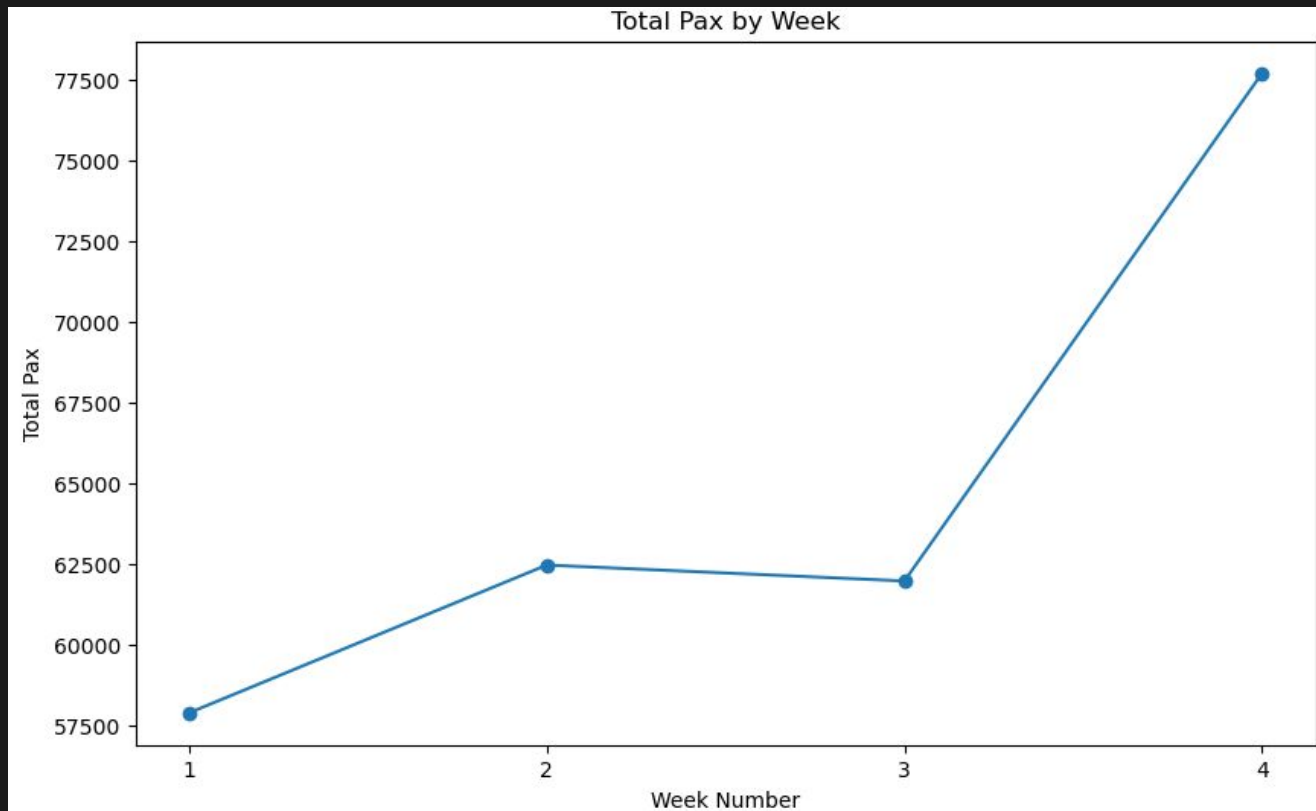
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Across the year of 2022, the revenue has been going up and this is probably due to the easing of government restrictions.

To meet the increase in demand, Grain could hire more people in the later part of the year.

Last week best week

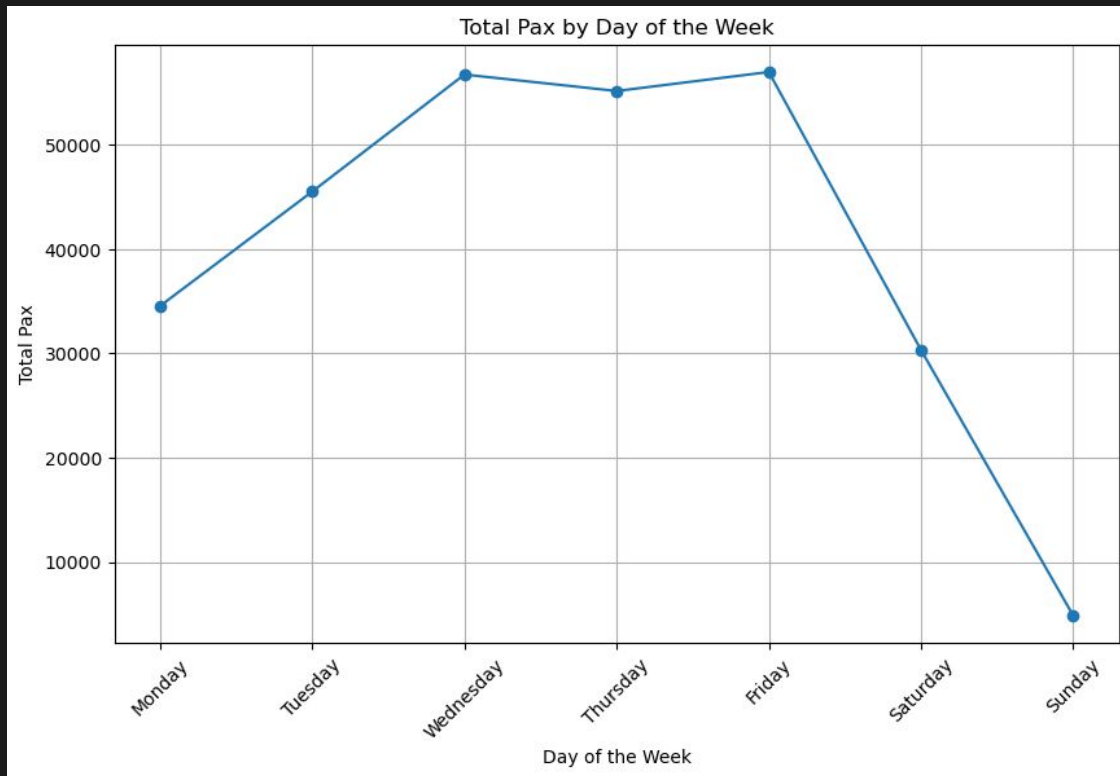


Across the year of 2022, if we were to split each month into 4 weeks, we would see that the last week is about 20% busier than the other weeks.

This could be because companies have hit their KPIs and would celebrate with food.

By allocating more manpower to the last week of the month, Grain would be prepared to handle the larger volume.

Midweek madness



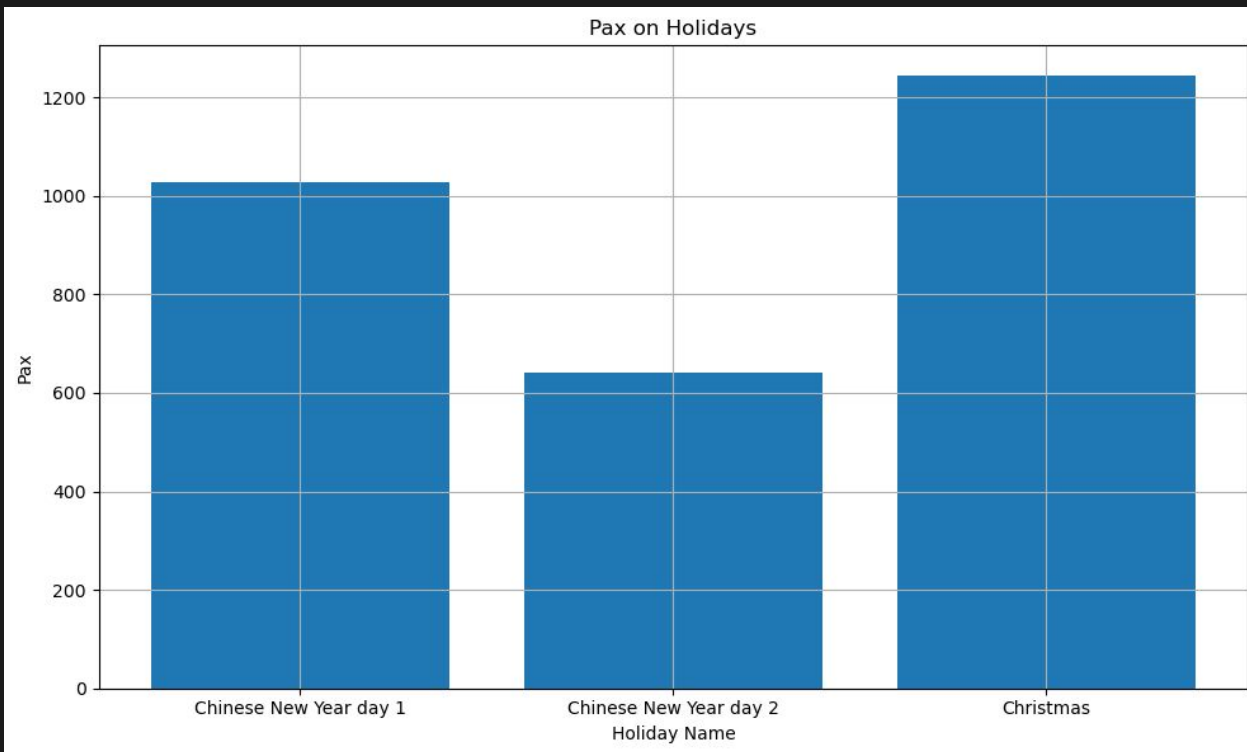
Wednesday, Thursday and Friday are the busiest days of the week on average.

This could be because most people are in the office during those days and is in the later part of the week.

Best dates for your events

- **Wednesdays, Thursdays and Fridays:** The worst of the week is over and a simpler peek the proximity of the weekend. In the professional sector these

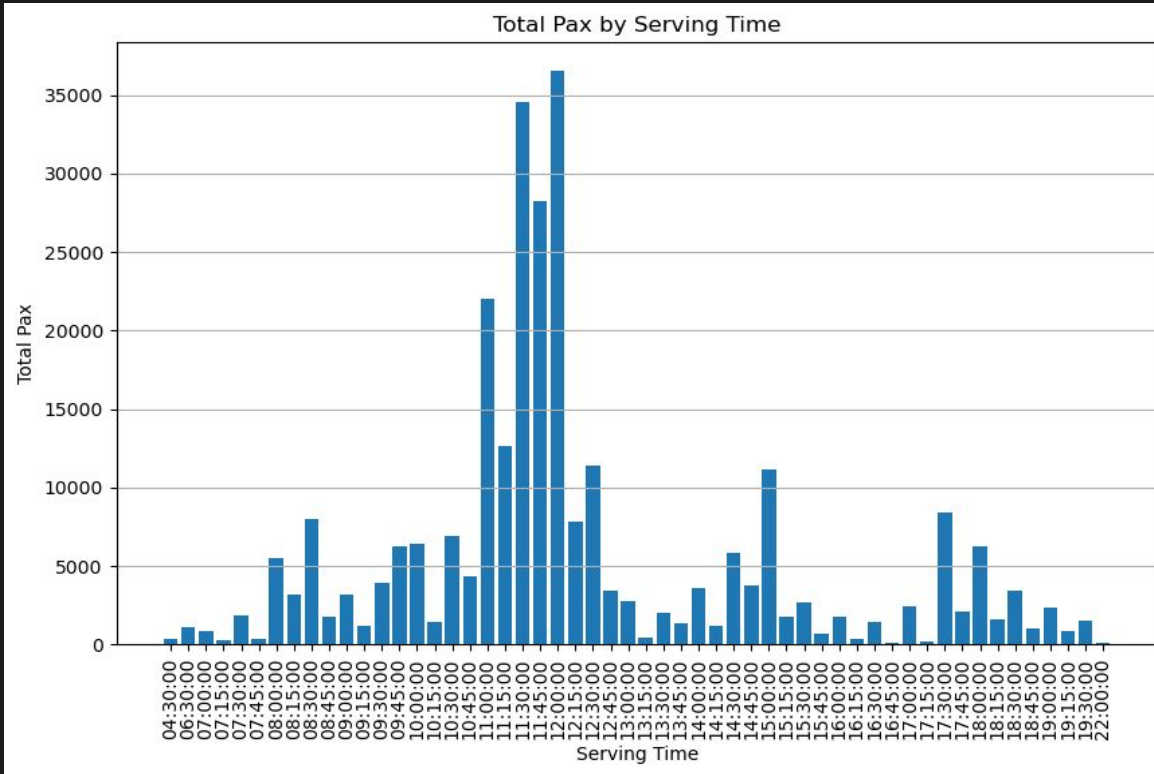
Holiday festivities



Grain is only open on 2 holidays: Chinese New Year and Christmas.

Christmas is the most popular holiday date for catering food on average of 780 pax. That's 1.6 times more!

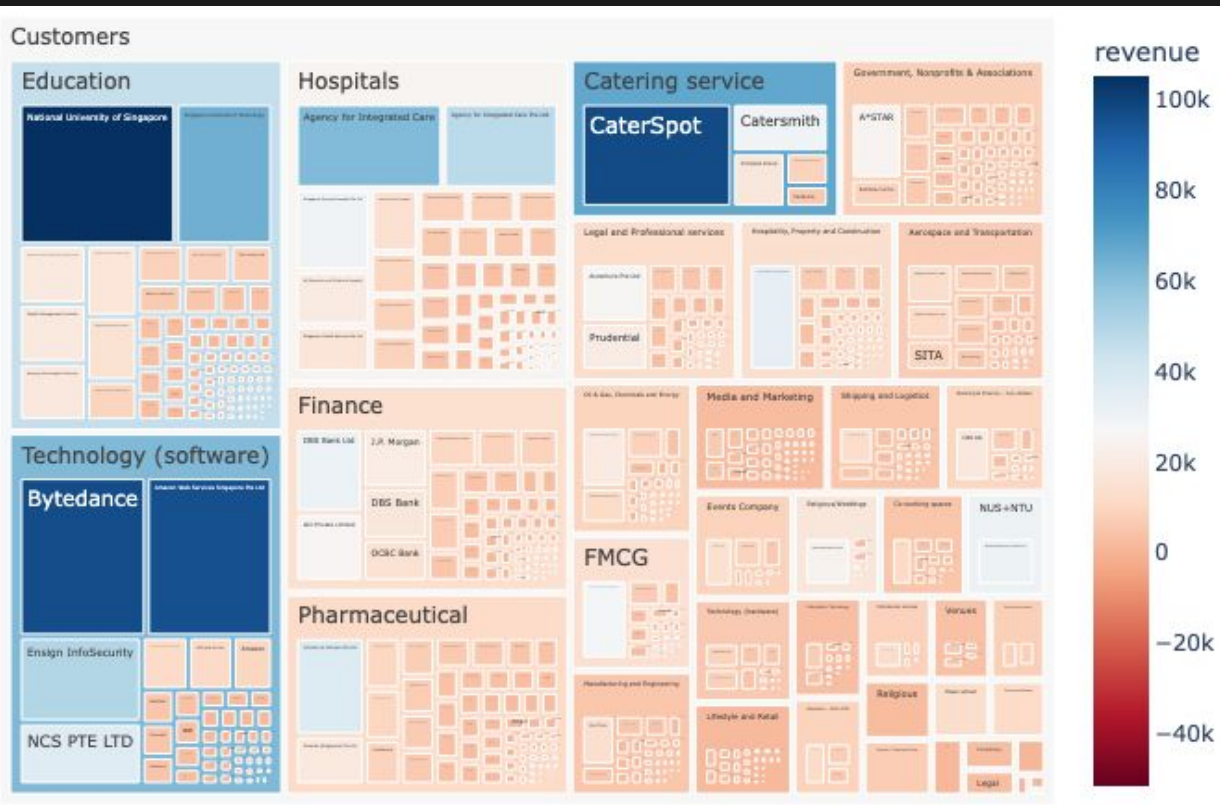
Lunch crunch



The most popular time to order mini buffets are during lunch time. More specifically from 11.30pm to 12pm.

It would be important to allocate more manpower in the early part of the day to prepare the orders.

Customer segments

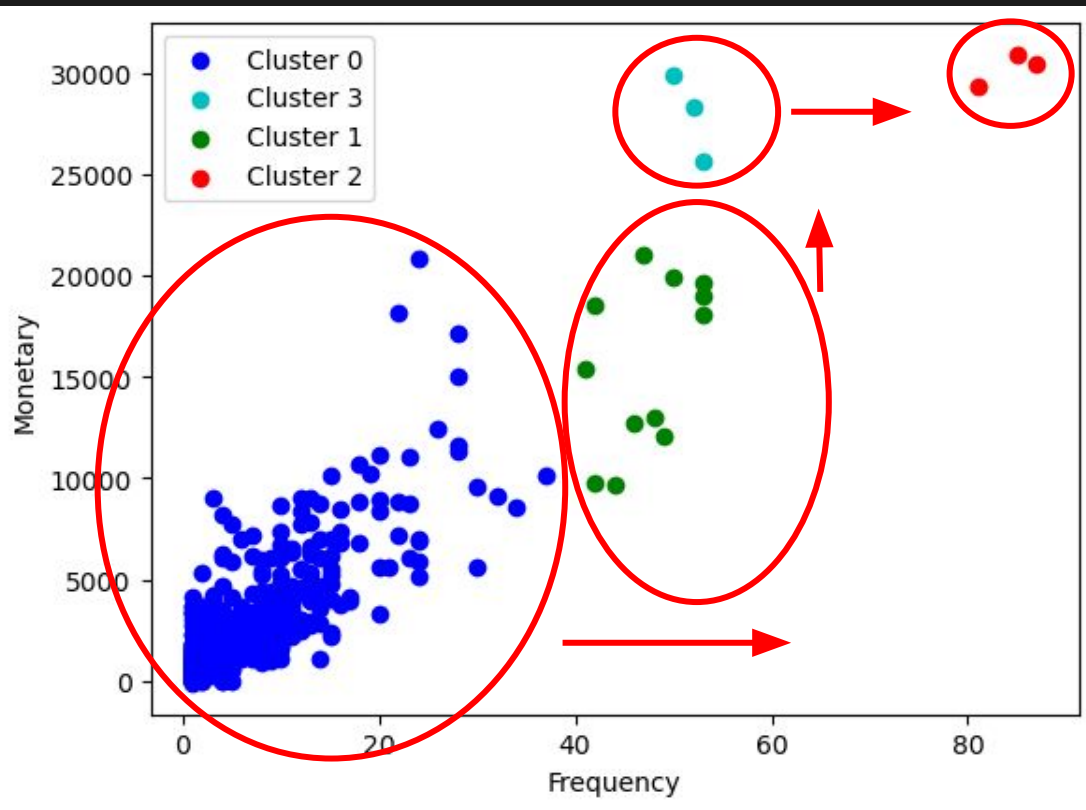


The biggest sector is Education followed by Technology (software) then Hospitals.

The most amount of deliveries in terms of pax goes to the hospitals sector. This could be because the people in hospitals are more health-conscious and would order healthier choices from caterers that offer healthier choices.

Customer segments

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DBScan formed 4 clusters after removing outliers.

Cluster 0 (Core customers)

- This is where most of our customers lie.

Cluster 1 (Loyal customers)

- These customers buy more frequently.

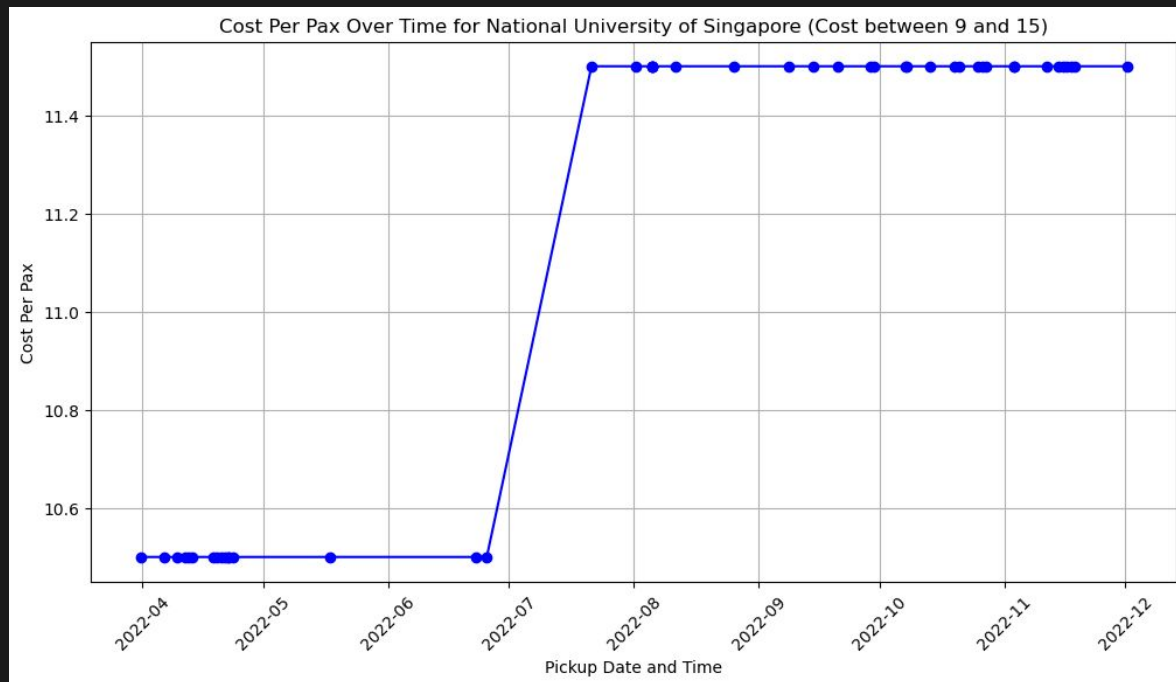
Cluster 3 (Increase frequency)

- These customers spend more than those in cluster 1.

Cluster 2 (Whales)

- We cannot lose these customers at all cost.


Differentiated pricing



The price of a basic meal box or a plant-based meal box is \$12.96 per box and meals on demand start from \$14 per box.

However, some companies may enjoy lower pricing due to the volume of orders.

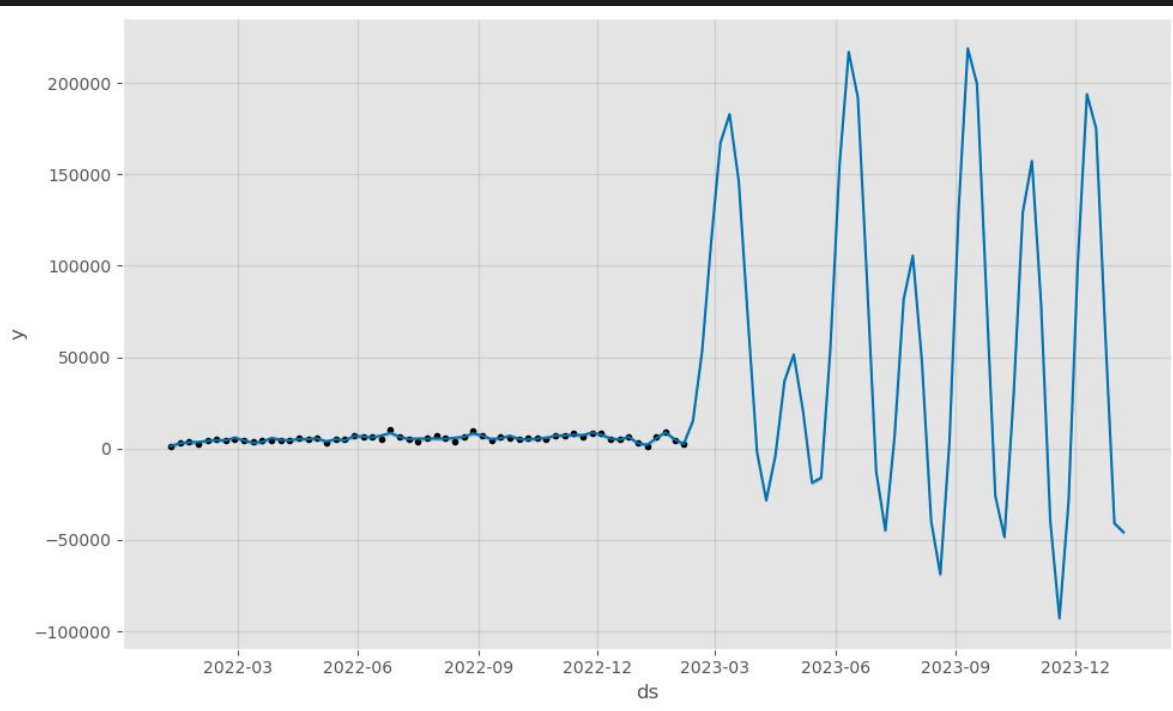
In this example, it seems like the meal boxes were initially sold for \$10.50 but later the price was increased to \$11.50. This could be due to inflation and re-negotiation with the company.

A collage of various spices and herbs. It includes a bowl of red chili powder, a bowl of yellow turmeric powder, a bowl of mixed red and black peppercorns, a bowl of brown coriander seeds, a whole star anise, a whole nutmeg, and a piece of ginger root. The background is a dark, textured surface with a grid of small white dots.

Machine learning

03

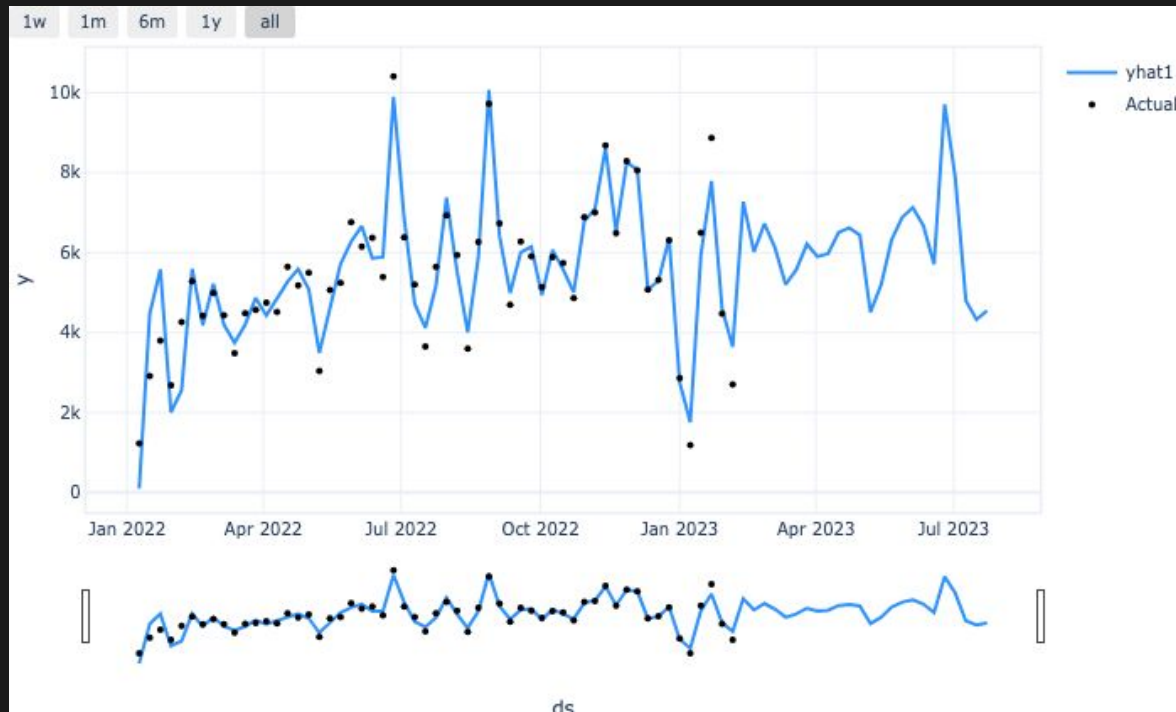
Demand forecasting



Using the prophet model, I managed to get an R-squared score of 0.95 and a RMSE of 542.

However, I realised that as I increased the fourier order, the R-squared value got higher. This led to an overfitting which may not accurately predict future demand.

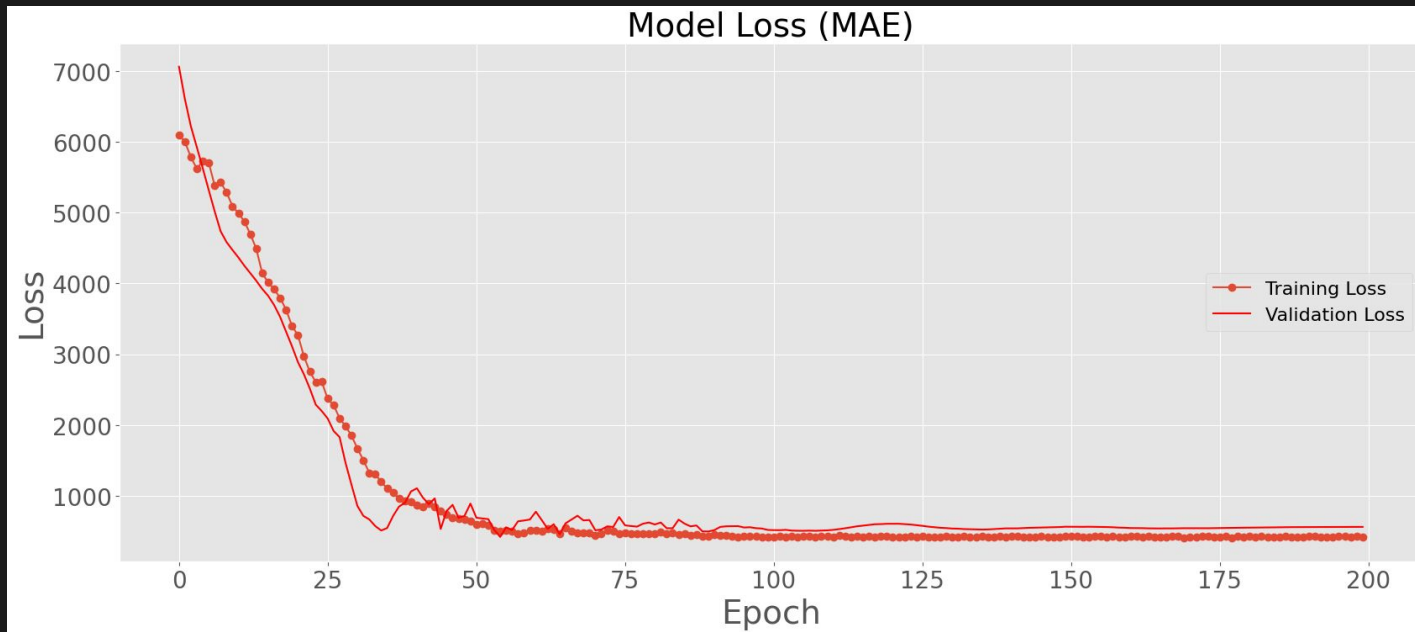
Demand forecasting



Therefore, I used the neural prophet model and split my data into a train set and a test set.

I got a R-squared score of 0.9 and a RMSE of 674 and the forecasted demand looks more appropriate.

Demand forecasting



The loss decreases as the number of epochs increases. With both the training and validation curve converging, there is no underfitting or overfitting.

If the model was underfitting, both the curves will not decrease in loss.

If the model was overfitting, the curves would diverge after a certain amount of epochs.

Price recommender



(Model	Adjusted R-Squared	R-Squared	RMSE	\
	XGBRegressor	0.57	0.58	0.78	
	ExtraTreesRegressor	0.49	0.50	0.84	
	LGBMRegressor	0.49	0.50	0.85	
	RandomForestRegressor	0.47	0.48	0.86	
	HistGradientBoostingRegressor	0.47	0.48	0.87	
	BaggingRegressor	0.41	0.42	0.91	
	GradientBoostingRegressor	0.39	0.40	0.93	
	OrthogonalMatchingPursuitCV	0.33	0.34	0.97	
	TransformedTargetRegressor	0.33	0.34	0.97	
	LinearRegression	0.33	0.34	0.97	
	Lars	0.33	0.34	0.97	
	LassoLarsIC	0.33	0.34	0.97	
	LarsCV	0.33	0.34	0.97	
	LassoLarsCV	0.33	0.34	0.97	
	HuberRegressor	0.33	0.34	0.97	
	LassoCV	0.33	0.34	0.97	
	Ridge	0.33	0.34	0.97	
	RidgeCV	0.33	0.34	0.97	
	ElasticNetCV	0.33	0.34	0.97	
	BayesianRidge	0.33	0.34	0.97	
	KNeighborsRegressor	0.32	0.33	0.98	
	NuSVR	0.31	0.32	0.98	
	LinearSVR	0.30	0.32	0.99	
	SGDRegressor	0.29	0.30	1.00	
	SVR	0.28	0.29	1.01	
	PoissonRegressor	0.27	0.28	1.02	

In order to predict price, I selected the relevant columns that were numerical. Columns like customer_id and revenue.

Then I used LazyPredict to test many models. The best model ended up being XGBRegressor.

Models comparison

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	Train accuracy	Test accuracy
Prophet	0.95	0.95
Neural prophet	0.88	0.92
Neural network	0.63	0.42
XGBRegressor	0.96	0.52

Driver allocation



event_id	pickup_date_time	serving_date_time	pax	address	postal_code	special_instructions	postal_code_new	hq_duration_mins	driver_allocation
I5776	2023-09-15 07:00:00	2023-09-15 08:15:00	70	5 Maxwell Road, #12- 01 Tower Block MND Complex	69110	70 x Bento + Cutlery \n **NO LLM	069110	18	KHAI
I5469	2023-09-15 07:45:00	2023-09-15 09:00:00	15	5 Stadium Dr, OCBC Arena Level 2	397631	15 x bento + cutlery\n \n\nContact Nur for de...	397631	11	KHAI
I5575	2023-09-15 08:45:00	2023-09-15 10:00:00	20	71 AYER RAJAH CRESCENT #02-18	139951	20 x bentos + cutlery 26 cups, sugar, creame...	139951	23	DAENG
I5693	2023-09-15 09:00:00	2023-09-15 10:15:00	29	Microsoft, 182 Cecil Street, Level #10-01 Fras...	69547	29 x bento + Cutlery	069547	18	KHAI
I5598	2023-09-15 09:15:00	2023-09-15 10:30:00	30	63 Alexandra Terrace, Harbourlink Innohub, #06-18	119937	30 x bento + cutlery 10 x packet juices 26...	119937	23	DAENG
I5425	2023-09-15 09:45:00	2023-09-15 11:00:00	35	One Raffles Quay, 1 Raffles Quay - South	48583	35 x meal box + cutleries Please use loading...	048583	17	DAENG

First I selected the relevant columns like pick up time and postal code.

I then used google API to find out the duration it would take to go from Grain's HQ to the event location.

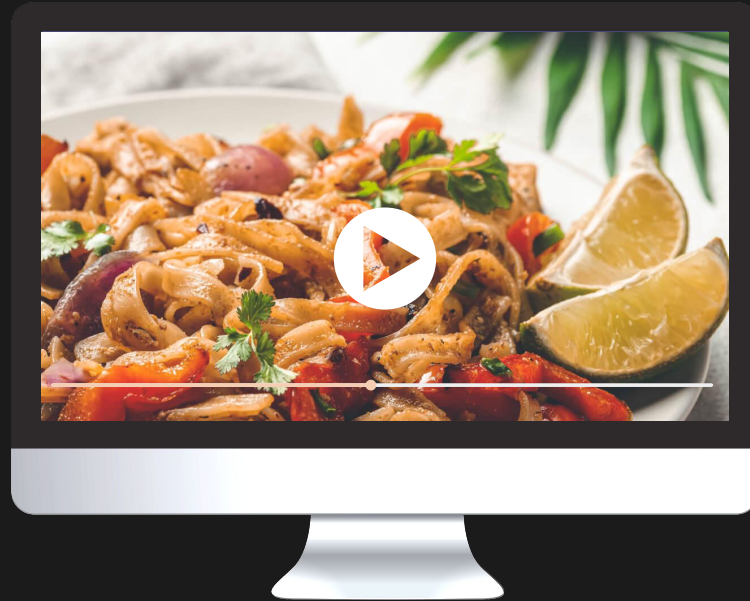
Lastly, I allocated the drivers based on the locations and delivery times.



Solution

04

SNEAK PEEK

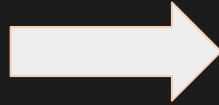


Problem

Given past data, can we forecast demand to efficiently carry out inventory management?

What is the recommended price for customers from different sectors?

Is there a way to automatically assign drivers for deliveries so that only a final check is needed?



Solution

Demand forecast dashboard that predicts how many pax to prepare for on a weekly basis.

Price recommender that recommends a price for different companies.

Automated driver allocation to ensure efficient deliveries.

Steps forward

01

Improve the model

Gather more specific data about the food items and their costs.

Train the model again to improve the accuracy

02

Deploy the solution

The sales department can get recommended prices.

The fulfilment department can use it to ease their daily operations

03

Update

Constantly change the model and add new features.

Add a chatbot and a recommender system.



THANKS

Do you have any questions?

What shall we eat next?



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