Vending Machine Logistics Prediction

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Problems statement

As Vending Drink Machine famous now a day with complicate recipes to mix , It's important to make machine available and ready for any menu all the time

For current process, machine will acknowledge when any ingredient in machine is in threshold capacity but this process still needed

- Warehouse planning that need to know before hand to plan
- Lag time from Logistics that need processing time also

So threshold indicator that

- Less margin threshold will not react fast enough to refill that cause lost sale
- More margin threshold will raise up operation cost

What if we can predict each machine with next 24, 48 hours and follow JIT process

Datasource

From one of our famous Drink vending machine reports

- from 2023-10-01 to 2023-10-31
- 15,634 transactions logs
- 3 positions of machine

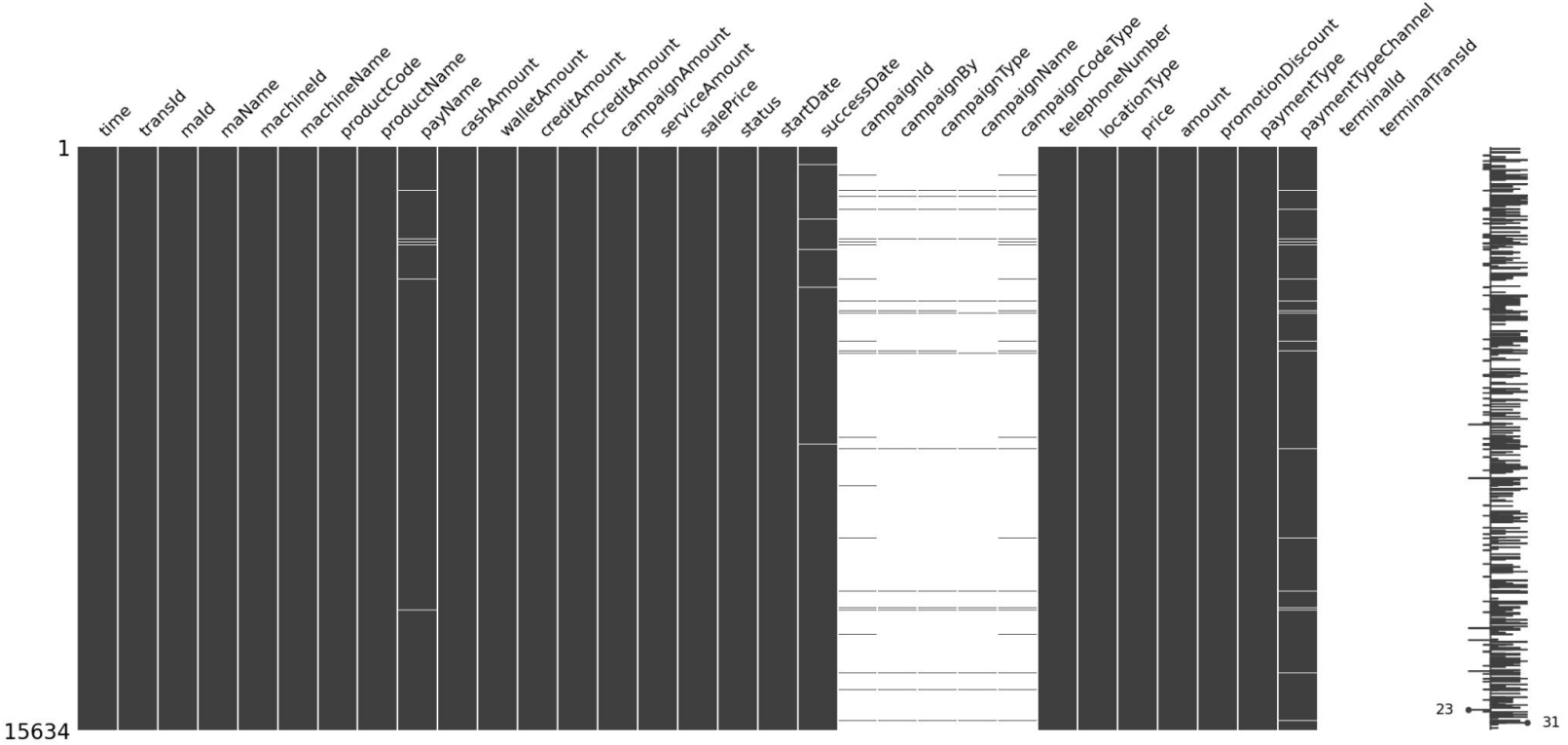
Without drinking menu’s recipe for each ingredients in machine

And holiday calendar of Thailand

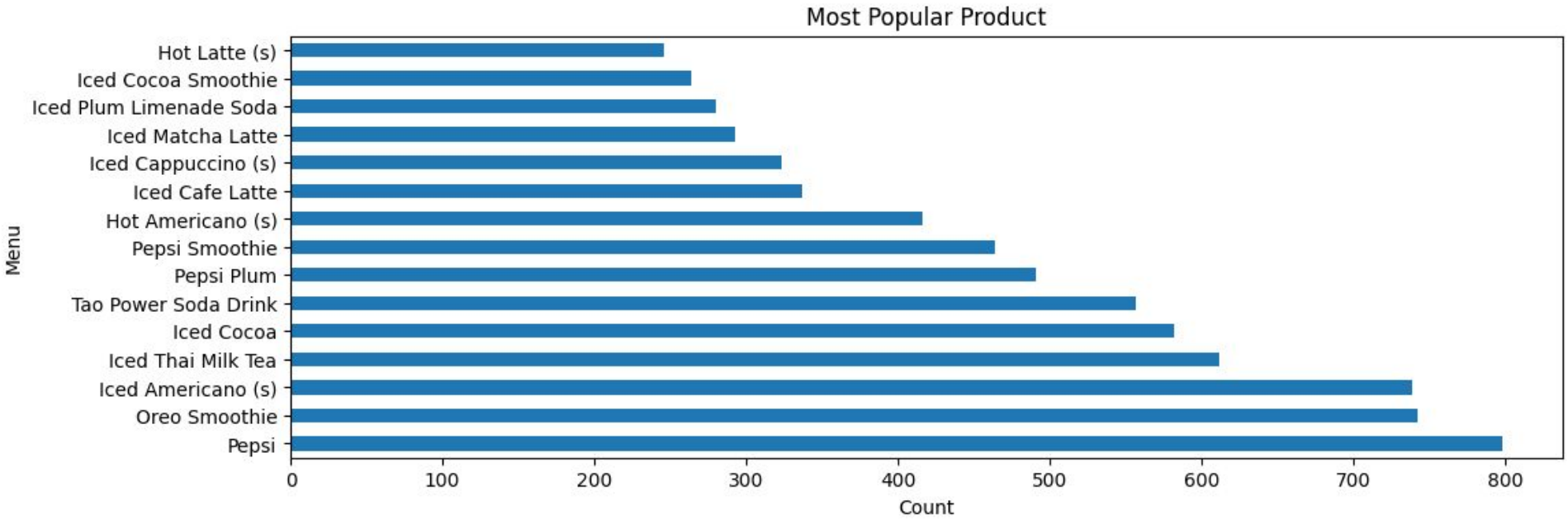
EDA

machineName	productCode	productName	payName	cashAmount	...	campaignCodeType	telephoneNumber	locationType	price	amount	promotionDiscount	paymentType
AOTสนามบินสุวรรณภูมิ (อาคารลานจอดรถ 3 ชั้น 5)	12-21-01-0004	Hot Latte (s)	linepay	0	...	NaN	816466651	Airport	35	35	0	qrcode
AOTสนามบินสุวรรณภูมิ (อาคารลานจอดรถ 3 ชั้น 5)	12-02-02-0046	Unknown Product	cash	30	...	NaN	817266264	Airport	30	30	0	cash
AOTสนามบินสุวรรณภูมิ (อาคารลานจอดรถ 3 ชั้น 5)	12-05-02-0046	Pepsi Plum	cash	20	...	NaN	922647207	Airport	20	20	0	cash
AOTสนามบินสุวรรณภูมิ (อาคารลานจอดรถ 3 ชั้น 5)	12-05-02-0046	Pepsi Plum	cash	20	...	NaN	899999999	Airport	20	20	0	cash
AOTสนามบินสุวรรณภูมิ (อาคารลานจอดรถ 3 ชั้น 5)	12-03-02-0005	Milk With Iced	cash	30	...	NaN	899999999	Airport	30	30	0	cash

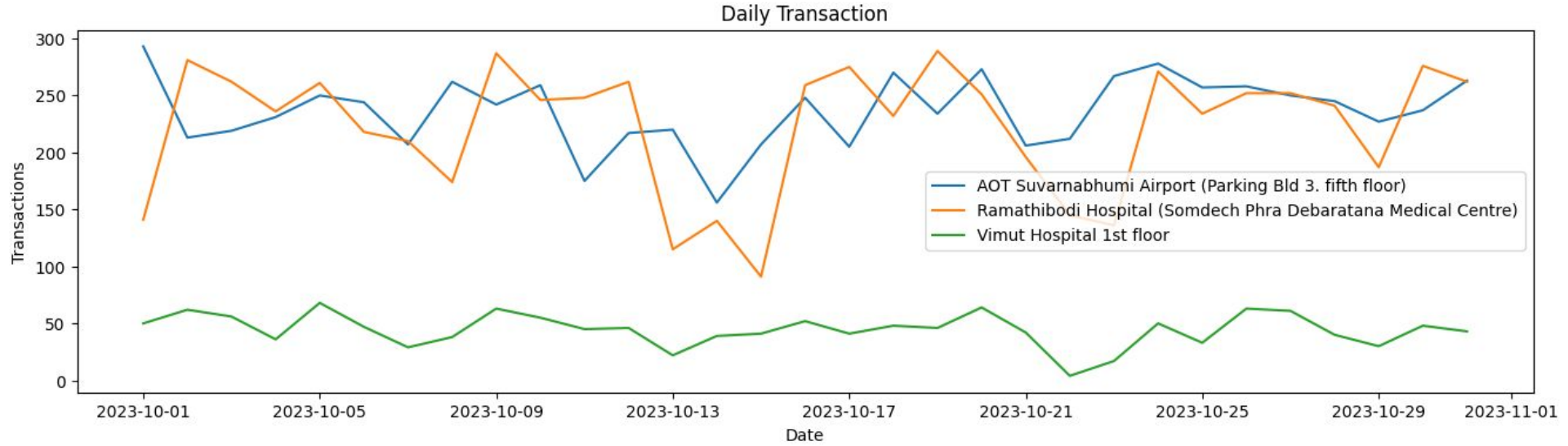
EDA


time
transId
maId
maName
machineId
machineName
productCode
productName
payName
cashAmount
walletAmount
creditAmount
mCreditAmount
campaignAmount
serviceAmount
salePrice
status
startDate
successDate
campaignId
campaignBy
campaignType
campaignName
campaignCodeType
telephoneNumber
locationType
price
amount
promotionDiscount
paymentType
paymentTypeChannel
terminalId
terminalTransId
1
15634
23
31

EDA


Most Popular Product
Menu
Hot Latte (s)
Iced Cocoa Smoothie
Iced Plum Limenade Soda
Iced Matcha Latte
Iced Cappuccino (s)
Iced Cafe Latte
Hot Americano (s)
Pepsi Smoothie
Pepsi Plum
Tao Power Soda Drink
Iced Cocoa
Iced Thai Milk Tea
Iced Americano (s)
Oreo Smoothie
Pepsi
0
100
200
300
400
500
600
700
800
Count

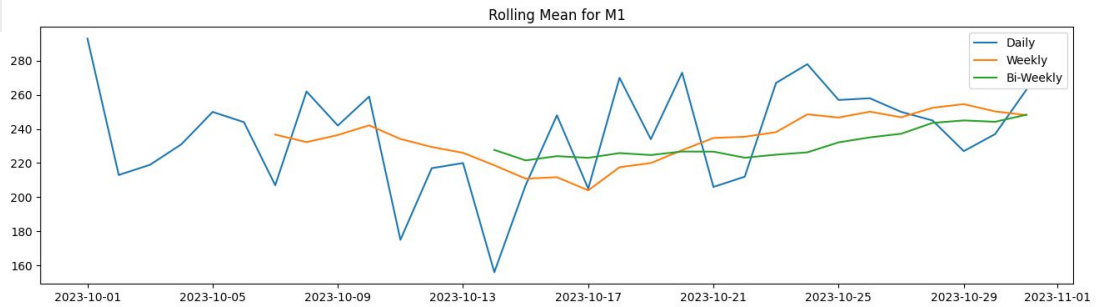
EDA

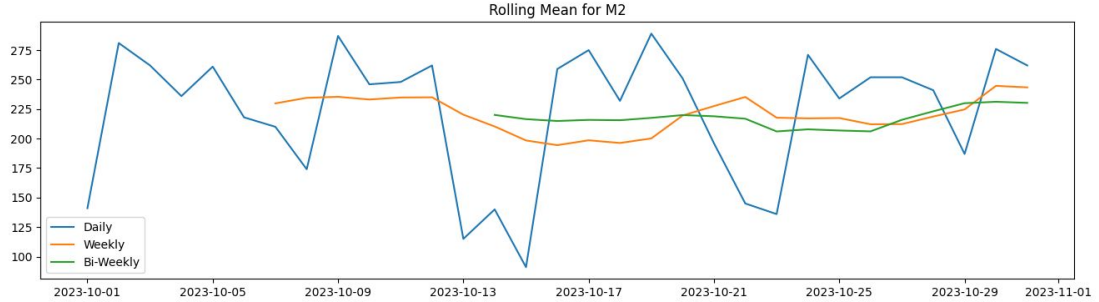

Daily Transaction
Transactions
Date
AOT Suvarnabhumi Airport (Parking Bld 3. fifth floor)
Ramathibodi Hospital (Somdech Phra Debaratana Medical Centre)
Vimut Hospital 1st floor
300
250
200
150
100
50
0
2023-10-01
2023-10-05
2023-10-09
2023-10-13
2023-10-17
2023-10-21
2023-10-25
2023-10-29
2023-11-01

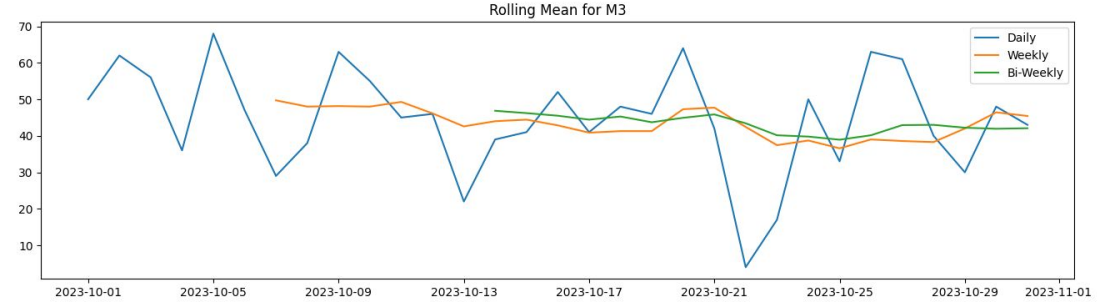
EDA - Daily Sampling

Re sampling data into `Daily` and finding pattern by rolling mean

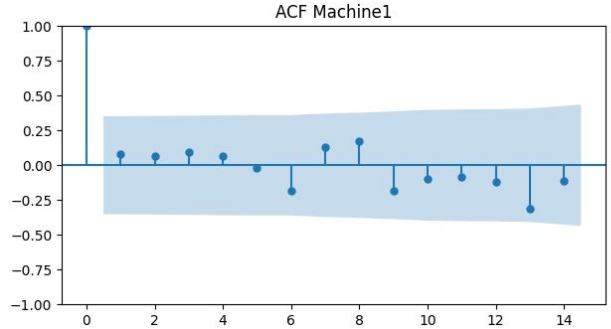
- Daily
- Weekly
- Bi-weekly

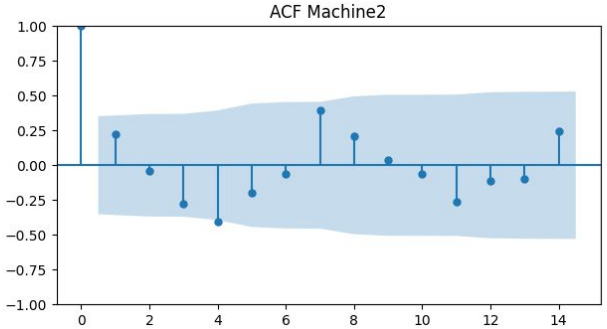


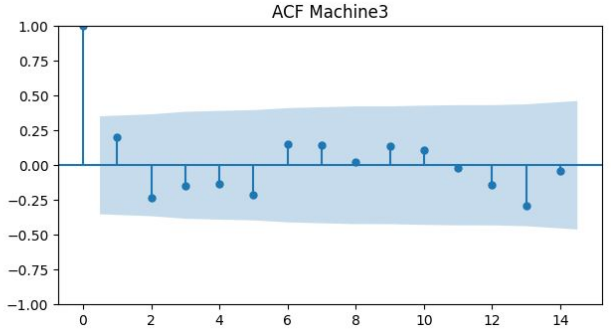


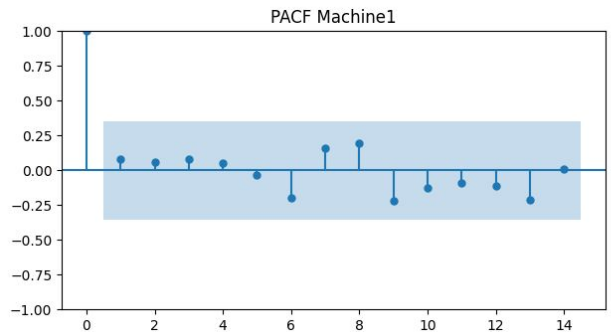


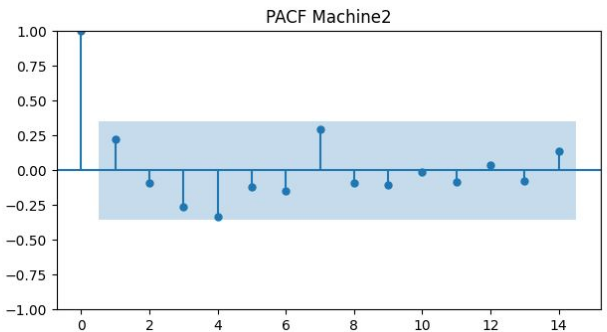
EDA - Daily Sampling

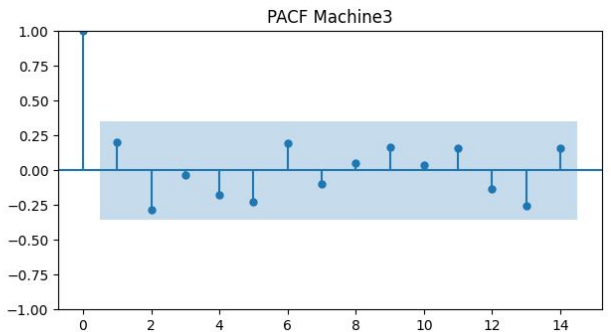








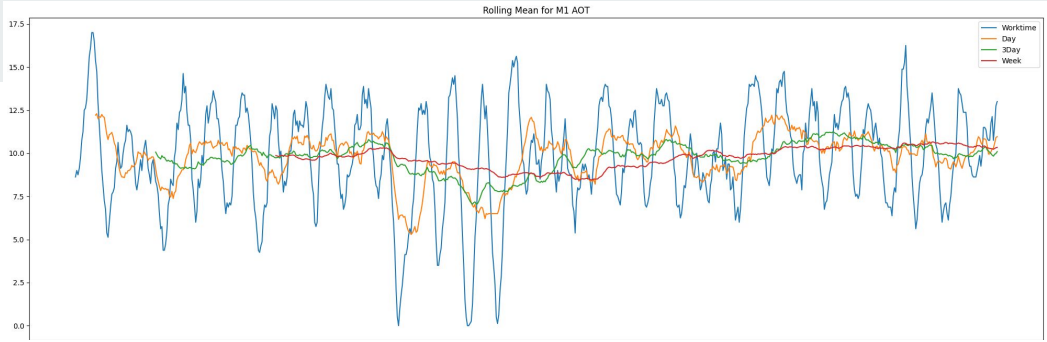


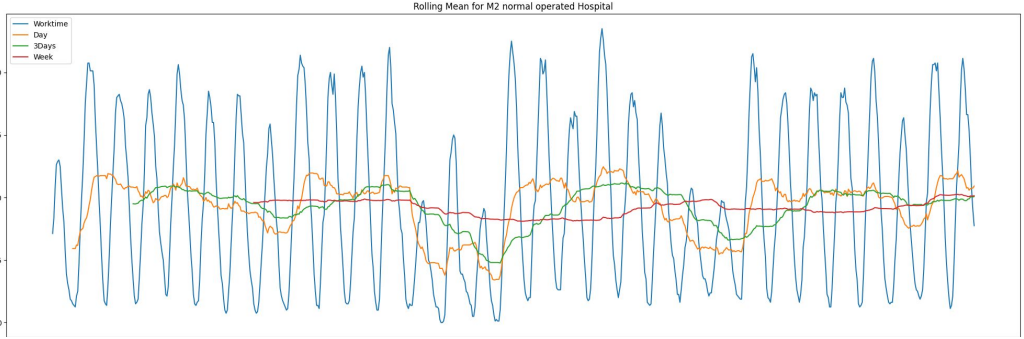


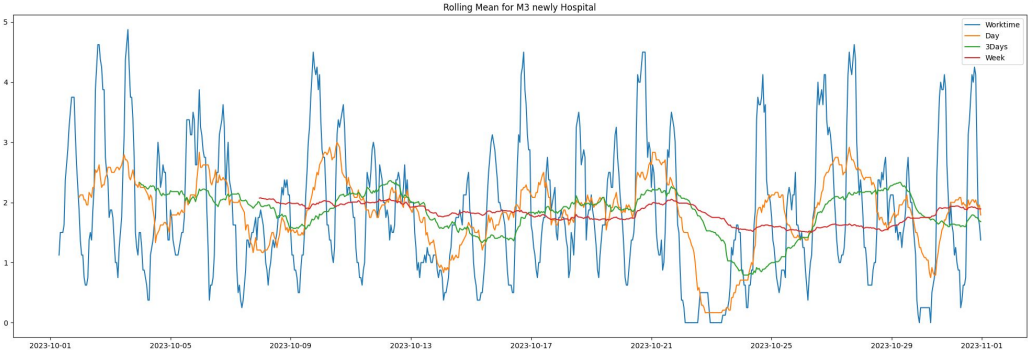
EDA - Hourly Sampling

Re sampling data into `Hourly` and finding pattern by rolling mean

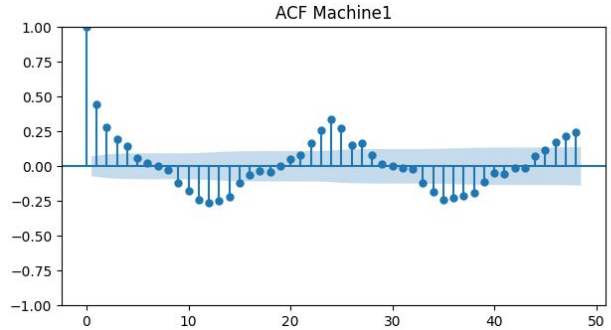
- Worktime (8hours)
- Day
- 3 Days
- Weeks

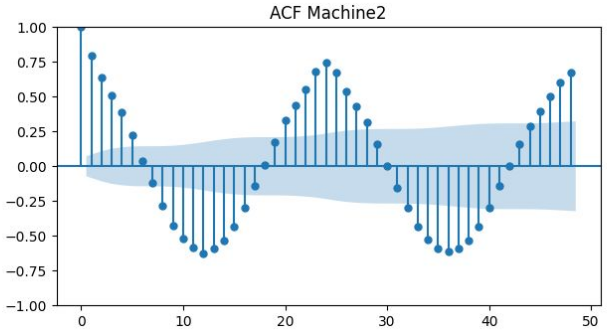


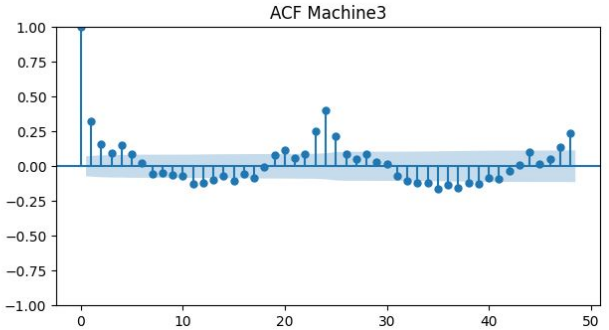


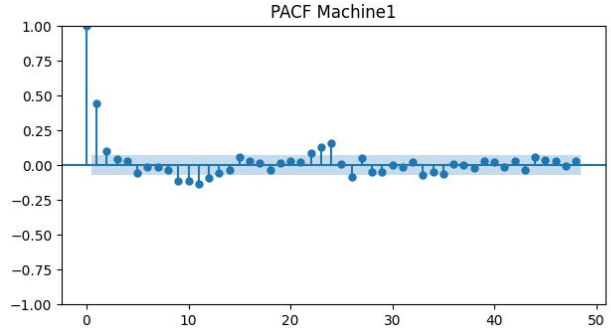


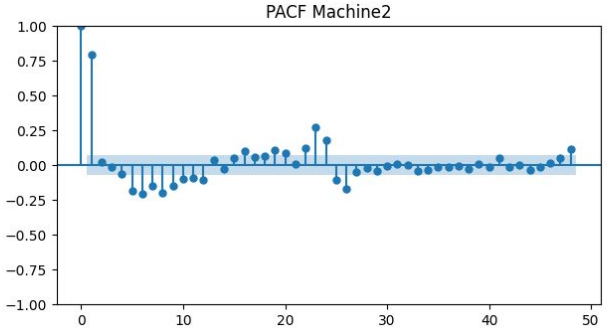
EDA - Hourly Sampling

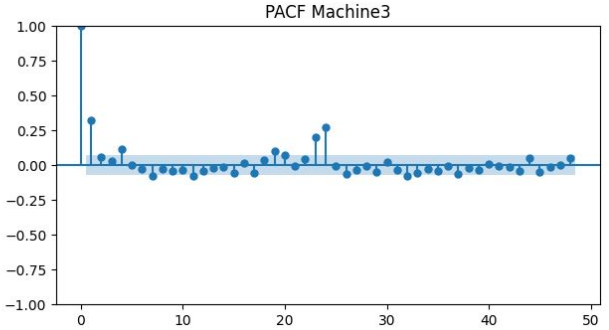








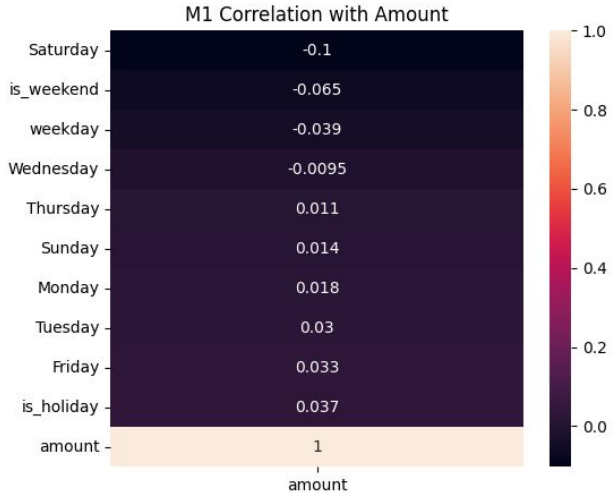


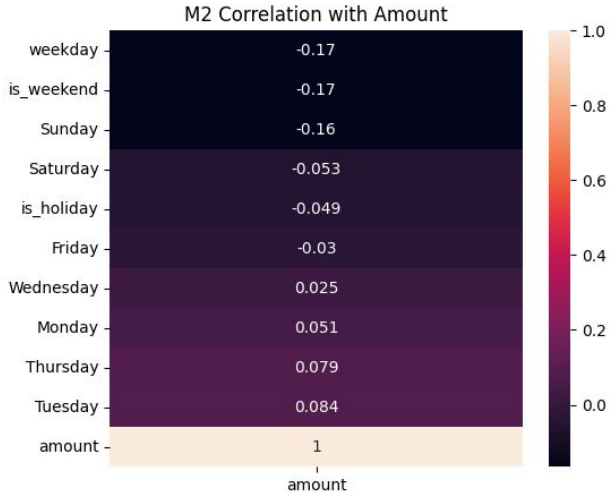


Feature Engineering

We engineering with Thailand calendar day with manual add holiday

And each machine response with calendar pattern differently



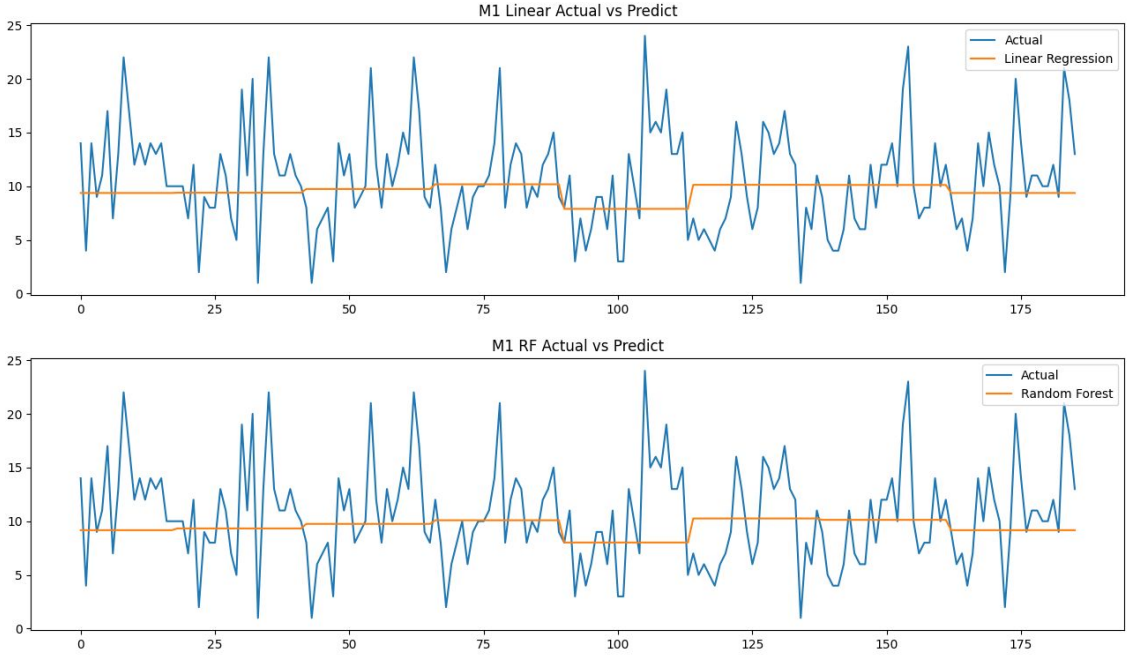


Modeling

After we try Linear Regression

we found that `predict` is didn't quite accurate enough for both

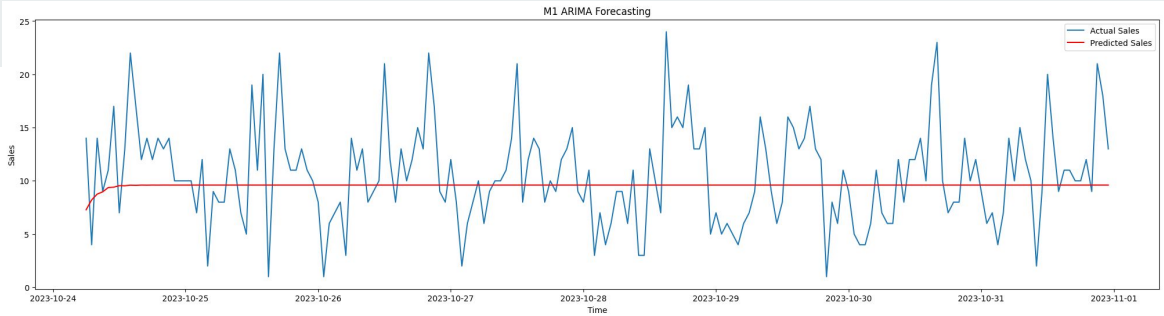
Linear regression and **RandomForrest**

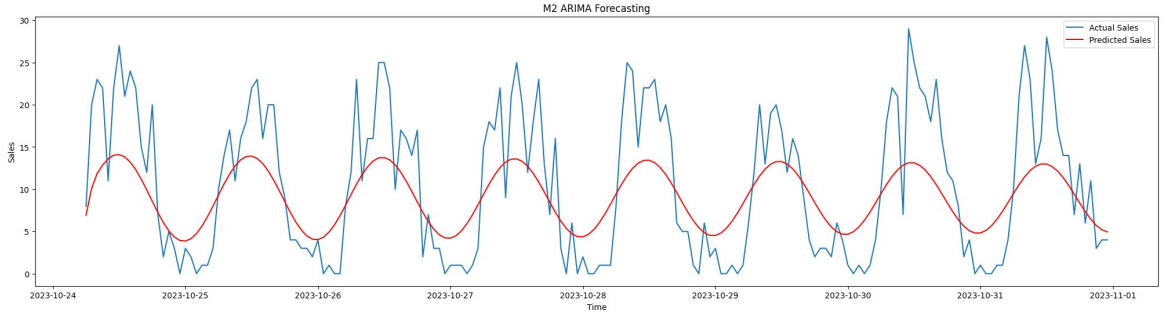


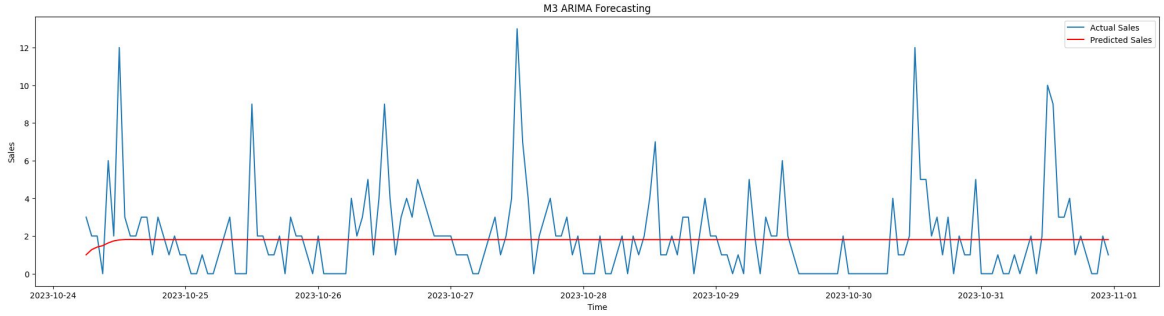
Modeling

For ARIMA best score seem able to capture trend for Machine that have period pattern

But for machine that various dynamic ARIMA seem can't capture trend



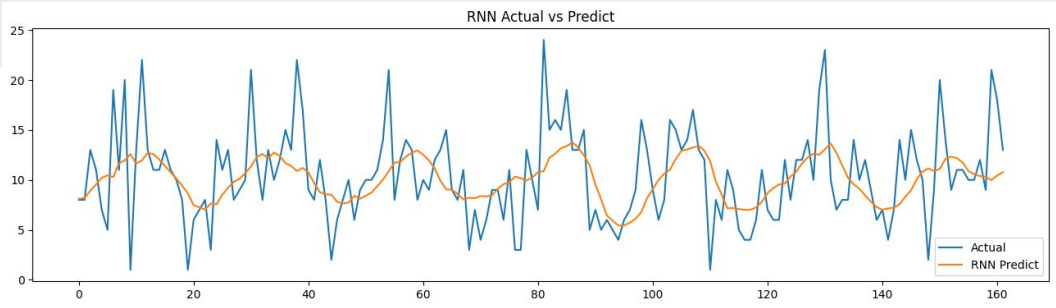


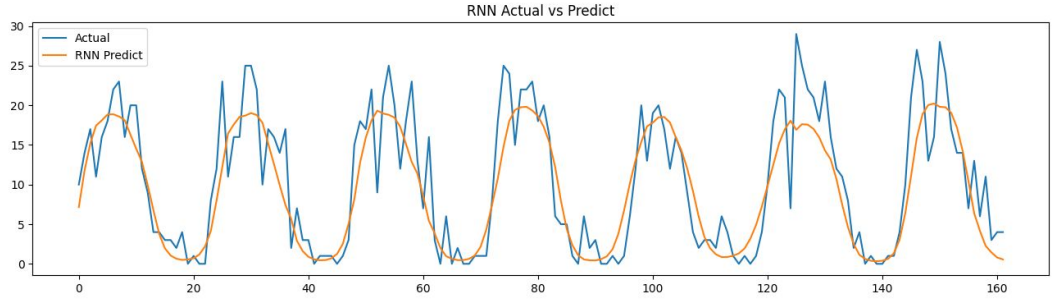


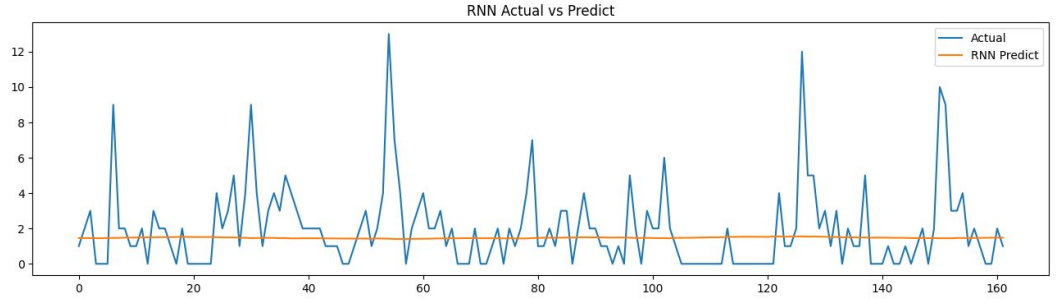
Modeling

RNN with LSTM model can cover almost pattern but at M3 seem little bit strange

After investigating found that I use RNN with only 1 feature `amount` only



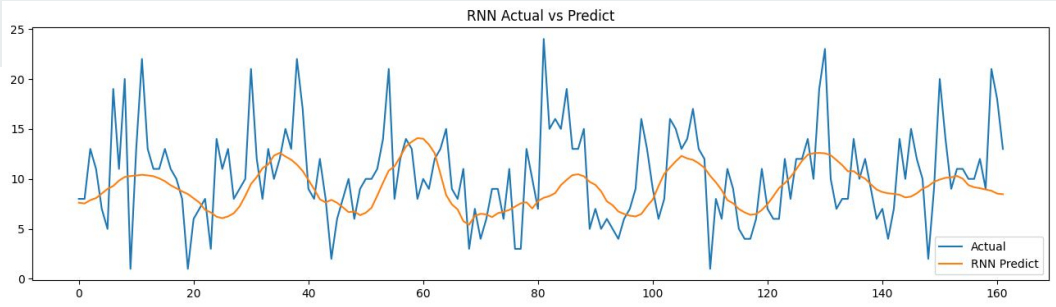


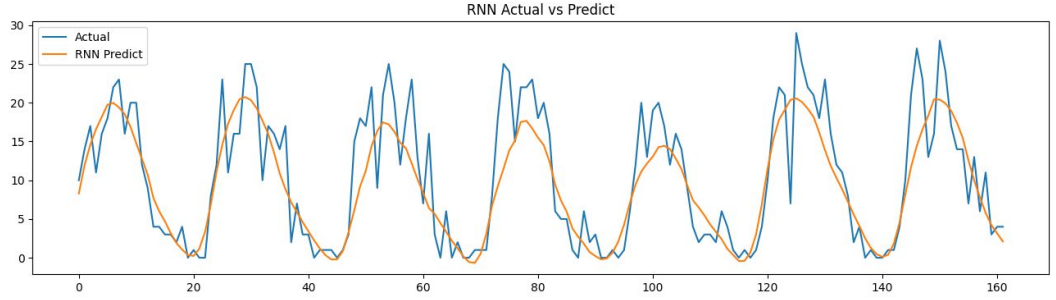


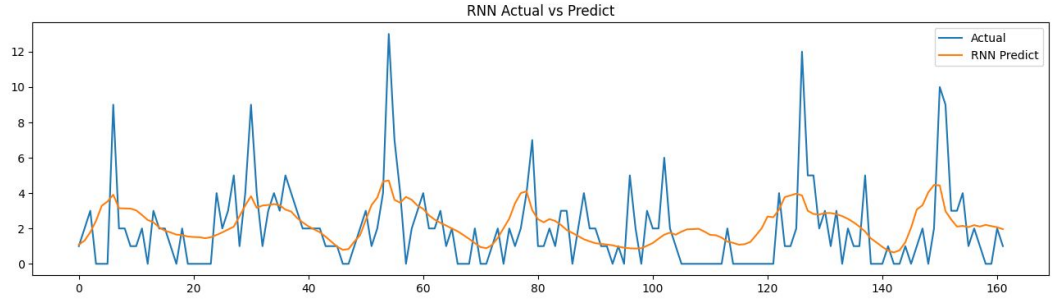
Modeling

After add feature to RNN and adjust LSTM to support multi features

Make overall predict better from improving M3 characteristics







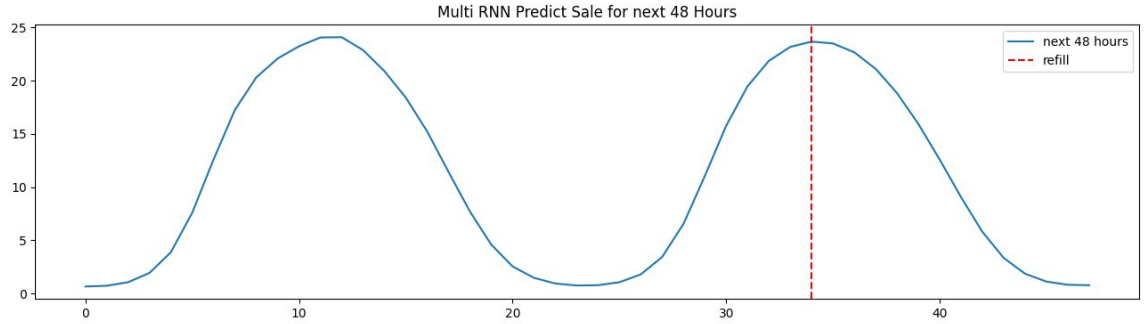
Usage

After Training with each machine (or grouping machine type, place, building population)

We can predict next 48 hours to check when we should refill machine by setup cups sell threshold

So warehouse's planning team can planning and packing beforehand

Logistics and Route planning according to the plan to setup route



Limit and Improvement

1. Still use rough indicator (CUPs) instead of in each ingredient details from drinking menus eg. matcha is run out
2. Lack of menu recipe and machine capacity for each ingredients
3. Limit on Time series information to 1 month OCT if we can gather more so we can analysis trends and seasonal
4. Can add surround data to add more features eg. Weather, Building populations and characteristics,
5. Finish this Proof of concept and pack into Application to use internal with MLOps

Q&A