

# 2023 Annual Case Competition

Team 13: Phoebe Carrathers, Nathan Lou, Seita  
Yoshifusa, Jenna Nguyen

# TABLE OF CONTENT



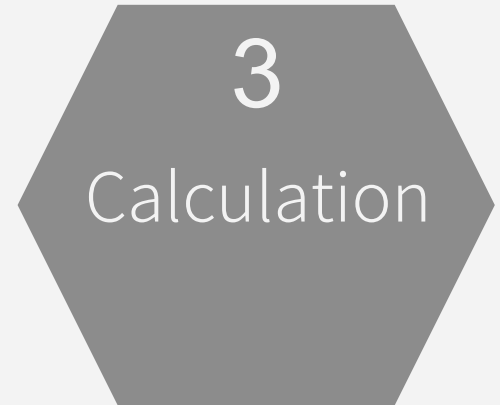
TRENDS  
CALCULATION

ADJUSTMENTS

XGBOOST

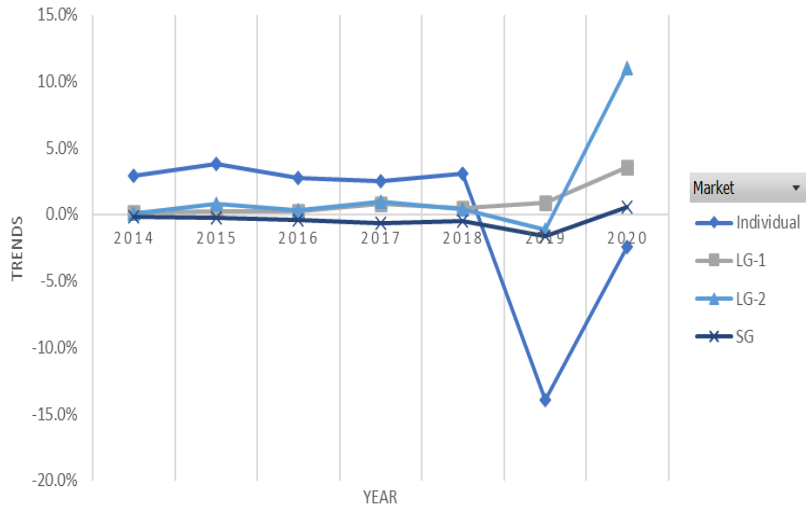
# Manual Trends Calculation

# Methodology

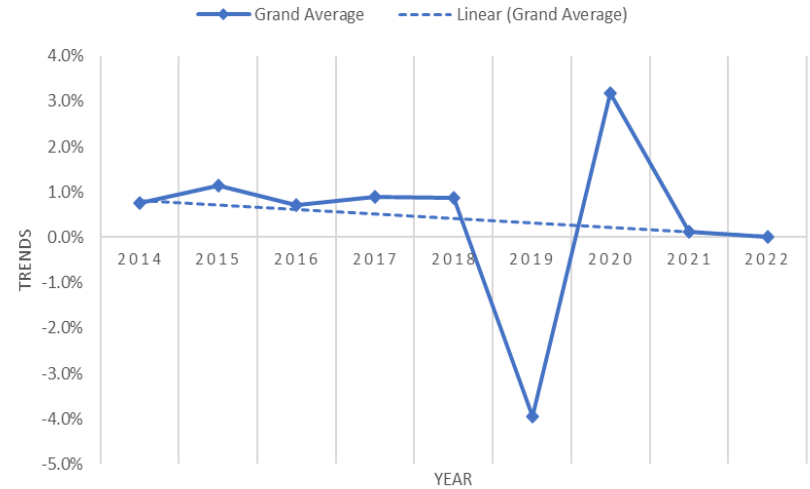


# Sample Raw Manual Trend

## ANCILLARY TRENDS: UTILIZATION



## ANCILLARY AVERAGE TREND: UTILIZATION



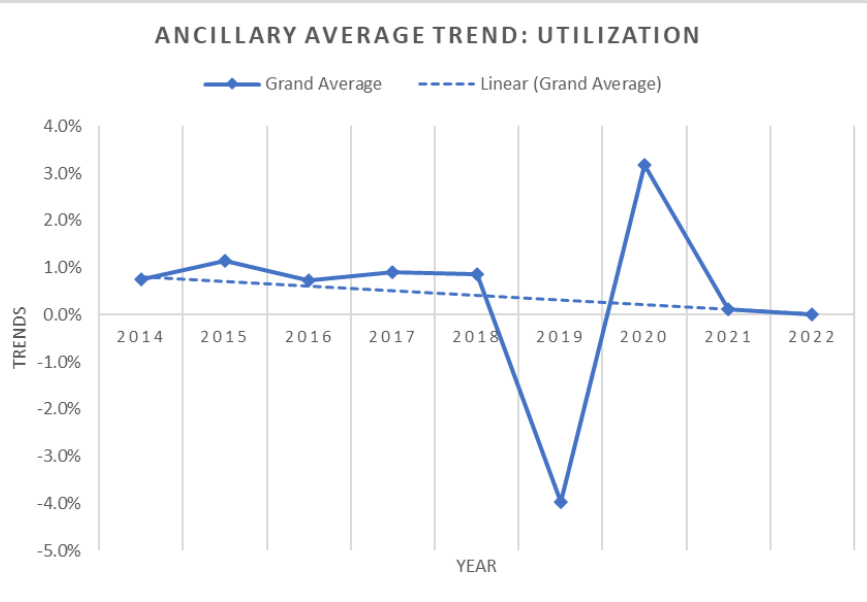
## Before Adjustment

Average of Utilization	Type of Service					
	Ancillary	Brand	Generic	IP	OP	Prof
Year						
2014	0.8%	-0.1%	-0.3%	1.5%	0.3%	3.8%
2015	1.1%	-0.7%	0.2%	3.9%	0.7%	3.5%
2016	0.7%	-1.5%	0.0%	0.6%	0.9%	4.9%
2017	0.9%	-2.1%	0.1%	2.1%	1.2%	5.7%
2018	0.9%	-2.0%	-0.5%	4.5%	1.7%	6.2%
2019	-4.0%	-2.5%	-1.2%	-1.7%	0.3%	84.6%
2020	3.2%	-4.9%	0.7%	5.5%	7.3%	62.0%
2021	0.1%	-4.6%	-0.2%	3.0%	4.8%	72.7%
2022	0.0%	-5.2%	-0.2%	3.2%	5.5%	84.7%

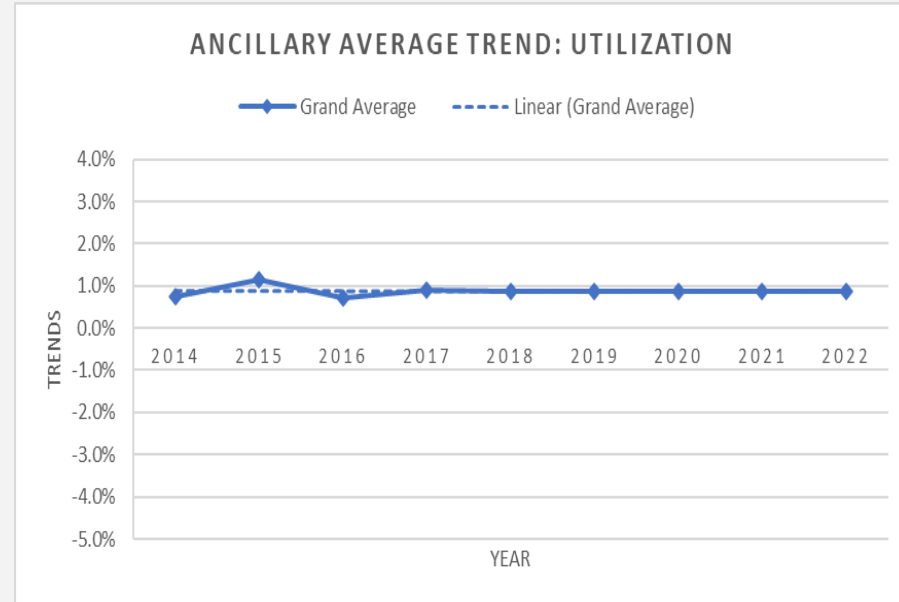
## After Adjustment

Average of Utilization	Type of Service					
	Ancillary	Brand	Generic	IP	OP	Prof
Year						
2014	0.8%	-0.1%	-0.3%	1.5%	0.3%	3.8%
2015	1.1%	-0.7%	0.2%	3.9%	0.7%	3.5%
2016	0.7%	-1.5%	0.0%	0.6%	0.9%	4.9%
2017	0.9%	-2.1%	0.1%	2.1%	1.2%	5.7%
2018	0.9%	-2.0%	-0.5%	4.5%	1.7%	6.2%
2019	0.9%	-1.3%	-0.1%	2.5%	0.9%	4.8%
2020	0.9%	-1.3%	-0.1%	2.5%	0.9%	4.8%
2021	0.9%	-2.0%	-0.1%	3.1%	1.4%	5.8%
2022	0.9%	-2.2%	-0.2%	3.3%	1.5%	6.0%

## Before Adjustment



## After Adjustment



## Core Trend Summary

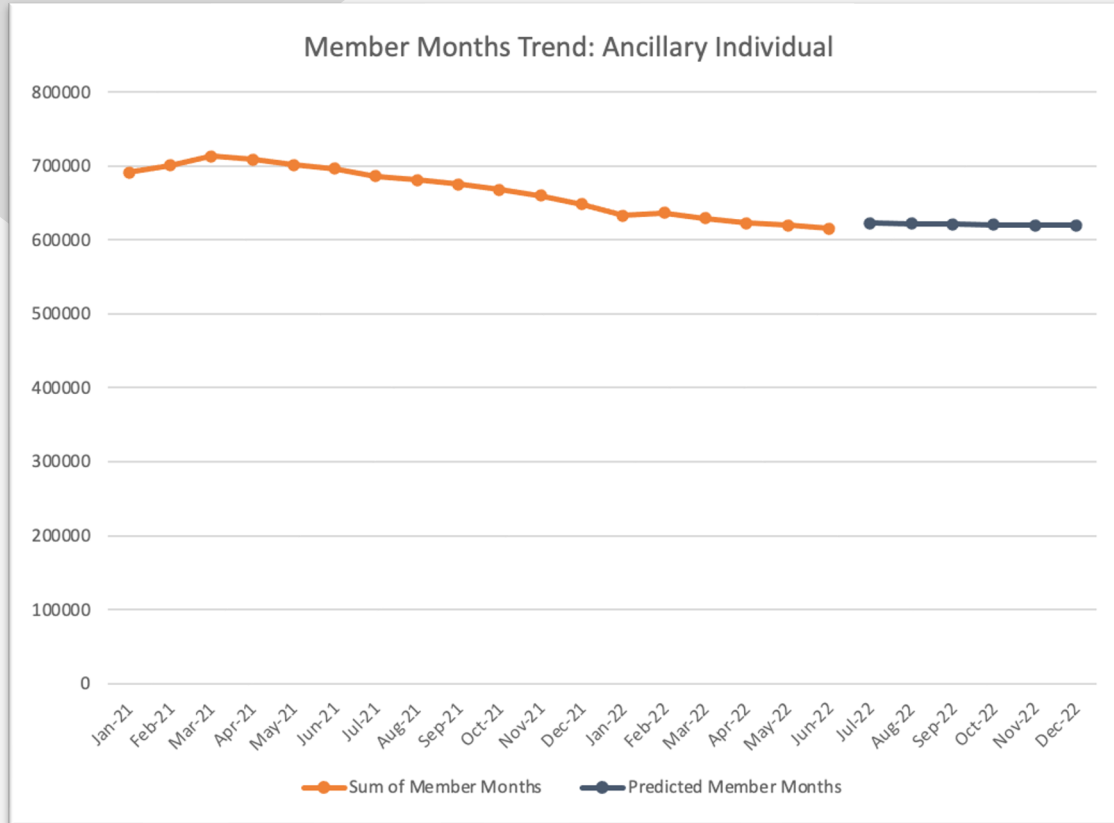
Benefit Type	Underlying Trend	Event Trend	Adjusted Core Trend
Utilization			
Inpatient	3.3%	1.9%	5.3%
Outpatient	1.5%	3.8%	5.4%
Professional	6.0%	73.3%	83.7%
Ancillary	0.9%	-0.4%	0.5%
Drugs	-2.0%	-1.2%	-3.2%
Total	1.9%	15.5%	18.3%





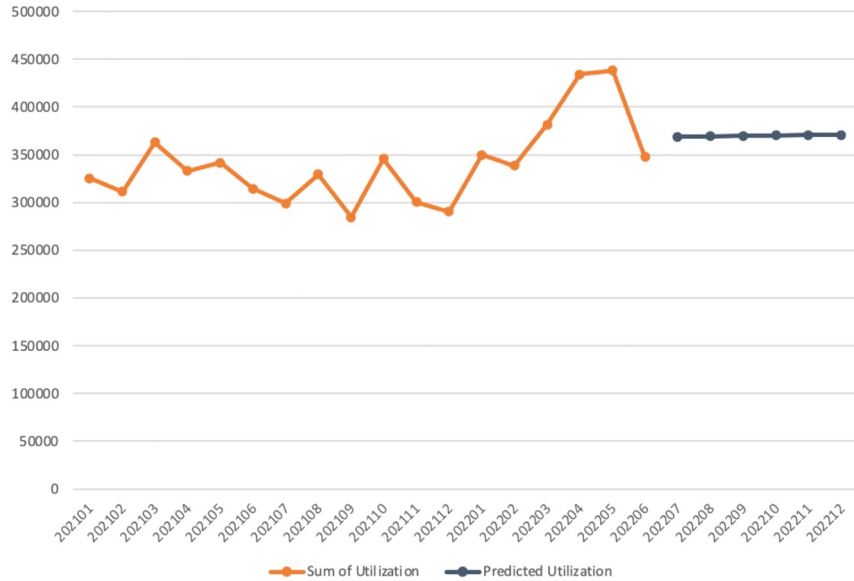
# Experience Trends Calculation

# Sample Raw Experience Trend

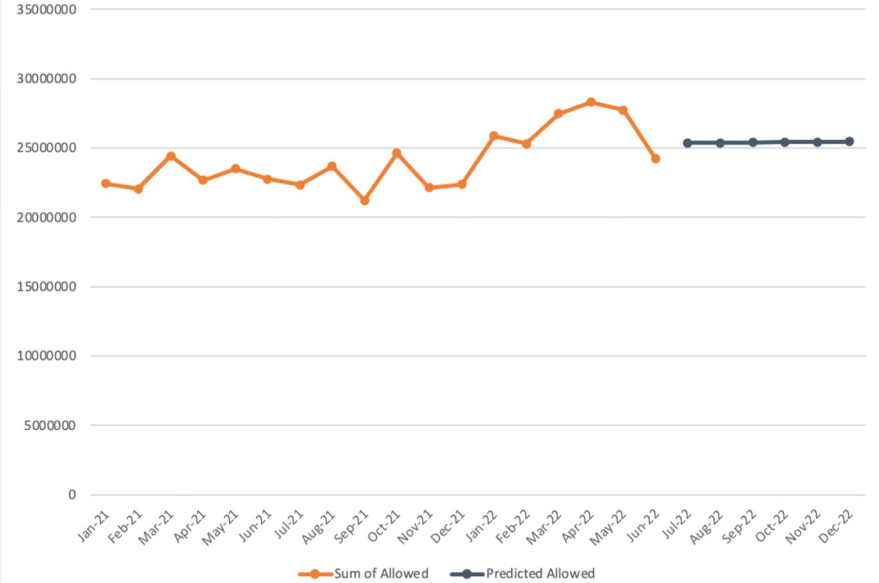


# Sample Raw Experience Trend

### Utilization Trend: Ancillary Individual



### Allowed Dollars Event Trend: Ancillary Individual



# EVENTS

## FLU VACCINES

Elevated by 5% in January and February 2022

Utilization  $\div$  1.05

## RENEWED CONTRACT

Expected to generate 7% and 2% in generic and brand drug savings

Generic Allowed \* 0.93  
Brand Allowed \* 0.98

## DEFERRED SERVICES

Reluctance to seek non-emergency care due to COVID concerns

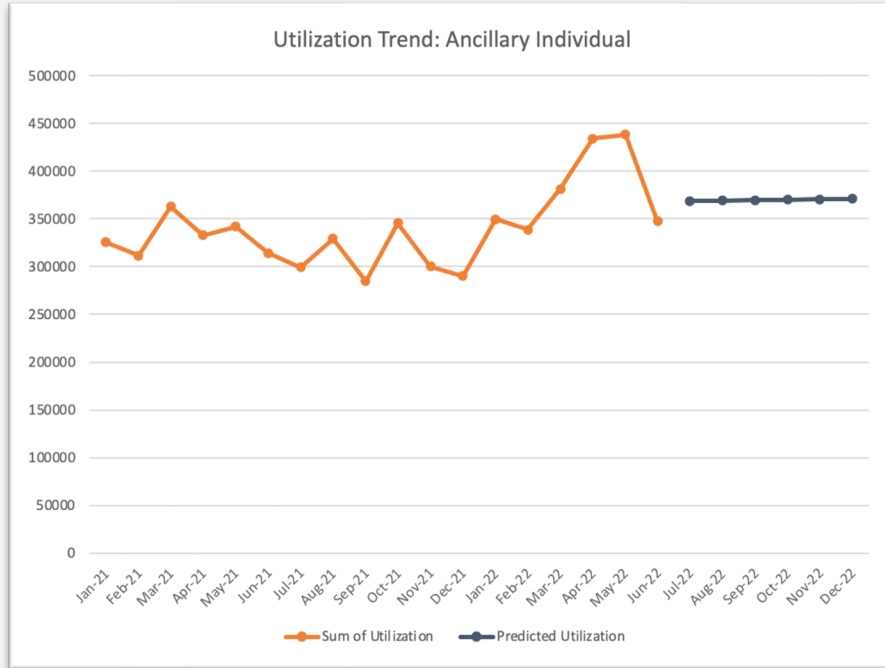
Utilization  $\div$  (1 - Estimate)

## SEASONALITY

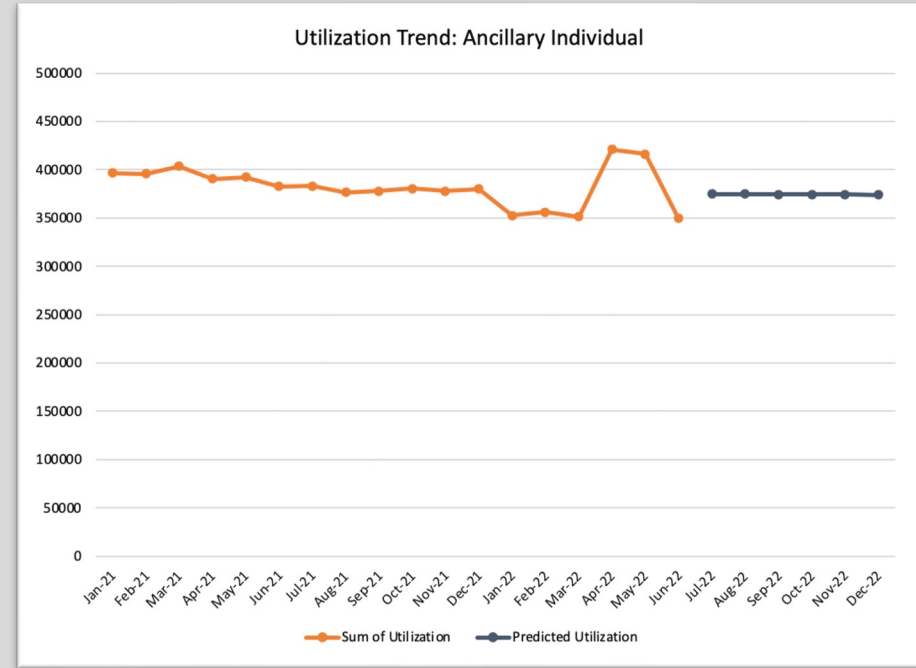
Further smooth fluctuations

Experience  $\div$  Seasonal  
Data Factors

## Before Adjustment



## After Adjustment



# Experience Trend

Ancillary:

	Event Trend	Underlying Trend
<b>Util/K</b>	5.93%	26.14%
<b>Unit Cost</b>	14.92%	-2.72%
<b>PMPM</b>	21.73%	22.71%

Professional:

	Event Trend	Underlying Trend
<b>Util/K</b>	6.87%	5.28%
<b>Unit Cost</b>	1.20%	0.82%
<b>PMPM</b>	8.15%	6.14%

## Blended Data

$$Z = 0.9478$$

$$Z * \text{Experience Estimate} + (1 - Z) * \text{Manual Estimate}$$

## Blended Data

Benefit Type	Market	Util/K	Unit Cost	PMPM
Ancillary	Individual	6.89%	14.50%	22.15%
	LG-1	4.30%	13.55%	18.76%
	LG-2	6.70%	15.25%	23.43%
	SG	4.02%	14.22%	18.92%
Prof	Individual	8.82%	1.42%	9.99%
	LG-1	6.67%	1.11%	9.37%
	LG-2	8.48%	6.28%	34.35%
	SG	6.41%	0.39%	9.48%



## WHAT IS XGBOOST?

A supervised machine learning model for defining the objective function & optimizing it.

$$\text{obj} = \sum_{i=1}^n l(y_i, \hat{y}_i^{(t)}) + \sum_{i=1}^t \omega(f_i)$$

$$\text{obj}^* = -\frac{1}{2} \sum_{j=1}^T \frac{G_j^2}{H_j + \lambda} + \gamma T$$

# PROS & CONS

**IT DOES NOT  
PERFORM WELL  
ON SPARSE &  
UNSTRUCTURED  
DATA**

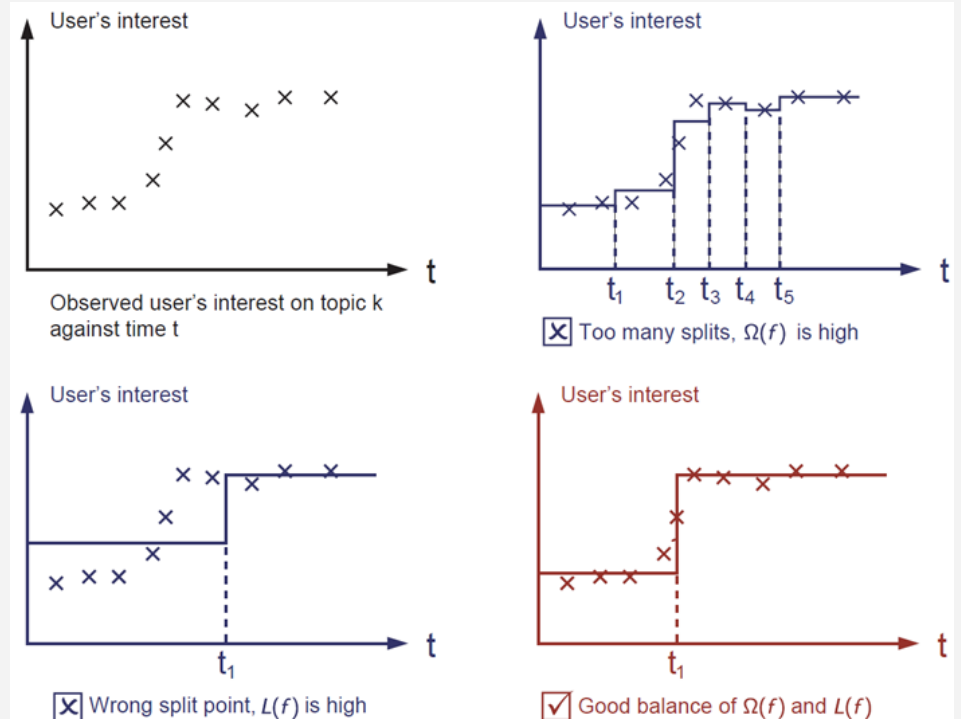
**IT IS  
FLEXIBLE &  
FAST**

**IT SUPPORTS  
REGULARIZA-  
TION**

**IT USES  
PARALLEL  
PROCESSING**

# GENERAL PRINCIPLE ON OUR MODEL

## BIAS-VARIANCE TRADEOFF



# DECISION CRITERIA

- HOW DO WE KNOW IF XGBOOST (SUPERVISED LEARNING) WILL YIELD GOOD RESULTS?
- IS THERE A LOT OF DATA?
- IS THERE ANY MISSING DATA?
- IS THERE A LOT OF NOISE IN THE DATA?
- ARE THERE A LOT OF NUMERICAL FEATURES?

# XGBOOST RESULTS:

market	month	batch_size	learning_rate	n_estimators	max_depth	min_samples_leaf	pred_trend_all
LG-1	3	100000	0.1	100	5	30	4.3%
SG	3	100000	0.1	100	5	30	6.4%
LG-2	3	100000	0.1	100	5	30	5.9%
Individual	3	100000	0.1	100	5	30	12.1%

market	month	batch_size	learning_rate	n_estimators	max_depth	min_samples_leaf	pred_trend_all
LG-1	6	100000	0.1	100	5	30	4.0%
SG	6	100000	0.1	100	5	30	7.0%
LG-2	6	100000	0.1	100	5	30	9.4%
Individual	6	100000	0.1	100	5	30	11.0%

**THANKS FOR  
LISTENING!**