

# Predicting iPhone 14 Claims in March 2023 for Asurion



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Data Science  
Institute  
*Discovery through data.*

# Project Overview

## Business Problem:

Asurion offers phone insurance that covers:

- cracked phone screens
- mechanical failures
- loss & theft protection
- water damage
- local repairs
- same day replacement

We want to look specifically at their same day replacement service. When clients file a claim, with same day replacement service, a new phone will be delivered the same day with every content in the old phone backed up

## Why our work is important for the business:

## Specific goal of our project:

Since the new phone is shipped from the Asurion inventory warehouse, Asurion wants to be able to forecast the amount of claims for the next few weeks.

By determining the optimum inventory levels at each warehouse, Asurion can reduce their inventory management cost and ensure the rate of which they ship out replacement phones.

# Data Summary of the Provided Dataset

Volume:

- .66 mb
- 26661 rows

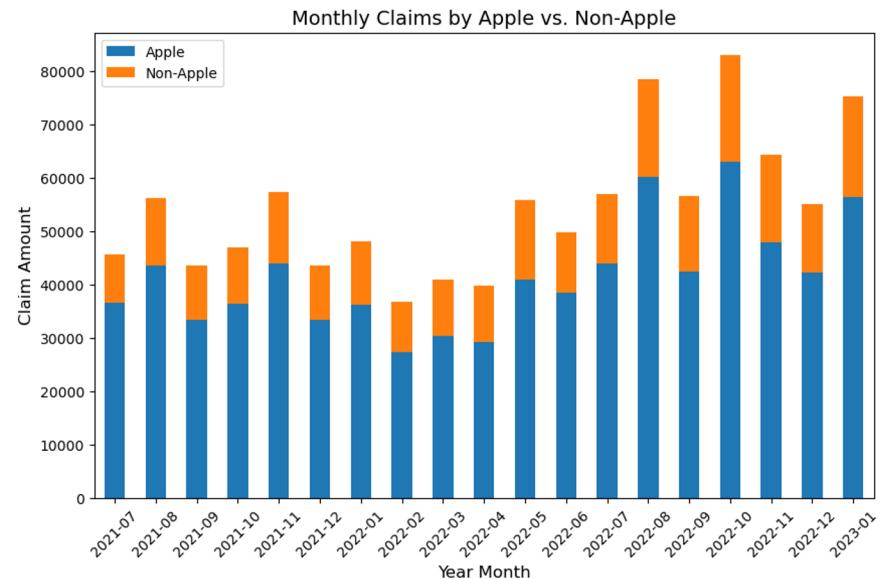
Each row:

- weeks\_monday: The Monday date of the week representing the claims for that week
- phone model: model of phone
- phone size: storage size of phone in gb
- phone color: color of phone
- claim: number of claims made for this phone model of this color and storage size for this week

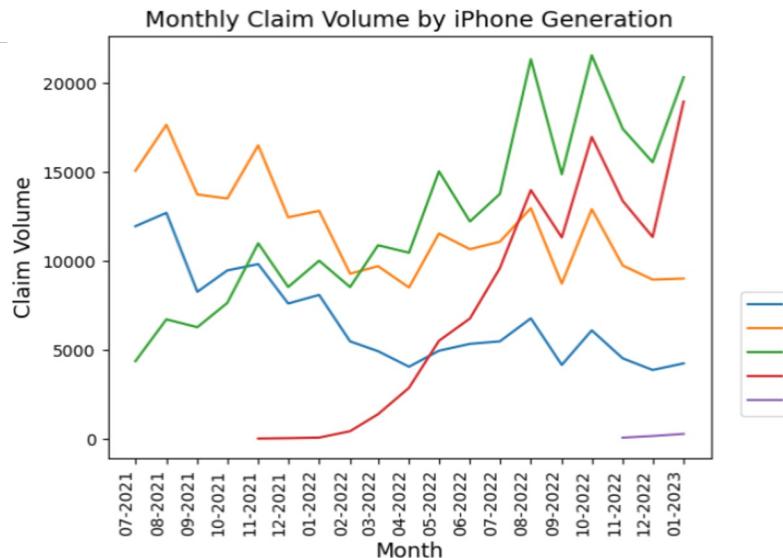
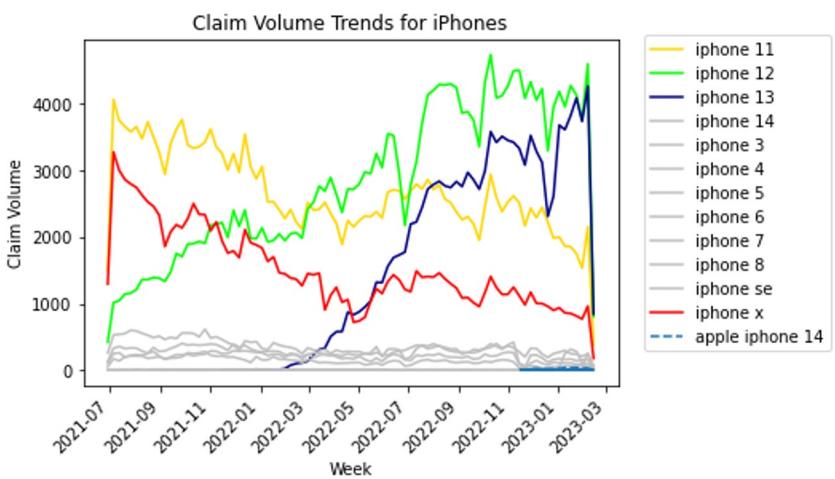
Challenges of Working with this Data:

- majority of phone models do not have data starting from their release dates

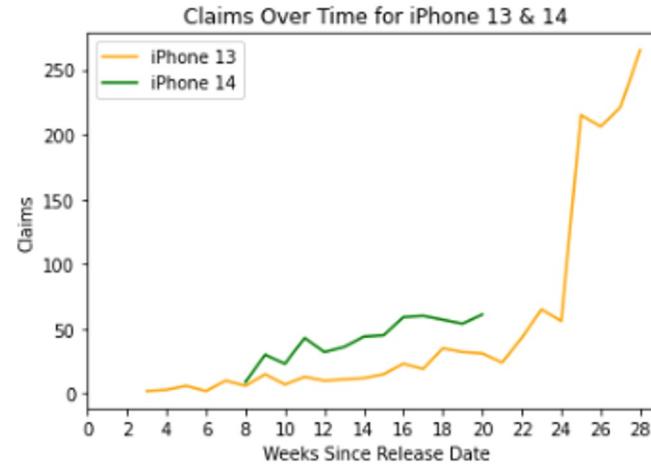
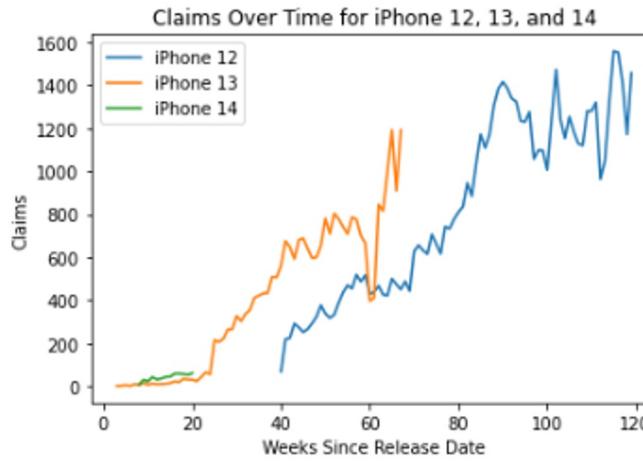
# Data Exploration



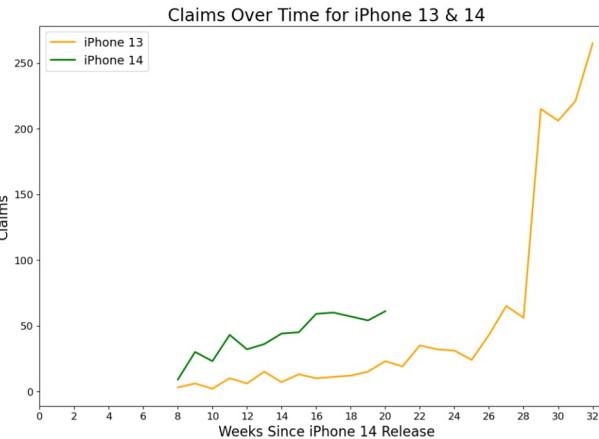
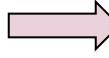
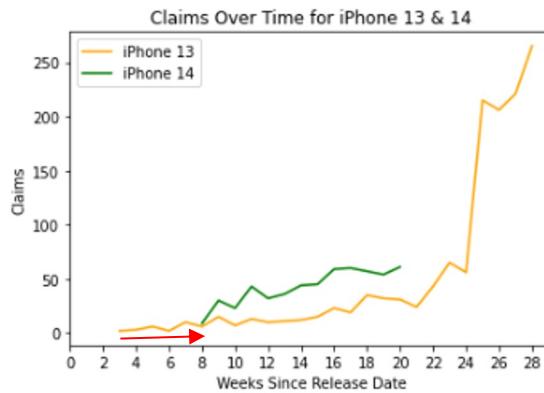
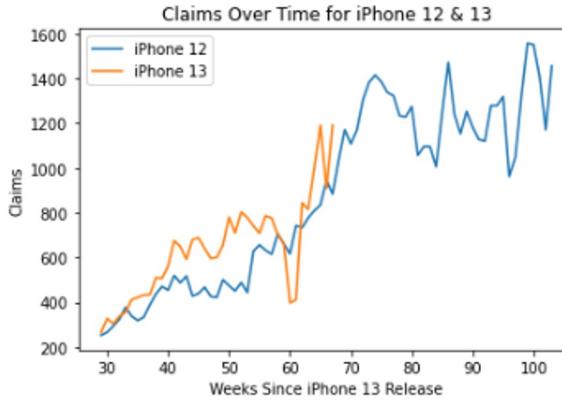
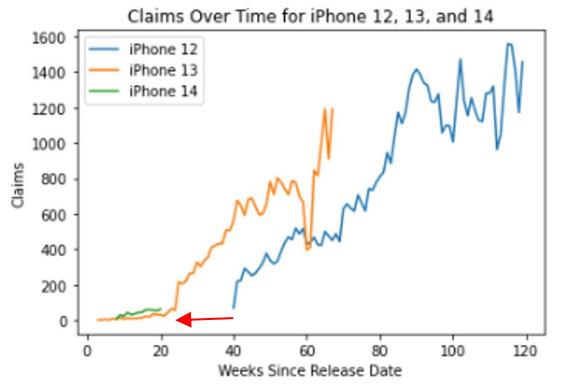
# Data Exploration



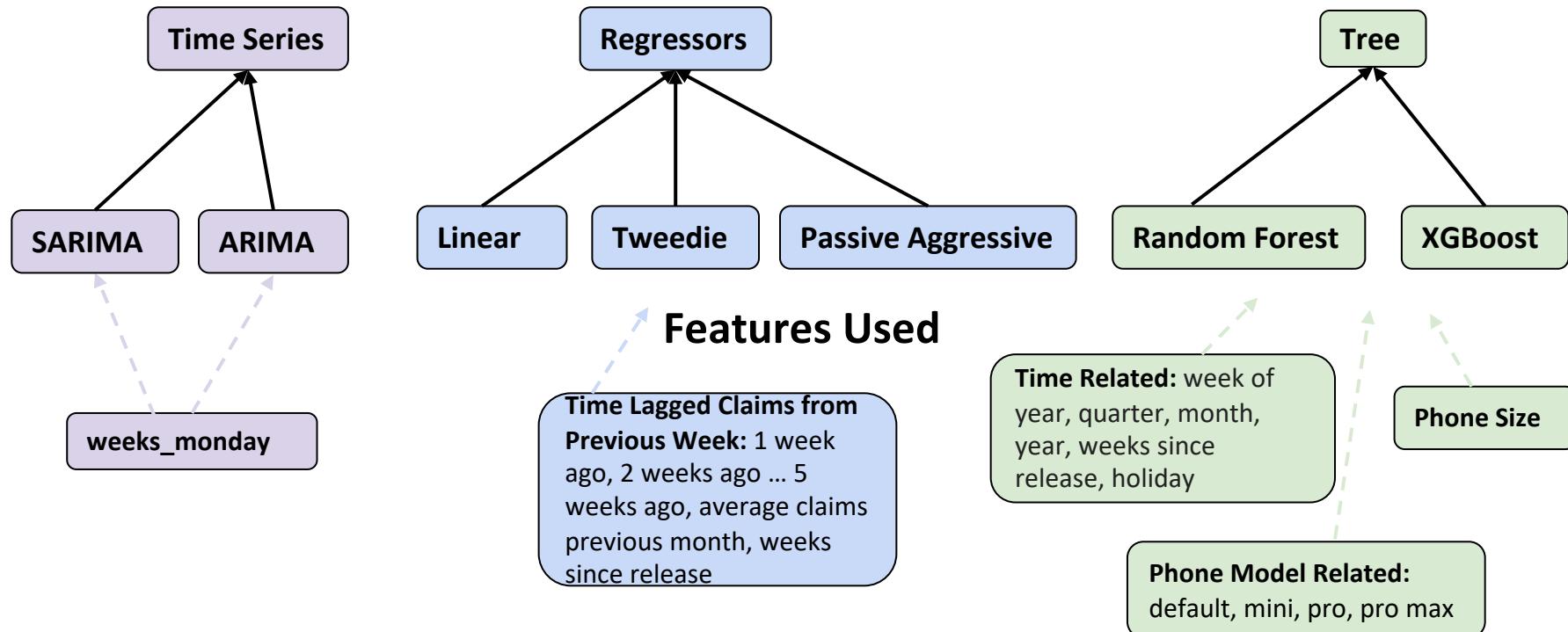
# Data Exploration



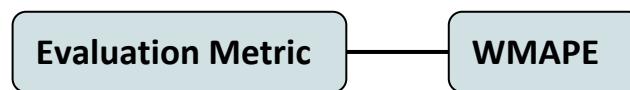
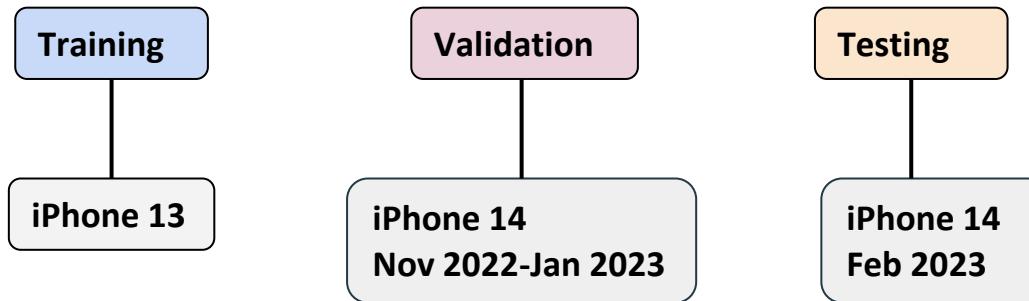
# Data Preprocessing–Time Series Alignment



# Models Trained



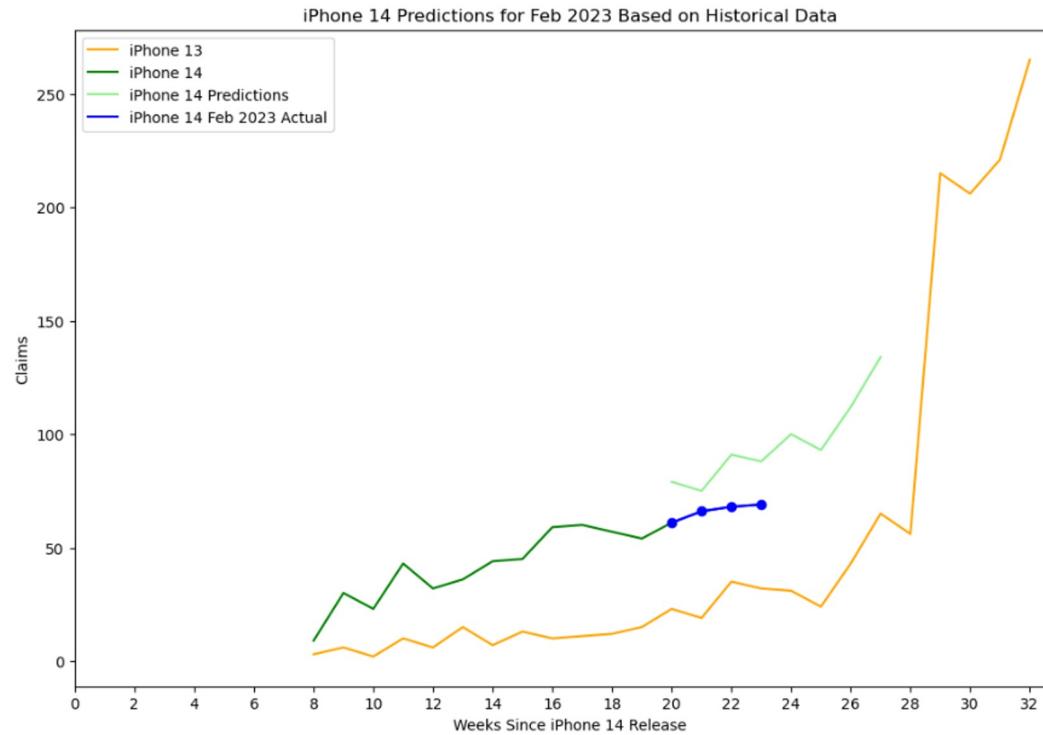
# Model Preparation & Evaluation



# Comparison of Model Performance

Model	WMAPE for Nov 2022-Jan 2023 iPhone 14	WMAPE for Nov 2022-Feb 2023 iPhone 14	WMAPE for Feb 2023 iPhone 14
ARIMA	14.25%	18.52%	26.26%
Tweedie Regressor	11.88%	10.12%	5.74%
Passive Aggressive Regressor	8.75%	6.73%	1.45%
Linear Regression	26%	19.43%	4.89%
Random Forest	61%	59%	58%
XGBoost	61%	73%	77%

## WMAPE of Baseline Model (that uses just historical data to predict February 2023 without machine learning)



WMAPE: 26%

## Comparison of Model Performance

Model	WMAPE for Nov 2022-Jan 2023 iPhone 14	WMAPE for Nov 2022-Feb 2023 iPhone 14	WMAPE for Feb 2023 iPhone 14
ARIMA	14.25%	18.52%	26.26%
Tweedie Regressor	11.88%	10.12%	5.74%
Passive Aggressive Regressor	9.31%	6.61%	1.78%
Linear Regression	26%	19.43%	4.89%
Random Forest	61%	59%	58%
XGBoost	61%	73%	77%

# Method 1- time series model

Model: ARIMA

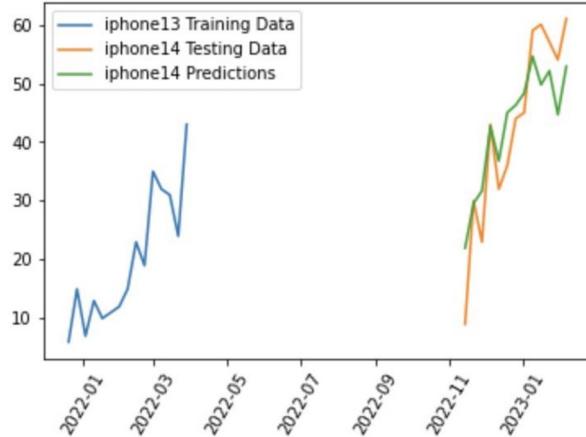
Train: iphone13 : weeks since release<=20

Test1: All iphone 14: **without February**

Train: iphone13 : weeks since release<=20

Test2: All iphone 14 **with February**

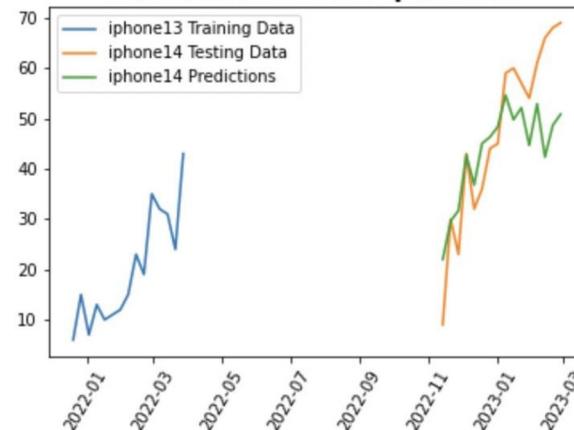
**ARIMAX model for iphone14**



WMAPE: 14.25%

VS

**ARIMAX model for iphone14**



WMAPE: 18.52%

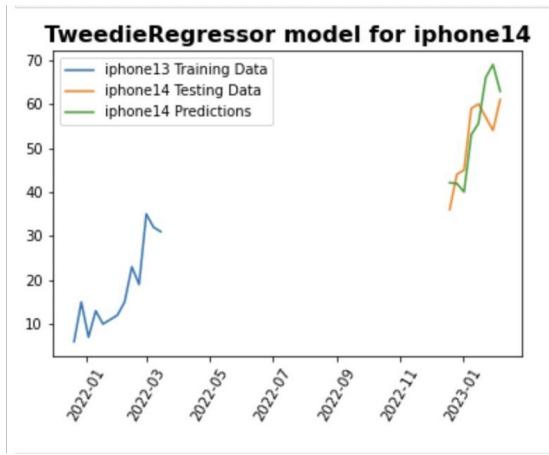
# Method 2- shifted dataset

Train: all iphone 13 : **weeks\_since\_release<=20**  
Test1: all iphone 14 **without February**

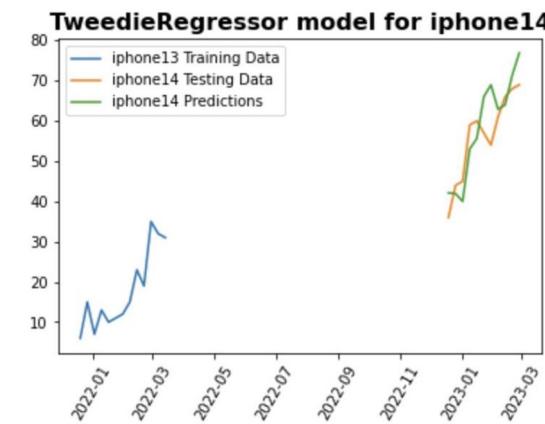
Train: all iphone 13 : **weeks\_since\_release<=20**  
Test2: all iphone 14 **with February**



Best Model: Tweedie Regressor



WMAPE: 11.88%  
R-Squared: 0.49



WMAPE: 10.12%  
R-Squared: 0.72



## Method 2- shifted dataset

train data: all iphone 13

test data1: all iphone 14 **without February**

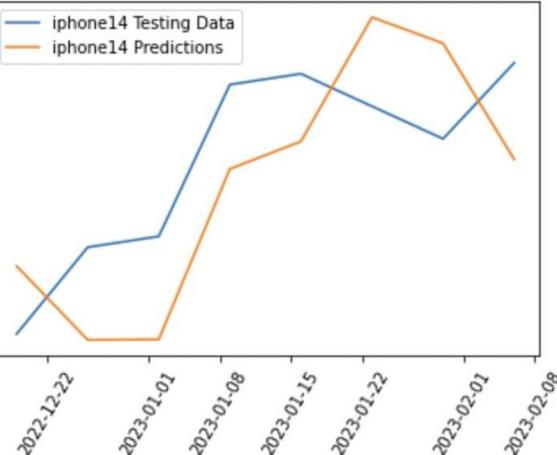
train data: all iphone 13

test data2: all iphone 14 **with February**



**Best Model: Passive Aggressive Regressor**

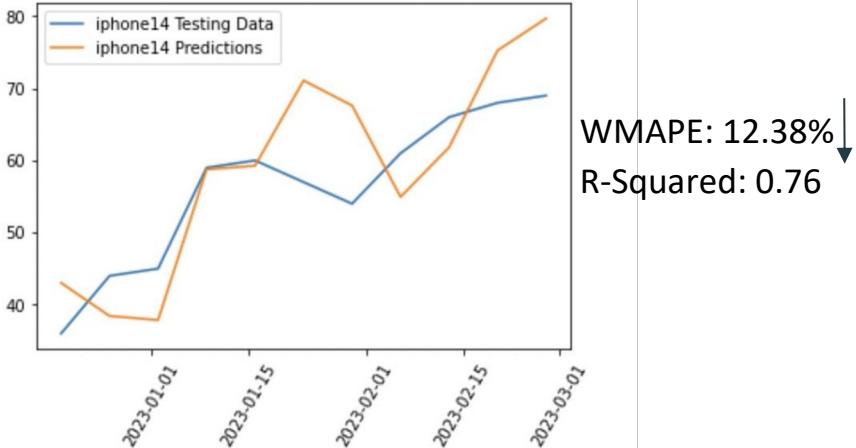
**PassiveAggressiveRegressor for iphone14**



WMAPE: 15.44%

R-Squared: 0.55

**PassiveAggressiveRegressor for iphone14**



WMAPE: 12.38%

R-Squared: 0.76

## Method 2- shifted dataset

train data: all iphone 12

test data1: all iphone 14 **without February**

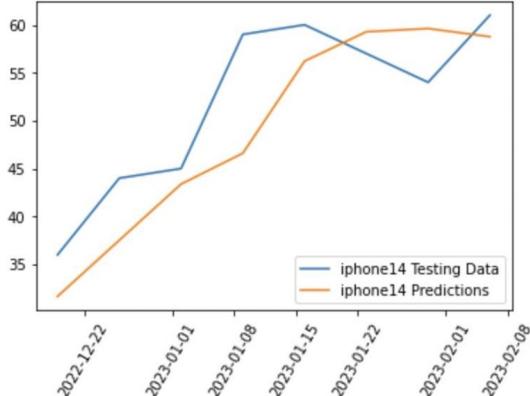
train data: all iphone 12

test data2: all iphone 14 **with February**



**Best Model: Passive Aggressive Regressor**

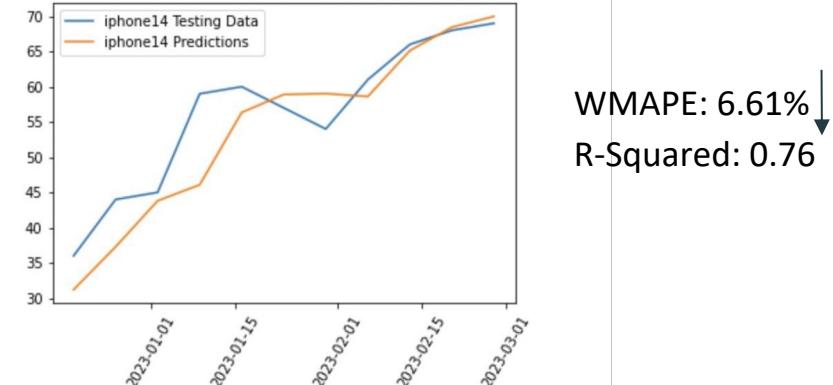
PassiveAggressiveRegressor model for iphone14



WMAPE: 9.31%

R-Squared: 0.46

PassiveAggressiveRegressor model for iphone14

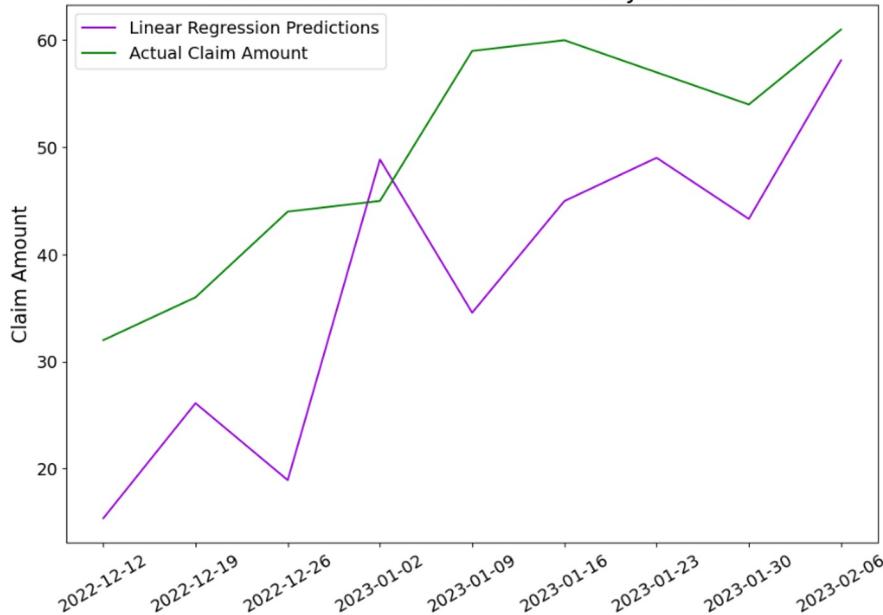


WMAPE: 6.61%

R-Squared: 0.76

# But a Dropping WMAPE may not be good...

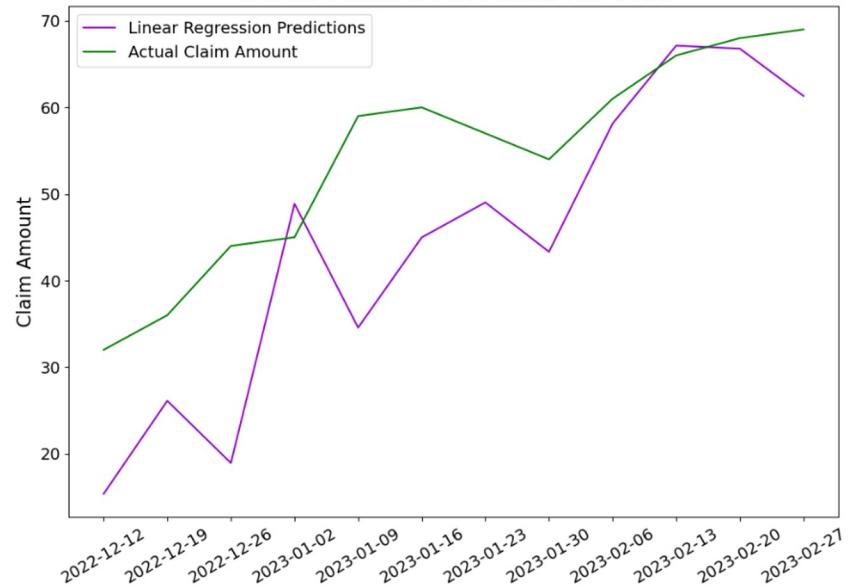
Validation on iPhone 14 Nov 2022-Jan 2023



Root Mean squared error for Linear Regression model is: 15.004998578831795  
WMAPE: 25.99%

WMAPE: 26%

Test on iPhone 14 Nov 2022-Feb 2023



Root Mean squared error for Linear Regression model is: 13.191166745608337  
WMAPE: 19.43%

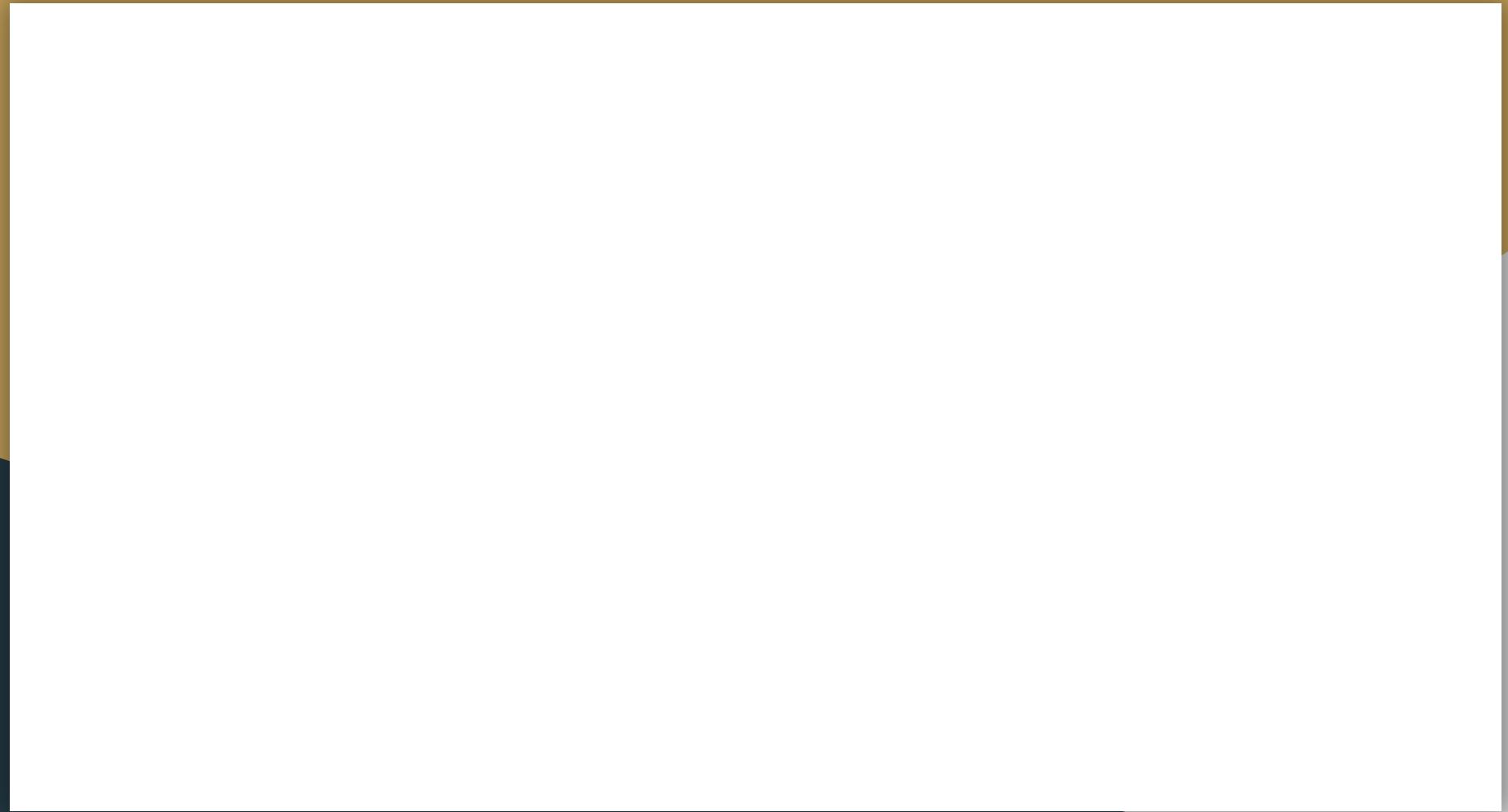
WMAPE: 19%

# Conclusion

1. **Weeks since release** more standardized than **days since release**
2. **Time Lag Features** with Regressors seem to achieve higher performance than **time related features** with phone size, model, etc. with Tree Based Models but must be cautious of true model fit
3. Time Series **Alignment** Preprocessing Step → Improves Performance
4. Be careful of predicting **more than 1 week out**
5. Examine **historic data** for *older iPhone Models* (12 and before) half a year out from their respective release dates & note their trends

# Q&A

*Thanks for listening!*



**older draft slides  
after this**

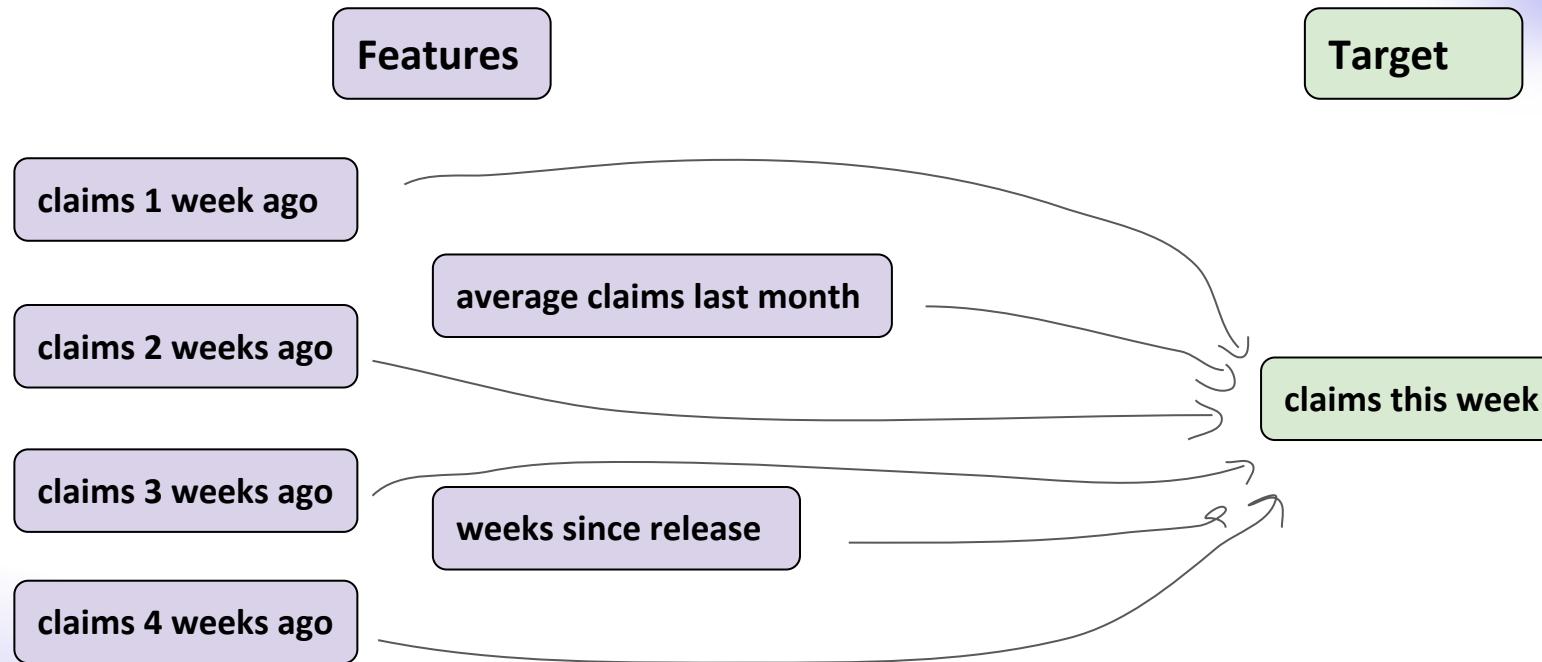
## Shift data:

“1 week ago”

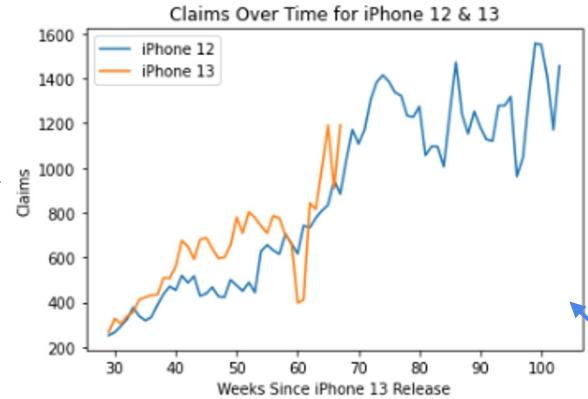
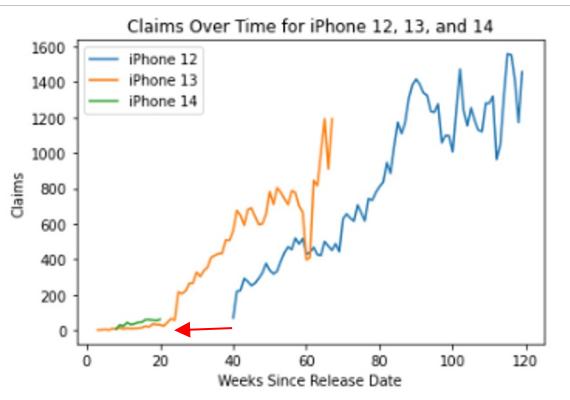
	claim	claim_lag1	claim_lag2	claim_lag3	claim_lag4	claim_lag5
weeks_monday						
2021-12-20	6	10.00	2.00	6.00	3.00	2.00
2021-12-27	15	6.00	10.00	2.00	6.00	3.00
2022-01-03	7	15.00	6.00	10.00	2.00	6.00
2022-01-10	13	7.00	15.00	6.00	10.00	2.00
2022-01-17	10	13.00	7.00	15.00	6.00	10.00
2022-01-24	11	10.00	13.00	7.00	15.00	6.00
2022-01-31	12	11.00	10.00	13.00	7.00	15.00
2022-02-07	15	12.00	11.00	10.00	13.00	7.00
2022-02-14	23	15.00	12.00	11.00	10.00	13.00

Add 5 lagged features for the claim variable

## Linear Regression with Lag Method—Features & Target

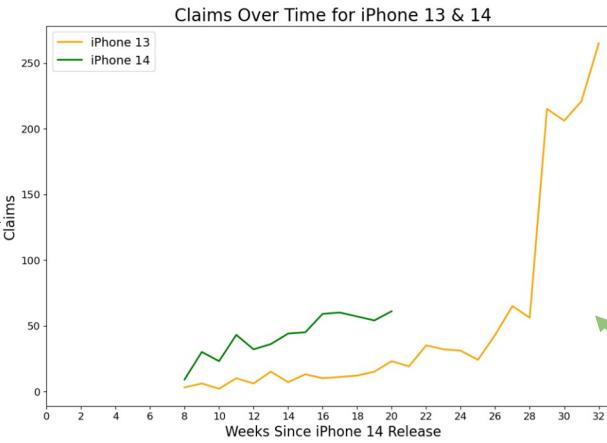
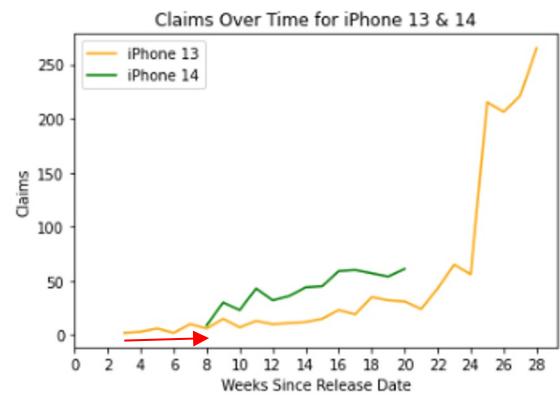


# Linear Regression with Lag Method—Time Series Alignment



month	claim_12	claim_13	growth_rate	diff
4	170.666667	159.00	-6.835937	-11.666667
5	275.400000	276.20	0.290487	0.800000
6	339.250000	381.25	12.380251	42.000000
7	407.000000	470.50	15.601966	63.500000
8	481.000000	631.20	31.226611	150.200000
9	438.500000	631.00	43.899658	192.500000
10	471.000000	745.00	58.174098	274.000000
11	632.750000	752.75	18.964836	120.000000

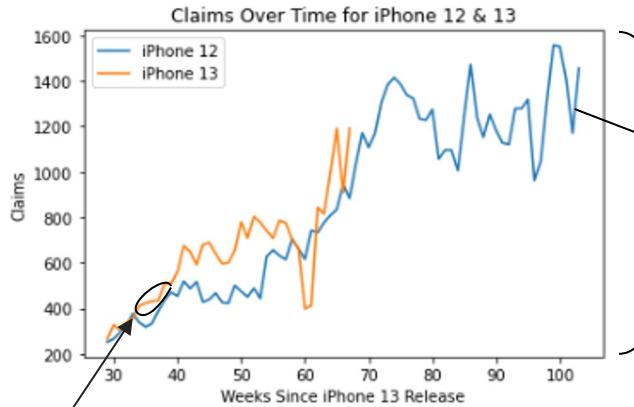
iPhone 12 & iPhone 13  
aligned to iPhone 13



month	claim_13	claim_14	growth_rate	diff
11	3.666667	20.666667	463.636364	17.00
12	9.500000	38.750000	307.894737	29.25
1	12.200000	55.000000	350.819672	42.80

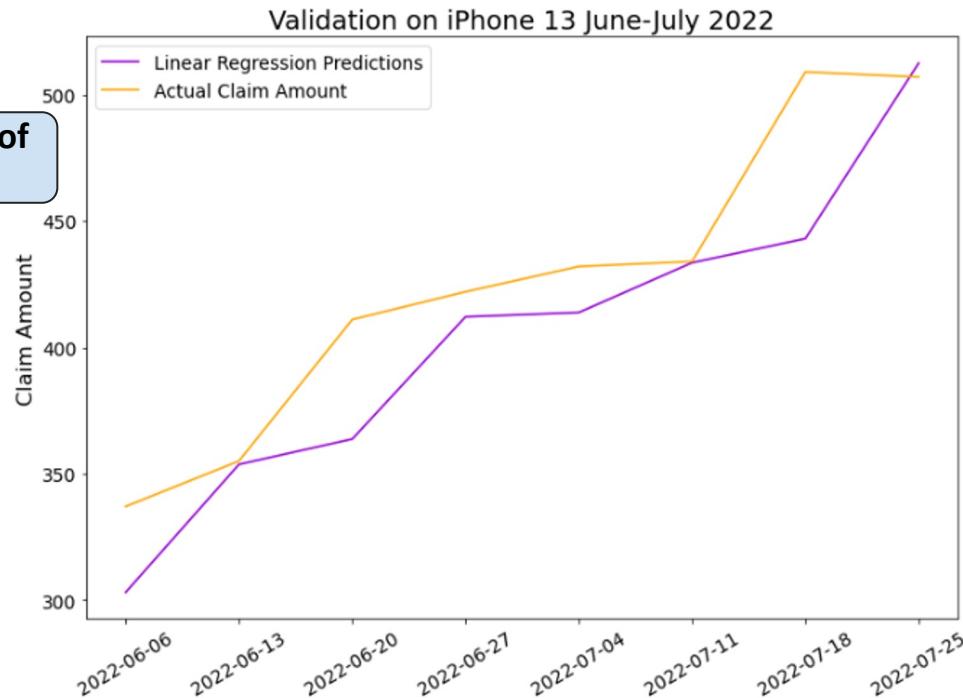
iPhone 13 & iPhone 14  
aligned to iPhone 14

# Linear Regression with Lag Method—Train iPhone 12, Validate iPhone 13



train on all of  
iPhone 12

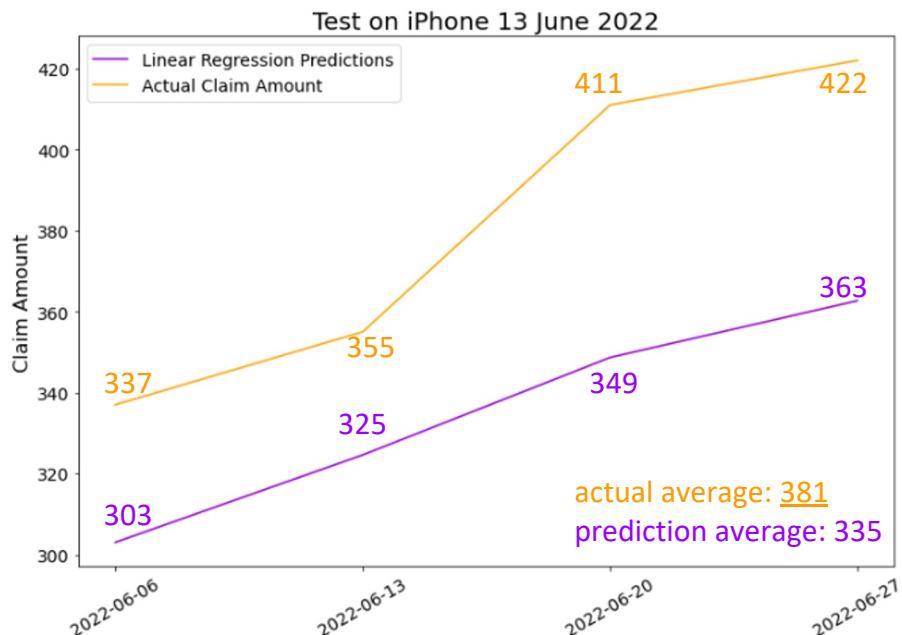
validate on June & July  
2022 of iPhone 13



WMAPE: 5.36%

! But Wait, Overly Optimistic  
Predictions !

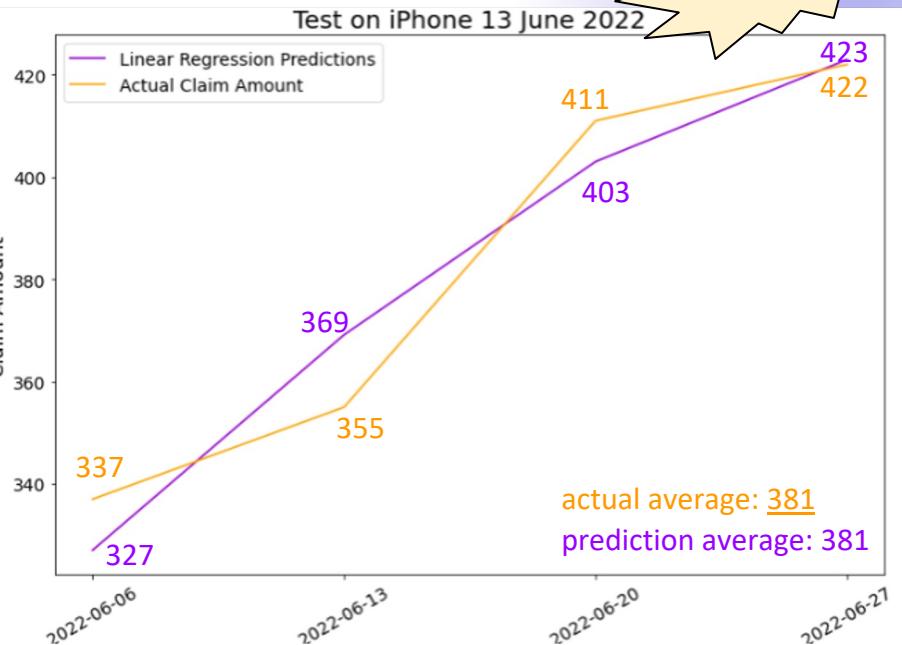
# Linear Regression with Lag Method—Validate iPhone 13 June 2022



WMAPE: 12.2 %

Raw difference in Average Claims for June between iPhone 13 & 12 = 42 (381 - 339)

Add 24 at each Prediction  
(before making next prediction)

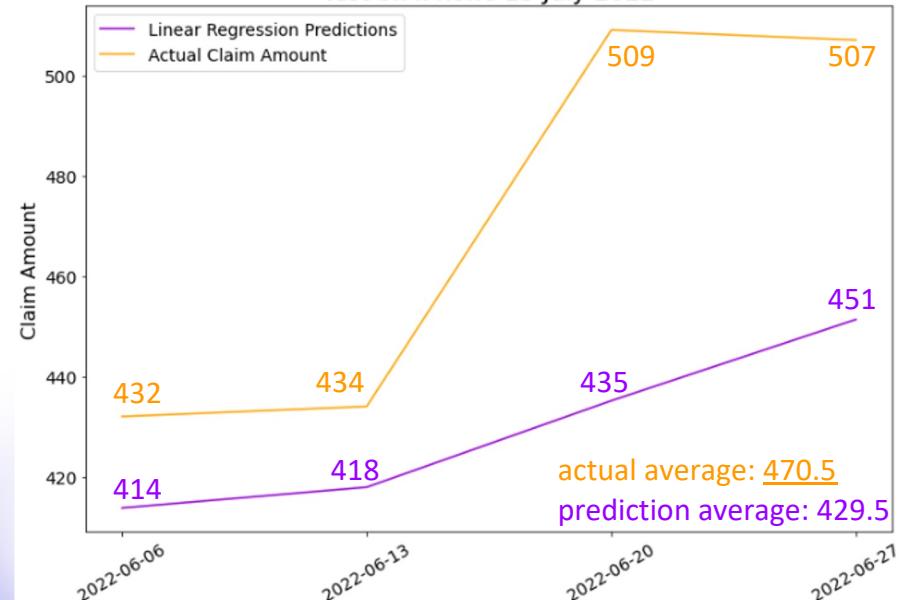


WMAPE: 2.2%

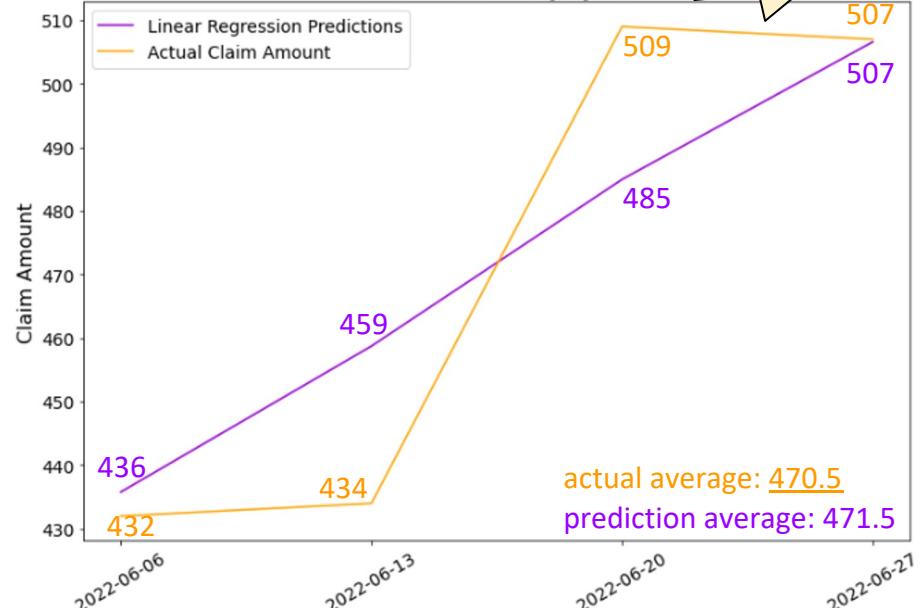
# Linear Regression with Lag Method—Validate iPhone 13 July 2022

Adjusted

Test on iPhone 13 July 2022



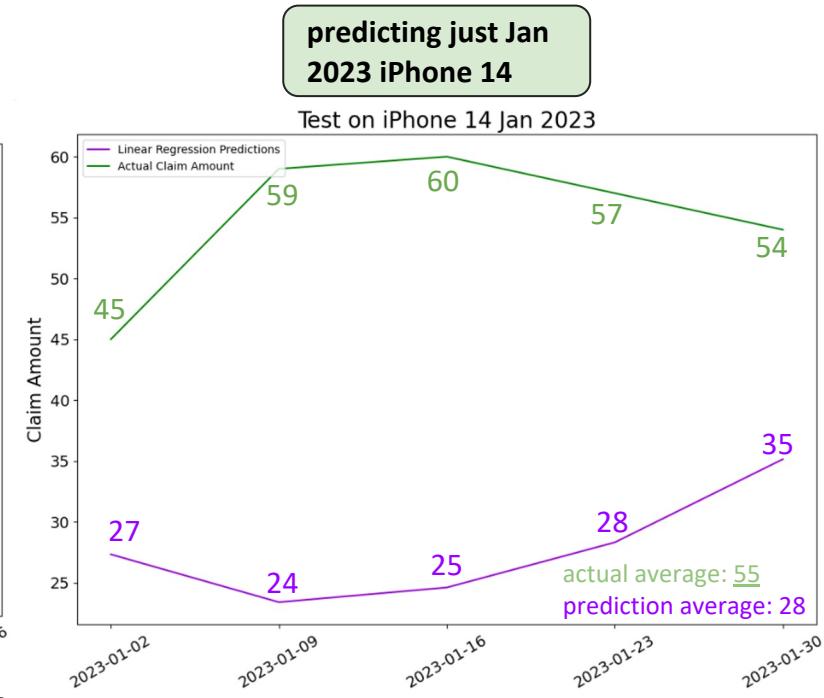
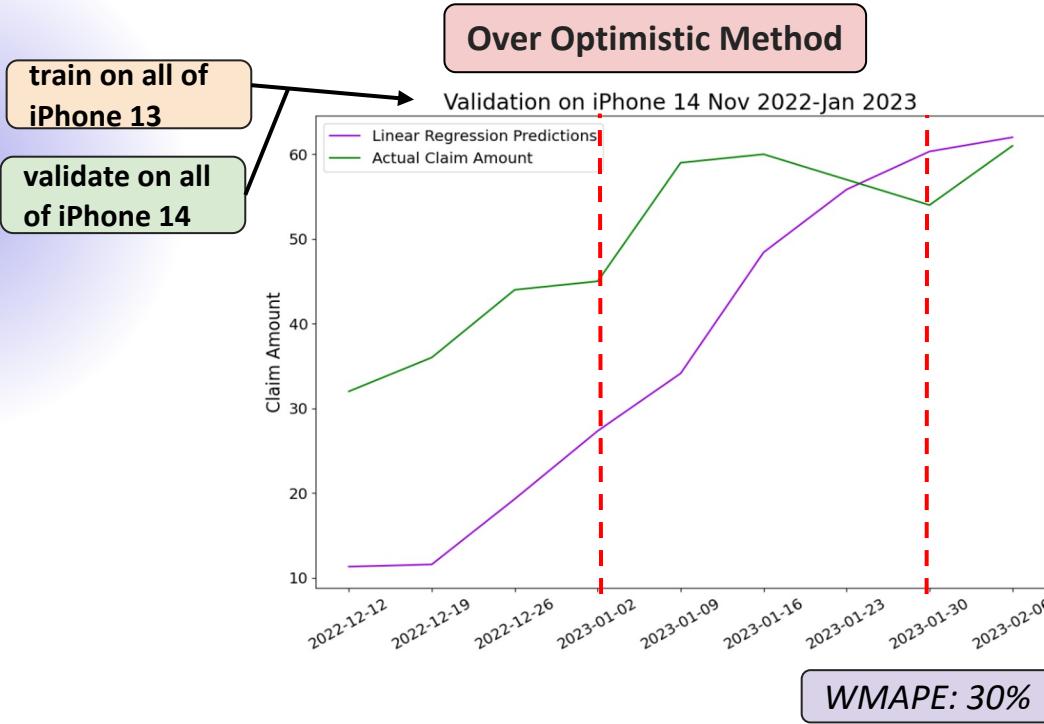
Test on iPhone 13 July 2022



Raw difference in Average Claims for July between iPhone 13 & 12 = 63.5  
(470.5 - 407)

Add 22 at each Prediction  
(before making next prediction)

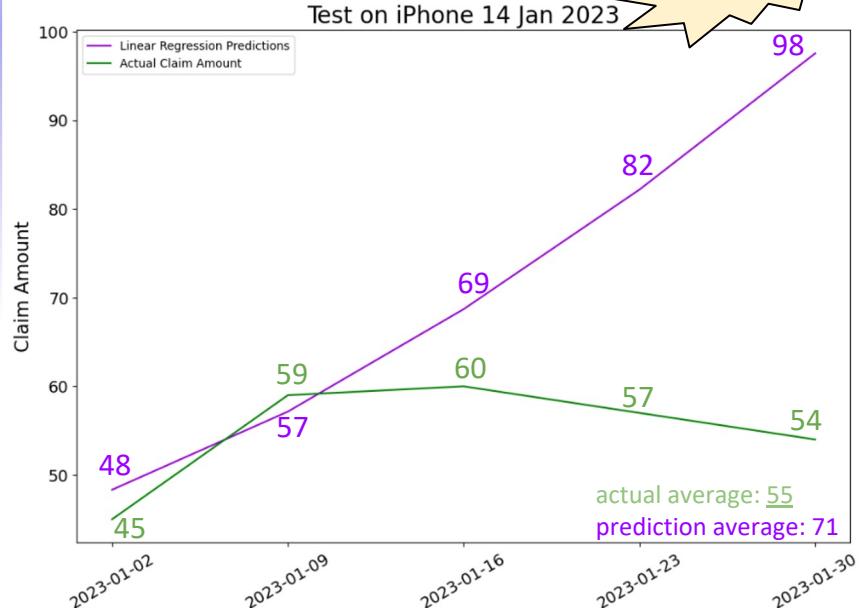
# Linear Regression with Lag Method—Train iPhone 13, Validate iPhone 14



# Linear Regression with Lag Method—Validate iPhone 14 Jan 2023 with Adjustments

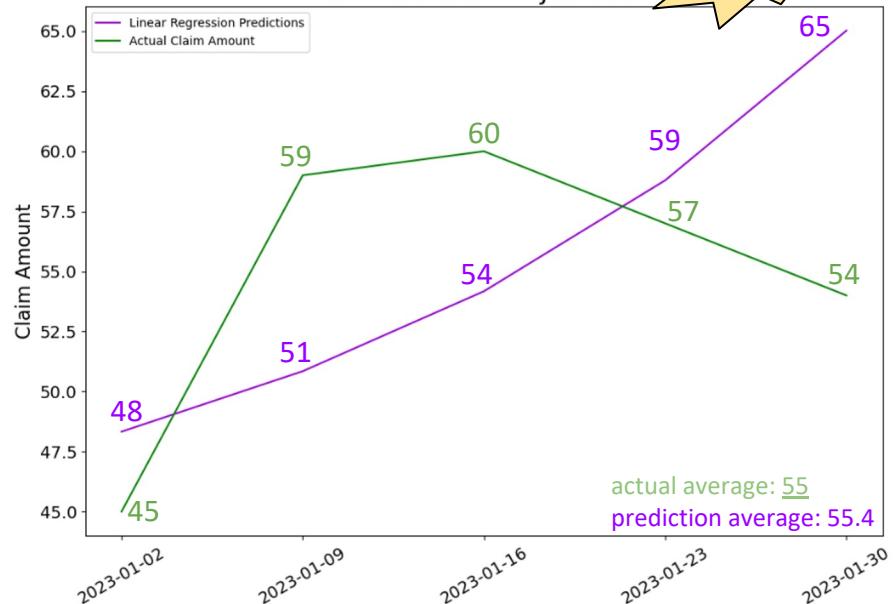
Test on iPhone 14 Jan 2023

Adjusted



Test on iPhone 14 Jan 2023

Adjusted Again



Raw difference in Average Claims for Jan between iPhone 14 & 13 = 43 (55-12)

Add 21 at each Prediction  
(before making next prediction)

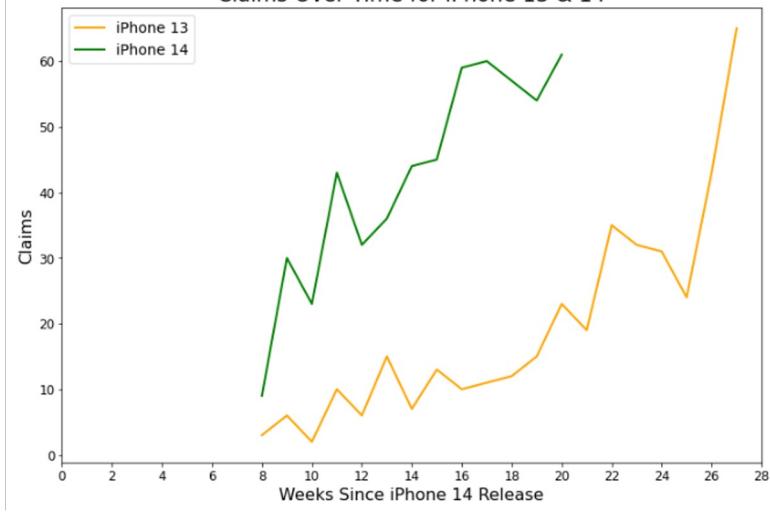
Initially Add 21 and each subsequent prediction Add 70% of previous addition

# Predicting iPhone 14 Feb & March 2023 Using Historical Data from iPhone 13 (with Alignment to iPhone 14)

month	claim_13	claim_14	growth_rate	diff
11	3.666667	20.666667	463.636364	17.00
12	9.500000	38.750000	307.894737	29.25
1	12.200000	55.000000	350.819672	42.80
2	27.25	83.25	206	
56	3	40.75	110	170
69				

$+ 12.25 \rightarrow (12.25 + 13.55) / 2 \approx 13$   
 $+ 13.55$   
 $+ 13$   
 $+ 13$

Claims Over Time for iPhone 13 & 14



# Predicting iPhone 14 Feb & March 2023 Using Historical Data from iPhone 13 (with Alignment to iPhone 14)

month	claim_13	claim_14	growth_rate	diff
11	3.666667	20.666667	463.636364	17.00
12	9.500000	38.750000	307.894737	29.25
1	12.200000	55.000000	350.819672	42.80
2	27.25	83.25	206	
	56			
3	40.75	110	170	
	69			



weeks_monday	weeks_since_release	this_week
2022-02-06	20	23
2022-02-13	21	19
2022-02-20	22	35
2022-02-27	23	32
2022-03-06	24	31
2022-03-13	25	24
2022-03-20	26	43
2022-03-27	27	65

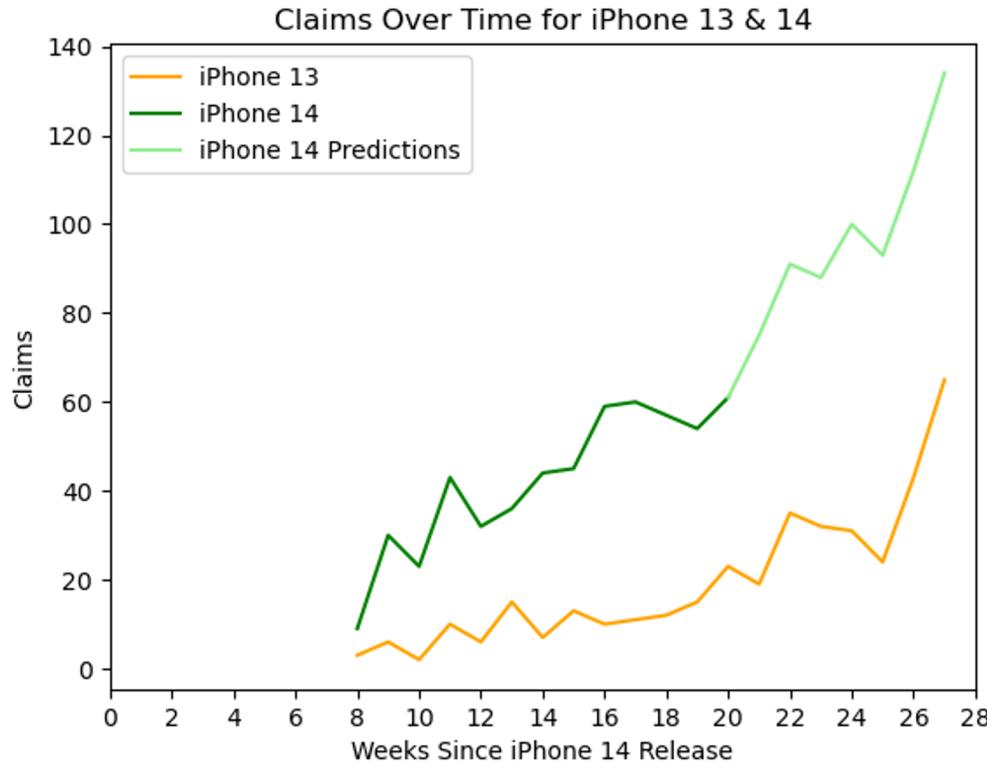
+ 56

+ 69



Weeks Monday	Weeks Since Release	Claims This Week
2/6/23	20	79
2/13/23	21	75
2/20/23	22	91
2/27/23	23	88
3/6/23	24	100
3/13/23	25	93
3/20/23	26	112
3/27/23	27	134

# Predicting iPhone 14 Feb & March 2023 Using Historical Data from iPhone 13 (with Alignment to iPhone 14)



Weeks Monday	Claims This Week
2/6/23	79
2/13/23	75
2/20/23	91
2/27/23	88
3/6/23	100
3/13/23	93
3/20/23	112
3/27/23	134