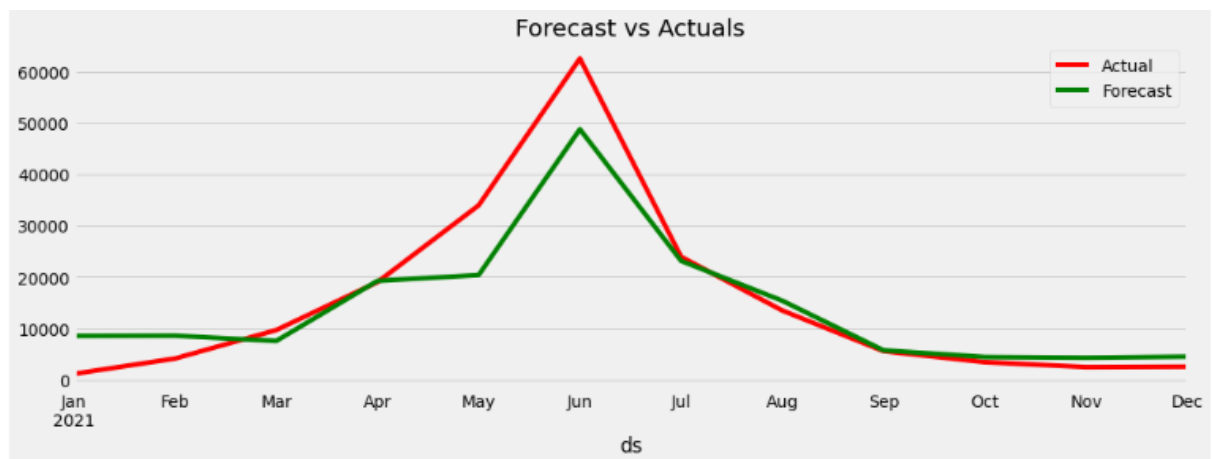


Time Series Analysis-

- **Univariate analysis using FB Prophet - Brand ID 1 (monthly data)**

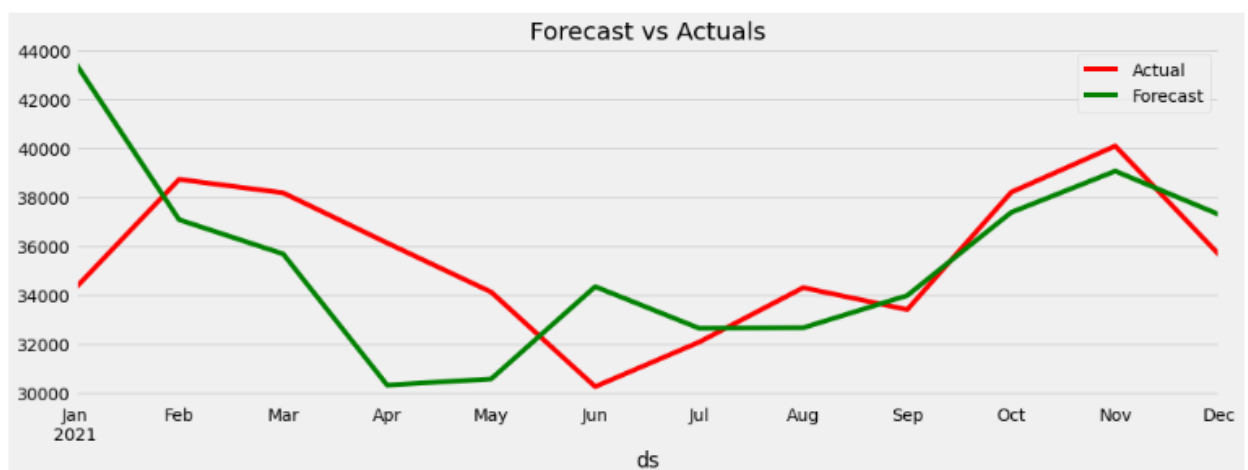
- we have focused only on ID -1 in this case, brand Sunnyside.
- We will train using 2 years of data and forecast 12 months in 2021
- Assumed these brands are from Germany and used holidays of Germany
- Used several Hyperparameter tuning using parametergrid
- Ran 200 models to find the best suitable hyperparameters
- Created regressors for main season (April to July) & peak season (June month)
- Seasonality is set to yearly

For base model, without any drivers – we have obtained this result for a 12 month window



- **Univariate analysis - Brand ID 2 (monthly data)**

- Similarly used ID-2 data
- Mape of 7.34 for the year 2021
- Used 24 data points for training and 12 for prediction



- **Univariate analysis for brand ID-2 using Holt winters (3 models)**

- **3 months forecast – 33 months training & 3 months test**

	Date	Sales	forecast_sales	diff
0	2021-10-01 00:00:00.000000	38221	35703.978440	6.585441
1	2021-11-01 00:00:00.000000	40110	36125.155251	9.934791
2	2021-12-01 00:00:00.000000	35656	34745.503185	2.553558

- **6 months forecast - 30 months training & 6 months test**

	Date	Sales	forecast_sales	diff
0	2021-07-01 00:00:00.000000	32092	31511.496212	1.808874
1	2021-08-01 00:00:00.000000	34319	29687.467578	13.495534
2	2021-09-01 00:00:00.000000	33420	33164.893409	0.763335
3	2021-10-01 00:00:00.000000	38221	34310.360779	10.231651
4	2021-11-01 00:00:00.000000	40110	34203.659820	14.725356
5	2021-12-01 00:00:00.000000	35656	32171.010170	9.773923

- **12 months forecast - 24 months training & 12 months test**

	Date	Sales	forecast_sales	diff
0	2021-01-01 00:00:00.000000	34289	33969.078671	0.933014
1	2021-02-01 00:00:00.000000	38746	34296.897188	11.482741
2	2021-03-01 00:00:00.000000	38195	35845.746534	6.150683
3	2021-04-01 00:00:00.000000	36145	34369.698374	4.911611
4	2021-05-01 00:00:00.000000	34139	36047.183265	5.589453
5	2021-06-01 00:00:00.000000	30271	34562.272099	14.176182
6	2021-07-01 00:00:00.000000	32092	36314.104968	13.156254
7	2021-08-01 00:00:00.000000	34319	35475.239926	3.369096
8	2021-09-01 00:00:00.000000	33420	39510.612379	18.224454
9	2021-10-01 00:00:00.000000	38221	39838.430896	4.231786
10	2021-11-01 00:00:00.000000	40110	41387.280242	3.184443
11	2021-12-01 00:00:00.000000	35656	39911.232082	11.934126

Hierarical-sales-forecsting

- The hierarchy in this dataset is the following
 - The brand of the company Fealgood GmbH & Co.KG is called Joylift and contains 16 products.
 - The brand of the company SunnyTude Ltd. is called Sunnyside and contains 86 products.

Hierarchical Structure Tree for sales data of Joylift & Sunnyside

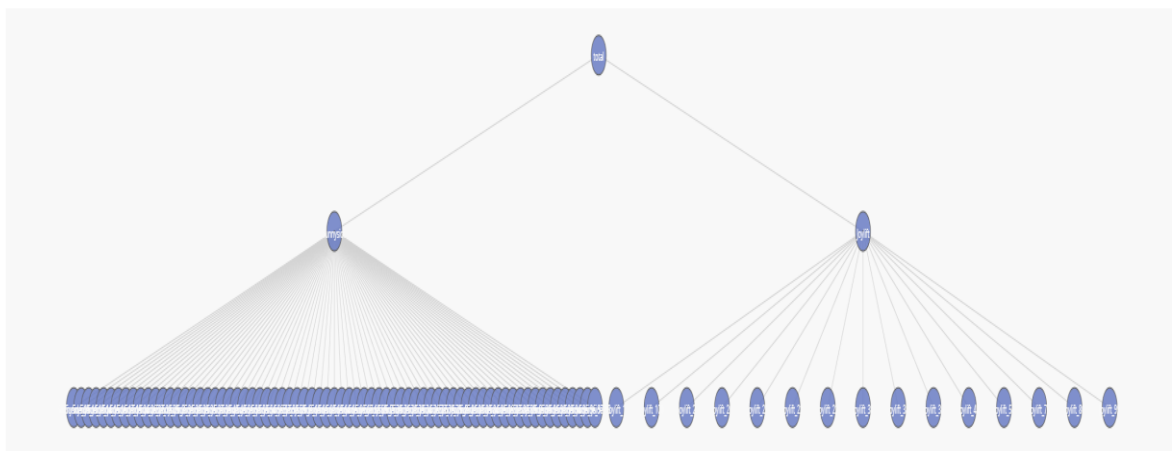


Image here doesn't look good but it's basically representation of Hierarchy. Per brand & product

Data exploration -

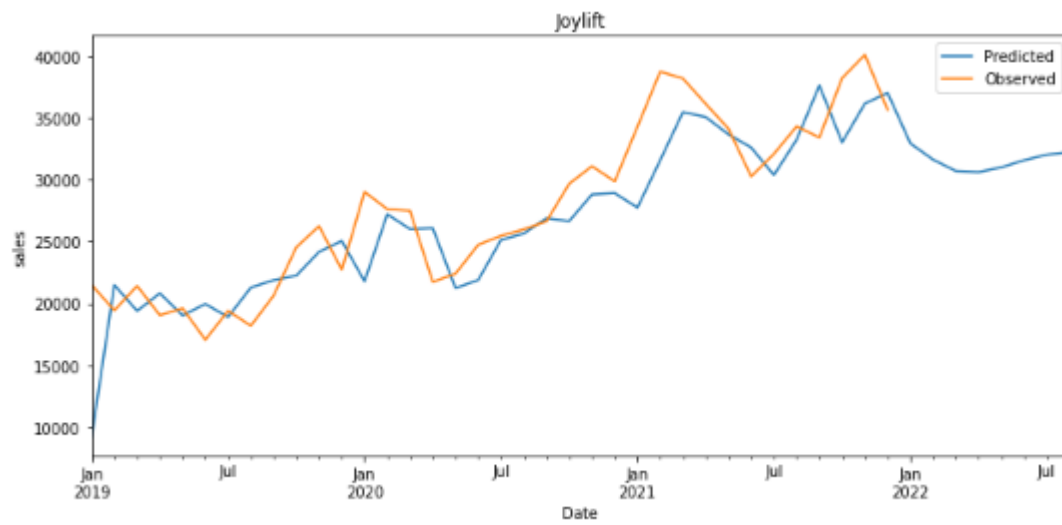
unique_bottom_id	Joylift_1	Joylift_100	Joylift_2	Joylift_20	Joylift_21	Joylift_22	Joylift_23	Joylift_30	Joylift_34	Joylift_36	...	Sunnyside_92	Sunnyside_93	Sunnyside_94	Sunnyside_95	Sunnyside_96	Sunnyside_97	Sunnyside_98	Joylift	Sunnyside	total
datetime																					
2019-01-01	460.0	NaN	1298.0	2883.0	1743.0	5214.0	348.0	1387.0	3595.0	850.0	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	21505.0	3936.0	25441.0
2019-02-01	408.0	NaN	1279.0	2319.0	1663.0	4670.0	355.0	1140.0	3550.0	834.0	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	19438.0	5818.0	25256.0
2019-03-01	457.0	NaN	1268.0	2694.0	1649.0	5277.0	404.0	1441.0	4061.0	816.0	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	21423.0	9546.0	30969.0
2019-04-01	348.0	NaN	1083.0	2106.0	1613.0	4842.0	391.0	1337.0	3737.0	655.0	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	19049.0	20003.0	39052.0
2019-05-01	302.0	NaN	1238.0	2308.0	1905.0	4919.0	302.0	1426.0	3388.0	737.0	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	19604.0	24114.0	43718.0

5 rows × 89 columns

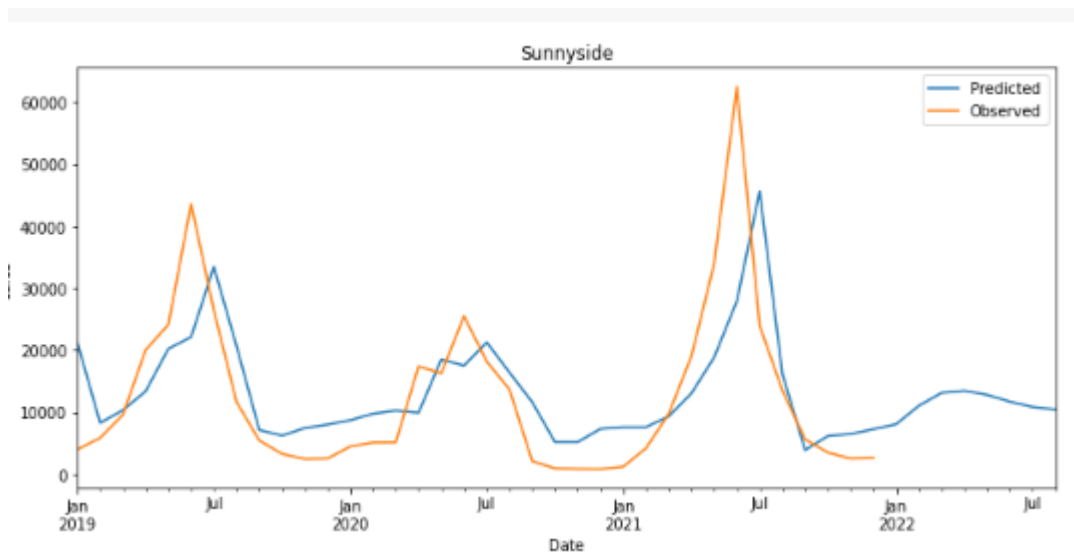
5 rows × 89 columns

Auto Arima results –

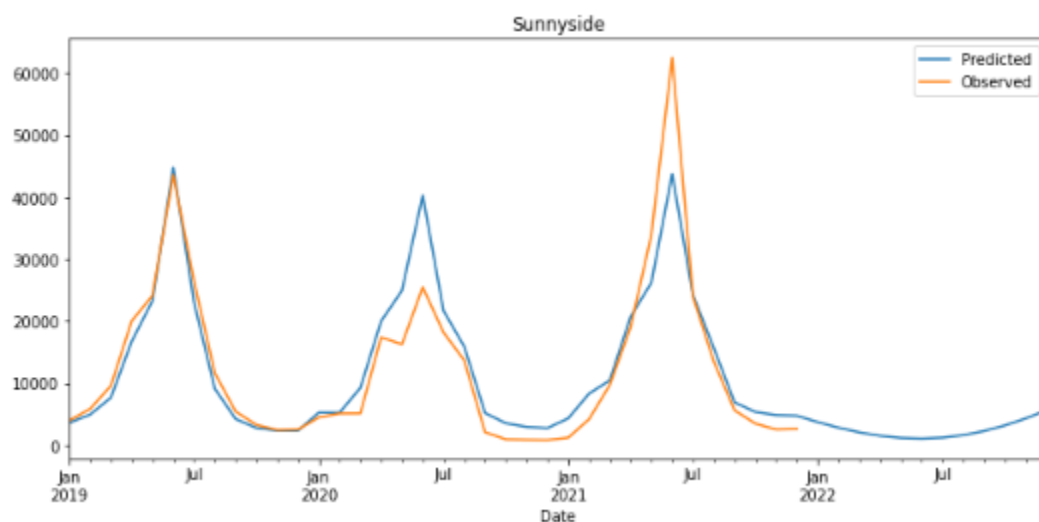
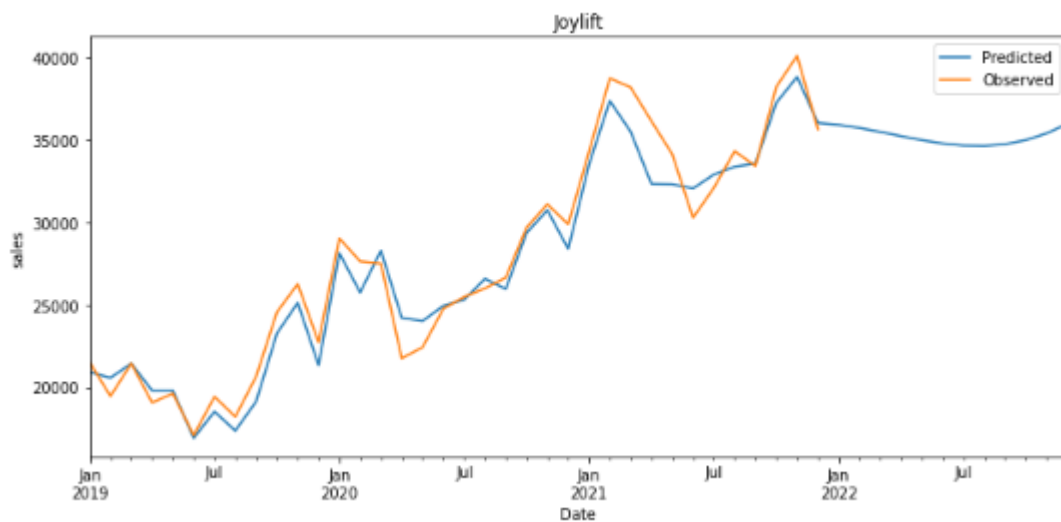
Joylift



Sunnyside



FB Prophet results –



This is basically product level forecasting, results are not satisfactory but let's just look it as a base model. We will need to dig deeper, understand each product or at least their core group's details, business drivers, sale drivers etc in order to forecast on product level accurately.