Model selection

AutoARIMA

Exogeneous regressors

- Separation per store
- Numerical : price
- Numerical (price) + categorical (holiday, season, cluster_id, promo_type_1)

Train, Validation , Forecast

No Exog. regressors

- Separation per store
- All products with sales in 2019
- Cluster
- Cross validation (3-cutoff)
- 2 data ranges (year split)
  - 2017-2019
  - 2018-2019

Evaluation

Store S0030

- Price doesn't seem to favor model as exogeneous variable.
- Dificult to evaluate per cluster.
- Products influence models performance (higher median value)
- Arima with data from **2017-2019 without** exogenous seems to have **lower WMAPE** value , when comparing with ARIMA Xreg and **lower RMSE** value compared with the same parameters for **clusters.**

No Exog.

store_id	unique_id	date_range	MAE	MSE	RMSE	WMAPE
S0030	all products	all data	0,571	0,644	0,802	**48,789**
		from 2018	0,597	0,727	0,853	64,218
	clusters	all data	2,844	10,392	3,195	20,370
		from 2018	2,278	7,595	2,691	19,906

No Exog. 3 best products

store_id	unique_id	date_range	MAE	MSE	RMSE	WMAPE
S0030	P0103	all data	8,608	88,094	9,386	**48,497**
		from 2018	9,172	95,881	9,792	41,666
	P0436	all data	4,267	25,722	5,072	**2,667**
		from 2018	3,937	21,419	4,628	4,367
	P0569	all data	4,767	24,562	4,956	**41,208**
		from 2018	4,924	25,503	5,050	50,109

Exog. for 3 best products (price)

store_id	unique_id	date_range	MAE	MSE	RMSE	WMAPE
S0030	P0103	all data	23,597	717,550	26,787	94,387
	P0436	all data	3,710	16,683	4,085	53,004
	P0569	all data	14,128	217,915	14,762	256,878

Evaluation

Store S0142

- Price doesn't seem to favor model as exogeneous variable.
- Dificult to evaluate per cluster.
- Products influence models performance (higher median value)
- Arima with data from **2017-2019 without** exogenous seems to have **lower WMAPE** value , when comparing with ARIMA Xreg and **lower RMSE** value compared with the same parameters for **clusters.**

No Exog.

store_id	unique_id	date_range	MAE	MSE	RMSE	WMAPE
S0142	all products	all data	0,432	0,308	0,555	**53,327**
		from 2018	0,402	0,333	0,577	59,625
	clusters	all data	6,508	61,846	7,727	31,354
		from 2018	7,320	73,839	8,471	25,710

No Exog. 3 best products

store_id	unique_id	date_range	MAE	MSE	RMSE	WMAPE
S0142	P0103	all data	5,114	36,767	6,064	**34,476**
		from 2018	4,762	39,088	6,252	32,100
	P0131	all data	2,610	8,277	2,877	**0,572**
		from 2018	5,646	40,044	6,328	34,221
	P0569	all data	3,500	17,382	4,169	**12,543**
		from 2018	5,993	53,110	7,288	83,625

Exog. for 3 best products (price)

store_id	unique_id	date_range	MAE	MSE	RMSE	WMAPE
S0142	P0103	all data	23,597	717,550	26,787	94,387
	P0131	all data	14,876	240,544	15,509	26,099
	P0569	all data	14,128	217,915	14,762	256,878

Evaluation

Store S0094

- Price doesn't seem to favor model as exogeneous variable.
- Dificult to avaluate per cluster.
- Products influence models performance (higher median value).
- Arima with data from **2017-2019 without** exogenous seems to have **lower WMAPE** value , when comparing with ARIMA Xreg and **lower RMSE** value compared with the same parameters for **clusters.**
- **Categorical** variables may be **tuned** for better product forecast with Xreg.

No Exog.

store_id	unique_id	date_range	MAE	MSE	RMSE	WMAPE
S0094	all products	all data	0,651	0,698	0,835	**54,851**
		from 2018	0,654	0,695	0,834	56,226
	clusters	all data	23,004	803,934	27,686	21,491
		from 2018	22,812	746,324	26,513	12,140

No Exog. 3 best products

store_id	unique_id	date_range	MAE	MSE	RMSE	WMAPE
S0094	P0103	all data	22,667	691,619	26,299	**66,983**
		from 2018	23,281	706,318	26,577	67,872
	P0131	all data	16,227	323,058	17,974	**20,682**
		from 2018	16,461	332,980	18,248	21,027
	P0364	all data	32,072	1589,841	39,873	20,893
		from 2018	32,062	1498,125	38,706	**19,772**

Exog. for 3 best products (price)

store_id	unique_id	date_range	MAE	MSE	RMSE	WMAPE
S0094	P0103	all data	23,597	717,550	26,787	94,387
	P0131	all data	14,876	240,544	15,509	26,099
	P0364	all data	13,817	198,282	14,081	36,846

Exog. for 3 best products (price, holiday, season, cluster_id, promo_type_1)

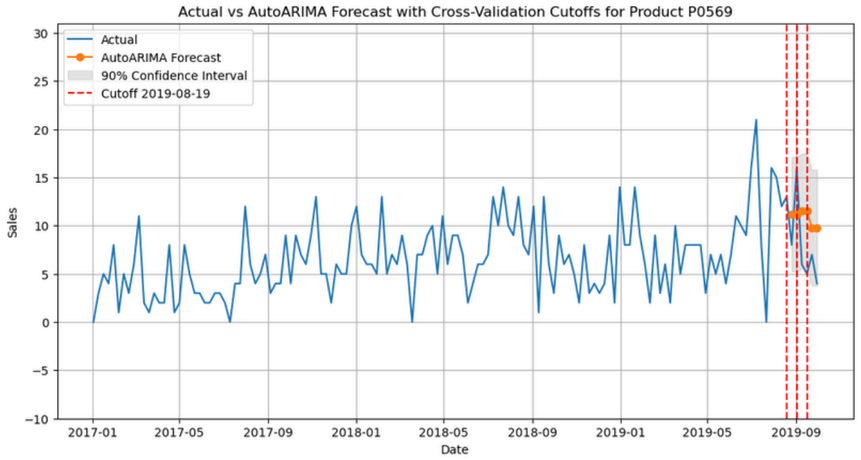
store_id	unique_id	date_range	MAE	MSE	RMSE	WMAPE
S0094	P0103	all data	22,284	614,672	24,793	88,137
	P0131	all data	16,331	297,545	17,249	28,652
	P0364	all data	7,448	85,441	9,243	19,862

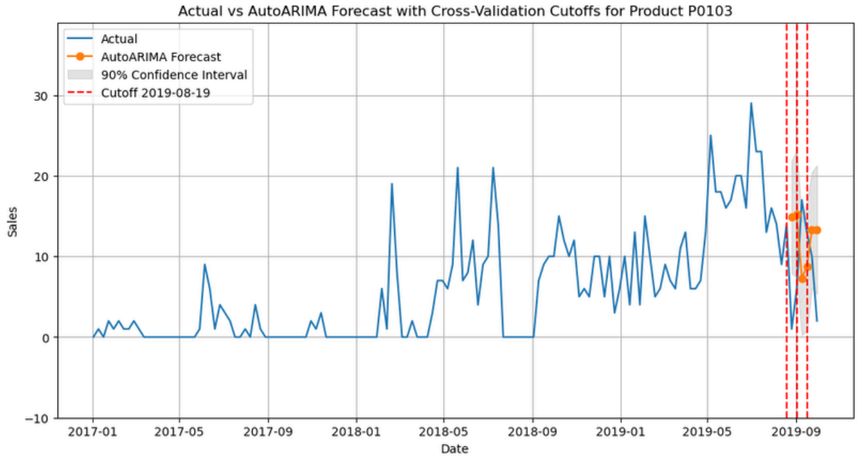
Evaluation

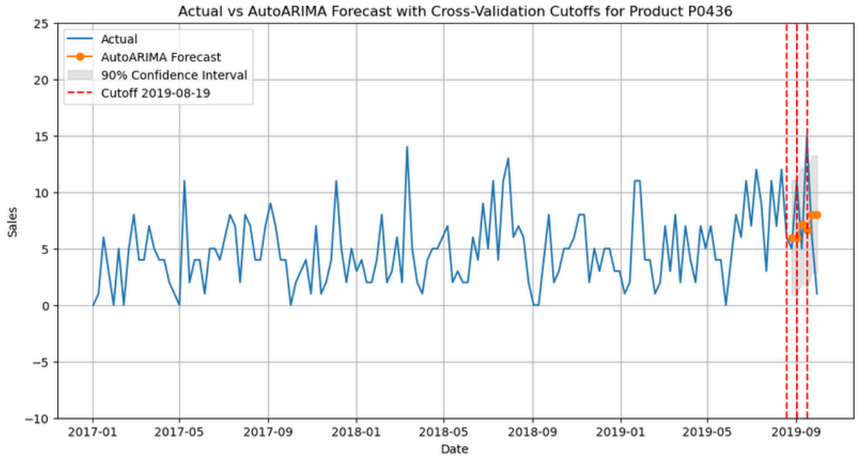
Best models

Store S0030

- **(p, d, q) = (1, 1, 2)**: The model uses one AR term, one differencing, and two MA terms to handle the non-seasonal components of the data.
- **(P, D, Q, period) = (0, 0, 0, 1): Not** considered any **seasonal components** .
- Coefficients: AR and MA coefficients quantify the influence of past values and past errors on the current value in the time series.
  - ar1: 0.679
  - ma1: -1.401
  - ma2: 0.418





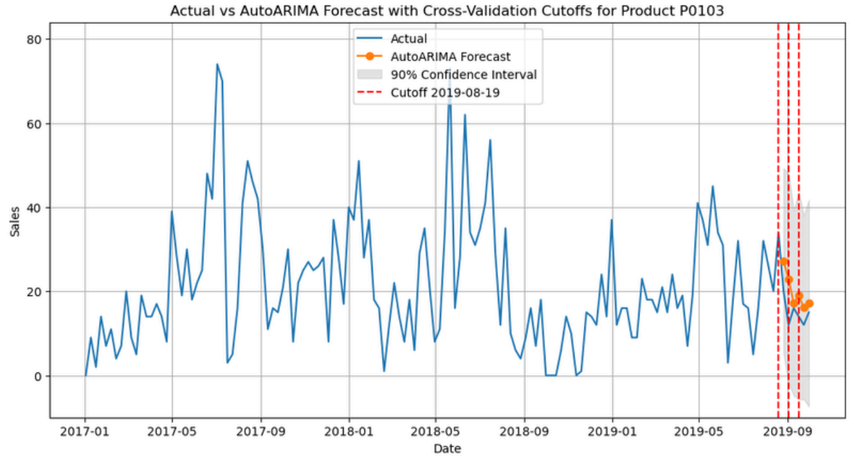


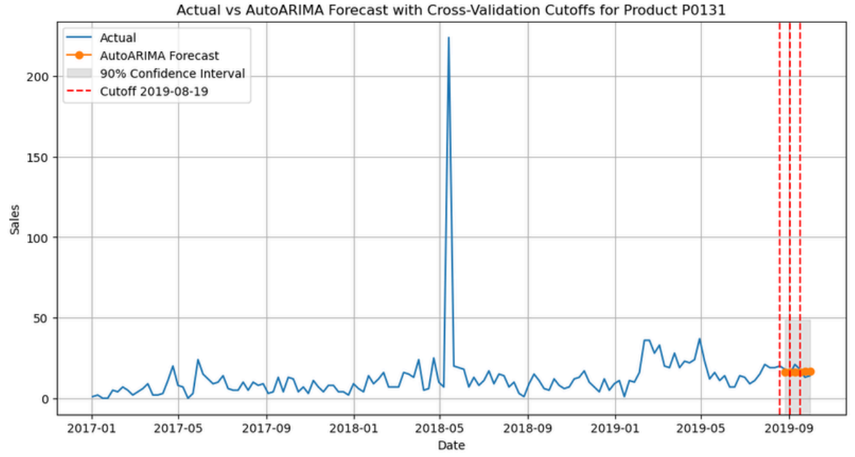
Evaluation

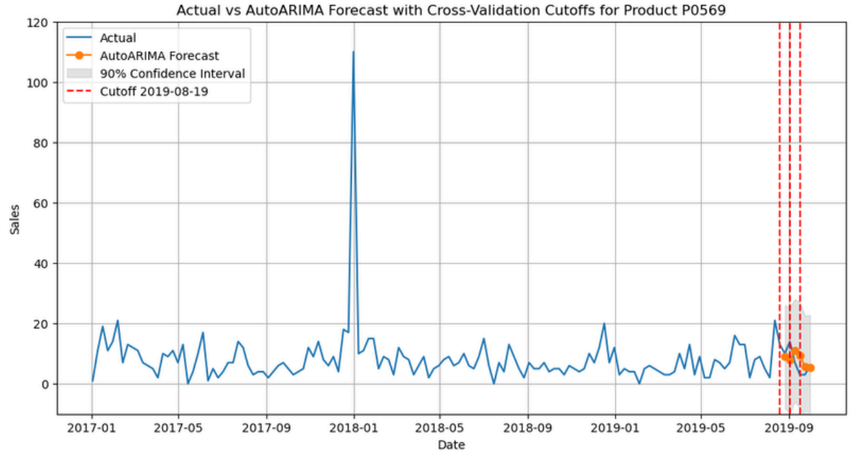
Best models

Store S0142

- **(p, d, q) = (0, 0, 0)**: The model uses none AR term, neither differencing, or MA terms to handle the non-seasonal components of the data.
- **(P, D, Q, period) = (0, 0, 0, 1): Not** considered any **seasonal components** .
- The model does not use past data to make predictions.
- The forecasted value is simply a constant value or the mean of the series.





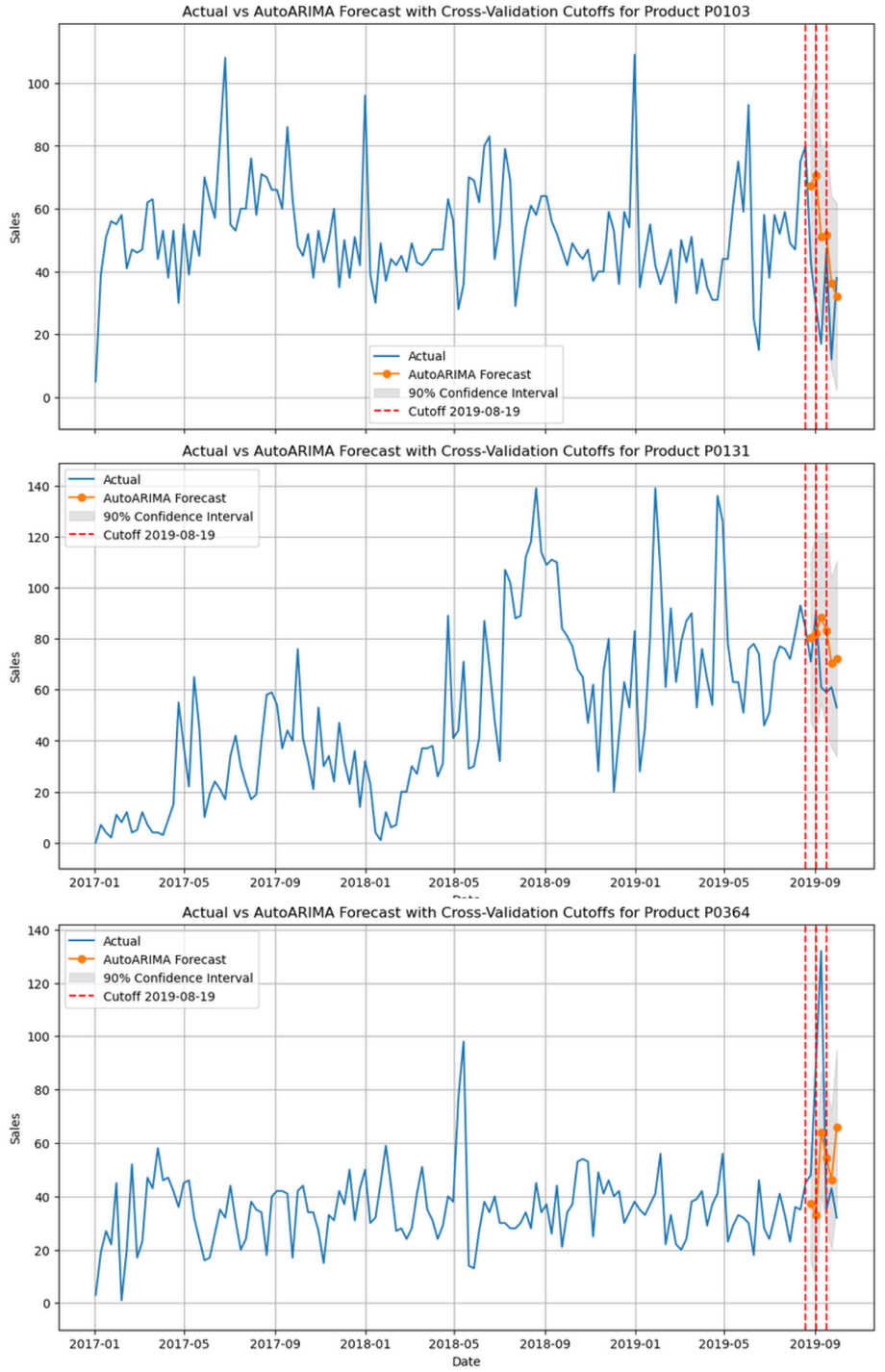


Evaluation

Best models

Store S0094

- **(p, d, q) = (3, 0, 2)**: The model uses three AR terms, zero differencing, and two MA terms to handle the non-seasonal components of the data.
- **(P, D, Q, period) = (0, 0, 0, 1): Not** considered any **seasonal components** .
- Coefficients: AR and MA components suggests that the model **relies more heavily on past** values for predictions, with significant adjustments based on errors from two periods ago.
    - ar1: -0.046
    - ar2: 0.708
    - ar3: 0.284
    - ma1: -0.010
    - ma2: -0.787



Forecast

Store S0030

unique_id	ds	AutoARIMA	AutoARIMA-lo-90	AutoARIMA-hi-90
P0015	2019-10-07	0.366563	-1.479692	2.212818
P0015	2019-10-14	0.430045	-1.486416	2.346506
P0026	2019-10-07	0.000000	-0.879211	0.879211
P0026	2019-10-14	0.000000	-0.879211	0.879211
P0035	2019-10-07	0.565303	-1.518490	2.649096
...	...	...	...	...
P0711	2019-10-14	0.000000	-3.162672	3.162672
P0718	2019-10-07	0.341611	-0.762704	1.445927
P0718	2019-10-14	0.341486	-0.762957	1.445930
P0729	2019-10-07	0.000000	0.000000	0.000000
P0729	2019-10-14	0.000000	0.000000	0.000000

128 rows × 4 columns

Store S0094

unique_id	ds	AutoARIMA	AutoARIMA-lo-90	AutoARIMA-hi-90
P0005	2019-10-07	0.097343	-0.438197	0.632883
P0005	2019-10-14	0.044856	-0.491544	0.581255
P0007	2019-10-07	0.228821	-0.490328	0.947970
P0008	2019-10-07	0.882989	-1.248524	3.014502
P0008	2019-10-14	0.882638	-1.249249	3.014524
...	...	...	...	...
P0741	2019-10-14	0.000000	-0.764841	0.764841
P0742	2019-10-07	-0.000002	-0.994910	0.994907
P0742	2019-10-14	0.000000	-1.106395	1.106395
P0748	2019-10-07	0.000000	-1.965976	1.965976
P0748	2019-10-14	0.000000	-1.965976	1.965976

609 rows × 4 columns

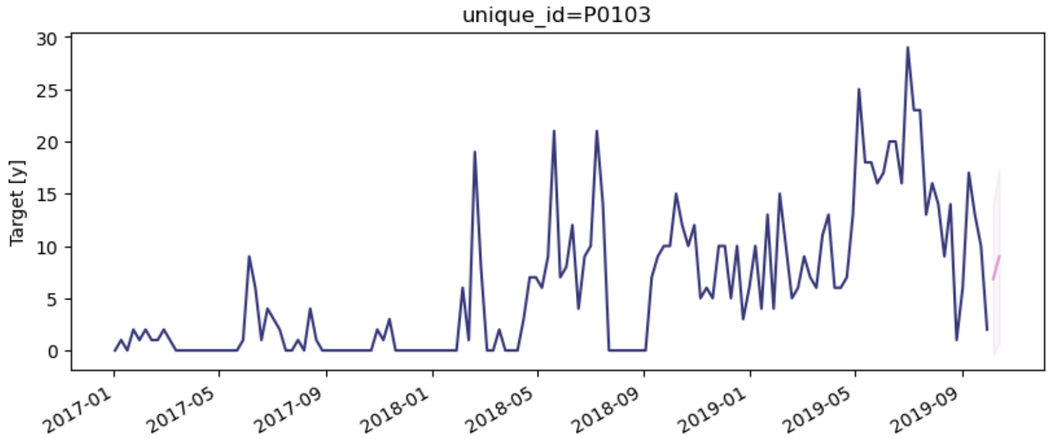
Store S0142

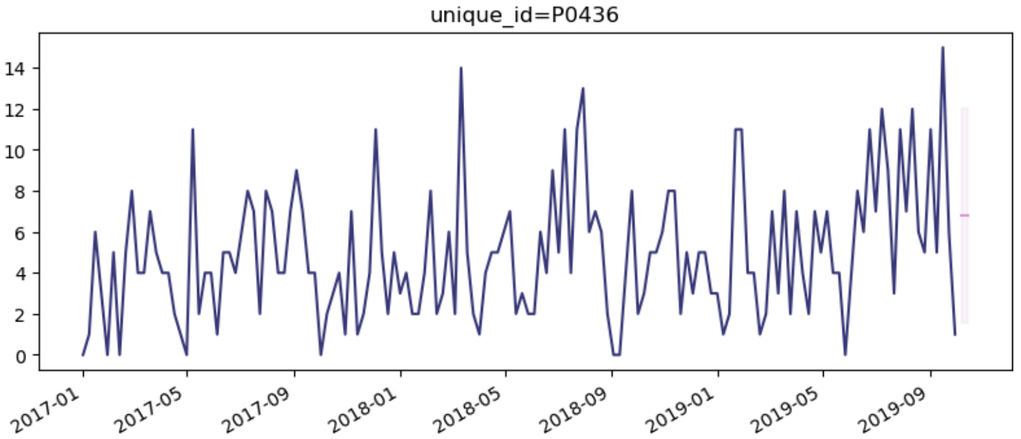
unique_id	ds	AutoARIMA	AutoARIMA-lo-90	AutoARIMA-hi-90
P0005	2019-10-07	0.000000e+00	0.000000	0.000000
P0005	2019-10-14	0.000000e+00	0.000000	0.000000
P0007	2019-10-07	-5.302479e-10	-0.490007	0.490007
P0007	2019-10-14	0.000000e+00	-0.523981	0.523981
P0009	2019-10-07	3.365103e-01	-1.398520	2.071540
...	...	...	...	...
P0742	2019-10-14	0.000000e+00	-0.660589	0.660589
P0747	2019-10-07	2.971069e-01	-5.019232	5.613446
P0747	2019-10-14	3.162127e-02	-5.314743	5.377986
P0748	2019-10-07	3.014096e-01	-0.668608	1.271427
P0748	2019-10-14	7.894382e-01	-0.223684	1.802560

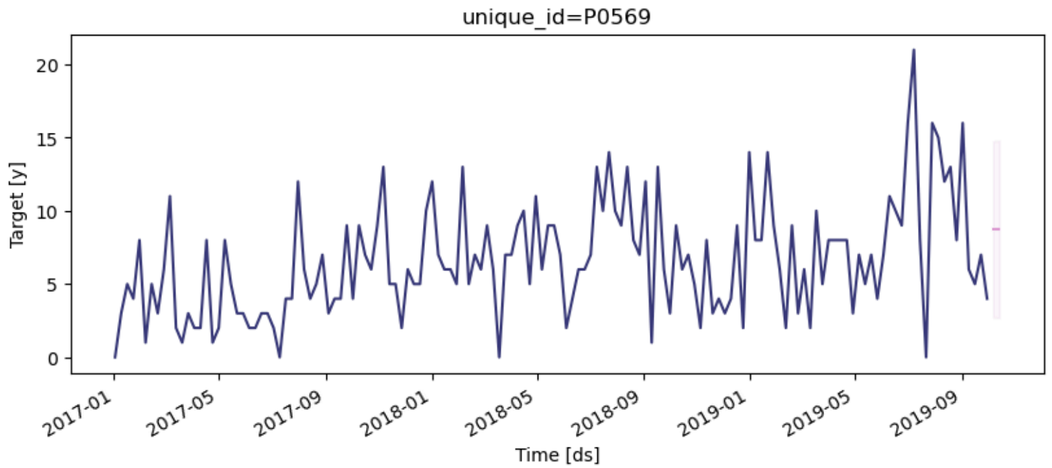
447 rows × 4 columns

Forecast

Store S0030 - top 3 products



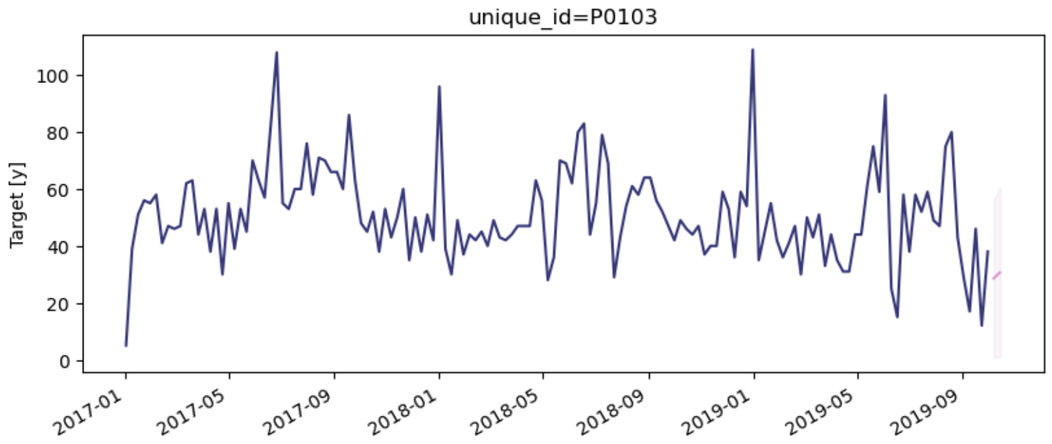


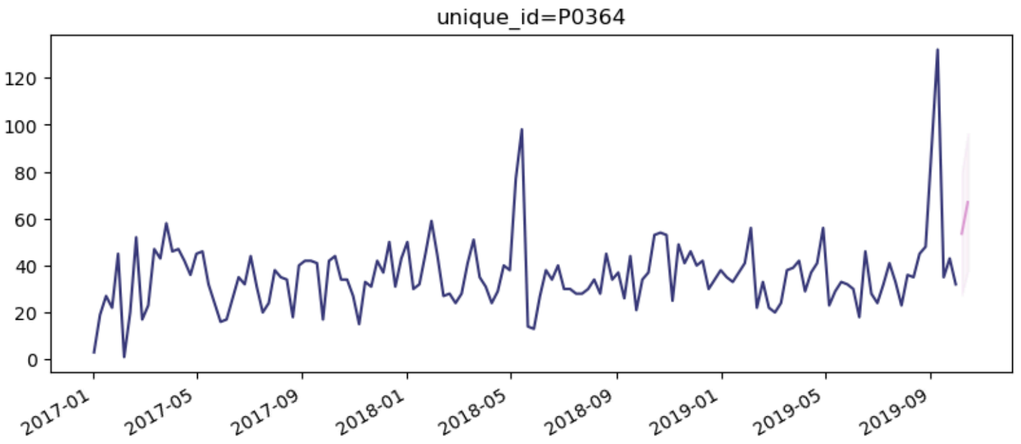


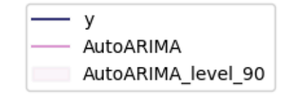
unique_id	ds	AutoARIMA	AutoARIMA-lo-90	AutoARIMA-hi-90
P0103	2019-10-14	9.009973	0.682099	17.337847
P0436	2019-10-14	6.825098	1.584950	12.065246
P0569	2019-10-14	8.739407	2.685228	14.793585

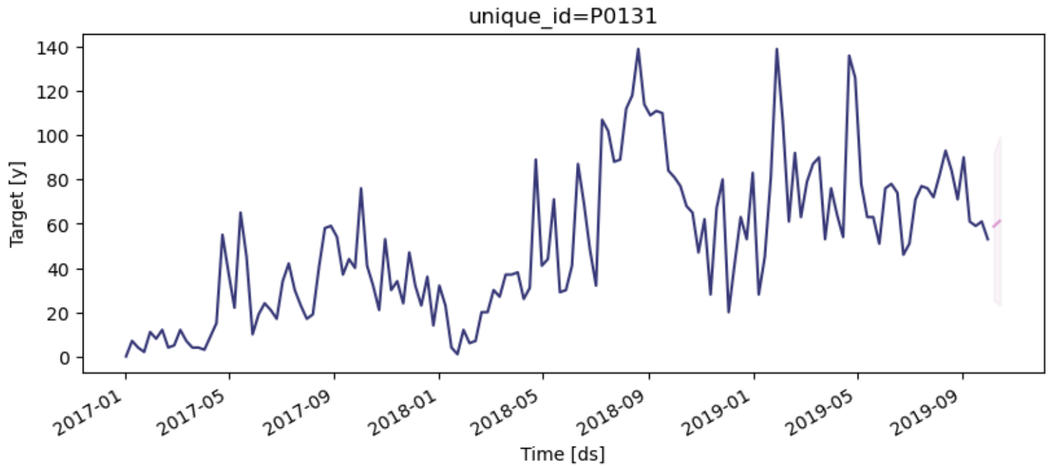
Forecast

Store S0094 - top 3 products





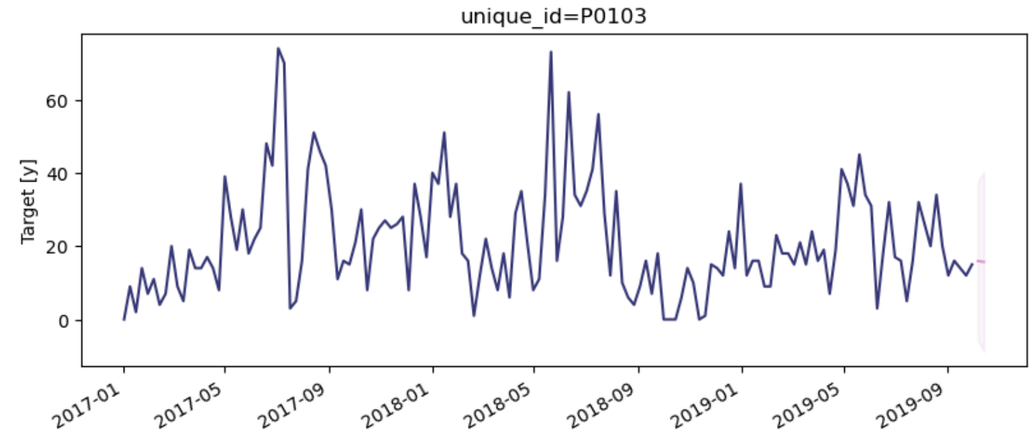


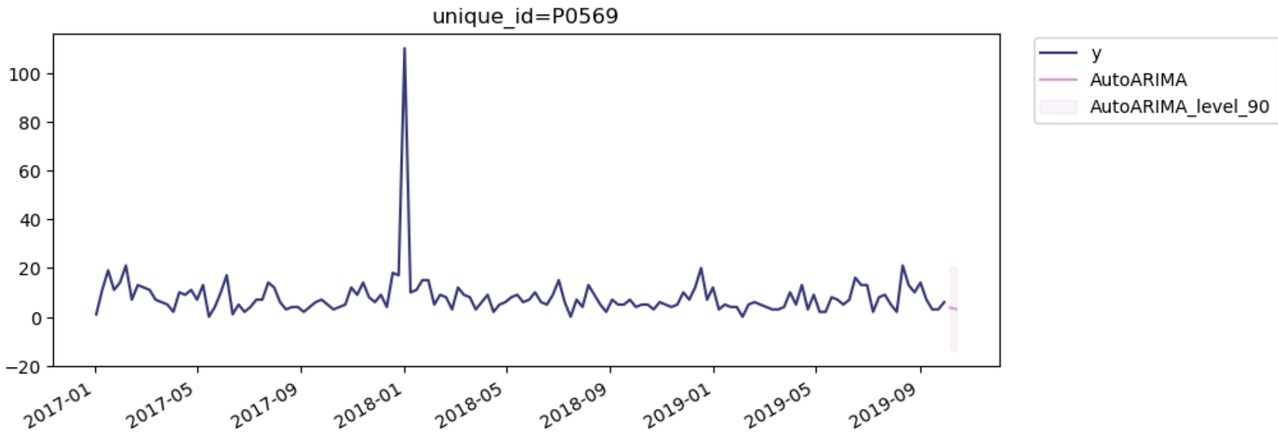


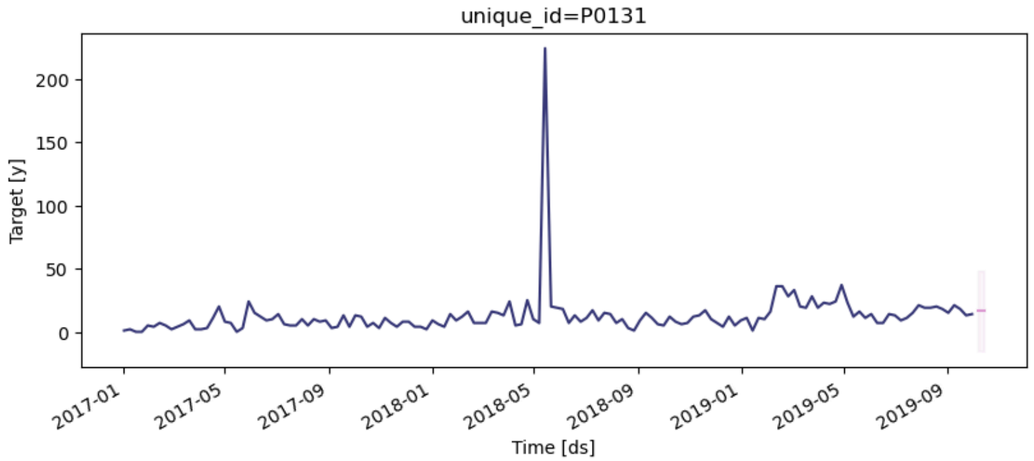
unique_id	ds	AutoARIMA	AutoARIMA-lo-90	AutoARIMA-hi-90
P0103	2019-10-14	30.622007	0.939955	60.304058
P0364	2019-10-14	66.936806	37.789753	96.083855
P0131	2019-10-14	61.259556	23.075565	99.443550

Forecast

Store S0142 - top 3 products







unique_id	ds	AutoARIMA	AutoARIMA-lo-90	AutoARIMA-hi-90
P0103	2019-10-14	15.710711	-8.688168	40.109589
P0569	2019-10-14	3.132645	-14.121902	20.387192
P0131	2019-10-14	16.442282	-15.305096	48.189659