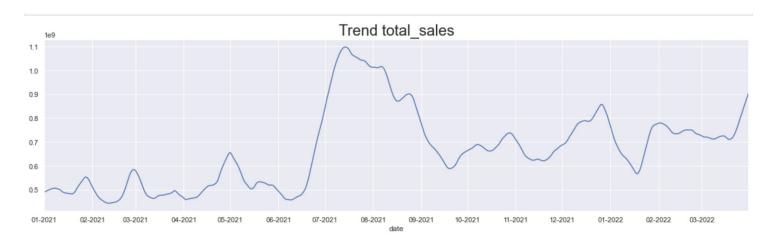
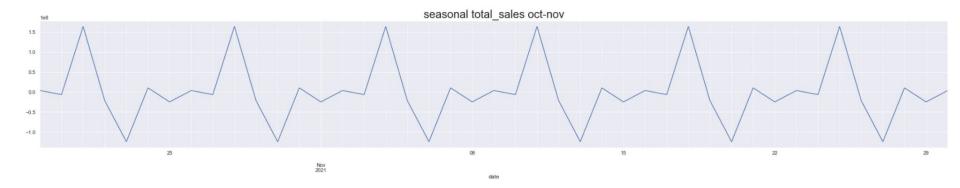
Sales Forecasting

RupaRupa IBP Sales Forecasting July 01, 2022

EDA (sales_total)

Stationarity: stationary hingga 10% (kurang ideal)

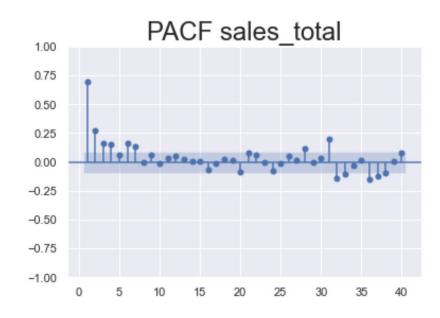




- Weekly Seasonality
- Senin-Selasa-Rabu ga terlalu beda, sharp rise di kamis(peak), drop smp sabtu, rise lumayan di minggu



ACF signifikan up to 20an lag



PACF signifikan up to 7 lag

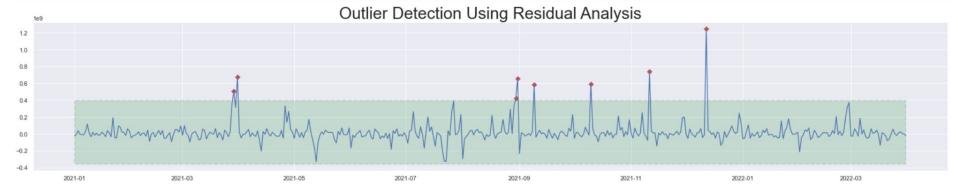
Anomaly Detection

```
resid_mu = resid_STL.mean()
resid_dev = resid_STL.std()

lower = resid_mu - 3*resid_dev
upper = resid_mu + 3*resid_dev
```

```
Dikategorikan Anomali apabila lebih besar/kurang dari 3 kali simpangan baku 2021-03-29
```

2021-03-31 2021-08-30 2021-08-31 2021-09-09 2021-10-10 2021-11-11 2021-12-12

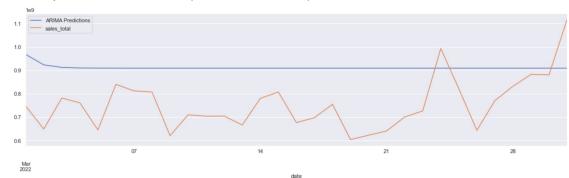


Models

- Model yang digunakan:
 - **ARIMA**: Assumption ANOVA tidak terpenuhi
 - Non-homogeneity of variance (levene test)
 - Non-normal data (shapiro-wilk)
 - Ada dependency antar variabel (Pearson Rank)

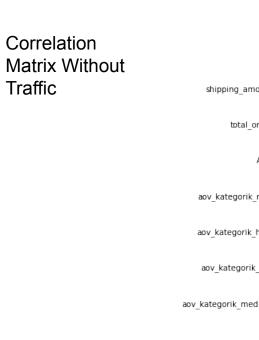
ARIMA tidak dapat fit dengan baik karena

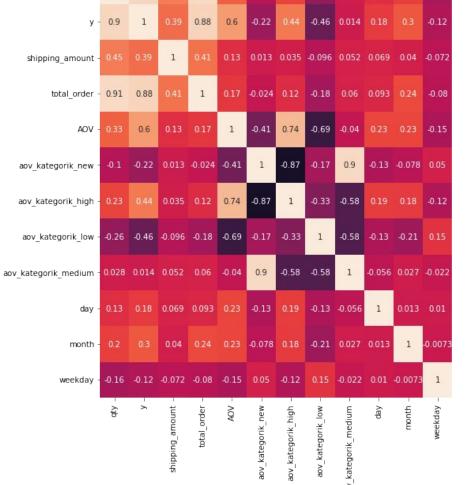
- 1. asumsi tidak terpenuhi
- 2. Data kurang stasioner
- 3. Doesn't have strong seasonality (Sehingga ARIMA hanya mengambil average of previous values (stackoverflow)



Models

- Model yang digunakan:
 - Prophet: interpretability, mudah dimanipulasi, use case sesuai
 - Notes:
 - Training menggunakan data Januari 2021 April 2022 (kecuali data yang melibatkan traffic, kl itu dari 19 oktober 2021)
 - Testing menggunakan data Mei 2022
 - Metrics: RMSE,MAE,MAPE
 - Penambahan regressor di model prophet memerlukan controlled variabel yaitu value regressor tersebut untuk bulan depannya (diinput secara manual)





0.9

0.91

0.23 -0.26 0.028 0.13 0.2

- 1.00

- 0.75

- 0.50

- 0.25

- 0.00

-0.25

- -0.50

- -0.75

- -1.00

shipping_amount	0.63	0.75	1	0.61	0.44	-0.22	0.31	-0.28	-0.11	0.089	0.22	-0.22	0.2	0.053	0.19	0.27	-0.16	-0.096	0.009	0.2
Correlation Matrix With	- 0.87	0.83	0.61	1	0.016	0.00075	0.011	-0.034	0.012	0.11	-0.088	-0.043	0.22	-0.12	0.13	-0.036	0.0066	-0.11	0.039	0.42
Traffic	0.24	0.56	0.44	0.016	1	-0.63	0.79	-0.55	-0.4	0.21	0.25	-0.21	0.14	0.2	0.14	0.21	-0.071	0.089	0.055	-0.063
aov_kategorik_new	-0.14	-0.35	-0.22	0.00075	-0.63	1	-0.94	-0.053	0.95	-0.19	-0.1	0.17	0.024	-0.021	-0.0058	-0.096	0.081	-0.0057	0.037	-0.047
aov_kategorik_high	0.18	0.44	0.31	0.011	0.79	-0.94	1	-0.29	-0.78	0.23	0.17	-0.21	0.033	0.067	0.065	0.13	-0.081	0.041	-0.0053	0.013
aov_kategorik_low	-0.13	-0.32	-0.28	-0.034	-0.55	-0.053	-0.29	1	-0.37	-0.13	-0.23	0.15	-0.17	-0.14	-0.18	-0.099	0.011	-0.1	-0.09	0.096
aov_kategorik_medium	-0.091	-0.22	-0.11	0.012	-0.4	0.95	-0.78	-0.37	1	-0.14	-0.02	0.11	0.076	0.027	0.052	-0.057	0.071	0.029	0.063	-0.075
day	0.058	0.2	0.089	0.11	0.21	-0.19	0.23	-0.13	-0.14	1	0.075	0.018	0.31	0.2	0.18	0.19	0.13	0.099	0.21	-0.15
month	-0.067	0.069	0.22	-0.088	0.25	-0.1	0.17	-0.23	-0.02	0.075	1	-0.01	0.075	0.14	0.41	0.65	-0.23	0.036	0.13	-0.25
weekday	-0.18	-0.14	-0.22	-0.043	-0.21	0.17	-0.21	0.15	0.11	0.018	-0.01	1	0.13	0.0066	-0.14	-0.08	-0.025	-0.002	-0.092	0.082
	100.00	2000	222	0000	260050	4,000	8.88366	6000000	V600 (55)	25500	77,539,535	16/30/130		55805	08.000	200200000	6008	82/59/	10.0000000	2017/03/2015

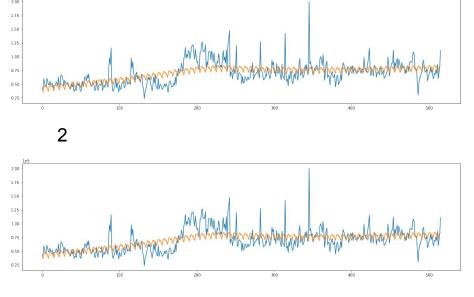
- 0.7

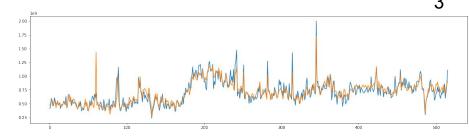
- 0.5

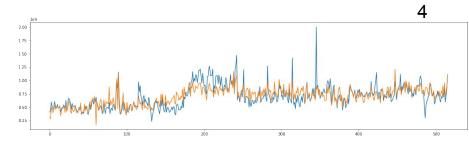
- 0.(

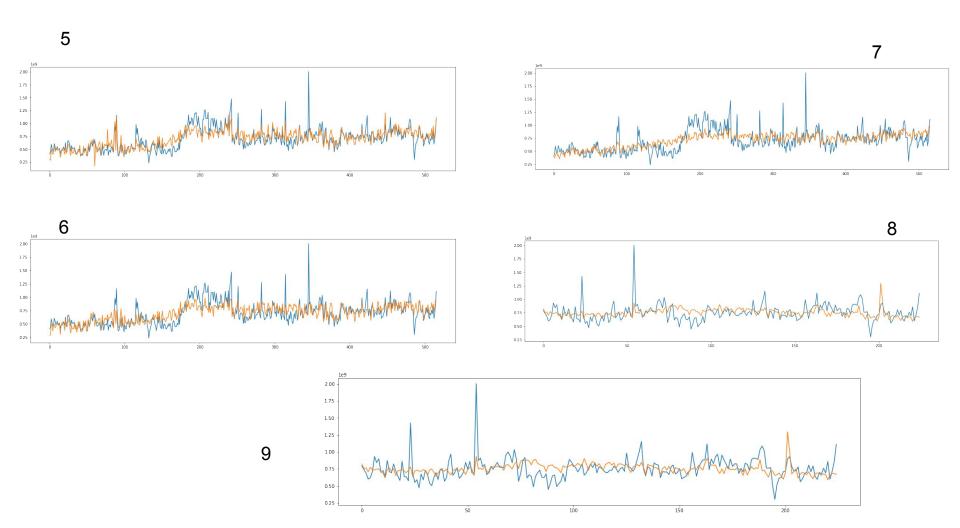
Beberapa Performance Prophet

No	Model		Testing			Training				
No	lviodei	RMSE	MAE	MAPE	RMSE	MAE	MAPE			
1	Prophet(Baseline)	172375665	133798410.8	23.51778319	172207818.6	125522798	18.61226997			
2	Prophet(Add Seasonality)	172375665	133798410.8	23.51778319	172207818.6	125522798	18.61226997			
3	Regressor (total_order)	95482535.73	80157980.62	11.74862379	92012285.63	63435779.29	9.204028294			
4	Regressor (AOV)	150558276.7	101011580.1	19.01717967	133002357.1	95949752.62	14.04029014			
5	Regressor (AOV, label encoder)	150558276.7	101011580.1	19.01717967	133002357.1	95949752.62	14.04029014			
6	Regressor (AOV, one hot)	141096133.9	101554913.2	18.25388762	146204027.2	106992071	15.84731476			
7	Regressor (date decomp, aov label)	180252752.3	145738280.3	25.44985342	158882059.7	114461852.5	17.18407947			
8	Baseline(dr 19 okt 2021)	181842033.2	145327305.1	25.11130419	159997166.5	106282728.3	14.08542843			
9	Regressor(Conversion)	161429713.9	114725108.8	17.68159828	155078495.2	107567821.5	14.32358972			



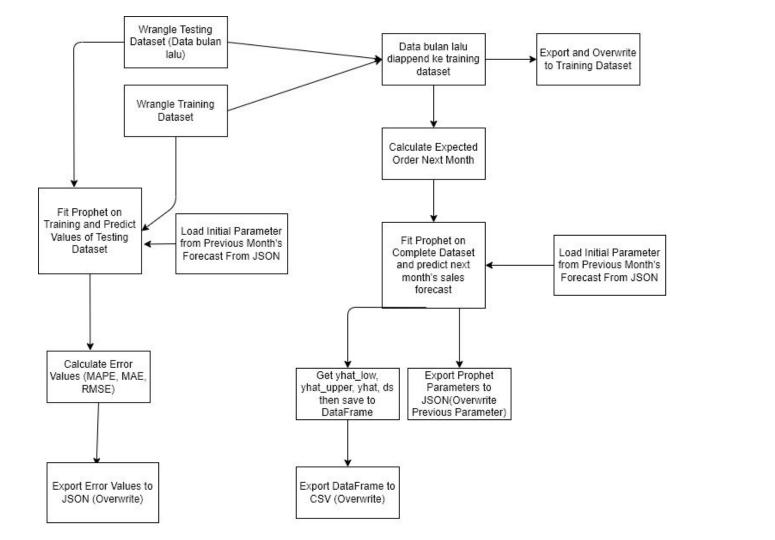






Models

- Model yang pernah dicoba digunakan:
 - Prophet + LightGBM: Menggunakan feature prophet sebagai regressor
 - Notes:
 - Flow lebih rumit
 - Performance comparable to Prophet Sendiri
 - FlaML (Microsoft AutoML): Menggunakan XGBoost Limited Depth
 - Notes:
 - Tanpa regressor yang highly correlated performance lebih buruk dari prophet dengan regressor



To Do

- Select kombinasi feature yang dapat dimanipulasi sebagai regressor
- Mencoba hyperparameter tuning prophet agar hasil lebih akurat lagi
 - Menambah kalendar High leverage observations (promosi 10/10 dkk)
 - Mencari seasonality sebenarnya