1. Personal part introduction

The time series data I analyze is the Gross Sale Revenue and close stock price of a corporation called NKG ( CTCP Thep Nam Kim) based on their time respectively: quarterly (from 2010 till 2022) and daily (from 2021 till 2022).

The data is from: [nkg : CTCP Thép Nam Kim (cophieu68.vn)](https://www.cophieu68.vn/snapshot.php?id=nkg). We will go through Gross Sale Revenue of it each quarter and the closed stock price each day.

1. Data
2. Quarter

As for the models, all the results formats are the same and for the limitation of our length in this report I will only summarize the MAPE, RMSE and AIC of the full data as well as show the graph of it until we hit something different.

From Figure 1 – 6, they all not fitted well, all of them are under-fitted, which make their prediction may pretty fall-off from the original data.

|  |  |  |  |
| --- | --- | --- | --- |
| 2. Linear time trend (series ~ time) | Chart  Description automatically generated | Chart, line chart  Description automatically generated | 3.log-linear time trend (log(series) ~ time) |
| 4 Seasonal (series ~ s2 + s3 +s4) | Chart, line chart, histogram  Description automatically generated | Chart, line chart  Description automatically generated | 5. Linear trend + seasonal (series ~ time + seas) |
| 6 Linear time trend \* seasonal (series ~ time \* seas) | Chart, line chart  Description automatically generated | Chart, line chart  Description automatically generated | Model 1: Linear time trend (series ~ time) |

A.7 Holt-winters additive

As for this model, we will use the table to demonstrate the forecast and then come the graph used before

Graphical user interface, text, application, table, Excel

Description automatically generatedChart, line chart, histogram

Description automatically generated

|  |  |
| --- | --- |
| RMSE | MAPE |
| 681672.7 | 0.212125 |

A.8 Holt-winters multiplicative

|  |  |
| --- | --- |
| RMSE | MAPE |
| 2467798 | 0.6093436 |

Chart, line chart, histogram

Description automatically generated

We can notice that, only from model 7 that the data can be considered well-fitted, but compare between 7 and 8, we can clearly see that model 7 fitted and predict better with a good value of MAPE (0.21 %) and a good RMSE compared to training set. It also offers us the best AIC out of all models we have tested of 1588.618.

In conclusion, model 7 is the most fitted model with a reasonable RMSE and MAPE considered the training set result.

1. Daily

Next, we will go through daily data with dickey-fuller test and ARIMA model but before that we need to check for stationary in the data using figure below:

Chart, line chart, histogram

Description automatically generated

After that, we will Test with trend and constant (H1: stationary around trend)

if trend is insignificant: Test with constant (H1: stationary around constant)

if constant is insignificant: Test without constant (H1: stationary around 0)

Text

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Lastly, before fit in the model, we will be using auto function to try and select the most optimize (p,d,q) for ARIMA also the order for AR and MA

Auto regressive (AR) process (p): Order p is the lag value after which PACF plot crosses the upper confidence interval for the first time.

Moving average (MA) process(q): Order q of the MA process is obtained from the ACF plot, this is the lag after which ACF crosses the upper confidence interval for the first time.

Chart

Description automatically generatedChart, box and whisker chart

Description automatically generated

So, the optimize number of ( p , d , q ) in ARIMA function is ( 0, 1, 1 )

We will move on to fitting and evaluating models.

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Description automatically generated

Next is the forecasted model with the RMSE and MAPE

Chart, line chart, histogram

Description automatically generatedGraphical user interface, text, application

Description automatically generated

Overall, looking at the result of RMSE and MAPE, we can see that RMSE of 0.866 on all observations and MAPE of 0.028 is really good. Not only that of the current data but also for the forecasted value of it, the MAPE of 0.178 on 10 first days of 2023 is really outstanding.