1. About Nam Kim Group

Ton Nam Kim, a leading business in Vietnam, founded in 23/12/2002, that specializes in the production of galvanized steel sheets, has always been a leader in technology investment to give both domestic and foreign customers products that meet the highest quality standards. Currently, Ton Nam Kim products are respected across the country and exported to more than 50 nations.

1. Data
2. Quarter – Gross Sale Revenue

Chart, line chart, histogram

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The time series data I analyze is the Gross Sale Revenue price of a corporation called NKG (CTCP Thep Nam Kim) from 2010 to 2022. The graph tells us that the company has gone through many states from steadily increasing until 2020 and experienced a rocket boost in GSR in 2022 to continually decrease from then. Overall, the graph shows a positive trend with only a slight downfall in 2022.

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 of the full data and last 4 observations as well as show the graph of it.

From Figure 1 – 6, they all are trend models, each has their own meaning, with linear time trend, it shows that the net profit series has a positive trend, and with seasonality, it show the average of net profit within a year (second quarter was the highest and fourth quarter the lowest)

|  |  |  |  |
| --- | --- | --- | --- |
| Linear time trend (series ~ time) | Chart, line chart  Description automatically generated | Chart  Description automatically generated | Log time trend (series ~ log(time)) |
| Log-linear time trend (log(series) ~ time) | Chart, line chart  Description automatically generated | Chart, line chart, histogram  Description automatically generated | Seasonal (series ~ s2 + s3 +s4) |
| Linear trend + seasonal (series ~ time + seas) | Chart, line chart  Description automatically generated | Chart, line chart  Description automatically generated | Linear time trend \* seasonal (series ~ time \* seas) |

Moreover, Holt-winters model can be used to forecast future profit:

Holt-winters additive

Graphical user interface, text, application, table, Excel

Description automatically generatedChart, line chart, histogram

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Holt-winters multiplicative

Chart, line chart, histogram

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|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Linear time trend | Log time trend | Log-linear time trend | Seasonality | Linear trend + seasonal | Linear time trend \* seasonal | Holt-winters additive | Holt-winters multiplicative |
| RMSE  (whole Data) | 1041127 | 1441906 | 3277096 | 2013084 | 1038149 | 1028837 | 681672.7 | 2467798 |
| RMSE  (last 4 obs) | 2299360 | 3274554 | 7076182 | 4597940 | 2273173 | 2169625 | 1724813 | 6358366 |
| MAPE  (whole data) | 0.3722754 | 0.7101393 | 0.9999898 | 1.11608 | 0.3714209 | 0.3756195 | 0.212125 | 0.6093436 |
| MAPE  (last 4 obs) | 0.2923381 | 0.3744985 | 0.9999976 | 0.6002338 | 0.2873729 | 0.2690645 | 0.2552807 | 0.8844114 |

We can notice that the predicted data from Holt-Winters model clearly points out that it fitted and predicted good with a good value of MAPE (0.21) and a good RMSE compared to training set. Regressing the net profit series on trend gives a positive forecast, which suggest that on a long run trend NKG will make profit in the future. The results also show us the positive prediction value, suggesting that the corporation will have a slight improvement compared to last quarter.

1. Daily – Stock price of NKG:

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.

The plots suggests that there is a MA(1) model fits here due to a clear cut off after lag 1 in the ACF plot and only one autocorrelation that is significantly non-zero at a lag of 0.

Chart

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To provide comparision, we will move on to fitting and evaluating models a few more ARIMA model was fitted on the NKG stock price series

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ARIMA  (0, 1, 1) | ARIMA  (1, 1, 1) | ARIMA  (2, 1, 1) | ARIMA  (1, 1, 0) | ARIMA  (4, 2, 1) |
| AIC | 1274.62 | 1276.26 | 1278.21 | 1274.27 | 1280.56 |
| BIC | 1287.25 | 1293.1 | 1299.25 | 1286.89 | 1305.8 |
| RMSE (Full data) | 0.86 | 0.86 | 0.86 | 0.86 | 0.86 |
| MAPE (Full data) | 2.8% | 2.8% | 2.8% | 2.8% | 2.8% |
| RMSE (last 10 obs) | 0.297 | 0.303 | 0.305 | 0.302 | 0.322 |
| MAPE (last 10 obs) | 1.7% | 1.8% | 1.8% | 1.8% | 1.9% |
| RMSE (first 10 days of 2023) | 2.827 | 2.826 | 2.821 | 2.826 | 3.23 |
| MAPE (first 10 days of 2023) | 17.8% | 17.8% | 17.8% | 17.8% | 20.3% |

The ARIMA (0,1,1) model was the best to use for modelling data of the last 10 observations, but when predicted, the model does a quite off job compared to ARIMA (2,1,1). However, the ARIMA(1,1,0) model have the lowest AIC and BIC values. In conclusion, when it come to overall performance the model ARIMA(0,1,1) is outstanding with good MAPE and RMSE for the whole data and last 10 observations, it also have a decent result in other fields compare to other model.

Graphical user interface, chart

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Next is the forecast model.

Chart, line chart, histogram

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