佑兴隆集团
YHL GROUP

QUYNH THO CHU

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INTRODUCTION

In July 2023, the biggest exporter of rice in the world, India, put a ban on non-basmati white rice exports to control the rise in their domestic food price and guarantee their food security. According to the United Nations Food and Agriculture Organisation, the sudden export ban caused panic buying in the United States, which made the rice price jump to a highest level over a decade (CNN Business 2023). YHL Group is one of the largest rice producers in Malaysia, which export high amount of Royal Umbrella rice to United States. So they concern about the availability and price of their rice in the U.S City, which may also be influenced by export restrictions from India and other factors like the CPI (Consumer Price Index for All Urban Consumers: Fuels and Utilities), the price of other goods in U.S City.

ARIMA and VAR models are used in this project to forecast the price of Royal Umbrella rice in U.S City based on the dataset that includes the global price of Royal Umbrella rice, CPI, and the price of Diesel fuel and Spaghetti & Macaroni in U.S City from January 1998 to August 2023. This project will support YHL Group in determining the product price for upcoming contracts with retail customers and partners to ensure their profitability and financial performance in the industry. Furthermore, this project suggests some solutions for YHL Group to deal with the fluctuations of rice prices.

According to the Granger causality, all CPI and the price of Diesel fuel and Spaghetti & Macaroni in U.S City are the major factors affect the Royal Umbrella rice. Furthermore, we discovered that VAR(1,0), with an MAPE of 4% is the best forecasting model and the price of Royal Umbbrella rice in the next 6 months is **$643.768/ton.**

RICE

Industry

According to Figure 1.0 from Mordor Intelligence source, it is predicted that at a CAGR of 3% over the projected period (2023-2028), the size of the global rice market will increase from USD 365.57 billion in 2023 to USD 423.80 billion by 2028.

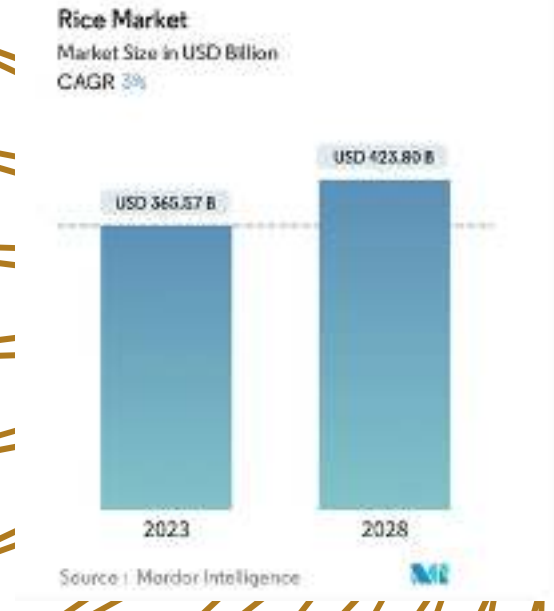

Figure 1.0: Rice market in 2023 and 2028 (Mordor Intelligence 2023)

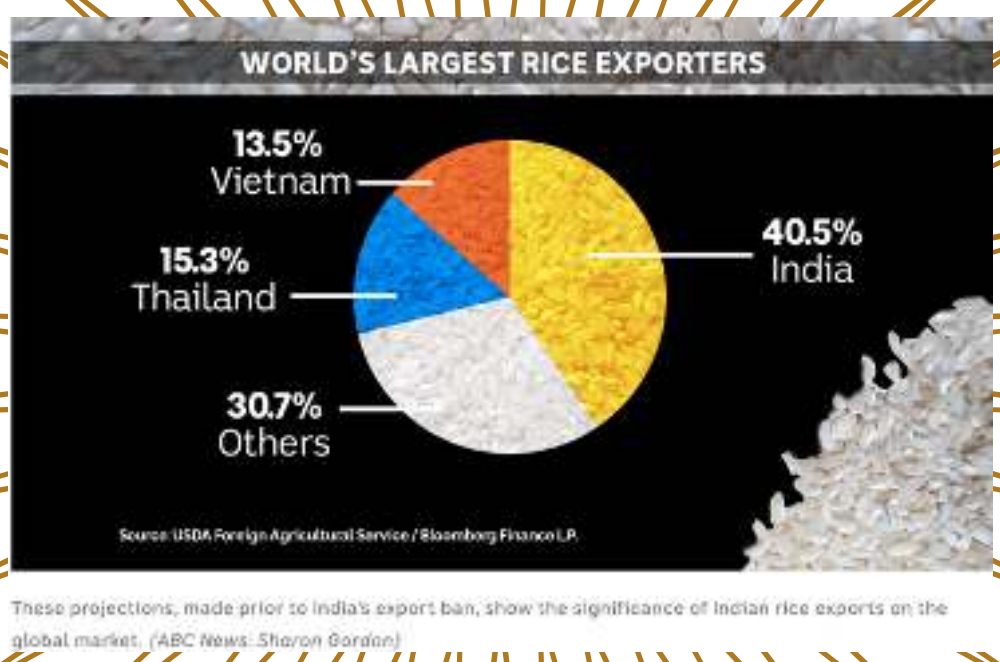

Figure 2.0: World's largest rice exporters (Clint Jasper 2023)

More than 120 countries grow rice, with India, Thailand and Vietnam being the top producers. Asia also consumes the majority of the world's rice, at roughly 90%. The demand for rice has been increasing globally because it is the most common food consumed by the majority of the world's population. As a result, the rice market is expected to expand in the upcoming years due to rising demand and government attempts to boost rice production (Modor Intelligence 2023).

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ROYAL UMBRELLA

1

YHL Group is a division of Padiberas National Berhad, which is Malaysia's leading rice producer with over 70 years of experience in the rice industry

2

It has 400 employees, warehouses, and processing facilities in the country.

3

Royal Umbrella is one of the well-known rice brand names that has been developed by YHL Group and has been recognized as a reliable international top brand because of its high-quality fragrant rice (YHL Group 2010)

4

Royal Umbrella rice has the most delicious taste in the world and achieved the Best Rice in the World Award in 2009.

Figure 3.0: The Awards of Royal Umbrella rice (Royal Umbrella)

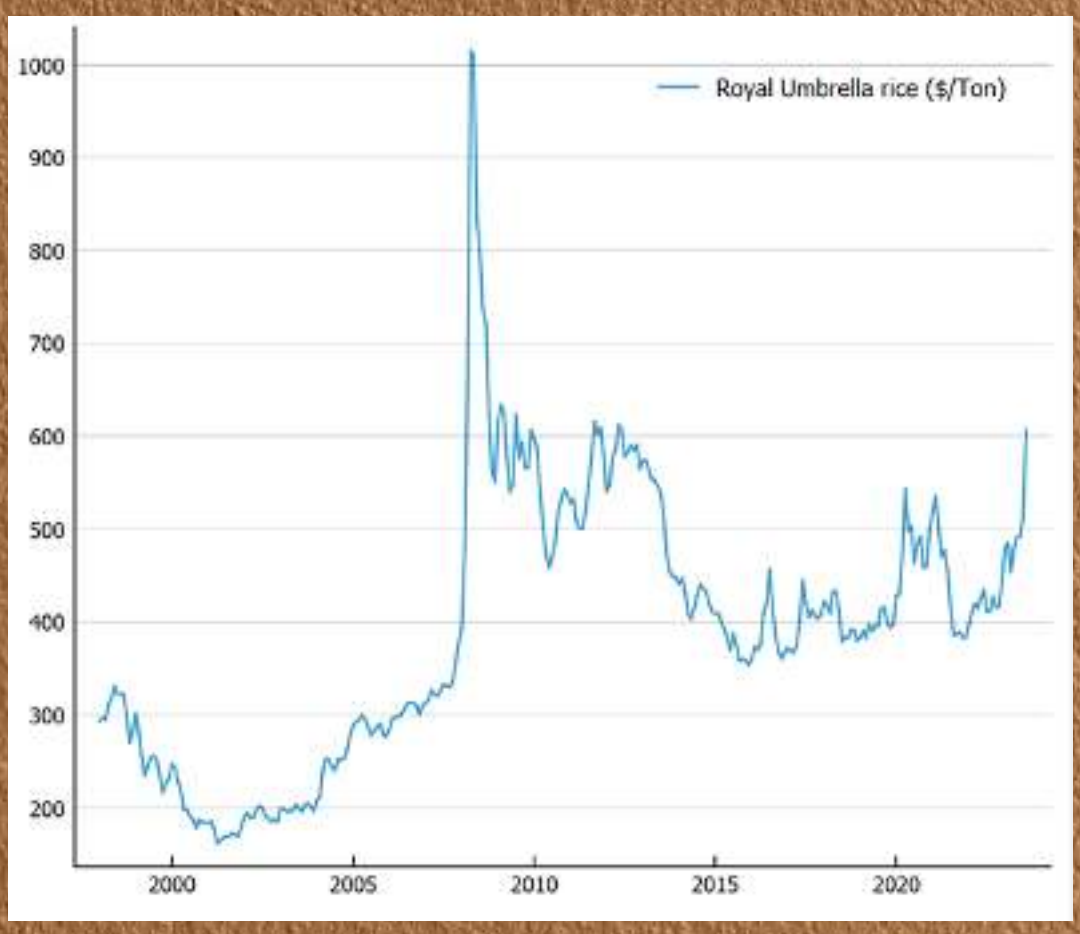


Figure 4.0: The price of Royal Umbrella rice from January 1998 to August 2023

From Figure 4.0, we can see that the price of Royal Umbrella rice was at the bottom in 2001 and reached a peak in 2008. The global rice prices as well as the price of Royal Umbrella rice were lowest in 2001 due to the China grain policies to minimize its excessive stocks starting in 1999/2000. The significant rise in rice prices in 2008 was due to the influence of major factors like trade restrictions by large suppliers, panic in the marketplace, a weak currency and oil prices (USDA 2009). However, the prices dropped quickly in the middle of 2008 as a result of a deal that permitted Japan to sell a portion of its rice supply to other countries (Princeton University 2023).

U.S City CPI & Price of other goods

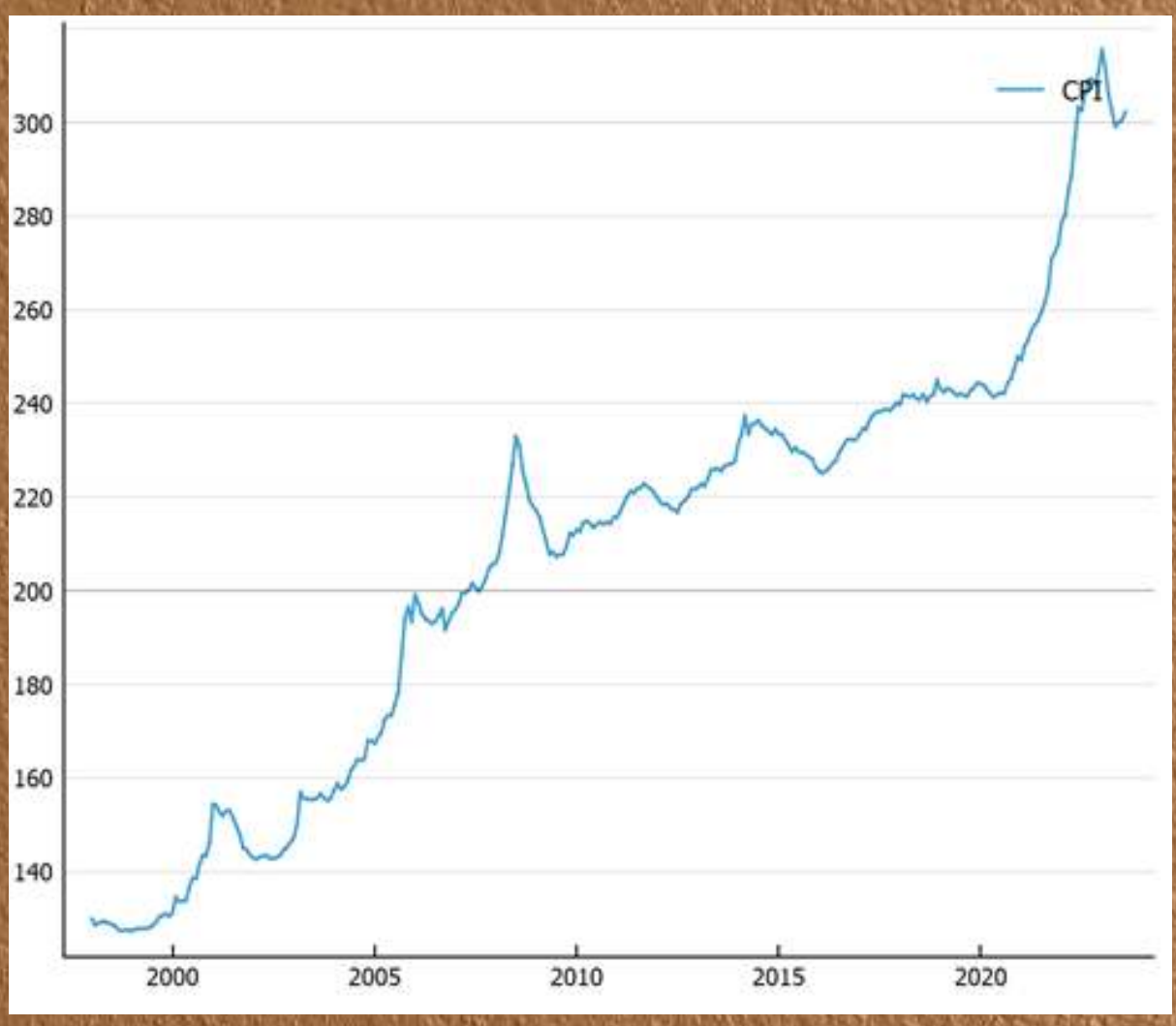
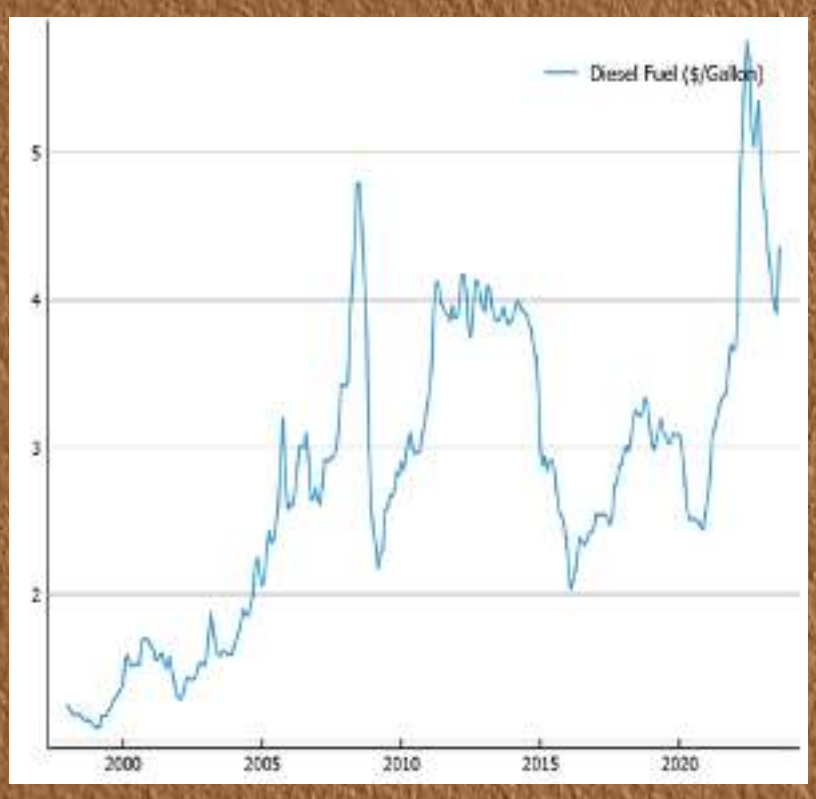


Figure 5.0: CPI for all urban consumers in U.S city

The Figure 4.0 reflects that the Consumer price index for all urban consumers (CPI) in U.S city has increased steadily overtime. Especially from 2020 to early 2023, after the Covid pandemic, the monthly CPI in U.S city increased continuously and declined gradually until the middle of 2023.



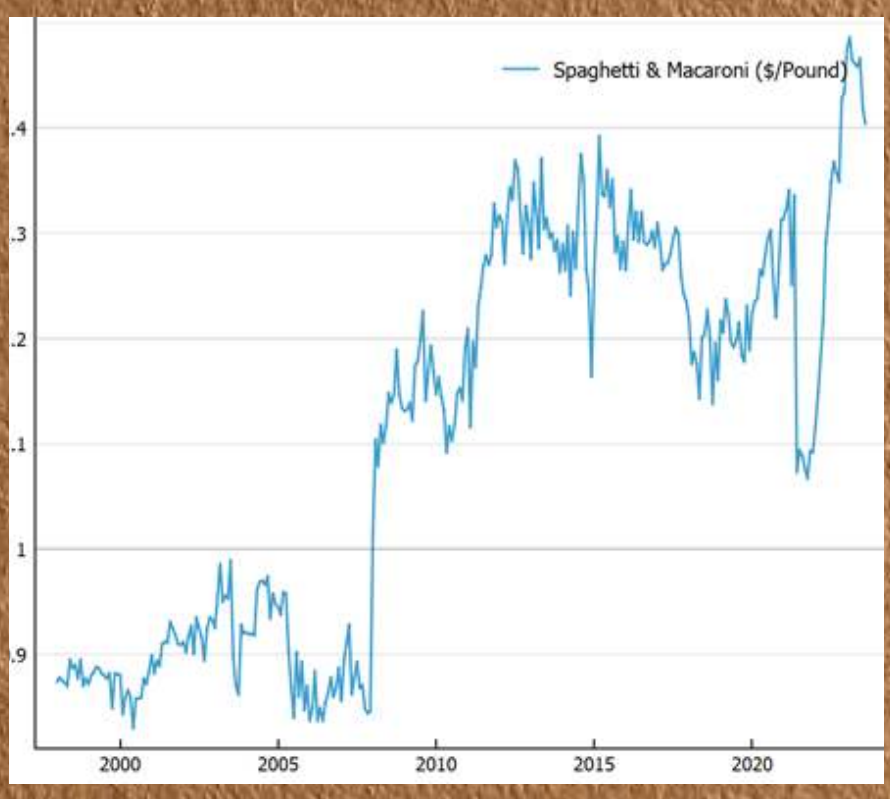


Figure 6.0 & 7.0: The price of Diesel fuel and Spaghetti & Macaroni in U.S city

As shown in Figure 6.0 and 7.0, the fluctuations in prices of Diesel fuel and Spaghetti & Macaroni in U.S city seem to be the same after 2010. Especially, their prices are down after 2020 and then increase continuously from 2022. This may be due to economic growth and inflation after pandemic recovery.

Data Statistics

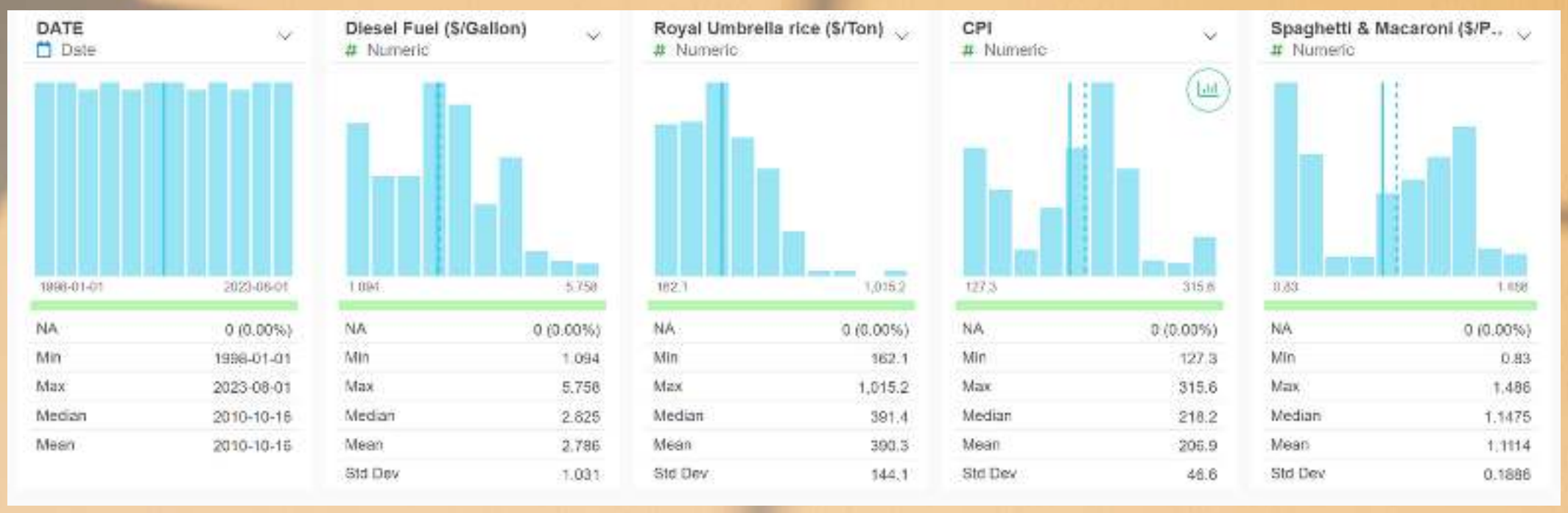


Figure 8.0: Data summary statistics of Royal Umbrella rice

According to the Figure 8.0, the dataset has no missing values and the minimum and maximum price of Royal Umbrella is $162/ton and $1,015/ton, respectively

FORECASTING

Model

ARIMA

The ARIMA model uses differences between values in the series as a predictor of future movements in securities or financial markets rather than actual values. If the data are not stationary, the differences in the data must be taken into account until the data are stationary before applying an ARIMA model to the collection of time-series data (Otexts).

&

VAR

The vector autoregressive (VAR) model, a time series model, links the most recent data for a variable to its historical data (Eric, 2021). The series must be stationary for the VAR model to be used in forecasting. If the series is not stationary, we must first make use of data differences to do so before fitting a VAR model to the data (Otexts).

DATA & DATA PRE-PROCESSING

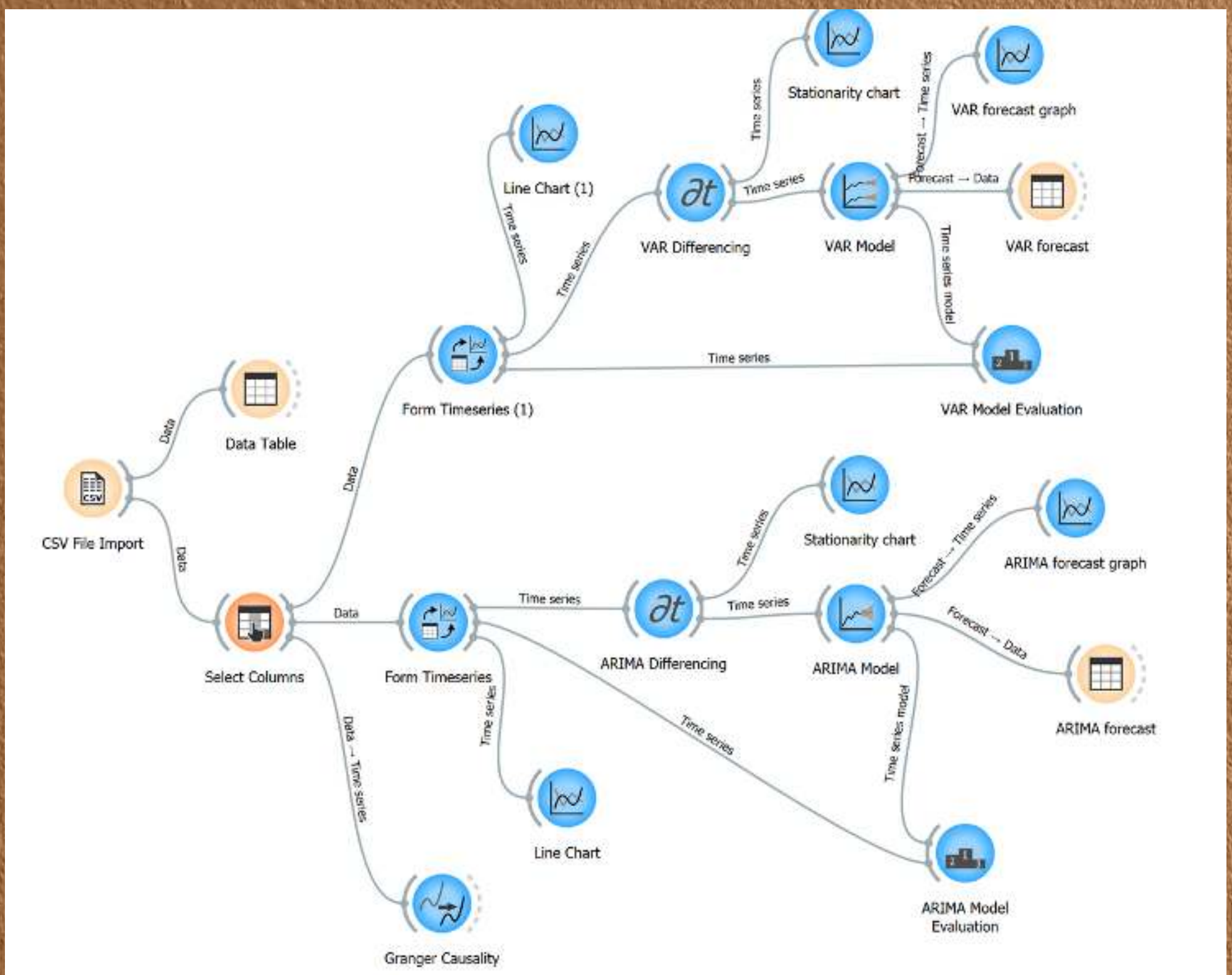


Figure 9.0: Orange workflow for forecasting

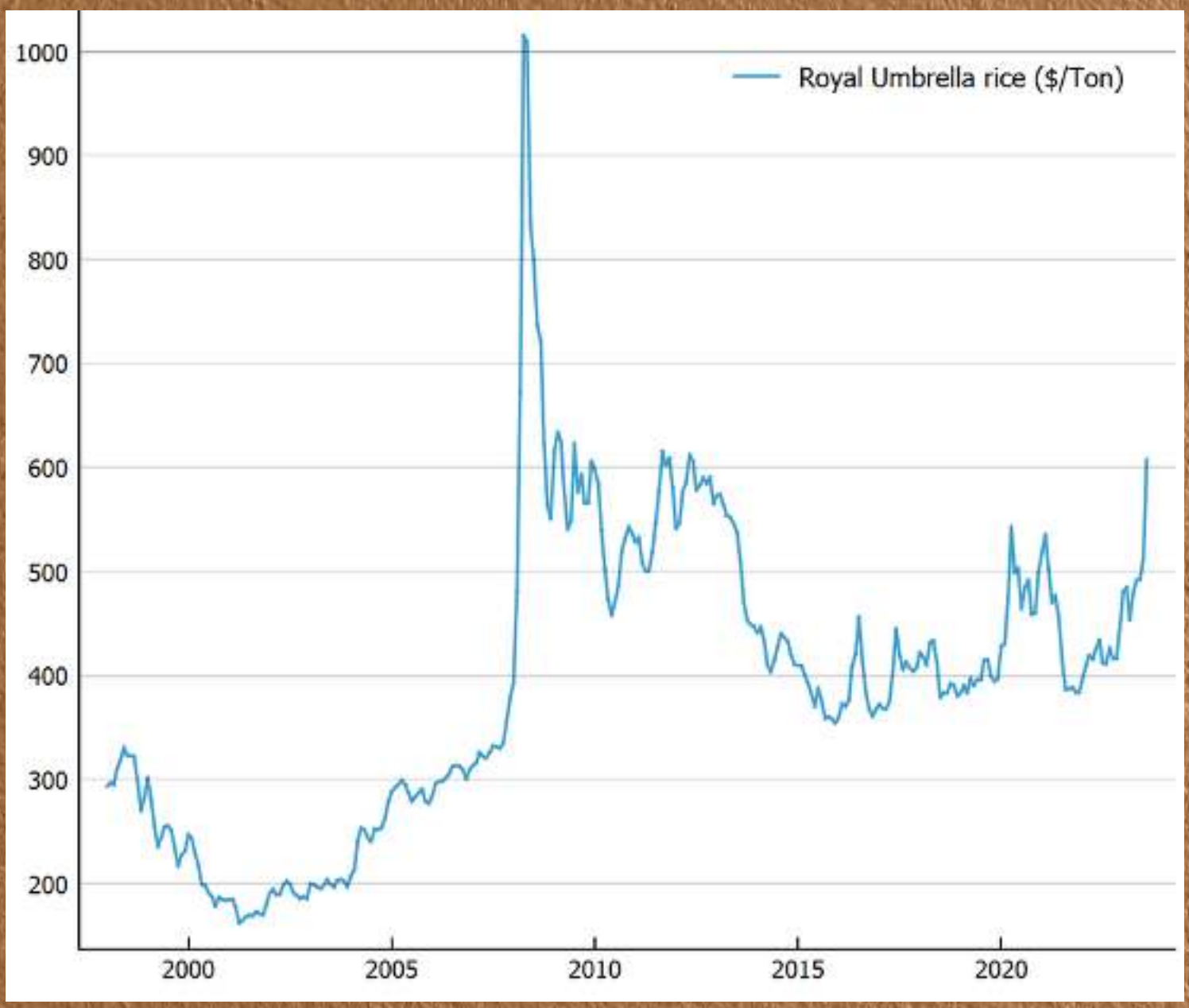


Figure 10.0: The price of Royal Umbrella rice

The time series is non-stationary as seen in Figure 10.0, so we utilise the Difference widget in Orange to make it stationary. Then, forecasting can be done using ARIMA and VAR models.

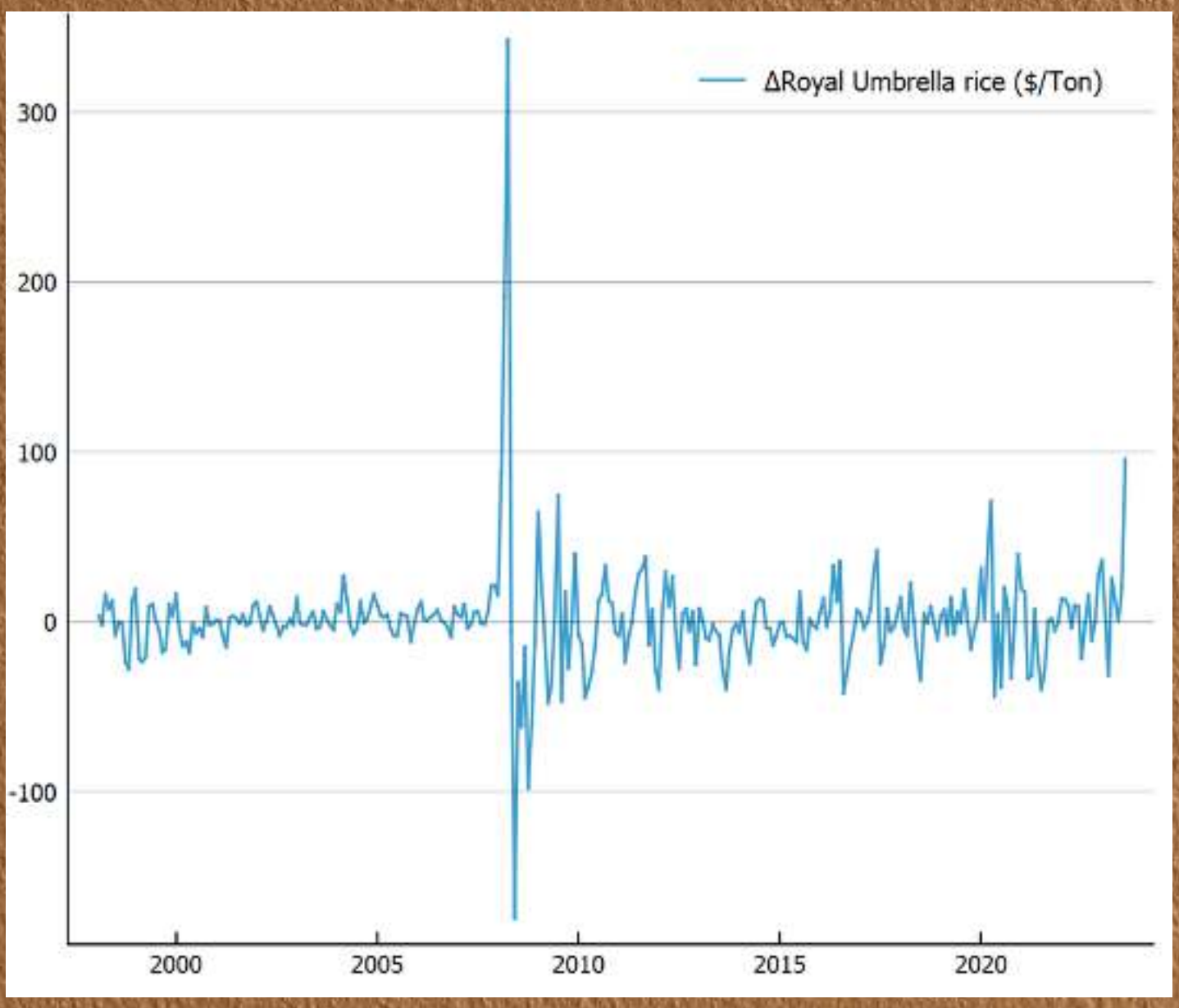
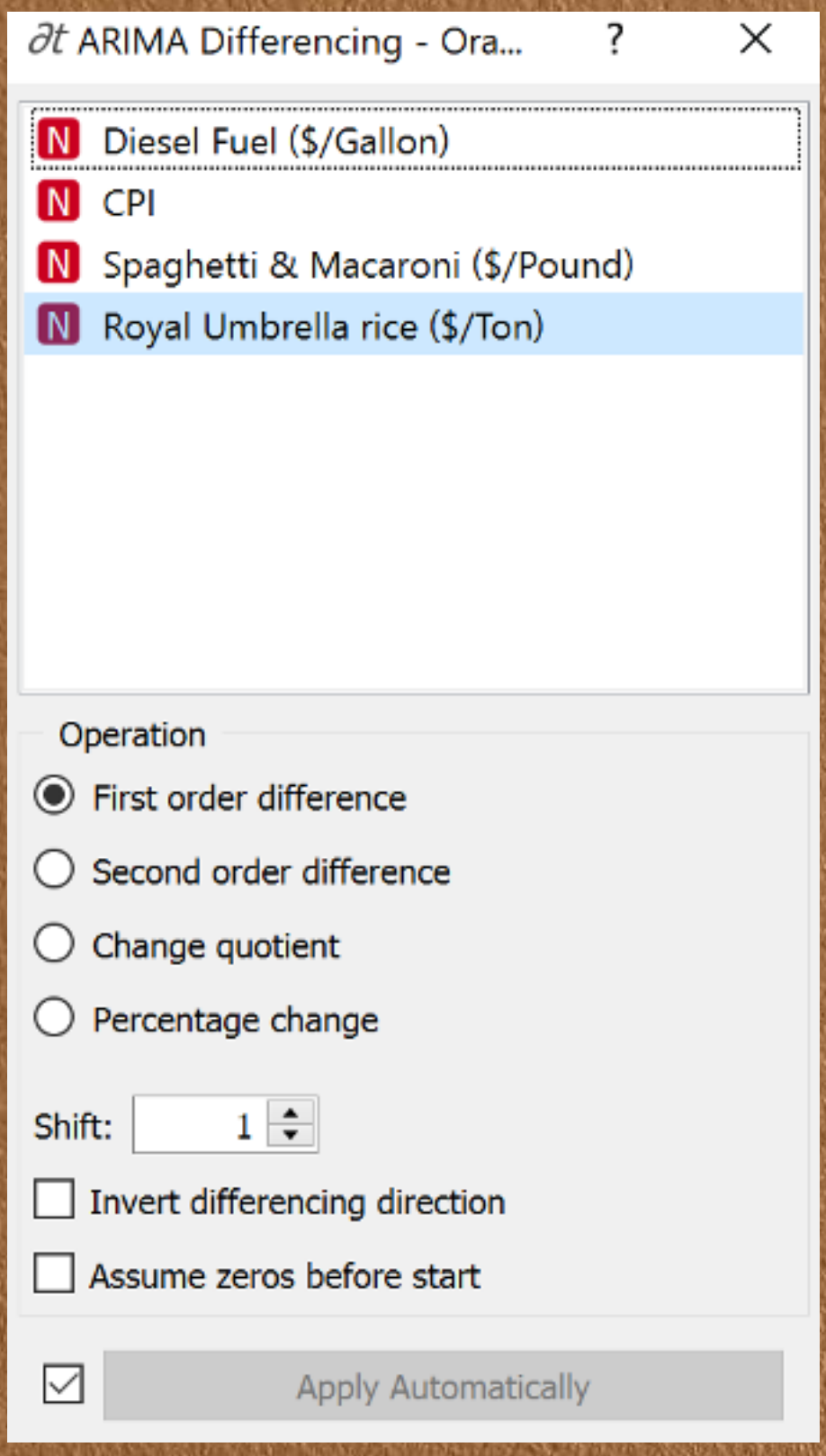


Figure 11.0: Price of Royal Umbrella rice after first order differencing to make the time series stationary



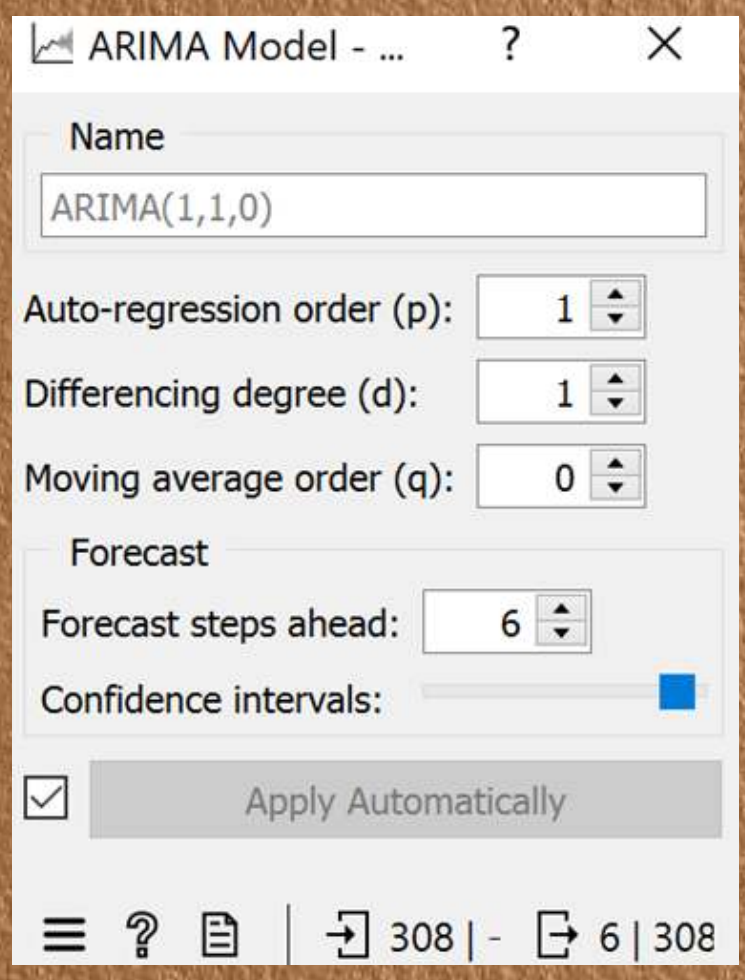
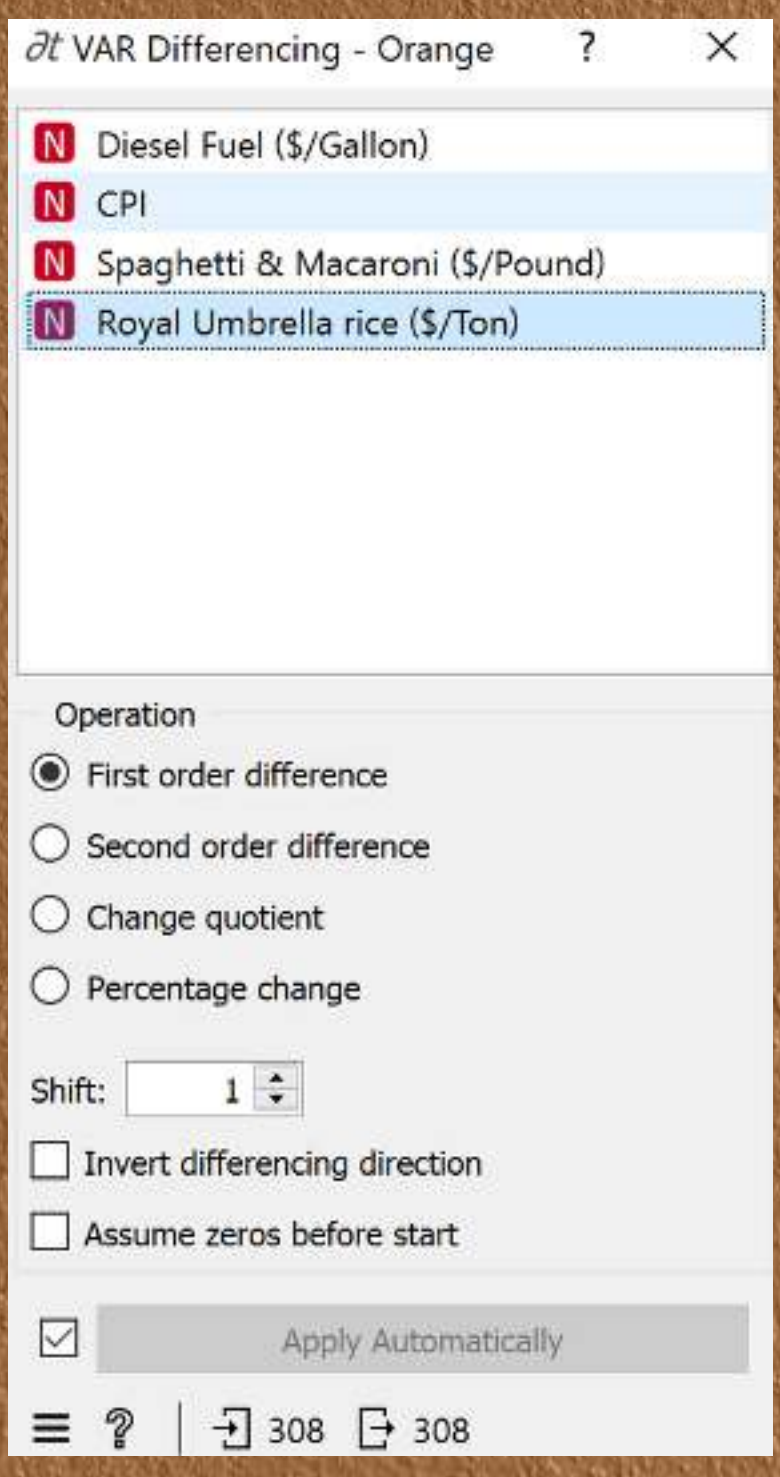


Figure 12.0 & 13.0: The details of ARIMA differencing & model settings with first order difference and forecast steps ahead of 6 months



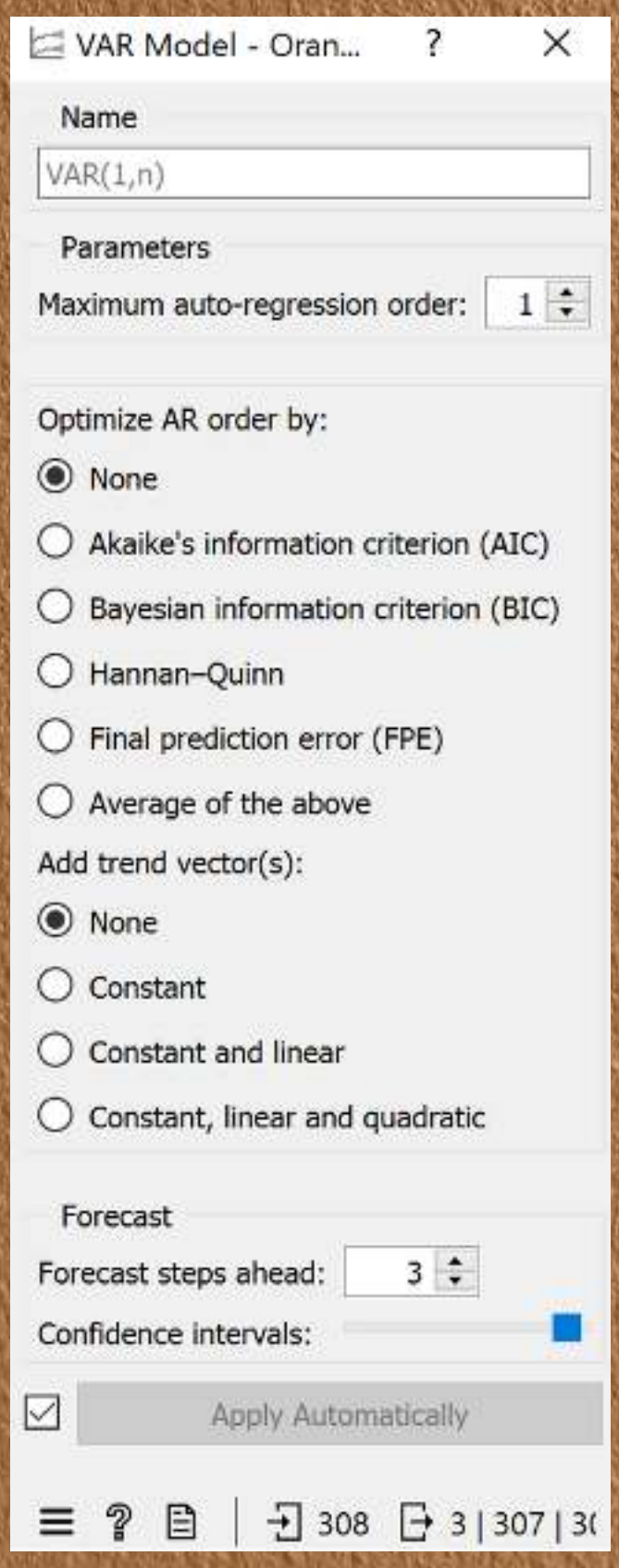


Figure 14.0 & 15.0: VAR differencing & model settings with second order difference and forecast steps ahead of 6 months

GRANGER CAUSALITY

Min. lag	p-value	Series 1		Series 2
1	1.12e-04	**Spaghetti & Macaroni ($/Pound)**	→	**CPI**
1	5.20e-04	**CPI**	→	**Spaghetti & Macaroni ($/Pound)**
1	7.28e-04	**Diesel Fuel ($/Gallon)**	→	**Spaghetti & Macaroni ($/Pound)**
4	9.62e-04	**Royal Umbrella rice ($/Ton)**	→	**CPI**
2	0.001	**Royal Umbrella rice ($/Ton)**	→	**Diesel Fuel ($/Gallon)**
10	0.018	**Spaghetti & Macaroni ($/Pound)**	→	**Diesel Fuel ($/Gallon)**
1	0.020	**Diesel Fuel ($/Gallon)**	→	**CPI**
2	0.023	**Diesel Fuel ($/Gallon)**	→	**Royal Umbrella rice ($/Ton)**
2	0.028	**CPI**	→	**Royal Umbrella rice ($/Ton)**
2	0.033	**CPI**	→	**Diesel Fuel ($/Gallon)**
2	0.049	**Spaghetti & Macaroni ($/Pound)**	→	**Royal Umbrella rice ($/Ton)**

Figure 16.0: Granger causality with the Royal Umbrella rice as the target variable

THE GRANGER CAUSALITY SHOWS IN FIGURE 15.0 THAT THE CPI, THE PRICE OF DIESEL FUEL AND SPAGHETTI & MACARORI IN U.S CITY ARE FACTORS THAT IMPACT THE PRICE OF ROYAL UMBRELLA RICE WITH THE P-VALUE <0.05.

- CPI of fuel and utilities rises can cause inflationary pressures in other sectors like agriculture because it increases the expense of using fuel and utilities in rice production.
- The rise in fuel prices will increase the costs in rice production, marketing and transportation.
- Spaghetti & Macaroni may be the factors behind the increase in rice prices because they are made from wheat, which are with rice are the two most common food grains worldwide and increase the usage of biofuels

FORECAST METRICS

	RMSE	MAE	MAPE	POCID	R^2	AIC	BIC
ARIMA(1,1,0)	46.8	16.1	0.069	55.9	0.138	2390.3	2397.3
ARIMA(1,1,0) (in-sample)	33.7	8.283	0.042	60.6	0.945	2949.9	2957.4

Figure 17.0: ARIMA(1,1,0) with forecast metrics

THE MAPE OF THE ARIMA(1,1,0) ARE HIGHER THAN THAT OF THE VAR(1,N).

	RMSE	MAE	MAPE	POCID	R^2	AIC	BIC
VAR(1,n)	39.9	19.0	0.063	67.8	0.373	-3.012	-2.785
VAR(1,n) (in-sample)	31.5	8.227	0.040	59.5	0.952	-2.508	-2.313

Figure 18.0: VAR(1,0) with forecast metrics

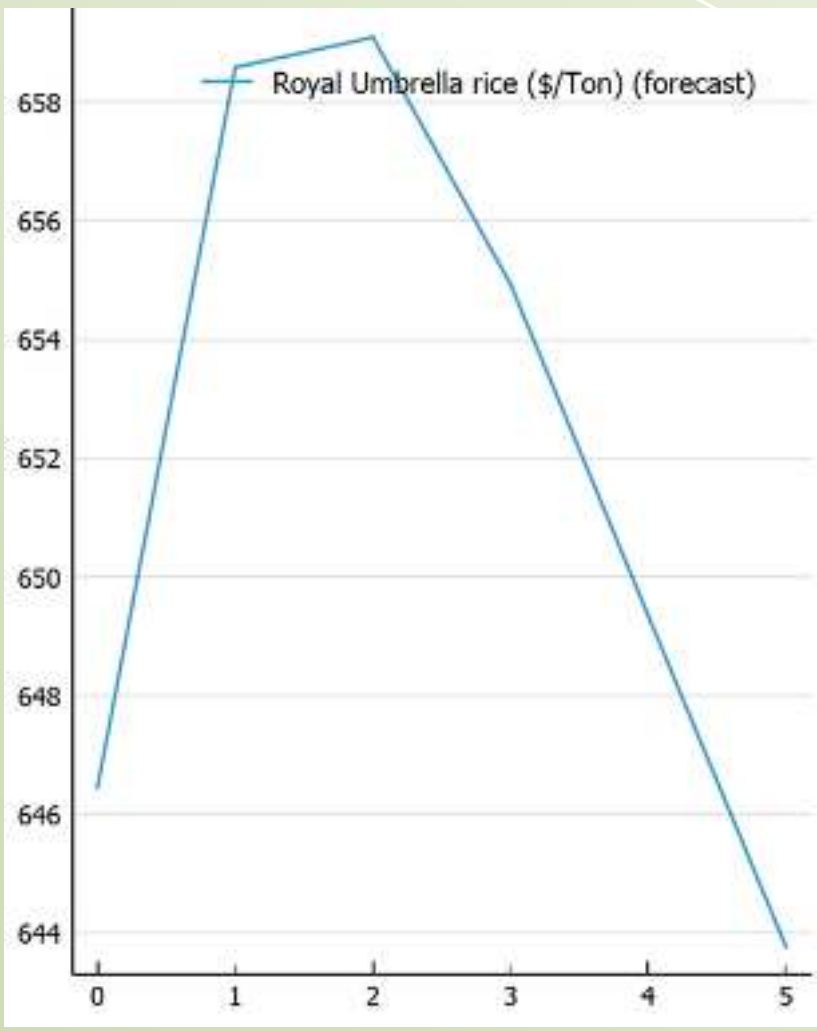


Figure 19.0: The next 6 months price of Royal Umbrella rice is displayed on a graph using the Var (1,0) forecast.

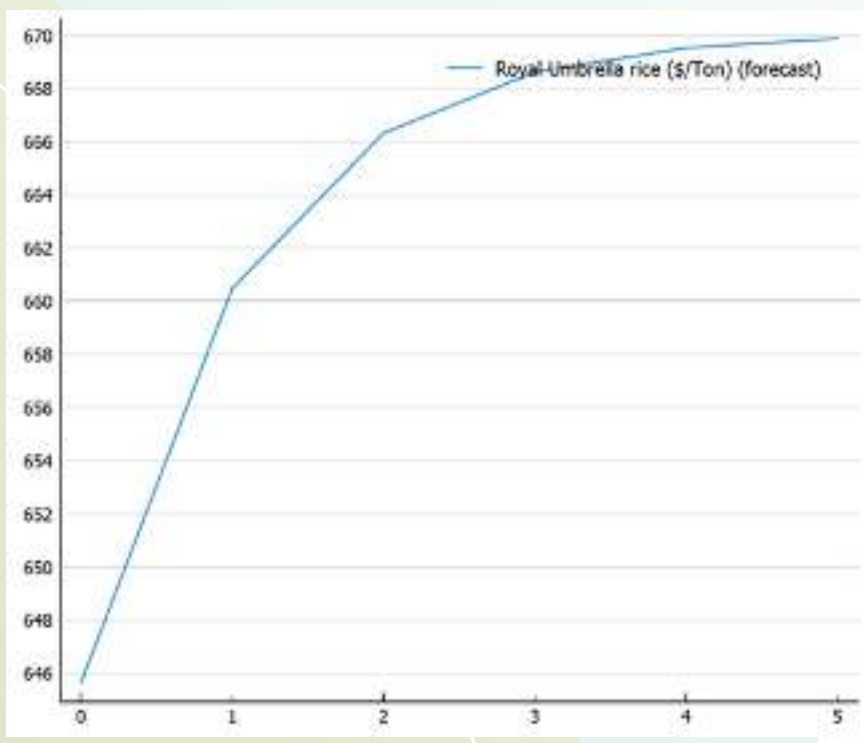


Figure 20.0: The graph of forecast Royal Umbrella rice price in next quarter using the ARIMA (1,1,0)

ROYAL UMBRELLA

Price

FORECAST

ARIMA

	Royal Umbrella rice ($/Ton) (forecast)
1	645.643
2	660.481
3	666.322
4	668.623
5	669.528
6	669.885

Figure 21.0: The ARIMA (1,1,0) prediction for the price of Royal Umbrella in the next 6 months

VAR

	Royal Umbrella rice ($/Ton) (forecast)
1	646.451
2	658.584
3	659.09
4	654.933
5	649.344
6	643.768

Figure 22.0: The Var(1,0) prediction for the price of Royal Umbrella in the next 6 months

RAW RICE

Best forecast model

VAR(1,0), with an MAPE of 4%

in forecasting the price of Royal Umbrella rice in the next 6 months

unique foods...

The forecast for price of Royal Umbrella rice

February 2024

$643.768/TON

This price is $35.811/ton higher than the price in August 2023, which was $607.957/ton

Solutions

For YHL Group

Assure profit and farmers' income

Negotiate with customers, partners to increase the selling price of Royal Umbrella for upcoming orders or sign contracts with flexible prices.

Improve productivity and lower input costs

Invest in modern machines and technologies

Increase the company's sustainability

Apply technological innovations to reduce the harm to the environment

Manage income and expenses

Financial planning and budgeting for price fluctuations

Solutions

For YHL Group

Follow market trend

Update information about factors that influence rice pricing such as export bans, climate change and the prices of other relevant goods.

Enhance partnerships

Establish strong relationships with partners, customers for more sufficient pricing agreements

Stabilize prices and supplies for the market until 2024

Follow or participate in the government's programs

Risk management

Protect against price volatility by employing risk management tools like futures contracts or insurance.

CHAT GPT

Solutions

- Cannot forecast the global price of rice in the next 6 months with the given dataset
- Only mentions the factors that impact rice prices
- Suggests referring to reputable sources and reports on on food price analysis and predictions like the Food and Agriculture Organization (FAO) or the World Bank
- Can propose solutions for the company to handle the surge in rice prices

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