Modelling the Economic Growth of the Philippines using Support Vector Machine and ARIMA Time Series Forecasting

SYSTEMS ANALYSIS & QUANTITATIVE METHODS

Presented by:
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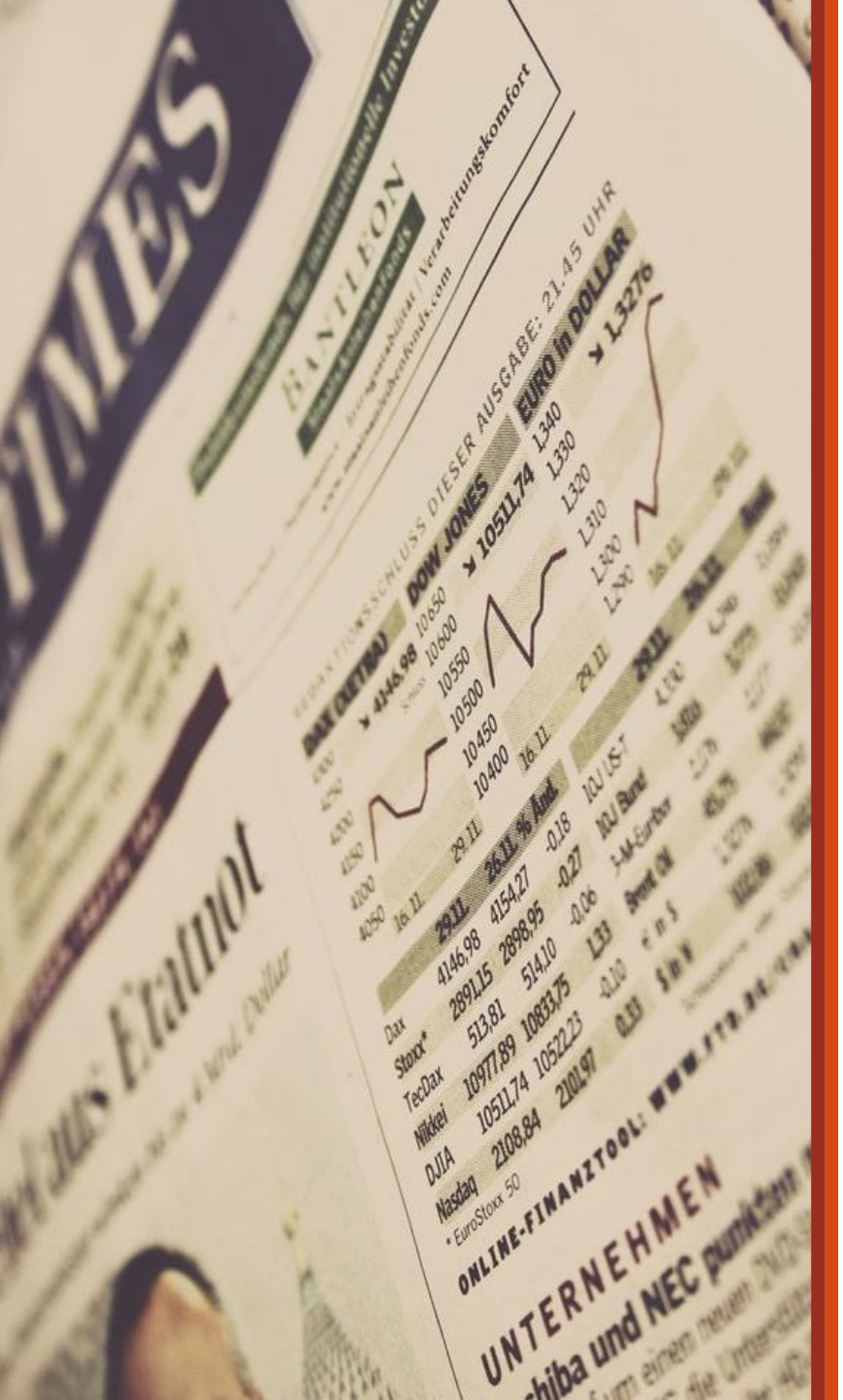
Contents

Introduction

Objectives, Dataset, Data Source, Data Structures



Dataset

The dataset was taken from:

Trade: International Merchandise and Domestic

of the OpenStat website of the Philippine Statistics Authority.

1. **Philippine Exports by Commodity Groups (GRT), 2000-2010**
   Select part: | View table: | Size: 3332731 Updated: 10/10/2018
   1. **Commodity**: GARMENTS, BASKETWORKS, CHRISTMAS DECOR, CERAMIC TILES AND DECOR, ..., ELECTRONIC EQPT. & PARTS (73)
   2. **Country Of Destination**: ARGENTINA, AUSTRALIA, AUSTRIA, BANGLADESH, ..., WESTERN PORTUGUESE AFRICA (265)
   3. **Year**: 2000, 2001, 2002, 2003, ..., 2010 (11)
   4. **Item**: Gross Kilo, Quantity, Fob, (3)

2. **Philippine Exports by Commodity Groups (GRT), 2011-2017**
   Select part: | View table: | Size: 2140169 Updated: 10/10/2018
   1. **Commodity**: GARMENTS, BASKETWORKS, CHRISTMAS DECOR, CERAMIC TILES AND DECOR, ..., NICKEL (74)
   2. **Country Of Destination**: ARGENTINA, AUSTRALIA, AUSTRIA, BAHRAIN, ..., KOSOVO (253)
   3. **Year**: 2011, 2012, 2013, 2014, ..., 2017 (7)
   4. **Item**: Gross Kilo, Quantity, Fob, (3)

3. **Philippine Imports by Commodity Groups (GRT), 2000-2010**
   Select part: | View table: | Size: 1637959 Updated: 10/10/2018
   1. **Commodity**: DAIRY PRODUCTS, CEREALS AND CEREAL PREPARATIONS, FEEDING STUFF FOR ANIMALS (NOT INCLUDING UNMILLED CEREALS), TEXTILES FIBER & THEIR WASTE, ..., OTHERS (36)
   2. **Country Of Destination**: ARUBA, AUSTRALIA, AUSTRIA, BELGIUM, ..., KYRGYZSTAN (255)
   3. **Year**: 2000, 2001, 2002, 2003, ..., 2010 (11)
   4. **Item**: Gross Kilo, Quantity, CIF, (3)

4. **Philippine Imports by Commodity Groups (GRT), 2011-2017**
   Select part: | View table: | Size: 1552582 Updated: 3/26/2019
   1. **Commodity**: DAIRY PRODUCTS, CEREALS AND CEREAL PREPARATIONS, FEEDING STUFF FOR ANIMALS (NOT INCLUDING UNMILLED CEREALS), TEXTILES FIBER & THEIR WASTE, ..., IRON ORE, NOT AGGLOMERATED (54)
   2. **Country Of Destination**: ARGENTINA, AUSTRALIA, AUSTRIA, BELGIUM, ..., TOKELAU (243)
   3. **Year**: 2011, 2012, 2013, 2014, ..., 2017 (7)
   4. **Item**: Gross Kilo, Quantity, CIF, (3)

Data

DOWNLOADED DATA

Philippine Imports by Commodity Groups (GRT), 2000-2010		
		2000
		Gross Kilo
DAIRY PRODUCTS	CHINA, PEOPLE'S REP. OF	1435858
	TAIWAN (REP. OF CHINA)	36781
	GERMANY	7623482
	HONG KONG	31870
	JAPAN (EXCLUDES OKINAWA)	150643
	KOREA, REP. OF (SOUTH)	88231
	NETHERLANDS	21212525
	SINGAPORE	4449251
	THAILAND	103388
	UNITED STATES OF AMERICA	19178688
CEREALS AND CEREAL PREPARATIONS	CHINA, PEOPLE'S REP. OF	192683640
	TAIWAN (REP. OF CHINA)	1211195
	GERMANY	114592
	HONG KONG	311217
	JAPAN (EXCLUDES OKINAWA)	408532
	KOREA, REP. OF (SOUTH)	854086

PRE-PROCESSED DATA

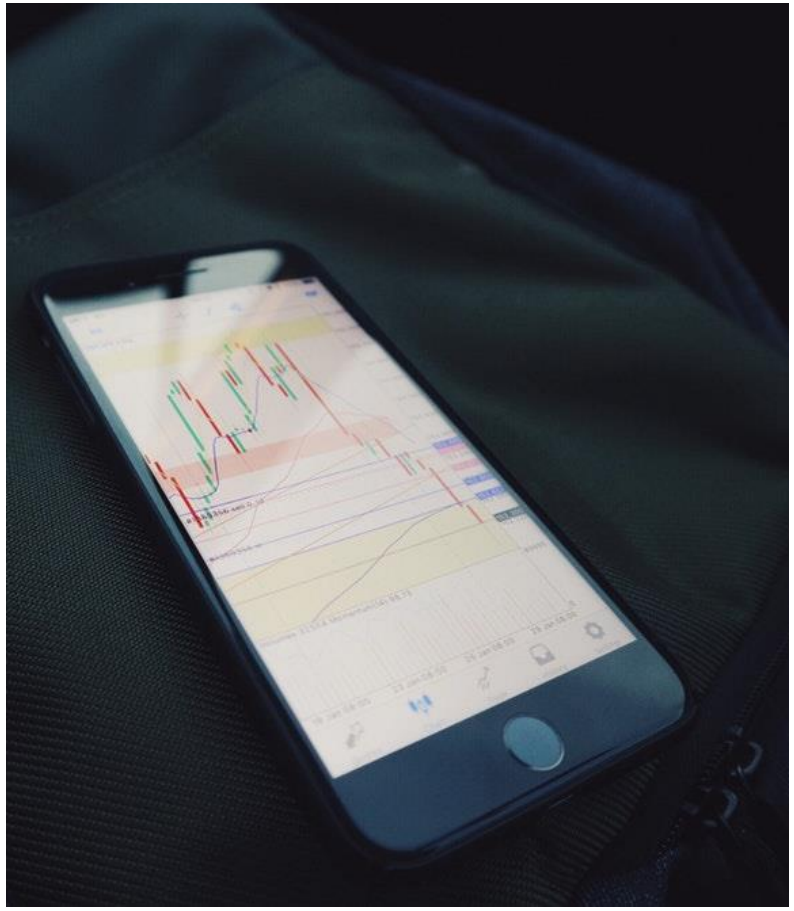
YEAR	GDP	INF_RATE	USA_IM	USA_EX	HKG_IM	HKG_EX	JPN_IM	JPN_EX	CHN_IM	CHN_EX	SGP_IM	S
2000	81026.3	5.709796	4189.496	1685.805	503.2835	1265.918	2455.207	7475.654	2256.291	832.02	1641.026	1
2001	76262.07	5.54948	3929.777	1747.688	430.337	697.6055	2318.322	7786.615	2759.065	784.7918	1073.741	7
2002	81357.61	4.162227	3295.135	1482.853	422.9383	396.5318	2285.557	7382.066	3789.797	1045.792	2331.552	9
2003	83908.21	3.201328	2696.238	1489.052	386.2103	265.5427	2074.685	7804.035	4723.376	1073.818	2171.476	8
2004	91371.24	5.516887	2520.324	2241.002	385.3965	319.2008	1877.272	8120.294	4332.112	993.293	2857.879	4
2005	103072	5.82801	3009.381	2022.833	356.8217	347.941	1607.073	7118.937	3446.992	1895.315	2598.372	7
2006	122211	4.949024	3266.881	2416.108	371.1434	1467.953	1959.364	8208.555	4544.426	5816.937	2765.46	1
2007	149360	3.090331	2503.986	1663.158	417.096	1143.501	2196.915	9142.957	4908.36	11180.25	3615.57	
2008	174195	7.549062	2921.706	1397.21	368.8505	485.4007	2076.528	8533.23	4689.721	5903.544	3087.855	1
2009	168335	2.773245	2884.095	1310.739	207.7716	244.4273	2557.501	6800.402	4387.375	9183.277	2666.029	8
2010	199591	4.222387	2668.938	1342.448	201.2166	258.094	2605.257	7349.299	4863.452	17282.83	3207.121	1
2011	224143	4.021723	4310.312	1692.037	194.7996	601.3463	2097.19	6653.283	5577.221	22312.04	1919.159	1
2012	250092	1.968384	3652.42	1619.537	285.9736	994.775	2246.063	8559.117	6392.129	32357.56	1846.68	1
2013	271836	2.045468	3249.558	5814.408	182.2188	954.7158	2371.295	11013.59	7734.179	47331.27	1860.472	1
2014	284585	3.157438	3898.24	1576.118	229.8867	507.3487	2229.2	12288.28	9083.206	47903.35	1778.121	1
2015	292774	-0.58657	5346.232	1408.658	174.6864	1290.467	3062.999	12380.6	12561.78	30543.92	2511.077	6
2016	304889	1.699096	6188.831	1946.504	239.7456	4798.801	5131.75	10420.98	20307.08	39155.15	2615.879	4
2017	313595	2.320709	6655.8	2061.016	253.262	988.6873	5186.697	9327.189	20058.18	46006.73	2260.008	1

GDP

The most watched data for any economy—economic growth. Economic growth can be considered among the most crucial indicators that are released. The reason why it's so important is that it indicates the growth in economic output, whether measured by GDP (gross domestic product), GVA (gross value added), or any other measure. Assessing economic output also helps investors understand what drives an economy. (Ashworth, 2015)

Data: https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2017&locations=PH&start=2000

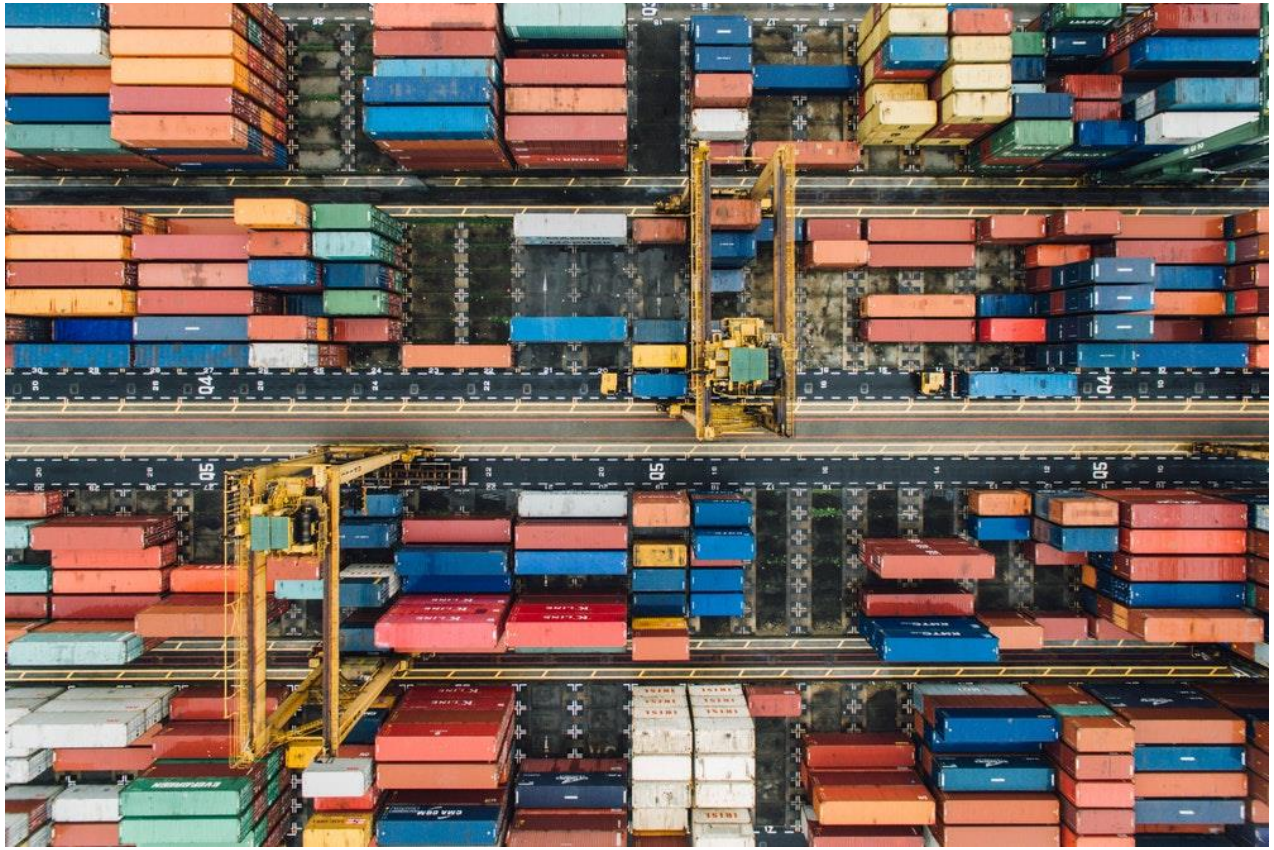
Inflation



Inflation represents a rise in the general price level in a country or region. The higher the inflation, the lower the quantum of a particular good that can be purchased compared to the past.

Like economic growth, inflation is comparable for countries in the same stage of evolution in the business cycle. Emerging economies have a higher rate of consumption growth and spending growth. As a result, a high level of inflation is normal for these economies.

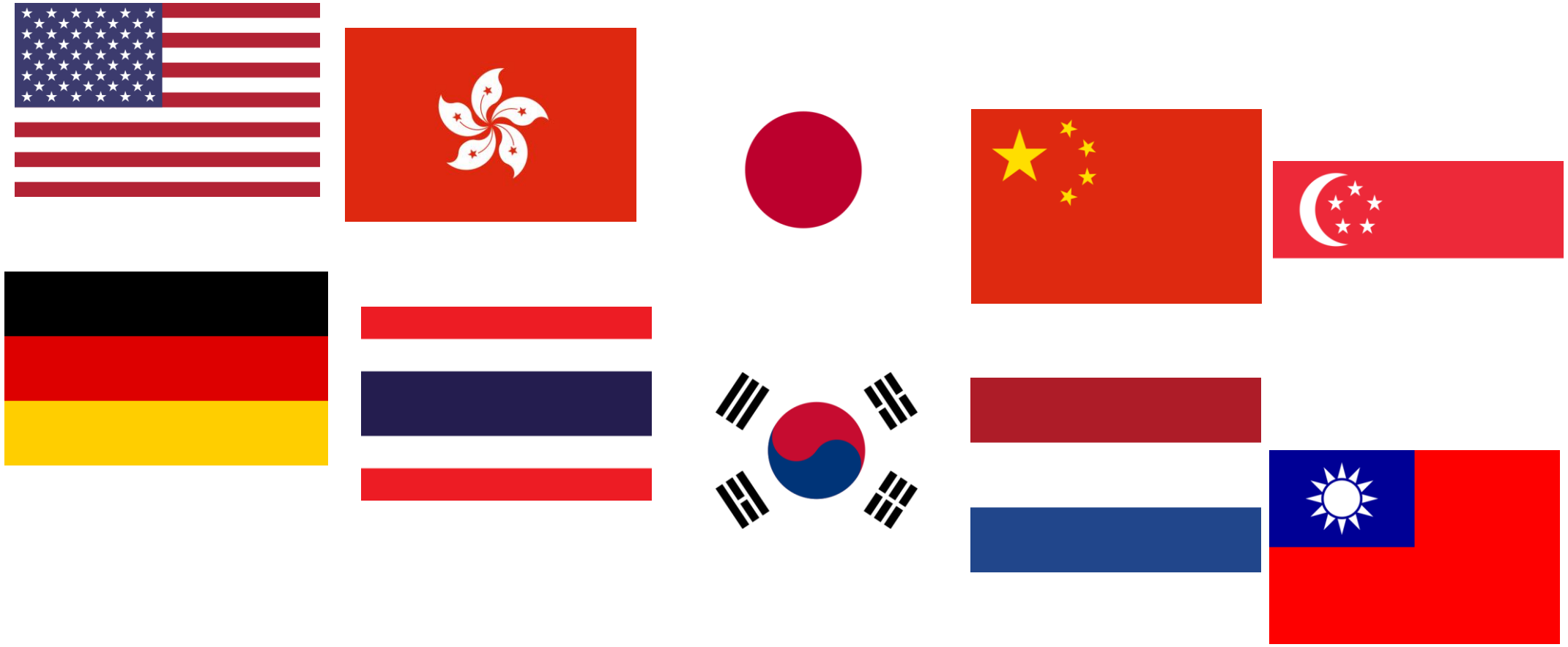
Imports and Exports



Imports and exports—the staples of international trade—may seem like terms that have little bearing on everyday life for the average person, but they can, in fact, exert a profound influence on both the consumer and the economy.

A healthy economy is one where both exports and imports are growing. This typically indicates economic strength and a sustainable trade surplus or deficit. (Kramer, 2019)

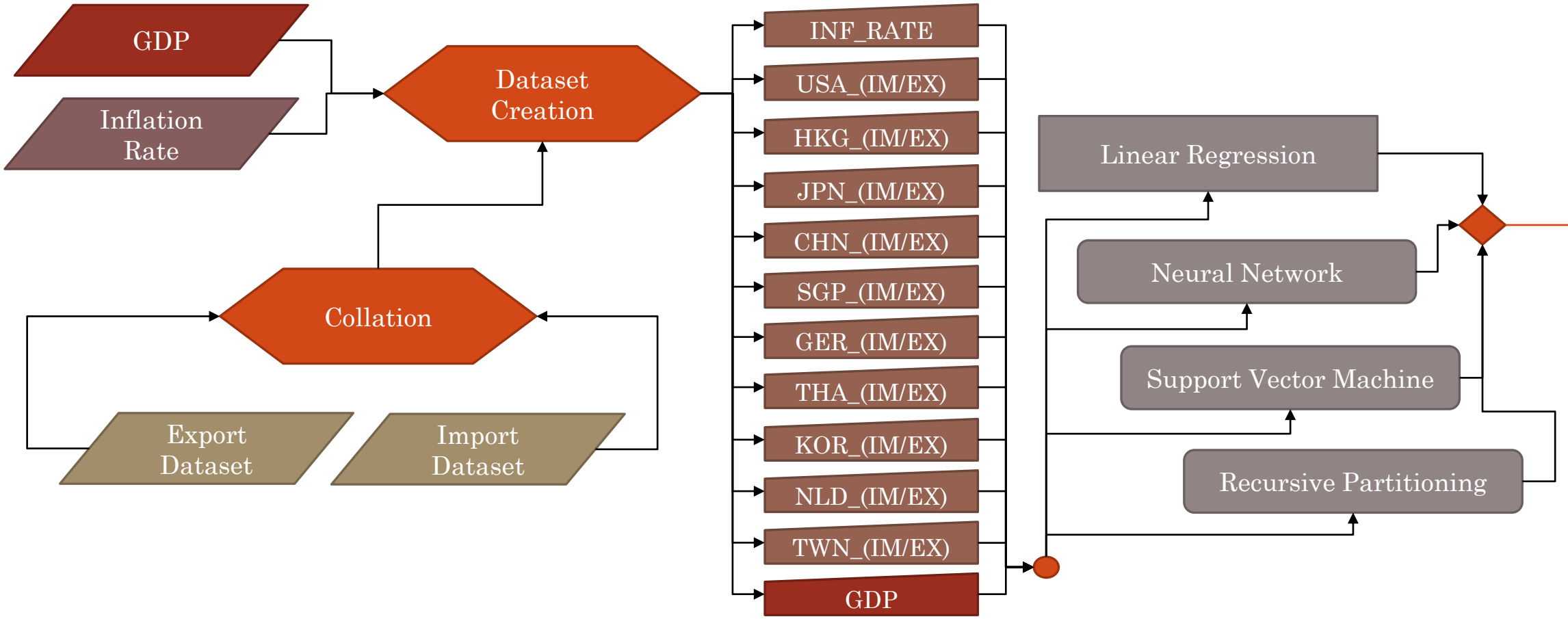
Philippines Top Trading Partners



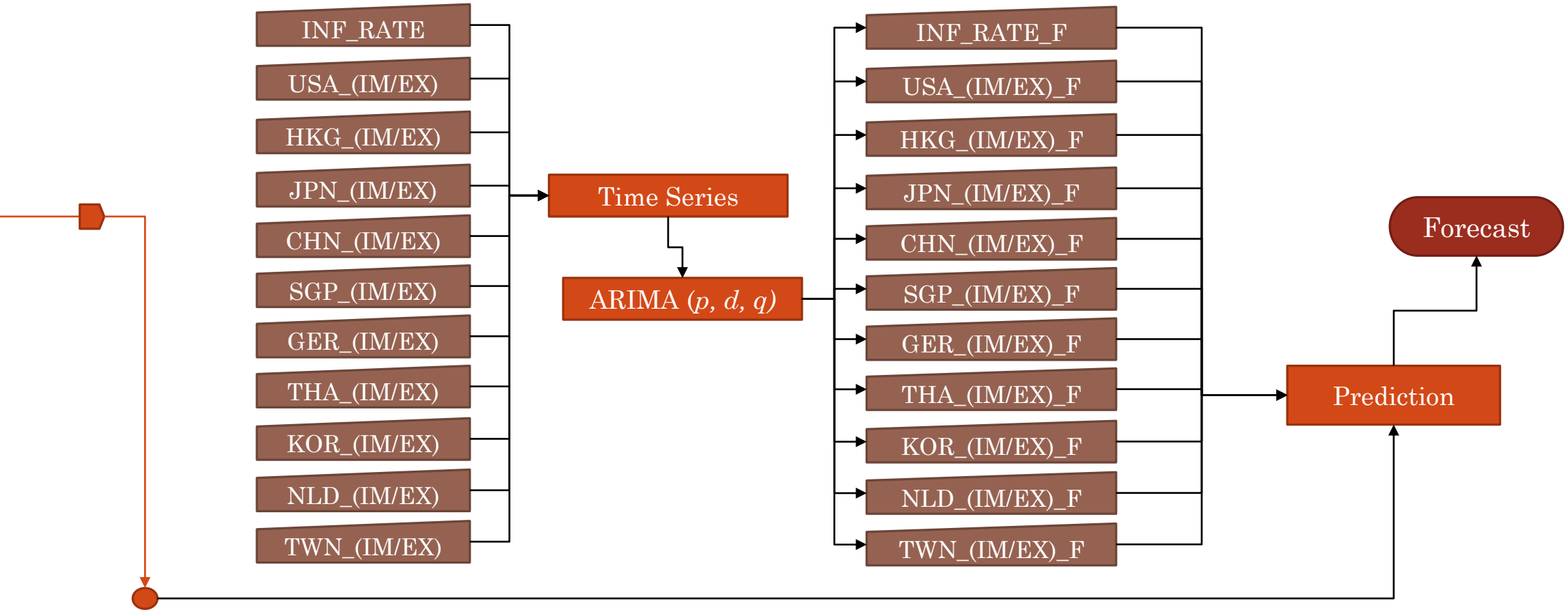
Methods

Workflow, Support Vector Machine, ARIMA Time Series Forecasting

Workflow


GDP
Inflation Rate
Dataset Creation
Collation
Export Dataset
Import Dataset
INF_RATE
USA_(IM/EX)
HKG_(IM/EX)
JPN_(IM/EX)
CHN_(IM/EX)
SGP_(IM/EX)
GER_(IM/EX)
THA_(IM/EX)
KOR_(IM/EX)
NLD_(IM/EX)
TWN_(IM/EX)
GDP
Linear Regression
Neural Network
Support Vector Machine
Recursive Partitioning

Workflow (cont'd)

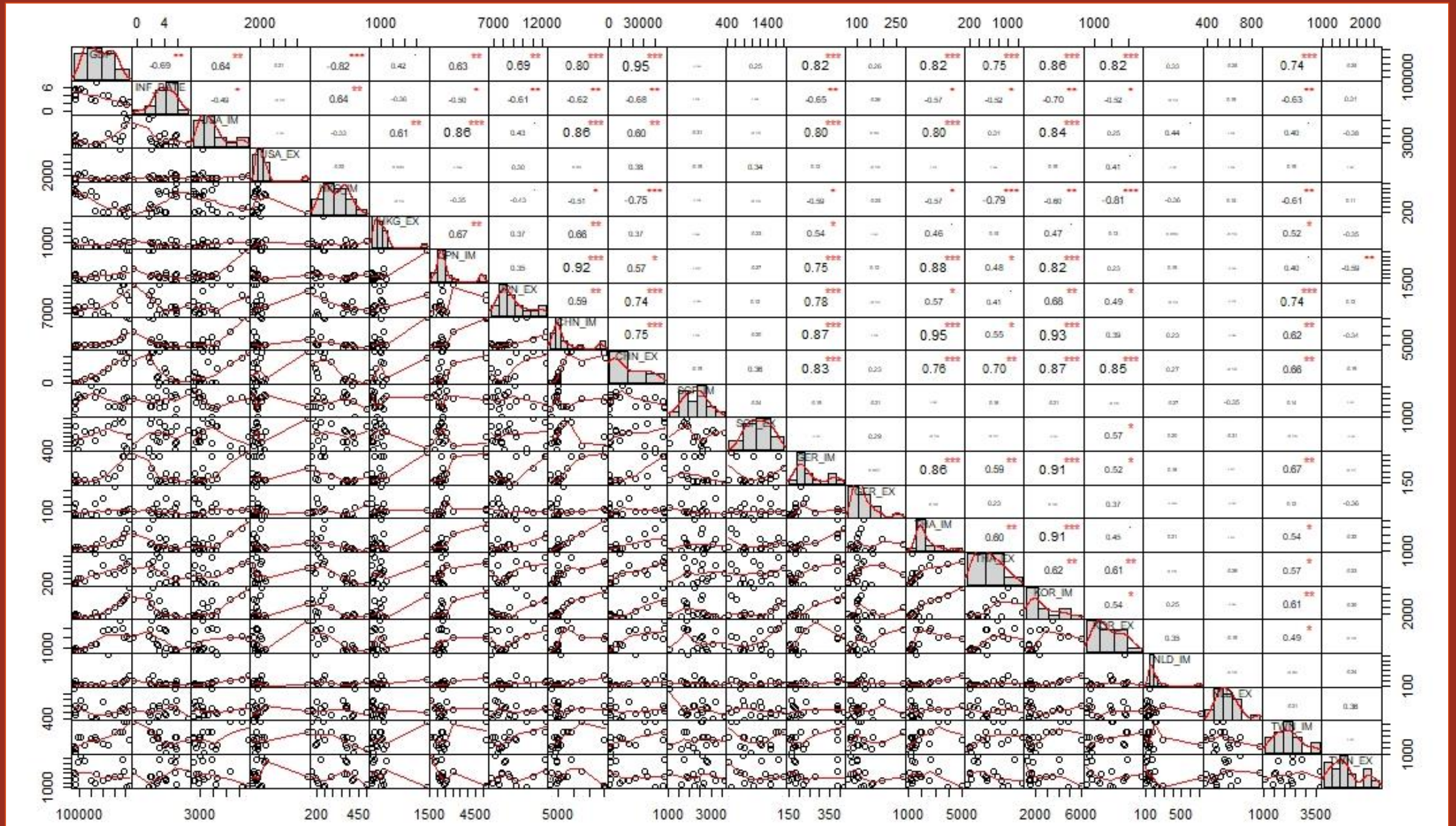


Summary

YEAR	GDP	INF_RATE	USA_IM	USA_EX	HKG_IM	HKG_EX	JPN_IM
Min. :2000	Min. : 76262	Min. :-0.5866	Min. :2504	Min. :1311	Min. :174.7	Min. : 244.4	Min. :1607
1st Qu.:2004	1st Qu.: 94296	1st Qu.: 2.4338	1st Qu.:2893	1st Qu.:1484	1st Qu.:213.3	1st Qu.: 360.1	1st Qu.:2082
Median :2008	Median :171265	Median : 3.6115	Median :3281	Median :1674	Median :321.4	Median : 649.5	Median :2266
Mean :2008	Mean :181811	Mean : 3.7321	Mean :3733	Mean :1940	Mean :311.8	Mean : 946.0	Mean :2574
3rd Qu.:2013	3rd Qu.:266400	3rd Qu.: 5.3749	3rd Qu.:4125	3rd Qu.:2004	3rd Qu.:386.0	3rd Qu.:1106.3	3rd Qu.:2532
Max. :2017	Max. :313595	Max. : 7.5491	Max. :6656	Max. :5814	Max. :503.3	Max. :4798.8	Max. :5187

JPN_EX	CHN_IM	CHN_EX	SGP_IM	SGP_EX	GER_IM	GER_EX
Min. : 6653	Min. : 2256	Min. : 784.8	Min. :1074	Min. : 431.8	Min. :144.1	Min. : 63.39
1st Qu.: 7405	1st Qu.: 4346	1st Qu.: 1279.2	1st Qu.:1875	1st Qu.: 780.2	1st Qu.:168.9	1st Qu.: 85.16
Median : 8164	Median : 4793	Median :10181.8	Median :2421	Median :1114.6	Median :187.8	Median :101.97
Mean : 8687	Mean : 7023	Mean :17866.8	Mean :2378	Mean :1092.7	Mean :234.7	Mean :117.46
3rd Qu.: 9281	3rd Qu.: 7399	3rd Qu.:31904.2	3rd Qu.:2741	3rd Qu.:1433.1	3rd Qu.:268.6	3rd Qu.:126.06
Max. :12381	Max. :20307	Max. :47903.3	Max. :3616	Max. :1795.9	Max. :419.9	Max. :274.75

THA_IM	THA_EX	KOR_IM	KOR_EX	NLD_IM	NLD_EX	TWN_IM	TWN_EX
Min. : 931.5	Min. : 146.2	Min. :1270	Min. : 768.0	Min. : 94.48	Min. :382.0	Min. :1040	Min. :1023
1st Qu.:1262.9	1st Qu.: 309.7	1st Qu.:1574	1st Qu.: 905.4	1st Qu.:108.46	1st Qu.:468.1	1st Qu.:1698	1st Qu.:1311
Median :1534.3	Median : 544.5	Median :1930	Median :1183.3	Median :129.21	Median :529.0	Median :2243	Median :1438
Mean :1972.8	Mean : 585.8	Mean :2560	Mean :1336.2	Mean :176.79	Mean :545.3	Mean :2248	Mean :1537
3rd Qu.:2366.5	3rd Qu.: 835.6	3rd Qu.:3379	3rd Qu.:1783.0	3rd Qu.:185.20	3rd Qu.:602.8	3rd Qu.:2700	3rd Qu.:1656
Max. :5024.0	Max. :1279.8	Max. :5976	Max. :2354.3	Max. :718.39	Max. :878.4	Max. :3691	Max. :2312

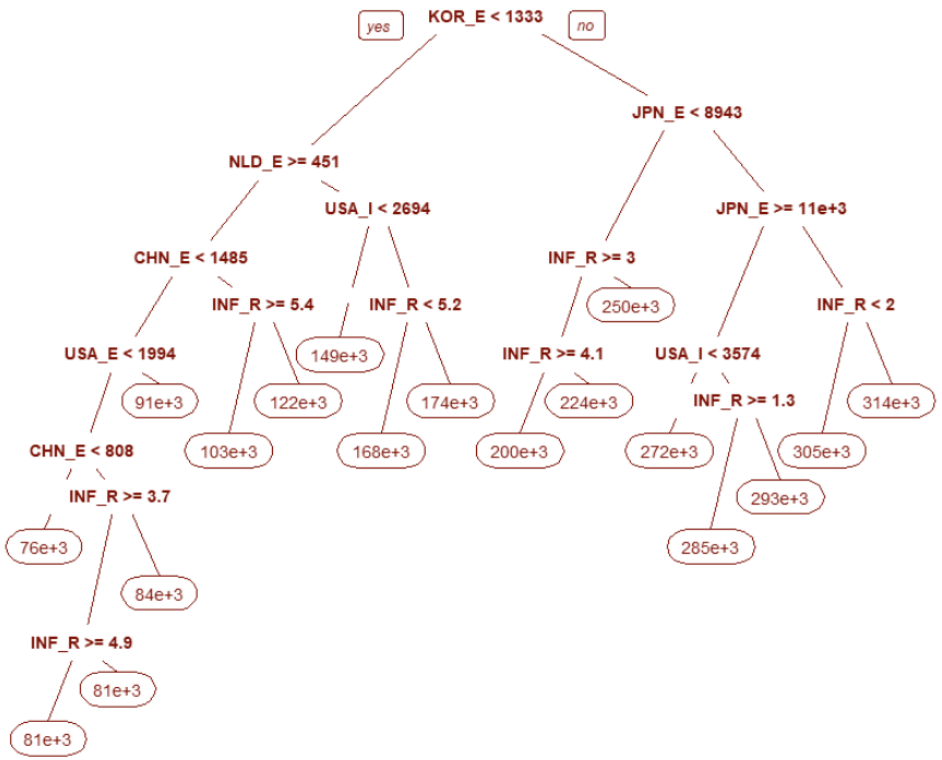

GDP
INF_RATE
USA_IM
USA_EX
UKG_IM
UKG_EX
JPN_IM
JPN_EX
CHN_IM
CHN_EX
SGP_IM
SGP_EX
GER_IM
GER_EX
INA_IM
INA_EX
KOR_IM
KOR_EX
NLD_IM
NLD_EX
TWN_IM
TWN_EX

Multiple Linear Regression

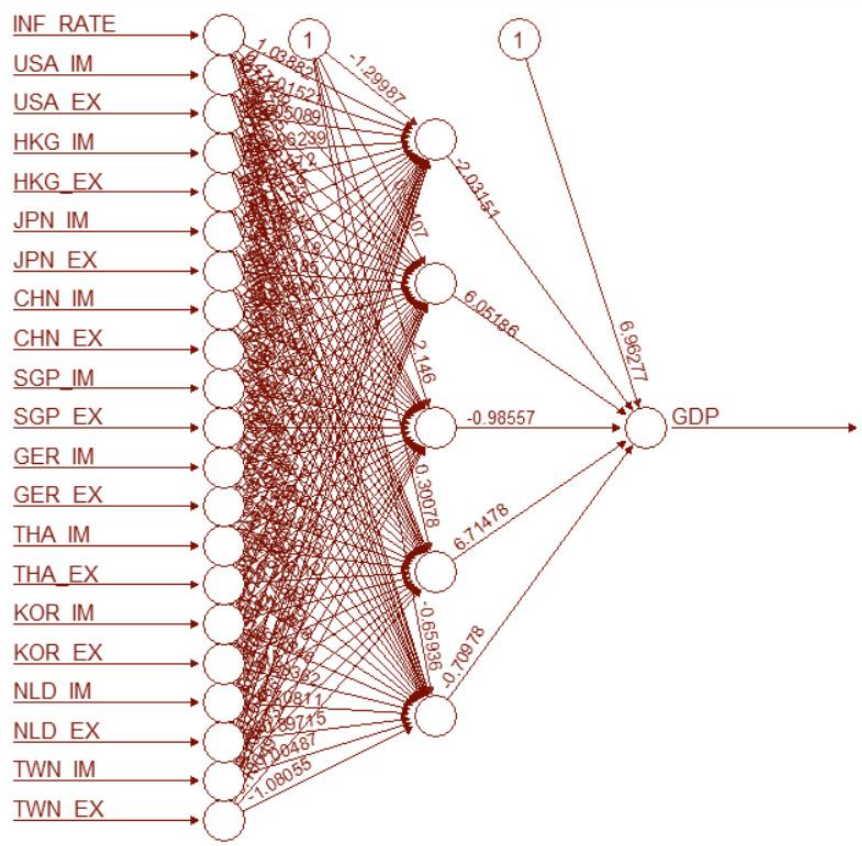
```
Call:
lm(formula = GDP ~ INF_RATE + USA_IM + USA_EX + HKG_IM + HKG_EX +
    JPN_IM + JPN_EX + CHN_IM + CHN_EX + SGP_IM + SGP_EX + GER_IM +
    GER_EX + THA_IM + THA_EX + KOR_IM + KOR_EX + NLD_IM + NLD_EX +
    TWN_IM + TWN_EX)

Residuals:
ALL 18 residuals are 0: no residual degrees of freedom!

Coefficients: (4 not defined because of singularities)
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -38881.099         NA      NA       NA
INF_RATE     29843.198         NA      NA       NA
USA_IM          -7.688         NA      NA       NA
USA_EX         -32.385         NA      NA       NA
HKG_IM        -990.215         NA      NA       NA
HKG_EX        -101.072         NA      NA       NA
JPN_IM         156.537         NA      NA       NA
JPN_EX          33.339         NA      NA       NA
CHN_IM          40.226         NA      NA       NA
CHN_EX           6.669         NA      NA       NA
SGP_IM          60.241         NA      NA       NA
SGP_EX          21.622         NA      NA       NA
GER_IM         389.681         NA      NA       NA
GER_EX         634.033         NA      NA       NA
THA_IM        -256.833         NA      NA       NA
THA_EX        -234.304         NA      NA       NA
KOR_IM         -49.228         NA      NA       NA
KOR_EX         -38.912         NA      NA       NA
NLD_IM              NA         NA      NA       NA
NLD_EX              NA         NA      NA       NA
TWN_IM              NA         NA      NA       NA
TWN_EX              NA         NA      NA       NA

Residual standard error: NaN on 0 degrees of freedom
Multiple R-squared:      1,     Adjusted R-squared:    NaN
F-statistic:   NaN on 17 and 0 DF,  p-value: NA
```

```
Call:
lm(formula = GDP ~ HKG_IM + CHN_IM + CHN_EX + GER_IM + THA_IM +
    KOR_IM + KOR_EX)

Residuals:
   Min     1Q Median     3Q    Max
-25235 -11742  -4750  11527  38343

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 144700.868  97960.859   1.477    0.170
HKG_IM        -189.270    110.566  -1.712    0.118
CHN_IM           4.819      4.323   1.115    0.291
CHN_EX           2.564      1.875   1.367    0.201
GER_IM         -12.353    155.934  -0.079    0.938
THA_IM           9.037     18.071   0.500    0.628
KOR_IM         -10.172     18.318  -0.555    0.591
KOR_EX          20.636     48.594   0.425    0.680

Residual standard error: 23220 on 10 degrees of freedom
Multiple R-squared:  0.9587,    Adjusted R-squared:  0.9298
F-statistic: 33.15 on 7 and 10 DF,  p-value: 3.883e-06
```

Recursive Partitioning



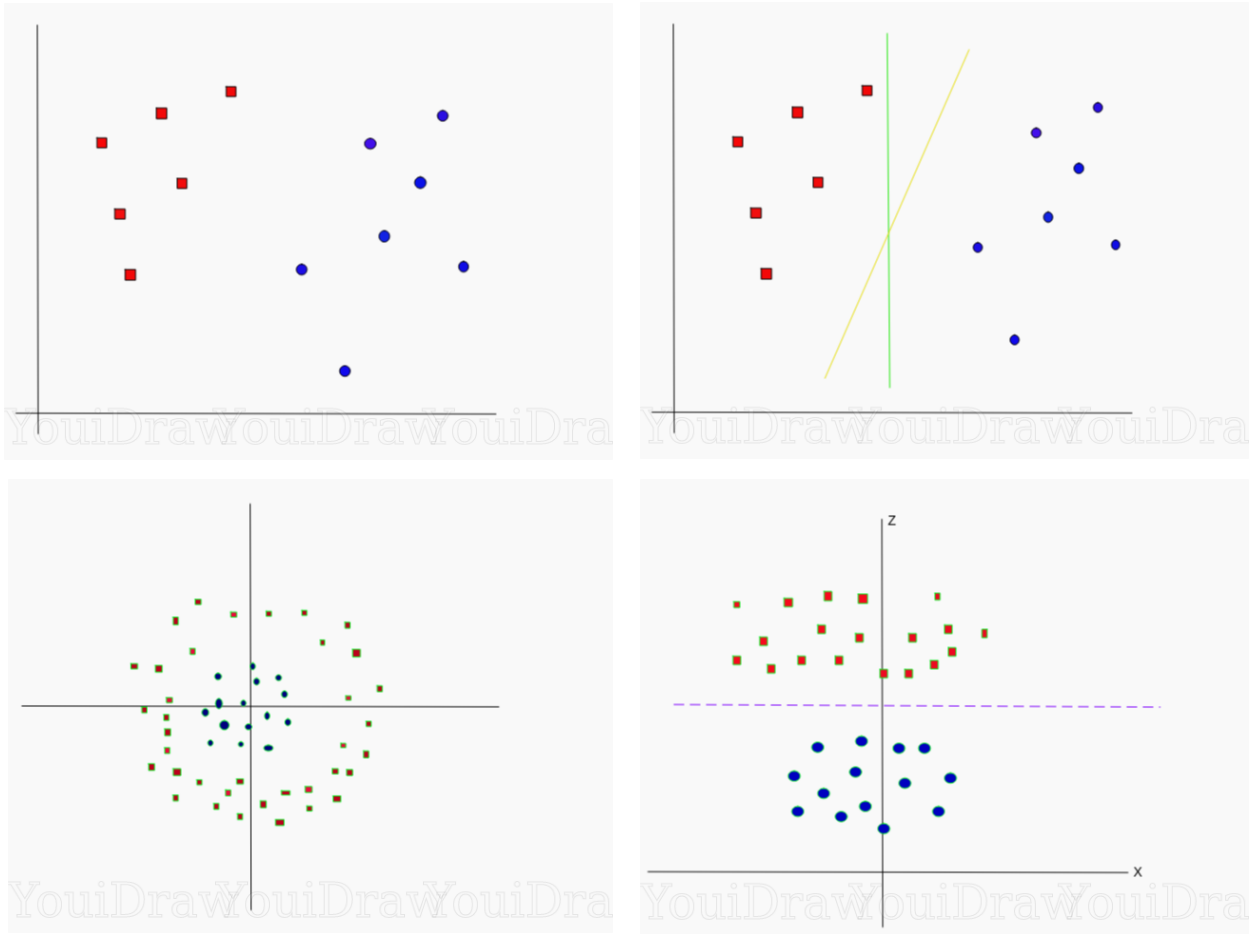
Neural Network



Support Vector Machine

SVM or Support Vector Machine is a linear model for classification and regression problems. It can solve linear and non-linear problems and work well for many practical problems. The idea of SVM is simple: The algorithm creates a line or a hyperplane which separates the data into classes. (Pupale, 2018)

According to the SVM algorithm we find the points closest to the line from both the classes. These points are called support vectors. Now, we compute the distance between the line and the support vectors. This distance is called the margin. Our goal is to maximize the margin. The hyperplane for which the margin is maximum is the optimal hyperplane.



ARIMA
(Autoregressive Integrated Moving Average Model)

An ARIMA model is a class of statistical models for analyzing and forecasting time series data.

It explicitly caters to a suite of standard structures in time series data, and as such provides a simple yet powerful method for making skillful time series forecasts.

- **AR**: *Autoregression*. A model that uses the dependent relationship between an observation and some number of lagged observations.
- **I**: *Integrated*. The use of differencing of raw observations (e.g. subtracting an observation from an observation at the previous time step) in order to make the time series stationary.
- **MA**: *Moving Average*. A model that uses the dependency between an observation and a residual error from a moving average model applied to lagged observations.

Auto ARIMA

The parameters of the ARIMA model are defined as follows:

p: The number of lag observations included in the model, also called the lag order.

d: The number of times that the raw observations are differenced, also called the degree of differencing.

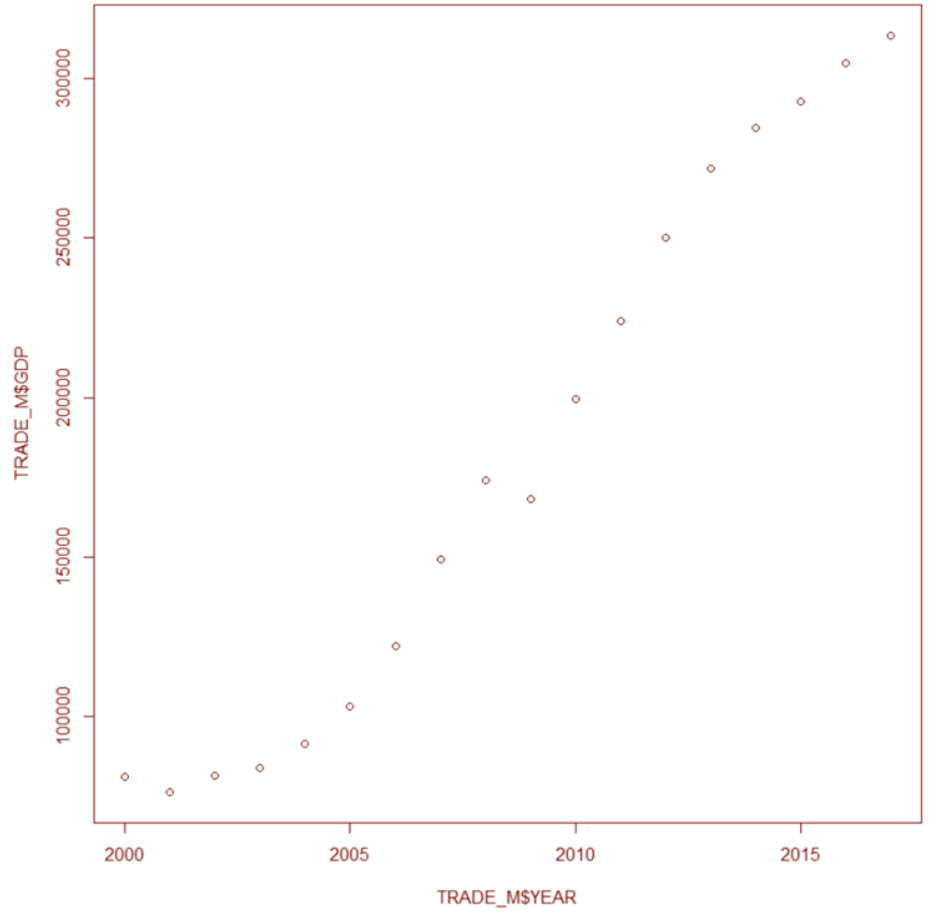
q: The size of the moving average window, also called the order of moving average.

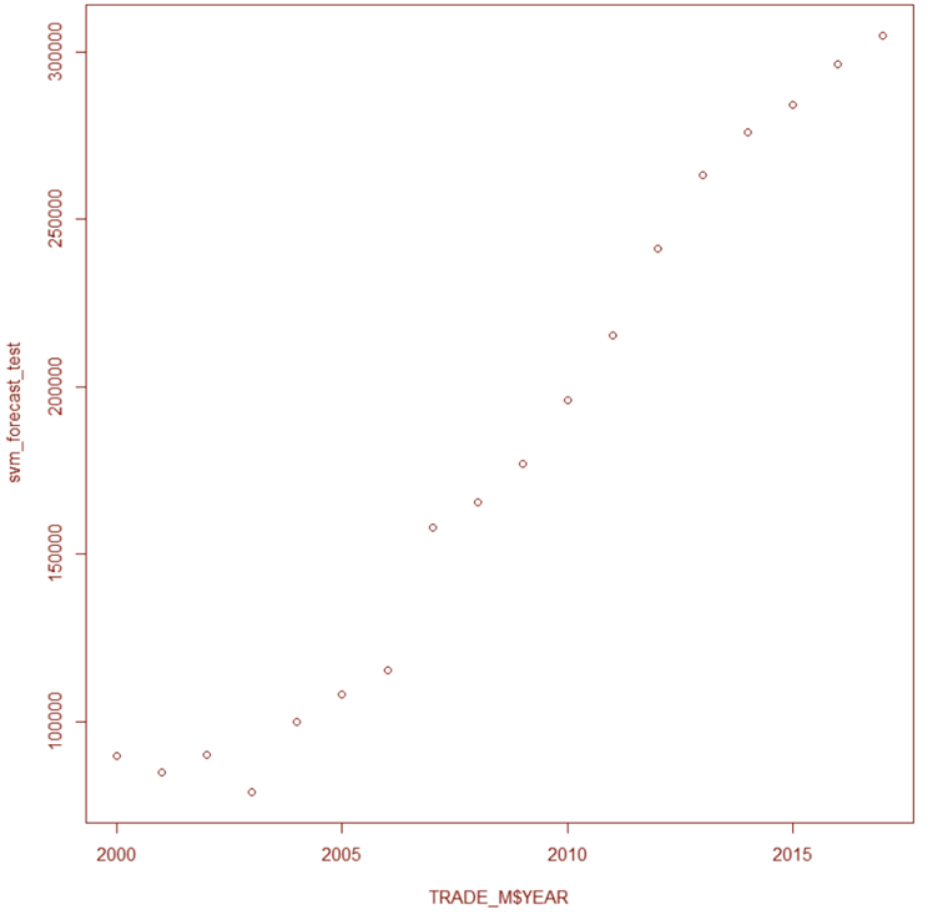
Auto-arima generates a best fit values for (*p,d,q)*.

Results and Discussion

Support Vector Machine, Time Series Forecasting and Prediction

Support Vector Machine

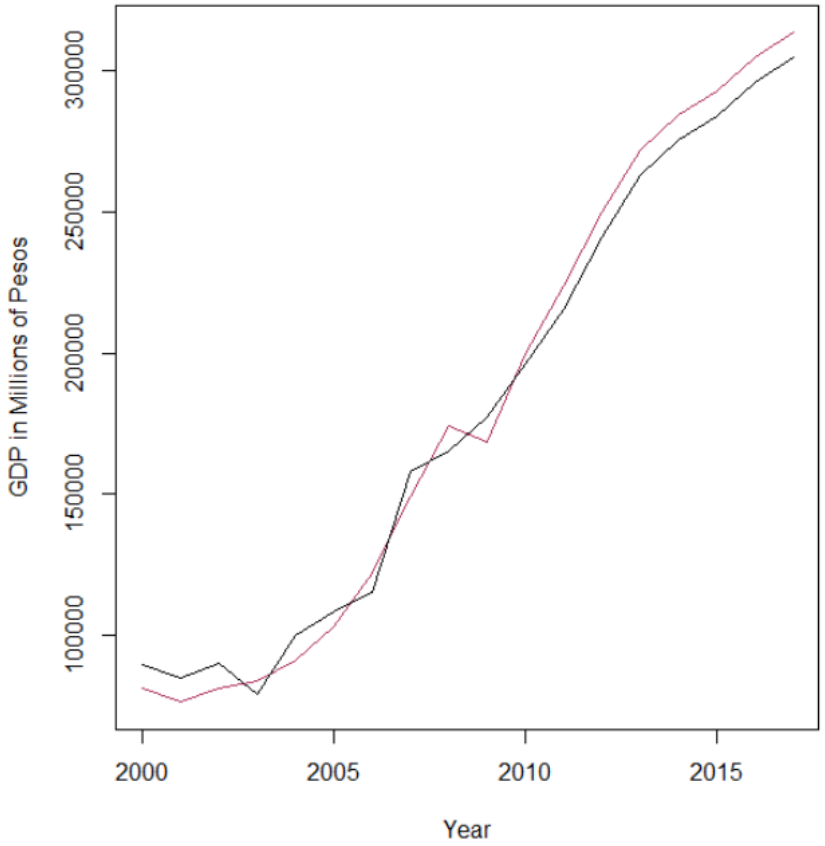




Support Vector Machine

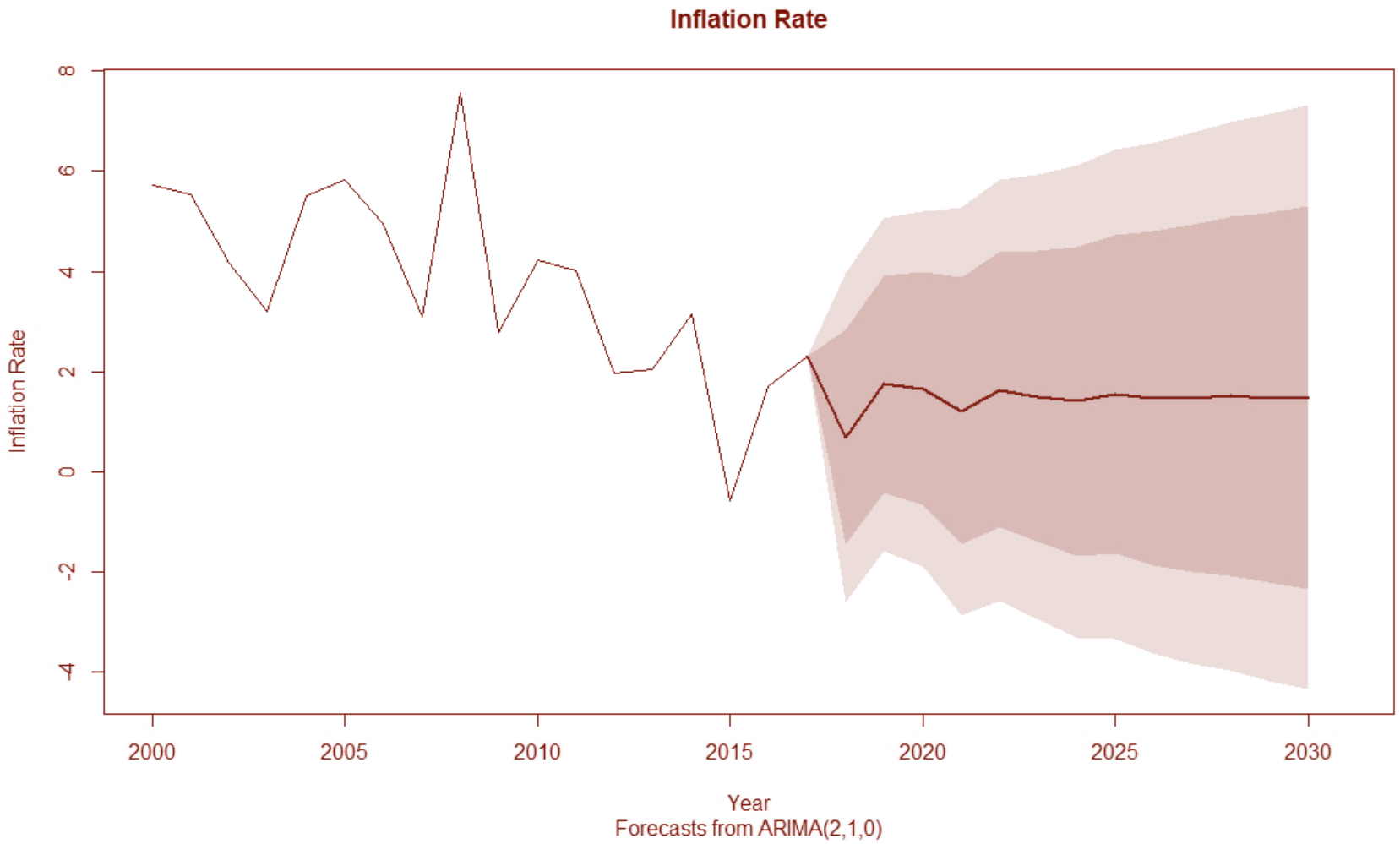
```
Call:
svm(formula = GDP ~ INF_RATE + USA_IM + USA_EX + HKG_IM + HKG_EX + JPN_IM + JPN_EX + CHN_IM +
    CHN_EX + SGP_IM + SGP_EX + GER_IM + GER_EX + THA_IM + THA_EX + KOR_IM + KOR_EX + NLD_IM +
    NLD_EX + TWN_IM + TWN_EX, data = TRADE)


Parameters:
   SVM-Type:  eps-regression
 SVM-Kernel:  radial
       cost:  1
      gamma:  0.04761905
    epsilon:  0.1


Number of Support Vectors:  14
```

- EPS-Regression - are used for regression problems, where you want to predict a continuous number say housing price.
- Kernel - used in training and predicting.
  - linear:u'*v
  - polynomial:(gamma*u'*v + coef0)^degree
  - radial basis: exp(-gamma*|u-v|^2)
  - sigmoid:tanh(gamma*u'*v + coef0)

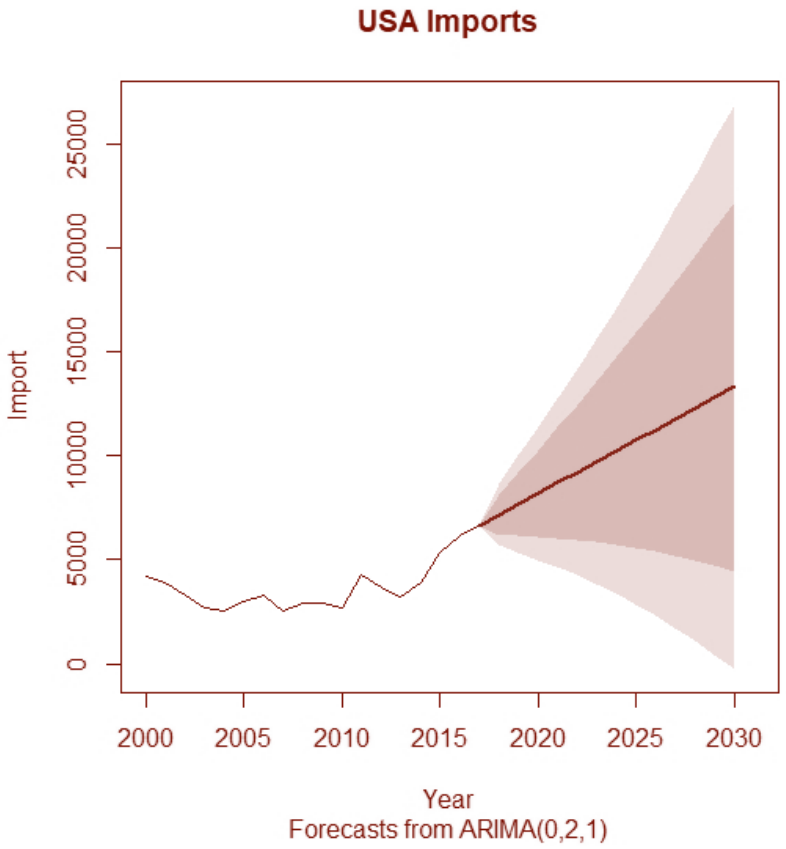


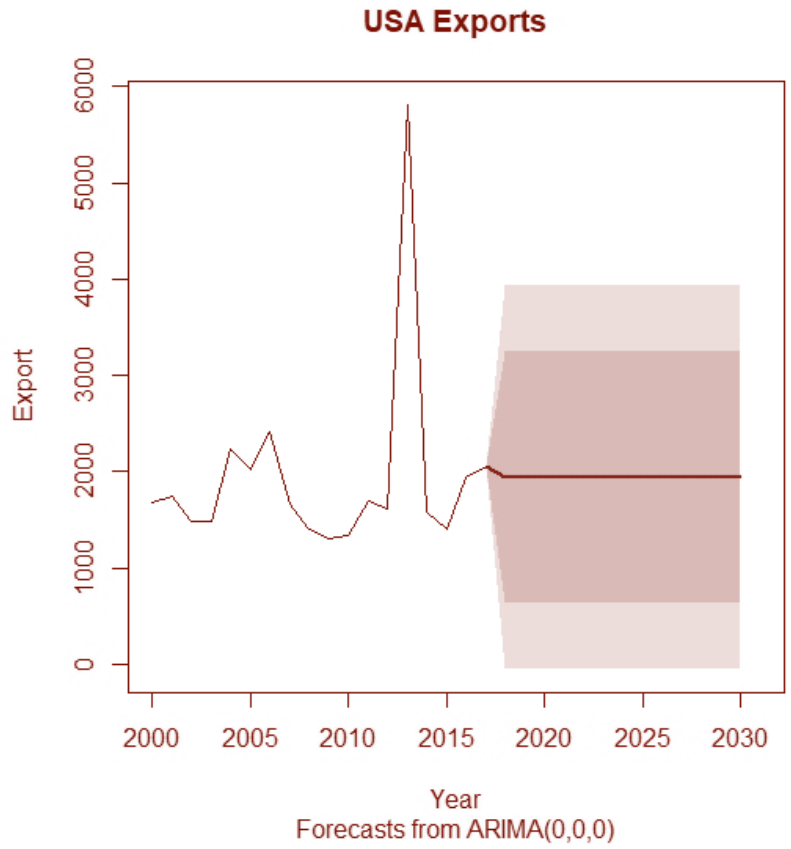
ARIMA

Inflation Rate

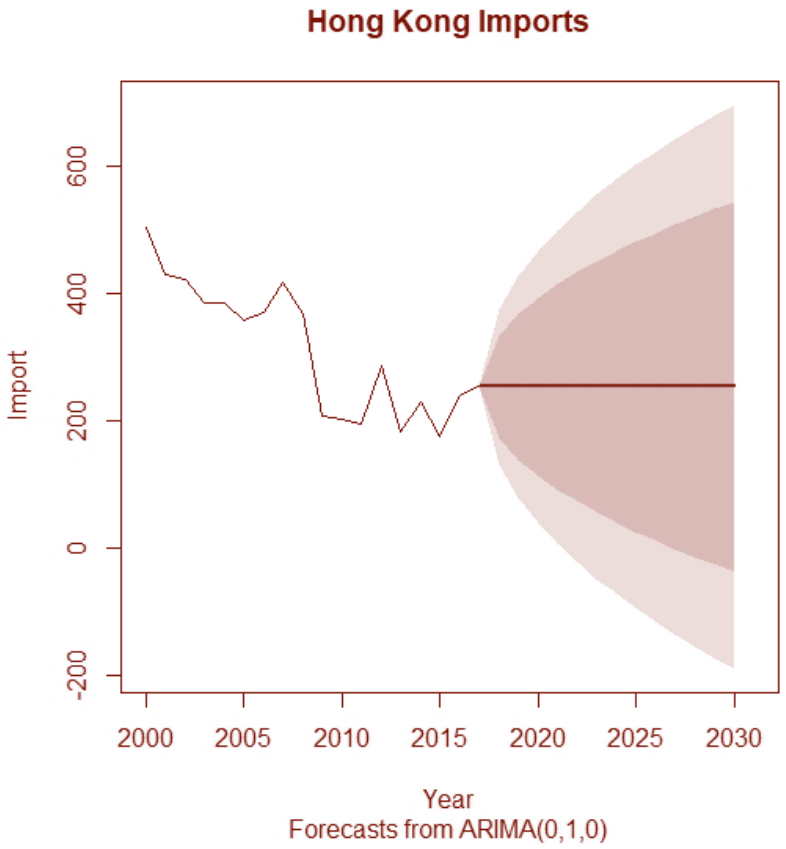


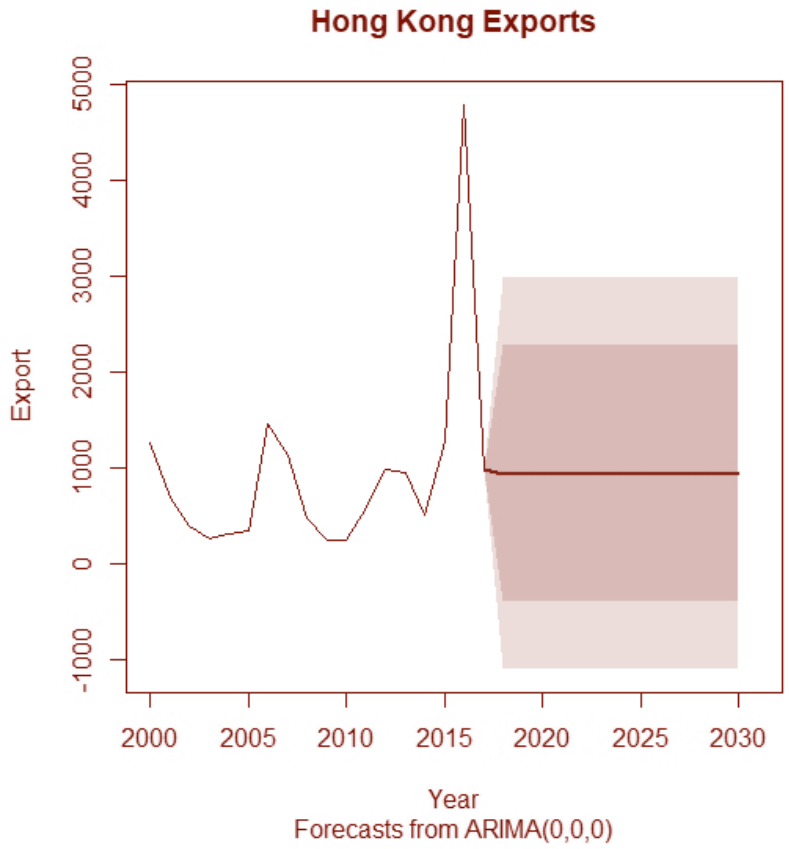
United States of America





Hong Kong


Hong Kong Imports
Import
-200
0
200
400
600
2000
2005
2010
2015
2020
2025
2030
Year
Forecasts from ARIMA(0,1,0)


Hong Kong Exports
Export
-1000
0
1000
2000
3000
4000
5000
2000
2005
2010
2015
2020
2025
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Year
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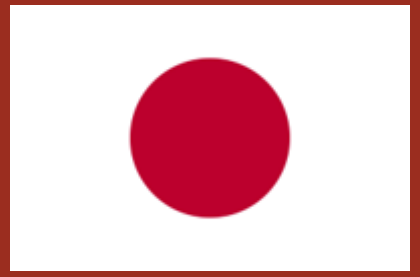
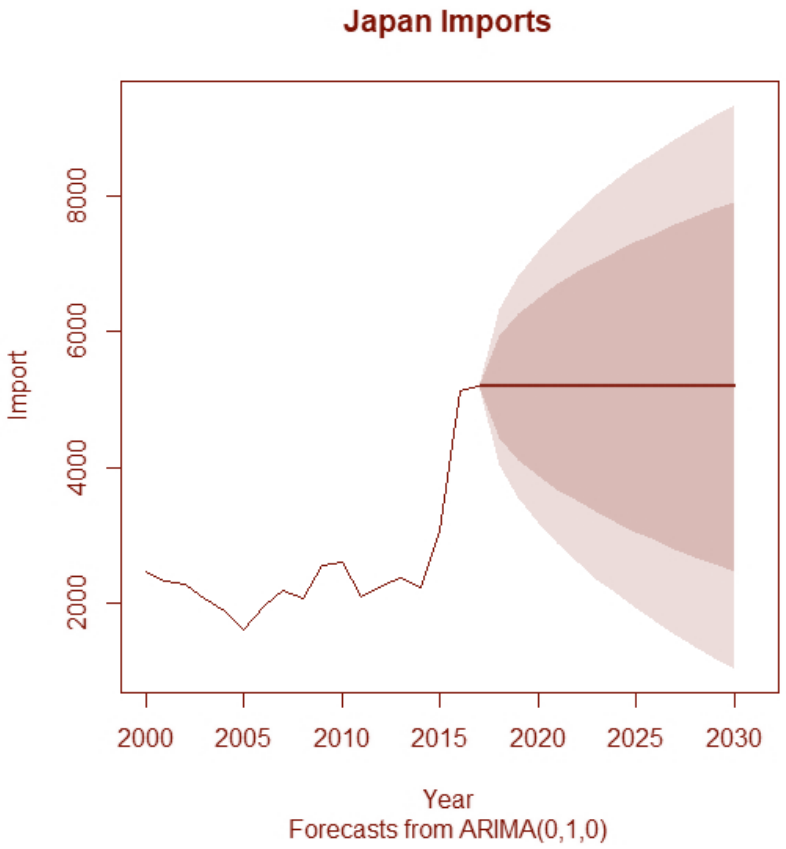
Japan

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2025
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Year
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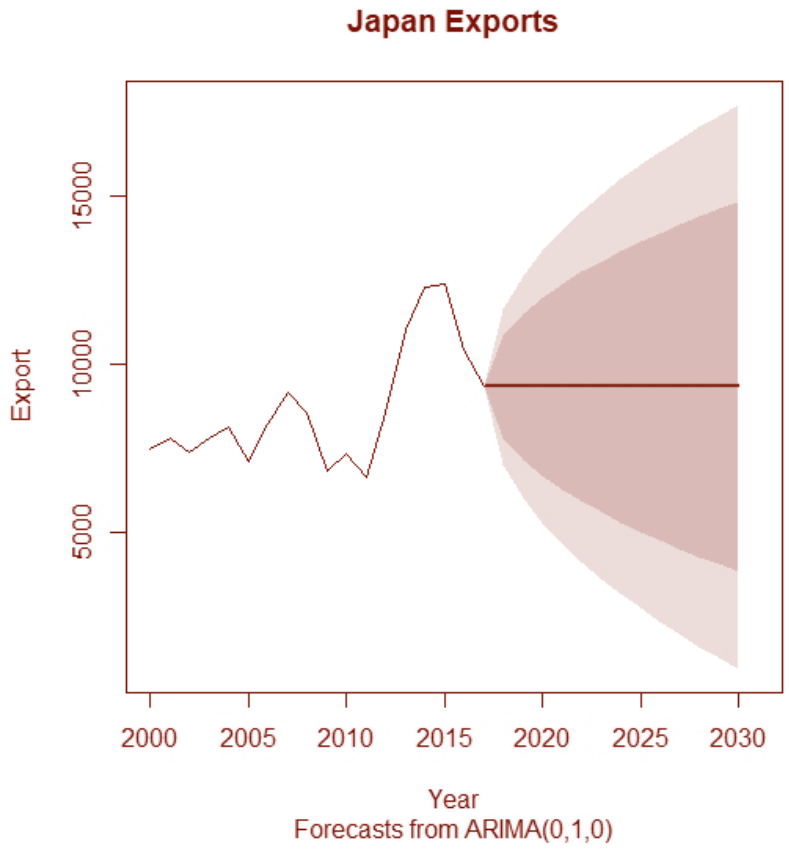
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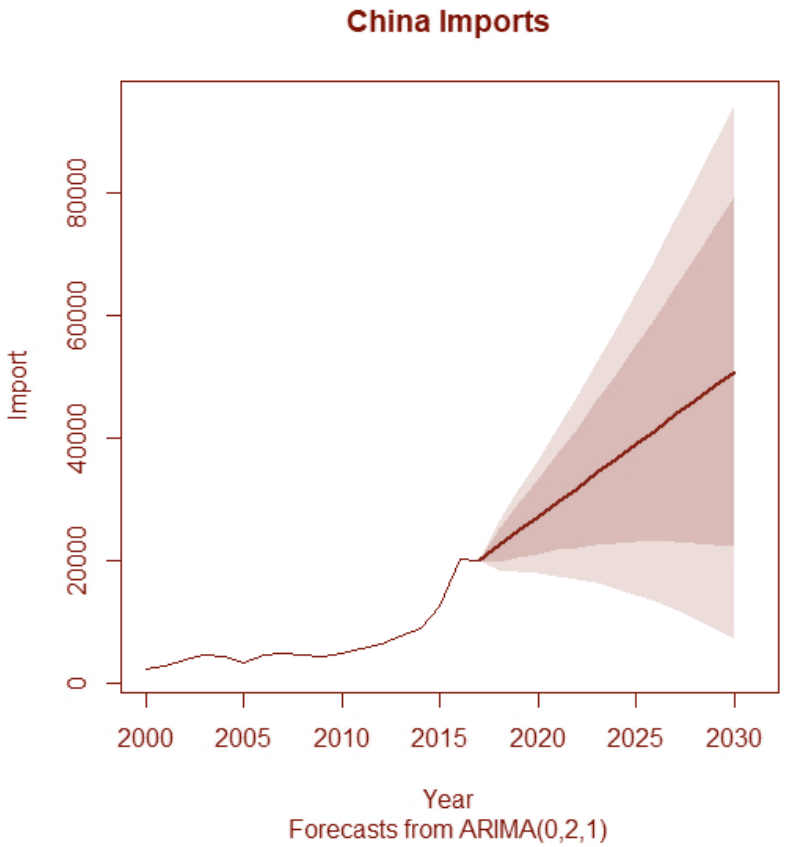
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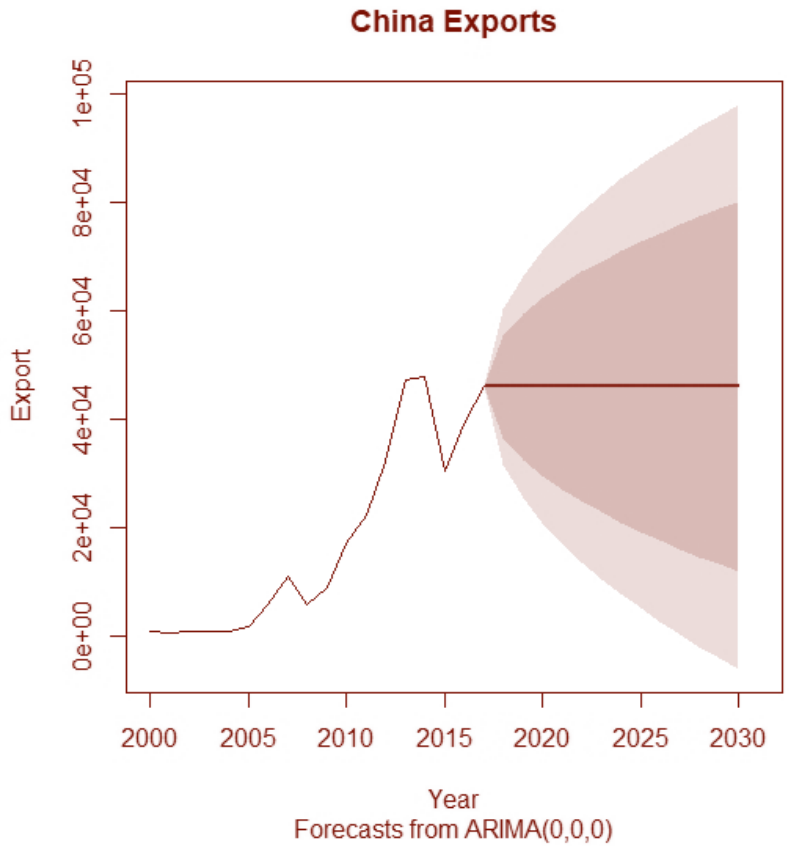
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Year
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Singapore


Singapore Imports
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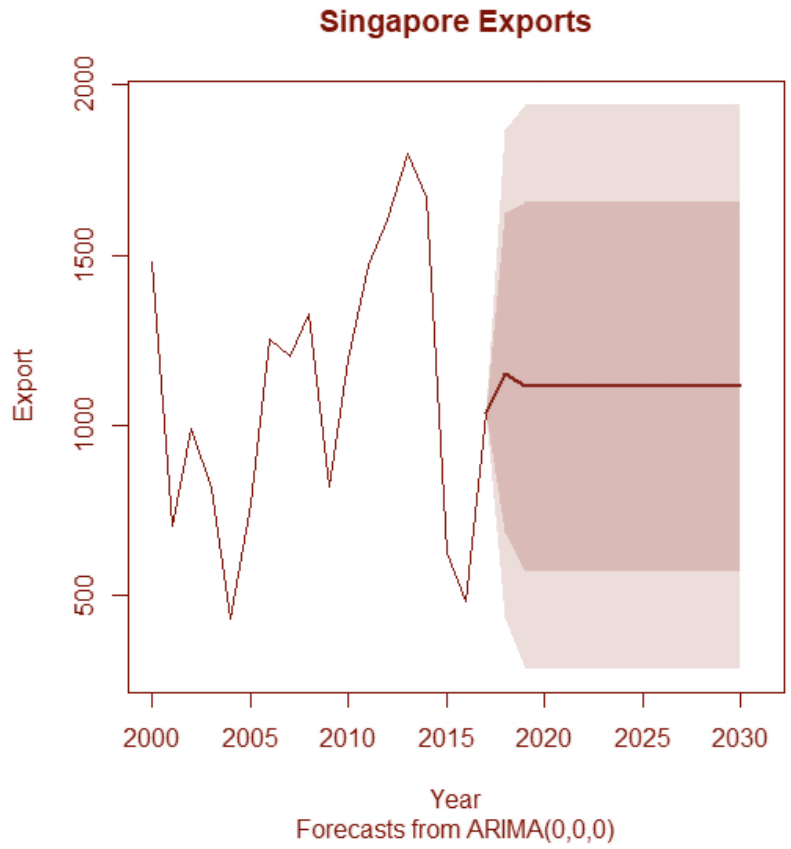
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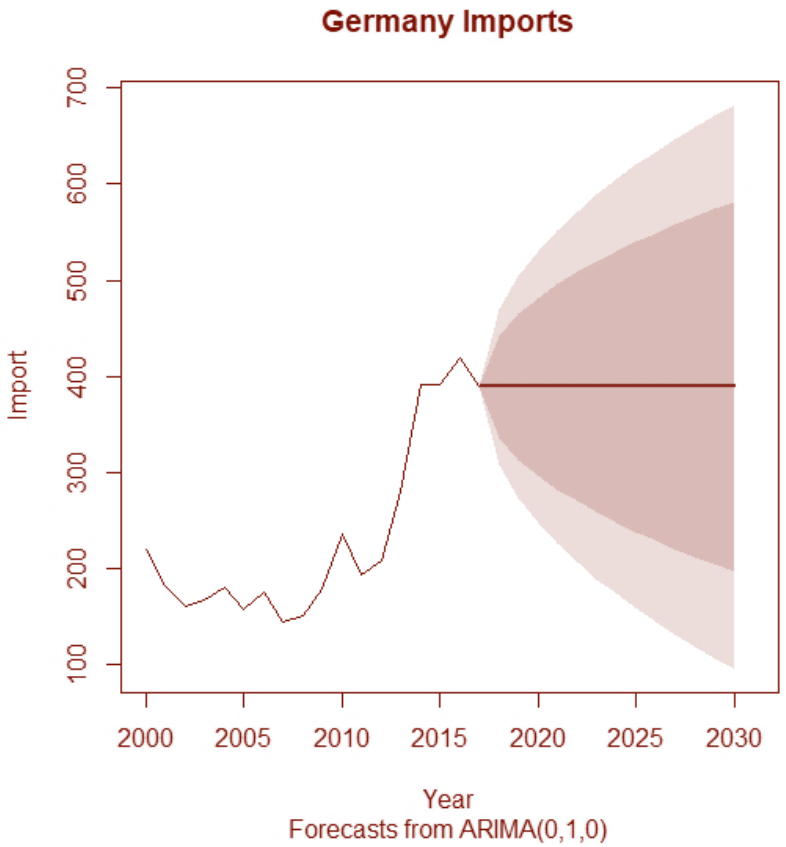
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2025
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Year
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Germany Exports
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Year
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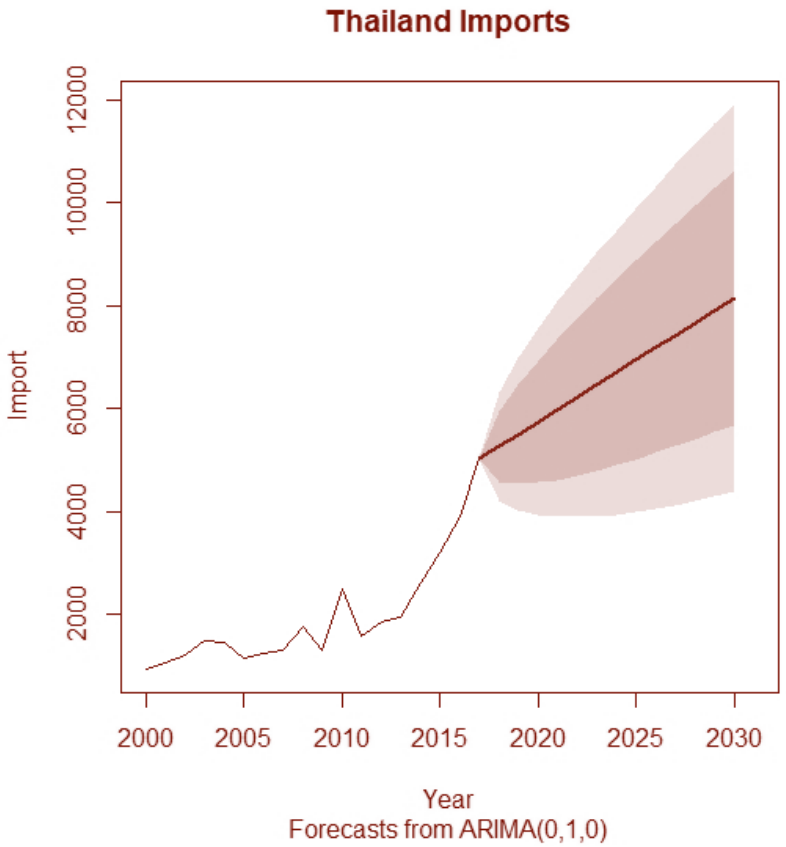
Thailand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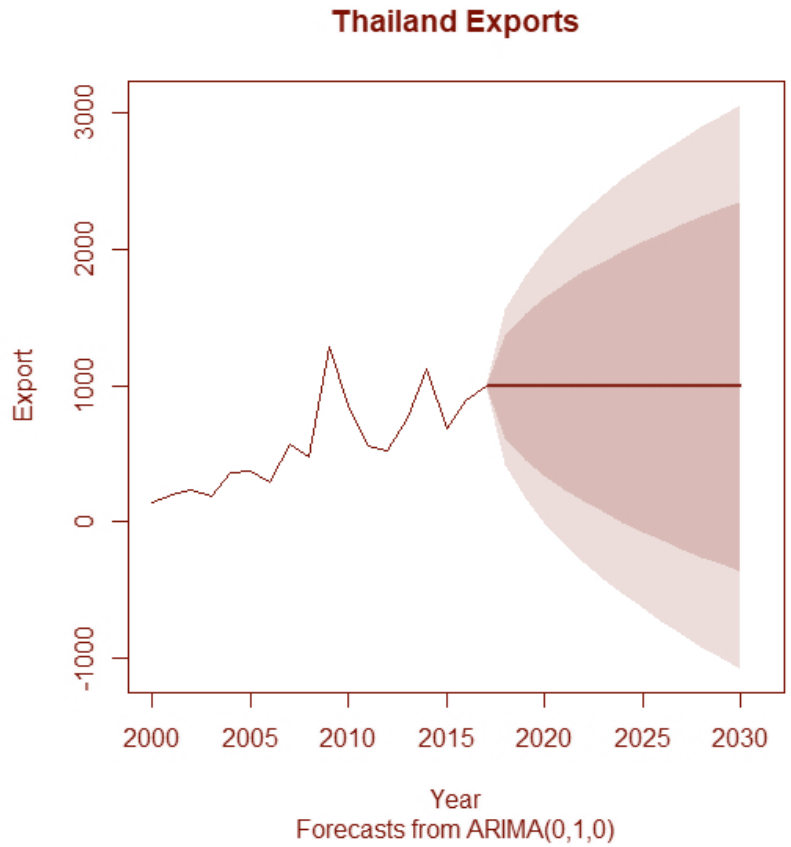
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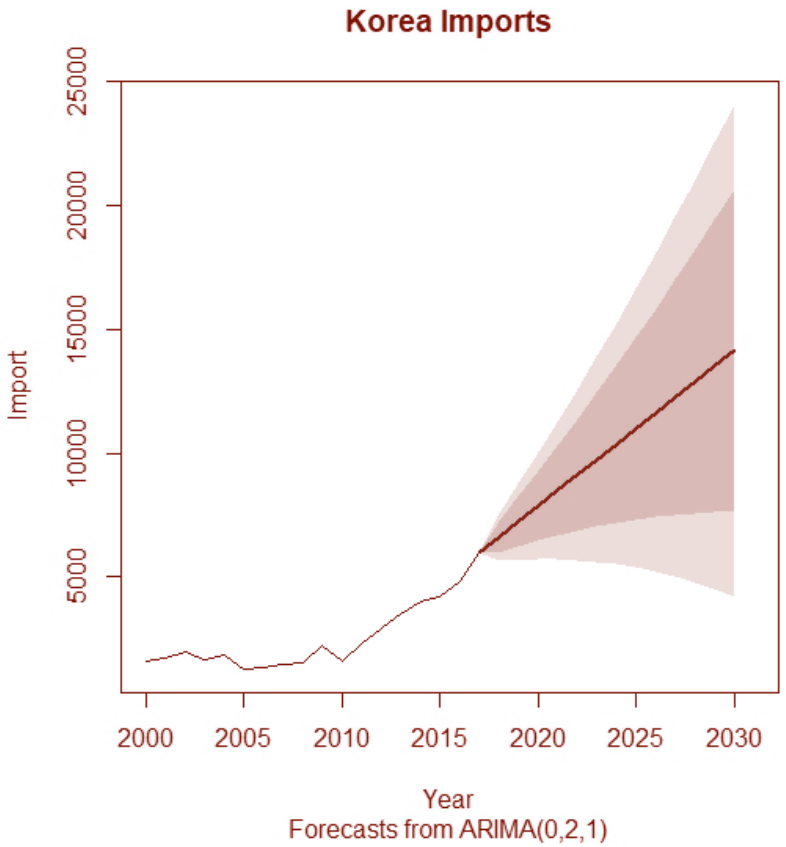
Korea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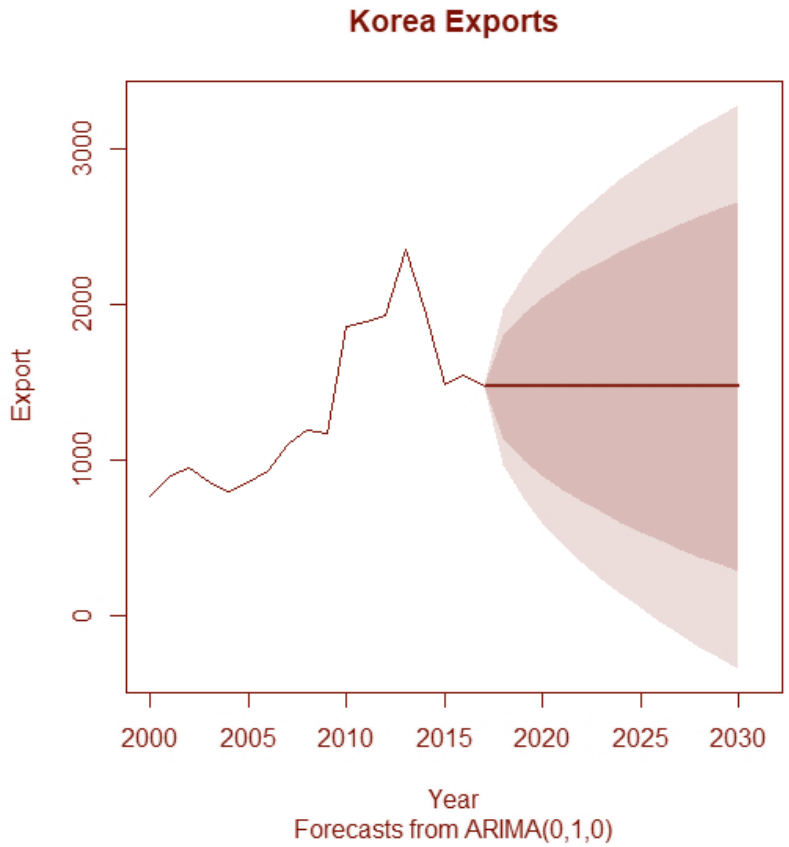
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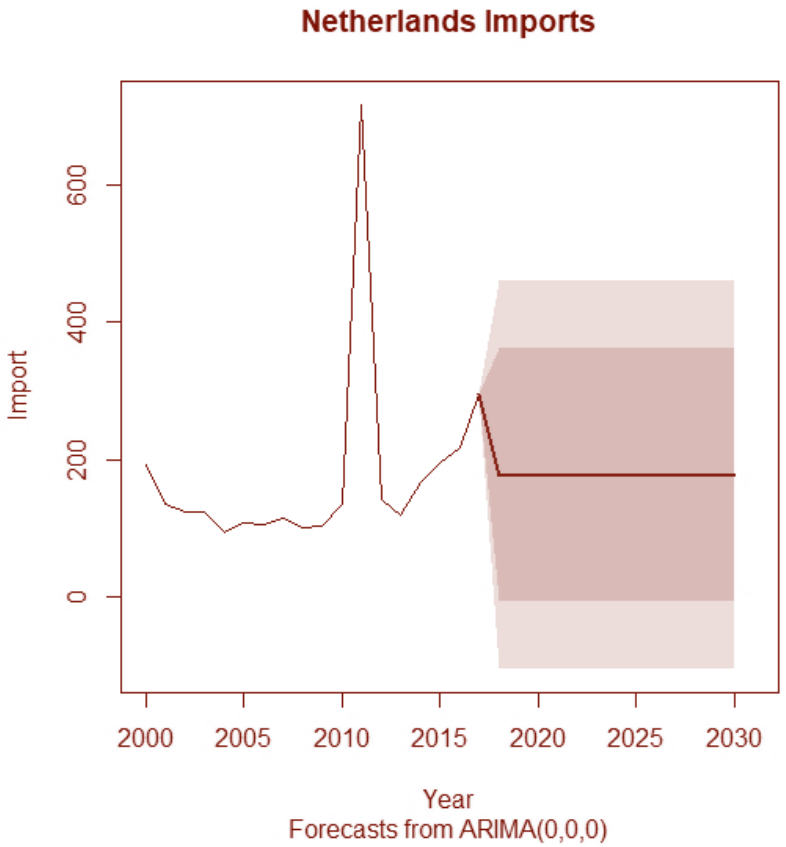
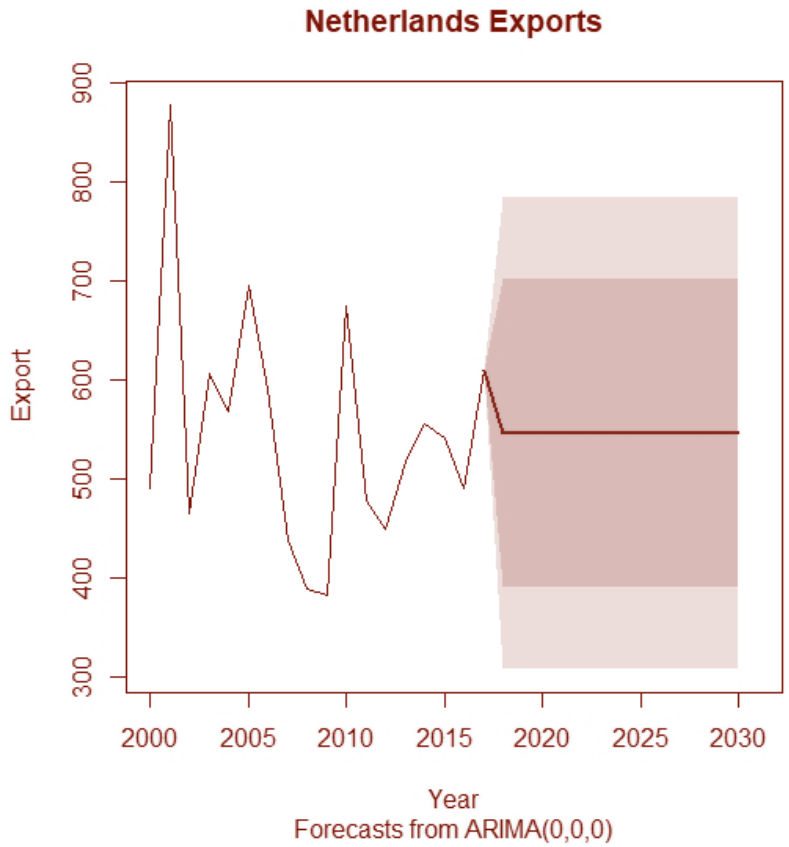
Year
Forecasts from ARIMA(0,1,0)

Netherlands





Taiwan


Taiwan Imports
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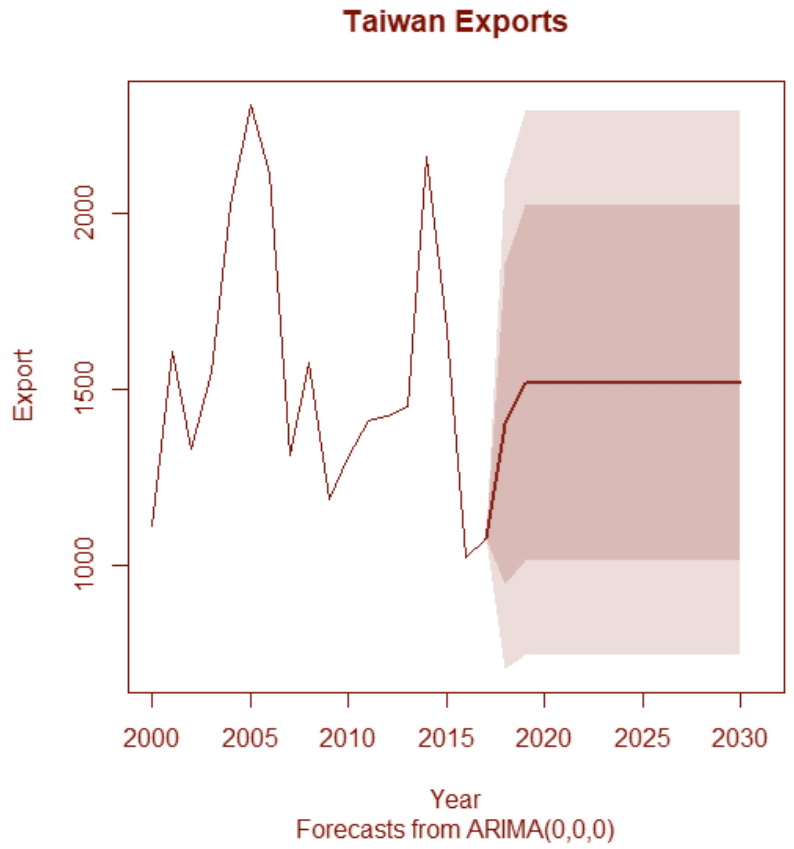
2010
2015
2020
2025
2030
Year
Forecasts from ARIMA(0,1,0)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2030
Year
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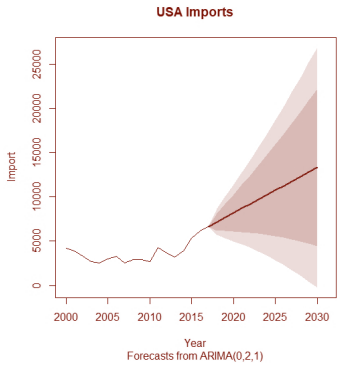
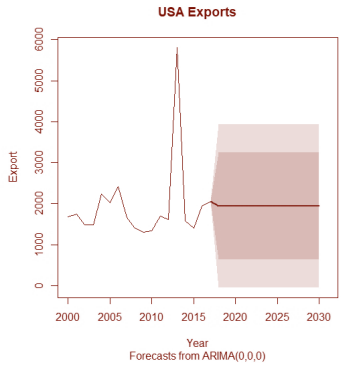

USA Imports
Import
Year
Forecasts from ARIMA(0,2,1)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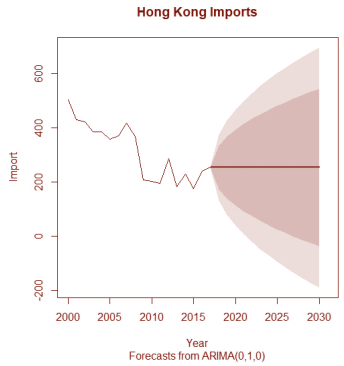
Hong Kong Imports
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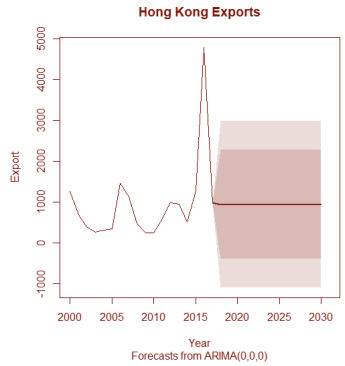
Year
Forecasts from ARIMA(0,1,0)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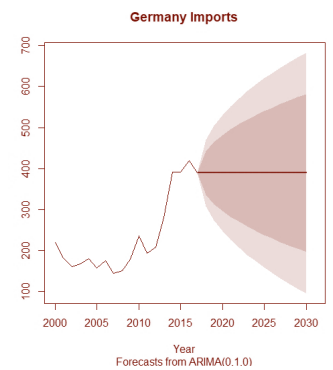
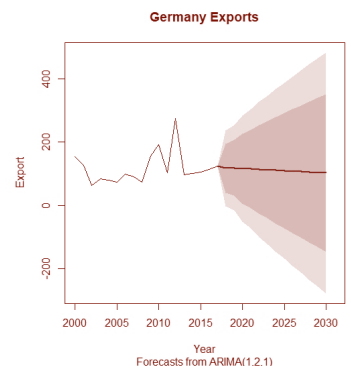

Germany Imports
Year
Forecasts from ARIMA(0,1,0)


Germany Exports
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Year
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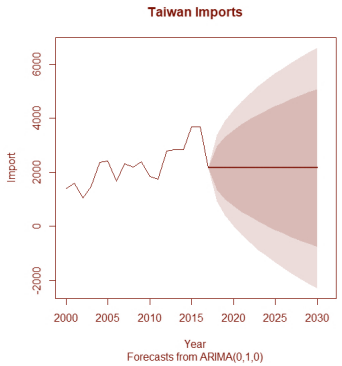
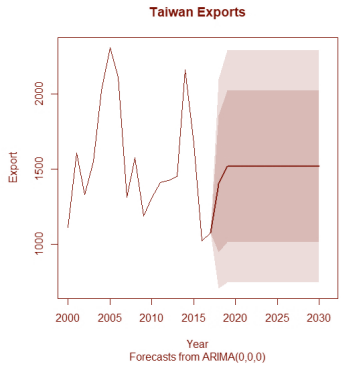

Taiwan Imports
Import
Year
Forecasts from ARIMA(0,1,0)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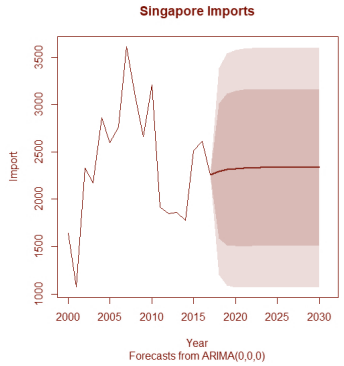
Export
Year
Forecasts from ARIMA(0,0,0)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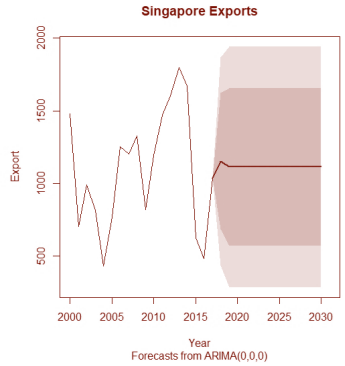
Import
Year
Forecasts from ARIMA(0,0,0)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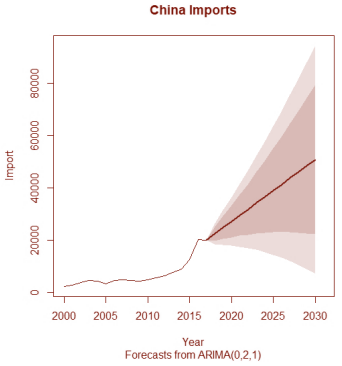
China Imports
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Year
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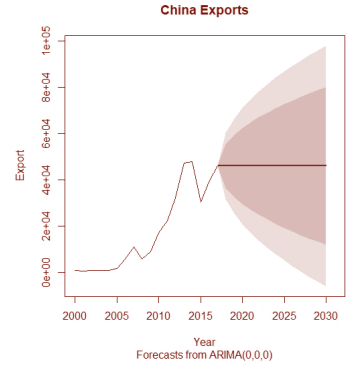
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Year
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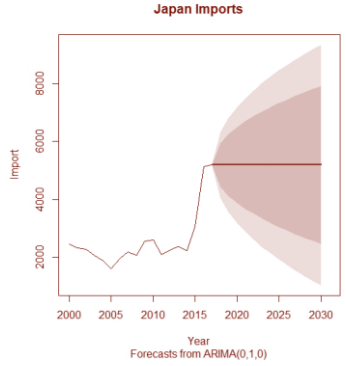
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Year
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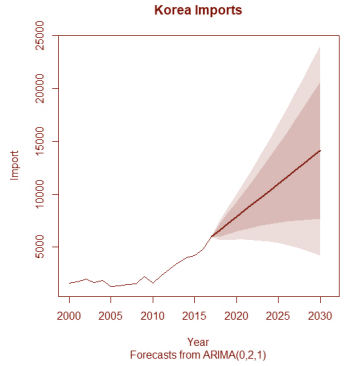
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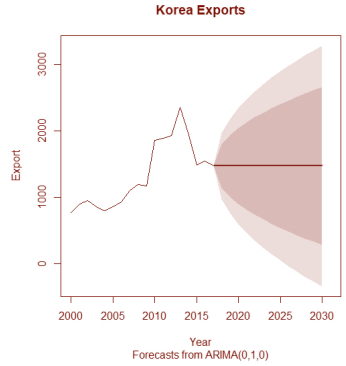
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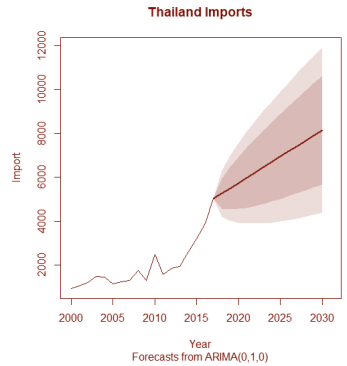
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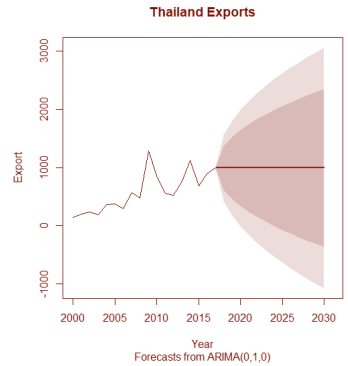
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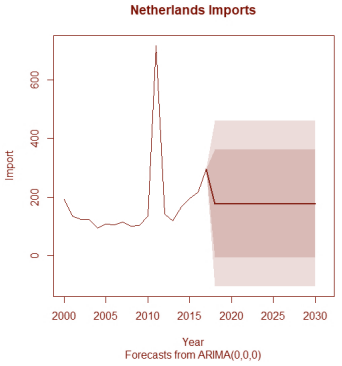
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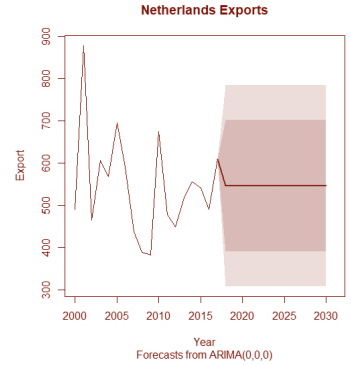
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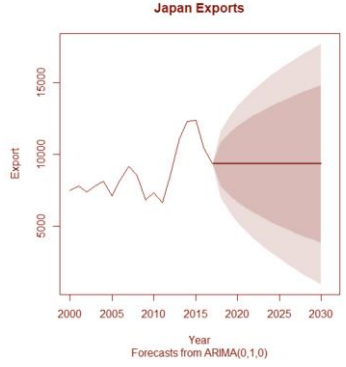
Japan Exports
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Forecasts from ARIMA(0,1,0)

Prediction

	INF_RATE	USA_IM	USA_EX	HKG_IM	HKG_EX	JPN_IM	JPN_EX	CHN_IM	CHN_EX	SGP_IM	SGP_EX	GER_IM	GER_EX	THA_IM	THA_EX	KOR_IM	KOR_EX	NLD_IM	NLD_EX	TWN_IM	TWN_EX
1	0.6885022	7168.982	1939.843	253.262	946.0143	5186.697	9327.189	22424.67	46006.73	2296.776	1152.543	389.0687	116.9537	5264.757	991.1294	6605.284	1472.366	176.7867	545.3032	2154.659	1402.697
2	1.7454682	7682.165	1939.843	253.262	946.0143	5186.697	9327.189	24791.15	46006.73	2315.387	1113.517	389.0687	118.9410	5505.492	991.1294	7234.811	1472.366	176.7867	545.3032	2154.659	1518.257
3	1.6604722	8195.347	1939.843	253.262	946.0143	5186.697	9327.189	27157.64	46006.73	2324.808	1113.517	389.0687	115.7693	5746.226	991.1294	7864.337	1472.366	176.7867	545.3032	2154.659	1518.257
4	1.2160238	8708.530	1939.843	253.262	946.0143	5186.697	9327.189	29524.13	46006.73	2329.577	1113.517	389.0687	115.2811	5986.960	991.1294	8493.863	1472.366	176.7867	545.3032	2154.659	1518.257
5	1.6277864	9221.712	1939.843	253.262	946.0143	5186.697	9327.189	31890.61	46006.73	2331.990	1113.517	389.0687	113.3970	6227.694	991.1294	9123.389	1472.366	176.7867	545.3032	2154.659	1518.257
6	1.5013620	9734.895	1939.843	253.262	946.0143	5186.697	9327.189	34257.10	46006.73	2333.212	1113.517	389.0687	112.2390	6468.428	991.1294	9752.916	1472.366	176.7867	545.3032	2154.659	1518.257
7	1.4059687	10248.077	1939.843	253.262	946.0143	5186.697	9327.189	36623.58	46006.73	2333.831	1113.517	389.0687	110.7033	6709.162	991.1294	10382.442	1472.366	176.7867	545.3032	2154.659	1518.257
8	1.5470849	10761.260	1939.843	253.262	946.0143	5186.697	9327.189	38990.07	46006.73	2334.144	1113.517	389.0687	109.3641	6949.896	991.1294	11011.968	1472.366	176.7867	545.3032	2154.659	1518.257
9	1.4760069	11274.443	1939.843	253.262	946.0143	5186.697	9327.189	41356.55	46006.73	2334.302	1113.517	389.0687	107.9227	7190.631	991.1294	11641.495	1472.366	176.7867	545.3032	2154.659	1518.257
10	1.4664372	11787.625	1939.843	253.262	946.0143	5186.697	9327.189	43723.04	46006.73	2334.382	1113.517	389.0687	106.5345	7431.365	991.1294	12271.021	1472.366	176.7867	545.3032	2154.659	1518.257
11	1.5090614	12300.808	1939.843	253.262	946.0143	5186.697	9327.189	46089.52	46006.73	2334.423	1113.517	389.0687	105.1185	7672.099	991.1294	12900.547	1472.366	176.7867	545.3032	2154.659	1518.257
12	1.4782109	12813.990	1939.843	253.262	946.0143	5186.697	9327.189	48456.01	46006.73	2334.444	1113.517	389.0687	103.7170	7912.833	991.1294	13530.074	1472.366	176.7867	545.3032	2154.659	1518.257
13	1.4831372	13327.173	1939.843	253.262	946.0143	5186.697	9327.189	50822.50	46006.73	2334.454	1113.517	389.0687	102.3080	8153.567	991.1294	14159.600	1472.366	176.7867	545.3032	2154.659	1518.257

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> svm_forecast
       1        2        3        4        5        6        7        8
294850.8 285822.5 274519.7 262371.6 251451.2 241766.9 234091.5 228489.5
       9       10       11       12       13
224616.4 222143.9 220665.8 219835.5 219399.8
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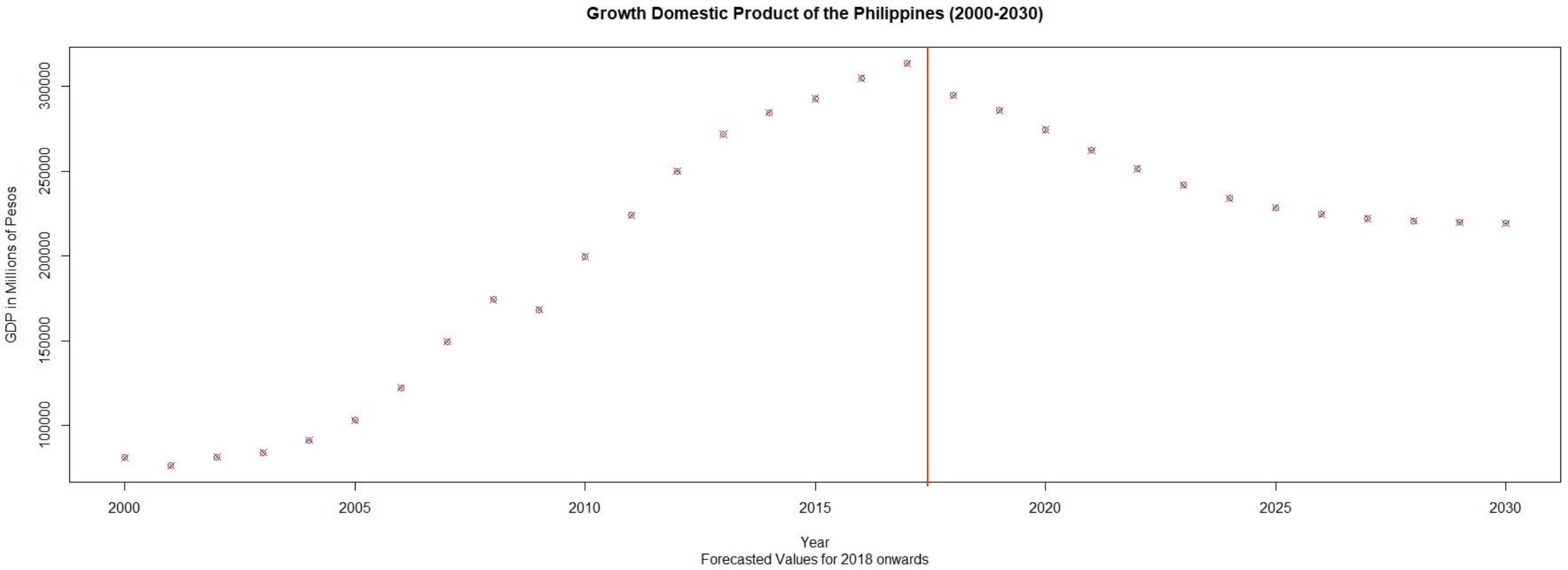
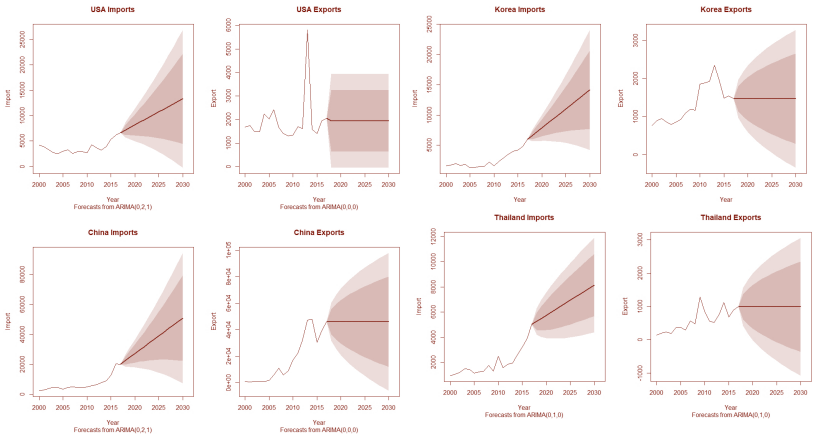


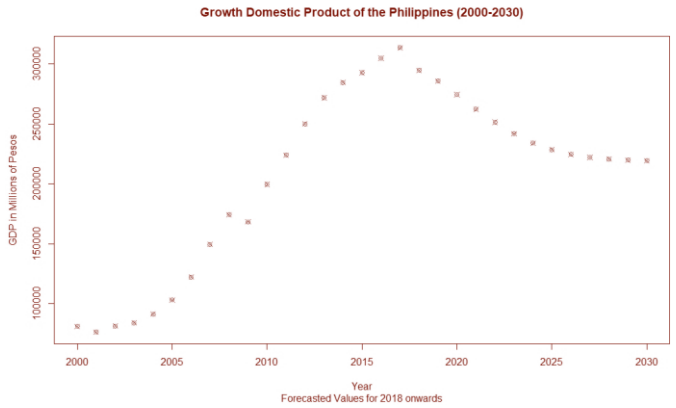
Prediction

We can observe a steady decline of the Gross Domestic Product of the Philippines starting from our forecast in 2018.

“Those exports bring money into the country, which increases the exporting nation's GDP. When a country imports goods, it buys them from foreign producers. The money spent on imports leaves the economy, and that decreases the importing nation's GDP.”

The Complete Idiot's Guide to Economics © 2003 by Tom Gorman





Conclusion

Through Support Vector Machine, I was able to create a reasonable model of forecasting the Growth Domestic Product of the Philippines from 2018 to 2030. The ARIMA models for the time series forecasting values for our import and export data GDP projection was also helpful in determining the pattern of the prediction in our SVM model.


Questions?

References

Ashworth, D. (2015). Economic Growth: Why Is It Important?. Retrieved 13 April 2019 from https://finance.yahoo.com/news/economic-growth-why-important-162936556.html

Brownlee, J. (2017). How to Create an ARIMA Model for Time Series Forecasting in Python. Retrieved 13 April from https://machinelearningmastery.com/arima-for-time-series-forecasting-with-python/

Gorman, T. (2003). The Complete Idiot's Guide to Economics

Kramer, L. (2019). Interesting Facts About Imports and Exports. Retrieved 13 April 2019 from https://www.investopedia.com/articles/investing/100813/interesting-facts-about-imports-and-exports.asp

Pupale, R. (2018). Support Vector Machines(SVM)—An Overview Retrieved 13 April 2019 from https://towardsdatascience.com/https-medium-com-pupalerushikesh-svm-f4b42800e989

Workman, D. (2019). Philippines Top Trading Partners. Retrieved 13 April 2019 from http://www.worldstopexports.com/philippines-top-import-partners/

Thank you