Journal of Positive School Psychology
2022, Vol. 6, No. 3, 9537–9541 http://journalppw.com

Forecasting Retail Oil and Natural Gas Vehicles Prices in Thailand Using Time Series Data Mining Techniques

Pitchayakorn Lake
Faculty of Information Technology, Siam University, Thailand
pitchayakorn@siam.edu

Abstract— The purpose of this research is to develop the model of forecasting retail oil and natural gas vehicles prices for automobiles in Thailand using time series data mining techniques. There are three techniques such as Linear Regression, Multi-Layer Perceptron and Support Vector Machine for Regression. The data used for this study was collected the retail oil and natural gas vehicles prices in Thailand from 2012-2018 AD. totally 84 months. This research found that the suitable forecasting model for retail oil and natural gas vehicles prices as followed: 1) The forecasting model using Linear Regression was the most suitable for Gasohol E85 and Ultra Force Diesel, which had the rate of MMRE (Mean Magnitude of Relative Error) with the percentage of 2.46, and 4.60. 2) The forecasting model using Support Vector Machine for Regression was the most suitable for Gasohol 91, Gasohol 95, Gasohol E20 and Natural Gas Vehicles (NGV), which had the rate of MMRE with the percentage of 3.69, 3.20, 3.54, and 6.89, respectively.

Index Terms—*Retail Oil and Natural Gas Vehicles Prices in Thailand, Times Series Analysis, Data Mining Techniques*

I. INTRODUCTION

Office of the National Economic and Social Development Council (NESDC) reported Thailand's economy grew at an average annual rate of 3.90% in 2017, compared with an increasing in 2016. According to an increasing of export products by 9.70%, household consumption, government expenditure, investment and business travel [1]. However, there is the increasing number of tourists arrive in Thailand. On the other hand, the industrial index (MPI) increases 1.60 percent, the production of rubber products, the manufacture of electronic tubes, and the production of engine and automobile spare parts etc. Then the use of energy is an important mechanism in driving the country's economy. Due to the shortage of energy, the government has to import energy for commercial use. The factors that cause energy crisis are as follows.

Decreasing the production of energy

Office of the National Economic and Social Development Board (NESDB) states that the energy consumption was 2,120 barrels compare to the crude oil consumption per day, which increased by 1.10 % from 2016. Natural gas has the highest consumption rate of 42.0% followed by coal/lignite tar, the use of hydroelectric/electricity imports. The decreasing of production energy were 972 barrels in 2016 compare to the crude oil consumption per day in 2015, which decrease by 4.60%. The production of natural gas, crude oil and lignite decrease by 3.90%, 13.40%, and 4.50%, respectively as a result of the decreasing source of energy.

Type of oil consumption

In 2017, the average consumption rate of gasoline and gasohol were 30.10 million liters per day, which increase by 3.40% from 2016, according to the falling oil prices of gasohol and gasoline. The car users switched from gasohol to gasoline because there were more gasoline service stations than gasohol service stations. However, natural gas consumption was 4,682 million cubic feet per day, which decreased by 1.0% from 2016. Although the usage of gasohol decreased by 12.90%, the consumption of natural gas in the industrial sector increased by 4.0%.

II. RESEARCH OBJECTIVES

The purpose of this research is to develop the model of forecasting retail oil and natural gas vehicles prices for automobiles in Thailand using time series data mining techniques. There are three techniques such as Linear Regression, Multi-Layer Perceptron and Support Vector Machine for Regression. The researcher chooses time series for the experiment, which can be divided into 6 data sets. the researcher selects 6 data sets for the increasing consumption e.g. Gasohol 91, Gasohol 95, Gasohol E20, Gasohol E85 and Ultra Force Diesel and natural gas for vehicles (NGV), which have the average price of 30.7835 baht, 31.9928 baht, 28.6693 baht, 21.4488 baht, 27.4076 baht, and 12.1327 baht respectively.

III. RESEARCH METHODS

Times Series Data

Time series data is a data set that is collected and stored continually under increasing time [2]. These data will be collected continuously for the periods of time such as gold price and the amount of water in the dam, which will be recorded in daily. Sometimes, the data may be collected though the sequence of time such as car accidents during the New Year Festival. Time series are the combination of level, trend, and seasonal components. However, the purpose of time series data collection is to create a model for prediction future values based on Times Series Analysis.

Linear Regression

Cai and Hall found that linear regression is the method for analyzing the data in order to find the relationship between dependent variables and independent variables [3]. It shows the relationship between the dependent variable and the independent variable in the form of quantitative data, which can be written as follow.

$$Y = a + bx_1 + cx_2 + \ldots$$

Multi-Layer Perceptron: MLP

Kubat suggested that multilayer perceptron has fully connected feed-forward nets [4].

This network has one or more layers that have been developed by the weakness of Single Layer Perceptron for providing higher computation. It consists of input layer, hidden layer and output layer [5].

Support Vector Machine for Regression

Support Vector Machine for Regression (SVM) is the algorithms used to classify group of data by using the decision hyperplane. SVM is applied to create equations for estimating linear regression that represents decision hyperplane. It is the method that used the current and historical data. After SVM can classify to the training data set, it can make predictions of outcomes. This research creates the method of linear regression function by using the sequential minimal optimization for SVM Regression (SMOreg) [6]. The methodology that the researcher used as follows:

1. Study and analyze the problem

The rate of domestic energy usage is increasing every year, especially the use of oil and natural gas. The import of energy has an impact on the growth rate of economy and industry. The researcher developed this model for forecasting retail oil and natural gas vehicles prices for automobile in Thailand according to fluctuated prices. The researcher gathered retail oil prices and natural gas prices last year. The data set was used by the researcher, which is the retail oil and natural gas for vehicles automobiles in Thailand for 2012 to 2018 (PTT Public Company Limited) [7].

2. Data Preparation.

This research focuses on building a model for predicting oil and natural gas prices for automobiles in Thailand by using times series data mining techniques e.g. Linear Regression, Multi-Layer Perceptron and Support Vector Machine for Regression. This forecasting model derived from three algorithms, which can compare the performance between them. This research was divided into 2 parts: 1) training data set by using Root Mean Square Error (RMSE) and Mean Absolute Error (MAE) for comparing the model efficiency. 2) testing data set by using Magnitude of Relative Error (MRE) for estimating the model's performance, which split it into monthly. This data set consists of retail oil and natural gas prices for automobiles, which divided into 84 months for 2012 – 2018. Each data set was divided into 2 parts: 1) training data set for predictive model in 2012-2017. 2) testing data set in 2018.

3. Data Analysis

The research used WEKA version 3.9.1 to analyze and create the model of forecasting retail oil and natural gas vehicles prices for automobiles in Thailand by using times series data mining techniques. Therefore, the result will be in the form of a model that is considered as the knowledge representation. The forecast model looks like sliding window, which is in the form of time series. The research used data set from 2012-2017 as a testing data. This data set was divided into 4 lagged: 1) 3 month 2) 6 months 3) 9 months and 4) 12 months. The results of the testing can be used to determine the algorithms that suitable for the model. The target prediction in 2018, which are an indicator of suitable algorithm as shown in Table 1

Table 1 Monthly Time Series Data Set

Price of Gasohol 91 (Bath/Liter)							
Month	2012	2013	2014	2015	2016	2017	2018 Testing Data set
January	34.3633	35.6300	38.2800	26.4467	22.9800	27.3050	27.9300
February	36.7700	37.2300	38.0800	27.2000	21.8467	27.8467	27.4300
March	38.4800	37.2600	38.3300	28.0300	23.0911	26.5800	27.5133
April	38.6550	35.8467	38.7300	27.3800	23.6050	27.0300	28.0050
May	36.5657	35.2800	38.4800	28.3133	24.8200	26.5467	29.0675
June	34.4000	36.3800	38.5800	28.7800	24.4371	25.4800	28.9800
July	35.2657	37.7467	37.7800	27.5967	23.4675	25.4050	29.3467
August	36.4550	37.1800	36.6300	26.1200	23.5133	26.5050	29.5500
September	35.3800	36.4550	35.7800	25.8550	24.7300	27.2800	30.5300
October	35.2633	35.9800	34.7200	25.9000	25.4600	26.9133	30.6467
November	34.5200	36.7300	32.7000	25.1800	25.1550	27.8300	28.3527
December	35.1300	37.7800	30.0800	23.7800	26.6800	27.6800	26.7800
Average	35.9373	36.6249	36.5142	26.7151	24.1488	26.8668	28.6777

Table 1 shows times series that will be split into 12 months. The researcher used time series data mining techniques for prediction retail oil and natural gas vehicles prices for automobiles: 1) Linear Regression, 2) Multi-Layer Perceptron, and 3) Support Vector Machine for regression

The researcher calculated the MRE and MMRE in order to select the appropriate model to implement. [8]

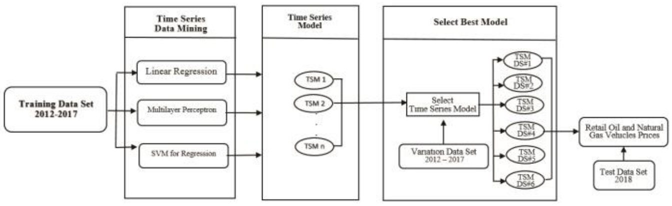

Fig. 1 The Model processing for forecasting retail oil and natural gas prices for automobiles [9]

IV. RESULTS

As the results, the model performance was measured for predicting retail oil and natural gas prices for automobile by using time series data mining techniques. These techniques conduct in 3 methods by using training data set. The model processing as follow:

1) Comparing the performance of predictive models.

The research selected the retail oil and natural gas price into 6 data sets for create the forecasting model. The data set was used in 2012-2017 for testing the model. Then they would be divided into 4 lagged: 1) 3 months, 2) 6 months, 3) 6 months, and 4) 12 months. These can create the model for predicting retail oil and natural gas prices for automobile as well as analyze the efficiency of data mining techniques.

Table 2 Comparison of prediction model performance by using historical data (Lagged).

Data Set		Times Series Data Mining Techniques					
Gasoline and Gasohol	Quarter Lagged	Linear Regression		Multilayer Perceptron		SMOreg	
		MAE	RMSE	MAE	RMSE	MAE	RMSE
DS#1 Gasohol 91	Lag 3	0.7965	0.9639	0.7868	0.9548	0.8192	1.0059
	Lag 6	0.7935	0.9582	0.9195	1.1325	0.7950	1.0257
	Lag 9	0.7416	0.9286	0.5468	0.6976	0.7663	1.0302
	Lag 12	0.7083	0.8906	0.4611	0.6039	0.6779	0.9858
DS#2 Gasohol 95	Lag 3	0.8139	1.0009	0.7839	0.9619	0.8563	1.0820
	Lag 6	0.8105	0.9954	0.7631	0.9179	0.8256	1.0935
	Lag 9	0.7979	0.9874	0.5990	0.7631	0.8003	1.0865
	Lag 12	0.7318	0.9379	0.5015	0.6293	0.7175	1.0570
DS#3 Gasohol E20	Lag 3	0.7971	0.9763	0.8589	1.0277	0.8245	1.0539
	Lag 6	0.7835	0.9594	0.9438	1.1828	0.7712	1.0151
	Lag 9	0.7367	0.9269	0.6348	0.8392	0.7527	1.0002
	Lag 12	0.7059	0.8999	0.5670	0.6798	0.6894	0.9361
DS#4 Gasohol E85	Lag 3	0.4816	0.6366	0.6621	0.8573	0.4796	0.6591
	Lag 6	0.4614	0.5995	0.6175	0.7832	0.4428	0.6007
	Lag 9	0.4490	0.5894	0.4912	0.6297	0.4263	0.5788
	Lag 12	0.4270	0.5425	0.2865	0.3706	0.4196	0.5869
DS#5 Ultra Force Diesel	Lag 3	0.5015	0.6982	0.4997	0.6811	0.4689	0.7672
	Lag 6	0.4965	0.6963	0.5155	0.6757	0.4421	0.7576
	Lag 9	0.4744	0.6718	0.5643	0.6822	0.4514	0.7766
	Lag 12	0.4671	0.6712	0.4842	0.6112	0.4533	0.7848
DS#6 NGV	Lag 3	0.1366	0.2160	0.1475	0.2381	0.1113	0.2219
	Lag 6	0.1332	0.2143	0.1786	0.2773	0.1057	0.2150
	Lag 9	0.1361	0.2187	0.1759	0.2388	0.1106	0.2198
	Lag 12	0.1392	0.2235	0.1712	0.2373	0.1165	0.2264

Table 2 shows the results of prediction for each data mining techniques. The research found that there are the different number of lagged by using MAE and RMSE as performance indicator. The experiment showed that the model used linear regression techniques, multi-layer Perceptron and support vector machine. It is the most efficient for lag 12 in price of gasohol 91 (DS#1), gasohol 95 (DS#2), and gasohol E20 (DS#3). Price of gasohol E85 (DS#4) is the most efficient when the model used linear regression techniques and multi-layer perceptron in lag 12. Due to support vector machine is the most efficient MAE in lag 12. The RMSE is the most effective in lag 9. Price of Ultra Force Diesel (DS#5) is the most efficient when the model used linear regression techniques and multi-layer perceptron in lag 12. However, support vector machine is suitable for lag 6. Price of NGV (DS#6) is the most efficient when the model used linear regression in lag 6. Multi-layer perceptron is the most efficient MAE in lag 3 whereas RMSE is the most effective in lag 12. Moreover, support vector machine is the most effective in lag 6. The researcher creates a model to predict monthly retail oil and natural gas vehicles prices for automobiles.

2) Comparison of Performance Prediction Model.

The researcher applies the model of forecasting retail oil and natural gas vehicles prices for automobiles in 2018. The data set was split type of gasoline and gasohol in each month by using time series data mining techniques, and magnitude of relative error as shown in Table 3.

Table 3 Comparing model's predictive performance gasohol 91

Data set			Time Series Data Mining Techniques					
Type	Year 2018		Linear Regression		Multilayer Perceptron		SMOreg	
			Lag 12		Lag 12		Lag 12	
	Month	Actual	Estimate	MRE	Estimate	MRE	Estimate	MRE
DS#1 Gasohol 91	January	27.9300	35.9075	0.2856	26.8717	0.0379	27.7347	0.0070
	February	27.4300	35.8603	0.3073	25.0089	0.0883	27.3465	0.0030
	March	27.5133	35.7595	0.2997	24.4817	0.1102	27.7129	0.0073
	April	28.0050	35.6418	0.2727	23.2181	0.1709	27.7402	0.0095
	May	29.0675	35.5215	0.2220	21.8570	0.2481	27.3787	0.0581
	June	28.9800	35.4041	0.2217	21.9469	0.2427	27.5031	0.0510
	July	29.3467	35.2915	0.2026	23.2207	0.2087	27.9837	0.0464
	October	29.5500	35.1843	0.1907	23.9153	0.1907	28.3147	0.0418
	September	30.5300	35.0824	0.1491	22.8576	0.2513	28.2128	0.0759
	October	30.6467	34.9858	0.1416	22.1891	0.2760	28.5163	0.0695
	November	28.3527	34.8942	0.2307	20.8302	0.2653	28.5551	0.0071
	December	26.7800	34.8074	0.2998	19.9072	0.2566	28.5514	0.0661
	MMRE		23.53%		19.56%		3.69%	

From Table 3, The model of support vector machine was the most efficient for gasohol 91, which had the rate of MMRE with the percentage of 3.69.

Table 4 Comparing model's predictive performance gasohol 95

Data set			Time Series Data Mining Techniques					
Type	Year 2018		Linear Regression		Multilayer Perceptron		SMOreg	
			Lag 12		Lag 12		Lag 12	
	Month	Actual	Estimate	MRE	Estimate	MRE	Estimate	MRE
DS#2 Gasohol 95	January	28.2000	28.2230	0.0008	27.8206	0.0135	28.0208	0.0064
	February	27.7000	28.1167	0.0150	27.0182	0.0246	27.7270	0.0010
	March	27.7833	28.3807	0.0215	27.2780	0.0182	28.0831	0.0108
	April	28.2750	28.5038	0.0081	27.1247	0.0407	28.1773	0.0035
	May	29.3375	28.3998	0.0320	26.8428	0.0850	27.9585	0.0470
	June	29.2500	28.5105	0.0253	27.2468	0.0685	28.2085	0.0356
	July	29.6167	29.0491	0.0192	28.1155	0.0507	28.7128	0.0305
	October	29.8200	29.6355	0.0062	29.0344	0.0263	29.0756	0.0250
	September	30.8000	29.8809	0.0298	28.9383	0.0604	29.0257	0.0576
	October	30.9167	30.3664	0.0178	29.0744	0.0596	29.3571	0.0504
	November	28.6227	30.6104	0.0694	28.2739	0.0122	29.4068	0.0274
	December	27.0500	30.8783	0.1415	27.6696	0.0229	29.4684	0.0894
	MMRE		3.22%		4.02%		3.20%	

From Table 4 found that the model of support vector machine was the most efficient for gasohol 95, which had the rate of MMRE with the percentage of 3.20.

Table 5 Comparing model's predictive performance gasohol E20

Data set			Time Series Data Mining Techniques					
Type	Year 2018		Linear Regression		Multilayer Perceptron		SMOreg	
			Lag 12		Lag 12		Lag 12	
	Month	Actual	Estimate	MRE	Estimate	MRE	Estimate	MRE
DS#3 Gasohol E20	January	25.6900	25.6721	0.0007	24.1821	0.0587	25.6696	0.0008
	February	25.1900	25.5194	0.0131	22.9804	0.0877	25.6133	0.0168
	March	25.2733	25.7144	0.0175	23.5308	0.0689	25.8924	0.0245
	April	25.7650	25.7700	0.0002	23.8313	0.0751	25.7218	0.0017
	May	26.8275	25.5901	0.0461	24.1078	0.1014	25.5399	0.0480
	June	26.7400	25.6076	0.0423	25.3737	0.0511	25.7170	0.0383
	July	26.7067	26.0518	0.0245	26.4194	0.0108	26.0404	0.0249
	October	26.8700	26.5618	0.0115	25.7678	0.0410	26.3316	0.0200
	September	27.7900	26.7426	0.0377	23.9651	0.1376	26.3093	0.0533
	October	27.9067	27.1565	0.0269	23.3505	0.1633	26.5697	0.0479
	November	25.6127	27.3377	0.0673	22.9681	0.1033	26.5663	0.0372
	December	24.0400	27.5267	0.1450	23.0670	0.0405	26.7128	0.1112
	MMRE		3.61%		7.83%		3.54%	

From Table 5 found that the model of support vector machine was the most efficient for gasohol E20, which had the rate of MMRE with the percentage of 3.54.

Table 6 Comparing model's predictive performance gasohol E85

Data set			Time Series Data Mining Techniques							
Type	Year 2018		Linear Regression		Multilayer Perceptron		SMOreg			
			Lag 12		Lag 12		Lag 9		Lag 12	
	Month	Actual	Estimate	MRE	Estimate	MRE	Estimate	MRE	Estimate	MRE
DS#4 Gasohol E85	January	20.7900	20.8678	0.0037	20.4903	0.0144	20.7984	**0.0004**	20.6889	0.0049
	February	20.5233	20.9929	0.0229	20.5878	**0.0031**	20.9961	0.0230	20.8908	0.0179
	March	20.2900	20.9557	**0.0328**	21.1583	0.0428	21.1125	0.0405	21.2013	0.0449
	April	20.4150	21.0425	**0.0307**	21.3291	0.0448	21.1122	0.0342	21.2124	0.0391
	May	21.1525	21.2028	**0.0024**	21.8175	0.0314	21.2196	0.0032	21.3126	0.0076
	June	21.1400	21.2158	**0.0036**	22.6214	0.0701	21.3126	0.0082	21.6184	0.0226
	July	21.1067	21.3020	**0.0093**	23.2485	0.1015	21.3580	0.0119	21.8546	0.0354
	October	21.2250	21.5887	0.0171	23.4458	0.1046	21.4504	**0.0106**	21.9803	0.0356
	September	21.7233	21.5227	**0.0092**	22.7755	0.0484	21.5240	0.0092	22.1291	0.0187
	October	21.7344	21.6714	**0.0029**	22.1138	0.0175	21.5833	0.0070	22.3218	0.0270
	November	20.5309	21.7589	0.0598	22.4273	0.0924	21.6581	**0.0549**	22.3586	0.0890
	December	19.7757	21.7772	0.1012	23.2667	0.1765	21.7390	0.0993	22.4643	0.1360
	MMRE		**2.46%**		6.23%		2.52%		3.99%	

From Table 6 found that the model of linear regression was the most efficient for gasohol E85, which had the rate of MMRE with the percentage of 2.46.

Table 7 Comparing model's predictive performance Ultra Force Diesel

Data set			Time Series Data Mining Techniques					
Type	Year 2018		Linear Regression		Multilayer Perceptron		SMOreg	
			Lag 12		Lag 12		Lag 6	
	Month	Actual	Estimate	MRE	Estimate	MRE	Estimate	MRE
DS#5 Ultra Force Diesel	January	27.6650	26.6787	0.0357	27.7382	**0.0026**	26.7091	0.0346
	February	26.8400	26.7058	**0.0050**	29.8247	0.1112	26.6545	0.0069
	March	27.0233	26.8884	**0.0050**	31.0814	0.1502	26.6935	0.0122
	April	27.6150	27.0173	**0.0216**	31.3501	0.1353	26.7174	0.0325
	May	28.9525	27.1478	**0.0623**	30.9634	0.0695	26.8252	0.0735
	June	28.7900	27.3285	**0.0508**	30.2987	0.0524	26.9881	0.0626
	July	29.0733	27.3950	0.0577	29.9226	**0.0292**	27.1247	0.0670
	October	29.1600	27.3615	0.0617	29.9919	**0.0285**	27.2314	0.0661
	September	29.7900	27.3539	0.0818	30.4105	**0.0208**	27.3238	0.0828
	October	29.8900	27.3717	0.0843	30.5736	**0.0229**	27.3938	0.0835
	November	28.7082	27.3884	0.0460	30.4718	0.0614	27.4564	**0.0436**
	December	26.3757	27.4289	**0.0399**	30.4825	0.1557	27.5265	0.0436
	MMRE		**4.60%**		7.00%		5.07%	

From Table 7 found that the model of linear regression was the most efficient for Ultra Force Diesel, which had the rate of MMRE with the percentage of 4.60.

Table 8 Comparing model's predictive performance NGV

Data set			Time Series Data Mining Techniques							
Type	Year 2018		Linear Regression		Multilayer Perceptron				SMOreg	
			Lag 6		Lag 3		Lag 12		Lag 6	
	Month	Actual	Estimate	MRE	Estimate	MRE	Estimate	MRE	Estimate	MRE
DS#6 NGV	January	13.3275	13.3029	**0.0018**	13.0761	0.0189	13.4137	0.0065	13.3690	0.0031
	February	13.5200	13.2597	0.0193	12.7639	0.0559	13.4296	**0.0067**	13.3590	0.0119
	March	13.6167	13.2183	0.0293	12.4204	0.0879	13.3719	**0.0180**	13.3626	0.0187
	April	13.5700	13.1787	0.0288	12.0218	0.1141	13.2625	0.0227	13.3761	**0.0143**
	May	13.9263	13.1407	0.0564	11.5362	0.1716	13.1144	0.0583	13.3802	**0.0392**
	June	14.0600	13.1042	0.0680	10.9784	0.2192	12.9783	0.0769	13.3871	**0.0479**
	July	14.2033	13.0693	0.0798	10.4899	0.2614	12.8714	0.0938	13.3928	**0.0571**
	October	14.4930	13.0359	0.1005	10.2348	0.2938	12.7763	0.1185	13.3981	**0.0755**
	September	14.8550	13.0038	0.1246	10.2028	0.3132	12.6688	0.1472	13.4039	**0.0977**
	October	15.4633	12.9731	0.1610	10.2922	0.3344	12.5656	0.1874	13.4095	**0.1328**
	November	16.0209	12.9437	0.1921	10.4112	0.3501	12.4782	0.2211	13.4151	**0.1627**
	December	16.0900	12.9155	0.1973	10.5047	0.3471	12.4250	0.2278	13.4208	**0.1659**
	MMRE		8.82%		21.40%		9.87%		**6.89%**	

From Table 8 found that the model of support vector machine was the most efficient for NGV, which had the rate of MMRE with the percentage of 6.89.

V. DISCUSSIONS

The purpose of this research was to compare the efficient algorithms for data mining techniques. The research used 3 techniques: 1) linear regression, 2) multi-layer perceptron, and 3) support vector machine. The data set was split into training data set and testing data set. The research calculates mean magnitude of relative error by using the historical data, which can provide the appropriate method for the forecasting. According to Panishussadon and Ketcham found that the forecasting of LPG by using neutral network. Average total sales are 10,000 baht that the error is equal to 600 units per day [10]. Lekkla and Thongkam investigated that forecasting of foreign exchange rate by using time series data mining techniques. They are also calculated mean absolute error and root mean square error, that the value is equal to 1.11±2.10 and 1.13±2.14 respectively by using linear regression, multi-layer perceptron, and sequential minimal optimization regression [11].

VI. RECOMMENDATIONS

Based on the findings of the research, here are the recommendations to be considered:

1. Other factors affecting oil and natural gas price for automobiles, such as inflation, should be considered in order to find the trending in price and rate of inflation. They can improve economics in long term.
2. Consideration other techniques such as artificial neutral network for the forecasting methods that are more suitable for data set.

CONCLUSION

This research investigated the algorithm that they are the most suitable for the forecasting. As the mentioned that the purpose of this research is to develop the model of forecasting retail oil and natural gas vehicles prices for automobiles in Thailand by using time series data mining techniques. As following conclusions can be drawn from the techniques which is the highest rate of MMRE and RMSE. The result of this study indicated the algorithms that researcher used as follows: 1) linear regression was the most suitable for gasohol E85 and ultra force diesel, which had the rate of MMRE with the percentage of 2.46, and 4.60. 2) support vectors machine for regression was the most suitable for gasohol 91, gasohol 95, gasohol E20 and NGV, which had the rate of MMRE with the percentage of 3.69, 3.20, 3.54, and 6.89, respectively.

REFERENCES

[1] Office of the National Economic and Social Development Council (NESDC), [Online], Source: http://www.eppo.go.th/index.php/en/component/k2/item/14166-energy-statistics-2561 [17 June 2019].

[2] AR. Hoshmand, Business Forecasting. 2nd edition. New York: Routledge, 2009.

[3] TT. Cai, and P. Hall, "Prediction in functional linear regression," Ann Stat., vol. 34, no.5, pp. 2159-79, 2006.

[4] M. Kubat, "Neural Networks: A Comprehensive Foundation by Simon Haykin, Macmillan," Knowl Eng Rev., vol. 13, no. 4, pp. 409–12, 1999.

[5] E, Frias-Martinez, A. Sanchez, and J. Velez, "Support vector machines versus multi-layer perceptrons for efficient off-line signature recognition," Eng Appl Artif Intell, vol.19, no. 6, pp. 693–704, 2006.

[6] SK. Shevade, SS. Keerthi, C. Bhattacharyya, and KRK. Murthy, " Improvements to the SMO algorithm for SVM regression," IEEE Trans. Neural Netw., vol. 11, no. 5, pp. 1188–93, 2000.

[7] PTT Oil and Retail Business Public Company Limited, [Online], Source: http://www.pttplc.com/th/ Media-Center/Oil-Price/pages/Bangkok-Oil-Price.aspx?s=1 [18 June 2019].

[8] SM. Weiss and N. Indurkhya, Predictive Data Mining: A Practical Guide. San Francisco: Morgan Kaufmann, 1998.S. Saigal, and D. Mehrotra, "Performance comparison of time series data using predictive data mining techniques," Adv Inf Min., vol. 4, no. 1, pp. 57–66, 2012.

[9] W. Panishussadon, and M. Ketcham, "Demand forecasting for LPG station by Time Series and Artificial Neural Network," J Inf Sci Technol., vol. 7, no. 1 pp. 42–49, 2017.

[10] S. Lekkla, and J. Thongkam, "Forecasting the Trend of Foreign Exchange Rates Using Time Series Analysis Techniques," Journal of

Innovative Technology Management Rajabhat Maha Sarakham University, vol. 5, no. 2, pp. 94–103, 2018.
.