A Hybrid Model SARIMA-SVR for Forecasting Monthly Electricity Consumption for Residential Houses : A Case Study in Muang Chiang Mai District, Chiang Mai

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ABSTRACT

This research aims to develop and select the most appropriate forecasting model for predicting monthly residential house electricity consumption in Mueang Chiang Mai District, Chiang Mai Province, from January 2014 to June 2024, totaling 126 months. The data is divided into two parts: the first part is the training data, from January 2014 to June 2023, comprising 114 months, used for model development; and the second part is the testing data, from July 2023 to June 2024, comprising 12 months, used to select the most suitable forecasting model. The selection is based on a comparison using the Mean Absolute Percentage Error (MAPE). The research results show that the hybrid model between SARIMA-SVR is the most suitable for forecasting monthly residential houses electricity consumption in Mueang Chiang Mai District, Chiang Mai Province, with the lowest MAPE training set of 0.607% and MAPE of the test set of 1.719%, R-Squared of 98.183%, and RER of 85.501%.

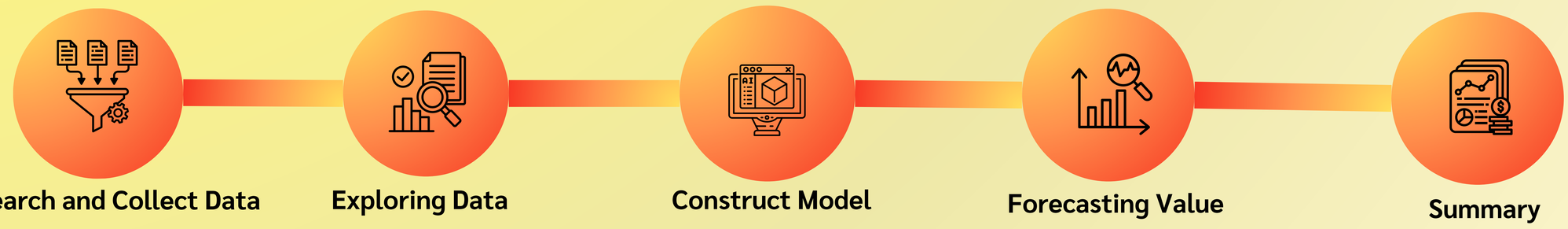
INTRODUCTION

Household electricity consumption is a key factor driving the increasing demand for energy, especially in areas with community expansion, such as Mueang District, Chiang Mai Province. Modern households use numerous electrical appliances, such as air conditioners, refrigerators, and smart devices, leading to higher electricity consumption, particularly during peak demand periods in the evening, which may cause power fluctuations or outages. Additionally, the increased electricity production from fossil fuels negatively impacts the environment by contributing to greenhouse gas emissions.

OBJECTIVES

1. Study and compare four models of forecasting liquid petroleum gas consumption of Thailand: Seasonal Autoregressive Integrated Moving Average Model (SARIMA), Support Vector Regression (SVR), and the hybrid model between SARIMA and SVR.
2. Find the most appropriate forecasting model to forecasting for the residential electricity consumption data in Mueang District, Chiang Mai Province.

METHODOLOGY



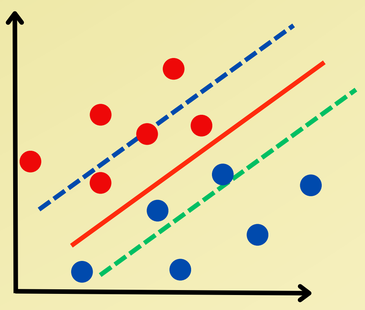
MODELS

1 SARIMA

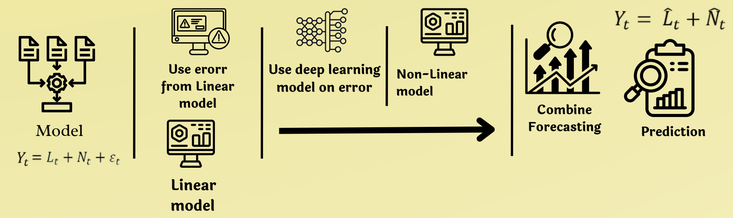
$$\left(1-\sum_{i=1}^{p}\emptyset_i B^i\right)\left(1-\sum_{k=1}^{P}\Theta_k B^{ks}\right)Z_t=\left(1-\sum_{j=1}^{q}\theta_j B^j\right)\left(1-\sum_{l=1}^{Q}\Theta_l B^{ls}\right)\varepsilon_t$$

where, $Z_t=(1-B)^d(1-B^s)^D Y_t$

2 Support Vector Regression



3 Hybrid



EVALUATION CRITERIA

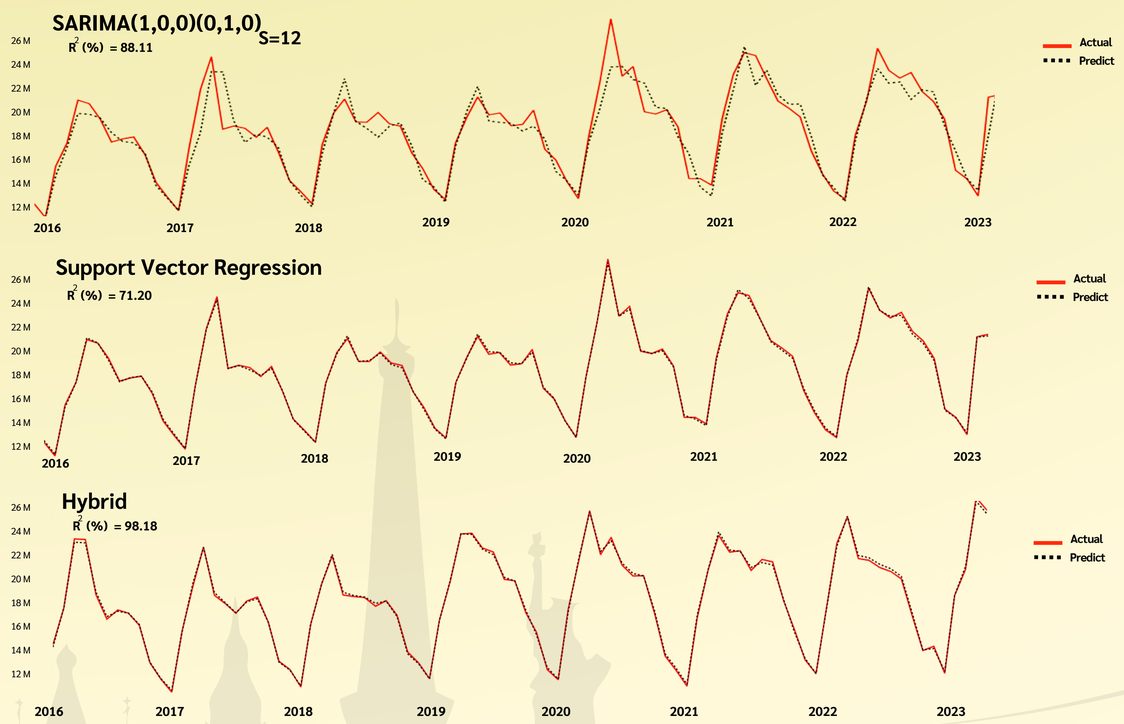
$$MAPE\ (\%) = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{Y_t-\hat{Y}_t}{Y_t}\right| \times 100$$

$$R^2(\%) = \left(1-\frac{\sum_{t=1}^{n}(Y_t-\hat{Y}_t)^2}{\sum_{t=1}^{n}(Y_t-\bar{Y})^2}\right) \times 100$$

$$RER\ (\%) = \left(1-\frac{MAPE_{Proposed}}{MAPE_{Original}}\right) \times 100$$

RESULT AND CONCLUSION

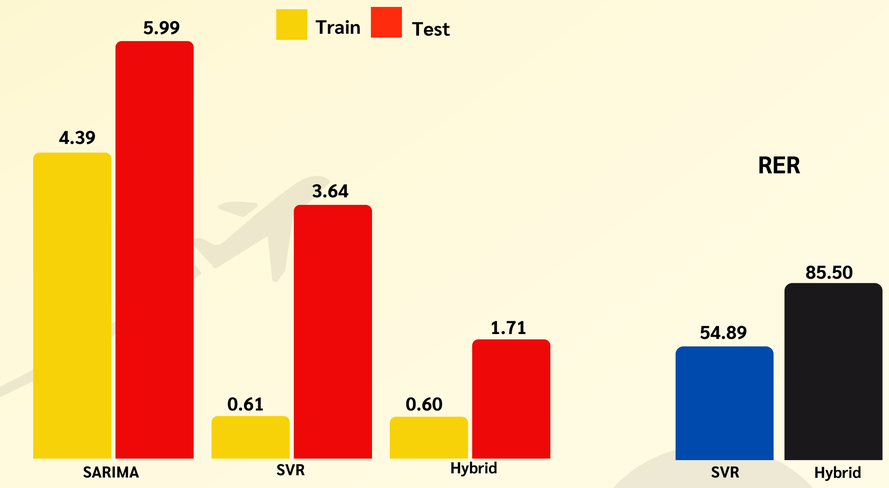
The results show that **the hybrid model between SARIMA-SVR is the best for forecasting** residential electricity consumption, with the lowest MAPE of 0.60% in the training set and 1.71% in the test set, as well as an R-Squared of 98.18% and an RER of 85.50%.



The efficiency of hybrid model between SARIMA-SVR had the highest RER of 85.50% for 12 months lead time forecasting , and the highest R-Squared of 98.18%.

DISCUSSION AND SUGGESTION

From the study, it was found that the Hybrid model is suitable for forecasting monthly residential house electricity consumption in Mueang Chiang Mai District. These findings align with the research of (Zhang,2003). Therefore, hybrid model is an effective way to improve more accurate forecasting than a single forecasting method.



We can try to use the linear component in Holt Winters method and the nonlinear component using a variety of deep learning neural networks such as Long Short Term Memory (LSTM) or Gated Recurrent Units (GRUs).

References

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[2] Zhang, G.P. (2003). Time series forecasting using a hybrid ARIMA and neural network model. Neurocomputing, 50, 159-175.