**Electricity Bill Prediction**

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**ABSTRACT**

The prediction of electric bills is an important task for both consumers and utility providers, enabling more efficient energy management, cost forecasting, and budget planning. This study presents a machine learning-based approach to predict monthly electricity consumption and corresponding bills. Using historical consumption data, weather patterns, time-of-day usage, and household characteristics as input features, various predictive models, including linear regression, decision trees, and neural networks, are evaluated for their accuracy in forecasting electric bills. The study highlights the effectiveness of machine learning algorithms in identifying key factors influencing electricity usage, such as seasonal variations, peak consumption hours, and appliance usage patterns. The results demonstrate that advanced models, such as random forests and deep learning, outperform traditional methods, offering high accuracy and scalability. The predictive model can serve as a valuable tool for both consumers to optimize energy usage and utility companies to enhance billing systems, demand forecasting, and resource planning. This approach also lays the groundwork for integrating smart grid technology and real-time monitoring systems into energy management platforms.

**Keywords:** electricity, electric bills, historical data, predictive model

1. **INTRODUCTION**

Electricity bill prediction is crucial for efficient energy management and budgeting, especially in households and industries with variable consumption patterns. A hybrid model combining Seasonal Autoregressive Integrated Moving Average (SARIMA) and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) offers a powerful approach for this task. SARIMA effectively captures seasonal trends and long-term patterns in electricity usage data, while GARCH models the volatility and sudden fluctuations often observed in energy consumption due to unpredictable factors. Together, this hybrid model provides more accurate and robust predictions, enabling better planning and cost control in dynamic energy markets.

1. **METHODOLOGY**

The proposed methodology involves a hybrid modeling approach using SARIMA and GARCH to predict electricity bills based on historical consumption data. First, the SARIMA model is applied to capture the linear trends, seasonality, and long-term dependencies in the time series data. The residuals from the SARIMA model, which may contain volatility and irregular fluctuations, are then modeled using the GARCH model to account for heteroskedasticity. This combined approach enhances prediction accuracy by effectively addressing both seasonal patterns and variable volatility in electricity usage.

1. **MODELING AND ANALYSIS**

In the modeling and analysis phase, historical electricity consumption data is first preprocessed to handle missing values and ensure stationarity. The SARIMA model is then fitted to identify and model seasonal trends and long-term dependencies in the data. After fitting SARIMA, residuals are extracted and analyzed for volatility clustering. The GARCH model is applied to these residuals to model the time-varying variance. Performance metrics such as RMSE, MAE, are used to evaluate the model's accuracy and compare it with individual models. The hybrid SARIMA-GARCH model demonstrates improved forecasting performance by effectively capturing both seasonality and volatility in electricity usage data.

 **3.1**

**Figure 1:** System Design

1. **RESULTS AND DISCUSSION**

The hybrid SARIMA-GARCH model was tested on real-world electricity consumption datasets to evaluate its prediction accuracy. The results showed that the combined approach significantly outperformed standalone SARIMA or GARCH models in capturing both seasonality and sudden fluctuations in consumption data.

4.1 Forecast Accuracy: Performance metrics such as Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and Mean Absolute Percentage Error (MAPE) were calculated. The hybrid model achieved lower error rates compared to individual models, confirming its effectiveness in enhancing prediction reliability.

4.2 Seasonal and Volatility Insights: SARIMA successfully modeled seasonal usage trends, such as higher consumption during summer months due to cooling loads. GARCH handled the volatility caused by unpredictable factors like holidays or abrupt weather changes, adding stability to predictions.

4.3 User-Level Impact: Predicted electricity bills closely matched actual bills for a majority of test users, demonstrating the system's practicality in real-life scenarios. The improved accuracy helps users plan their budgets more effectively and encourages energy-efficient behavior.

1. **CONCLUSION**

This study presented a hybrid forecasting approach combining SARIMA and GARCH models to improve the accuracy of electricity bill prediction. The SARIMA model effectively captured long-term trends and seasonal consumption patterns, while the GARCH model addressed the volatility and irregular fluctuations in electricity usage. By integrating both models, the system provided more reliable and consistent forecasts compared to individual models.

The proposed method demonstrated its ability to handle real-world data, producing accurate predictions that can assist users in managing their electricity usage and budgeting more efficiently. This hybrid model not only enhances predictive performance but also contributes to the development of smart energy management systems. Future work may focus on incorporating external variables such as weather conditions, appliance-level data, or dynamic tariff rates to further improve the model’s predictive capabilities.

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