PROJECT PROPOSAL PRESENTATION

TIME SERIES FORECASTING FOR ENERGY CONSUMPTION IN MALAYSIA USING REGRESSION TECHNIQUE

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INTRODUCTION

BACKGROUND

- Malaysia's energy landscape has undergone significant changes over the past few decades.

- The country's energy sector, characterized by a diverse mix of fossil fuels (natural gas, coal, oil) and renewable energy sources (hydropower, solar, biomass), has seen substantial growth in demand due to industrial expansion, urban development, and population growth.

- Accurate forecasting is essential for ensuring energy security, economic efficiency, and environmental sustainability.

PROBLEM STATEMENT

- Forecasting energy consumption in Malaysia presents several challenges. Economic growth, technological advancements, climate variations, and policy changes all impact energy demand. Traditional forecasting methods often need to capture these complexities, leading to inaccurate predictions. Accurate forecasts are vital for managing energy demands, preventing deficits and wastage, and formulating effective energy policies.

RESEARCH QUESTIONS & OBJECTIVES

Research Question

- **RQ 1**: How effective are different regression techniques (linear, polynomial, multiple linear regression) in forecasting energy consumption in Malaysia?

- **RQ2**: How do advanced regression models compare to traditional time series forecasting methods regarding accuracy and reliability?

- **RQ3** : What are the potential future trends in energy consumption in Malaysia based on current data and regression model predictions?

Research Objectives

- To collect and analyse historical data on energy consumption in Malaysia to identify trends, patterns, and seasonal variations.

- To develop regression models (linear, polynomial, multiple linear regression) for forecasting future energy consumption in Malaysia.

- To evaluate the performance of different regression models using metrics such as Mean Absolute Error (MAE), Mean Squared Error (MSE), and Root Mean Squared Error (RMSE).

SCOPE OF THE STUDY

Data will be sourced from reputable national and international databases, including the Energy Commission of Malaysia, the Department of Statistics Malaysia, Tenaga National Berhad, the Climate Change Knowledge Portal and global organizations such as the International Energy Agency (IEA) and the World Bank.

The study will incorporate various types of data, such as total energy consumption, sector-specific consumption, economic indicators (GDP), consumer price index (CPI), demographic data (population growth), and climatic variables (temperature, humidity).

Different types of regression analysis, such as linear regression, polynomial regression, and multiple linear regression will be applied.

Model evaluation metrics like Mean Absolute Error (MAE), Mean Squared Error (MSE), and Root Mean Squared Error (RMSE) will be used, and cross-validation techniques will be employed to ensure the models' reliability and applicability are tested.

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LITERATURE REVIEW

LITERATURE REVIEW (lebih dari satu slide)

Regression Techniques and Their Application in Time Series Analysis

- Linear Regression
- Polynomial Regression
- Multiple Regression
- Regularization technique

Definition & Concept Time Series

- Trends
- Seasonality
- Noise

Key Components

Energy Consumption Trends in Malaysia
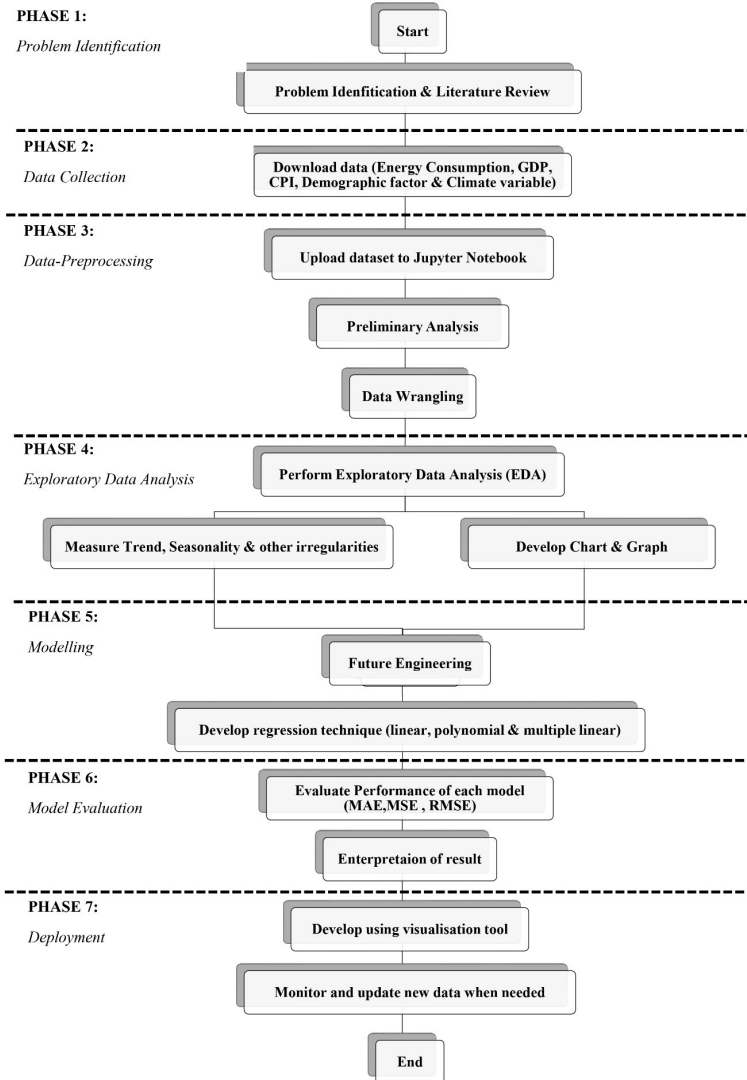
- Increasing rapidly due to economic development, industrialisation, and urbanisation.
- population growth in the urban area high use of energy on-premises
- Industrial growth triggered high commercial and industrial energy usage.

Key Influencing Factors on Energy Consumption

- Economic Factors
- Demographic Factors
- Climatic Factors

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METHODOLOGY

PHASE 1:

Problem Identification

Start

Problem Idenfitication & Literature Review

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PHASE 2:

Data Collection

Download data (Energy Consumption, GDP, CPI, Demographic factor & Climate variable)

- -

PHASE 3:

Data-Preprocessing

Upload dataset to Jupyter Notebook

Preliminary Analysis

Data Wrangling

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PHASE 4:

Exploratory Data Analysis

Perform Exploratory Data Analysis (EDA)

Measure Trend, Seasonality & other irregularities

Develop Chart & Graph

- -

PHASE 5:

Modelling

Future Engineering

Develop regression technique (linear, polynomial & multiple linear)

- -

PHASE 6:

Model Evaluation

Evaluate Performance of each model (MAE,MSE , RMSE)

Enterpretaion of result

- -

PHASE 7:

Deployment

Develop using visualisation tool

Monitor and update new data when needed

End

A research framework for time series forecasting of energy consumption using Regression methods

DATA SOURCES AND COLLECTION METHODS

Energy Commission of Malaysia (Suruhanjaya Tenaga)	Tenaga Nasional Berhad	Department of Statistics Malaysia (DOSM)	Climate Change Knowledge Portal	World Bank and International Energy Agency (IEA)
• Provides detailed reports and statistics on energy consumption by sector, including residential, industrial, and commercial energy use.	• Provides details about the electricity consumed in Malaysia.	• This agency offers economic and demographic data, such as GDP, population growth, and urbanization rates.	• Provide details about climate variables such as temperature and humidity	• Provide global economic indicators and comprehensive energy statistics.

DATA CLEANING

- Handle missing values within the dataset.

- Remove the duplicate data. It is essential to check and eliminate duplicate data to avoid redundancy and ensure that the data is unique.

- Outlier detection and treatment are other essential aspects of data cleaning. These are treated to prevent them from skewing the analysis, and this can be done either by removing them or capping their values to a more reasonable range

FUTURE ENGINEERING

- Generate lagged variables to capture temporal dependencies in time series data

- Create interactions between features to capture the combined effects

- Develop polynomial features to non-linear relationships, calculate rolling to smooth out the short-term fluctuations

- Create dummy variables to capture seasonal effects such as months, quarters, or seasons.

VISUALISATIONS

Time Series Plots
- Separate plots for different sectors will be created to identify the consumption patterns.
- A time series for energy demands by sector in Malaysia may reveal increases in usage during a specific time.

Correlation Heatmaps
- A heatmap will display the correlation between energy consumption in Malaysia and various economic, demographic, and climatic variables.
- Strong positive correlation between GDP and energy consumption would indicate that economic growth drives higher energy usage, and population growth leads to higher energy consumption.

Scatter Plots
- This will examine the relationship between energy consumption and key predictors such as GDP, population growth, temperature, and humidity.
- plotting energy consumption in Malaysia against GDP can reveal whether there is a linear relationship (indicating GDP increases so with the energy consumption) or to see if there are non-linear patterns.

Box Plots
- The box plot will visualize the distribution of variables such as energy consumption, GDP, economic factors, and climate variables.
- It will help to identify the outliers and understand the spread and central tendency of the data.

Histograms
- Assess the distribution of individual variables, such as energy consumption, GDP, and temperature.
- a histogram of energy consumption might reveal a right-skewed distribution, indicating that a few periods have exceptionally high consumption.

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INITIAL INSIGHTS

Trends and Seasonality
- Identification of long-term trends in various energy consumption in Malaysia, such as the pattern of increases or decreases.

Relationships Between Variables
- Strong correlations between energy consumption in Malaysia and economic factors such as GDP, industrial and residential.
- The impact of climatic factors such as temperature and humidity on energy usage in Malaysia.

Sector-Specific Insights
- Differences in energy consumption patterns across residential, industrial, and commercial sectors.
- Identification of high-consumption periods and potential causes.

THANK YOU