📊 Power Consumption Forecasting Report

Project Title:
Predictive Analytics for Power Consumption in Zone 1 – Tetouan City

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🎯 Business Objective

To empower energy stakeholders with data-driven insights for proactive energy management in **Zone 1 of Tetouan City**.
The predictive model supports:

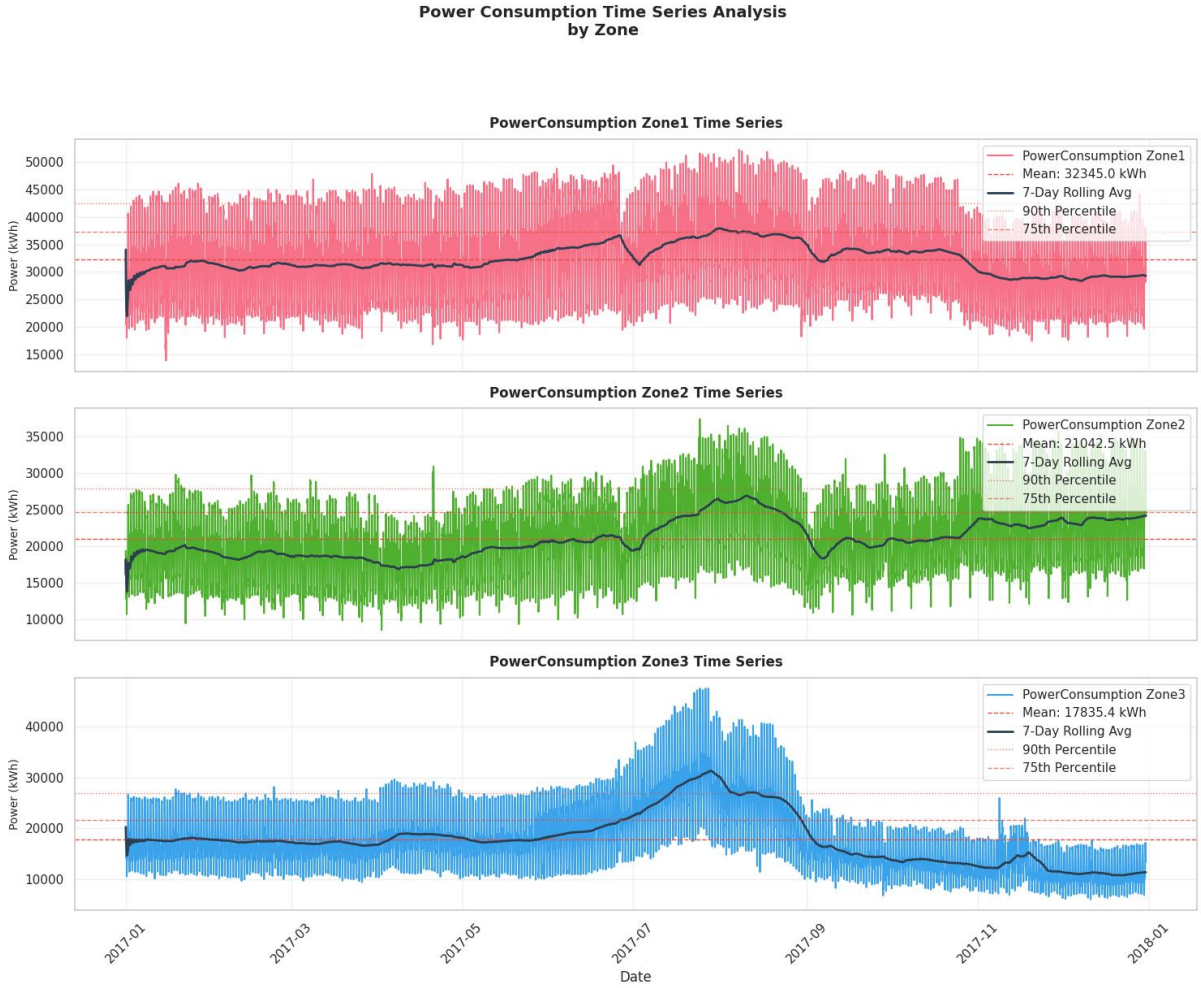
- Smarter resource planning
- Demand forecasting
- Operational efficiency
- Informed decision-making for energy distribution

🗂️ Data Overview

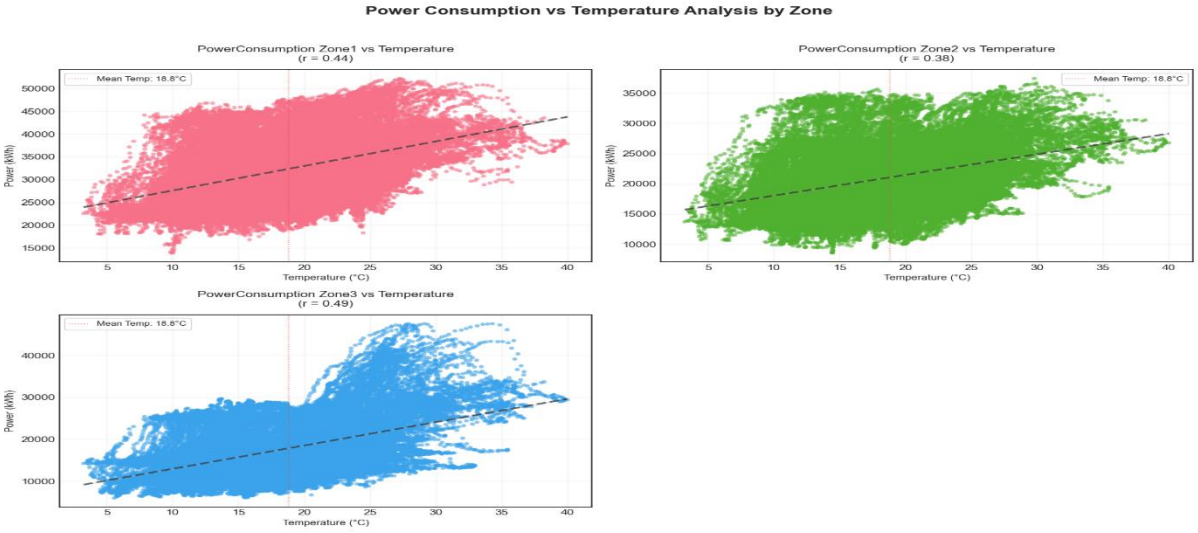
- **Source:** UCI Machine Learning Repository
- **Collection Frequency:** Every 10 minutes
- **Key Variables:**
    - Environmental Factors: Temperature, Humidity, Wind Speed, Diffuse Flows
    - Power Consumption: Zone 1 (Forecast Target), Zone 2, Zone 3 (Reference Data)

🧩 Key Business Insights

- **Stable Power Demand in Zone 1:**
  Continuous, high usage suggests critical operational demand in this area.



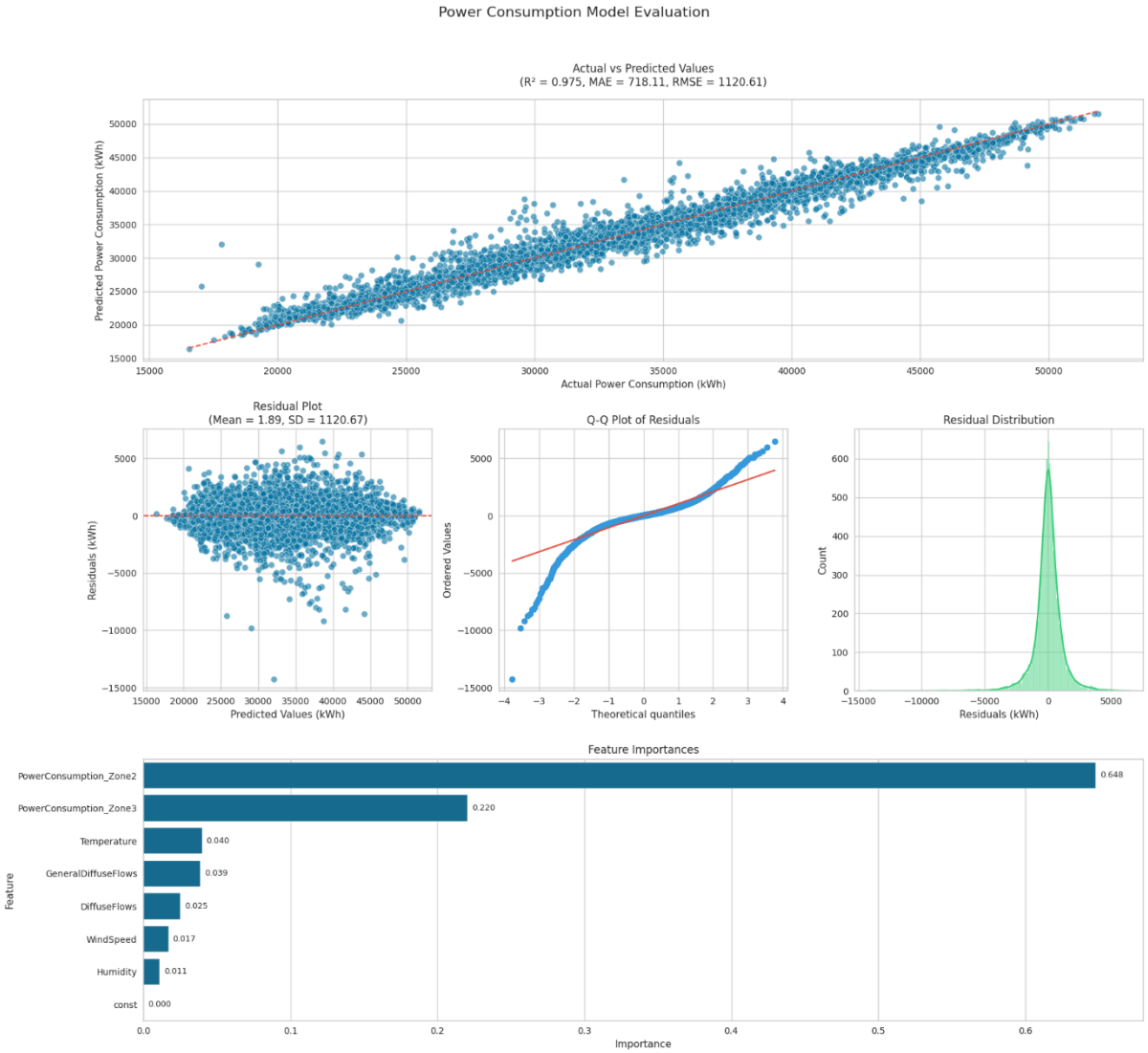
- **Seasonality & Weather Impact:**
  Power usage patterns correlate with temperature and seasonal changes, highlighting the need for adaptive demand strategies.



- **Cross-Zone Influence:**
  Zone 2 and Zone 3 consumption strongly relate to Zone 1 demand—indicating shared operational drivers.
- **Significant Environmental Predictors:**
  - **Humidity & Diffuse Flows**: Increase in these factors leads to higher power usage.
  - **Wind Speed**: Acts as a demand reducer.
  - **Temperature**: Surprisingly, not a significant driver for Zone 1 demand.

📈 Modeling Outcome

- **Model Used:** Random Forest Regressor
- **Performance:** R^2 Score of **0.975** (explains 97.5% of demand variability)



✅ **Business Value of Model:**

- Predicts power consumption with high accuracy
- Enables better load management and operational forecasting
- Supports strategic planning for energy provision

✅ **Recommendations for Stakeholders**

- **Deploy the Model in Operations:**
  Use forecasts for daily and weekly energy management.
- **Integrate with Monitoring Systems:**
  Real-time dashboards for proactive insights and alerts.
- **Consider Model Enhancements:**
  Test advanced ensemble methods (e.g., XGBoost) for further optimization.
- **Maintain and Update Models Regularly:**
  Update forecasts with new data to ensure ongoing relevance.
- **Extend Predictive Approach City-Wide:**
  Apply this methodology to other city zones for comprehensive energy planning.

🌟 **Business Impact Summary**

By leveraging predictive analytics:

✔ **Operational Efficiency Improves**
✔ **Costs are Reduced through Smarter Planning**
✔ **Energy Sustainability Goals are Supported**

Data-driven forecasting ensures Tetouan City is equipped for smarter, future-ready energy management.