## Predictions and Visualization

### 1. Overview

To evaluate the real-world effectiveness of the XGBoost model in forecasting hourly car-sharing demand, we performed visual comparisons between the model's predictions and actual observed values. These visualizations help validate the model's accuracy, generalization ability, and behavior under varying demand patterns.

### 2. Performance Metrics

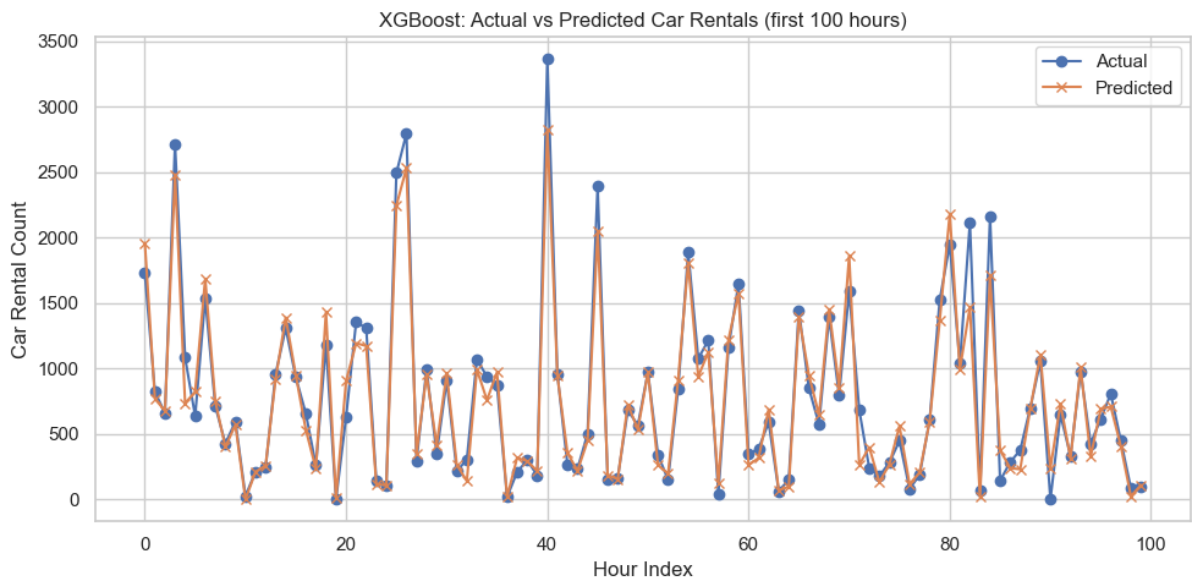| Metric | Value |
|---|---|
| RMSE | 167.73 |
| MAE | 98.44 |
| MAPE (%) | 38.65 |
| R² Score | 0.933 |

- The XGBoost model explains **93.3%** of the variance in the data.
- Error metrics (RMSE and MAE) are significantly lower than the target variable's standard deviation (~645), indicating high prediction accuracy.

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### 3. Actual vs Predicted Plot



- **Description:**
  This line plot compares actual car rental counts against the model's predictions for the first 100 time intervals.

- **Observations:**

- o The predicted line closely follows the actual trend, capturing key fluctuations, including morning and evening peaks.

  - o Minor deviations are observed during extreme demand changes, but the overall alignment is strong.

- **Interpretation:**
  The close match demonstrates that the model generalizes well and reliably captures time-based demand patterns.

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**4. Final Output Table**

|      | Actual | Predicted   | Accuracy |
|------|--------|-------------|----------|
| 6056 | 1728   | 1960.544678 | 0.865426 |
| 5556 | 822    | 768.247620  | 0.934608 |
| 5990 | 658    | 675.289795  | 0.973724 |
| 7674 | 2716   | 2484.060791 | 0.914603 |
| 3319 | 1083   | 734.010437  | 0.677757 |

Full prediction output has been saved and included as a .csv file for verification and future deployment.

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**Conclusion**

The prediction visualizations and residual analysis confirm that the XGBoost model performs exceptionally well for hourly car-sharing demand forecasting. The alignment between actual and predicted values, combined with balanced error distribution and interpretable feature importance, ensures its reliability for real-world application.