# Weather Data Analysis and Forecasting

## Overview

This project involves analyzing weather data to uncover patterns, trends, and insights. It includes steps for data cleaning, exploratory data analysis (EDA), forecasting, and model evaluations, along with visualizations and recommendations.

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## 1. Data Cleaning

- Inspected raw data for missing or inconsistent entries.  
- Converted time-related columns to datetime format.  
- Standardized numerical data using Min-Max scaling.  
- Removed duplicates and irrelevant fields.

## 2. Exploratory Data Analysis (EDA)

- Visualized temperature and precipitation trends over time.  
- Identified correlations using heatmaps.  
- Analyzed seasonal variations through box and violin plots.

### Key Findings:

- Significant correlations observed between temperature and humidity.  
- Seasonal patterns detected in precipitation levels.  
- Outliers corresponded to extreme weather events.

## 3. Forecasting Models

- Utilized `last\_updated` column for time series analysis.  
- Built ARIMA models to forecast temperature and precipitation.

### Evaluation Metrics:

- RMSE: 3.2 (temperature)  
- MAE: 2.8 (temperature)

## 4. Advanced Analyses

- Seasonal decomposition provided insights into trends and cyclic behavior.  
- Outlier analysis revealed anomalous weather patterns.

## 5. Results and Insights

- Warming trends were evident mid-year.  
- ARIMA provided reliable short-term weather forecasts.  
- Key anomalies align with major weather disruptions.

### Recommendations:

- Implement predictive models in agriculture and urban planning.  
- Utilize monthly weather forecasts for operational efficiency.

## 6. Setup Instructions

### Prerequisites

- Python 3.8+  
- Libraries: pandas, matplotlib, seaborn, statsmodels

### Installation

1. Clone the repository:  
 ```bash  
 git clone <repository\_url>  
 ```  
2. Install required dependencies:  
 ```bash  
 pip install -r requirements.txt  
 ```

### Running the Analysis

1. Open `WeatherTrendForecasting.ipynb` in Jupyter Notebook.  
2. Execute all cells to reproduce the analysis.

## Future Enhancements

- Integration of external factors (e.g., geography, climate indices).  
- Implementation of advanced models (e.g., LSTM, Prophet) for improved accuracy.