# EXPERIMENT 10

AIM:
To develop a Vector Auto Regression (VAR) model for forecasting multiple related time series variables such as temperature, humidity, and rainfall using the `Crop_recommendation.csv` dataset.

PROCEDURE:
**Dataset Upload:**

- Upload the `Crop_recommendation.csv` file using a file upload widget in a Colab/Notebook environment.

**Data Preprocessing:**

- Extract relevant numeric features like `temperature`, `humidity`, and `rainfall`.
- Fill missing values (if any) using forward-fill method.
- Assign a date index to simulate time series data.

**Model Development:**

- Split the dataset into training data and forecast target.
- Fit a VAR model using the training data.
- Determine the optimal lag using AIC (Akaike Information Criterion).

**Forecasting:**

- Use the fitted VAR model to forecast the next 10 days for all selected variables.

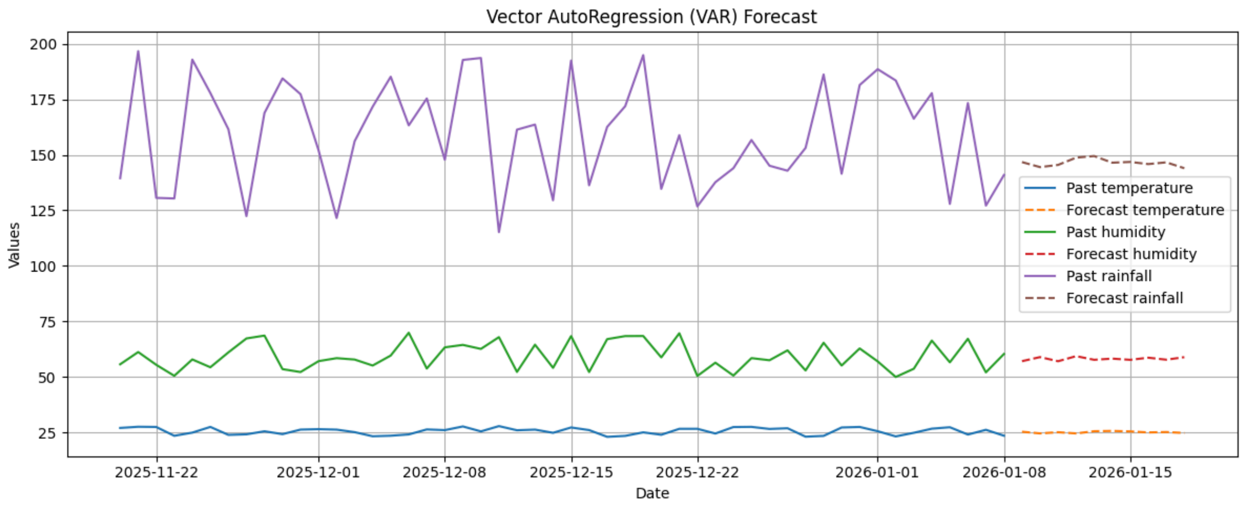
**Visualization:**

- Plot the last 50 days of actual data along with the 10-day forecast for each variable.

CODE:

```
# Install necessary packages if running in Colab
# !pip install ipywidgets statsmodels --quiet

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from statsmodels.tsa.api import VAR
import ipywidgets as widgets
from IPython.display import display

# Create file upload widget
upload = widgets.FileUpload(accept=".csv", multiple=False)
display(upload)

def handle_upload(change):
    if upload.value:
        # Read the uploaded CSV file
        uploaded_file = next(iter(upload.value.values()))
        df = pd.read_csv(pd.io.common.BytesIO(uploaded_file['content']))

        # Optional: set a datetime index if available, else use dummy daily dates
        df.index = pd.date_range(start="2020-01-01", periods=len(df), freq='D')

        # Select multiple numeric columns for multivariate time series
        # We'll use 'temperature', 'humidity', 'rainfall' if they exist
        columns = ['temperature', 'humidity', 'rainfall']
        selected_cols = [col for col in columns if col in df.columns]

        if len(selected_cols) < 2:
            print("Dataset must contain at least two of the following columns: temperature, humidity,
rainfall")
            return

        df_selected = df[selected_cols]
        # Check for missing values
        df_selected = df_selected.fillna(method='ffill')

        # Split into train and forecast sets
        train = df_selected[:-10]
        model = VAR(train)

        # Fit model and select optimal lag
        results = model.fit(maxlags=15, ic='aic')

        # Forecast 10 steps ahead
        forecast_input = df_selected.values[-results.k_ar:]
        forecast = results.forecast(y=forecast_input, steps=10)

        forecast_df = pd.DataFrame(forecast, columns=selected_cols)
        forecast_df.index = pd.date_range(start=df_selected.index[-1] + pd.Timedelta(days=1), periods=10)

        # Plotting forecasted values
        plt.figure(figsize=(12, 5))
        for col in selected_cols:
            plt.plot(df_selected.index[-50:], df_selected[col].iloc[-50:], label=f"Past {col}")
            plt.plot(forecast_df.index, forecast_df[col], '--', label=f"Forecast {col}")

        plt.title("Vector AutoRegression (VAR) Forecast")
        plt.xlabel("Date")
        plt.ylabel("Values")
        plt.legend()
        plt.grid(True)
        plt.tight_layout()
        plt.show()

# Trigger upload handler
upload.observe(handle_upload, names='value')
```

OUTPUT:



RESULT:

The VAR model successfully forecasted future values for temperature, humidity, and rainfall. The predicted trends were visualized alongside historical trends, showing how the model captures relationships among the variables and extends them into the future. The model is useful for multivariate environmental forecasting in agriculture-related decision-making.