Social Impact Report: Analyzing Rainfall Trends in India (1901-2017)

TrainIT Hackathon - IMPACTX

Ananya Saxena
Pankajh Jhamtani

Introduction

India's economy, agriculture, and water resources depend on monsoons

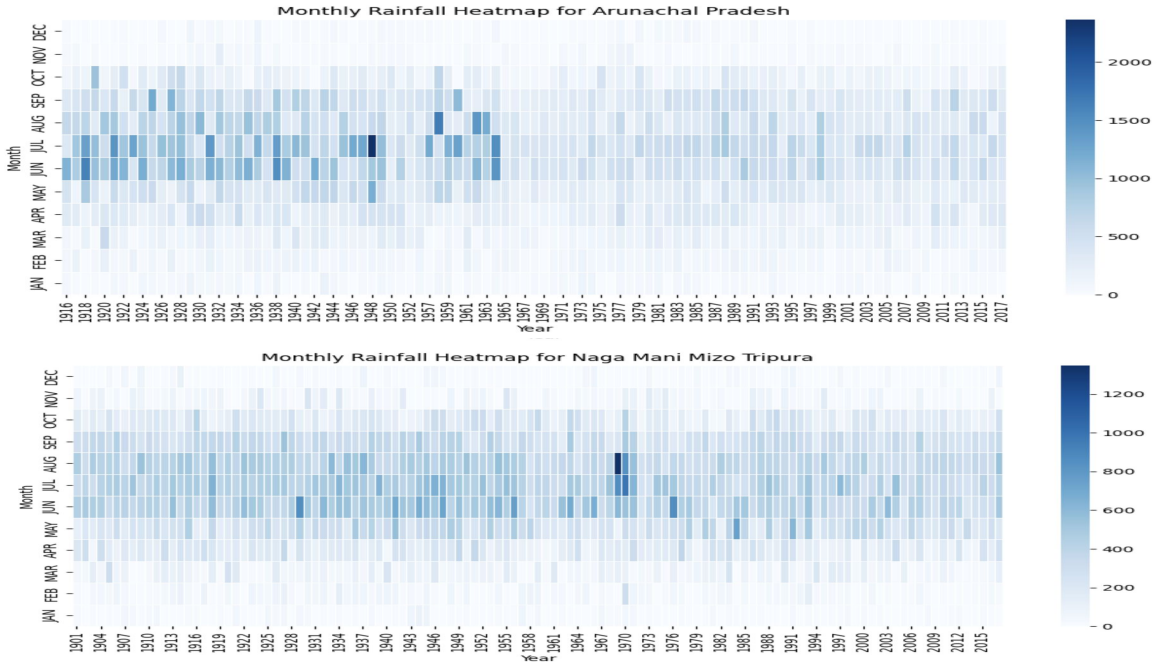
Objectives:

- Analyze historical rainfall patterns (1901-2017)- dataset used
- Use statistical and machine learning models for forecasting
- Provide insights for climate risk mitigation

Key Findings - Long-Term Rainfall Trends

- **Stable Rainfall Patterns**: Most states show stable trends, except NE India
- **Monsoon Dependency**: 75% rainfall occurs between June-September
- **Implications**: Essential for water resource management and policy planning

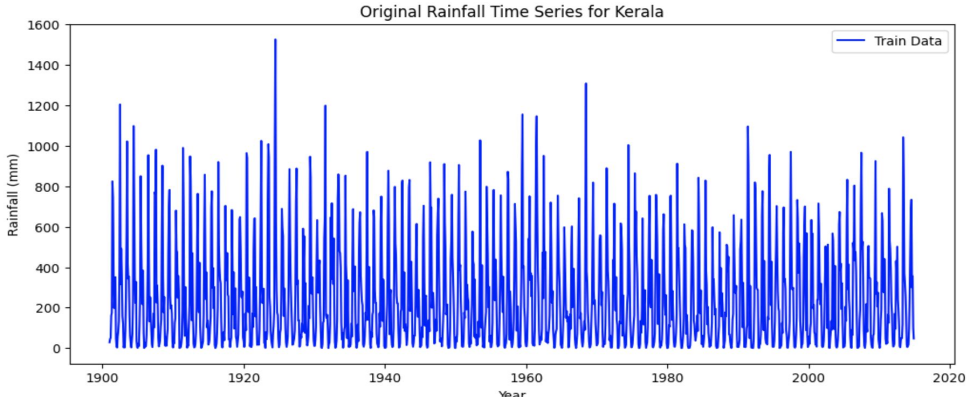
Exceptions in rainfall heatmaps

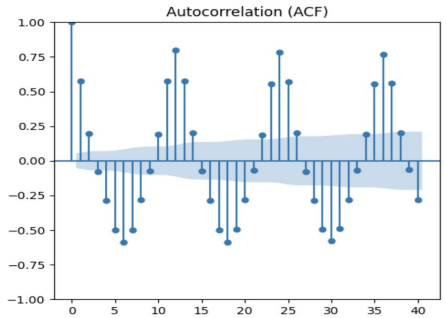


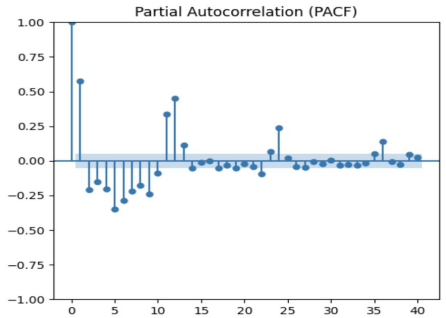
Seasonality & Stationarity in Rainfall Data

- **Time series analysis** shows stationarity (Dickey-Fuller test and time series visualisation)
  a. ADF Statistic: -5.5716
  b. p-value: 1.463

- **ACF & PACF plots** reveal seasonal dependencies

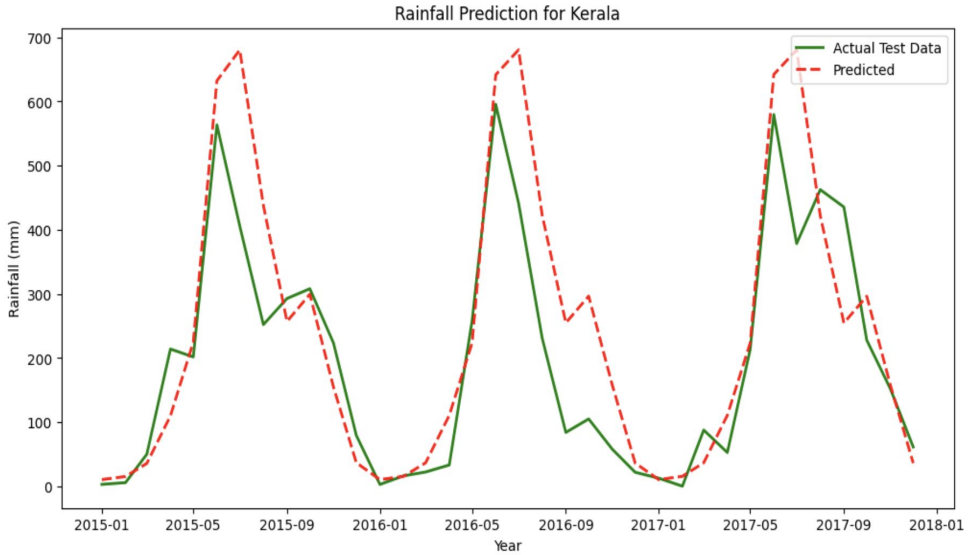






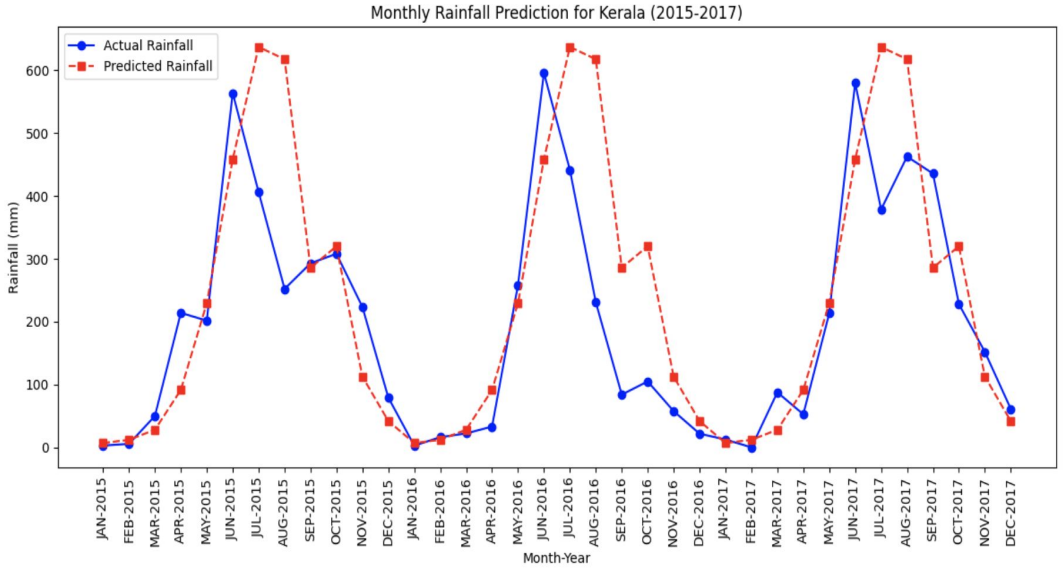
Region wise time series forecasting

- We have multiple ‘subdivisions’ or regions in the data. In a way we have multiple time series.
- Starting the analysis with considering them **independent** we try to fit a **SARIMA** model
- Model parameters are guessed using **ACF and PACF plots.**
- SARIMA(1,0,0) X (1,1,1,12)
- Prediction results:
  - RMSE: **112.41**
  - R^2: **0.61**



Spatial dependance in Rainfall

- Rainfall patterns vary significantly across regions
- **Example**: Assam & Bihar face excessive monsoon floods, Rajasthan faces drought
- Therefore we incorporate both spatial data and temporal data while fitting a XBboost regression model - **spatial XGBoost**
- A clear improvement in prediction is observed:
  - RMSE: **83.31**
  - R^2: **0.71**
- This model captures geographic dependencies



Social & Economic Impact

Flood & Drought Management:

- AI-driven early warning systems
- Reducing economic & human losses

Agriculture & Food Security:

- 70% farmers depend on monsoons → Need for crop planning
- Recommending drought-resistant crops

Climate Change Adaptation:

- River basin management, afforestation, sustainable irrigation

Conclusion

Conclusion & Key Takeaways

- Data-driven insights can **enhance climate resilience**
- **Combining Geographic dependency + ML** yields better rainfall predictions
- **Policymakers, farmers, and disaster response teams** can benefit from such analysis
- Need for continued monitoring & adaptation to climate change