# Seasonal Decomposition and Socioeconomic Analysis of Inflation Indicators


## ABSTRACT

Inflation is a crucial macroeconomic indicator that impacts economic stability, purchasing power, and societal well-being. Understanding inflation requires analyzing not only long-term trends but also short-term fluctuations and interactions with socioeconomic factors. This project performs an in-depth exploratory data analysis and seasonal decomposition of multiple inflation indicators using global economic data. The study incorporates headline, energy, food, core, and producer price inflation along with GDP deflator growth rates, and integrates socioeconomic variables such as GDP per capita, social support, life expectancy, freedom of choice, generosity, and perceptions of corruption. Seasonal decomposition is applied to isolate trend, seasonal, and irregular components.


## PROBLEM STATEMENT

Inflation varies across countries, periods, and economic conditions, yet conventional analysis often relies solely on descriptive statistics or annual averages, ignoring seasonal behavior and socioeconomic interactions. Such approaches fail to capture structural patterns, cyclical trends, and institutional influences that shape inflation outcomes. Additionally, the relationship between inflation and social well-being indicators such as happiness, social support, and corruption perception remains insufficiently explored. Without a structured analytical framework, inflation insights remain fragmented, reducing their interpretability and policy relevance.

## OBJECTIVES

- This project aims to provide a structured framework for analyzing inflation by combining seasonal decomposition, exploratory data analysis, and statistical modeling.
  The objectives are:
- Preprocess and clean multi-country economic datasets.
- Identify trends, seasonal components, and irregular patterns in inflation indicators.
- Examine regional and temporal variations in inflation.
- Assess the impact of inflation and socioeconomic variables on happiness scores.
- Apply hypothesis testing and regression analysis to validate findings.
- Deliver visualizations and insights for policymakers.

## EXISTING SYSTEM

Traditional inflation analysis relies heavily on descriptive statistics and trend charts. These methods treat inflation as a static variable, often ignoring seasonal patterns, volatility, and regional heterogeneity. Socioeconomic indicators are analyzed independently from inflation measures, resulting in incomplete insights. Missing values and outliers are frequently overlooked, leading to biased and less reliable results.

## DISADVANTAGES OF THE EXISTING SYSTEM

- Ignore seasonal variation and cyclical patterns in inflation data.
- Do not integrate economic and social indicators for holistic analysis.
- Lack hypothesis testing or regression modeling to validate observed trends.
- Inadequate handling of missing values and outliers, reducing reliability.

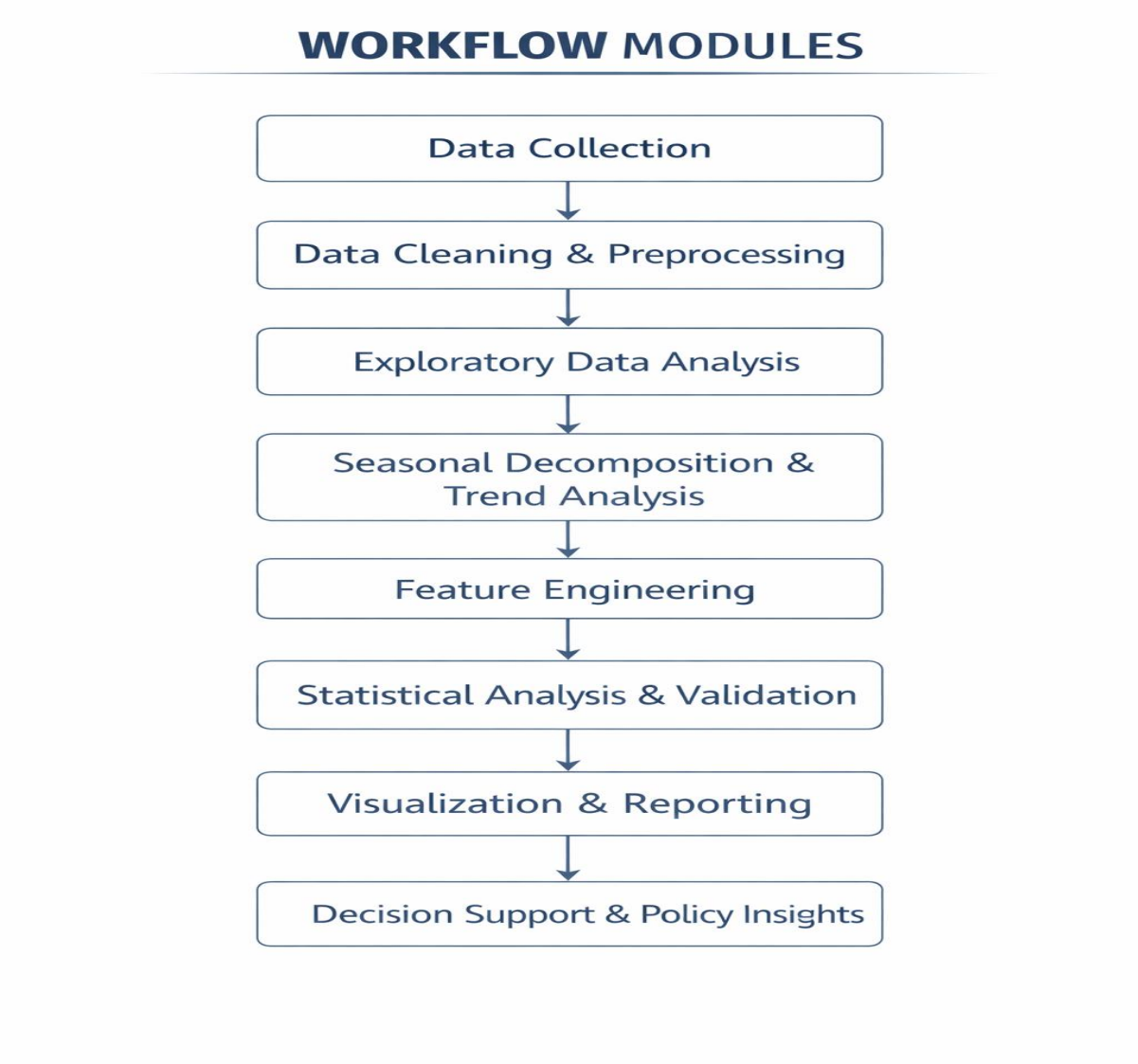
## PROPOSED SYSTEM

The proposed system introduces a structured, data-driven framework that integrates preprocessing, exploratory data analysis, seasonal decomposition, and statistical modeling. Inflation indicators are treated as time-series data to extract trend, seasonal, and residual components. Socioeconomic variables are incorporated to examine their influence on happiness scores. Robust statistical techniques, such as ANOVA, Spearman correlation, and OLS regression, ensure results are interpretable, reliable, and meaningful for economic policymaking.

**Advantages of Proposed System:**

- Captures both short-term fluctuations and long-term trends in inflation.
- Integrates socioeconomic indicators to understand broader well-being impacts.
- Handles missing values and outliers systematically to improve data reliability.
- Performs hypothesis testing to validate patterns across time and regions.
- Provides actionable insights for policymakers and researchers.
- Generates reproducible visualizations and statistical summaries.
- Facilitates identification of structural changes, seasonality, and volatility in inflation data.

**WORKFLOW**




**Modules**

**Data Collection**

The workflow begins with the collection of raw macroeconomic and socioeconomic data from publicly available global datasets. This includes country-wise and year-wise inflation indicators such as headline consumer price inflation, food inflation, energy inflation, core inflation, producer price inflation, and GDP deflator growth rates. In addition to economic variables, socioeconomic indicators including GDP per capita, social support, life expectancy, freedom of choice, generosity, perceptions of corruption, and happiness scores are collected. These datasets form the primary input for the analysis and represent economic conditions and social well-being across multiple regions and time periods.

**Data Cleaning and Preprocessing**

After data collection, the dataset undergoes rigorous cleaning and preprocessing to ensure analytical reliability. Missing values in socioeconomic indicators are handled using mean imputation, while inflation variables are treated as time-series data and filled using country-wise linear interpolation with fallback mean imputation where necessary. The dataset is sorted by country and year to maintain temporal consistency. Outliers are identified using the Interquartile Range (IQR) method and removed to prevent distortion of statistical results. This module ensures that the data is accurate, consistent, and suitable for advanced time-series and statistical analysis.

**Exploratory Data Analysis**

Once preprocessing is complete, exploratory data analysis is performed to understand the underlying structure of the dataset. Summary statistics are generated to assess central tendency and variability. Boxplots and histograms are used to visualize distributions, detect skewness, and confirm the effectiveness of outlier removal. Correlation heatmaps are created to examine relationships among inflation indicators and between economic and socioeconomic variables. This stage provides initial insights into patterns, relationships, and potential dependencies within the data.

**Seasonal Decomposition and Trend Analysis**

In this module, inflation indicators are treated as time-series data to extract meaningful temporal patterns. Trend analysis is conducted to observe long-term inflation movements across years and countries. Seasonal behavior and cyclical variations are examined to identify recurring inflationary patterns, particularly in food and energy prices. This process helps distinguish structural inflation trends from short-term fluctuations, improving interpretability and economic relevance.

**Feature Engineering**

To enhance analytical depth, additional features are derived from existing variables. Logarithmic transformation is applied to skewed variables such as perceptions of corruption to stabilize variance and improve interpretability. Socioeconomic indicators are also categorized where appropriate to support comparative analysis. These engineered features strengthen correlation analysis and regression modeling by improving statistical robustness.

**Statistical Analysis and Validation**

This module applies statistical techniques to validate observed relationships and patterns. Spearman rank correlation is used to measure monotonic relationships between inflation indicators, socioeconomic variables, and happiness scores. One-way ANOVA tests examine whether inflation significantly differs across years and regions. The Augmented Dickey-Fuller (ADF) test assesses the stationarity and persistence of inflation series, identifying trend and seasonal effects. Ordinary Least Squares (OLS) regression modeling quantifies the combined

influence of inflation and socioeconomic factors on happiness scores. These methods ensure that insights are statistically sound and not based on random variation.

### Visualization and Reporting

Validated results are presented using clear and interpretable visualizations, including line plots for trend analysis, boxplots for distribution assessment, and heatmaps for correlation analysis. Regression summaries and statistical outputs support analytical conclusions. This module translates complex statistical findings into intuitive visuals and structured interpretations, enabling effective communication of results to both technical and non-technical stakeholders.

### Decision Support and Policy Insights

The final module converts analytical findings into actionable insights for economic and policy analysis. By understanding inflation trends, seasonal behavior, and their interaction with socioeconomic indicators, policymakers and researchers can better evaluate economic stability and social well-being. The framework supports informed decision-making related to inflation control, social welfare planning, and long-term economic development strategies.

## CONCLUSION

Incorporating seasonal decomposition and socioeconomic variables enhances the analysis of inflation. The study demonstrates substantial temporal and regional variations in inflation indicators, while GDP per capita, social support, and perceptions of corruption significantly influence happiness scores. Although inflation alone does not show a strong direct association with institutional trust, integrating economic and social indicators explains broader well-being trends. The proposed framework provides a structured, reproducible, and data-driven approach for understanding inflation dynamics and their socioeconomic implications.

## FUTURE SCOPE

Future work could include higher-frequency inflation data, panel data modeling for causal analysis, incorporation of monetary policy indicators, and development of predictive machine learning models. The analytical framework could be extended into an interactive dashboard for real-time monitoring and decision support, allowing policymakers to make more informed economic interventions.