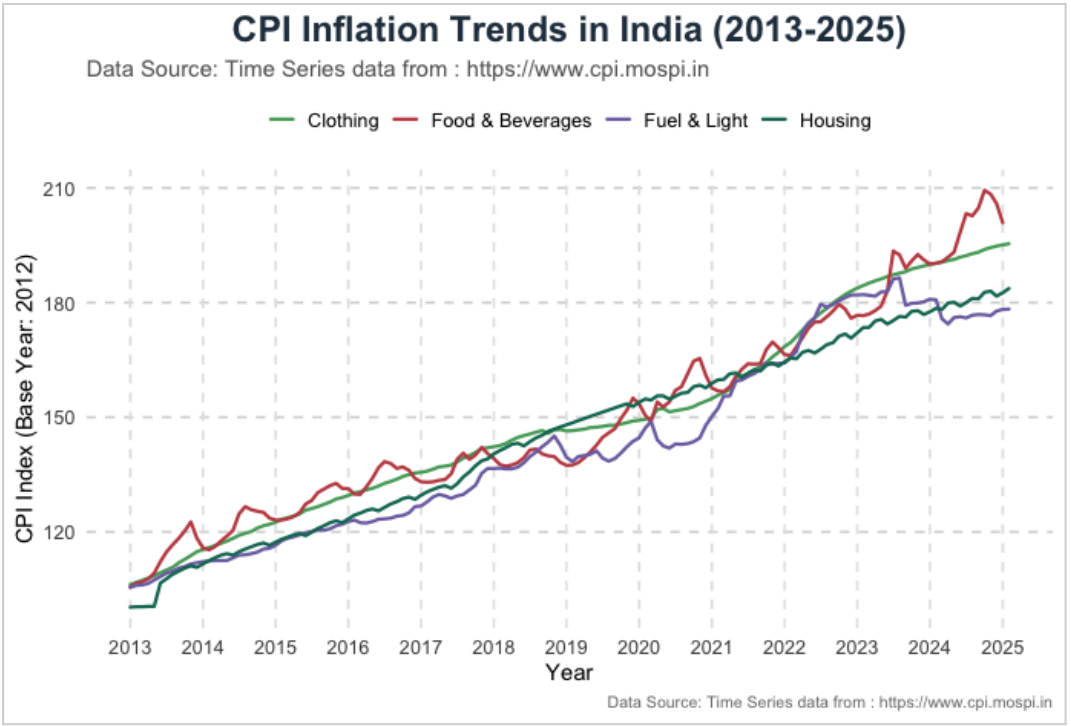
Final Report on Analysis & Data Visualization

~ Suchibrata Patra

This report analyzes the Consumer Price Index (CPI) inflation trends in India from 2013 to 2025, focusing on four key sectors: Clothing, Food & Beverages, Fuel & Light, and Housing. The CPI index, with a base year of 2012, serves as a measure of price fluctuations and inflationary pressures in the economy. The analysis is based on time-series data obtained from official sources and provides insights into the inflationary trends across different sectors.

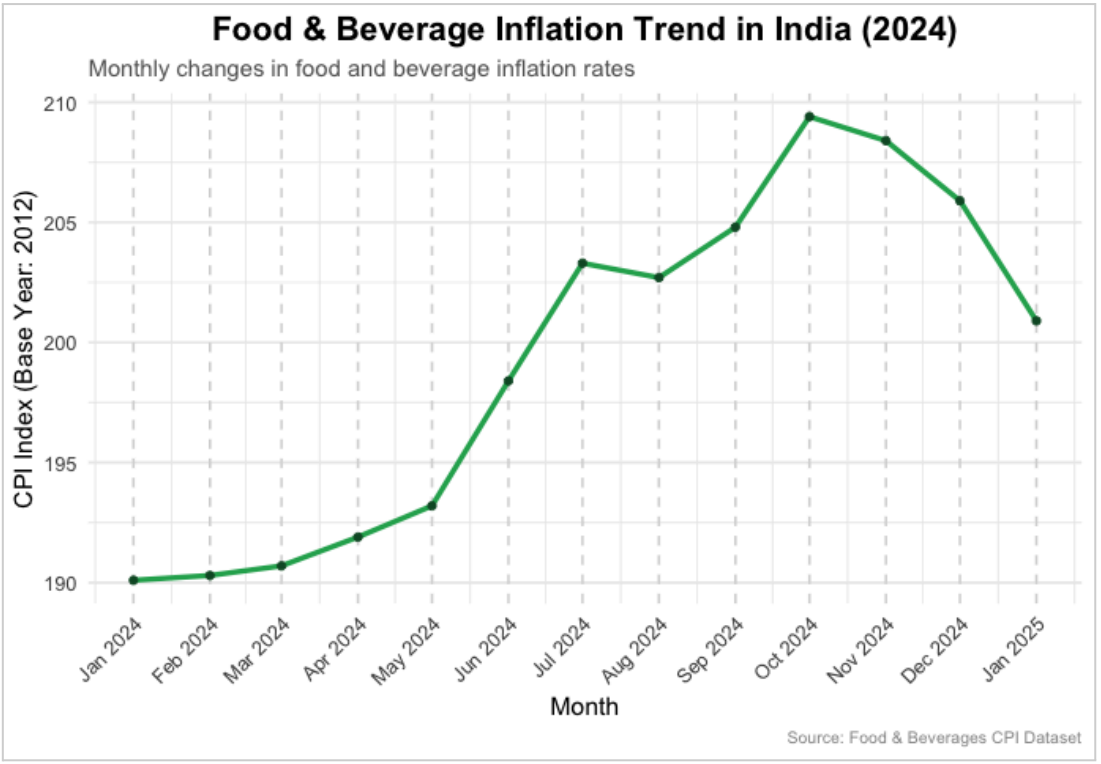
CPI Trends and Sectoral Analysis

The overall CPI index has shown a consistent upward trend from 2013 to 2025, reflecting a sustained increase in consumer prices. Among the four categories analyzed, Food & Beverages exhibit the highest volatility, with significant price fluctuations observed throughout the period. Notable spikes are evident around 2019 and 2024, which may be attributed to supply chain disruptions, seasonal demand variations, or macroeconomic factors influencing food prices. The Clothing sector demonstrates a steady and gradual increase in prices over the years, with fewer fluctuations compared to other categories. This suggests a stable inflationary trend in textile and apparel products. Similarly, Housing prices have experienced a consistent upward trajectory, reflecting long-term appreciation in real estate and rental markets without significant volatility. In contrast, Fuel & Light prices remained relatively stable until 2019 but exhibited more pronounced fluctuations in subsequent years. These variations could be linked to global energy price shifts, domestic fuel policy changes, and variations in supply and demand. The post-2020 period shows increased price volatility in this sector, reflecting external economic influences and market dynamics.



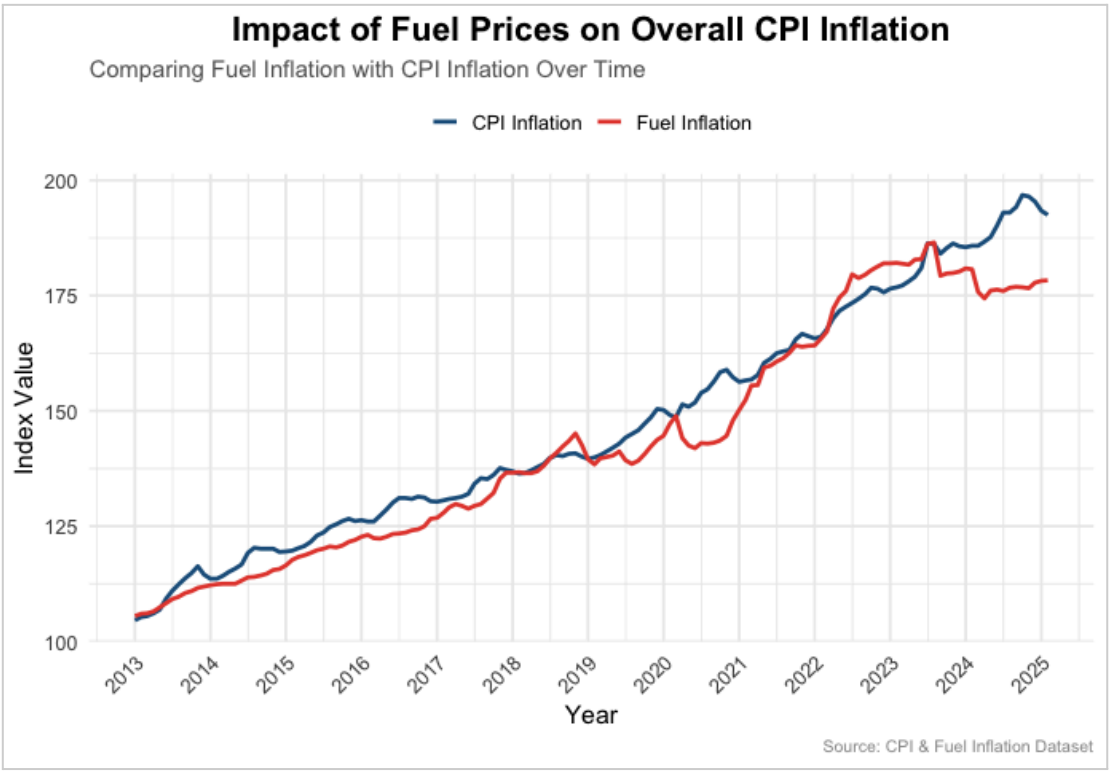
Factors Influencing Food & Beverage Inflation in 2024

The food and beverage inflation trend in India during 2024 exhibited a dynamic pattern, with noticeable fluctuations across the months. At the beginning of the year, inflation remained relatively stable, with only marginal increases observed from January to May. This period of moderate price growth suggests stable supply conditions and controlled inflationary pressures. However, from June onward, a sharp rise in food and beverage prices was recorded, with a significant spike occurring between June and July. This period of heightened inflation could be attributed to seasonal factors, supply chain disruptions, or increased demand for essential food commodities. Inflationary pressures continued to build through September and peaked in October, potentially influenced by festive season demand, fluctuations in agricultural output, and global commodity price trends. Following this peak, the CPI index for food and beverages showed a slight decline in November and December, suggesting price corrections and improved market stability toward the year's end. This downward trend could be linked to the easing of seasonal demand, better supply chain management, and government interventions to control food inflation. Overall, food and beverage inflation in 2024 followed a pattern of gradual early-year increases, a mid-year surge, a peak in October, and a mild decline toward December. This trend highlights the impact of seasonal cycles, economic policies, and external market conditions on food price inflation in India.



Impact of Fuel Prices on Overall CPI Inflation in India

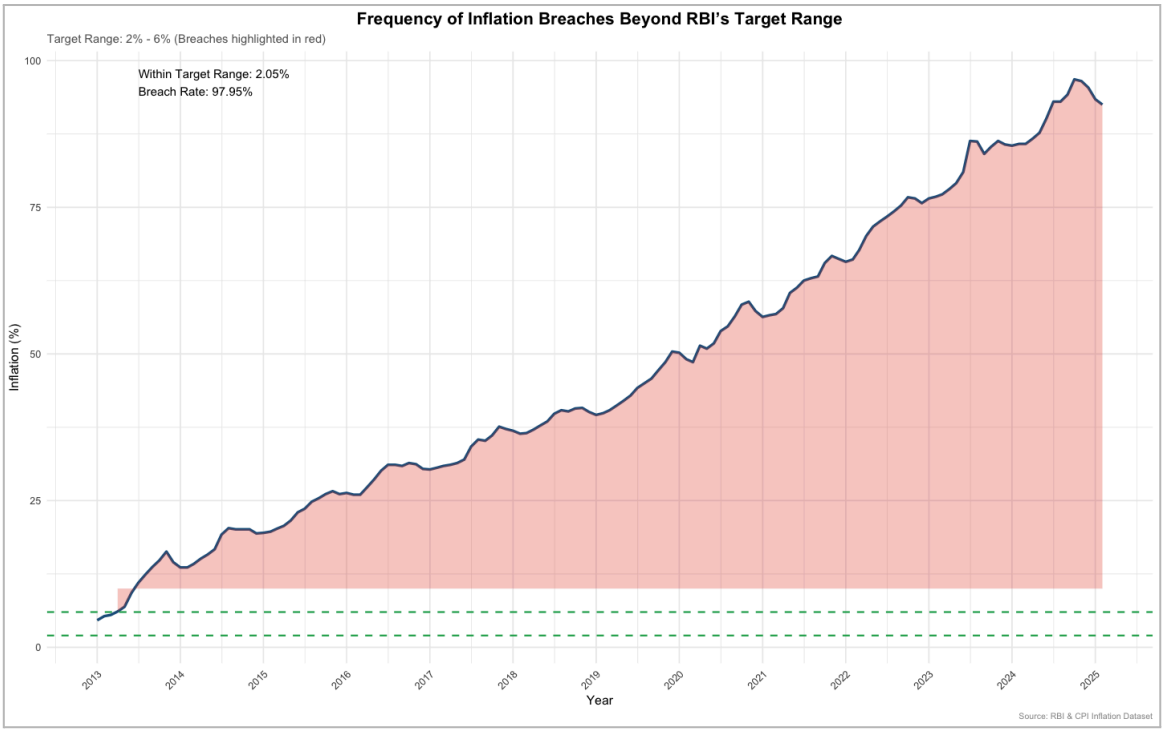
The analysis demonstrates a robust correlation of 0.978 between fuel inflation and overall CPI inflation in India, indicating a highly significant relationship between the two variables. A comparative time-series analysis reveals a near-identical trajectory between fuel and CPI inflation, emphasizing the direct influence of fuel price fluctuations on aggregate inflationary trends. Regression modeling further quantifies this dependency, with the fuel inflation coefficient of 1.008, signifying that each unit change in fuel inflation is associated with a proportional change in CPI inflation. The R-squared value of 0.957 indicates that 95.7% of the variability in CPI inflation is explained by fuel price movements, reinforcing the substantial impact of fuel costs on broader inflation. The statistical significance of the model is affirmed by the p-value (<2.2e-16). These findings underscore the central role that fuel prices play in driving overall inflation, with implications for economic stability. The direct link between fuel and CPI inflation, particularly in sectors like transportation, manufacturing, and energy, highlights the need for targeted policy interventions to manage fuel price volatility, ensuring more stable inflation dynamics and broader economic resilience.



Breach of Inflation according to RBI Guidelines

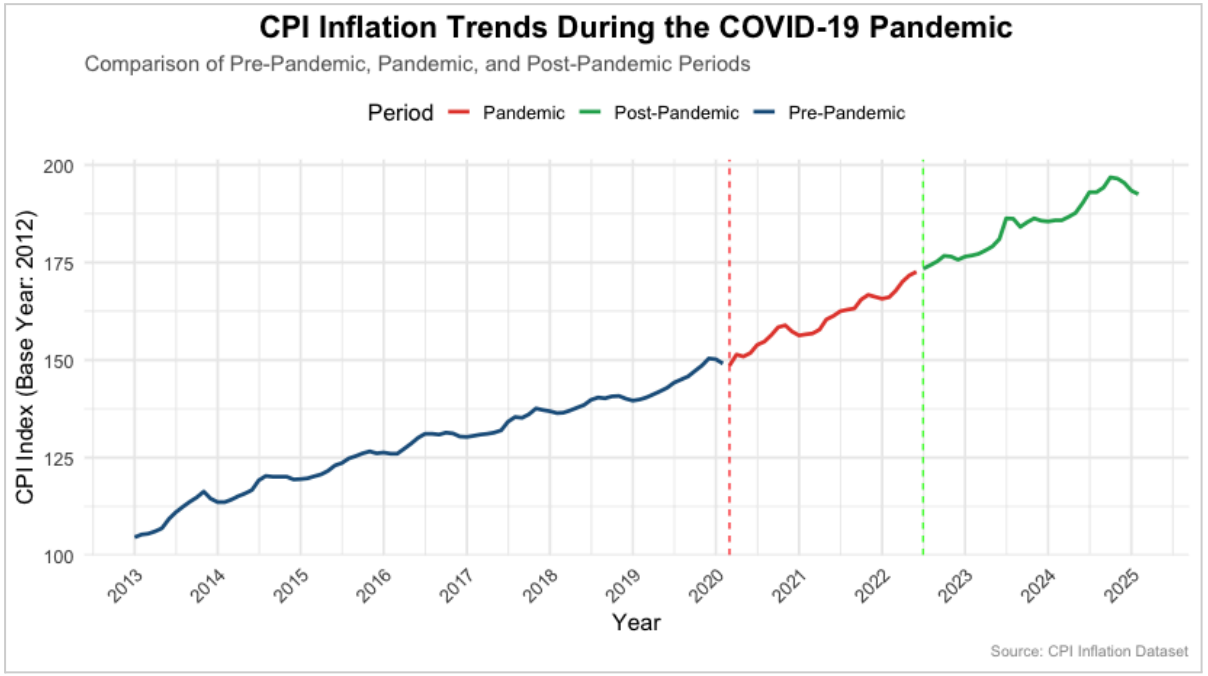
CPI data over the years highlights a consistent breach of the Reserve Bank of India's (RBI) target inflation range. From January 2013 to February 2025, inflation has frequently exceeded the central bank's comfort level, with particularly sharp increases during the pandemic and post-pandemic periods. The pre-pandemic years saw intermittent breaches, whereas the pandemic era brought significant price surges due to supply chain disruptions and economic instability. Even after the pandemic, inflation has remained persistently high, reflecting ongoing economic pressures.

The breach rate of 97.95% underscores the persistent nature of inflationary pressures, with inflation staying within the RBI's target range only 2.05% of the time. This highlights a prolonged challenge in controlling price levels, leading to economic consequences such as reduced purchasing power, higher costs of living, and the need for active monetary interventions. The data suggests that inflation has shown a continuous upward trajectory, especially post-2020, driven by global disruptions and domestic economic factors. This continuous breach of the target range has notable economic implications. It affects the cost of living, reduces purchasing power, and necessitates policy interventions by the RBI, such as interest rate adjustments. Given the trends observed, sustained monitoring and strategic monetary policies are essential to managing inflation and ensuring long-term economic stability.



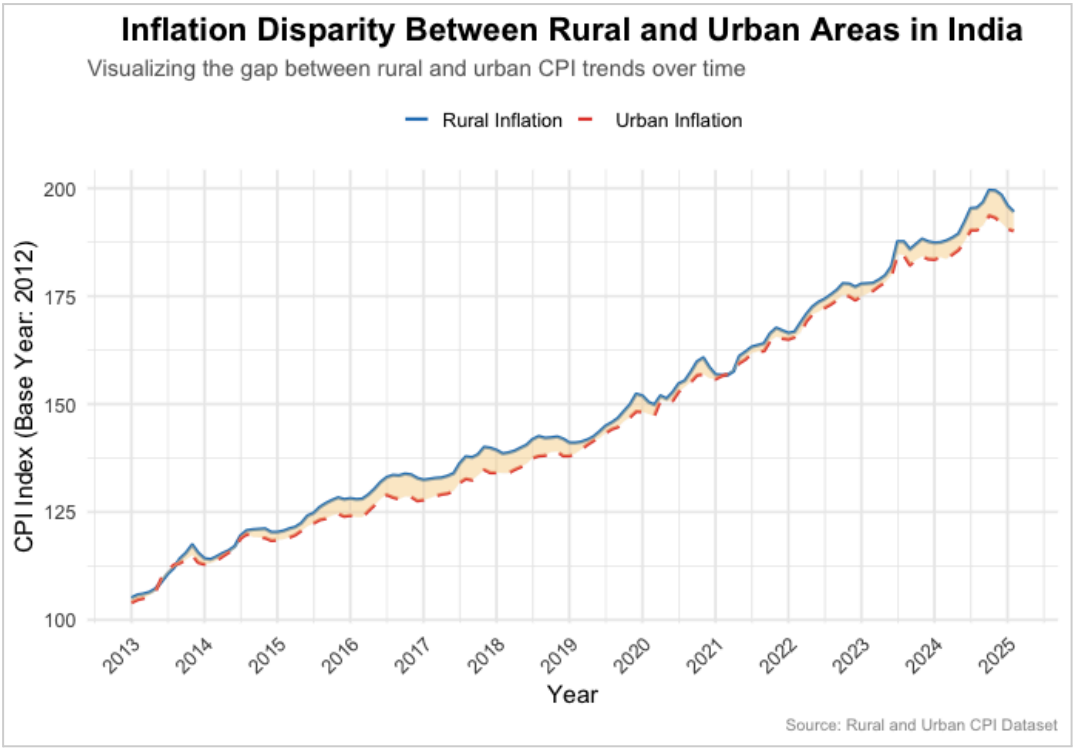
CPI Inflation Trends During the COVID-19 Pandemic

Inflation patterns shifted significantly across the pre-pandemic, pandemic, and post-pandemic periods, reflecting the economic disruptions caused by COVID-19. Before the pandemic, inflation remained stable, with an average Consumer Price Index (CPI) of 128, fluctuating between 105 and 150. The standard deviation of 11.8 indicates moderate variations, but overall, inflation was under control, reflecting steady economic conditions. During the pandemic (March 2020 to June 2022), inflation rose sharply. The average CPI increased to 160, with values ranging from 149 to 173. This period was marked by supply chain disruptions, lockdowns, and government stimulus measures, which fueled inflationary pressures. The lower standard deviation of 6.51 suggests that while inflation increased, its fluctuations were relatively contained, likely due to government interventions stabilizing prices to some extent. In the post-pandemic period (from July 2022 onward), inflation continued its upward trend, reaching an average CPI of 185, with values fluctuating between 173 and 197. This phase saw persistent inflation due to global supply chain realignments, rising energy and production costs, and labor market shifts. The standard deviation of 7.25 indicates sustained volatility, highlighting ongoing economic adjustments. Overall, inflation was lowest and most stable before the pandemic, spiked significantly during the crisis, and remained elevated in the recovery phase. The post-pandemic period recorded the highest average inflation, signaling long-term economic challenges beyond the immediate effects of COVID-19.



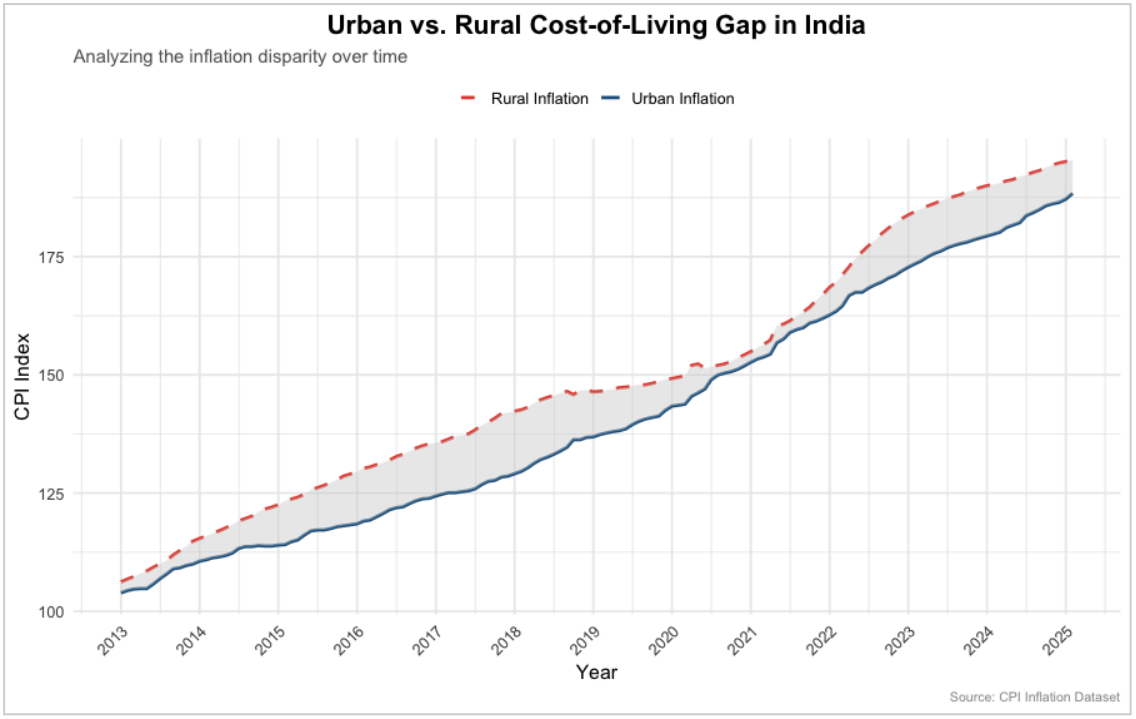
Analyzing Inflation Disparity Between Rural and Urban Areas in India

The inflation disparity between rural and urban areas in India reveals significant variations in the CPI trends over time. From 2013 to 2025, the data shows that rural inflation (represented by the blue line) has consistently followed a slower growth trajectory compared to urban inflation (represented by the red dashed line). The gap between these two inflation trends fluctuates throughout the period, with rural inflation generally trailing behind urban inflation. A closer examination of the disparity between rural and urban inflation over time shows that there are periods when rural inflation accelerates and narrows the gap, and other times when urban inflation rises more rapidly, expanding the disparity. This variation highlights the different economic dynamics and pressures affecting rural and urban areas, such as rural supply chain issues, agricultural output changes, and urban market conditions. The average disparity between rural and urban inflation is approximately 2.78 CPI units, suggesting a consistent but moderate gap between the two sectors. The maximum disparity recorded is 6.4 CPI units, highlighting periods of pronounced inflation differences, while the minimum disparity is 0.8 CPI units, indicating times when the gap between rural and urban inflation was narrowest. This analysis underscores the economic distinction between rural and urban regions in India, emphasizing the need for targeted policy interventions to address inflation disparities. The fluctuations in the disparity gap are influenced by varying local and national economic factors, such as agricultural price changes, government policies, and shifts in urban consumption patterns. The visual representation of these trends provides valuable insights into how inflation impacts different regions in India, highlighting the importance of considering both rural and urban economic conditions when crafting inflation management strategies.



Urban vs. Rural Inflation Gap Analysis

The statistical analysis of the urban-rural inflation gap highlights a persistent difference in cost-of-living trends between rural and urban areas. On average, rural inflation has been 8.12 points higher than urban inflation, suggesting that rural areas face consistently higher price increases. This gap is not uniform over time, as indicated by the standard deviation of 3.31, which reflects moderate fluctuations in the inflation disparity. The smallest recorded gap of -1.9 points suggests a brief period where rural and urban inflation rates were nearly equal, possibly due to economic shifts, government interventions, or changes in market dynamics. On the other hand, the largest gap of -13.4 points indicates significant inflation divergence, where rural inflation surged much higher than urban inflation, potentially driven by supply chain disruptions, agricultural price volatility, or differing consumption patterns. Additionally, the stability index of -0.41 suggests that the gap has not remained consistent over time and has shown periodic fluctuations. This instability may be influenced by various economic factors, such as changes in fuel prices, wage growth disparities, or policy decisions impacting rural and urban areas differently. Overall, these trends highlight the need for targeted policy measures to address the rural-urban inflation gap. Policymakers should focus on stabilizing inflation disparities by improving rural infrastructure, enhancing market accessibility, and ensuring that inflationary pressures do not disproportionately impact rural households.



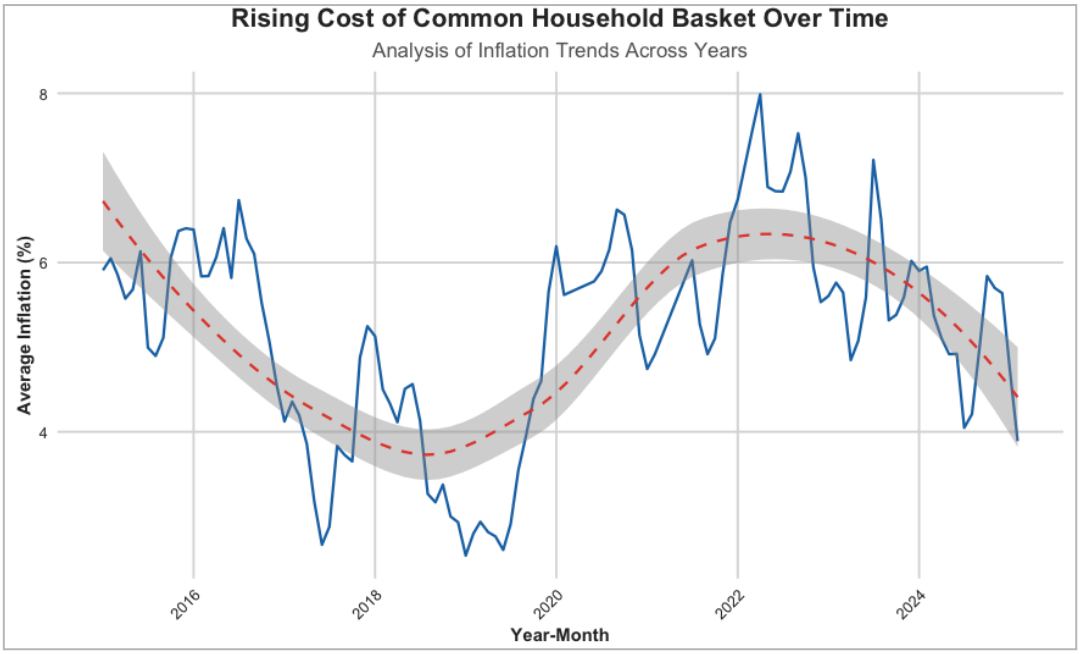
Rising Cost of Common Basket Over Time

The analysis of the rising cost of a common household basket of goods over time shows noticeable fluctuations in inflation rates from 2015 onwards. Monthly inflation data was used to track the average percentage change in the cost of the basket. A time series plot was generated, which illustrated the trend of inflation over the years. The main inflation trend was plotted alongside a smoothed trend line (using LOESS), highlighting the general upward movement in inflation, though with periodic fluctuations.

The data suggests that inflation rates for the common basket of goods are not constant and vary significantly from year to year. This is especially evident in certain years, where inflation spikes sharply, likely due to external factors such as economic disruptions, supply chain challenges, or changes in market conditions.

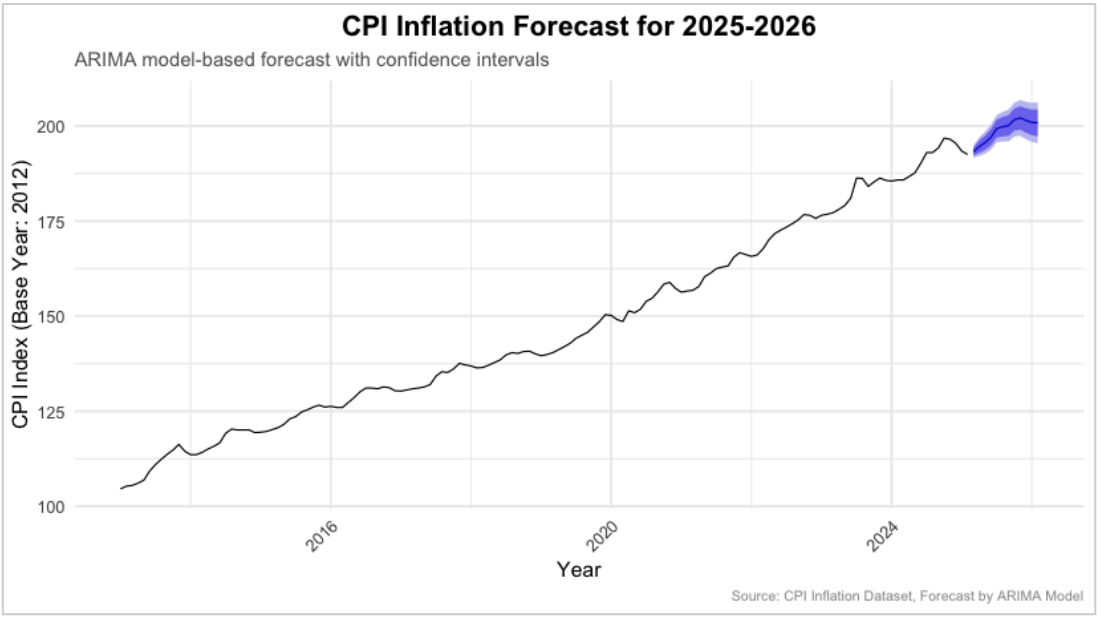
An ANOVA test was conducted to assess whether there were significant differences in inflation rates across different years. The test returned a p-value of less than 2e-16, which indicates that the inflation rate is indeed significantly different from year to year. The F-value of 28.45 further supports this, showing that the variance between years is much greater than the variance within the years, confirming that there are underlying factors contributing to the fluctuations in inflation.

Overall, the data demonstrates a clear trend of increasing inflation for the common basket of goods over time, with significant year-to-year variability. This variability suggests that inflation is influenced by a complex mix of economic, political, and global factors, making it essential for consumers and policymakers to stay vigilant about these shifts.



Prediction Of Future Inflation rates

The Consumer Price Index (CPI) inflation trend has remained a critical concern for policymakers, businesses, and households alike. Analyzing past inflation data, a predictive approach using the ARIMA (AutoRegressive Integrated Moving Average) model has been employed to project inflation rates for the next 12 months. The model, specifically an ARIMA(0,1,2)(0,1,1)[12] configuration, was selected based on statistical optimization, ensuring the best fit for forecasting future trends.The results indicate a steady upward trajectory in inflation, with March 2025 projected at 193.21, rising gradually to 200.83 by February 2026. The confidence intervals suggest that inflation is expected to stay within a range, though fluctuations are inevitable. The lower and upper bounds of the estimates provide insights into possible variations due to economic conditions, external shocks, or policy interventions. Key takeaways from the forecast include the continued persistence of inflation, highlighting the need for proactive monetary policies. As inflation remains above the RBI's target range, measures such as interest rate adjustments and liquidity control may be necessary to maintain economic stability. The forecasted trend underscores the importance of vigilance in price stability measures, ensuring that inflation does not erode purchasing power and economic growth. By leveraging data-driven models like ARIMA, policymakers and analysts can make informed decisions to navigate the challenges posed by persistent inflationary pressures. As the year progresses, real-time monitoring and adaptive economic strategies will be crucial in addressing potential risks and maintaining financial stability.


CPI Inflation Forecast for 2025-2026
ARIMA model-based forecast with confidence intervals
CPI Index (Base Year: 2012)
200
175
150
125
100
2016
2020
2024
Year
Source: CPI Inflation Dataset, Forecast by ARIMA Model