Data Visualisation Project Report

Project Title:

Financial Data Analysis Dashboard

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Applied Session: 4
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Table of Contents

Introduction

In this project, we introduce the Financial Data Analysis Dashboard, an interactive tool for extracting insights from a financial dataset. It addresses the question of how inflation (CPI), gold prices, S&P 500, and the DXY evolve and interact over time. Users can explore these metrics dynamically through narrative visualization.

Objectives:

1. **Interactive Visualization:** To provide an interactive narrative visualization platform that enables users to explore financial data with ease.

2. **Statistical Insights:** To calculate and display essential statistical insights for different chart types, including scatter plots, line charts, and dual-axis line charts.

3. **User-Friendly Interface:** To ensure the dashboard's user-friendliness, making it suitable for both financial analysts and individuals with little to no technical background.

Significance:

Analysing financial data is crucial for economic predictions, policymaking, and investments. This dashboard bridges the gap between raw data and actionable insights, catering to a wide range of users. Its accessibility and versatility make it a valuable tool for a diverse user base, facilitating informed financial decisions and predictions.

Project Background

Target Audience:

1. **Financial Analysts:** For in-depth data exploration and trend analysis, assisting them in making informed investment decisions.

2. **Investors:** Seeking a user-friendly tool to visualize financial data and identify investment opportunities.

3. **Data Enthusiasts:** Interested in exploring financial trends and understanding the dynamics of the financial market.

4. **General Public:** Who wish to access and comprehend financial data without the need for advanced technical knowledge.

Data Source:

The dataset used in this project comprises of financial and economic data, with information on Consumer Price Index (CPI), U.S. Dollar Index (DXY), S&P 500 stock market performance, and gold prices. It covers the period from January 2001 to October 2023.

This dataset was chosen due to its relevance to economic analysis and dataset tracks several financial and economic indicators over time, including:

Date: The date of each data point.
CPI Price: Consumer Price Index, a measure of inflation.
CPI Change%: Monthly inflation rate.
DXY Price ($): U.S. Dollar Index price.
DXY Change%: Monthly change in the U.S. dollar's value.
S&P 500 Close Price ($): Closing price of the S&P 500 stock index.
S&P 500 Change%: Monthly performance of the stock market.
Gold Price ($): Price of gold, a precious metal.
Gold Change%: Monthly change in the price of gold.

Scope:

The dashboard focuses on three main types of visualizations: scatter plots, line charts, and dual-axis line charts. These visualizations enable users to explore relationships between variables and observe trends over time and provide with key insights about the selected data for each chart type. These insights include mean, median, standard deviation, minimum, and maximum values.

Design

The design of the "**Financial Data Analysis Dashboard"** follows a thoughtful and user-centred approach to effectively convey insights from financial data. The design process consists of five design sheets, each addressing a specific aspect of **the narrative visualization**.

Scatter Plot (From Design Sheet 4):

The reason for considering this in the final sheet is because of comparisons. For e.g., comparing (CPI Price to DXY Price). The design choices for this chart include:

Consistency in Design: The layout and colour scheme of this scatter plot maintain consistency with other chart types in the dashboard. This ensures a seamless user experience when switching between different visualizations.

Colour Palette: The primary colour for data points is set to #007BFF, [**A shade of Blue**]. This colour choice is visually appealing and easy to distinguish. It aligns with the principles of effective use of colour to enhance data interpretation.

Narrative Style: The scatter plot follows a narrative style of comparison, allowing users to identify trends and relationships between for e.g., CPI Price and DXY Price. **The positioning of the axes and labelling** provides clear context for interpretation.

Justification: The scatter plot facilitates comparative analysis of CPI Price, DXY Price, Gold price etc. It's flexible, allowing users to select variables for comparing trends and relationships, aiding pattern, and correlation identification.

Line Chart (From Design Sheet 3):

The reason for considering this in final sheet is because **of time-series analysis.** The design choices for this chart include:

Consistency in Design: The overall layout and color scheme of the line chart align with other chart types in the dashboard. This consistency ensures a unified user experience.

Colour Palette: In this chart, a distinctive colour (#DC3545) **[RED]** is chosen for the line, emphasizing the time-series data. The choice of a contrasting colour enhances the visibility of the line.

Narrative Style: The line chart employs a **time-series narrative style**. Users can analyse data trends over time, a common approach for financial data analysis. The axis labels provide context for interpreting the data points.

Justification: The line chart is ideal for **time-series analysis,** visualizing trends, and changes over time in a single variable on the Y-Axis. It offers insights into long-term financial trends and cycles.

Dual Axis Line Chart (From Design Sheet 4):

The reason for considering this in final sheet is because of a dual-axis line chart for **comparative analysis.** The design choices for this chart include:

Consistency in Design: The design remains consistent with other charts in the dashboard, maintaining a coherent user experience.

Colour Palette: Two distinct colours (#DC3545**[RED]** and #28A745**[Green]**) are used for the dual axes. The choice of colours is deliberate, making it easy for users to differentiate between the two variables.

Narrative Style: This chart adopts a comparative narrative style. By using dual axes, users can **compare two variables simultaneously**. The placement of the axes and labels ensures clarity in interpretation.

Justification: The dual-axis line chart enables simultaneous visualization of **two financial indicators**, aiding in comparative analysis and **revealing correlations or divergences** between them.

By combining comparative and time-series narratives, the chosen visualizations provide a well-rounded perspective on financial data, allowing users to uncover trends, correlations, and insights. [Please note I have not included Area chart (4) as per the Final sheet as it provided the same results as line chart]

Implementation

This section contains a high-level description of the implementation of the "Financial Data Analysis Dashboard." It includes details about the libraries used, references to external code sources, and any reasons for differences between the final design and the actual implementation.

Libraries Used: The implementation of the "Financial Data Analysis Dashboard" relies on several essential libraries for its functionality:

1. Shiny: The **Shiny** library is the core of the interactive web application, allowing us to create a user-friendly interface and dynamically update content based on user input.

2. Plotly: The **Plotly** library is used for creating interactive and visually appealing plots and charts. It is integrated into the dashboard to visualize financial data efficiently.

3. Shinythemes: The **Shinythemes** library enhances the visual aesthetics of the application, providing a theme with a flat design and styling for the sidebar and headers.

Data Source: The financial data used in the dashboard is loaded from a CSV file named "Final_dataset.csv." This file should be placed in the same directory as the Shiny app for successful data loading.

Statistical Insights Calculation:

The "Financial Data Analysis Dashboard" includes a function named **calculateInsights**, which is used to calculate statistical insights for different chart types. These insights include metrics such as mean, median, standard deviation, minimum, and maximum values, depending on the selected chart type. The implemented chart types and their associated insights are as follows:

Scatter Plot Insights: This chart type compares two variables (CPI Price and DXY Price) and provides insights like max value and min value into their relationships.

Line Chart Insights: The line chart focuses on time-series analysis of a single selected variable like standard deviation.

Dual Axis Line Chart Insights: This chart type allows users to compare two variables using dual Y-axes like median value and mean value.

Interactive Elements: The "Financial Data Analysis Dashboard" offers users a range of interactive elements:

1.Select Input Widgets: Users can choose variables for charts.
2.Dynamic Chart Updating: Charts update instantly based on user selections.
3. Statistical Insights: Summary statistics change with chart and variables.
4. Visualizations: Interactive charts allow data exploration.
5.Theme Selection: Users can customize the visual theme.
6.Dashboard Title: Clear identification of the dashboard's purpose.

Challenges In Implementation

The implementation of this project had its share of challenges. The most notable challenges included:

Data Wrangling: While loading the dataset is relatively straightforward, advanced data wrangling was required for more extensive datasets with **missing values, outliers, or non-standard formats.** This implementation assumes a clean dataset for simplicity.

Interactive Visualization: Implementing interactive data visualization, especially with features like dynamically updating charts based on user selections, required a good understanding **of Shiny and Plotly** libraries.
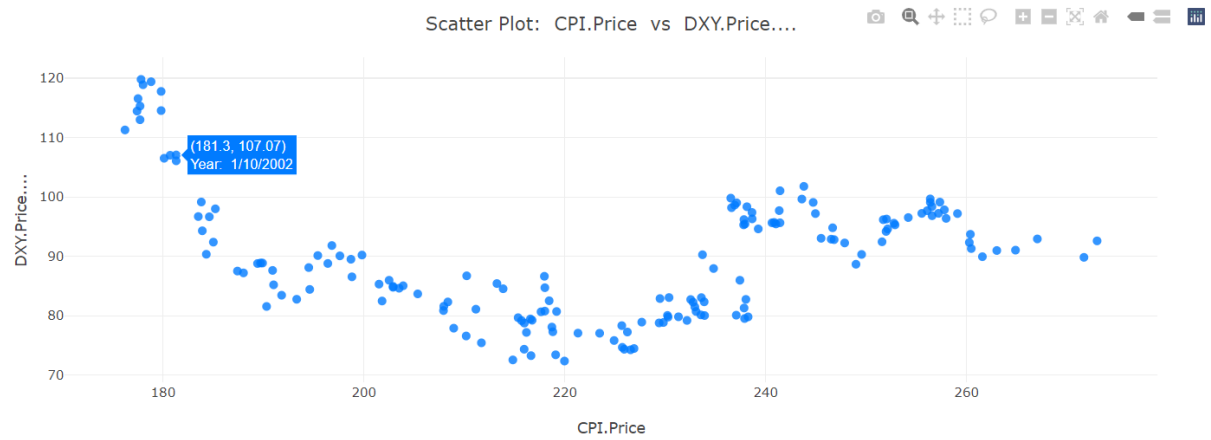
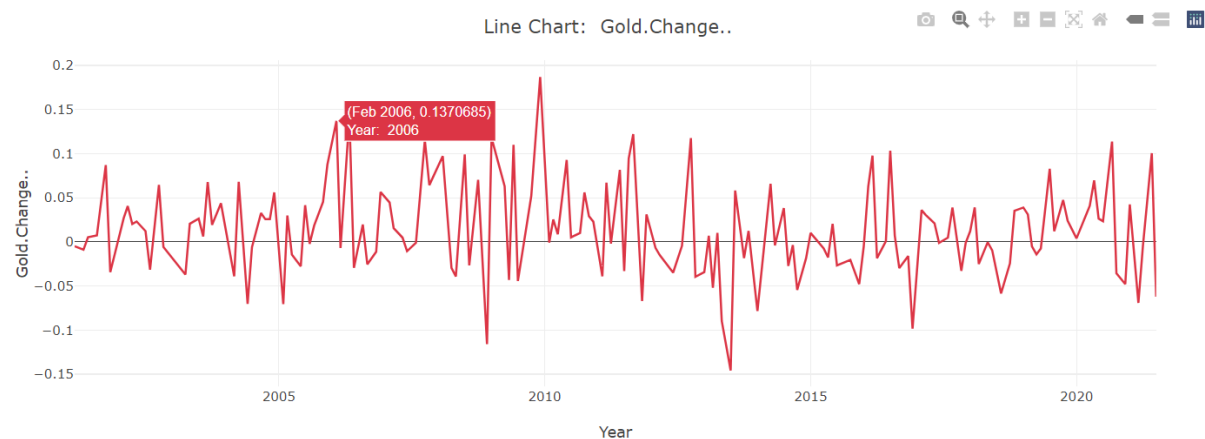# Dashboard Visualizations
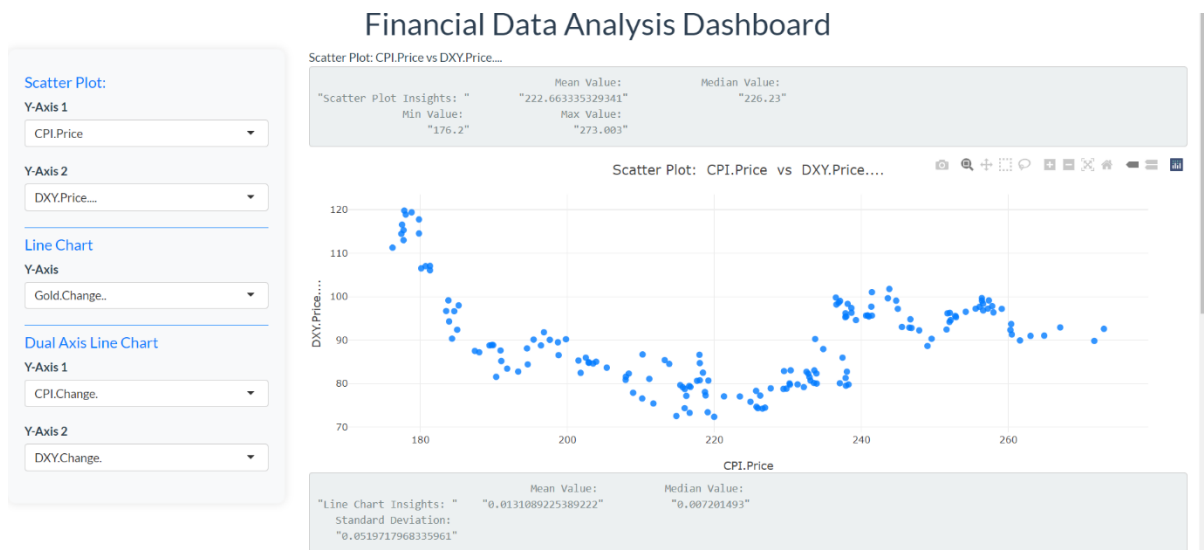
Overview Of Dashboard

Scatter Plot: CPI.Price vs DXY.Price....

	Mean Value:	Median Value:
"Scatter Plot Insights: "	"222.663335329341"	"226.23"
Min Value:	Max Value:	
"176.2"	"273.003"	

Scatter Plot: CPI.Price vs DXY.Price....

(181.3, 107.07)
Year: 1/10/2002

CPI.Price

Scatter Plot

	Mean Value:	Median Value:
"Line Chart Insights: "	"0.0131089225389222"	"0.007201493"
Standard Deviation:		
"0.0519717968335961"		

Line Chart: Gold.Change..

(Feb 2006, 0.1370685)
Year: 2006

Year

Line Chart

Mean Value (Axis 1):
"Dual Axis Line Chart Insights: "   NA
         Median Value (Axis 1):   Mean Value (Axis 2):
                  "0.00%"   NA
         Max Value (Axis 2):
                  "1.43%"

Dual Axis Line Chart: DXY.Change. and Gold.Change..
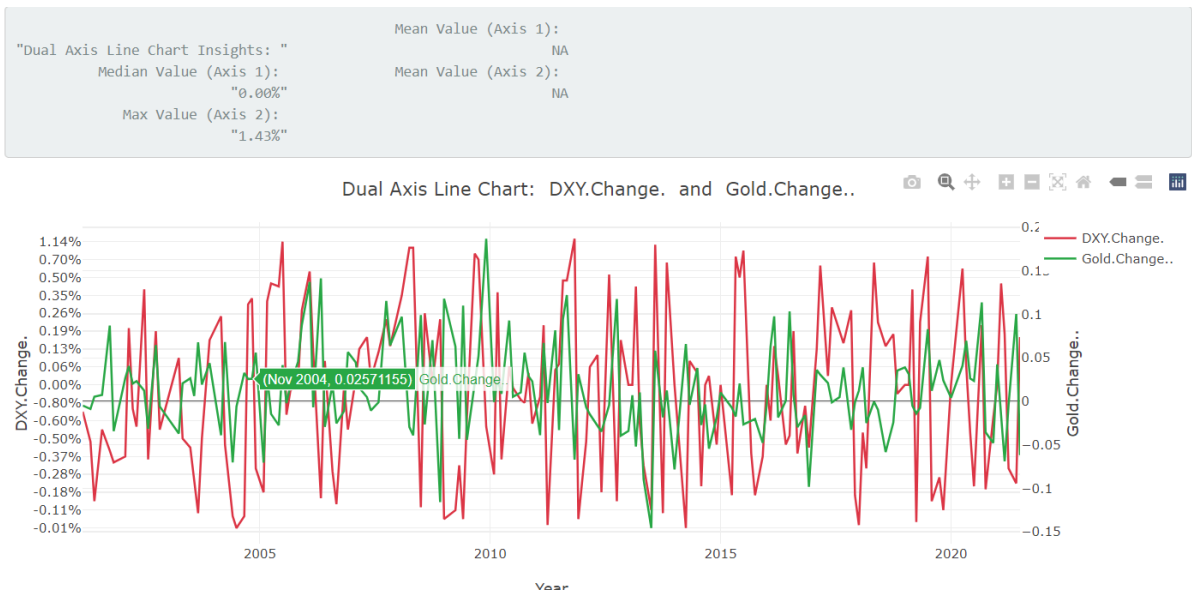
Dual-Axis Chart

Scatter Plot:

Y-Axis 1

CPI.Price ▾

Y-Axis 2

DXY.Price.... ▾

Line Chart

Y-Axis

Gold.Change.. ▾

Dual Axis Line Chart

Y-Axis 1

CPI.Change. ▾

Y-Axis 2

DXY.Change. ▾

Scatter Plot:

Y-Axis 1

CPI.Price ▲

X
CPI.Price
CPI.Change.
DXY.Price....
DXY.Change.
sp500.Close.Price....
sp500.Change..
Gold.Price

Dual Axis Line Chart

Y-Axis 1

CPI.Change. ▾

Y-Axis 2

DXY.Change. ▾

Side Panel

<u>User Guide</u>

Installation of Required Packages: Explain that users should ensure they have the required packages (shiny, plotly, shinythemes) installed. If not, provide instructions on how to install these packages.

Data Loading: Instruct users to place the CSV file named "Final_dataset.csv" in the same directory as the Shiny app. Explain that this file serves as the data source for the dashboard.

Chart Selection: Describe how to interact with the dashboard to select different chart types.
Explain that there are three chart types: Scatter Plot, Line Chart, and Dual Axis Line Chart.
Emphasize that users can choose different Y-axis variables for each chart type using the provided dropdown menus.

Statistical Insights: Highlight that the dashboard provides statistical insights for each selected chart.
Specify that the insights include **Mean Value, Median Value**, and additional statistics depending on the chart type (e.g., **Standard Deviation** for the Line Chart).
Mention that these insights update dynamically based on the user's selections.

Interactive Charts: Explain that the visualizations are interactive, and users can interact with them by **hovering over data points** or **panning and zooming.**
Encourage users to explore the data by **interacting** with the charts to gain deeper insights.

Theme Customization: Mention that users can customize the visual theme of the dashboard according to their preferences.
Describe how to switch between themes if the dashboard offers theme options.
Dashboard Title: Indicate that the title of the dashboard is "Financial Data Analysis Dashboard," providing users with a clear understanding of the dashboard's purpose.

<u>Conclusion</u>

<u>Summary of Findings:</u>
In this project, we've created an interactive financial data dashboard. Users can explore data through different chart types like Scatter Plots, Line Charts, and Dual Axis Line Charts. It provides statistical insights, allows theme customization, and offers a user-friendly interface.

<u>Reflection:</u>
Key Takeaways:

User-Centered Design: Emphasizing user-friendly design with clear instructions and interactive features enhances user engagement and understanding.

Real-Time Insights: Dynamic statistical insights based on user choices greatly aid data analysis.

Data Accessibility: Future improvements might focus on streamlining data access for a more seamless experience.

Customization: Expanding customization options could make the dashboard more adaptable to diverse user preferences.

<u>Future Enhancements</u>

<u>Plans for the Future:</u>

More Chart Types: Add diverse chart types for **broader data analysis capabilities.**

User Authentication: Implement secure user authentication and access control for collaborative work.

Data Integration: Connect the dashboard to **live data sources** for streamlined data access.

Advanced Analytics: Include **advanced analytics and machine learning models** for predictive insights.

Feedback Loop: Incorporate a feedback system to gather user input and enhance the dashboard continuously.

<u>Bibliography</u>

[1] Jareño, F., & Negrut, L. (2016). US stock market and macroeconomic factors. Journal of Applied Business Research (JABR), 32(1), 325-340.

[2] Chang, W. (2021, January 25). *Themes for shiny [R package shinythemes version 1.2.0].* The Comprehensive R Archive Network.

https://cran.rproject.org/web/packages/shinythemes/index.html

[3] Wang, K. T. K. (2022, November 11). *Five design-sheet methodology approach to data visualisation*. Medium. https://towardsdatascience.com/five-design-sheet-methodology-approach-to-data-visualisation-603d760f2418

[4] Shiny. RStudio. (n.d.). https://www.rstudio.com/products/shiny/

[5] Plotly. Plotly r graphing library in R. (n.d.). https://plotly.com/r/

Data Description:

[6] Tabular data 9k rows * 2 columns. It has simple text for that includes numbers for dates and numbers for average gold rates.

https://www.kaggle.com/datasets/hemil26/gold-rates-1985-jan-2022

[7] Tabular data 5k rows * 8 columns. It has simple text for that includes Date: date of the stock, Open: price of the stock when market opens. High: highest price of the stock when day. Low: Lowest price of the stock, Close: price of stock when market closes. Volume: Number of shares traded in day.

https://www.kaggle.com/datasets/rprkh15/sp500-stock-prices

[8] Tabular data 1.5k rows * 2 columns. It has CPI(consumer Price Index).That is average of CPI for all cities of Us along with the dates.

https://www.kaggle.com/datasets/varpit94/us-inflation-data-updated-till-may-2021

[9] Tabular data 5k rows * 6 columns. It has simple text. Dollar Index is an index of the value of the US dollar relative to a basket of foreign currencies. The Index goes up when the U.S. dollar gains strength (value)

https://www.kaggle.com/datasets/balabaskar/us-dollar-index-data?resource=download

All the useful columns from these datasets are used and is combined into csv file called Final_dataset. (Previously mentioned in DEP Project)

APPENDIX

Title: Financial Sheet - 1

Author: data Distribution Dashboard
Chaitanya Tambokkar

Date: 10/10/23

Sheet: -1

Task: Explore and Understand distribution and changes in inflation CPI, Gold rates, the S&P 500, DXY (US Dollar Index over time

① CPI, DXY, Gold price vs Time period

② CPI, DXY vs Time period

③ DXY change % vs Time period change, S&P 500 change

④ CPI, Gold Price, Gold change % vs Time

⑤ CPI change %, Gold change vs Time period

⑥ Gold change %, DXY change % vs Time period

⑦ Gold, CPI, DXY, S&P Change %, DXY Change %

⑧ DXY Price, Gold Price, S&P Price, CPI Price vs Time/Period

⑨ Pie chart: DXY Price, Gold Price, S&P Price, CPI Price

2. Filter

⑨ DXY Price | Gold Price / S&P Price | CPI Price → lacks a dimension of time

Gold, CPI, DXY vs Time → overlapping of bubbles can make it difficult to distinguish → Keeping Track of particular item over time becomes difficult

3. Categorize

①, ⑤ → Distribution of Financial Data

②, ④ → Analyzing Trends in financial data

③, ⑥ → Comparison of different financial metrics.

4. Combine and Refine

①, ⑤ → integrate to show Category wise distribution

CPI, DXY, Gold vs Year + CPI, DXY, Gold vs Year
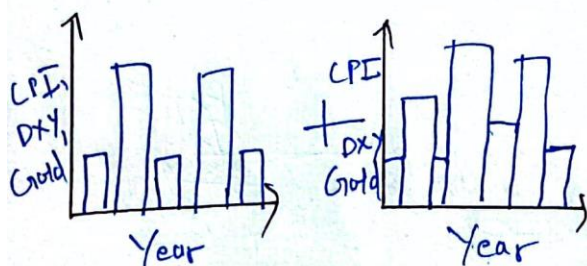
②, ④ → Trends over Time

CPI, DXY, Gold vs Time
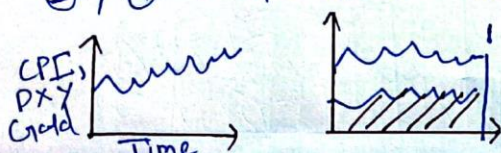
③, ⑥ → Relationship with different metrics.
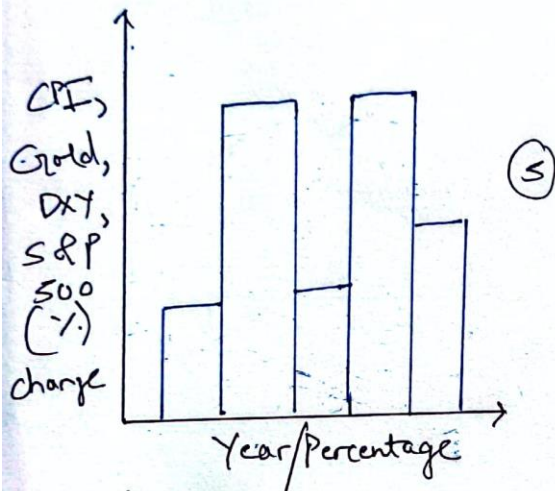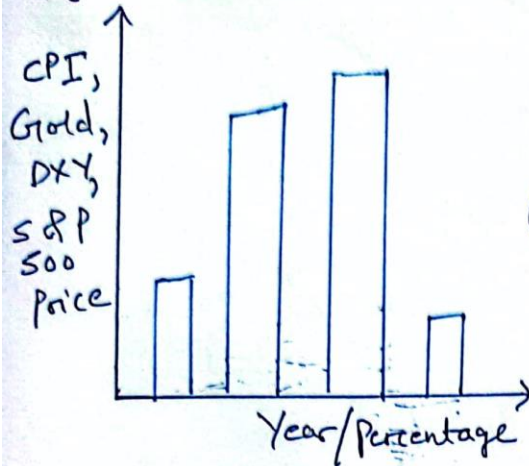
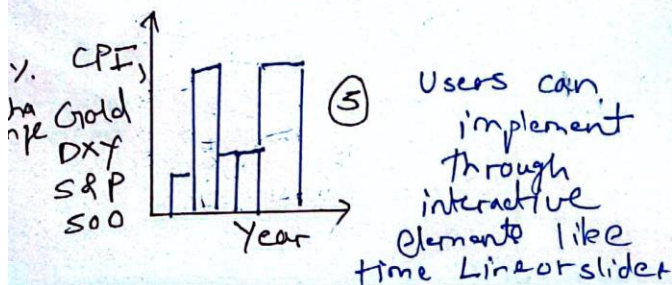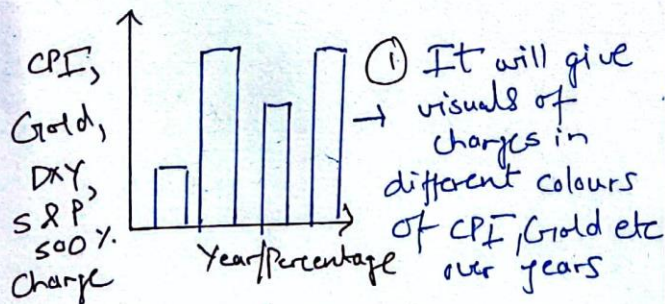Y axis: Gold Price, DXY Price vs Time (X axis)
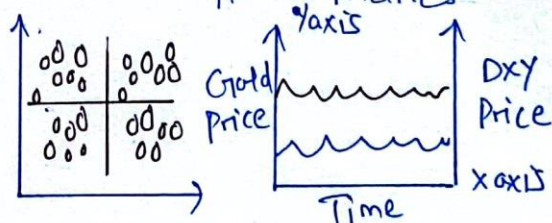
5 Question

How does changes in inflation (CPI), Gold rates the S&P 500 and DXY over time affect each other what insights can we derive from them

Sheet -2

Layout:

CPI,
Gold,
DXY,
S&P
500
Price

①

Year/Percentage

CPI,
Gold,
DXY,
S&P
500
(%)

charge

⑤

Year/Percentage

Focus/Zoom

CPI,
Gold,
DXY,
S&P
500 %.
Charge

Year/Percentage

① It will give
→ visuals of
charges in
different colours
of CPI, Gold etc
over years

%. CPI,
ha Gold
nye DXY
S&P
500

Year

⑤

Users can
implement
through
interactive
elements like
time Line or slider

Title: Financial Data
        Analysis Dashboard

Author: Chaitanya Tambolkar

Sheet: 2

Task: To visually represent
the distribution of
financial data for various
financial metrics.

operations!

• When user hover their
  cursor over bars in
  bar chart, it should
  display category specific
  details such as values
  and percentages.

• Histogram should allow
  users to adjust bin
  sizes dynamically.

Pros and Cons:

User friendly: Design provides
an intuitive and user
friendly interface enables
exploration of data.

Cons: Combining a bar
chart and histogram
on a single page
might take interface
complex and ensure
it is not user-friendly

Layout — Sheet-3

Y axis

② Line chart

CPI, DxY, S&P 500, Gold Price/ Change

Max

Min

Time period → X axis

Y axis

④ Area Chart

CPI, DxY, S&P 500, Gold

Time period → X axis
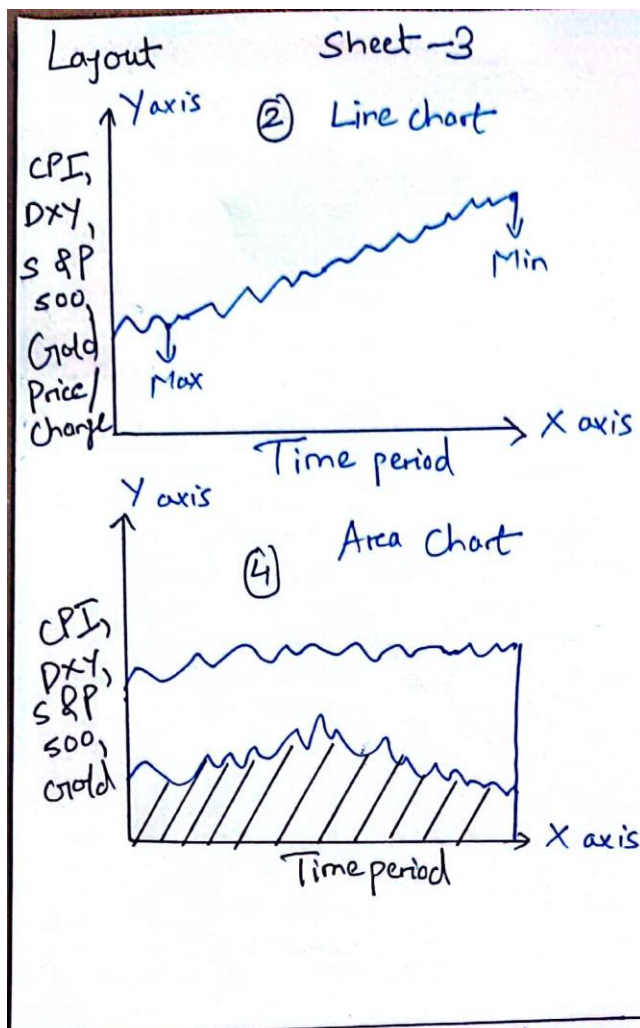
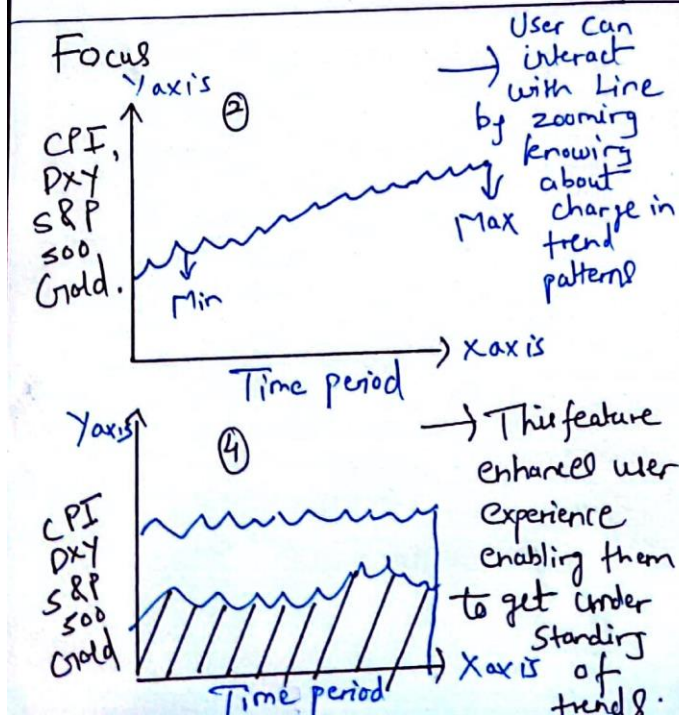**Title:** Financial Data Distribution Dashboard

Author: Chaitanya Tambolkar

Sheet: 3

Task: Trend analysis Visualizations to understand how different financial metrics change over time Operations!

- one of key features of this design is the user's ability to switch between line chart and area chart.

- User's can simply do toggle switch, providing them with two different perspective on same data.

Focus

Y axis

②

CPI, DxY, S&P 500, Gold.

Min   Max

Time period → X axis

→ User can interact with Line by zooming knowing about change in trend patterns

→ This feature enhances user experience enabling them to get understanding of trends.

Y axis

④

CPI DxY S&P 500 Gold

Time period → X axis

Discussion:

Pros:

- Trend Analysis! The Line chart provides a clear representation of trend data while area charts helps users understand Cumulative performance

Cons!

~~Fre~~ Required Data: Effectiveness of this design depends on continuous time series

Layout:

③ scatter plot

⑥ Dual Axis

Focus:
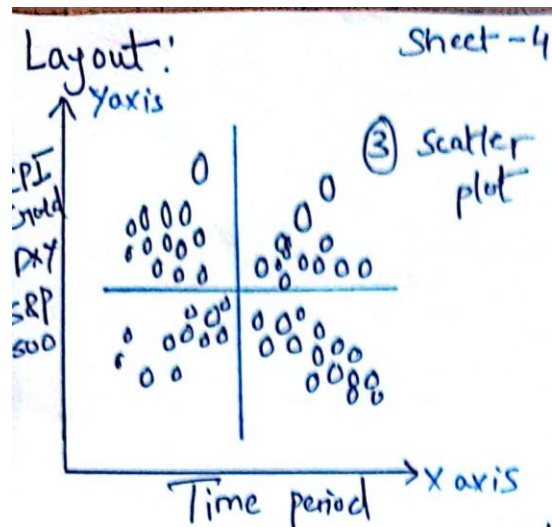
Title: Financial Metric Comparisons DashBoard

**Author:** Chaitanya Tombalkar

Sheet: 4

Task: It serves as a valuable resource for analyzing resource for data effectively.
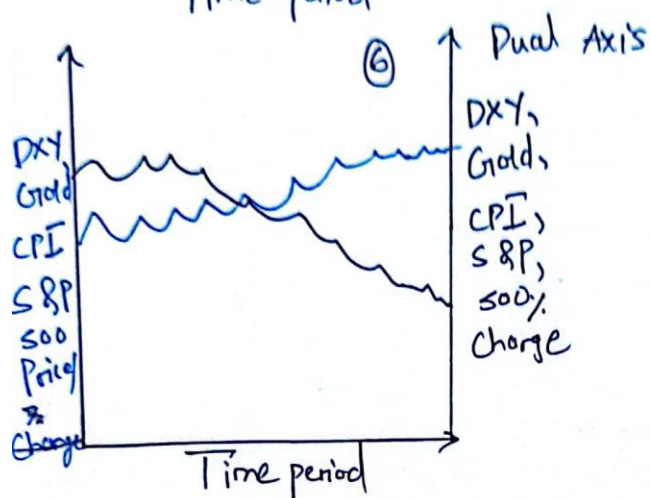
Operations:

• **Interactive dropdown:** Users can interactactive drop down menus to select the financial variables or metric they want to compare on both scatter Chart and Dual Axis chart.

• **Data Exploration:** The design facilitates easy data exploration, empowering users to dynamically adjust variables.
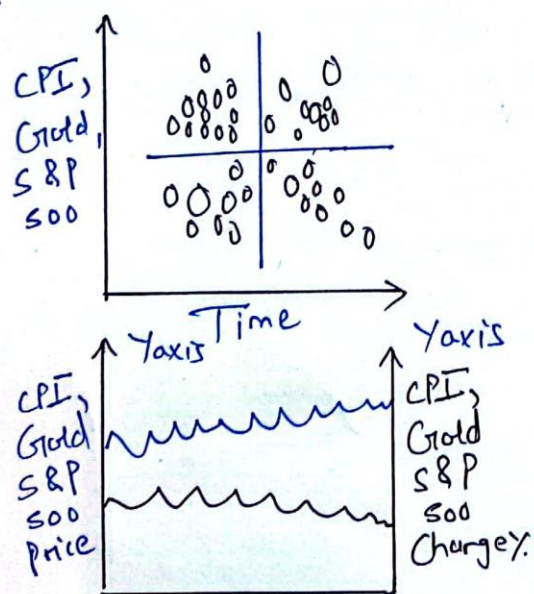
Discussions:

Pros:

Enhanced Comparisons: This design effectively enables users to compare and contrast different financial metrics side by side, enhancing their understanding.

Cons:

Complexity: Depending on number of variables available for Comparison, the dashboard can become complex.

Layout!   Sheet – 5
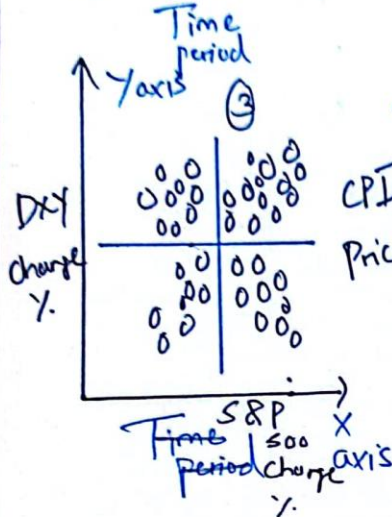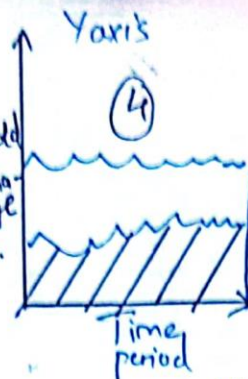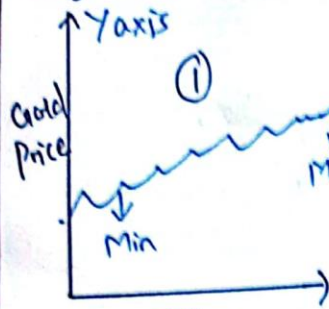
Title: Financial Trends
Dashboard – Realization
Design.

Authors: Chaitanya Tambotkar

**Date:** 10/10/23

Sheet: 5

Task: To visually represent
all the final des sheets.

Operations:

• The dashboard integrates
various interactivity features
from previous sheets
including tooltips, point selection

• For line chart users can
switch between two views.

• In scatter plots and dual
axis interactive dropdowns
allow users to select and
compare specific financial
variables.

Focus   Users can interact by
                    zooming
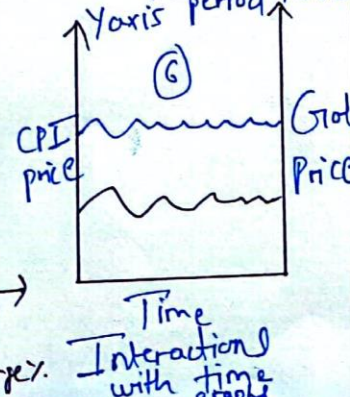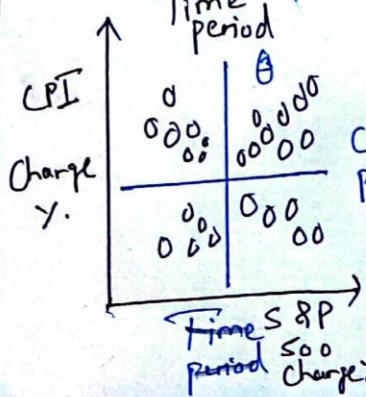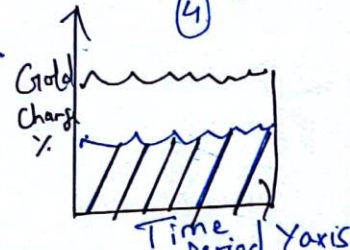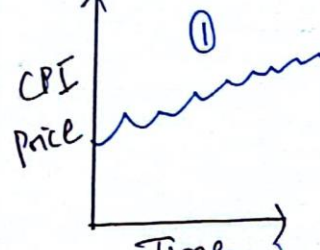
Discussions: –/Detail! –

Time required: 2/3 weeks

libraries! R shiny, ggplot
ggplot 2.

Requirement – R shiny/
R studio, internet
connection.