



PROBLEM STATEMENT

Patient Health Monitoring: Analyzing Blood Pressure, Sugar Levels, and Weight Trends

This report investigates the relationships between **blood pressure**, **blood sugar levels**, and **weight** in patients over time. The goal is to identify the health trends that may help in early detection of problems like hypertension, diabetes, and obesity. Through the analysis of patient data, the objective is to provide insights into how these parameters affects.

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CLASS ROLL NO. 17

Introduction

Nowadays, there has been an increasing focus on preventive healthcare, where continuous monitoring of key health parameters can help identify potential risks at an early stage. Blood pressure, blood sugar levels, and weight are three crucial metrics that directly influence the overall health and well-being of individuals. For example:

Hypertension (high blood pressure) is a major risk factor for heart disease and stroke.

Diabetes, which is elevated blood sugar levels, can lead to serious long-term health complications.

Obesity is known to contribute to various diseases, including heart disease and diabetes.

Considering these facts, it is essential to identify patterns between these health indicators to improve the understanding between them. Monitoring these variables can help in early detection, personalized healthcare plans, and improving patient outcomes.

This report focuses on a dataset containing patient information, specifically their blood pressure (both systolic and diastolic), sugar levels (measured in mg/dL), and weight (measured in kg). By analyzing this dataset over a period of time, the objective is to identify trends that can provide valuable insights into how these health metrics evolve together.

Through data visualization, this report aims to highlight:

The trends in blood pressure and sugar levels over time.

The relationship between blood pressure and sugar levels.

The impact of weight fluctuations on blood pressure and sugar levels

Methodology

The approach to analyze the patient health data involves several key steps that include data preparation, data analysis, and visualization. Below are the specific techniques and tools used for this analysis:

Data Collection and Preparation:

Dataset Creation: A sample dataset was taken which represents patient data. The dataset consists of the following features:

Patient ID

Date

Blood Pressure (Systolic and Diastolic)

Sugar Level

Weight

This dataset was created for four patients over a period of three days. This simplified dataset was used for demonstrating the methodology and visualizations.

Data Preprocessing:

The **Date** column was converted into a datetime format to facilitate easier time-based analysis and plotting.

The dataset was stored as a Pandas DataFrame.

Analysis and Visualization:

Blood Pressure Trends:

Line plots were used to track **Systolic** and **Diastolic** blood pressure levels for each patient over time. This helped identify any fluctuations or patterns in blood pressure that might signal potential health issues.

Blood Pressure vs. Sugar Level:

A **scatter plot** was generated to examine the relationship between **Systolic Blood Pressure** and **Sugar Levels**. The goal was to explore whether higher blood pressure is associated with higher sugar levels, which is a common trend in conditions like hypertension and diabetes.

Blood Pressure Distribution:

A **box plot** was used to analyze the distribution of **Systolic Blood Pressure** for each patient. The box plot highlighted the median blood pressure values, the spread of the data, and any potential outliers for each patient.

Correlation Analysis:

A **correlation matrix** was generated to explore the relationships between **Systolic Blood Pressure**, **Diastolic Blood Pressure**, **Sugar Levels**, and **Weight**. This heatmap allowed us to visually examine the strength of correlations between these parameters, helping identify any significant associations.

Weight Change over Time:

A line plot was used to track the change in **Weight** for each patient over time. This allowed for the identification of trends such as weight gain or loss, which could have a direct impact on the patients' blood pressure and sugar levels.

Tools Used:

Python programming language

Pandas for data manipulation and analysis

Matplotlib for data visualization (line plots, scatter plots, box plots, and heatmaps)

NumPy for numerical calculations and handling arrays

CODE

```
import numpy as np

import pandas as pd

import matplotlib.pyplot as plt


# Step 1: Create a sample dataset for patient data

# This dataset includes Patient ID, Date, Blood Pressure (Systolic and Diastolic), Sugar Level, and Weight

data = {

    'Patient ID': ['001', '001', '001', '002', '002', '002', '003', '003', '003', '004', '004', '004'],

    'Date': ['2025-03-01', '2025-03-02', '2025-03-03', '2025-03-01', '2025-03-02', '2025-03-03', '2025-03-01', '2025-03-02', '2025-03-03'],

    'Blood Pressure (Systolic)': [120, 122, 118, 135, 137, 130, 140, 142, 138, 125, 128, 123],

    'Blood Pressure (Diastolic)': [80, 82, 78, 85, 87, 85, 90, 92, 88, 80, 82, 80],

    'Sugar Level (mg/dL)': [95, 98, 92, 105, 110, 108, 115, 120, 118, 100, 105, 102],

    'Weight (kg)': [75, 75.2, 74.8, 82, 82.3, 82.5, 90, 90.2, 90.5, 78, 78.2, 78.5]

}


# Step 2: Convert the data into a Pandas DataFrame

df = pd.DataFrame(data)


# Step 3: Convert the 'Date' column to a datetime object for easier manipulation

df['Date'] = pd.to_datetime(df['Date'])


# Display the first few rows of the DataFrame

print(df)


# ---- Visualizations ----


# Step 4: Plot Blood Pressure (Systolic and Diastolic) over Time for Each Patient
```

```

plt.figure(figsize=(12, 6)) # Create a figure with specific size

for patient in df['Patient ID'].unique(): # Loop through each unique patient ID

    patient_data = df[df['Patient ID'] == patient] # Filter the dataset for this patient

    # Plot Systolic Blood Pressure over time

    plt.plot(patient_data['Date'], patient_data['Blood Pressure (Systolic)'], label=f'Patient {patient} - Systolic', marker='o')

    # Plot Diastolic Blood Pressure over time

    plt.plot(patient_data['Date'], patient_data['Blood Pressure (Diastolic)'], label=f'Patient {patient} - Diastolic', marker='x')

```

```

# Adding labels and title to the plot

plt.xlabel('Date') # X-axis label

plt.ylabel('Blood Pressure (mmHg)') # Y-axis label

plt.title('Blood Pressure (Systolic and Diastolic) over Time') # Title of the plot

plt.legend() # Show legend for different lines

plt.xticks(rotation=45) # Rotate the x-axis labels for better readability

plt.tight_layout() # Adjust layout to avoid label overlap

plt.show() # Show the plot

```

Step 5: Scatter plot for Blood Pressure vs. Sugar Level

```

plt.figure(figsize=(8, 6)) # Create a new figure

# Loop through each patient and plot their Blood Pressure vs Sugar Level

for patient in df['Patient ID'].unique():

    patient_data = df[df['Patient ID'] == patient] # Filter data for the patient

    # Scatter plot: Systolic Blood Pressure vs Sugar Level

    plt.scatter(patient_data['Blood Pressure (Systolic)'], patient_data['Sugar Level (mg/dL)'],
label=f'Patient {patient}')

```

```

# Adding labels and title to the plot

plt.xlabel('Blood Pressure (Systolic) [mmHg]') # X-axis label

plt.ylabel('Sugar Level (mg/dL)') # Y-axis label

plt.title('Blood Pressure (Systolic) vs Sugar Level') # Title of the plot

plt.legend() # Show legend to identify patients

```

```
plt.show() # Show the plot
```

```
# Step 6: Box plot for Blood Pressure Distribution (Systolic) for Each Patient
```

```
plt.figure(figsize=(8, 6)) # Create a new figure for the box plot
```

```
# Box plot for Blood Pressure (Systolic) by Patient ID
```

```
plt.boxplot([df[df['Patient ID'] == patient]['Blood Pressure (Systolic)'] for patient in df['Patient ID'].unique()],
```

```
            labels=df['Patient ID'].unique()) # Each patient gets a box plot
```

```
# Adding labels and title to the plot
```

```
plt.xlabel('Patient ID') # X-axis label
```

```
plt.ylabel('Blood Pressure (Systolic) [mmHg]') # Y-axis label
```

```
plt.title('Blood Pressure (Systolic) Distribution by Patient') # Title of the plot
```

```
plt.show() # Show the plot
```

```
# Step 7: Correlation Heatmap between Blood Pressure, Sugar Levels, and Weight
```

```
correlation_matrix = df[['Blood Pressure (Systolic)', 'Blood Pressure (Diastolic)', 'Sugar Level (mg/dL)',  
                        'Weight (kg)']].corr()
```

```
# Create a heatmap to visualize the correlation between these features
```

```
plt.figure(figsize=(8, 6)) # Create a new figure for the heatmap
```

```
plt.imshow(correlation_matrix, cmap='coolwarm', interpolation='none') # Heatmap display
```

```
plt.colorbar() # Add a color bar to show correlation scale
```

```
# Set labels for the x and y axes based on the correlation matrix columns
```

```
plt.xticks(np.arange(4), correlation_matrix.columns, rotation=45)
```

```
plt.yticks(np.arange(4), correlation_matrix.columns)
```

```
plt.title('Correlation Matrix between Blood Pressure, Sugar Levels, and Weight') # Title of the plot
```

```
plt.show() # Show the heatmap
```

```
# Step 8: Weight Change Over Time for Each Patient
```

```
plt.figure(figsize=(12, 6)) # Create a figure with specific size
```

```
for patient in df['Patient ID'].unique(): # Loop through each unique patient ID
```

```
    patient_data = df[df['Patient ID'] == patient] # Filter data for this patient
```

```
# Plot Weight over time for each patient

plt.plot(patient_data['Date'], patient_data['Weight (kg)'], label=f'Patient {patient}', marker='o')


# Adding labels and title to the plot

plt.xlabel('Date') # X-axis label

plt.ylabel('Weight (kg)') # Y-axis label

plt.title('Weight Change Over Time for Each Patient') # Title of the plot

plt.legend() # Show legend for different patients

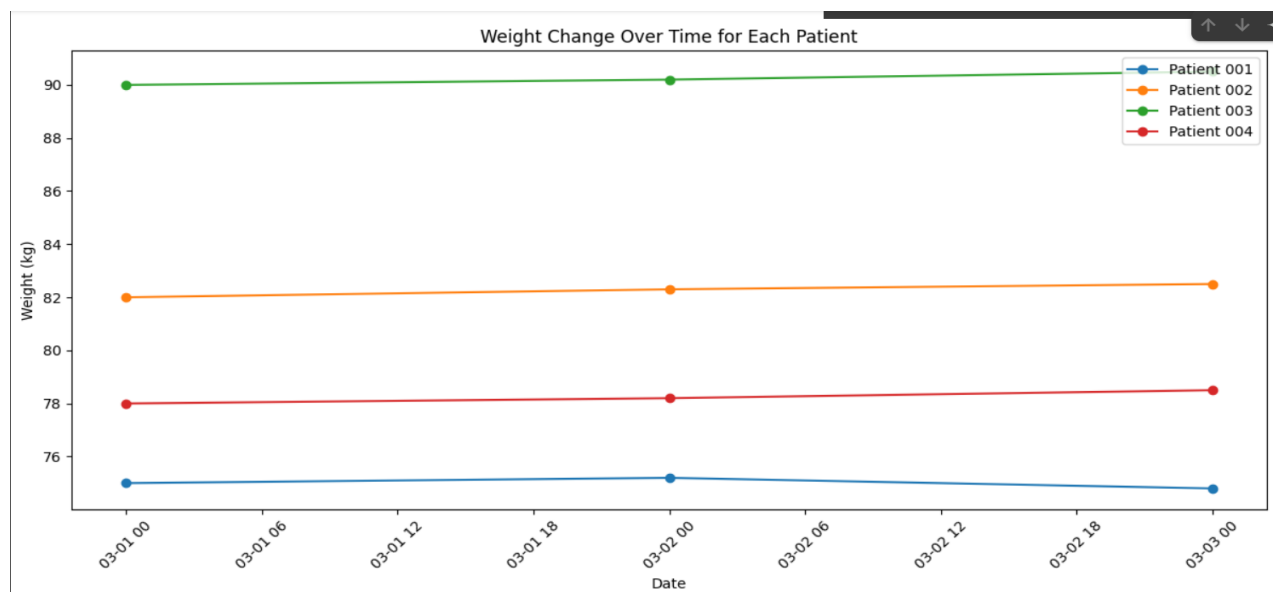
plt.xticks(rotation=45) # Rotate x-axis labels

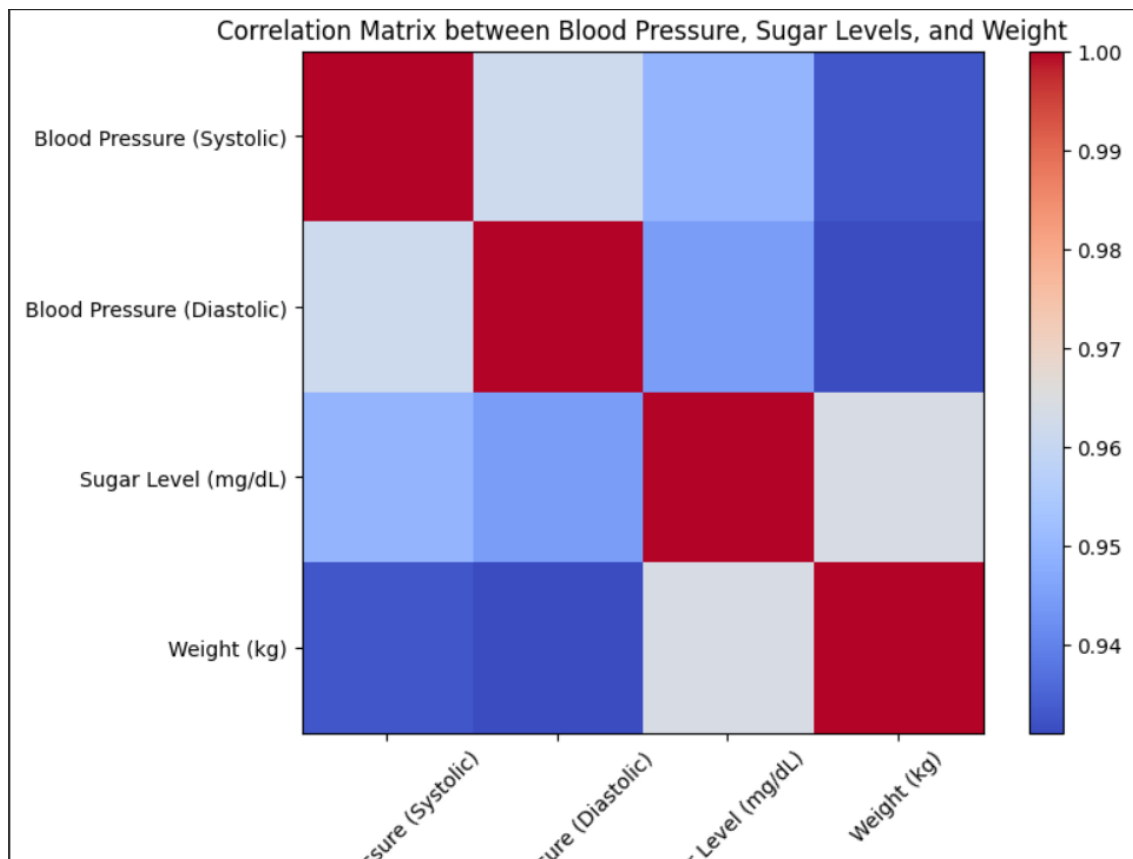
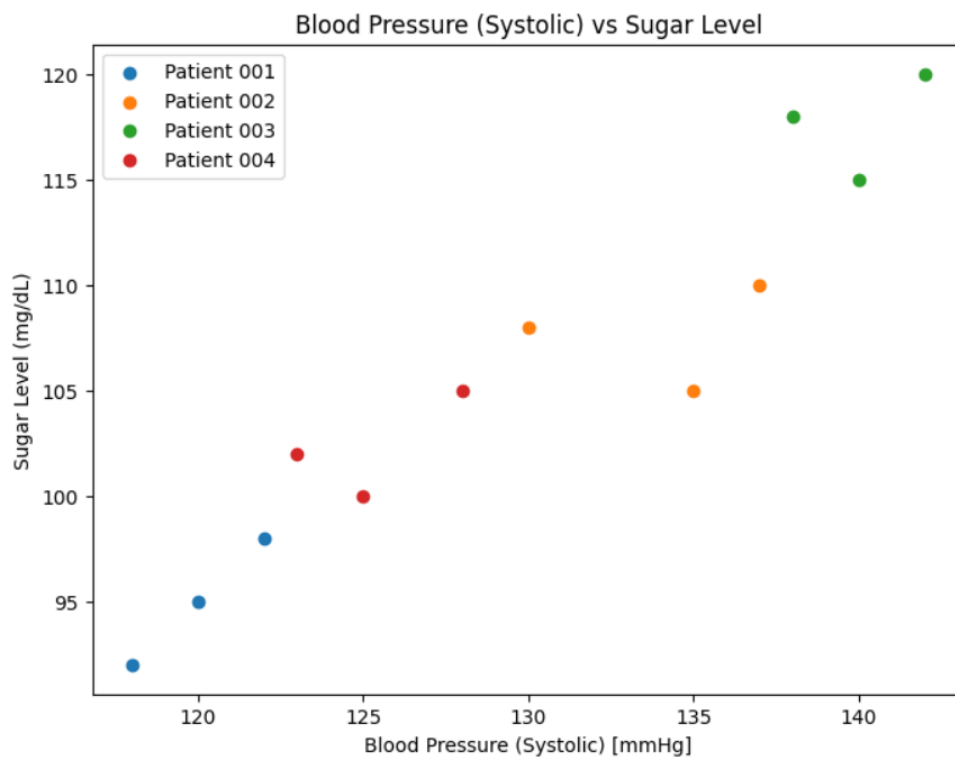
plt.tight_layout() # Adjust layout

plt.show() # Show the plot
```


	Patient ID	Date	Blood Pressure (Systolic)	\
0	001	2025-03-01	120	
1	001	2025-03-02	122	
2	001	2025-03-03	118	
3	002	2025-03-01	135	
4	002	2025-03-02	137	
5	002	2025-03-03	130	
6	003	2025-03-01	140	
7	003	2025-03-02	142	
8	003	2025-03-03	138	
9	004	2025-03-01	125	
10	004	2025-03-02	128	
11	004	2025-03-03	123	

	Blood Pressure (Diastolic)	Sugar Level (mg/dL)	Weight (kg)
0	80	95	75.0
1	82	98	75.2
2	78	92	74.8
3	85	105	82.0
4	87	110	82.3
5	85	108	82.5
6	90	115	90.0
7	92	120	90.2
8	88	118	90.5
9	80	100	78.0
10	82	105	78.2
11	80	102	78.5





REFERENCES-

1. Dataset from google
2. NumPy Documentation
3. Pandas Documentation
4. Matplotlib Documentation