Public Health Data Visualization App

Health Dashboard showing BMI trends in Age (vs) Gender

Module GPH-: Digital Health

Responsible: Prof. Dominic

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Overview of the Health Data Dashboard

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App link: https://hamzairshad.shinyapps.io/HealthShinnyAPP/

Repository Link: https://github.com/24W-DGPH/Hamzairshad267-Rep.git

The Health Data Dashboard is an interactive web-based application designed using R and the Shiny framework. This app enables users to explore and analyze health-related data, specifically focusing on attributes like Age, BMI (Body Mass Index), and Gender. Its user-friendly interface and rich visualizations make it an effective tool for understanding health trends, filtering data, and deriving insights based on user-defined criteria.

This app is structured into a single-page layout with various tabs, each offering unique visual and functional insights into the dataset. The interactive elements, like sliders and dropdowns, make it accessible to users of all technical backgrounds. The combination of simplicity and functionality ensures that the dashboard meets both educational and analytical needs.

Use Case

This Shiny app addresses the problem of analyzing health-related trends over time, which is crucial for decision-making in public health, policy development, and economic planning. The stakeholders involved in this use case include:

1. **Public Health Officials**:

These stakeholders need to analyze trends like the **average body mass index (BMI)**, **life expectancy**, and **health expenditure** across different years. Their primary challenge is obtaining quick insights from large datasets and presenting them to policymakers in a digestible format.

2. **Researchers and Data Analysts**:

Health researchers are interested in observing correlations between metrics such as increasing health expenditures and life expectancy improvements. Their challenge is creating customizable plots and tables that allow them to visualize this data interactively without requiring extensive coding.

3. **Policy Makers and Economists**:

This group requires clean visualizations to make informed decisions on resource allocation and policy formulation. Their challenge is understanding the relationships between rising healthcare costs and their outcomes on public health.

Problem Description:

Currently, stakeholders rely on static reports that are time-consuming to generate and difficult to customize for specific needs. This limits their ability to interact with real-time data or explore custom year ranges and health metrics. Therefore, an interactive application that allows users to dynamically upload datasets, filter data, and visualize trends is essential to solving these issues efficiently.

Pathway to Finding a Solution

We developed a **Shiny web application** that dynamically reads uploaded datasets and provides flexible visualizations for key health metrics, including **Average BMI**, **Life Expectancy**, and **Health Expenditure**.

The solution involves the following key components:

1. **Interactive File Upload:**

Instead of relying on hardcoded datasets, users can upload custom CSV files containing health metrics. This ensures that the app remains flexible and adaptable to different datasets, accommodating users across various regions and research areas.

2. **Dynamic Year Filtering:**

A slider input allows users to specify a range of years they want to analyze. This feature is useful when analyzing short-term or long-term trends, helping public health professionals focus on specific time periods.

3. **Metric Selection:**

Users can select one of the three key metrics for analysis:

   o **Average BMI**: Monitors changes in obesity trends over time.

   o **Life Expectancy**: Tracks improvements in general population health.

   o **Health Expenditure**: Examines how investments in healthcare correlate with public health outcomes.

4. **Interactive Data Table:**

The application provides a tabular representation of the filtered data, allowing users to view underlying data before interpreting visual trends.

5. **Dynamic Line Plot:**

The line plot displays trends for the selected metric across the specified year range, with tooltips to enhance the data exploration experience. Researchers can visualize whether rising health expenditures correlate with improvements in life expectancy or other outcomes.

Benefits of the Application

- Dynamic Filtering and Visualization: Users can filter data by Age range and Gender to focus on specific groups of interest. This ensures tailored analysis based on real-world scenarios.
- Comprehensive Insights: The app offers multiple ways to explore the data—tables, histograms, scatter plots, and trendlines. Each tab provides a distinct view of the dataset.
- Interactive User Experience: The use of sliders and dropdowns allows for seamless interaction with the data, making it a great tool for demonstrations, teaching, or even internal reporting.
- Real-Time Data Exploration: All outputs update dynamically as users adjust filters, offering immediate visual feedback.
- Accessible and Customizable: Built using Shiny and ggplot2, this app can be easily extended or modified to accommodate new datasets, fields, or features.

Explanation of Tabs

1. Table Tab

The Table tab provides a tabular view of the filtered dataset. This view is essential for users who want a granular look at the data. It allows for sorting, searching, and exploring individual records without needing to generate custom queries.

2. Histogram Tab

The Histogram tab provides a graphical representation of BMI distribution across the filtered dataset. This visualization helps identify trends or anomalies in BMI values and their frequency.
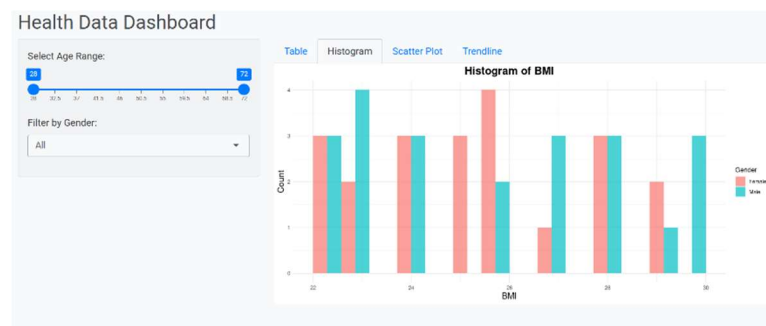

Figure 1 Counts in Male and female showing N.

3. Scatter Plot Tab

The Scatter Plot tab visually represents the relationship between Age and BMI, making it possible to detect patterns or correlations.

4. Trendline Tab

The Trendline tab takes the scatter plot further by adding a linear regression line to show the overall trend between Age and BMI and using gender filter, you can see with age BMI of which gender is increasing.
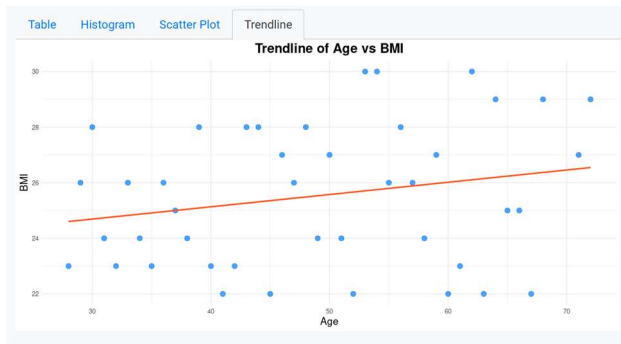

Figure 2 Trendline showing BMI trends change with age (With Gender filter)

Visualization and Display:

- Table: Displays the filtered dataset using the DT package.
- Histogram: Uses ggplot2 to create a bar chart of BMI frequency.
- Scatter Plot: Uses ggplot2 to plot BMI against Age, differentiated by Gender.
- Trendline: Adds a linear regression line to the scatter plot for trend analysis.
- UI Design: The app uses the bslib package for theming, ensuring a modern and professional appearance with custom colors and fonts.

Usability

The Health Data Dashboard is highly versatile and can be used in various contexts, including:

1. **Educational Settings**:

   o Demonstrate basic concepts of data visualization and analysis.

   o Teach relationships between variables like Age and BMI.

2. **Health Research**:

   o Analyze BMI trends across different Age groups and Genders.

   o Identify outliers or specific patterns in health data.

3. **Public Health Policy**:

   o Use insights to inform policies targeting specific demographics.

   o Explore the impact of Age on BMI distributions.

4. **Corporate Use**:

- o Track and visualize health metrics for employees in corporate wellness programs.

Conclusion

The Health Data Dashboard is a powerful yet simple tool for exploring health data. Its interactive design, diverse visualizations, and ease of use make it suitable for a wide range of users, from students and researchers to policymakers and professionals. By leveraging the strengths of Shiny and ggplot2, this app provides a comprehensive platform for analyzing and understanding the relationship between Age, BMI, and Gender.