Name: Mahin Montasir Afif

Mail: 22-46573-1@student.aiub.edu

Project Name: Biomedical Engineering for Sustainable Health: A Qualitative Study on Advancing SDG 3 in Bangladesh

Objective: Through a qualitative analysis, this project insights into the current use of biomedical engineering solutions for achieving SDG 3 objectives in Bangladesh. Through an analysis of these interventions from the perspectives of healthcare equity, quality, and accessibility, the research highlights the advantages and disadvantages that might lead to future health policies and policy decisions.

Data and Methods:

Data collection:

1. Bangladesh Health Watch Reports (2015-2023),
2. Ministry of Health and Family Welfare (MoHFW),
3. Bangladesh World Health Organization (WHO) SDG 3 Reports,
4. UNICEF Bangladesh Maternal and Child Health Studies

Method used:

Following the collection of data, a **time series analysis** has been done using a range of parameters to show the progression and impact of biomedical advancements. The analyzed parameters include Biomedical Technologies Introduced, Health Indicators Improved (Count), Population Covered (Millions), Government Investment (Million USD), Private Investment (Million USD), R&D Projects (Count), Training Programs Conducted and Key Innovations. To visualize the trend, graphs were plotted using Python Matplotlib library.

The relationships between the analyzed parameters were further examined using **Pearson Correlation**, which measures the strength and direction of linear relationships.

$$r = \frac{n\sum(A_i B_i) - \sum A_i \sum B_i}{\sqrt{(n\sum A_i^2 - (\sum A_i)^2)(n\sum B_i^2 - (\sum B_i)^2)}}$$

The p-value (p) is typically computed through hypothesis testing for the correlation coefficient to assess its statistical significance. It is generally derived from the t-distribution with the formula:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$
$$p = 1 - \text{CDF}(t, n-2)$$

The t-statistic (t) is used to assess the significance of the correlation coefficient (r). It compares the observed correlation to what might occur by chance. r measures the strength and direction of the linear relationship between two variables, with values between -1 and 1. The number of data points (n) is used in calculating the t-statistic and affects the degrees of freedom. The CDF (Cumulative Distribution Function) of the t-distribution helps determine the p -value, which indicates if the correlation is statistically significant. A low p -value suggests a meaningful relationship between the variables.

Result:

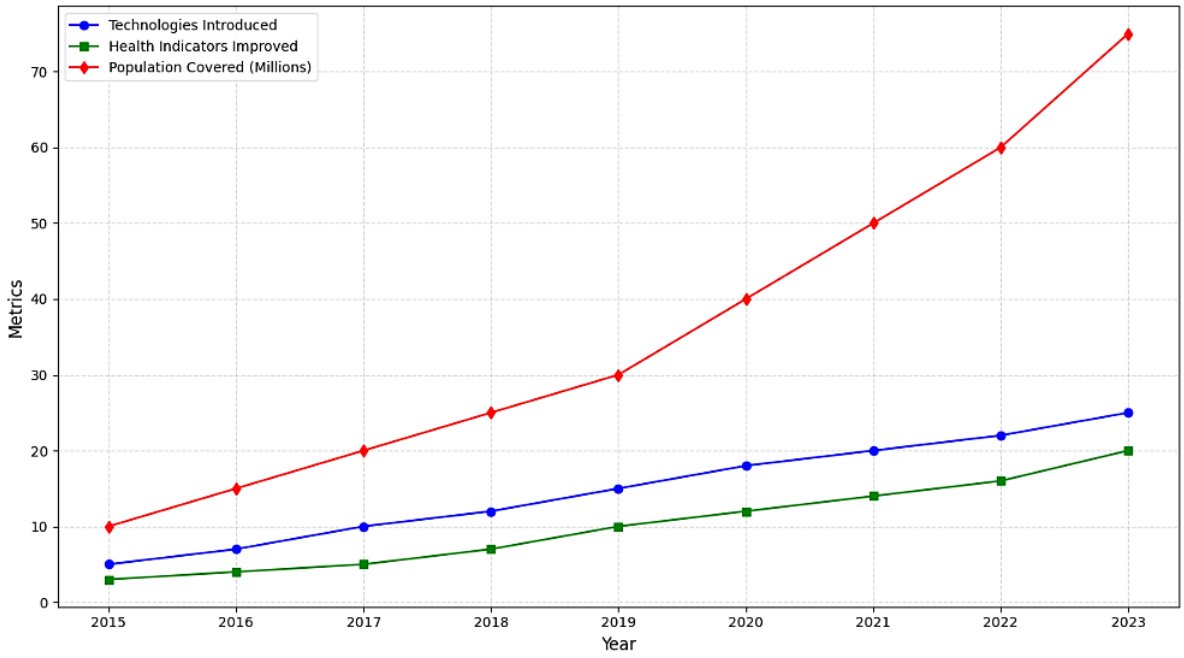

Fig. 1: Trends in Biomedical Metrics (2015-2023)

Fig.2: Correlation Heatmap of Numerical Features

Figure 1 presents a graphical representation of three critical biomedical metrics in Bangladesh from 2015 to 2023. The plot tracks the evolution of biomedical technologies, health indicators, and population coverage over an eight-year period. The number of biomedical technologies deployed has shown a consistent increase, starting from 5 in 2015 and growing to 25 by 2023. This upward trend is indicative of ongoing advancements in healthcare solutions such as telemedicine, mobile diagnostics, and wearable health devices. These technologies have played a pivotal role in expanding access to healthcare across the country.

The correlation matrix in **figure 2** illustrates strong linear relationships between key metrics, emphasizing the interconnected impact of biomedical technologies, investments, and training on health outcomes. For instance, training programs have shown a direct positive influence on improved health indicators and population

coverage by equipping healthcare professionals with essential skills to effectively utilize biomedical devices, thereby increasing the accessibility and quality of care. For instance, increased government and private investments are closely linked to broader population coverage and improved health indicators, underscoring the importance of coordinated efforts in advancing healthcare.