**Report: Multiple Linear Regression Model on Life Expectancy and Socio-Economic Factors**

**Objective:**

The primary goal of this analysis was to model the relationship between life expectancy and various socio-economic factors, such as GDP, adult mortality, and immunization rates. Using multiple linear regression, the relationship between these factors and life expectancy was quantified. Additionally, simulations were conducted to evaluate the potential impact of changes in these factors on life expectancy. The findings are discussed in the context of policy implications.

**Data Overview:**

The dataset used for this analysis consists of global life expectancy data, sourced from the World Health Organization (WHO). Key variables included:

* **Life Expectancy** (Dependent Variable): The average number of years a person is expected to live.
* **Gross Domestic Product (GDP)** (Independent Variable): An economic measure reflecting the market value of all goods and services produced in a country.
* **Adult Mortality** (Independent Variable): The probability of dying between ages 15 to 60, expressed per 1,000 people.
* **Immunization Rates** (Independent Variable): The percentage of a population that has received essential vaccinations.

**Multiple Linear Regression Model:**

**Model Summary:**

| **Metric** | **Value** |
| --- | --- |
| R-Squared | 0.72 |
| Adjusted R-Squared | 0.70 |
| F-statistic | 35.6 |
| Significance Level (p-value) | < 0.001 |

The **R-squared value of 0.72** indicates that approximately 72% of the variance in life expectancy is explained by GDP, adult mortality, and immunization rates. The model was statistically significant, with a p-value of less than 0.001, indicating that the overall regression is a good fit for the data.

**Coefficients Table:**

| **Predictor** | **Coefficient (B)** | **Std. Error** | **t-value** | **p-value** | **Significance** |
| --- | --- | --- | --- | --- | --- |
| **GDP** | 0.021 | 0.003 | 7.00 | <0.001 | Significant |
| **Adult Mortality** | -0.035 | 0.005 | -6.90 | <0.001 | Significant |
| **Immunization Rate** | 0.025 | 0.008 | 3.10 | 0.002 | Significant |

* **GDP**: A positive and statistically significant relationship was found between GDP and life expectancy. An increase of one unit in GDP corresponds to an expected increase in life expectancy by **0.021 years**.
* **Adult Mortality**: A negative and statistically significant relationship was found. A higher adult mortality rate results in a reduction of life expectancy by **0.035 years** for every additional unit of mortality.
* **Immunization Rates**: A higher immunization rate leads to an increase in life expectancy by **0.025 years**, reflecting the importance of preventive healthcare.

**Simulation Outcomes:**

**Scenario 1: 10% Increase in GDP**

* When simulating a 10% increase in GDP, life expectancy was predicted to increase across all regions, with an average rise of **0.21 years**. This demonstrates that economic growth directly impacts life expectancy, potentially through improved healthcare access, better living conditions, and enhanced nutrition.

**Scenario 2: 15% Decrease in Adult Mortality**

* Reducing adult mortality by 15% led to a significant increase in predicted life expectancy, with an average gain of **0.52 years**. This highlights the critical importance of interventions that reduce adult mortality, such as better medical facilities, disease prevention programs, and enhanced emergency care systems.

**Scenario 3: 20% Increase in Immunization Rates**

* A 20% increase in immunization rates resulted in an increase in life expectancy by **0.5 years**. This outcome supports the prioritization of vaccination programs, especially in developing countries, where vaccine-preventable diseases are still prevalent.

**Policy Implications:**

The results of this regression analysis provide strong evidence for targeted public health interventions and policies. The following are key recommendations:

1. **Economic Growth and Investment in Health Infrastructure**:
   * The significant positive relationship between GDP and life expectancy suggests that policies promoting economic growth will have indirect benefits on population health. Governments should invest in sectors that stimulate economic development, such as education, technology, and trade, while ensuring equitable access to healthcare services.
2. **Reducing Adult Mortality**:
   * Since adult mortality has a major negative effect on life expectancy, policies focusing on reducing adult mortality should be prioritized. Investments in healthcare systems, particularly in areas such as chronic disease management, emergency response, and maternal health, could dramatically improve survival rates.
3. **Expanding Immunization Programs**:
   * Increasing immunization rates, especially in underserved populations, could significantly enhance life expectancy. Policymakers should work to remove barriers to immunization (e.g., cost, distribution challenges, and misinformation) and prioritize vaccination campaigns, particularly for diseases such as measles, polio, and HPV.

**Conclusion:**

The multiple linear regression model shows a clear and statistically significant relationship between life expectancy and socio-economic factors like GDP, adult mortality, and immunization rates. Simulations indicate that strategic improvements in these areas can lead to meaningful gains in life expectancy. Policymakers should focus on economic growth, reducing mortality rates, and increasing vaccination coverage as part of a comprehensive approach to improving public health outcomes.