Immunization: It's Relationship between Target Groups and Rivers State Yearly Total Population Using Linear Regression

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Abstract— **Infectious diseases are prevented through immunization. Rivers State consists of 23 Local Government Areas (LGAs). The State is classified into three Senatorial Districts; Rivers East, Rivers West and Rivers South East. The inhabitants of the state are randomly spread. Ikwerre, Port-Harcourt and Obio-Akpor are the heavily occupied LGAs in Rivers State. This paper gives an overview of Immunization with key interest in showcasing the relationship between persons that require immunization services in Rivers State and the States total population for year 2010 – 2018. Linear Regression, a supervised machine learning tool was used and MatLAB 2015a was used for simulation.**

Index Terms— **immunization, Vaccines, Child Bearing Age, Tetanus, Linear Regression**

I. INTRODUCTION

Immunization is a proper and a convenient method to protect kids, women of child bearing age and pregnant women from serious infectious diseases [10]. It does not only protect individuals; it also safeguards the larger public by minimizing the blowout of ailments. Vaccine-preventable diseases are defined as those infectious diseases for which an effective preventive vaccine exists and may be prevented by vaccinating individuals per standard recommendations [4].

The injections for the prevention of the supposed infectious ailments functions by activating ones' system to resist certain diseases. Assuming an immunized person comes in contact with these ailments, its body system that has already been activated to resist sicknesses will respond more excellently, and ensures that the disease do not develop.

Vaccines are administered in liquid form, either by injection, by oral, or by intranasal routes. Immunization is a very important community involvement, and an inexpensive method to reduce the illnesses and death associated with communicable infections. More than two million demises are deferred through immunization every year in the world [5, 6]. More so, vaccine-avertable infections are one of the major causes of infants' death with an approximate number of three million deaths per year [8]. It will interest us to know that lots of health facilities are under pressure in the world to offer immunization services. Some of the major diseases immunization prevent includes; whooping cough, measles, chickenpox, tetanus, polio, diphtheria, hepatitis [10].

The afore stated ailments can lead to clients' hospitalization, and severe health challenges which includes

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cancer, brain damage and deafness. High immunization services in communities have led to many of these illnesses become uncommon. Nevertheless, they are still in existence but the effects or problems from these ailments are greater than the effects from immunization. Factors that enhances the ability of a vaccine to control or eliminate a disease includes but not limited to the effectiveness of the vaccine and immunization coverage achieved in a given population.

Vaccines are administered after a careful examination by the medical practitioners. During the administration of vaccines, it causes discomfort and may cause pain, redness, or inflammation at the spot of injection, but this is preferred compared to the pain, discomfort and trauma these vaccines prevent.

A. Linear Regression

Linear regression is a supervised machine learning tool used to find relationships amongst numerical variables [2] and to assess whether there is a correlation and dependences between variables where graphs with straight lines are superimposed on scatterplots

B. Supervised Machine Learning

Supervised learning takes available set of data and identifies re-actions to the data (output) and trains a model to produce extrapolations for the response to new data [15]. Supervised learning uses classification and regression methods to develop analytical models.

C. Machine Learning

This uses set of rules to learn information directly from available data without depending on a set equation as a guide. The algorithms applied on available data improve their performance as the number of samples obtained for learning increases [14]. Machine learning processes discovers acceptable patterns in data that produces understanding, that assist in making better decisions. These patterns are applied in our day to day activities to make critical decisions in medical diagnosis, stock dealing, projections, and more. Business organizations use it to understand their customers procuring behavior.

II. RELATED LITERATURE

A. Background and Epidemiology

Regardless of the fact that, vaccine-avertable illnesses are the major cause of infant death with an approximate number of three million deaths per year in the world [8]. Presently, immunization has contributed immensely on measles demise. From year 2000 to 2005, about 360 million infants worldwide

benefitted from measles vaccine through community immunization service. However, progresses are made in the day to day immunization service over this period. These progress in services has given rise to a significant decline in projected worldwide measles demise. Generally, worldwide measles death reduced by 60% between year 1999 and 2005 while the major gains happened in Africa where measles cases and deaths declined by approximately 75% [9].

For Smallpox: A crusade was carried out by the World Health Organization (WHO) on immunization from the year 1967 to 1977. This crusade occasioned the suppression of smallpox but the program started, [11] the disease threatened 60% of the world's inhabitants and killed every fourth victim.

For Polio: Ever since WHO came into existence and its associates of the Global Polio Eradication Initiative in 1988, ailments have dropped by 99%, while an estimated five mil-lion persons in the world have absconded from paralysis [4].

For Tetanus: The estimated figure for tetanus related death worldwide is 213,000 in 2002. Out of which 198,000 are children under five years of age, including neonatal Tetanus [3].

B. Importance of Immunization

When a child, an expectant mother or a female of child bearing age is immunized, new born child is vaccinated against disease [11], the child's body system is trained to resist natural infection. The body produces antibodies to combat the disease by rapidly clearing the infection. The leftovers are a sequence of cells aimed to fight against future infection. Once your child comes into connection with these infections, their immune system will effectively resist and prevent the ailment from developing. By having woman of child bearing age, pregnant women and new born children immunized, you help protect them from diseases. Immunization services have put to an end and in most cases, eradicated many infections that caused death few eras ago. For instance, the vaccines for smallpox eliminated that disease globally. As such our children will no longer get smallpox explosions because the dis-ease no longer in existence.

C. Perceived benefits of routine Immunization

According to [7], the benefits derived from day to day immunization are good health and existence of children, cost-savings from a minor occurrence of disease and reduced repeated visits to the hospital. Also, in 2004, parents in Lagos and Enugu informed that immunization has reduced sick-nesses and deaths which has greatly minimized the nervousness associated with raising children.

D. Benefits of Immunizing women of child bearing Age(15-49years)

This age bracket makes twenty-two percent (22%) of the total population. By this you have covered a large proportion of women that give birth to children. When women are vaccinated, it Confers immunity for all childbearing age, when appropriately administered. It prevents maternal tetanus that strikes women during pregnancy or within six weeks of

the termination of a pregnancy. Women are wide-open to tetanus when non-sterile instruments or objects are used to take delivery, including during non-sterile abortions. Prefer-ably, women folk are to be current with their vaccinations prior to their pregnancy [12]. It will interest us to know that majority of pregnancies are not planned for as such, very important to keep women of child bearing age current with vaccines, irrespective of actively trying to conceive or not. According to the National Programme on Immunization [10], day to day immunization of women of child bearing age in the country is carried out using the following injections that includes; Influenza, Td/Tdap.

E. Benefits of Immunizing pregnant women

It confers immunity for 5 years for the target group which is five percent (5%) of the total population and It prevents Neo-natal. A pregnant woman is administered first dose of vaccine at first contact which is minimum of 16 weeks into pregnancy while Second dose at least one month after the first dose.

III. RESEARCH METHODOLOGY

Linear Regression as a tool for digital signal processing was adopted. It is a machine learning tool that aids in show casing the relationship amongst variables by applying a linear equation and plotting linear graph. The target groups for immunization program according National standard is Children less than one (1) year, women of child bearing age (15-49 years) and pregnant women.

Step 1: The total population for Rivers State and Number of persons to be immunized according to standard target population is shown in table 1 for the years 2010 – 2018.

TABLE 1

YEAR	Population	<1 year	15-49yrs	Preg. Women
2010	5,927,402	257096	1304028	1304028
2011	6,128,934	245157	1348365	306447
2012	6,337,318	253493	1394210	316886
2013	6,552,787	262111	1441613	327639
2014	6,775,581	271023	1490628	228779
2015	7,005,951	280238	1541309	350298
2016	7,244,154	289766	1593714	362208
2017	7,490,455	299618	1647900	374523
2018	7,745,130	309805	1703929	387257

Source: [13]

Step 2: Plotting of graphs

The plotting of the graph is done in MatLAB 2015a for each cate-gory and state population. State population is our y variable (dependent variable), while <1 Year, 15-49 years, pregnant women are x variables (independent variable).
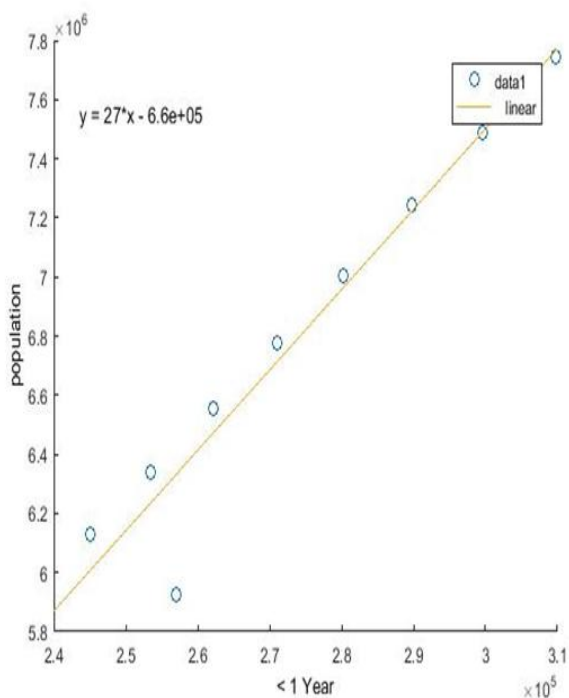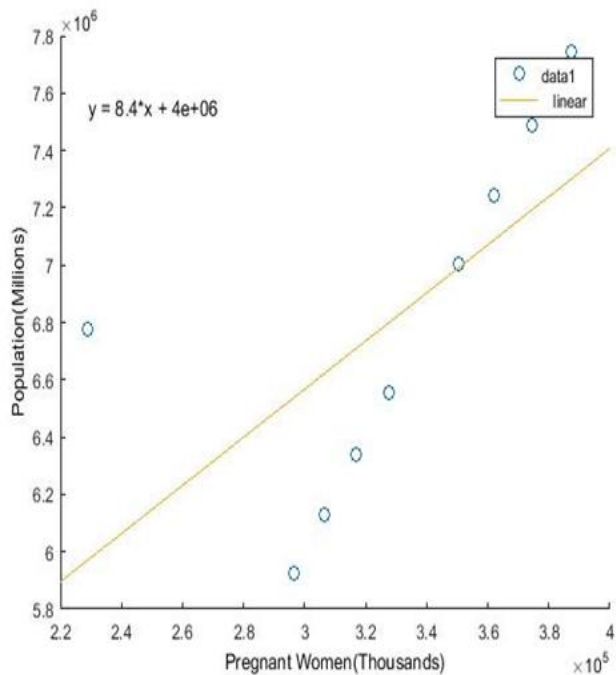
Step 3: Plotting's

Fig 1: Graph for < 1 year versus state population
$$y = 27x - 6.6 * 10^{\wedge}5$$

Fig 2: Graph for 15-49yrs versus State population

$$y = 8.4x + 4 * 10^{\wedge}6$$
Fig 3: Graph of pregnant women versus State population

Step 3: Calculation for Linear Regression

Regression is calculated for each category using our state population. This was done to determine the relationship between the target populations for state immunization program and total state population using the rate of accuracy (R^2) of our model.

IV. DISCUSSION/CONCLUSION

In this paper, considering our model and our coefficients, it is agreed that all three (3) categories for immunization program contribute to the variability of our total population, but category 15-49years has major impact on our state populations and will require more immunization services. Also considering our graphs for the various categories, the relationship amongst variables for women of child bearing age (15-49 year) are closer than that of <1 year and pregnant women.

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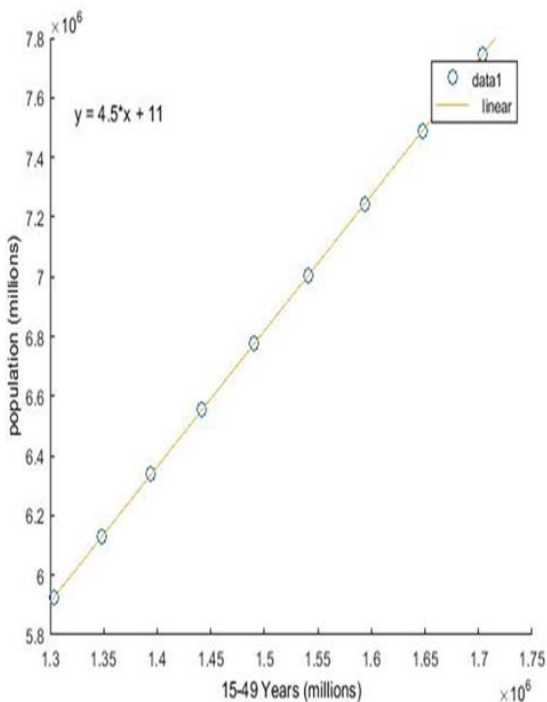
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