International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 6, Issue 7, pp 563-567, July-2022

https://doi.org/10.47001/IRJIET/2022.607126

Assessing the Feasibility of Achieving Substantial Reduction of under Five Mortality in Zimbabwe By 2030 Using Holt's Linear Method

[1]Dr. Smartson. P. NYONI, [2]Thabani NYONI

[1]ZICHIRe Project, University of Zimbabwe, Harare, Zimbabwe
[2]Independent Researcher & Health Economist, Harare, Zimbabwe

***Abstract* - This study uses annual time series data on under five mortality rate (U5MR) for Zimbabwe from 1960 to 2020 to predict future trends of U5MR over the period 2021 to 2030. Residuals and forecast evaluation criteria indicate that the applied Holt's linear(double exponential smoothing) model is stable in forecasting under five mortality rate. Optimal values of smoothing constants α and β are 0.9 and 0.6 respectively based on minimum MSE. The exponential smoothing model projections revealed that annual U5MR will decline but still remain high over the out of sample period. Therefore, we encourage the Zimbabwean government to allocate more resources to the maternal and child health (MNCH) program to ensure availability of medical supplies and staff at all levels of healthcare and address all the major challenges that significantly contribute to under five mortality.**

Keywords: Exponential smoothing, Forecasting, U5MR.

I. INTRODUCTION

In September 2015 all 193 United Nations member states drafted a global outcome document, 'The Agenda 2030 for sustainable development' with 17 objectives and 169 targets. This important document highlighted a road map towards achieving sustainable development by 2030 (UN, 2016; UN, 2015). It was agreed by all UN member countries that this world needs peace, security, good health and prosperity. The third sustainable development goal (SDG3)was meant to ensure healthy lives and promote well-being for all at all stages of life. Maternal and child health issues dominated discussions on global health problems (UNICEF, 2019).SDG 3.1 focuses on the reduction of maternal mortality ratio to less than 70 maternal deaths per 100 000 live births and target 3.2 aims to ensure substantial reduction in neonatal mortality rate to at least 12 deaths per 1000 live births and under five mortality to levels as low as 25 deaths per 1000 live births (UN, 2020; UNICEF, 2019; WHO, 2019; UNICEF, 2018). In line with the Agenda 2030 for sustainable development and the Cape Town Global Action Plan (2017),this study predicts future trends of under-five mortality rate in Zimbabwe using double exponential smoothing (Holt) and the findings of this research are expected to inform maternal and child health (MNCH)policies, planning and allocation of resources in order to end all preventable under five deaths by 2030.

II. LITERATURE REVIEW

Gage & Bauhoff (2020) assessed the impact of PBF on early neonatal health outcomes and associated health care utilization and quality in Burundi, Lesotho, Senegal, Zambia and Zimbabwe. Authors utilized data from Demographic and Health Surveys and Multiple Indicator Cluster Surveys and applied difference-in-differences analysis to estimate the effect of PBF projects supported by the World Bank on early neonatal mortality and low birth weight and concluded that PBF had no impact on early neonatal health outcomes in the five African countries studied and had limited and variable effects on the utilization and quality of neonatal health care.Masaba & Phetoe (2020) described the trends of neonatal mortality within the two sub-Saharan countries. The study concluded that in 2018, the neonatal mortality rate for Kenya was 19.6 deaths per 1000 live births. The neonatal mortality rate had fallen gradually from 35.4 deaths per 1000 live births in 1975. On the other hand, South Africa had its neonatal mortality rate fall from 27.9 deaths per 1000 live births in 1975 to 10.7 deaths per 1000 live births in 2018.A study conducted in Zimbabwe by Nyoni & Nyoni (2020) analyzed monthly time series data on neonatal death cases at Chitungwiza Central Hospital (CCH) from January 2013 to December 2018 using Box-Jenkins SARIMA models and found out that there will be a slow but steady decrease in neonatal deaths at CCH over the out-of-sample period. Another study by Nyoni & Nyoni, 2020 applied the Box-Jenkins ARIMA methodology to forecast neonatal deaths in Zimbabwe using annual time series data on neonatal deaths in Zimbabwe from 1966 to 2018.The ARIMA (8, 2, 0) was found to be the optimal model. The study findings revealed that the numbers of neonatal deaths per year would decline sharply over the next 25 years. A similar forecasting study by Nyoni & Nyoni, 2020utilized the ARIMA model to model and forecast infant mortality in Zimbabwe. The ARIMA (1,2,5) was the best model and the forecast results indicated that the number of infant deaths per year, over the out-of-sample period, will follow a downward trend. Chaibva et al. (2019) analyzed stillbirths and neonatal deaths in Mutare district. The study did a retrospective

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 6, Issue 7, pp 563-567, July-2022

https://doi.org/10.47001/IRJIET/2022.607126

review of 346 patient records, of women who delivered at Sakubva Hospital and those referred for Mutare district facilities to Mutare Provincial Hospital, between January and June 2014 and then used descriptive statistics to explore the contributors to stillbirths and neonatal deaths in Mutare. Their findings showed that of the 346 women, 15.6% (i.e. 54) experienced an adverse pregnancy outcome (stillbirth or neonatal death). Their results also indicated that predictors of adverse pregnancy outcomes included birth weight, gestational age, delivery complications and delivery methods.

III. METHODOLOGY

This study utilizes an exponential smoothing technique to model and forecast future trends of under-five mortality rate in Zimbabwe. In exponential smoothing forecasts are generated from the smoothed original series with the most recent historical values having more influence than those in the more distant past as more recent values are allocated more weights than those in the distant past. This study uses the Holt's linear method (Double exponential smoothing) because it is an appropriate technique for modeling linear data.

$C_t = \mu_t + b_t t + \varepsilon_t$

Smoothing equation

$L_t = \alpha C_t + (1-\alpha)(L_{t-1} + b_{t-1})$

Trend estimation equation

$T_t = \beta (L_t - L_{t-1}) + (1-\beta) b_{t-1}$

Forecasting equation

$f_{t+h} = L_t + h b_t$

C_t is the actual value of time series at time t

L_t is the exponentially smoothed value of time series at time t

α is the exponential smoothing constant for the data

β is the smoothing constant for trend

f_{t+h} is the h step ahead forecast

T_t is the trend estimate

Data Issues

This study is based on annual under five mortality rate in Zimbabwe for the period 1960 – 2020. The out-of-sample forecast covers the period 2021– 2030. All the data employed in this research paper was gathered from the World Bank online database.

IV. FINDINGS OF THE STUDY

Exponential smoothing Model Summary

Table 1: ES model summary

Variable	C
Included Observations	61 (After Adjusting Endpoints)
Smoothing constants	
Alpha (α) for data	0.900
Beta (β) for trend	0.600
Forecast performance measures	
Mean Absolute Error (MAE)	2.030864

International Research Journal of Innovations in Engineering and Technology (IRJIET)
ISSN (online): 2581-3048
Volume 6, Issue 7, pp 563-567, July-2022
https://doi.org/10.47001/IRJIET/2022.607126

Sum Square Error (SSE)	744.534219
Mean Square Error (MSE)	12.205479
Mean Percentage Error (MPE)	0.180089
Mean Absolute Percentage Error (MAPE)	2.049206

Residual Analysis for the Applied Model

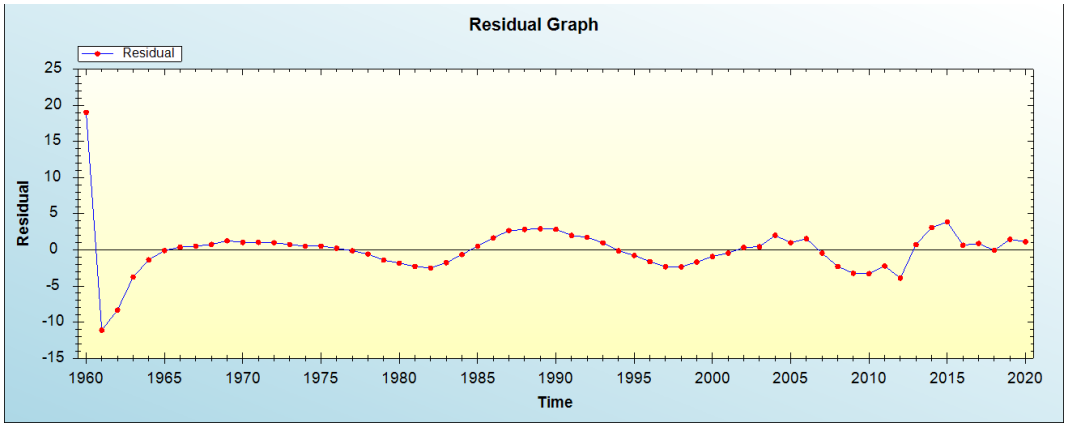

Figure 1: Residual analysis

In-sample Forecast for C

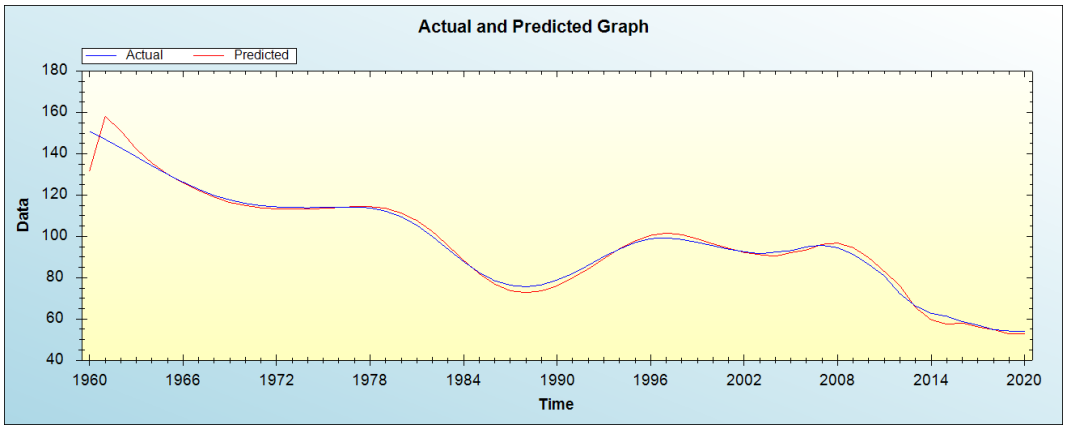

Figure 2: In-sample forecast for the C series

Actual and smoothed graph for C

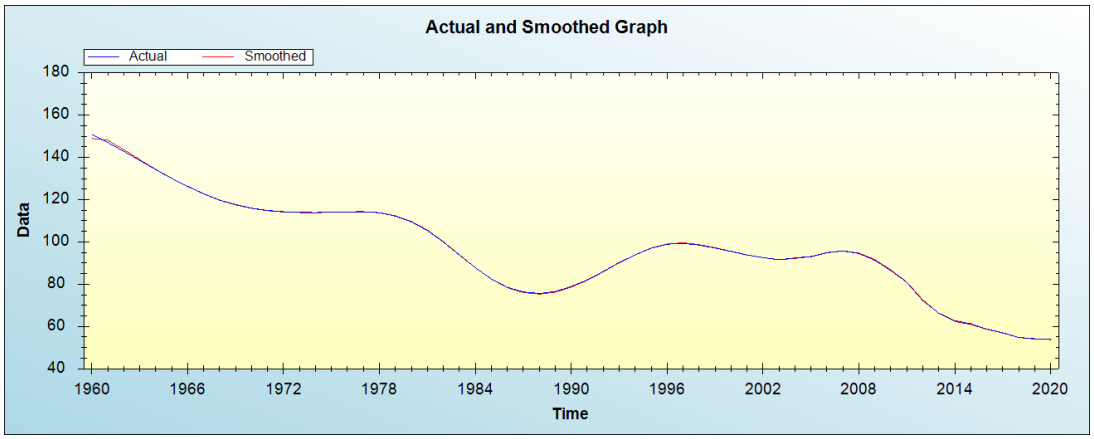

Figure 3: Actual and smoothed graph for C

International Research Journal of Innovations in Engineering and Technology (IRJIET)
ISSN (online): 2581-3048
Volume 6, Issue 7, pp 563-567, July-2022
https://doi.org/10.47001/IRJIET/2022.607126

Out-of-Sample Forecast for C: Actual and Forecasted Graph

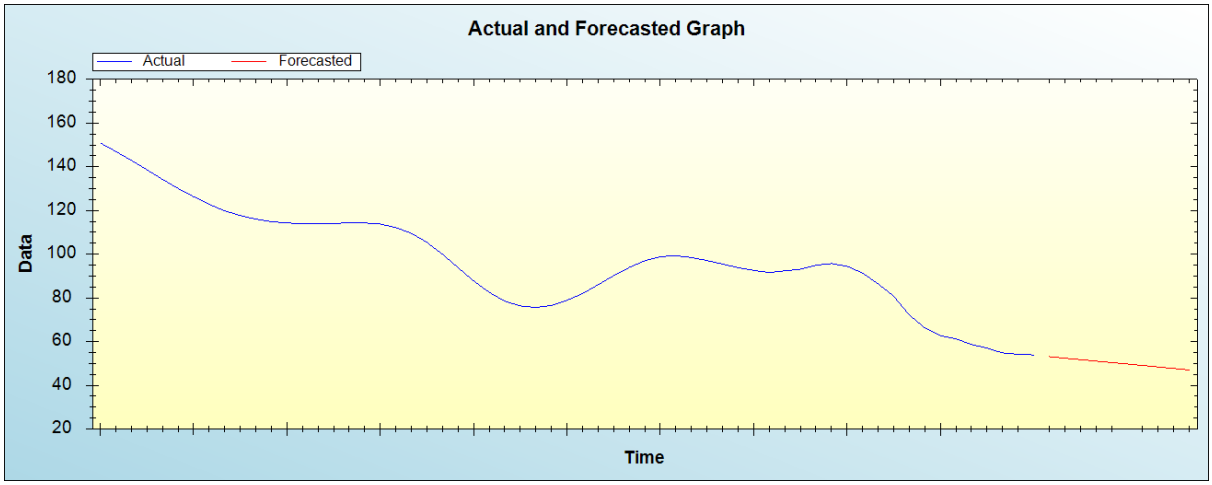

Figure 4: Out-of-sample forecast for C: actual and forecasted graph

Out-of-Sample Forecast for C: Forecasts only

Table 2: Tabulated out-of-sample forecasts

2021	53.1137
2022	52.4404
2023	51.7672
2024	51.0940
2025	50.4208
2026	49.7475
2027	49.0743
2028	48.4011
2029	47.7279
2030	47.0547

The main results of the study are shown in table 1. It is clear that the model is stable as confirmed by evaluation criterion as well as the residual plot of the model shown in figure 1. It is projected that annual U5MR will decline but still remain high over the out of sample period.

V. POLICY IMPLICATION & CONCLUSION

Sub-Saharan Africa has numerous health challenges that negatively impact on child survival. The continent continues to report high absolute numbers of teenage pregnancies which significantly contribute to under five mortality. Zimbabwe has made significant progress in the reduction of under-five mortality as evidenced by the reported gradual decline of under-five mortality over the past 2 decades. However, absolute numbers of under five deaths remain high and therefore there is need to implement appropriate strategies to reduce mortality to levels as low as 25 deaths per 1000 live births by 2030. Forecasting the future path of under-five mortality is expected to inform child health policies, decisions and allocation of resources. This study applied Holt's double exponential smoothing model to project future trends of under-five mortality rate for Zimbabwe and model projections revealed that annual U5MR will decline but still remain high over the out of sample period. Hence, the Zimbabwean government must allocate more resources to the maternal and child health (MNCH) program to ensure availability of medical supplies and staff at all levels of health care and address all the various factors that significantly contribute to under five mortality across the country.

REFERENCES

[1] UNICEF. (2019). Levels and trends in child mortality: report 2019. Estimates developed by the UN Inter-agency Group for child mortality estimation. New York: UNICEF.
[2] United Nations. (2015). transforming our world: The 2030 agenda for sustainable development, A/RES/70/1. New York: UN General Assembly.

ISSN (online): 2581-3048
Volume 6, Issue 7, pp 563-567, July-2022
https://doi.org/10.47001/IRJIET/2022.607126

[3] UN (2020) sustainable development goals. https://www.un.org/sustainabl development/development-agenda
[4] UNICEF (2018). Every Child alive. New York: UNICEF
[5] World Health Organization (WHO) (2019). SDG 3: Ensure healthy lives and promote wellbeing for all at all ages.
[6] United Nation. Transforming our world: The 2030 agenda for sustainable development 2016.

Citation of this Article:

Dr. Smartson. P. NYONI, Thabani NYONI, "Assessing the Feasibility of Achieving Substantial Reduction of under Five Mortality in Zimbabwe By 2030 Using Holt's Linear Method" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 6, Issue 7, pp 563-567, July 2022. Article DOI https://doi.org/10.47001/IRJIET/2022.607126

****

