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Tracking Guinea's Future Progress towards Achieving Substantial Reduction of Under Five Mortality By 2030

[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 Guinea 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 model is stable in forecasting U5MR. This study applies the Holt's linear exponential smoothing model to predict U5MR. The optimal values for smoothing constants α and β are 0.9 and 0.3 respectively based on minimum MSE. The model projections revealed that annual U5MR will decline but remain high over the out of the sample period. Therefore, we encourage the government of Guinea to focus on improving the working conditions of healthcare workers and ensuring adequate medical supplies at all levels of healthcare by allocating more resources to the maternal and child (MNCH) program.**

Keywords: Exponential smoothing, Forecasting, U5MR.

I. INTRODUCTION

The 2nd and 3rd sustainable development goals (SDGs) will remain at the top of the global priority list as millions of people continue to be driven into poverty and new health problems are continuously emerging. The second SDG focuses on eradicating all forms of poverty and hunger, and promotion of sustainable agriculture (UN, 2016; UN, 2015). The third SDG focuses on ensuring healthy lives and promotion of well-being for all at all stages of life. Tremendous effort has been made in both SDGs. The nutritional status of communities has improved over the years although certain developing countries are still suffering from malnutrition due to persistent droughts and climate change effects. In addition, there is significant progress made on SDG3 as evidenced by a decline in maternal, newborn and under five mortality rates (World Bank, 2019). By end of 2030, all UN member states are expected to have achieved neonatal and under five mortality rates which are as low as 12 neonatal deaths per 1000 births and 25 under five deaths per 1000 live births (UN, 2020; UNICEF, 2019; WHO, 2019; UNICEF, 2018).This empirical study focuses on forecasting future trends of under-five mortality rate for Guinea using the Holt's linear exponential smoothing method. The results are expected to stimulate an early response to the challenge of child mortality in the country.

II. LITERATURE REVIEW

A cross-sectional study carried out by Edem *et al.* (2020) investigated the health practices, care-seeking behavior, and referral of sick out-born neonates to a district and regional hospital in the Upper West Region of Ghana. The study findings revealed that socio-cultural factors strongly influence health seeking behavior and the health outcome of neonates in this setting. Bhatia *et al.* (2019) analyzed the patterns and trends in the mortality rates of infants and children under the age of 5 in India (1992–2016) and quantified the variation in performance between different geographical states through three rounds of nationally representative household surveys. Three rounds of cross-sectional survey data. The study is conducted at the national level: India and its selected good-performing states, namely Haryana, Kerala, Maharashtra, Punjab and Tamil Nadu, and selected poor-performing states, namely Bihar, Chhattisgarh, Madhya Pradesh and Uttar Pradesh. The study revealed that attempts to reduce infant and child mortality rates in India are heading in the right direction although there is huge variation in performance between states. A similar cross-sectional study in Ghana was conducted by Annan & Asiedu (2018) who applied the logistic regression model to assess the maternal, neonatal, and health system related factors that influence neonatal deaths in the Ashanti Region, Ghana. The study concluded that there was a high number of neonatal deaths which were mainly caused by birth asphyxia, infections, congenital anomalies and respiratory distress syndrome. Rai *et al.* (2017) carried out a study to identify the medical causes of death and contribution of non-biological factors towards infant mortality by a retrospective analysis of routinely collected data using verbal and social autopsy tools. The study site was Health and Demographic Surveillance System (HDSS), Ballabgarh, North India Participants All infant deaths during the years 2008– 2012 were included for verbal autopsy and infant deaths from July 2012 to December 2012 were included for social autopsy. Outcome measures were cause of death ascertained by a validated verbal autopsy tool and level of delay based on a three-delay model using the INDEPTH social autopsy tool were the main outcome measures. The level of delay was defined as follows: level 1, delay in identification of danger signs and decision making to seek care; level 2, delay in reaching a health facility from home; level 3, delay in getting healthcare at the health

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facility. The study revealed that there is a high proportion of preventable infant mortality which exists in an area which is under continuous health and demographic surveillance.

III. METHODOLOGY

This study utilizes an exponential smoothing technique to model and forecast future trends of under-five mortality rate in Guinea. 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.

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

Smoothing equation

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

Trend estimation equation

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

Forecasting equation

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

X_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 Guinea 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	X
Included Observations	61 (After Adjusting Endpoints)
Smoothing constants	
Alpha (α) for data	0.900
Beta (β) for trend	0.300
Forecast performance measures	
Mean Absolute Error (MAE)	1.260802
Sum Square Error (SSE)	484.858689
Mean Square Error (MSE)	7.948503
Mean Percentage Error (MPE)	0.159663
Mean Absolute Percentage Error (MAPE)	0.559863

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Residual Analysis for the Applied Model

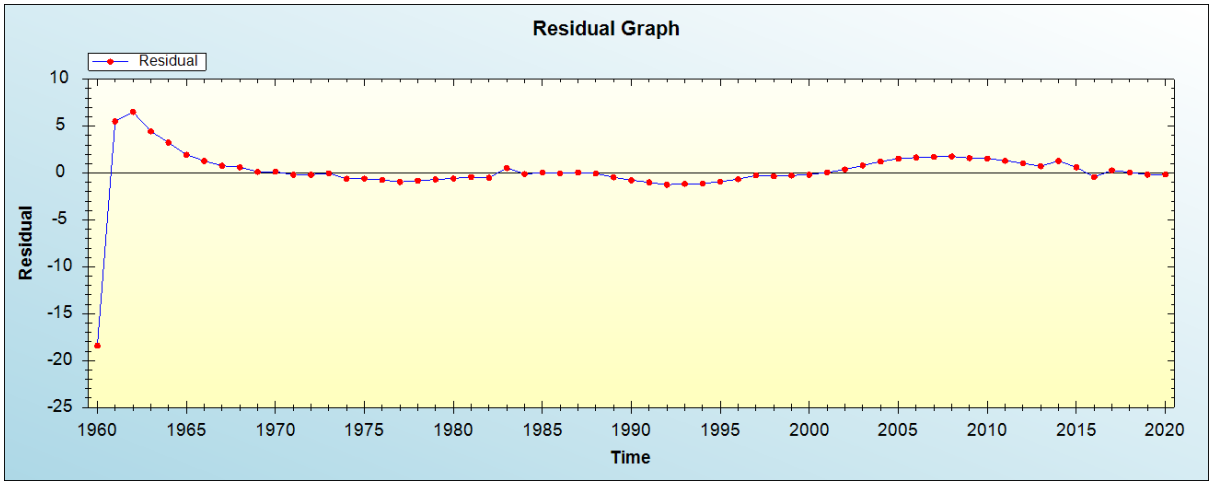

Figure 1: Residual analysis

In-sample Forecast for X

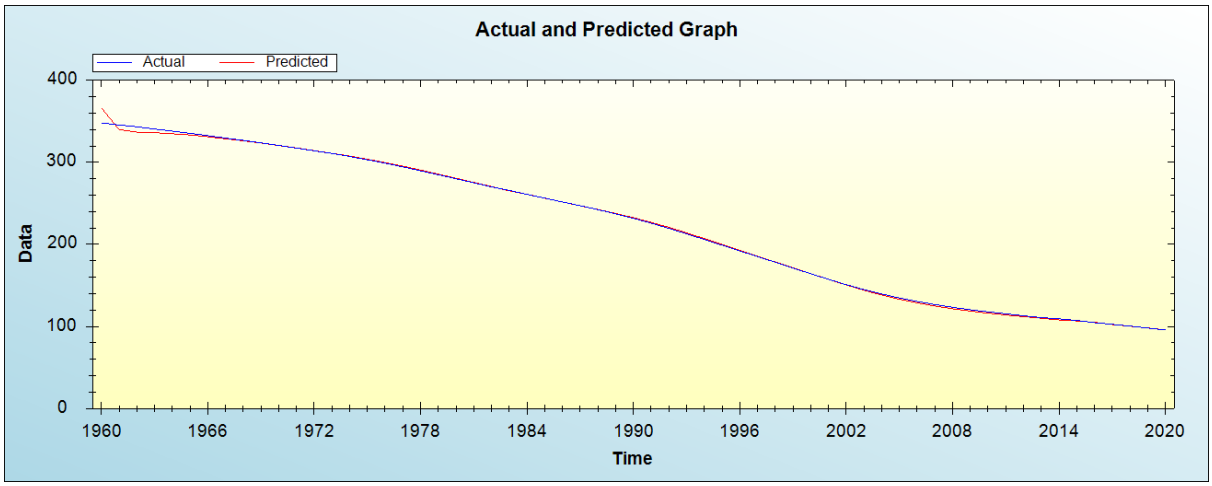

Figure 2: In-sample forecast for the X series

Actual and smoothed graph for X

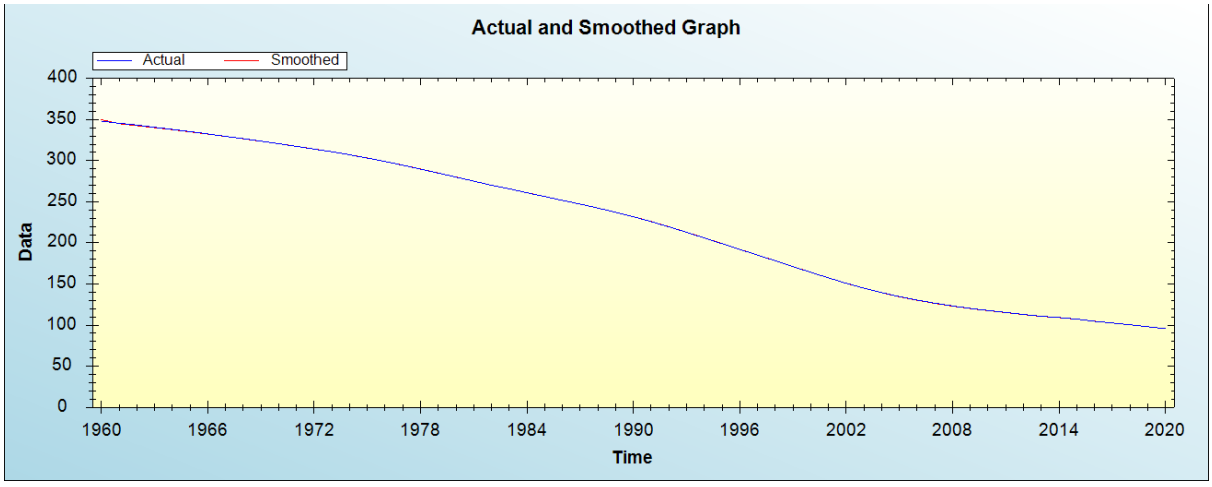

Figure 3: Actual and smoothed graph for X

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

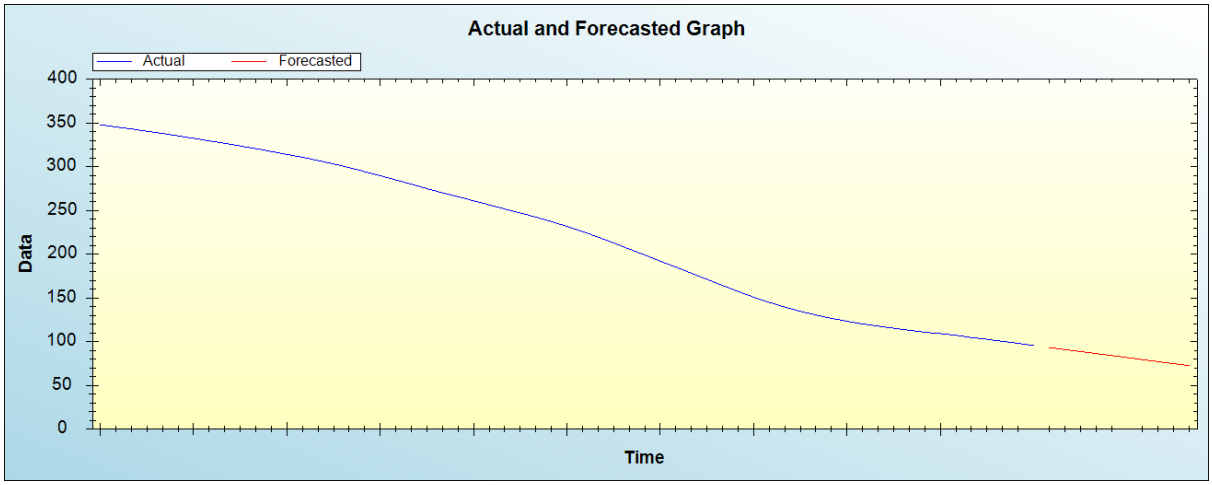

Figure 4: Out-of-sample forecast for X: actual and forecasted graph

Out-of-Sample Forecast for X: Forecasts only

Table 2: Tabulated out-of-sample forecasts

2021	93.3020
2022	90.9898
2023	88.6776
2024	86.3654
2025	84.0532
2026	81.7410
2027	79.4288
2028	77.1166
2029	74.8044
2030	72.4922

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 remain high over the out of the sample period.

V. POLICY IMPLICATION & CONCLUSION

Guinea has made significant progress in the reduction of under-five mortality as evidenced by the downward trend of under-five mortality rate over the past decades. This study applied the Holt's linear exponential smoothing model to project future trends of under-five mortality rate in Guinea. The findings revealed that annual U5MR will decline but remain high over the out of the sample period. Therefore, we encourage the government of Guinea to focus on improving working conditions for healthcare workers and ensuring adequate medical supplies at all levels of healthcare.

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