

Forecasting Future Trends of Under Five Mortality Rate for Malta Using Double Exponential Smoothing

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

¹ZICHIRE Project, University of Zimbabwe, Harare, Zimbabwe

²Independent Researcher & Health Economist, Harare, Zimbabwe

Abstract - This study uses annual time series data on under five mortality rate (U5MR) for Malta 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 exponential smoothing model is stable in forecasting under five mortality rate. Optimal values of smoothing parameters α and β are 0.9 and 0.1 respectively based on minimum MSE. The double exponential smoothing model projections indicate that annual U5MR will hover around 6 deaths per 1000 live births throughout the out of sample period. Hence, we implore the government of Malta to continue supporting maternal and child health program activities in order to keep mortality among under five children under control.

Keywords: Exponential smoothing, Forecasting, U5MR.

I. INTRODUCTION

The UN general assembly held in September 2015 at the Headquarters of the United Nations in New York was attended by 193 Heads of State and High representatives. This meeting was very special in the sense that it ushered in the era of global sustainable development goals that were designed to finish up the work left behind by Millennium development goals (UN, 2016; UN, 2015). The agenda 2030 for sustainable development was the product document of the high level meeting which carried 17 objectives and 169 targets that were meant to address all the major global issues that affect the human race. Since the introduction of this global action plan UN member countries have made significant strides in ensuring that all the highlighted problems are solved as quickly as possible to alleviate human suffering. However developing countries are lagging behind in SDG progress whereas developed countries are ahead and some of the first world countries have already managed to achieve the set SDG targets well on time before 2030 (UN, 2020; UNICEF, 2019; WHO, 2019; UNICEF, 2018). The aim of this study is to apply the Holt's linear method to forecast future trends of under-five mortality rate in Malta. We expect the findings to trigger an appropriate response to the problem of under-five mortality.

II. LITERATURE REVIEW

Harpur *et al.* (2021) investigated trends in infant mortality rates (IMR) and stillbirth rates by socio-economic position (SEP) in Scotland, between 2000 and 2018, inclusive. Data for live births, infant deaths, and stillbirths between 2000 and 2018 were obtained from National Records of Scotland. Annual IMR and stillbirth rates were calculated and visualized for all of Scotland and when stratified by SEP. Negative binomial regression models were used to estimate the association between SEP and infant mortality and stillbirth events, and to assess for break points in trends over time. The study revealed that IMR fell from 5.7 to 3.2 deaths per 1000 live births between 2000 and 2018, with no change in trend identified. Stillbirth rates were relatively static between 2000 and 2008 but experienced accelerated reduction from 2009 onwards. When stratified by SEP, inequalities in IMR and stillbirth rates persisted throughout the study and were greatest amongst the sub-group of post-neonates. Regression analysis was employed by Jawad *et al.* (2021) to assess the association between conflict and maternal and child health globally. Data for 181 countries (2000–2019) from the Uppsala Conflict Data Program and World Bank were analyzed using panel regression models. The study findings showed that armed conflict is associated with substantial and persistent excess maternal and child deaths globally. Aghai *et al.* (2020) determined the gender differences in neonatal mortality, stillbirths, and perinatal mortality in south Asia using the Global Network data from the Maternal Newborn Health Registry. It was noted that the risks of stillbirths, and early neonatal mortality were higher among male infants than their female counterparts. However, there was no gender difference in mortality after 7 days of age. Nath *et al.* (2020) examined the effect of extreme prematurity and early neonatal deaths on infant mortality rates in England. Authors used aggregate data on all live births, stillbirths and linked infant deaths in England in 2006–2016 from the Office for National Statistic. Infant mortality decreased from 4.78 deaths/1000 live births in 2006 to 3.54/1000 in 2014 (annual decrease of 0.15/1000) and increased to 3.67/1000 in 2016 (annual increase of 0.07/1000). This rise was driven by increases in deaths at 0–6 days of life.

III. METHODOLOGY

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

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

Smoothing equation

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

Trend estimation equation

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

Forecasting equation

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

M_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 Malta 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	M
Included Observations	61 (After Adjusting Endpoints)
Smoothing constants	
Alpha (α) for data	0.900
Beta (β) for trend	0.100
Forecast performance measures	
Mean Absolute Error (MAE)	0.524092
Sum Square Error (SSE)	94.506795
Mean Square Error (MSE)	1.549292
Mean Percentage Error (MPE)	1.398127
Mean Absolute Percentage Error (MAPE)	2.848951

Residual Analysis for the Applied Model

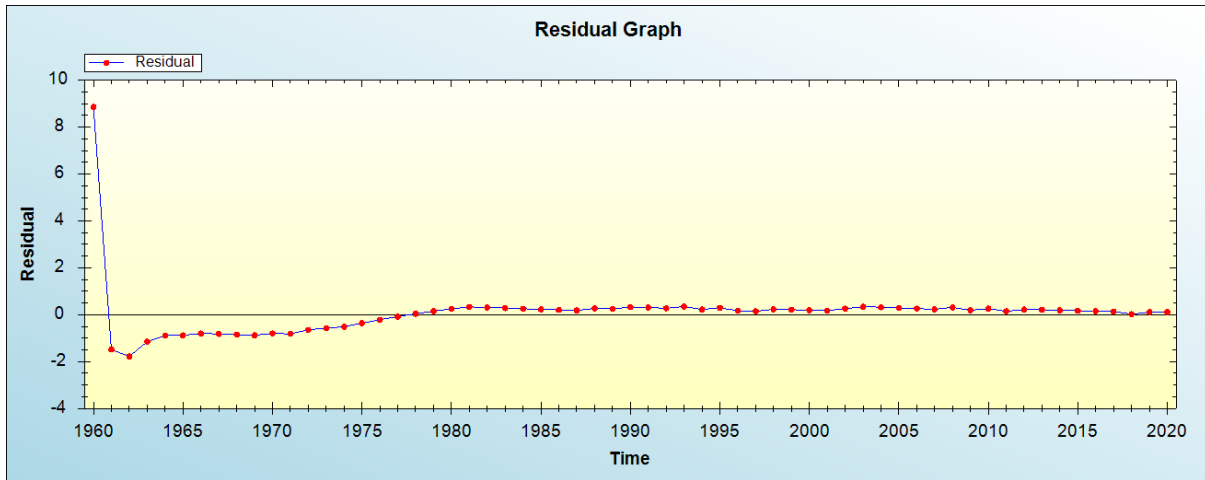


Figure 1: Residual analysis

In-sample Forecast for M

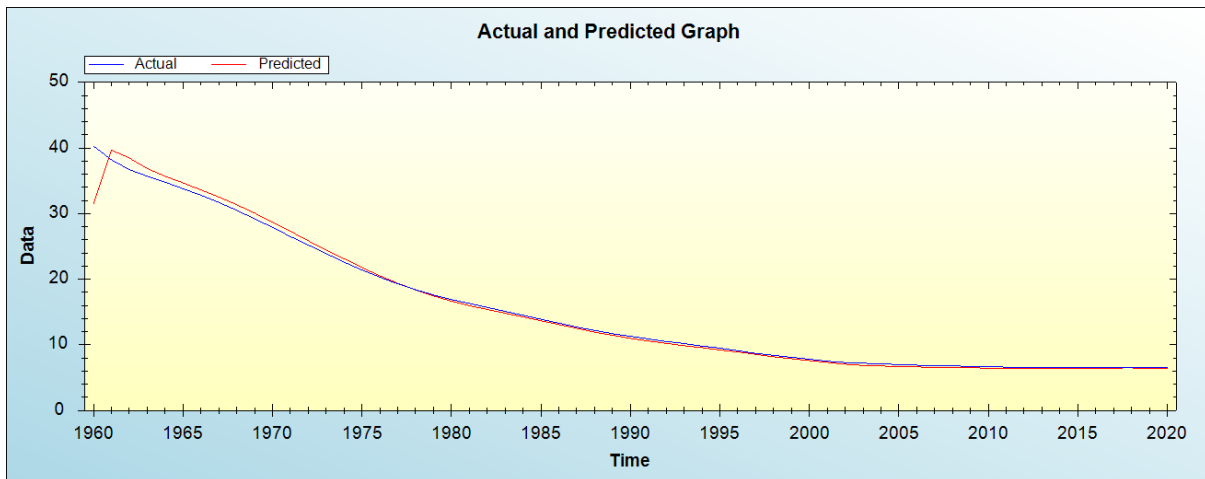


Figure 2: In-sample forecast for the M series

Actual and Smoothed graph for M series

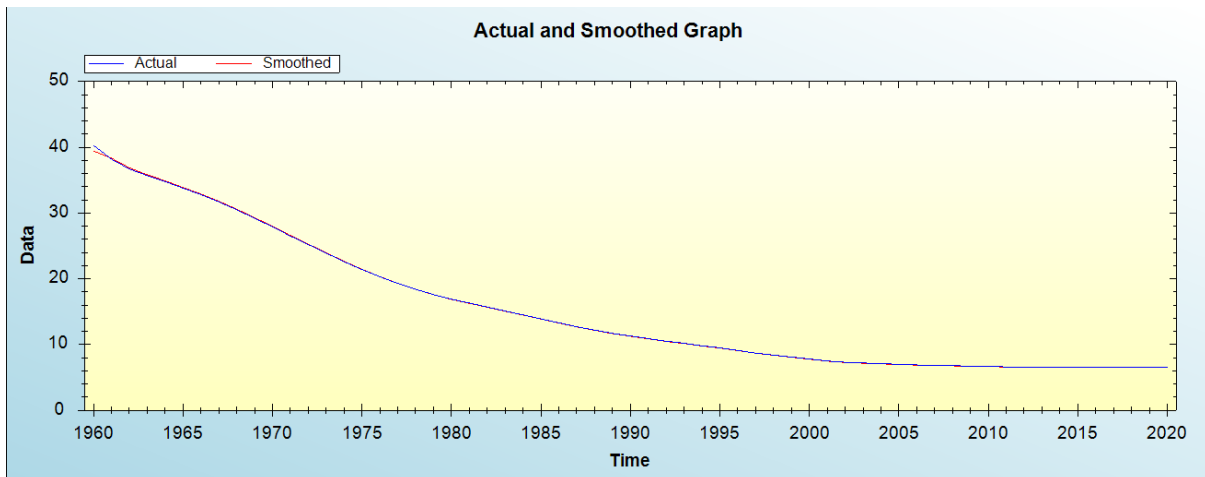


Figure 3: Actual and smoothed graph for M series

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

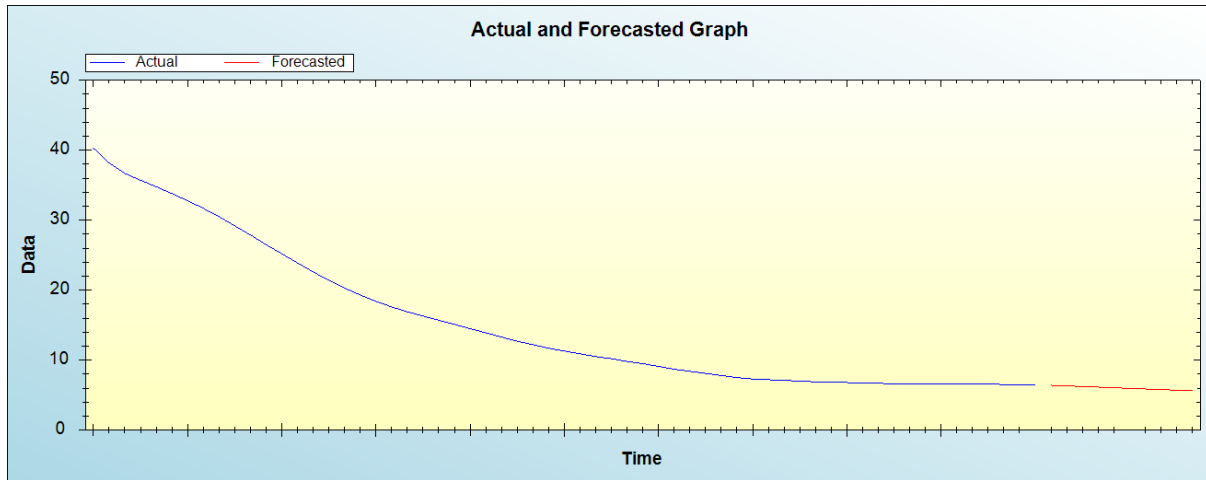


Figure 4: Out-of-sample forecast for M: actual and forecasted graph

Out-of-Sample Forecast for M: Forecasts only

Table 2: Tabulated out-of-sample forecasts

2021	6.4019
2022	6.3145
2023	6.2272
2024	6.1398
2025	6.0525
2026	5.9651
2027	5.8778
2028	5.7905
2029	5.7031
2030	5.6158

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 hover around 6 deaths per 1000 live births throughout the out of sample period.

V. POLICY IMPLICATION & CONCLUSION

Developed countries have done very well in the achievement of sustainable development goals (SDGs) as they are leading in most of the 17 thematic areas outlined in the agenda 2030 for sustainable development. However, these governments must craft strategies that will help keep under five mortality under control. This study applied the Holt’s linear method to predict under-five mortality in Mali and the results revealed that annual U5MR will hover around 6 deaths per 1000 live births throughout the out of sample period. Therefore, the authorities in Mali should continue supporting the maternal and child health program activities to maintain this desirable path.

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.
- [3] UN (2020) sustainable development goals. <https://www.un.org/sustainabledevelopment/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, “Forecasting Future Trends of Under Five Mortality Rate for Malta Using Double Exponential Smoothing” Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 6, Issue 7, pp 361-365, July 2022. Article DOI <https://doi.org/10.47001/IRJIET/2022.607077>
