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

ISSN (online): 2581-3048
Volume 7, Issue 8, pp 309-313, August-2023
https://doi.org/10.47001/IRJIET/2023.708045

Determination of Anticipated Future Trends of Annual Neonatal Mortality Rate for Jamaica Using the ARIMA Model

[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 neonatal mortality rate (NMR) for Jamaica from 1960 to 2019 to predict future trends of NMR over the period 2020 to 2030. Unit root tests have shown that the series under consideration is an I (1) variable. The optimal model based on AIC is the ARIMA (2,1,5) model. The study findings revealed that neonatal mortality will gradually decline from around 9 in 2020 to 4 deaths per 1000 live births by the end of 2030. Therefore, the Jamaican government should continuously provide adequate funding to maternal and child health programs and address local problems affecting neonatal healthcare programs in the country.**

Keywords: ARIMA, Forecasting, NMR.

I. INTRODUCTION

Jamaica is an island country in the Caribbean with an economy heavily dependent on tourism (50%) and tourism (15%) (WHO, 2018). In 2015 the country reported an under 5 mortality rate of 15.7 per 1000 live births, neonatal mortality rate (NMR) was 11.6 deaths per 1000 and Maternal mortality ratio of 89 deaths per 100 000 live births (WHO, 2018). The government's national development plan vision 2030 is an effective policy document that acts as a tool to achieve sustainable development goal 3 by 2030 which ensures good health for all at all ages. Target 3.2 aims to reduce neonatal mortality rate to at least 12 per 1000 live births in every country and under five mortality to levels as low as 25 deaths per 1000 live births by 2030 (UN, 2020; UNICEF, 2019; WHO, 2019; UNICEF, 2018). The objective of this study is to project future trends of NMR for Jamaica using the Box-Jenkins ARIMA technique. This statistical and econometric model is a useful early surveillance tool in public health. It is useful for modelling linear time series data (Nyoni, 2018; Box & Jenkins, 1970). The findings of this study are expected to inform policy, decision making and resource mobilization for maternal and child health programs in the country especially crafting effective neonatal policies that will help in controlling neonatal mortality in Jamaica. Forecast results will also assist in tracking the country's progress towards achieving SDG-3 target 3.2 by 2030.

II. LITERATURE REVIEW

Kassebaum (2021) investigated current rates, recent trends, and potential trajectories of child mortality for the next decade. The author presented the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019 findings for all-cause mortality and cause-specific mortality in children younger than 5 years of age, with multiple scenarios for child mortality in 2030 that include the consideration of potential effects of COVID-19, and a novel framework for quantifying optimal child survival. It was found that Global child mortality declined by almost half between 2000 and 2019, but progress remains slower in neonates and 65 (32%) of 204 countries, mostly in sub-Saharan Africa and south Asia, are not on track to meet either SDG 3.2 target by 2030. A description of household factors associated with under-five mortality in Bankass, a remote region in central Mali was done by Boettiger*et al.* (2021). The authors analyzed baseline household survey data from a trial being conducted in Bankass. The survey was administered to households between December 2016 and January 2017. Under-five deaths in the five years prior to baseline were documented along with detailed information on household factors and women's birth histories. Factors associated with under-five mortality were analyzed using Cox regression. The study concluded that U5 mortality is very high in Bankass and is associated with living a greater distance from healthcare and several other household factors that may be amenable to intervention or facilitate program targeting. Ewere & Eke (2020) investigated the impact of maternal / child care characteristics on neonatal mortality in Nigeria using the logistic regression model. The study concluded that stake holders in the public health sector must improve the quality of existing health care facilities and access to quality services in order to substantially reduce neonatal mortality in the country. A cross-sectional study carried out by Edem *et al.* (2020) examined the health practices, care-

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

ISSN (online): 2581-3048

Volume 7, Issue 8, pp 309-313, August-2023

https://doi.org/10.47001/IRJIET/2023.708045

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 suggested that socio-cultural factors strongly influence health seeking behavior and the health outcome of neonates in this setting. Boulos *et al*. (2017) investigated the aetiology of severe bacterial infections in neonates. Researchers conducted a secondary retrospective analysis of a de-identified database from the Neonatal Intensive Care Unit (NICU) at Nos Petit Fre`reset Soeurs-St. Damien Hospital (NPFS-SDH). Records from 1292 neonates admitted to the NICU at NPFS-SDH in Port-au-Prince Haiti from 2013 to 2015 were reviewed. Sepsis accounted for 708 of 1292 (54.8%) of all admissions to the NICU. The most common organism cultured was Streptococcus agalactiae, followed by Klebsiellapneumoniae, Pseudomonas aeroginusa, Enterobacteraerogenes, Staphylococcus aureus and Proteus mirabillis.

III. METHODOLOGY

The Box – Jenkins Approach

The first step towards model selection is to difference the series in order to achieve stationarity. Once this process is over, the researcher will then examine the correlogram in order to decide on the appropriate orders of the AR and MA components. It is important to highlight the fact that this procedure (of choosing the AR and MA components) is biased towards the use of personal judgement because there are no clear – cut rules on how to decide on the appropriate AR and MA components. Therefore, experience plays a pivotal role in this regard. The next step is the estimation of the tentative model, after which diagnostic testing shall follow. Diagnostic checking is usually done by generating the set of residuals and testing whether they satisfy the characteristics of a white noise process. If not, there would be need for model re – specification and repetition of the same process; this time from the second stage. The process may go on and on until an appropriate model is identified (Nyoni, 2018). The Box – Jenkins technique was proposed by Box & Jenkins (1970) and is widely used in many forecasting contexts.

Data Issues

This study is based on annual NMR in Jamaica for the period 1960 to 2019. The out-of-sample forecast covers the period 2020 to 2030. All the data employed in this research paper was gathered from the World Bank online database.

Evaluation of ARIMA Models

Criteria Table

Table 1: Criteria Table

Model Selection Criteria Table
Dependent Variable: D(J)
Date: 01/22/22 Time: 14:50
Sample: 1960 2019
Included observations: 59

Model	LogL	AIC*	BIC	HQ
(2,5)(0,0)	70.404146	-2.081496	-1.764584	-1.957787
(4,5)(0,0)	71.204643	-2.040835	-1.653498	-1.889635
(4,3)(0,0)	68.868357	-2.029436	-1.712523	-1.905726
(3,1)(0,0)	65.586045	-2.019866	-1.808591	-1.937393
(1,2)(0,0)	64.117342	-2.003978	-1.827915	-1.935250
(2,3)(0,0)	66.089404	-2.003031	-1.756543	-1.906812
(2,2)(0,0)	64.968613	-1.998936	-1.787661	-1.916463
(4,1)(0,0)	65.777590	-1.992461	-1.745973	-1.896242
(3,2)(0,0)	65.712538	-1.990256	-1.743768	-1.894037
(4,0)(0,0)	64.516272	-1.983602	-1.772327	-1.901129
(1,3)(0,0)	64.221628	-1.973615	-1.762340	-1.891141
(4,2)(0,0)	66.173436	-1.971981	-1.690281	-1.862017
(2,4)(0,0)	66.100269	-1.969501	-1.687801	-1.859536

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

ISSN (online): 2581-3048

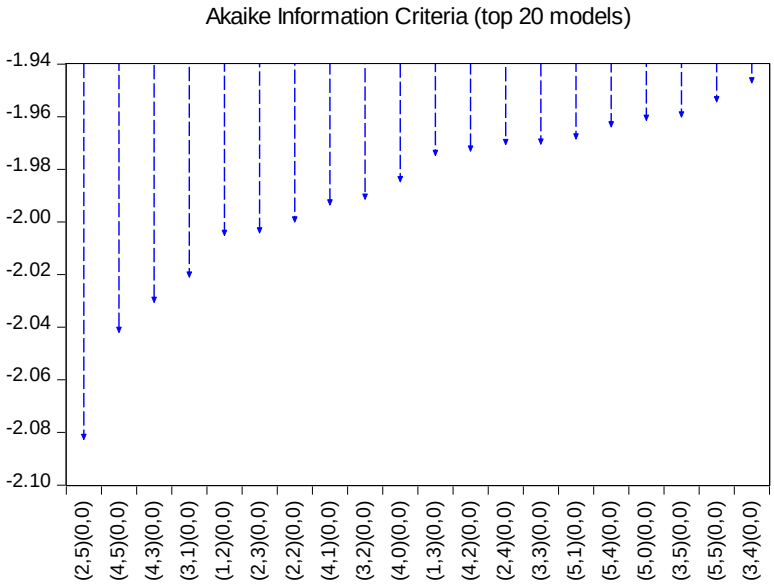
Volume 7, Issue 8, pp 309-313, August-2023

https://doi.org/10.47001/IRJIET/2023.708045

(3,3)(0,0)	66.095363	-1.969334	-1.687634	-1.859370
(5,1)(0,0)	66.037292	-1.967366	-1.685666	-1.857402
(5,4)(0,0)	68.900397	-1.962725	-1.575388	-1.811524
(5,0)(0,0)	64.826918	-1.960235	-1.713747	-1.864016
(3,5)(0,0)	67.791561	-1.959036	-1.606911	-1.821581
(5,5)(0,0)	69.621498	-1.953271	-1.530721	-1.788325
(3,4)(0,0)	66.408567	-1.946053	-1.629141	-1.822343

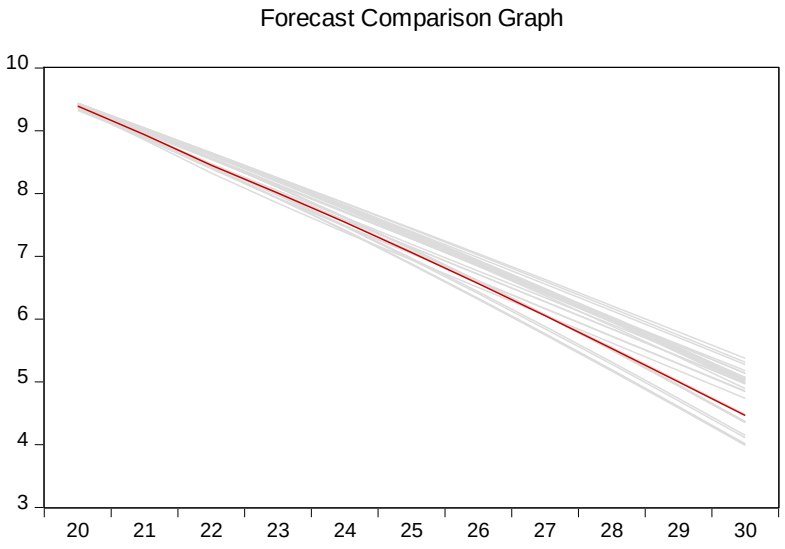
Criteria Graph

Figure 1: Criteria Graph



Forecast Comparison Graph

Figure 2: Forecast Comparison Graph



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

ISSN (online): 2581-3048

Volume 7, Issue 8, pp 309-313, August-2023

https://doi.org/10.47001/IRJIET/2023.708045

Table 1 and Figure 1 indicate that the optimal model is the ARIMA (2,1,5) model. Figure 2 is a combined forecast comparison graph showing the out-of-sample forecasts of the top 25 models evaluated based on the AIC criterion. The red line shows the forecast line graph of the optimal model, the ARIMA (2,1,5) model.

IV. RESULTS

ARIMA () Model Forecast

Tabulated Out of Sample Forecasts

Table 2: Tabulated Out of Sample Forecasts

Year	Forecasts
2020	9.392997603298812
2021	8.934945210921293
2022	8.451044053501409
2023	8.005493262371395
2024	7.541489493905225
2025	7.060250167076294
2026	6.563379826549916
2027	6.052820098771166
2028	5.530792811021036
2029	4.999737854786229
2030	4.462247458972449

Table 2 clearly indicates that neonatal mortality will gradually decline from around 9 in 2020 to 4 deaths per 1000 live births by the end of 2030.

V. POLICY IMPLICATION & CONCLUSION

Neonatal mortality remains an important public health problem across the globe and its control requires strong political commitment and timeous allocation of adequate resources. It is unfortunate to mention that low and middle income countries are currently witnessing numerous challenges that hinder progress towards achieving set targets of sustainable development goals by the end of 2030. Health authorities in various countries are encouraged to utilize limited resources at their disposal to design and implement local policies that will effectively address this problem. This study proposes the Box-Jenkins ARIMA approach to model and forecast future trends of NMR and the findings indicate that neonatal mortality will gradually decline from around 9 in 2020 to 4 deaths per 1000 live births by the end of 2030. Therefore, the Jamaican government should continuously provide adequate funding to maternal and child health programs and address local problems affecting neonatal healthcare programs in the country.

REFERENCES

[1] Box, D. E., and Jenkins, G. M. (1970). Time Series Analysis, Forecasting and Control, Holden Day, London.

[2] Nyoni, T. (2018). Box-Jenkins ARIMA Approach to Predicting net FDI Inflows in Zimbabwe, *University Library of Munich*, MPRA Paper No. 87737.

[3] WHO (2018). Jamaica country cooperation strategy at a glance, 1-2.

[4] World Health Organization (WHO) (2019). SDG 3: Ensure healthy lives and promote wellbeing for all at all ages.

[5] UNICEF (2018). Every Child alive. New York: UNICEF

[6] UNICEF (2019). Child Mortality 2019. New York: United Nations Children's Fund.

[7] UN (2020) sustainable development goals. https://www.un.org/sustainabl development/development-agenda.

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

ISSN (online): 2581-3048

Volume 7, Issue 8, pp 309-313, August-2023

https://doi.org/10.47001/IRJIET/2023.708045

Citation of this Article:

Dr. Smartson. P. NYONI, Thabani NYONI, "Determination of Anticipated Future Trends of Annual Neonatal Mortality Rate for Jamaica Using the ARIMA Model" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 7, Issue 8, pp 309-313, August 2023. Article DOI https://doi.org/10.47001/IRJIET/2023.708045

****

