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

ISSN (online): 2581-3048

Volume 7, Issue 8, pp 296-300, August-2023

https://doi.org/10.47001/IRJIET/2023.708043

# Usage of ARIMA Model Forecasts to Assess the Possibility of Eradicating All Avoidable Neonatal Deaths in Indonesia by the End of 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* - It is not surprising that neonatal mortality remains a public health problem in Indonesia. The government has implemented several strategies in an attempt to end all preventable neonatal deaths by the end of 2030.These efforts have yielded positive results as shown by the downward spiral of neonatal mortality trends over the past decades. This article uses annual time series data on neonatal mortality rate (NMR) for Indonesia 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 (2) variable. The optimal model based on AIC is the ARIMA (2,2,4) model. The findings of this study revealed that neonatal mortality will gradually decline from approximately 12 in 2020 to around 9 deaths per 1000 live births by the end of 2030.We therefore, encourage Indonesian policy-makers to design local policies that will reduce neonatal deaths (NNDs)by directing their efforts on promoting institutional deliveries, availing adequate medical supplies especially in primary healthcare facilities and provide medical staff retention packages particularly for those working in remote areas.**

***Keywords:*** ARIMA, Forecasting, NMR.

## I. INTRODUCTION

One of the global sustainable development goals (SDGs) which were launched in 2015 is SDG-3 which focuses on ensuring good health for all at all ages. SDG-3 target 3.2 aims to substantially reduce neonatal mortality rate (NMR) to at least 12 per 1000 live births and under five mortality to levels as low as 25 deaths per 1000 live births by 2030 whereas target 3.1 aims to reduce maternal mortality ratio to less than 70 maternal deaths per 100 000 live births by 2030 (UN, 2019). Child mortality is constituted by neonatal deaths (NND), postnatal deaths (PND) and under 5 deaths. Global neonatal mortality declined from 35 deaths per 1000 live births in 1990 to 19 deaths per 1000 live births in 2015 (Huge *et al*. 2019). The main causes of NND were found to be birth asphyxia, prematurity, sepsis and congenital malformations (Abdullah *et al.* 2016). The Indonesian government is committed to reducing NNDs to the set SDG target by 2030.In this paper we propose the popular Box-Jenkins ARIMA model to model and forecast NMR for Indonesia. This statistical technique is very useful in modelling linear time series data (Nyoni, 2018; Box & Jenkins, 1970). The forecast results are expected to inform policy, planning, decision making and allocation of resources towards maternal and child health programs in the country. It is also expected that evidence based neonatal interventions will be implemented timeously to curtail neonatal mortality in this Asian country.

## II. LITERATURE REVIEW

Schellekens (2021) estimated the contribution of maternal education to infant mortality decline in Indonesia. A longitudinal, individual-level analysis of the determinants of trends in infant mortality in Indonesia was done by utilizing pooled data from all available phases of the Demographic and Health Survey (1980-2015).The study findings revealed that maternal education explains 15% of the infant mortality decline in Indonesia from 1980 to 2015. Soleman *et al.*(2020)conducted a cross-sectional study in Indonesia to describe trends and main causes of children mortality in Indonesia from 2000 to 2017.The data was taken from World Health Organization Maternal Child Epidemiology Estimation from 2000 to 2017. The study found that the trend of three parameters of child mortality declined within 17 years and the main causes of mortality were premature birth in neonates, ARI in post neonates and premature birth in under five children. A comparison of Pakistan's under-five mortality, neonatal mortality, and postnatal newborn care rates with those of other countries was done by Ahmed & Won(2017). Neonatal mortality rates and postnatal newborn care rates from the Demographic and Health Surveys (DHSs) of nine low- and middle-income countries (LMIC) from Asia and Africa were analyzed. The study results indicated that postnatal newborn care in Pakistan was higher compared with the rest of countries, yet its neonatal mortality remained the worst. In Zimbabwe, both mortality rates

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

ISSN (online): 2581-3048

Volume 7, Issue 8, pp 296-300, August-2023

https://doi.org/10.47001/IRJIET/2023.708043

have been increasing, whereas the neonatal mortality rates in Nepal and Afghanistan remained unchanged. In another Indonesian study by Suparmi *et al.*(2016), cox proportion hazard regression was used to analyze the contribution of low birth weight on neonatal mortality. Authors concluded that children born with low birth weight and born from younger mothers had higher risk of neonatal mortality.

## 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 Indonesia 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 2: Criteria Table

| | | | |
|---|---|---|---|
| Model Selection Criteria Table | | | |
| Dependent Variable: DLOG(Y, 2) | | | |
| Date: 01/22/22 Time: 14:39 | | | |
| Sample: 1960 2019 | | | |
| Included observations: 58 | | | |
| Model | LogL | AIC* | BIC |
| (2,4)(0,0) | 251.595851 | -8.399857 | -8.115658 |
| (5,3)(0,0) | 252.249271 | -8.353423 | -7.998174 |
| (3,5)(0,0) | 251.576079 | -8.330210 | -7.974961 |
| (5,4)(0,0) | 252.249570 | -8.318951 | -7.928177 |
| (4,5)(0,0) | 252.064650 | -8.312574 | -7.921800 |
| (5,1)(0,0) | 248.528939 | -8.294101 | -8.009902 |
| (5,2)(0,0) | 246.869568 | -8.202399 | -7.882675 |
| (1,0)(0,0) | 240.733295 | -8.197700 | -8.091125 |
| (1,5)(0,0) | 245.633382 | -8.194255 | -7.910056 |
| (0,1)(0,0) | 240.421323 | -8.186942 | -8.080368 |
| (0,2)(0,0) | 241.278131 | -8.182005 | -8.039905 |
| (0,5)(0,0) | 244.167592 | -8.178193 | -7.929519 |
| (0,0)(0,0) | 238.960091 | -8.171038 | -8.099988 |
| (0,3)(0,0) | 241.908509 | -8.169259 | -7.991635 |
| (2,5)(0,0) | 245.842956 | -8.166998 | -7.847275 |
| (2,0)(0,0) | 240.819124 | -8.166177 | -8.024077 |
| (1,1)(0,0) | 240.773165 | -8.164592 | -8.022492 |
| (3,3)(0,0) | 244.661127 | -8.160729 | -7.876529 |

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

**ISSN (online): 2581-3048**

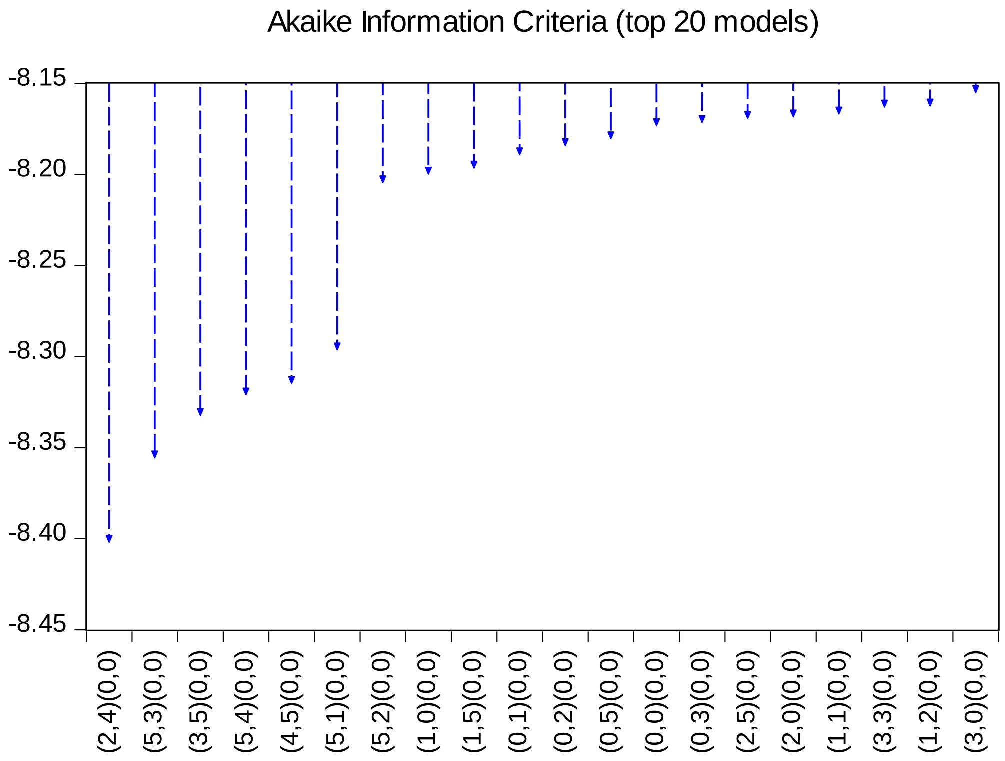
**Volume 7, Issue 8, pp 296-300, August-2023**

https://doi.org/10.47001/IRJIET/2023.708043

| | | | |
|---|---|---|---|
| (1,2)(0,0) | 241.644131 | -8.160142 | -7.982518 |
| (3,0)(0,0) | 241.434207 | -8.152904 | -7.975279 |

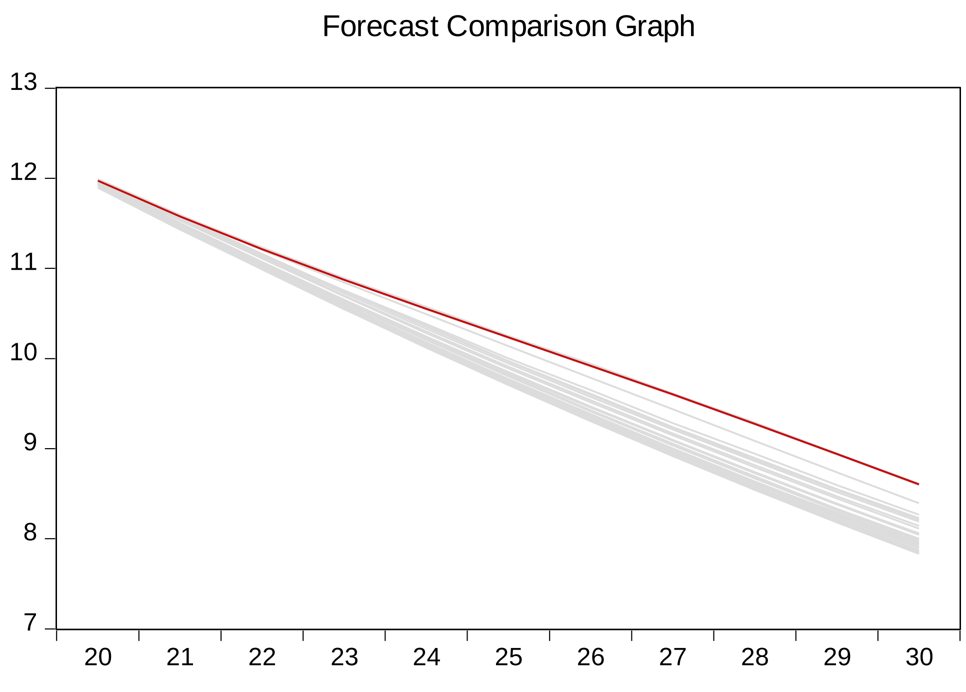
**Criteria Graph**

Figure 1: Criteria Graph




**Forecast Comparison Graph**

Figure 2: Forecast Comparison Graph



ISSN (online): 2581-3048
Volume 7, Issue 8, pp 296-300, August-2023
https://doi.org/10.47001/IRJIET/2023.708043

Table 1 and Figure 1 indicate that the optimal model is the ARIMA (2,2,4) 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 (2,2,4) model.

## IV. RESULTS

**ARIMA () Model Forecast**

**Tabulated Out of Sample Forecasts**

Table 5: Tabulated Out of Sample Forecasts

| Year | Forecasts |
|---|---|
| 2020 | 11.97275408318479 |
| 2021 | 11.57699748055646 |
| 2022 | 11.21333007670367 |
| 2023 | 10.87393351195185 |
| 2024 | 10.55041524300124 |
| 2025 | 10.23472968795417 |
| 2026 | 9.919997654284111 |
| 2027 | 9.601146270813738 |
| 2028 | 9.275299071471737 |
| 2029 | 8.94187190733672 |
| 2030 | 8.602372997571478 |

Table 2 clearly indicates that neonatal mortality will gradually decline from approximately 12 in 2020 to around 9 deaths per 1000 live births by the end of 2030.

## V. POLICY IMPLICATION & CONCLUSION

Countries in South-Central Asia just like Sub-Saharan African countries are battling the challenge of neonatal mortality. Several factors have been identified as causes of deaths in neonates such as prematurity, birth asphyxia, congenital anomalies and sepsis. It is crucial to mention that home deliveries, teenage pregnancies and failure to recognize complications early contribute significantly to maternal and neonatal mortality. This study applied the Box-Jenkins ARIMA approach to model and forecast neonatal mortality for Indonesia and the findings suggest thatneonatal mortality will gradually decline from approximately 12 in 2020 to around 9 deaths per 1000 live births by the end of 2030.We therefore, encourage the Indonesian policy-makers to design local policies that will help reduce neonatal deaths (NNDs) by directing their efforts on promoting institutional deliveries, availing adequate medical supplies especially in primary healthcare facilities and provide medical staff retention packages particularly for those working in remote areas.

## 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] United Nations (2019). The Sustainable Development Goals Report. 2019.https://unstats.un.org
[4] Abdullah A., Hort K., Butu Y., and Simpson L (2016). Risk factors associated with neonatal deaths: a matched case control study in Indonesia. Glob Health Action, 2016, 9, 1–12.
[5] Hug L., Alexander M., You D., and Alkema L (2019). National, regional, and global levels and trends in neonatal mortality between 1990 and 2017, with scenario-based projections to 2030: a systematic analysis. Lancet Glob Heal, 7, 6, e710–20.

**ISSN (online): 2581-3048**
**Volume 7, Issue 8, pp 296-300, August-2023**
https://doi.org/10.47001/IRJIET/2023.708043

**Citation of this Article:**

Dr. Smartson. P. NYONI, Thabani NYONI, "Usage of ARIMA Model Forecasts to Assess the Possibility of Eradicating All Avoidable Neonatal Deaths in Indonesia by the End of 2030" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 7, Issue 8, pp 296-300, August 2023. Article DOI https://doi.org/10.47001/IRJIET/2023.708043

*******