

Detecting Future Trends Of Maternal Mortality For Australia Using A Machine Learning Technique

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ABSTRACT

This research article employs annual time series data on MMR for Australia from 1985 to 2023 to predict future trends of MMR over the period 2024 to 2035. The forecast evaluation criteria of the applied model indicate that the ANN (12, 12, 1) model is stable. The neural network model projections revealed that MMR will remain very low throughout the out of sample period. Therefore, we encourage the government to continue addressing local causes of preventable maternal deaths and surveillance of severe maternal morbidity at all levels of healthcare.

Keywords:

Introduction

Maternal mortality rate (MMR) is defined as the number of deaths due to complications of the pregnancy (direct deaths) or aggravation of existing disease processes by the pregnancy (indirect deaths) per 100 000 women giving birth (WHO, 2024; WHO, 2012). The calculation does not include deaths from unrelated causes that occur in pregnancy or the puerperium (incidental deaths) and deaths that occur more than 42 days after the end of a pregnancy (WHO, 2015). The death of a mother or a baby has significant immediate and late impacts for the surviving child, family members, community and health workers who cared for them. The World Health Organization estimated that 303 000 women died in pregnancy and childbirth in 2015, with 99% of these deaths happened in low-income countries. The MMR in Australia is low; it declined from 41.2 in the 1964 -1966 period to 7.1 over the period 2008 -2012 (Humphrey et al. 2015). The aim of this study is to model and forecast MMR for Australia using a machine learning technique. The results of the study are expected to inform policy and allocation of resources to the healthcare sector.

Literature Review

Author(s)	Objective(s)	Methodology	Main finding(s)
Mackin et al. (2026)	to understand how levels of MNH care are organized in different country contexts	Scoping review	Three or four levels of MNH facility care were most commonly reported. Linking maternal and newborn facility care to community connections is an

			important consideration to ensure equitable access to routine and emergency care.
Tsushima et al. (2026)	To determine the long-term incidence of dysglycemia and dyslipidemia after GDM and evaluated whether postpartum changes in body mass index (BMI) independently predicted these outcomes.	Prospective cohort study	Postpartum BMI increase was independently associated with new-onset dysglycemia. No independent predictor of T2DM progression was identified. Dyslipidemia was independently associated with higher pre-pregnancy BMI and multiparity, whereas postpartum BMI change was not independently associated after multivariable adjustment
Yue et al. (2026)	to perform an umbrella review to summarize the current evidence to provide a reference for clinicians and future research	Systematic review	Positive aPLs significantly increased the risk of miscarriage rate in assisted reproductive technology (ART) and were also associated with total fetal loss, PE, intrauterine growth retardation and placental abruption
Nunn et al. (2025)	To explore whether changes in key characteristics among Victorian Aboriginal and/or Torres Strait Islander women contributed to reduced perinatal death rates	Retrospective population-based cohort study of all births in Victoria from 2000–2019	Changes in key maternal characteristics may have contributed to improved perinatal death rates among babies of Victorian Aboriginal and/or Torres Strait Islander women

Diguisto et al. (2022)	To compare maternal mortality in eight countries with enhanced surveillance systems	Descriptive multi-country population-based study	Variations in maternal mortality ratios exist between high income European countries with enhanced surveillance systems
Morong et al. (2017)	This study was a retrospective cohort study of cases of in-hospital maternal deaths in the Ochsner Health System (Louisiana, United States) and the Queensland Health System (Australia) from 1995 to 2013	-to determine if American and Australian women have a similar rate of preventable maternal death and if the deaths were attributable to the same factors	Women from Louisiana, United States and Queensland, Australia have similar rates of preventable maternal death. No statistically significant factors explained trends in Australian maternal death; American maternal mortality was significantly associated with point of entry into prenatal care, likely influenced by insurance status
Nahidi & Hajifoghaha (2017)	To provide the current situation and trend of MMR in the Eastern Mediterranean region between 1990 and 2015	Systematic review	Based on the collected data, 36 out of 66 studies met the required criteria and were chosen for analysis. All countries of this region showed a downward trend between 1990 and 2015, and this change varied from 16.30% in Yemen to 76.56% in Lebanon. The maternal mortality reduction was 69.88% in Iran in the same time
Bouvier-Colle et al. (2012)	To assess capacity to develop routine monitoring of maternal health in the European Union	Analysis of aggregate data from routine statistical systems compiled by the EURO-PERISTAT	Currently available data on maternal mortality and morbidity are insufficient for

	using indicators of maternal mortality and severe morbidity	project and comparison with data from national enquiries	monitoring trends over time in Europe and for comparison between countries

Methodology

The Artificial Neural Network (ANN) approach, which is flexible and capable of nonlinear modelling; will be applied in this study. The ANN is a data processing system consisting of a large number of highly interconnected processing elements in architecture inspired by the way biological nervous systems of the brain appear like. Since no explicit guidelines exist for the determination of the ANN structure, the study applies the popular ANN (12, 12, 1) model based on the hyperbolic tangent activation function. This paper applies the Artificial Neural Network (ANN) approach in predicting annual maternal mortality ratio (MMR) for Australia.

Data Issues

This study is based on annual MMR in Australia for the period 1985 – 2023. The out-of-sample forecast covers the period 2024 – 2035. All the data employed in this research paper was gathered from the World Bank online database.

Findings

ANN Model Summary

Table 1: ANN model summary

Variable	A
Observations	27 (after adjusting endpoints)
Neural Network Architecture:	
Input Layer Neurons	12
Hidden Layer Neurons	12
Output Layer Neurons	1
Activation Function	Hyperbolic Tangent Function
Back Propagation Learning	
Learning Rate	0.005
Momentum	0.05
Criteria:	
Error	0.091668
MSE	0.089488
MAE	0.235016

Residual Analysis for the Applied Model

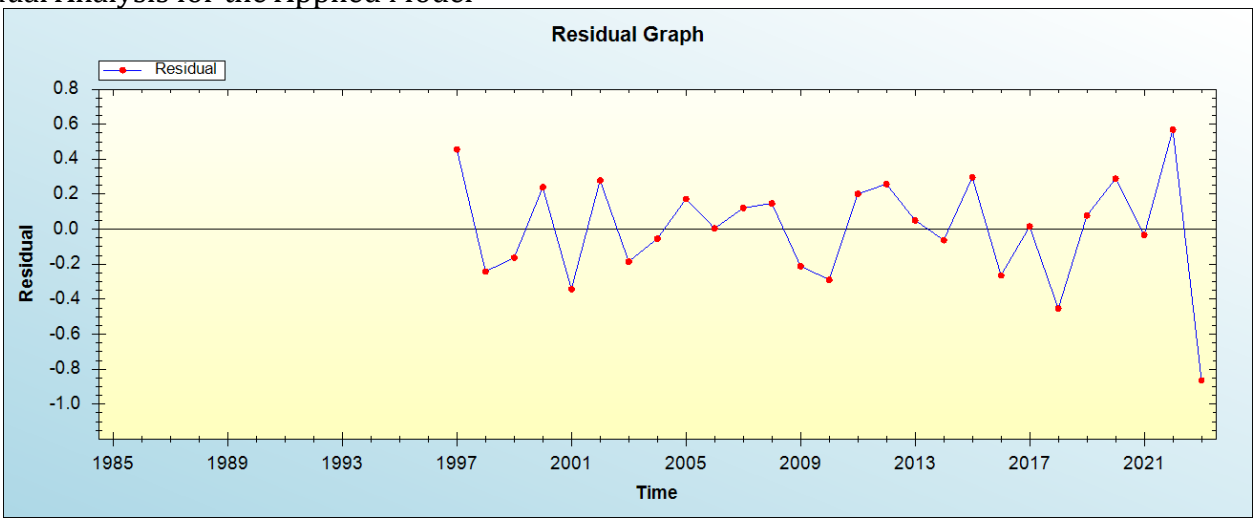


Figure 1: Residual analysis

In-sample Forecast for A

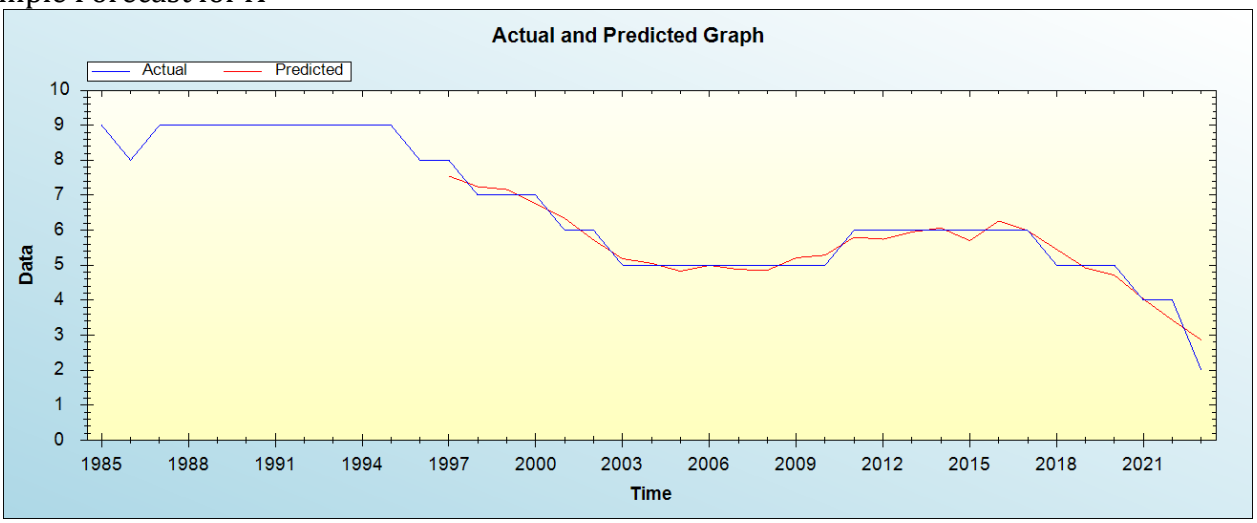


Figure 2: In-sample forecast for the A series

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

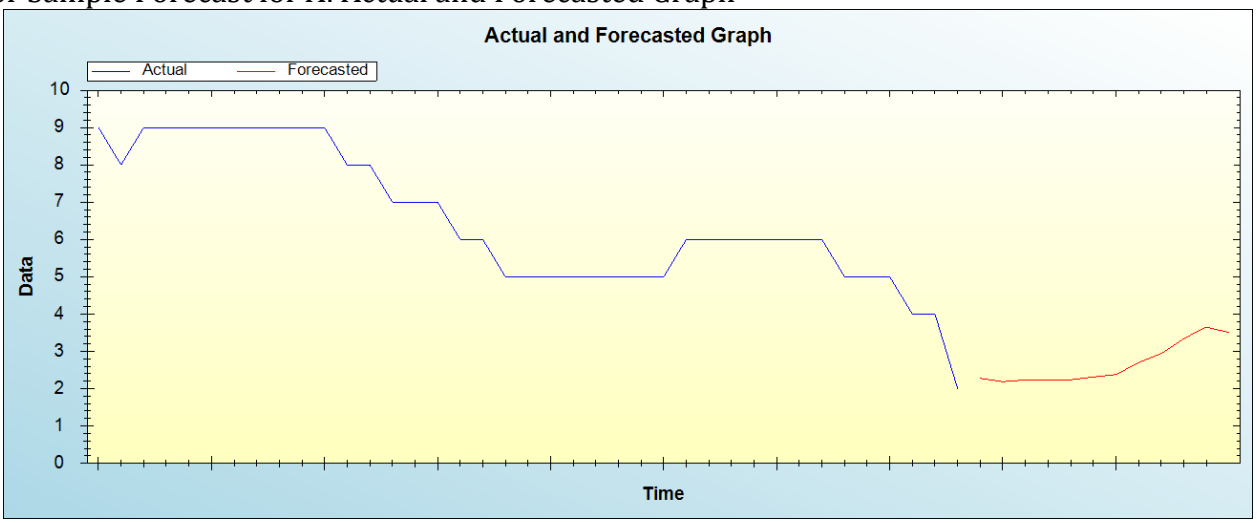


Figure 3: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasted MMR
2024	2.2774
2025	2.1877
2026	2.2333
2027	2.2292
2028	2.2394
2029	2.3124
2030	2.3778
2031	2.6964
2032	2.9385
2033	3.3423
2034	3.6518
2035	3.5061

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 MMR will remain very low throughout the out of sample period.

Conclusion

This paper demonstrates the use of a machine learning model in forecasting MMR for Australia. Historical data shows that health authorities have managed to substantially reduce maternal mortality to levels below 30 per 100 000 live births. This reflects the high quality maternal and child health services being offered in the country. Forecast results indicate that MMR will remain very low throughout the out of sample period. We therefore encourage authorities to continue addressing local drivers of maternal deaths and surveillance of severe maternal morbidity (SMM) at all levels of health care.

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