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

ISSN (online): 2581-3048

Volume 5, Issue 8, pp 211-215, August-2021

https://doi.org/10.47001/IRJIET/2021.508044

Projecting Total Fertility Rates for Jordan Using Artificial Neural Networks

[1]Dr. Smartson. P. NYONI, [2]Tatenda. A. CHIHOHO, [3]Thabani NYONI

[1]ZICHIRe Project, University of Zimbabwe, Harare, Zimbabwe
[2]Independent Health Economist
[3]SAGIT Innovation Center, Harare, Zimbabwe

***Abstract* - This study intended to predict total fertility rates (TFR) for Jordan using Artificial Neural Networks from 2019 to 2030. Jordanian data on TFRs from World Bank Online database from 1960 to 2018 was used. Results show that TFRs for Jordan is predicted to slightly increase from 3.2 to 3.4 in 2027 before declining to 3.2 by 2030.**

Keywords: ANN, Forecasting, Total fertility rate (TFR).

I. INTRODUCTION

Fertility levels of Jordanian women has been as high as 7.7 in the late 1970s, one of the highest rates in the Arab region (Anderson et al, 1985). Since then, fertility has been falling slowly, reaching 2.8 in 2018 (World Bank Indicators). Such demographic transition has direct impact on the age structure and composition of the Jordanian population thereby influencing resource allocation, social structure and economic development for Jordan. Which then brings about the need for public policies tailored to align economic resources with the new demographic structure or to change that demographic structure so that the economy grows. This study therefore aims to predict the future path of total fertility rates (TFR) in Jordan up to the year 2030 and that data may be used by authorities in Jordan to make informed decisions on public policies to influence population and economic dynamics in Jordan.

II. LITERATURE REVIEW

A brief review of literature on TFRs is given below:

Table 1: Literature on TFRs

Author/s (Year)	Study period	Method	Topic	Key results
Rizk (1977)	1950 to 1975	-quantitative analysis	Trends in fertility and family planning in Jordan	-50% of married women said they had used contraceptives at some time in their lives -75% did not attempt to prevent pregnancy until they had at least 4 pregnancies -41% had 7 or more before using contraceptives
Rasheed and Tashtoush (2021)	2007 and 2012	Multiple regression analysis	The fertility and its relation with some demographic, economic and social variables in Jordan	-fertility levels are lower in urban areas than in rural areas -average age at first marriage, proportion of women in labour force, number of hospitals, doctors nurses and midwives are statistically significant in affecting fertility
Anderson et al (1985)	1983	-quantitative analysis	Fertility trends and determinants in Jordan	-TFR was 8 -By 30 years of age women will have at least 5 children -current fertility levels are lower than those observed 15 years ago -little increase in the use of contraceptives -fertility decline was due to later

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

ISSN (online): 2581-3048

Volume 5, Issue 8, pp 211-215, August-2021

https://doi.org/10.47001/IRJIET/2021.508044

				marriages
Cetorelli and Leone (2012)	1990, 1997, 2002, 2007 and 2009	-Linear regression model	Is fertility stalling in Jordan?	-fertility is really stalling in Jordan and not due to data errors -for more than ten years fertility in Jordan has remained constant at a rate more than 3.5 children
Gubhaju, Jongstra and Raikoti (2013)	1966, 1976, 1986, 1996, 2007	-own children method, Cho 1973. -Decomposition analysis technique	- Below replacement fertility of ethnic Indians in Fiji: a decomposition analysis of the components of changes in the total fertility rate	- educational attainment has a significant, negative impact on fertility -changes in marital structure have a negative impact on fertility in Fiji -marital fertility is positively related to TFR in Fiji
Ismail and Hussein (2018)	1995-2014,2015,	-comparative statistical analysis -finite mixture clustering model	Population ageing and long-term care policies in the Gulf region: a case study of Oman	-Oman had average life expectancy of 77 -Oman's TFR was relatively lower than other Arab countries
Tabyshalieva (1997)	Soviet to post-Soviet era	Narrative review	Women of Central Asia and the fertility cult	-development of Central Asia from viewing women as second class, inferior citizens to their emancipation as mothers with equal rights to men as evidenced by their participation in economic growth programmes and provision of education and health facilities for them
Al-Riyami and Afifi (2003)	2000	-multi stage stratified probability design -multiple linear regression model	Determinants of women fertility in Oman	-women with higher freedom of movement were more likely to have less children in the first 20 years -women with high score of decision making are more likely to have longer closed birth interval than those with lower score

III. METHODOLOGY

The Artificial Neural Network (ANN) approach, which is flexible and capable of nonlinear modeling; 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 total fertility rates in Jordan.

Data Issues

This study is based on annual total fertility rate (births per woman) in Jordan for the period 1960 – 2018. The out-of-sample forecast covers the period 2019 – 2030. All the data employed in this research paper was gathered from the World Bank online database.

IV. FINDINGS OF THE STUDY

ANN Model Summary

Table 2: ANN model summary

Variable	TFR
Included Observation	47 (After Adjusting Endpoints)
Neural Network Architecture	
Input Layer Neurons	12

International Research Journal of Innovations in Engineering and Technology (IRJIET)
ISSN (online): 2581-3048
Volume 5, Issue 8, pp 211-215, August-2021
https://doi.org/10.47001/IRJIET/2021.508044

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	0.061177
MSE	0.032447
MAE	0.151351

Residual Analysis for the Applied Model

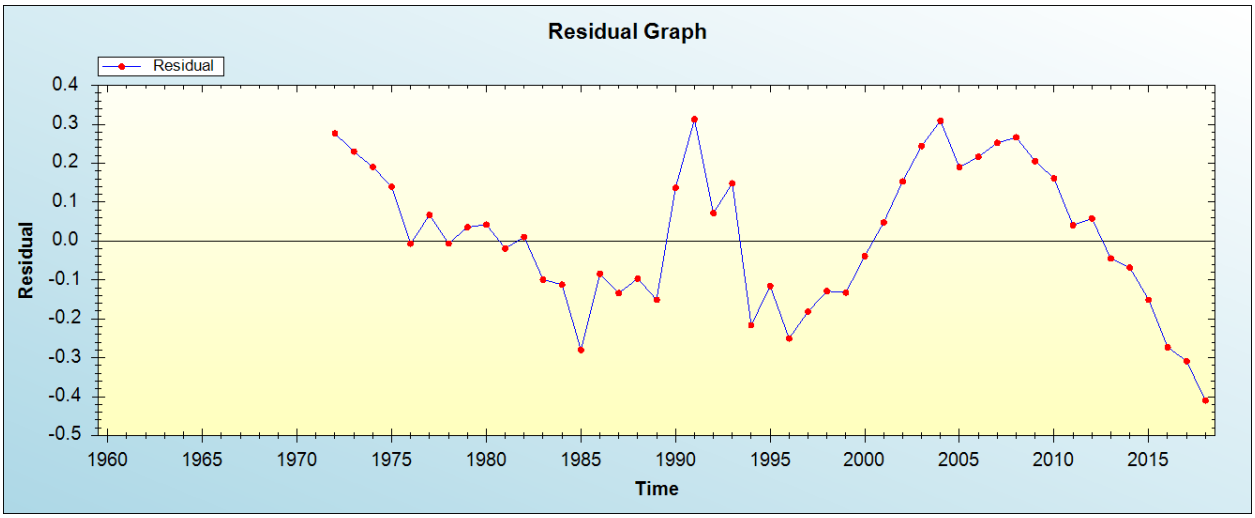

Figure 1: Residual analysis

In-sample Forecast for TFR

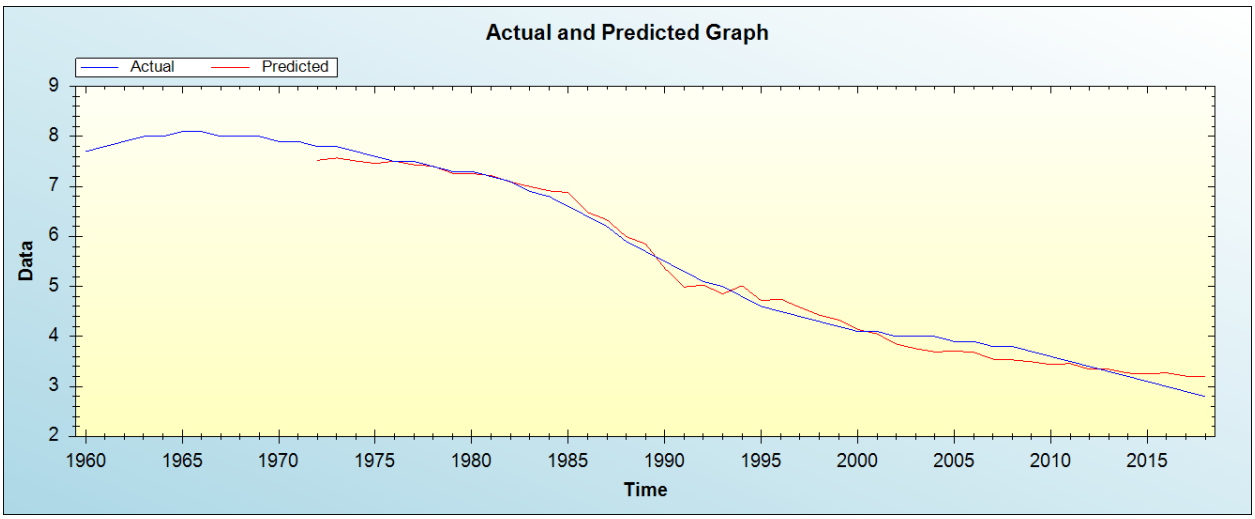

Figure 2: In-sample forecast for the TFR series

International Research Journal of Innovations in Engineering and Technology (IRJIET)
ISSN (online): 2581-3048
Volume 5, Issue 8, pp 211-215, August-2021
https://doi.org/10.47001/IRJIET/2021.508044

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

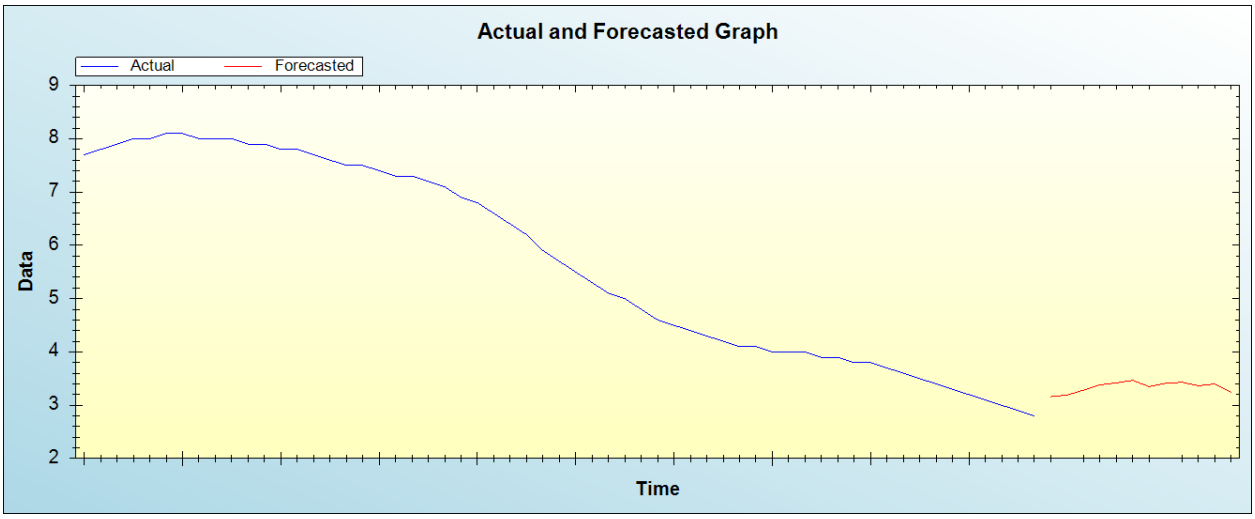

Figure 3: Out-of-sample forecast for TFR: actual and forecasted graph

Out-of-Sample Forecast for TFR: Forecasts only

Table 3: Tabulated out-of-sample forecasts

Year	Forecasted
2019	3.1616
2020	3.1931
2021	3.2842
2022	3.3818
2023	3.4197
2024	3.4669
2025	3.3492
2026	3.4118
2027	3.4319
2028	3.3664
2029	3.3982
2030	3.2455

The main results of the study are shown in table 2. 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 total fertility rates in Jordan are likely to slightly increase until 2027 before slightly falling.

V. CONCLUSIONS AND RECOMMENDATIONS

The results show that future TFRs for Jordan will slightly increase from 3.2 in 2019 to 3.4 in 2027 before falling to 3.2 by 2030. These rates are above the replacement level of 2.1 meaning that Jordanian population will continue to grow during the out of sample period ceteris paribus. There is need for the authorities to consider birth control policies and incentives as well as technological innovation to match future population growth with resources.

REFERENCES

[1] Al-Riyami, A. A., & Afifi, M. (2003). Determinants of women's fertility in Oman, Saudi Medical Journal, 24(7), 748-753.
[2] Anderson, J. F. et al. (1985). Fertility trends and determinants in Jordan, International Family Planning Perspectives, 11(2), 47.
[3] Cetorelli, V., & Leone, T. (2012). Is fertility stalling in Jordan? Demographic Research, 26(13), 293-318.

ISSN (online): 2581-3048
Volume 5, Issue 8, pp 211-215, August-2021
https://doi.org/10.47001/IRJIET/2021.508044

[4] Gubhaju, B., Jongstra, E., & Raikoti, M. (2013). Below-replacement fertility of ethnic Indians in Fiji: a decomposition analysis of the components of changes in the total fertility, International Population Conference, Busan, South Korea.
[5] Ismail, M., & Hussein, S. (2018). Population aging and long-term care policies in the Gulf region: A case study of Oman, Journal of Aging and Social Policy, 1-20.
[6] Rasheed, N. M., & Tashtoush, M. A. (2021). The fertility and its relation with some demographic, economic and social variables in Jordan, Turkish Journal of Computer and Mathematics Education, 12(11), 5088-5095.
[7] Rizk, H. (1977). Trends in fertility and family planning in Jordan, Studies in Family Planning, 8(4), 91
[8] Tabyshalieva, A. (1997). Women of Central Asia and the fertility cult, Anthropology and Archaeology of Eurasia, 36(2), 45-62.

Citation of this Article:

Dr. Smartson. P. NYONI, Tatenda. A. CHIHOHO, Thabani NYONI, "Projecting Total Fertility Rates for Jordan Using Artificial Neural Networks" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 8, pp 211-215, August 2021. Article DOI https://doi.org/10.47001/IRJIET/2021.508044

****

