

# Demonstrating the Importance of Evidence-Based Adolescent Health Policy-Making and Implementation of Effective Strategies in Iraq through the Use of a Smoothing Technique

<sup>1</sup>Smartson. P. NYONI, <sup>2</sup>Thabani NYONI

<sup>1</sup>ZICHIRE Project, University of Zimbabwe, Harare, Zimbabwe

<sup>2</sup>Independent Researcher & Health Economist, Harare, Zimbabwe

**Abstract** - This research article uses annual time series data of adolescent fertility rate for Iraq from 1960 to 2020 to predict future trends of adolescent fertility rate over the period 2021 to 2030. The study utilizes Holt's linear exponential smoothing model. The optimal values of smoothing constants  $\alpha$  and  $\beta$  are 0.9 and 0.8 respectively based on minimum MSE. The results of the study indicate that annual adolescent fertility rate will hover around 72 births per 1000 women aged 15-19 years throughout the out of sample period. Therefore, we encourage policy makers in Iraq to strictly enforce laws that protect the rights of women and girls, set up adolescent friendly clinics and establish a youth fund that will finance various youth empowerment projects.

**Keywords:** Exponential smoothing, Forecasting, adolescent fertility rate.

## I. INTRODUCTION

By the end of 2030, all UN member countries are expected to meet their sustainable development goal targets including that of substantial reduction of maternal and child mortality. The global maternal mortality should decrease to levels below 70 maternal deaths per 100 000 live births, neonatal mortality should drop down to levels as low as 12 deaths per 1000 live births and under five mortality should decline to levels as low as 25 deaths per 1000 live births (UN, 2020; WHO, 2019; UNICEF, 2018; UN, 2016; UN, 2016). The burden of maternal and child mortality is more pronounced in low and middle income countries as a result of a myriad of persistent challenges such as poverty, mass exodus of health workers due to poor remuneration, political conflicts, poor health infrastructure and economic crisis driven by climate change and the COVID-19 pandemic. It is important to highlight that adverse pregnancy outcomes are largely preventable therefore health authorities in different countries should make an effort of identifying local challenges and address those using available resources. Teenage pregnancy being one of the drivers of maternal and child mortality must be given special attention it deserves. Previous research papers indicated that pregnant adolescents have a higher risk of experiencing adverse sexual and reproductive health outcomes when compared to women in their twenties (Woog & Kagesten, 2017; Greene, 2015; Tebeu *et al.* 2012). In addition, infants born to teenage mothers are prone to neonatal complications such as low birth and prematurity (Amjad *et al.* 2019; Grønvik & Fossgard, 2018; Kirbas *et al.* 2016; Neal *et al.* 2016). Previous researchers revealed that poverty, low education levels, inadequate sexual and reproductive health knowledge, low contraceptive prevalence are the major drivers of teenage pregnancy (Coast *et al.* 2019; Yount *et al.* 2017). Iraq continues to report high teenage pregnancy rates despite government measures that have been put in place to curb the problem. According to World Bank reports, adolescent fertility rate dropped from around 141 births per 1000 women aged 15-19 in 1960 to around 72 births per 1000 women aged 15-19 in 2020. This indicates that teenage pregnancy is still high and there is urgent need to come up with new strategies to bring down adolescent fertility in the country.

The purpose of this paper is to forecast future trends of adolescent fertility in Iraq using the double exponential smoothing technique. Findings are envisioned to highlight the future burden of adolescent fertility in the out of sample period. This will form the basis of reviewing current legal instruments and policies in order to urgently address child marriage and teenage pregnancy with a goal to reduce adverse maternal and child health outcomes in the country.

## II. METHODOLOGY

This study utilizes an exponential smoothing technique to model and forecast future trends of adolescent fertility rate in Iraq. 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.

Holt's double exponential smoothing method is specified as follows:

### Model equation

$$A_t = \mu_t + \rho_t t + \varepsilon_t$$

### Smoothing equation

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

$$0 < \alpha < 1$$

### Trend estimation equation

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

$$0 < \beta < 1$$

### Forecasting equation

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

$A_t$  is the adolescent fertility rate at time  $t$

$\varepsilon_t$  is the time varying **error term**

$\mu_t$  is the time varying mean (**level**) term

$\rho_t$  is the time varying **slope term**

$t$  is the trend component of the time series

$L_t$  is the exponentially smoothed value of adolescent fertility rate at time  $t$

$\alpha$  is the exponential smoothing constant for the data

$\beta$  is the smoothing constant for trend

$f_{t+h}$  is the  $h$  step ahead forecast

$b_t$  is the trend estimate at time  $t$

$b_{t-1}$  is the trend estimate at time  $t-1$

### **Data Issues**

This study is based on annual adolescent fertility rate in Iraq 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.

### III. FINDINGS OF THE STUDY

#### Exponential smoothing Model Summary

Table 1: ES model summary

Variable	A
Included Observations	61
Smoothing constants	
Alpha ( $\alpha$ ) for data	0.900
Beta ( $\beta$ ) for trend	0.800
Forecast performance measures	
Mean Absolute Error (MAE)	0.763295
Sum Square Error (SSE)	204.889737
Mean Square Error (MSE)	3.358848
Mean Percentage Error (MPE)	0.099777
Mean Absolute Percentage Error (MAPE)	0.721695

#### Residual Analysis for the Applied Model

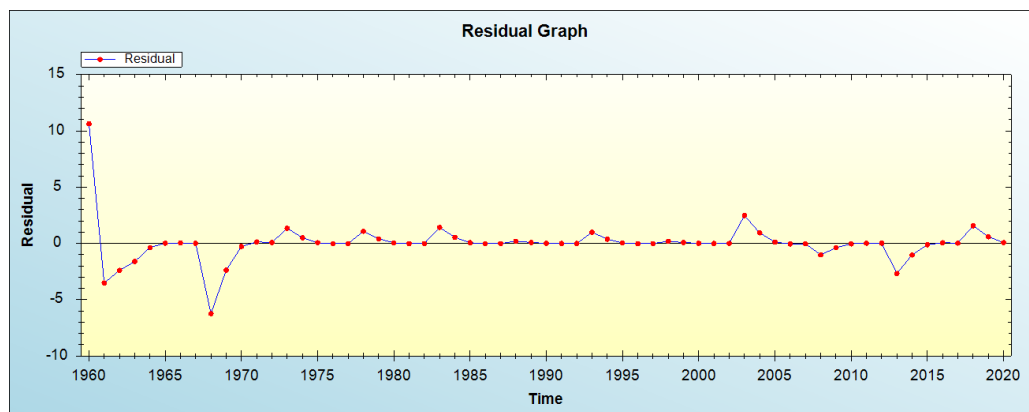


Figure 1: Residual analysis

#### In-sample Forecast for A

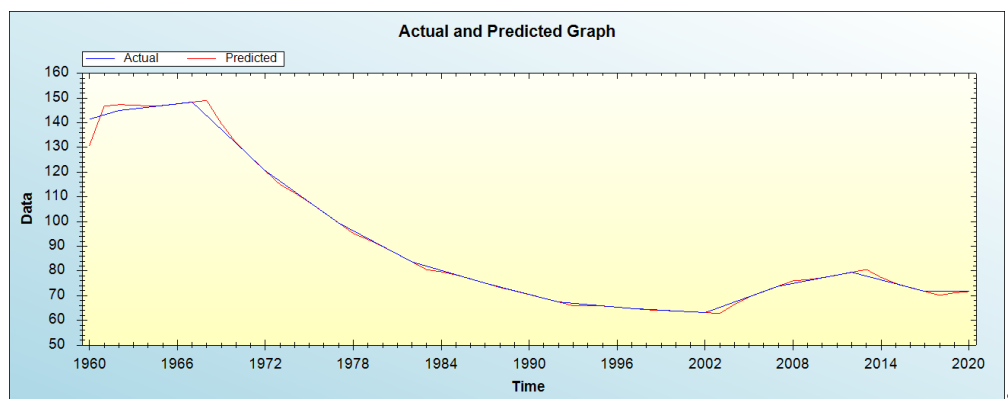


Figure 2: In-sample forecast for the A series

Actual and Smoothed graph for A series

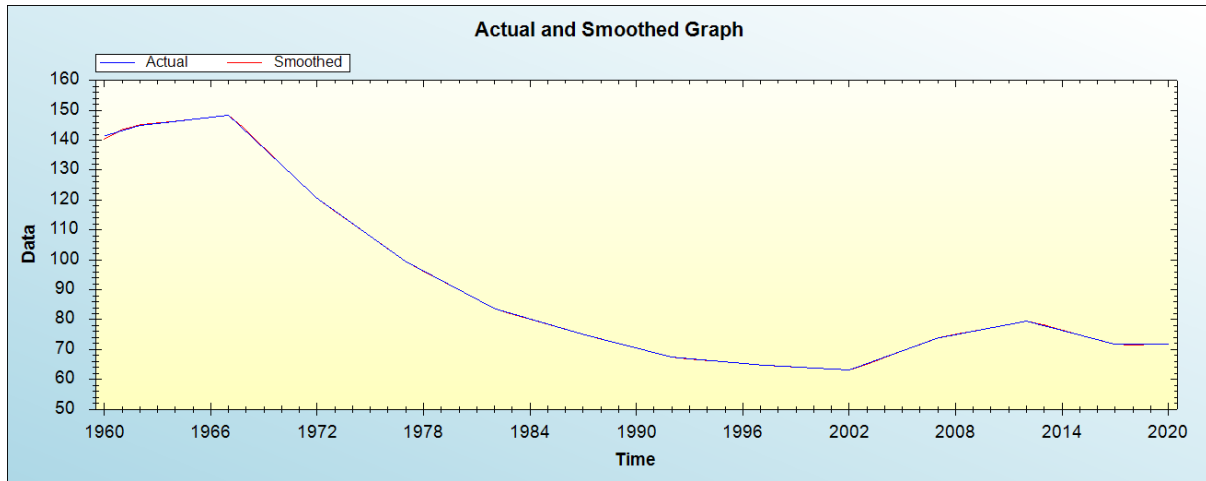


Figure 3: Actual and smoothed graph for A series

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

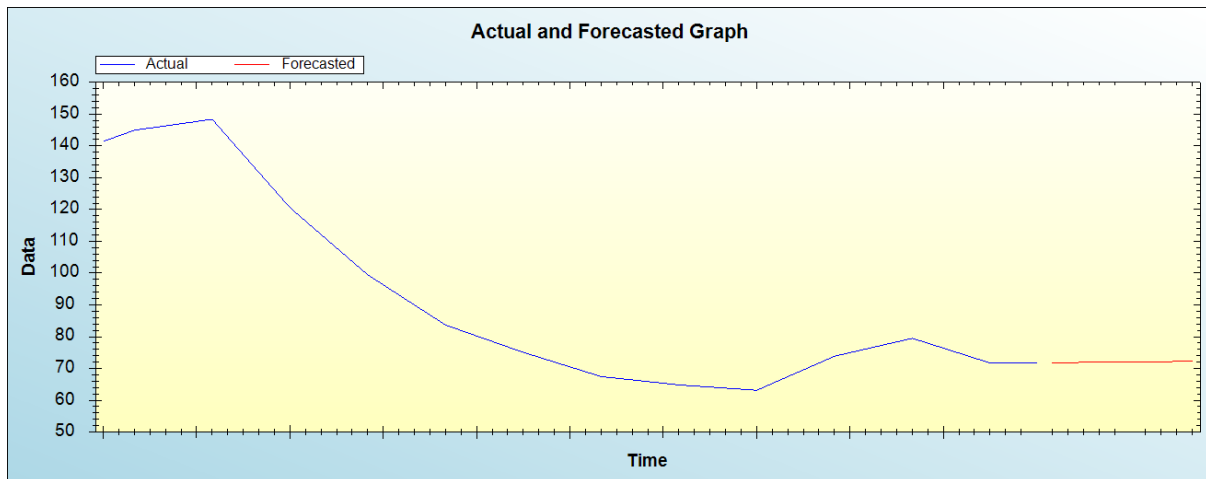


Figure 4: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasted adolescent fertility rate
2021	71.8007
2022	71.8494
2023	71.8981
2024	71.9468
2025	71.9955
2026	72.0442
2027	72.0929
2028	72.1416
2029	72.1903
2030	72.2390

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 adolescent fertility will hover around 72 births per 1000 women aged 15-19 years throughout the out of sample period.

#### IV. POLICY IMPLICATION & CONCLUSION

Iraq continues to report high teenage pregnancy rates despite government measures that have been put in place to curb the problem. Adolescent fertility rate declined from around 141 births per 1000 women aged 15-19 in 1960 to around 72 births per 1000 women aged 15-19 in 2020. This indicates that teenage pregnancy is still high and there is urgent need to come up with new initiatives to bring down adolescent fertility in the country. Poverty, low educational levels, inadequate sexual and reproductive health knowledge, refusal to use contraceptives are the major drivers of teenage pregnancy. This study proposed Holt's double exponential smoothing technique to forecast future trends of adolescent fertility for Iraq. Our study findings revealed that adolescent fertility will hover around 72 births per 1000 women aged 15-19 years throughout the out of sample period. Therefore, the government must strictly enforce laws that protect the rights of women and girls, set up adolescent friendly clinics and establish a youth fund that will finance various youth empowerment projects.

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