

Tracking Progress towards Substantial Reduction of Adolescent Fertility for Algeria Using the Double Exponential Smoothing Approach

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Abstract - This research article uses annual time series data of adolescent fertility rate for Algeria from 1960 to 2020 to predict future trends of adolescent fertility over the period 2021 to 2030. The study utilizes Holt's linear exponential smoothing model. The optimal values of smoothing constants α and β are 0.9 and 0.9 respectively based on minimum MSE. The results of the study indicate that annual adolescent fertility will continue to decline throughout the out of sample period. Therefore, we encourage authorities in Algeria to address local factors which significantly contribute to teenage pregnancy.

Keywords: Exponential smoothing, Forecasting, adolescent fertility rate.

I. INTRODUCTION

Universal access to quality and affordable healthcare is very critical for socio-economic development. The 3rd sustainable development goal (SDG-3) was designed to address all the major essential components of human health including sexual and reproductive health which is covered under SDG3 target 3.7. Under SDG3 the aim is to substantially reduce adolescent pregnancies so as to avert adverse maternal and child health outcomes (UN, 2020; WHO, 2019; UNICEF, 2019; UNICEF, 2018; UN, 2016; UN, 2015). The 1994 International conference on Population and development was a precursor to the Agenda 2030 for sustainable development and laid a very important foundation for the establishment of sound legal frameworks that protect sexual and reproductive health rights of women and girls (UN, 1995). In addition, the signatories to the conference highlighted the need to improve access to sexual and reproductive (SRH) services for adolescent girls and women. It was also emphasized that an individual or couple has a right to decide on the number children, birth spacing and time of childbirths. Both sexes have a right to education, health and employment opportunities. Many researchers found out that adolescent girls and young women in developing countries are at risk of having unwanted pregnancies, unsafe abortions, and unsafe sex practices which predispose them to adverse SRH outcomes. In addition, it has been proven that health information and education is of paramount importance among this age group to prevent unintended pregnancies and to improve women's health and economic well-being of individual families and communities (Braeken & Rondinelli, 2012; Kennedy *et al.* 2011; Crawford *et al.* 2009; Wilson *et al.* 1994). Many adolescent girls and young women continue to have unwanted pregnancies, unsafe abortions and bad obstetric outcomes (WHO, 2014). Gender based violence and sexual abuse cases of adolescent girls and women are being reported during this COVID-19 pandemic (Mittal & Singh, 2020). About 17 million adolescent girls give birth each year and most of them are in low and middle income countries (WHO, 2014; Ganchimeg *et al.* 2014). Religion and early marriages were found to be the major causes of high numbers of adolescent pregnancies as reported by Parson *et al.* (2015).

This paper applies the double smoothing technique to forecast future trends of adolescent fertility for Algeria and the findings are expected to highlight the likely future burden of adolescent births in the country. This will help policymakers to come up with appropriate policies to tackle early child marriages and sexual abuse of adolescent girls and women.

II. METHODOLOGY

This study utilizes an exponential smoothing technique to model and forecast future trends of adolescent fertility rate in Algeria. 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 linear method is expressed as follows:

Model equation

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

Smoothing equation

$$S_t = \alpha A_t + (1-\alpha)(S_{t-1} + b_{t-1})$$

Trend estimation equation

$$b_t = \beta (S_t - S_{t-1}) + (1-\beta)b_{t-1}$$

Forecasting equation

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

A_t is the actual value of adolescent fertility rate at time t

ε_t is the time varying **error term**

μ_t is the time varying mean (**level**) term

ρ_t is the time varying **slope term**

t is the trend component of the time series

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

α is the exponential smoothing constant for the data

β is the smoothing constant for trend

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

b_t is the trend estimate

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

Data Issues

This study is based on annual adolescent fertility rate in Algeria 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 (α) for data	0.900

Beta (β) for trend	0.900
Forecast performance measures	
Mean Absolute Error (MAE)	0.562444
Sum Square Error (SSE)	122.434179
Mean Square Error (MSE)	2.007118
Mean Percentage Error (MPE)	0.480112
Mean Absolute Percentage Error (MAPE)	1.331392

Residual Analysis for the Applied Model

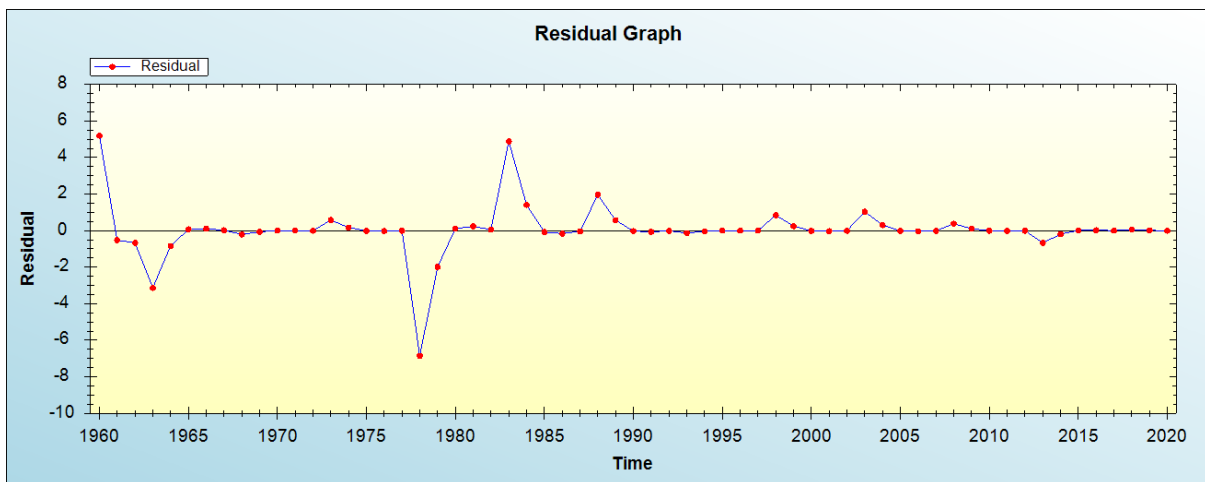


Figure 1: Residual analysis

In-sample Forecast for A

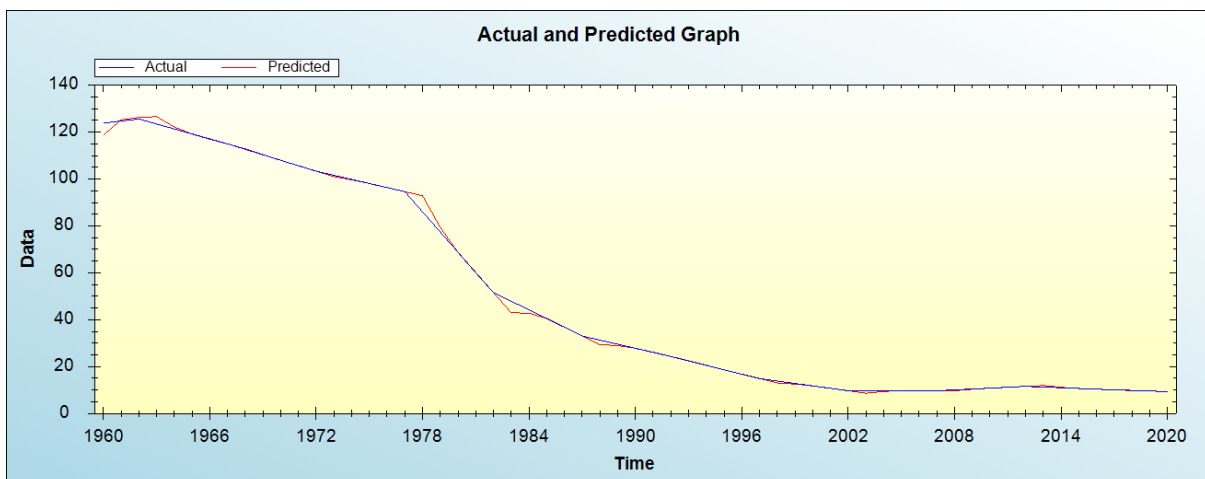


Figure 2: In-sample forecast for the A series

Actual and Smoothed graph for A series

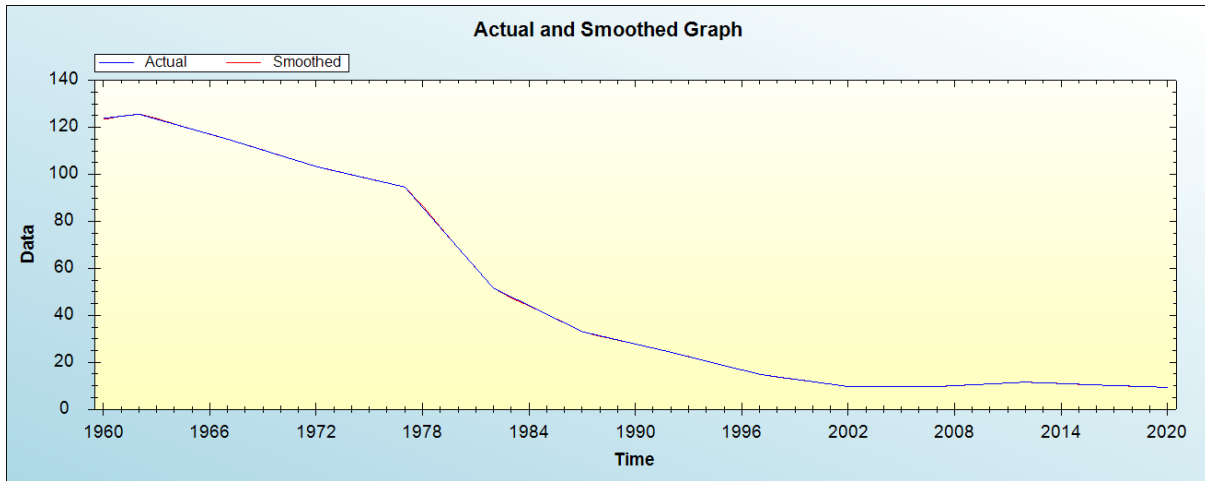


Figure 3: Actual and smoothed graph for A series

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

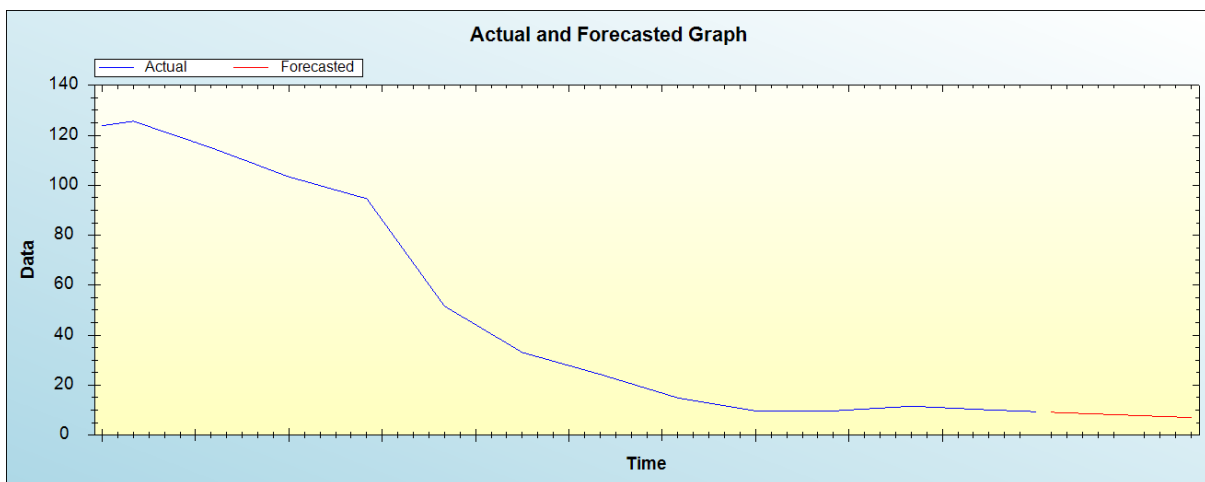


Figure 4: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasting adolescent fertility rate
2021	9.1242
2022	8.8888
2023	8.6535
2024	8.4182
2025	8.1829
2026	7.9475
2027	7.7122
2028	7.4769
2029	7.2415
2030	7.0062

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 rate will continue to decline throughout the out of sample period.

IV. POLICY IMPLICATION & CONCLUSION

Adolescent pregnancy is still an important public health issue for developing and developed countries. Adolescent girls living in the rural areas, without adequate SRH information, having peer pressure, lacking parental guidance and experiencing sexual abuse have a higher risk of experiencing adverse pregnancy outcomes. Adolescent fertility in Algeria has been gradually declining during the period 1960-2020 to levels around 10 births per 1000 women aged 15-19 years. This indicates tremendous progress made towards the reduction of adolescent fertility and the anticipated positive impact on maternal and child health. This study applied Holt's double exponential smoothing technique to forecast future trends of adolescent fertility for Algeria. Our study findings revealed that adolescent fertility will continue to drop throughout the out of sample period. Therefore, we encourage the government to address local factors which significantly contribute to teenage pregnancy.

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