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Tracking Future Trends of Adolescent Fertility for Albania Using the Double Exponential Smoothing Approach

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***Abstract* - This research uses annual time series data of adolescent fertility rate for Albania 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 are0.9 and0.5 respectively based on minimum MSE. The results of the study indicate that annual adolescent fertility will hover around 19 births per 1000 women aged 15-19 throughout the out of sample period. Therefore, we encourage authorities in Albania to maintain adequate funding of SRH services in order to control adolescent pregnancies and associated adverse outcomes.**

Keywords: Exponential smoothing, Forecasting, adolescent fertility rate.

I. INTRODUCTION

The Agenda 2030 for sustainable development is an important document that seeks to solve various issues affecting human health and the environment in which people live. The ultimate goal of the document is to provide a roadmap for the achievement of sustainable development by 2030. All 193 UN member states regard human health as a key component in the achievement of sustainable development (UN, 2020; WHO, 2019; UNICEF, 2018; UN, 2016, UN, 2015). The 3rd sustainable development goal (SDG-3) focuses on ensuring good health for all at all ages. Target 3.7 seeks to ensure access to quality and affordable sexual and reproductive health services which includes adolescent SRH services. The aim of this target is to substantially reduce adverse pregnancy outcomes as a result of unwanted pregnancies including teenage pregnancies. Teenage pregnancies are associated with complications such as STIs, unsafe abortions, obstetric fistula as a result of difficult vaginal delivery and adverse neonatal outcomes. Sub-Saharan Africa is known for reporting high adolescent pregnancies which are as a result of social, cultural, economic and geographic reasons. The 1994 International conference on Population and development (ICPD) was a lifesaver particularly for adolescent girls and women as the signatories agreed to solve sexual and reproductive health issues for both sexes particularly upholding the rights of women and adolescent girls (UN, 1995). Since 1994 SRH and rights became a global health priority (WHO, 1998). WHO developed guidelines to reduce adverse reproductive health outcomes and these included legal reform, strategies to reduce child marriages, increased contraceptive use, reduce coerced sex, unsafe abortions and increase the use of maternity services (WHO, 2011).Previous research has shown that family planning is an important intervention for reducing maternal and infant mortality there by stimulating economic development through increased participation of women in labor force and equitable use of resources sue to reduced population growth (Gribbi *et al*. 2012; Canning& Schultz, 2012; Cleland *et al.* 2006).

This paper applies the double exponential smoothing technique to forecast future trends of adolescent fertility in Albania and the findings are envisioned to provide an insight of the likely burden of adolescent births in the out of sample period. This will guide policymakers in planning and allocation of resources towards adolescent sexual and reproductive health services.

II. METHODOLOGY

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

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Holt's linear method is specified as follows:

Model equation

$A_t = \mu_t + \rho_t \mathbf{t} + \varepsilon_t$

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

$f_{t+h} = L_t + \mathrm{h} b_t$

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

L_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 (slope of the trend)

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

Data Issues

This study is based on annual adolescent fertility rate in Albania 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

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Table 1: ES model summary

Variable	A
Included Observations	61
Smoothing constants	
Alpha (α) for data	0.900
Beta (β) for trend	0.500
Forecast performance measures	
Mean Absolute Error (MAE)	0.830193
Sum Square Error (SSE)	295.460889
Mean Square Error (MSE)	4.843621
Mean Percentage Error (MPE)	0.333333
Mean Absolute Percentage Error (MAPE)	2.329158

Residual Analysis for the Applied Model

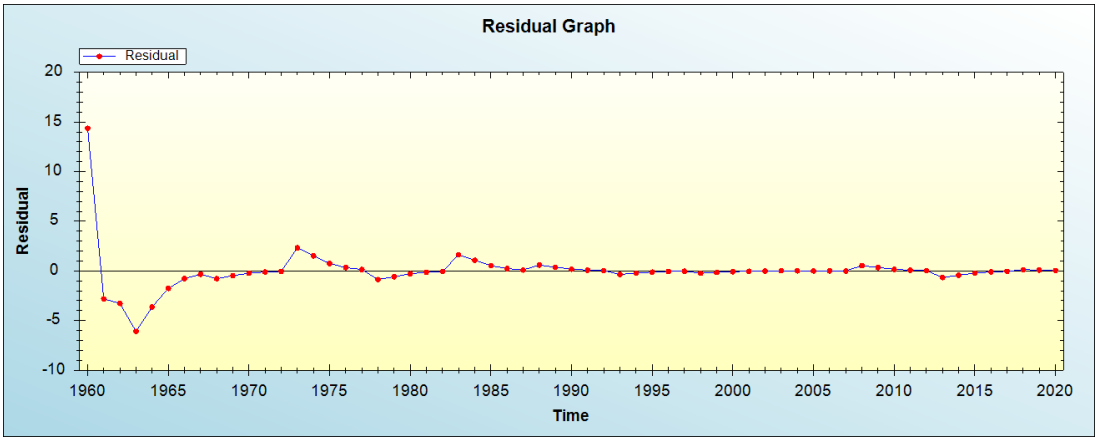

Figure 1: Residual analysis

In-sample Forecast for A

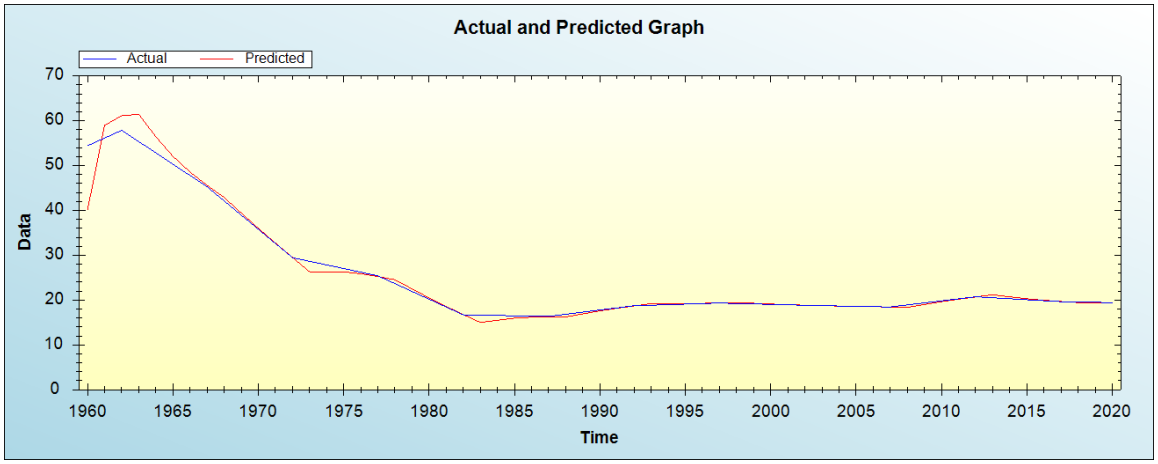

Figure 2: In-sample forecast for the A series

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Actual and Smoothed graph for A series

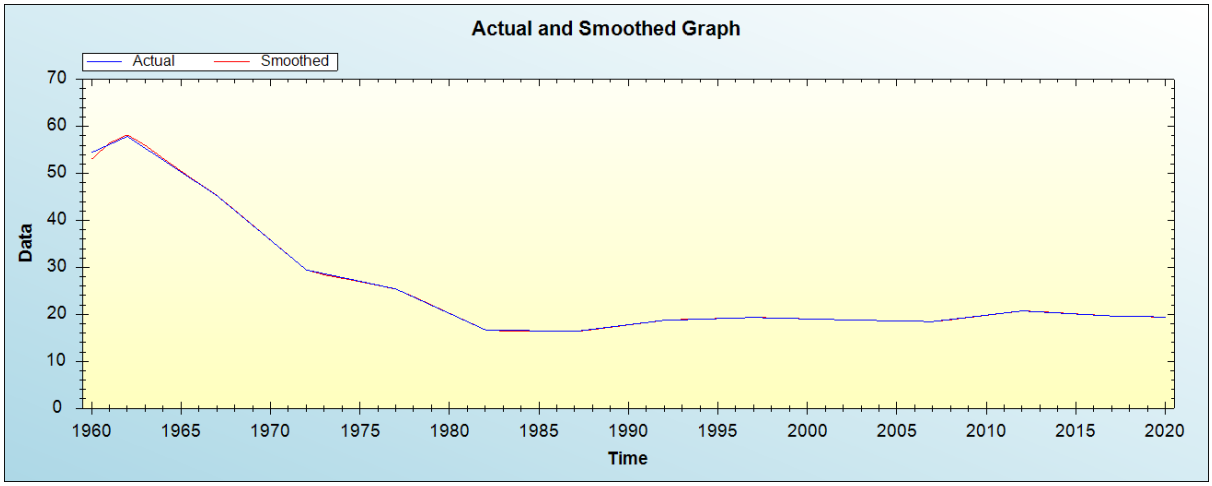

Figure 3: Actual and smoothed graph for A series

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

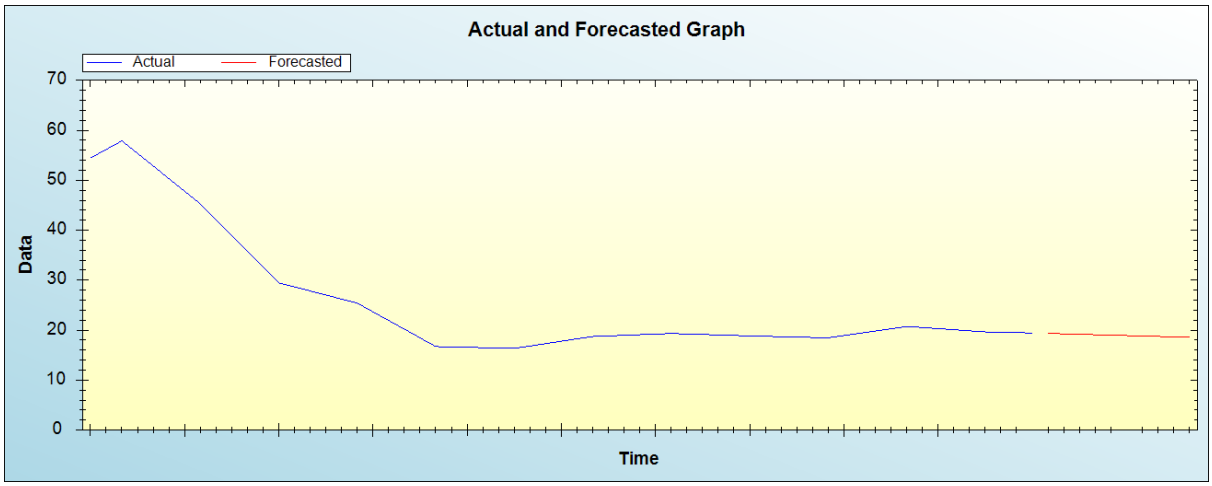

Figure 4: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasted adolescent fertility rate
2021	19.3433
2022	19.2580
2023	19.1726
2024	19.0872
2025	19.0019
2026	18.9165
2027	18.8311
2028	18.7458
2029	18.6604
2030	18.5750

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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 hover around 19 births per 1000 women aged 15-19throughout the out of sample period.

IV. POLICY IMPLICATION & CONCLUSION

Family planning is an essential health intervention for reducing adverse pregnancy outcomes such as obstructed labor, anemia, hypertensive disorders, preterm delivery and unsafe abortions. The generally global decline of adolescent fertility can be partly attributed to use of modern methods of contraception. Adolescent fertility for Albania has been declining during the period 1960-2020. This reflects the success of the national family planning program and improvements in the education sector among other factors. This study applied Holt's double exponential smoothing technique to forecast future trends of adolescent fertility for Albania. Our study results indicate that adolescent fertility will hover around 19 births per 1000 women aged 15-19 throughout the out of sample period. Therefore, we encourage the government to maintain adequate funding of SRH services in order to control adolescent pregnancies and associated adverse outcomes.

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