

# Examining Future Trends of Adolescent Fertility for Venezuela Using Holt’s Linear Method

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**Abstract -** This research article uses annual time series data of adolescent fertility rate for Venezuela 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  $\alpha$  and  $\beta$  are 0.9 and 0.3 respectively based on minimum MSE. The results of the study indicate that annual adolescent fertility will continue to decrease but remain high throughout the out of sample period. Therefore, we encourage authorities in Venezuela to continue supporting girl child education, fund empowerment projects for youths, protect sexual and reproductive health rights of women and girls, and offer affordable and accessible adolescent health services.

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

## I. INTRODUCTION

Adolescent pregnancy is one of the major sources of adverse sexual and reproductive health outcomes in the developing world (Grønvik & Fossgard, 2018; Banke-Thomas *et al.* 2017; Ganchimeget *et al.* 2014; WHO, 2014; UNFPA, 2013; UNECA *et al.* 2013; de Vienne, 2009). Sub-Saharan Africa persistently reports the highest number of teenage pregnancies followed by South East Asia and then lastly Latin America and the Caribbean (Rodriguez *et al.* 2010). In Latin America and the Caribbean, young people aged 10-24 years represent 30 percent of the total population and adolescents aged 10-19 make up 20 percent of all pregnancies in the world. Venezuela has the highest unplanned teenage pregnancy rates in Latin America (Kizer, 2013). Thirty percent of adolescent girls begin sexual intercourse between 12-18 years while sixty percent do not use any contraceptive method. In Venezuela, teenage pregnancy is driven by lack of SRH information, adherence to social norms and refusal to use contraceptives (Para & Perez, 2010).

The purpose of this paper is to forecast future trends of adolescent fertility in Venezuela using the double exponential smoothing technique. The findings are expected to highlight the future burden of adolescent births in the country. This will trigger an appropriate timeous response to the problem of teenage pregnancy through implementation of suitable policies.

## II. LITERATURE REVIEW

Author (s)	Study area	Topic	Methodology	Main Finding(s)
J. Pueyo (2022)	Southern Mindanao	Moms Too Soon: Status and Challenges of Teenage Mothers— Implications for Extension	phenomenological research design	Social norms that drive teenage pregnancy include liberal and loose relationship, easy acceptance of teenage pregnancy by the family, curiosity, and technology use.
Cuberos et al. (2019)	Venezuelan-Colombian border	School Dropout of Adolescent Mothers in a Colombian Venezuelan Border	Mixed methods study	Lower educational level influences teenage pregnancy. The sociological age influences by an

				advance of roles not linked to chronological age
Do et al. (2017)	Ho Chi Minh City, Vietnam	Parental perceptions of teenagers' sexuality in urban Vietnam	Qualitative analysis	Vietnamese parents have negative views of sex and sexuality education for their teenage children
Nguyen et al. (2016)	Vietnam	Prevalence and Factors Associated with Teen Pregnancy in Vietnam: Results from Two National Surveys	analytical study	The prevalence of pregnancy among Vietnamese teenagers in the surveys was stable at 4%, or 40 pregnancies per 1000 adolescent girls aged 14 to 19. Age, experience of domestic violence, and early sexual debut were positively correlated with higher odds of teenage pregnancy for both survey cohorts (2003 & 2008)
J. Lisboa (2016)	Venezuela	Adolescence and teenage pregnancy: A look from the social and public health problem in Venezuela	Narrative review	Teenage pregnancy in Venezuela, occurs as a result of a combination of social norms, traditions and economic constraints

### III. METHODOLOGY

This study utilizes an exponential smoothing technique to model and forecast future trends of adolescent fertility rate in Venezuela. 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 specified as follows:

#### Model equation

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

Smoothing equation

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

$$0 < \alpha < 1$$

Trend estimation equation

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

$$0 < \beta < 1$$

Forecasting equation

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

$V_t$  is the actual value of 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 Venezuela 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.

**IV. FINDINGS OF THE STUDY**

Exponential smoothing Model Summary

Table 1: ES model summary

Variable	V
Included Observations	61
Smoothing constants	
Alpha ( $\alpha$ ) for data	0.900
Beta ( $\beta$ ) for trend	0.300
Forecast performance measures	

Mean Absolute Error (MAE)	0.706283
Sum Square Error (SSE)	156.527682
Mean Square Error (MSE)	2.566028
Mean Percentage Error (MPE)	0.025397
Mean Absolute Percentage Error (MAPE)	0.611433

Residual Analysis for the Applied Model

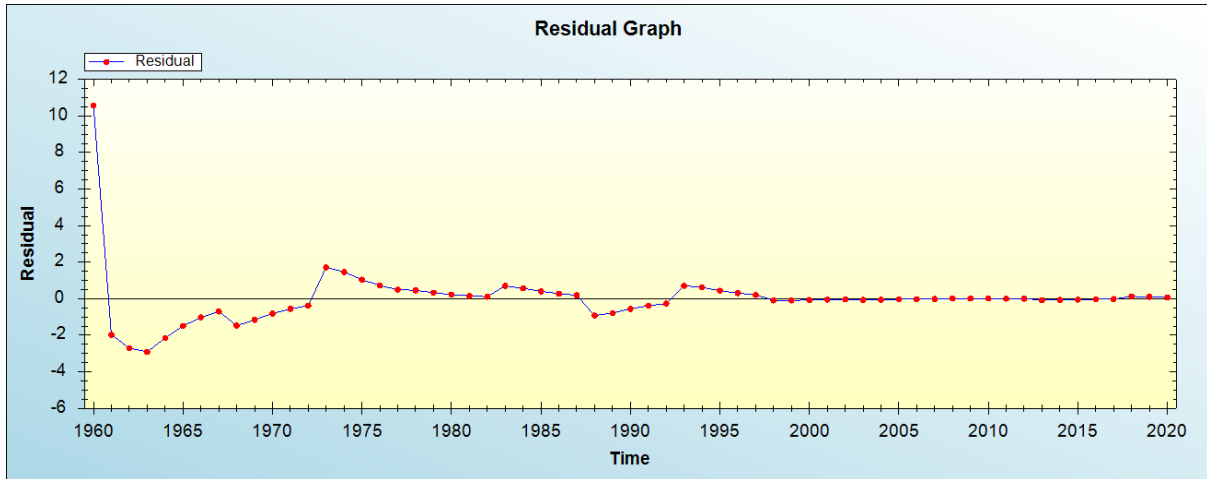


Figure 1: Residual analysis

In-sample Forecast for V

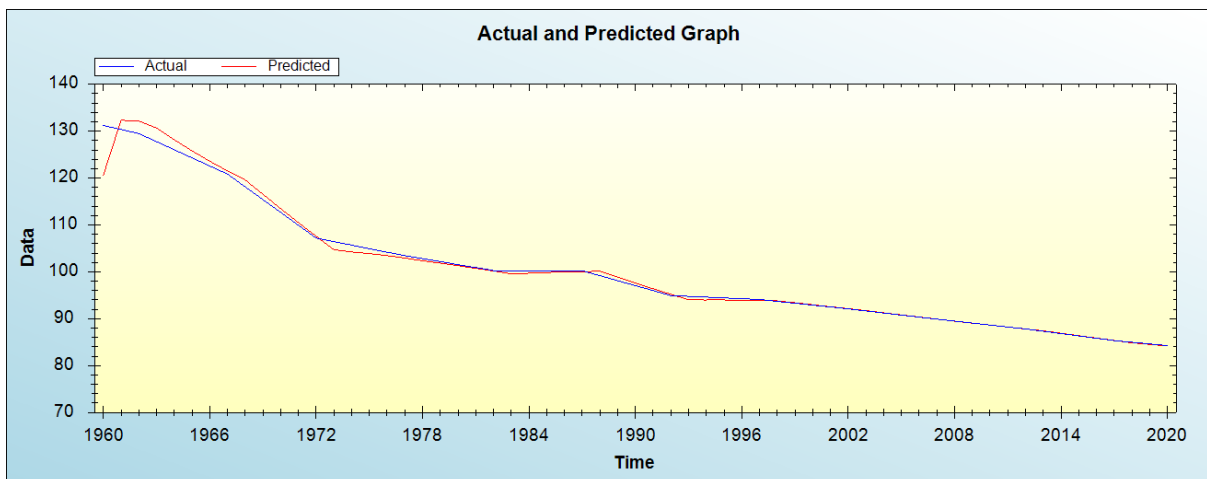


Figure 2: In-sample forecast for the V series

Actual and Smoothed graph for V series

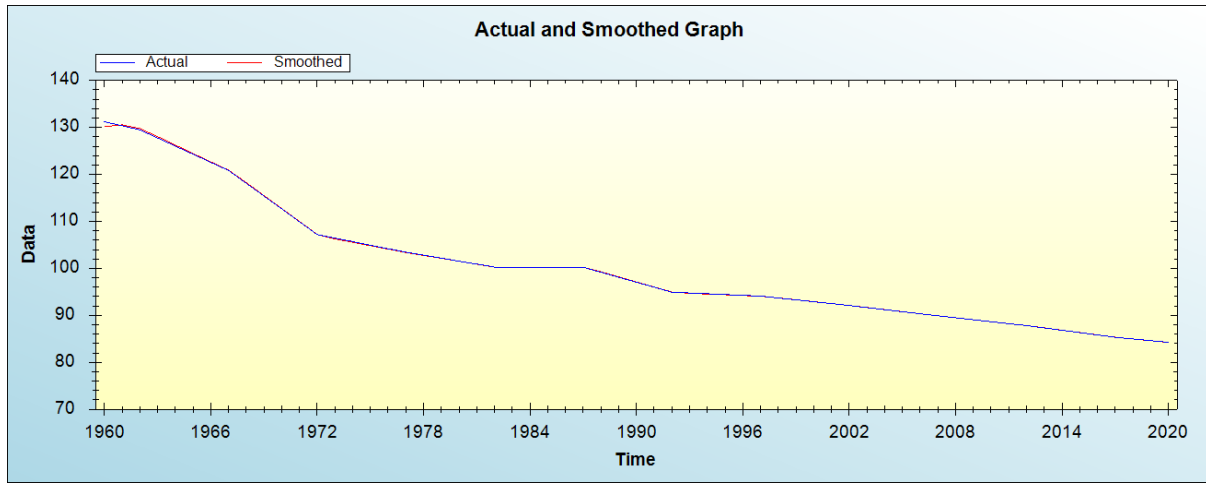


Figure 3: Actual and smoothed graph for V series

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

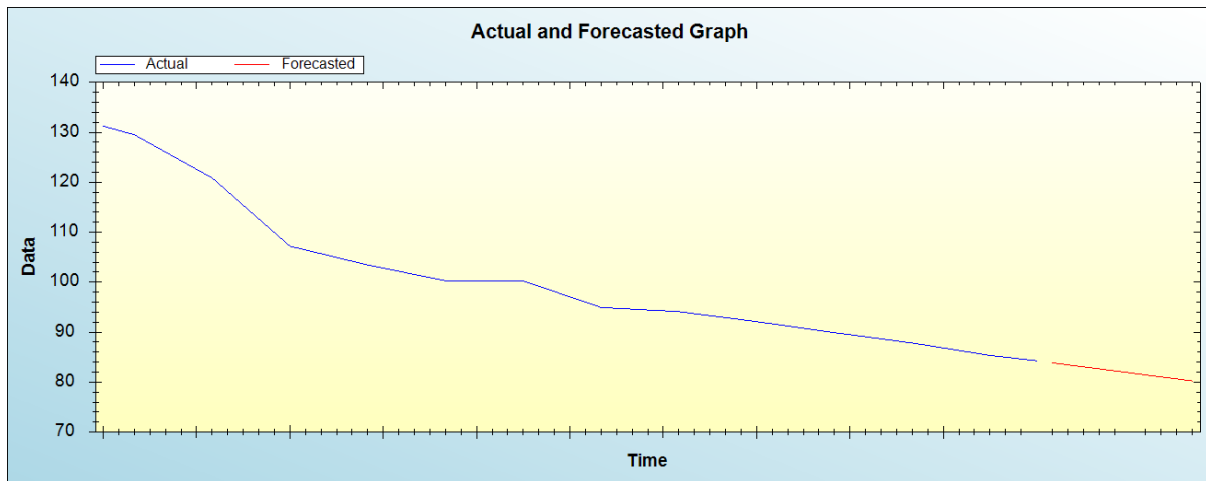


Figure 4: Out-of-sample forecast for V: actual and forecasted graph

Out-of-Sample Forecast for V: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasted adolescent fertility rate
2021	83.8542
2022	83.4524
2023	83.0505
2024	82.6486
2025	82.2467
2026	81.8449
2027	81.4430
2028	81.0411
2029	80.6392
2030	80.2374

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 but remain high throughout the out of sample period.

## V. POLICY IMPLICATION & CONCLUSION

Adolescent pregnancy poses a threat to social and economic development of any country due to the long term consequences to the affected teenager, her family and the society. The government of Venezuela continues to report high teenage pregnancy rates as a result of existing poverty among the communities, lack of SRH knowledge, adherence to social norms and refusal to use contraceptive methods. This study forecasted future trends of adolescent fertility for Venezuela using Holt's double exponential smoothing technique. The results of this piece of work revealed that adolescent fertility will continue on a downward trend but will still remain high. Therefore, we implore authorities in Venezuela to adopt our 4-fold policy recommendation outlined below:

- i. To continue supporting girl child education
- ii. To fund youth empowerment projects
- iii. continuously protect sexual and reproductive health rights of women and girls
- iv. Offer affordable and accessible adolescent health services

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