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Forecasting Adolescent Fertility for Vietnam Using Holt's Linear Method

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***Abstract* - Adolescent pregnancy remains an important public health issue in Vietnam. Drug and substance abuse, delinquency, adherence to social norms and high risk sexual activity are the most common risk factors for pregnancy among women aged 15-19 years of age. This study uses annual time series data of adolescent fertility rate for Vietnam 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 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 fall throughout the out of sample period. Therefore, we encourage authorities in Vietnam to continue supporting girl child education, strictly enforce laws to protect women's rights, scale up educational campaigns among communities and provide affordable and accessible adolescent health services.**

Keywords: Exponential smoothing, Forecasting, adolescent fertility rate.

I. INTRODUCTION

It is estimated that approximately 12 million girls aged 15– 19 years and at least 777,000 girls aged below15 years give birth every year in developing regions (WHO, 2020). Globally, babies born to adolescent girls constitute about 11% of all births, and 95% of these are found in developing countries (Kassa *et al.* 2018). In Africa, the estimated prevalence of adolescent pregnancy is 18.8%; a higher prevalence is observed in the East African sub-region (21.5%) and the lowest is in the North Africa (9.2%) (Kassa *et al.* 2018).Pregnancy during adolescence stage can result in undesirable health consequences among adolescent mothers, their babies, families and society(Poudel *et al.* 2018; Pradhan *et al.* 2018; Islam *et al.* 2017; Sukrat, 2014; Okonofua, 2013; Osotimehin *et al.* 2013;Uwaezuoke*et al.* 2004;).Early pregnancy is more common among women from poorer families, single-parent households, areas of greater deprivation, and those born to teenage parents (ISDS, 2018; Hodgkinso n*et al.* 2014).Early sexual activity places adolescents at increased risk of adolescent pregnancy especially those who have unmet needs for, or reasons not to use contraception (Lara and Abdo, 2016).Adolescent mothers are more likely to take part in unsafe abortions and also have a fivefold risk of repeat pregnancies (WHO, 2014; Ganchimeg *et al.* 2014;Chandra-Mouli*et al.* 2013; Falk *et al.* 2006). Adolescents encounter several challenges including limited contraceptive access, unmet information needs and lack of negotiating power, which can put them at risk (Sserwanja *et al.* 2022; Du Preez *et al.* 2019; Wado *et al.* 2019; Geda, 2019; WHO, 2018; Zamawe *et al.* 2016;Maxwell *et al.* 2016; Thobejane, 2015; Meeker s*et al.* 2007). Vietnamese adolescent pregnancies are usually associated with drug and substance abuse, delinquency, adherence to social norms and high risk sexual activity. According to United Nations Population Fund, 20 percent of students are sexually active, but less than 0.5% of them have knowledge on contraception. Teen pregnancy rates and births in Vietnam are similar to those of neighboring and developing countries. World Bank reports have revealed that birth rates per 1000 teenagers aged15–19 in Vietnam fluctuated between 1980 and 2013, increasing steadily from 20 per 1000 to 34 between 1980 and 1992, then dropping to 28 in 2002. Rates rose again to 32 in 2007 before dropping to 30 in 2011, and 29 in 2013.TheVietnam 2020-2021 multiple cluster survey indicated that adolescent birth rate is 42 live births per 1,000 women. There is a geographic, social and ethnic variation in adolescent fertility. The Kinh/Hoa ethnic group has an adolescent fertility rate of 28 live births per 1,000 women whereas the Mong ethnic group has an adolescent fertility rate of 210 births per 1000 women. The adolescent birth rate is higher among those living in the Northern Midland and Mountain region and among the poorest women.

In this paper, we applied the double exponential smoothing technique to forecast future trends of adolescent fertility for Vietnam. The findings of this research will depict the likely future burden of adolescent births in the out of sample period. This will inform policy making, decisions and allocation of resources to programs designed to control teenage pregnancies and child marriages in the country.

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II. LITERATURE REVIEW

Author (s)	Study area	Topic	Methodology	Main finding(s)
Huong et al. (2021)	Northern Central Vietnam	Reproductive Health Education for Vietnamese High School Students in the Current Context	Analytical study	-integrating comprehensive sexuality education into the education curriculum is critical to address teenage pregnancy in schools
Londeree et al. (2020)	Vietnam	Under estimation of pregnancy risk among women in Vietnam	Cross-sectional study	Pregnancy risk underestimation varied by marital status, ethnicity, educational level and beliefs relating contraceptive use
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 surveycohorts (2003 & 2008)
Ospina (2015)	Guatemala	Why is Guatemala's teen pregnancy rate so high?	Narrative review	Poverty, lower educational level, inadequate SRH information and low contraceptive use are contributing to adolescent pregnancy

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III. METHODOLOGY

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

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

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

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

V_t is the actual adolescent fertility rate at time period 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 time series at time period 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 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 Vietnam 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.

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IV. FINDINGS OF THE STUDY

Exponential smoothing Model Summary

Table 1: ES model summary

Variable	V
Included Observations	61
Smoothing constants	
Alpha (α) for data	0.900
Beta (β) for trend	0.900
Forecast performance measures	
Mean Absolute Error (MAE)	0.239159
Sum Square Error (SSE)	16.321131
Mean Square Error (MSE)	0.267560
Mean Percentage Error (MPE)	-0.083829
Mean Absolute Percentage Error (MAPE)	0.905893

Residual Analysis for the Applied Model

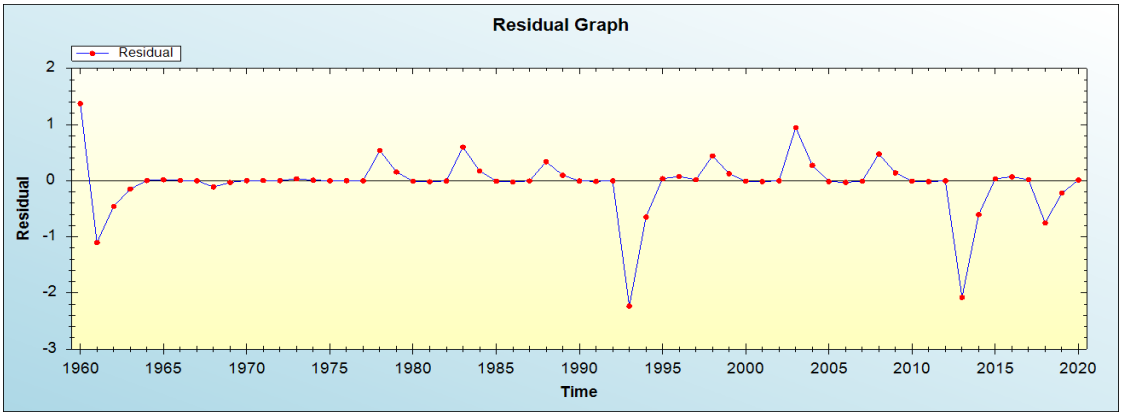

Figure 1: Residual analysis

In-sample Forecast for V

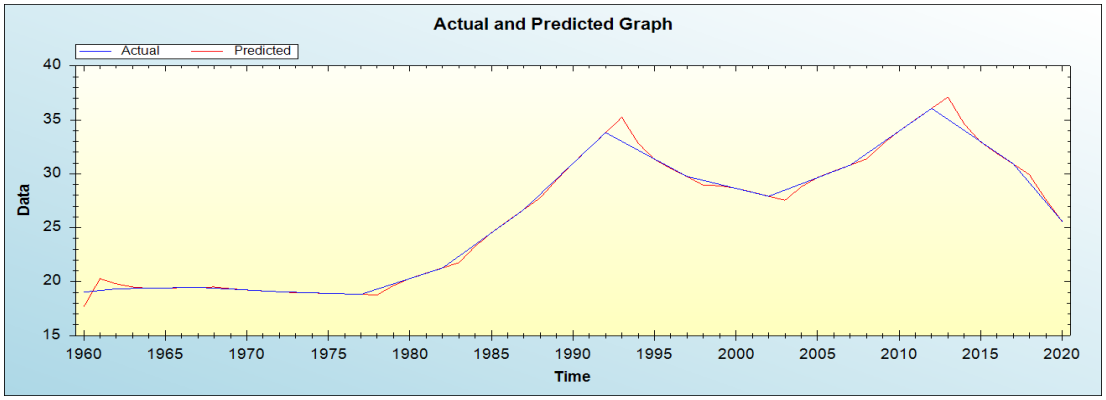

Figure 2: In-sample forecast for the V series

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Actual and Smoothed graph for V series

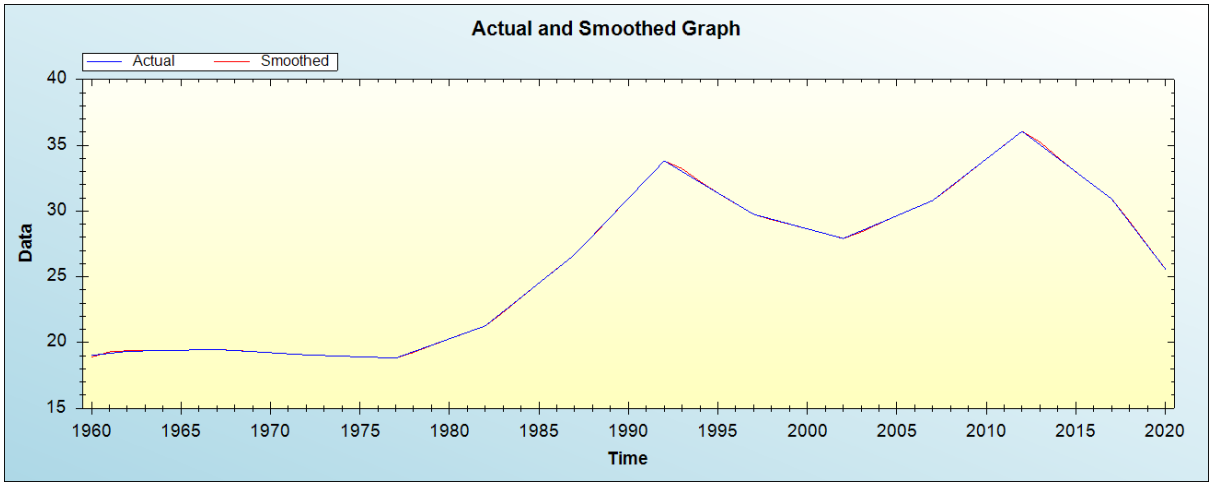

Figure 3: Actual and smoothed graph for V series

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

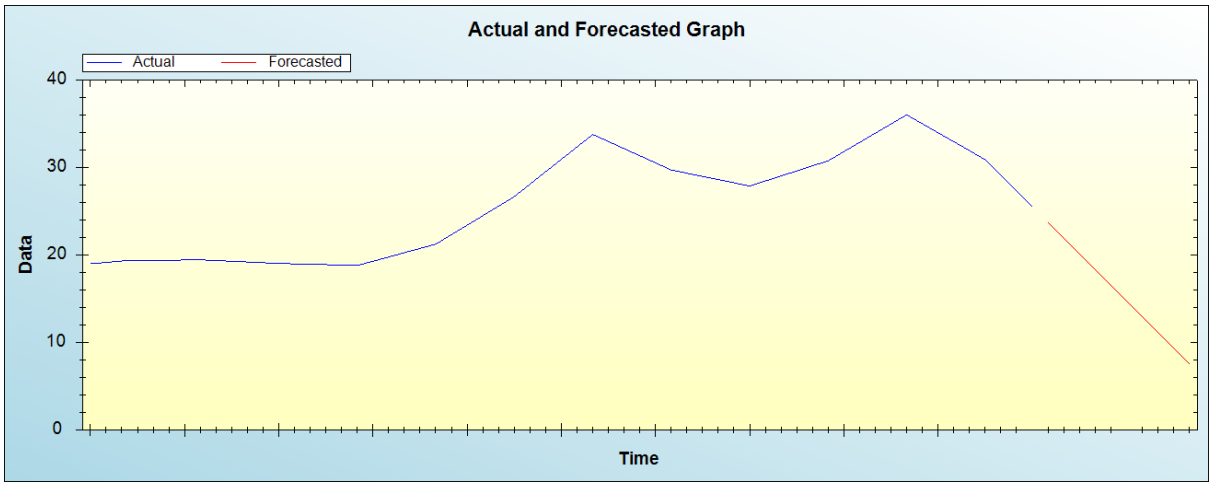

Figure 4: Out-of-sample forecast for V: actual and forecasted graph

Out-of-Sample Forecast for V: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasted adolescent fertility rate
2021	23.7949
2022	21.9935
2023	20.1921
2024	18.3907
2025	16.5893
2026	14.7879
2027	12.9866
2028	11.1852
2029	9.3838
2030	7.5824

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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 continue to decline throughout the out of sample period.

V. POLICY IMPLICATION & CONCLUSION

Adolescent fertility is an important public health issue around the globe due to the increased risk of experiencing complications during pregnancy and child birth among adolescents. The decline in adolescent fertility in Vietnam over the past decades reflects the political will to achieve set targets under the 3rd sustainable development goal. Holt's double exponential smoothing model was employed in this paper to forecast adolescent fertility for Vietnam. Research findings indicate that adolescent fertility will sharply decline throughout the out of sample period. We implore the Vietnamese government to adopt our 4-fold policy recommendation which is highlighted below:

i. To continue supporting girl child education
ii. Scale up educational campaigns among communities
iii. To provide affordable and accessible adolescent health services.
iv. Relentlessly enforce laws to protect women's rights.

REFERENCES

[1] Sukrat B (2014). Thailand adolescent birth rate: trend and related indicators. Thai Journal of Obstetrics and Gynecology. 2014: 15-21
[2] WHO (2018). Adolescent pregnancy. Factsheets.2018. https://www.who. Int/news-room/fact-sheets/detail/adolescent-pregnancy.
[3] Lara L.A and Abdo CH (2016). Age at time of initial sexual intercourse and health of adolescent girls. J Pediatr Adolesc Gynecol. 29(5):417-423
[4] WHO (2020), Fact sheet - Adolescent pregnancy. https://www.who.int/news-room/fact-sheets/ detail/adolescent-pregnancy
[5] Kassa GM., Arowojolu AO., Odukogbe AA., and Yalew AW (2018). Prevalence and determinants of adolescent pregnancy in Africa: a systematic review and meta-analysis. Reproductive Health. 15(1):1-7
[6] World Health Organization(2014). Adolescent pregnancy factsheet [Internet]. World Health Organization. http://www. who. int/ mediacentre/ factsheets/ fs364/ en/
[7] Ganchimeg T., Ota E., Morisaki N (2014). Pregnancy and childbirth outcomes among adolescent mothers: a World Health Organization multi country study. BJOG: Int J Obstet Gy.121 (Suppl. 5):40–8.
[8] Chandra-Mouli V., Camacho AV, Michaud P-A (2013). WHO guidelines on preventing early pregnancy and poor reproductive outcomes among adolescents in developing countries. J Adolesc Health. 52:517–22.
[9] Zamawe COF., Banda M., and Dube AN (2016). The impact of a community driven mass media campaign on the utilization of maternal health care services in rural Malawi. BMC Pregnancy Childbirth 2016; 16:21.
[10] Meekers D., Van Rossem R., Silva M (2007). The reach and effect of radio communication campaigns on condom use in Malawi. Stud Fam Plann. 38:113–20.
[11] Sserwanja Q., Mukunya D., Nabachenje P (2022). Continuum of care for maternal health in Uganda: a national cross-sectional study. PLoS One. 17:e0264190.
[12] Hodgkinson S., Beers L., and Southammakosane C (2014). Addressing the mental health needs of pregnant and parenting adolescents. Pediatrics. 133:114–22. doi:10.1542/peds.2013-0927
[13] Information Services Division Scotland (2018). Teenage Pregnancy: Year of Conception. https://www.isdscotland.org/Health-Topics/SexualHealth/Publications/2018-07-03/2018-07-03-TeenPreg-Report.pdf
[14] Falk G., Östlund I., Magnuson A (2006). Teenage mothers - a high-risk group for new unintended pregnancies. Contraception. 74:471–5. doi:10.1016/j.contraception.2006.07.014
[15] Wado Y.D., Sully EA., and Mumah JN (2019). Pregnancy and early motherhood among adolescents in five East African countries: a multi-level analysis of risk and protective factors. BMC Pregnancy and Childbirth, 2019; 19:59.
[16] Geda YF(2019). Determinants of teenage pregnancy in Ethiopia: A Case–control study. Curr Med Issues. 17:112‑7.
[17] Du Preez A., Botha AJ., Rabie T and Manyathi DG (2019). Secondary school teachers' experiences related to learner teenage pregnancies and unexpected deliveries at school. Health SA Gesondheids. 24(0): a1079.
[18] Maxwell G.M., RadzilaniMakatu M and Takalani JF (2016). Awareness of prevention of teenage pregnancy amongst secondary school learners in Makhado municipality. Afr J Pri Health Care Fam Med. 2016; 8(2): 967.

ISSN (online): 2581-3048
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https://doi.org/10.47001/IRJIET/2023.702079

[19] Thobejane TD (2015). Factors contributing to teenage pregnancy in South Africa: The case of Matjitjileng Village. J Soc Anth. 6(2): 273-277.
[20] Islam M.M., Islam MK., Hasan MS (2017). Adolescent motherhood in Bangladesh: Trends and determinants. PLoS One. 12(11):1–14.
[21] Pradhan R., Wynter K., Fisher J (2018). Factors associated with pregnancy among married adolescents in Nepal: secondary analysis of the National Demographic and Health Surveys from 2001 to 2011.Int J Environ Res Public Health. 15(229):12.
[22] Poudel S., Upadhaya N., Khatri RB (2018). Trends and factors associated with pregnancies among adolescent women in Nepal: pooled analysis of Nepal Demographic and Health Surveys (2006, 2011 and 2016). PLoS One. 13(8):1–13.
[23] Uwaezuoke A.I., Uzochukwu BS., Nwagbo D F(2004). Determinants of teenage pregnancy in rural communities of Abia State, South East Nigeria. Int J Med Health Dev. 9(1):28–33.
[24] Okonofua F (2013). Prevention of child marriage and teenage pregnancy in Africa: need for more research and innovation. Afr J Reprod Health. 17(4):9–13.
[25] Osotimehin B (2013).Thestateoftheworldpopulation2013: mother hood in childhood: facing the challenge of adolescent pregnancy. New York: United Nations Population Fund.
[26] World Bank (2016). Adolescent Fertility Rate (Births per 1000 Women Ages 15–19). Available online: http://data.worldbank.org/indicator/SP.ADO.TFRT.
[27] UNFPA (2013). More than a Third of Vietnamese Young People Still Lack Access to Contraceptives—Improving Access to Sex Education and Services Hold Key to Preventing Teenager Pregnancy. http://vietnam.unfpa.org/public/pid/14592
[28] Vietnam SDG CW 2020-2021Multiple Indicator Cluster Survey. pp.1-18.

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