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Applying Holt's Linear Method to Forecast Adolescent Fertility for Myanmar

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***Abstract* - This research paper uses annual time series data of adolescent fertility rate for Myanmar 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 0.8 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 Myanmar to continuously enforce laws that protect sexual and reproductive rights of women and girls, and improve on accessibility and affordability of adolescent health services.**

Keywords: Exponential smoothing, Forecasting, adolescent fertility rate.

I. INTRODUCTION

Teenage pregnancy is an important public health problem that is being addressed by sustainable development goals, specifically SDG 1–5, 8 and 10(UN, 2016; UNFPA, 2015). Every year approximately 16 million girls aged 15–19 years and another one million girls below the age of 15 give birth. The majority of these births occur in low- and middle-income countries, with the highest rates being reported in sub-Saharan Africa and south Asia. Births to adolescents below the age of 20 years represent eleven percent of all births worldwide but twenty-three percent of the overall burden of disease in this age group (WHO, 2014). There is substantial evidence on the damaging consequences of teenage pregnancies for adolescent mothers and their babies (Bain *et al.* 2019; Wado *et al.* 2019; Geda *et al.* 2019; Siegel & Brandon, 2014; Ruedinger & Cox, 2012; Malabarey *et al.* 2012; Santhya, 2011). The negative health effects include anemia in pregnancy, pregnancy induced hypertension, HIV, STIs, mental disorders, preterm delivery, low birth weight and malnutrition (Kassa *et al.* 2019; Wall-Wieler *et al.* 2019; Grønvik & Fossgard, 2018; Pradhan *et al.* 2018; Poudel *et al.* 2018; Leftwich & Alves, 2017; Islam *et al.* 2017; Azevedo *et al.* 2015; GBDPC,2014; WHO, 2014; UNFPA, 2013). The majority of teenage pregnancies are associated with poverty, living in the rural areas, difficult access to health care and family planning, early marriage and lack of SRH education (UNFPA, 2013). The 2015-2016 Myanmar DHS reported that sixty percent of women and 62 percent of men age 1549 are currently married. Nineteen percent of women and seven percent of men age 25-49 were married by age 18. Only six percent of young women age 15-19 are already mothers or are pregnant with their first child. Teenage childbearing varies with geographic region. Teen pregnancy is most common in Kachin State, Shan State, and Chin State. Teenage childbearing is basically non-existent among those with more than secondary education, while 19 percent of young women age 15-19 with no education have begun childbearing.

This paper applies the double exponential smoothing technique to model and forecast future trends of adolescent fertility in Myanmar. Research findings are expected to depict the future burden of adolescent births in the country. This will inform policies, decisions and allocation of resources to teen pregnancy prevention programs.

II. METHODOLOGY

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

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

Smoothing equation

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

$0<\alpha<1$

Trend estimation equation

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

$0<\beta<1$

Forecasting equation

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

M_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 slope of the trend at time t

b_{t-1} is the slope of the trend at time t-1

Data Issues

This study is based on annual adolescent fertility rate in Myanmar 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	M
Included Observations	61
Smoothing constants	
Alpha (α) for data	0.900
Beta (β) for trend	0.800

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Forecast performance measures	
Mean Absolute Error (MAE)	0.340258
Sum Square Error (SSE)	35.064655
Mean Square Error (MSE)	0.574830
Mean Percentage Error (MPE)	0.101290
Mean Absolute Percentage Error (MAPE)	0.505699

Residual Analysis for the Applied Model

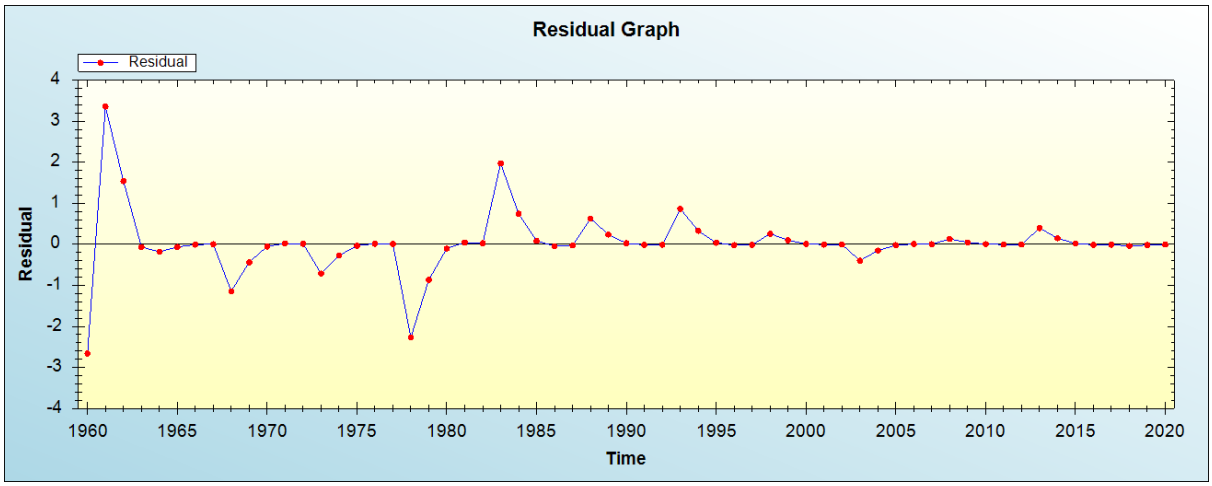

Figure 1: Residual analysis

In-sample Forecast for M

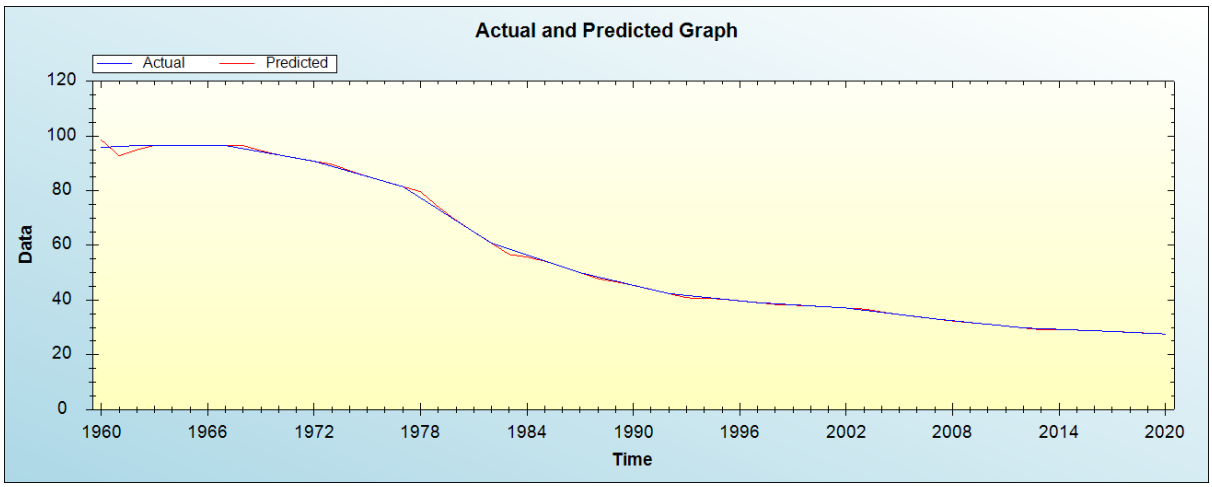

Figure 2: In-sample forecast for the M series

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Actual and Smoothed graph for M series

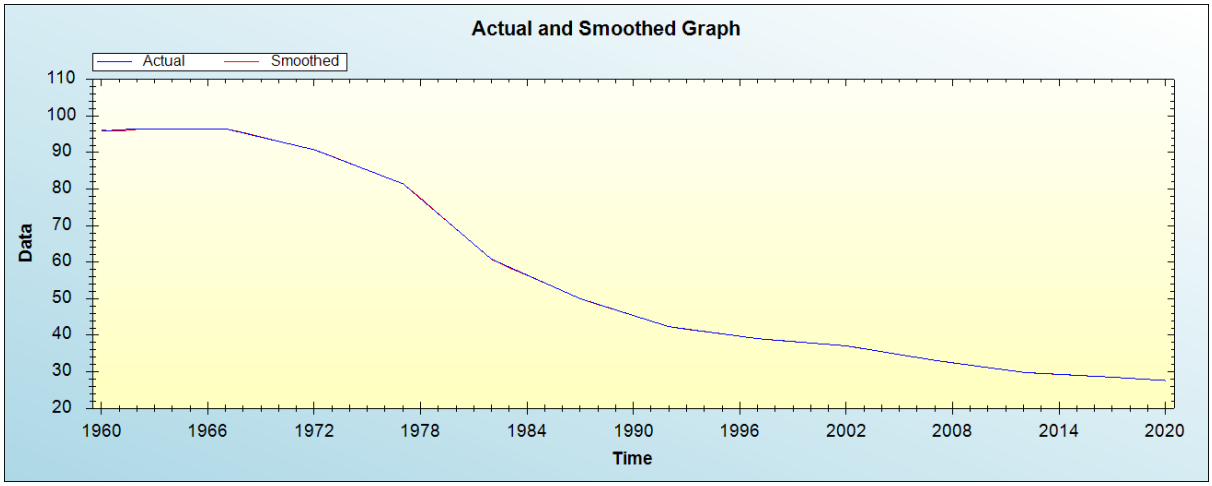

Figure 3: Actual and smoothed graph for M series

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

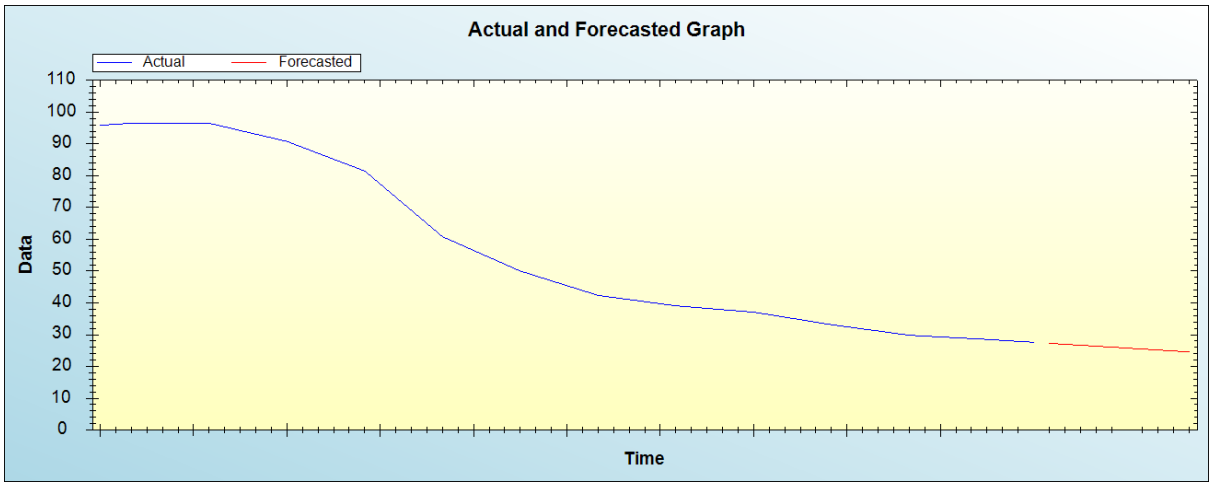

Figure 4: Out-of-sample forecast for M: actual and forecasted graph

Out-of-Sample Forecast for M: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasted adolescent fertility rate
2021	27.2985
2022	26.9951
2023	26.6917
2024	26.3883
2025	26.0848
2026	25.7814
2027	25.4780
2028	25.1745
2029	24.8711
2030	24.5677

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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.

IV. POLICY IMPLICATION & CONCLUSION

Teenage pregnancy continues to be a public health issue in Myanmar. Adolescent fertility has been gradually declining from1960 to 2020. This decline can be attributed to increase in age at marriage and increase in contraceptive use among teenagers. This study applied the double exponential smoothing technique to forecast future trends of adolescent fertility for Myanmar. Findings of this study revealed that adolescent fertility will continue to decline throughout the out of sample period. Therefore, we encourage authorities in Myanmar to continuously enforce laws that protect sexual and reproductive rights of women and girls, and improve on accessibility and affordability of adolescent health services.

REFERENCES

[1] UNFPA (2015). Sustainable development goals. New York: UNFPA. http:// www.unfpa.org/sdg.
[2] World Health Organization (2014). Adolescent pregnancy: fact sheet number 364. Geneva: WHO. http://www.who.int/mediacentre/ factsheets/fs364/en/.
[3] Ruedinger E., and Cox JE (2012). Adolescent childbearing: consequences and interventions. Curr Opin Pediatr. https://doi.org/10.1097/MOP.0b013e3283557b89.
[4] Malabarey O.T., Balayla J., Klam S.L., Shrim A., and Abenhaim H.A (2012). Pregnancies in young adolescent mothers: a population-based study on 137 million births. J Pediatr Adolesc Gynecol. https://doi.org/10.1016/j.jpag.2011.09.004.
[5] Santhya K.G (2011). Early marriage and sexual and reproductive health vulnerabilities of young women: a synthesis of recent evidence from developing countries. Curr Opin Obstet Gynecol. https://doi.org/10. 1097/GCO.0b013e32834a93d2.
[6] Siegel R.S., and Brandon AR (2014). Adolescents, pregnancy, and mental health. J Pediatr Adolesc Gynecol. 2014; https://doi.org/10.1016/j.jpag.2013.09.008.
[7] World Health Organization (WHO). Adolescent pregnancy: fact sheet number 364. Geneva: WHO; 2014. http://www.who.int/mediacentre/ factsheets/fs364/en/.
[8] United Nations Population Fund (UNFPA). Adolescent pregnancy: a review of the evidence. New York: UNFPA; 2013. http://www.unfpa.org/ sites/default/files/pub-pdf/ADOLESCENT%20PREGNANCY_UNFPA.pdf.
[9] Global Burden of Disease Pediatrics Collaboration. Global and national burden of diseases and injuries among children and adolescents between 1990 and 2013: findings from the global burden of disease 2013 study. JAMA Pediatr. 2015; https://doi.org/10.1001/jamapediatrics.2015.4276.
[10] Myanmar2015-16 Demographic and Health Survey Key Findings. pp.1-20
[11] Azevedo WFd., Diniz M.B., Fonseca E.S.V.B., Azevedo L.M.Rd., Evangelista C.B (2015) Complications in adolescent pregnancy: systematic review of the literature. Einstein (Sao Paulo, Brazil). 13(4):618.
[12] Leftwich H.K, and Alves M.V.O (2017). Adolescent pregnancy. The Pediatric Clinics of North America. 64(2):381–8.
[13] Wado Y.D., Sully E.A and Mumah J.N (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.
[14] Geda Y.F (2019). Determinants of teenage pregnancy in Ethiopia: A Case–control study. Curr Med Issues. 17:112‑7.
[15] United Nation (2016). Transforming our world: The 2030 agenda for sustainable development.
[16] Islam M.M., Islam M.K., and Hasan M.S (2017) Adolescent motherhood in Bangladesh: Trends and determinants. PLoS One. 12(11):1–14.
[17] Pradhan R., Wynter K., and Fisher J (2018). Factors associated with pregnancy among married adolescents in Nepal: secondary analysis of the National Demographic and Health Surveys from 2001to 2011.Int J Environ Res Public Health. 15(229):12.
[18] Poudel S., Upadhaya N., and Khatri RB (2018).Trends and factors associated with pregnancies among adolescent women in Nepal: pooled analysis of Nepal Demographic and Health Surveys (2006, 2011and 2016). PLoSOne. 13(8):1–13.
[19] Grønvik T., and Fossgard Sandøy I (2018). Complications associated with adolescent child bearing in sub-Saharan Africa: a systematic literature review and meta-analysis. PLoS One. 13(9):e0204327.
[20] Wall-Wieler E, Lee JB, Nickel N, et al. The multigenerational effects of adolescent motherhood on school readiness: a population-based retrospective cohort study. PLoS One. 14(2):e0211284.

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https://doi.org/10.47001/IRJIET/2023.702039

[21] Kassa G.M., Arowojolu A.O., Odukogbe A.A (2019). Adverse neonatal outcomes of adolescent pregnancy in northwest Ethiopia. PLoS One. 14(6):e0218259.

[22] Bain L. E., Zweekhorst M.B.M., Amoakoh-Coleman M (2019). Tokeepornot to keep? Decision making in adolescent pregnancies in Jamestown, Ghana. PLoS One. 14(9):e0221789.

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