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Study on the Mathematical Models Based on Weather Parameters in Mandalay, Myanmar

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Abstract:
Accurate forecasting of temperature has been one of the most prominent issues in hydrological research. Temperature changes in the applied issue of science and technology are to forecast severe weather. Above all reasons, the study aims to predict the temperature changes in Mandalay from January to December in 2013. The prediction equations are determined by analyzing the simple linear regression and polynomial regression models. Among them, polynomial regression model is the best fit model to forecast temperature conditions based on time dependent. The empirical results demonstrate that the proposed model generates well forecasting performance.

Keywords **—Temperature, Simple Linear Regression, Polynomial Regression, Mandalay.**

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INTRODUCTION

Temperature changes play prominent issue for agricultural sectors because it is related to deal with the amount of precipitation [1]. Therefore, weather forecasting is a vital area of analysing field in everyday life. Weather forecasting is popular application tool of science and technology to forecast the condition of atmosphere for a future time and a given location [2-4].

In the past decades, various approaches have been validated and modified to develop for weather forecasting and statistical analysis [5]. Among them, regression models are still widely useful approaches for computing future events. These models are based on the observed relationships of the dependent variables with various independent variables in the form of unknown parameters to be determined by regression or other prediction methods with suitable data [6-7].

Mandalay is the second largest city in Myanmar which is located on the east bank of the Ayeyarwady River. The city has a population of 1,225,553. Mandalay is located in the central dry zone of Myanmar. Therefore, people living in it have suffered very hot condition in summer season. Mandalay is the major trading and communications centre for northern and central Myanmar. Therefore the temperature change is an important issue for living organism to rescue their lives. The study aims to predict the equation of minimum temperature changes with seasonal data in Mandalay using the simple linear regression and polynomial regression analyses.

I. MATHEMATICAL REGRESSION MODEL

linear regression is widely used statistical technique; it is a model to determine the relationship between two sets of variables [1]. Regression is to investigate for analyzing statistical data mining which has a popular application tool in many sectors like business, biological sciences, and climate prediction. It is to become a beneficial tool in society. The linear regression model is expressed as

$$y = b_0 + b_1\chi_1 + \varepsilon \quad (1)$$

Where, y is the value of the dependent variable, b0 is a constant value and b1 is the predictor coefficient, the slope of the regression line, χ_1 is predictor variables or independent variables and ε is an error term. The estimated regression equation (ERE) is expressed as follows:

$$\hat{y} = b_0 + b_1\chi_1 \quad (2)$$

Where,

$\hat{y}$ = the estimated value of the response variables
b0 = the y-intercept of the regression line
b1 = the slope of the regression line
b0 and b1 are called the regression coefficient.
The polynomial regression equation is an appropriate case for multiple regression, concerning one independent variable χ. The polynomial regression model can be expressed as:

$$y = b_0 + b_1\chi + b_2\chi^2 + b_3\chi^3 + \ldots\ldots + b_n\chi^n \quad (3)$$

Where n is the degree of the polynomial. The order of the model is the degree of the polynomial.
Where, y is the value of independent variable and χ is the independent variable, and b0 is the intercept and b1, b2 is the slope of the regression line.

The regression coefficient is expressed as:

$$b_1 = \frac{\sum \chi_i y_i - \left[\left(\sum \chi_i\right)\left(\sum y_i\right)\right]/n}{\sum \chi_i^2 - \left(\sum \chi_i\right)^n/n} \quad (4)$$

$$b_0 = \bar{y} - b_1\bar{\chi} \quad (5)$$

Where "n" is the total number of observations, $\bar{\chi}$ the mean value for the predictor variable, $\bar{y}$ the mean value for the dependent variable, and the summations are i = 1 to n. The coefficient of determination (R2) measures how the linear approximation produced by the least-square regression line fits the data observed. The sum of squares tool (SST):

$$SST = \sum_{i=1}^{n} (y - \bar{y})^2 \quad , \quad (6)$$

where $\bar{y}$ is the mean value of response variables.

SST is a measure of the total variability in the values of the response variable. The Sum of Squares regression (SSR) is a measure of the overall improvement in prediction accuracy [5].

$$SSR = \sum_{i=1}^{n} (\hat{y} - \bar{y})^2 \quad (7)$$

And the coefficient of determination equation is as follows:

$$R2 = \frac{SSR}{SST} \quad (8)$$

The coefficient of determination is an prominent factor for determining regression model in a good fit.

The standard error of the estimate (s) is a measure of the accuracy of the estimates produced by the regression. The Error Sum of Square (SSE) is expressed as:

$$SSE = SST - SSR \quad (9)$$

Besides, the Mean Squared Error (MSE) is as the following:

$$MSE = \frac{SSE}{n - m - 1} \quad (10)$$

Where, m indicates the number of predictor variables which is "1" for the simple linear regression case. The equation of standard error (s) is:

$$s = \sqrt{MSE} = \sqrt{\frac{SSE}{n - m - 1}} \quad (11)$$

The standard error play an important role to determine a good model is regression analysis. The standard error values are less than 2 for the good fit model.

II. Result and Discussion

There are twelve months composing three seasons in Myanmar such as summer, rainy, and winter season. In this analysis, the prediction of minimum temperature changes is investigated using simple regression model and polynomial regression model. The data based on temperature changes from 2013 in Mandalay is collected from the Meteorological Department in Myanmar. In these analyses, y is denoted as the average minimum temperature, and χ is denoted as the number of days. Table 1 shows the average minimum temperature for 12 months in Mandalay. In these tables, the highest temperature is 26.8 in July and the lowest temperature is 15.2 in Jan.

Table 1. Average minimum temperature for Mandalay

No. of Months	Temperature (℃)
JAN	15.2
FEB	18.4
MAR	22.2
APL	25.9
MAY	26.2
JUN	26.4
JUL	26.8
AUG	26.1

In Figure 1, the bar chart shows the temperature changes based on monthly time dependent. In this figure, the horizontal direction is referred to minimum temperature and the vertical direction is

referred to months. The figure is indicated to explain clearly the data in Table 1.

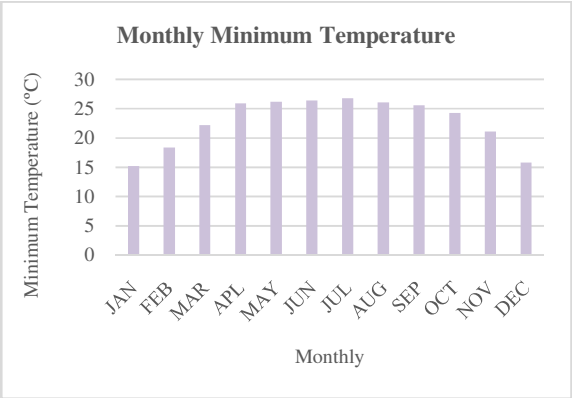

Figure 1. Average monthly minimum temperature for Mandalay

The trend the minimum temperature based on daily time dependent concerning seasonal data is described in Figure 2. In this figure, the value of minimum temperature (30º) is the highest point in Apr. According to the data, Apr is the hottest temperature among other months in Mandalay.

In linear regression analysis, the model is good fit and suitable to use the prediction equation. According to the results shown in Table 2, the standard error according to the 95% confident line interval5 is less than 2, and the coefficient of determination is R2 = 0.78. The explanation of the results are described in Table 2. The linear regression model are expressed as:

Min_temp = 24.5 + 0.133 (day)

To be performed in this result, the minimum temperature is directly proportional to the daily time dependent. The value of minimum temperature is expected to increase since the slope of the regression is positive.

Table 2. Model Summary for Linear Regression Analysis

Coefficient of Determination (R2)	Intercept (b0)	Slope of regression (b1)	Standard error (s)
0.78	24.5	0.133	1.99

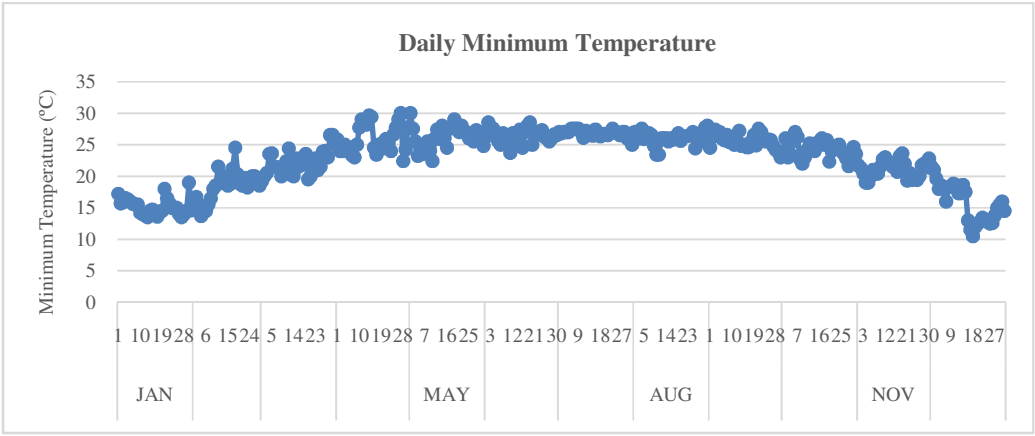

Figure 3. The trend of the observing daily minimum temperature

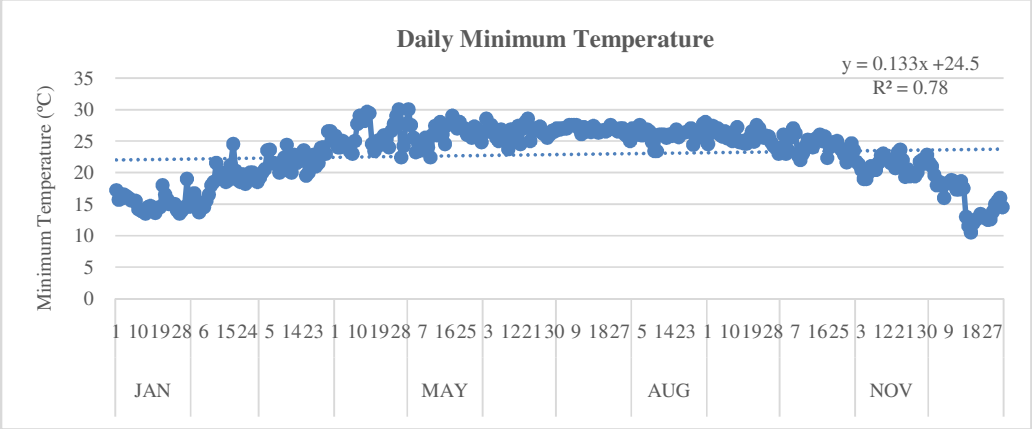

Figure 4. The trend of the forecasting daily minimum temperature using linear regression analysis

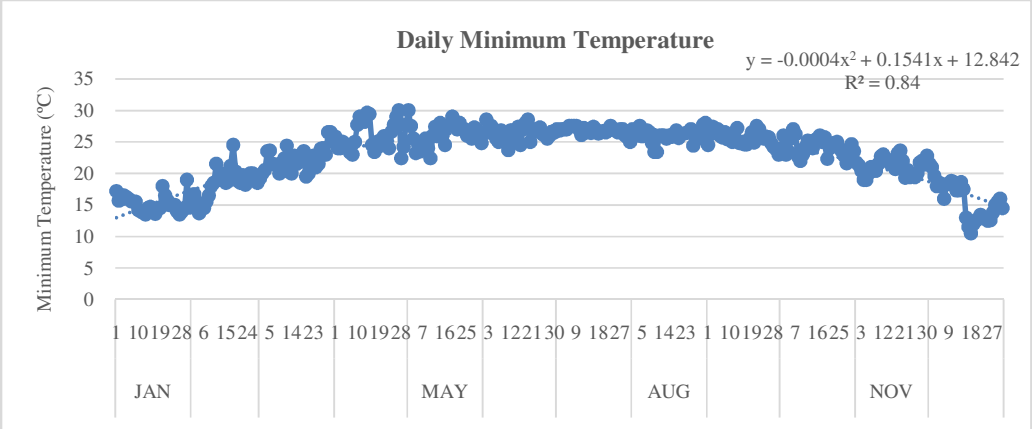

Figure 5. The trend of the forecasting daily minimum temperature using polynomial regression analysis

In Figure 3, the polynomial regression models of minimum temperature based on daily time dependent are the good fit because the coefficient of determination of minimum temperature is 0.84. The detailed explanation of the results are shown in Table 3. The polynomial regression model are expressed as:

Min_temp = 12.842 + 0.1541 (day) – 0.004 (day)2

Table 3. Model Summary for Linear Regression Analysis

R2	b0	b1	b2	s
0.84	12.842	0.1541	-0.0004	1.75

According to the regression models, the polynomial regression model is better fit than linear regression based on time dependent in these analyses. The coefficient of determination in polynomial regression model is nearly equal to 1 and so the model is good fit. These models are referred to forecast higher or lower temperature changes in study area. These regression model are beneficial tools to predict the temperature changes for agricultural sectors and other sector in Mandalay.

III. CONCLUSION

In this study, the predicted models of temperature changes in Mandalay are determined by using the simple linear regression and polynomial regression models. In these models, they are good fit to use the prediction equation. Among them, the polynomial regression model is most suitable used in this study area. In this future study, it will be collecting various temperatures from the last decades to recent year and the well-predicted equation will be determined to investigate temperature conditions. In this study, the predicted equations are beneficial tools given climate awareness for the agricultural sectors and other sectors to rescue living organisms. The goal and object of the study have been achieved where the analyses results show the relationship between observed and predicted temperature conditions.

References

[1] Beatrice C.B, Nasser R. Afshar, Selaman O. S, and H.Fahmi, Application of mathematical modelling in rainfall forecast: a csae study in sgs. Sarawak basin, International Journal of Research in Engineering and Technology, 2014, vol 3, pp. 316 – 319.

[2] Wei-Chiang Hong, Rainfall forecasting by technological machine learning models, Applied Mathematics and Computation, 2008, pp. 41 – 57.

[3] Sahai AK, Soman MK, Satyan V. All India summer monsoon rainfall prediction using an artificial neural network. Climate Dynamics 16, 2000, pp. 291–302.

[4] Z. ismail, et.al, "Forecasting Gold Prices Using Multiple Linear Regression Method" in American Journal of Applied Sciences. 6(8), 2009, pp. 1509-1514.

[5] Wint Thida Zaw, et.al. "Empirical Statistical Modeling of Rainfall Prediction over Myanmar" in World Academy of Science, Engineering and Technology. 22, 2008, pp. 10-270.

[6] S. Nkrintra, et al., "Seasonal Forecasting of Thailand Summer Monsoon Rainfall", in International Journal of Climatology, Vol. 25, Issue 5, American Meteorological Society, 2005, pp. 649-664.

[7] R. Samuel Selvaraj and Raajalakshmi "Statistical Method of Predicting the Northeast Rainfall of Tamil Nadu". Universal Journal of Environmental Research and Technology. Volume 1, Issue 4, pp 557-559.

