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Marine Fish Landing Estimation with Multiple Linear Regression Analysis in Sattahip District

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Abstract

The objectives of the present study were to predict monthly marine fish landing in Sattahip District, Chonburi province, Thailand using multiple linear regression analysis. For building multiple linear regression equation, the data, marine fish landing (Y), average sea level pressure (X_1), rainfall (X_2), average relative humidity (X_3), average air temperature (X_4), wind speed (X_5), average wind direction (inward: X_6) and average wave direction (outward: X_7), were collected since 2001 to 2010. The results of the present study found that the regression equation for prediction of marine fish landing was $\hat{Y}' = -157 + 0.167X_1 + 0.0028X_2 - 0.0857X'_3 - 0.0002X'_4 - 0.000009X'_7$ with adjusted coefficient of determination 29.20 and standard error of estimation 86.964.

Mathematics Subject Classification: 62J05

Keywords: MLR, marine fish landing

INTROCUTION

Sattahip District, Chonburi province, is a city with marine resources which is an important one in Thailand. Land fishing in Chonburi province is divided into three types, freshwater fishing, marine fishing and farming in the coast. This present research studied marine fishing because it is the main occupation of the people in Chonburi province which are a source of jobs and income for local people. Sattahip District is one of the main sources of marine fishing in Chonburi province that there is a lot of fishing. The present study analyzes the amount of marine fish landing in Sattahip District using multiple linear regression (MLR) analysis to determine the relationship between climate factors, sea level pressure, rainfall, relative humidity, air

temperature and wind speed, and sea condition factors, wind direction and wave direction, which effect to amount of marine fish landing [1][2][3][4].

MATERIAL AND METHODS

All data was collected since 2001 to 2010. The amount of marine fish landing (Y) was collected from the Department of Fisheries and five climate factors, the average sea level pressure (X_1), rainfall (X_2), the average relative humidity (X_3), average air temperature (X_4) and wind speed (X_5), were collected from the Thai Meteorological Department and two sea condition factors, average wind direction (inward: X_6) and average wave direction (outward: X_7), were collected from the Hydrographic Department.

1. DETERMINING THE SIMPLE CORRELATION COEFFICIENTS

Simple correlation coefficients (R) were firstly calculated to identify relationship among amount of marine fish landing, climate factors and sea condition factors

2. BUILDING THE MLR EQUATION

The MLR equation to estimate amount of marine fish landing was generated by MLR model as of Equation 1 and the best subset method was used to choose the equation [5].

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon \qquad (1)$$

3. CHECKING ASSUMPTIONS FOR MLR ANALYSIS

After obtaining the appropriate MLR equation, checking all assumptions of MLR analysis was proceeded. There are four assumptions to be tested; (I) normality of the error distribution using Anderson-Darling statistic (AD) [6]; (II) independence of the errors using Durbin-Watson statistic (DW) [7]; (III) homoscedasticity of the errors using Breusch-Pagan statistic (BP) [8]; (IV) multicollinearity among predictor variables using Variance Inflation Factor (VIF) [9].

4. COMPARISON BETWEEN THE REAL AND ESTIMATED VALUES

After testing all assumptions, the comparison between the real values (RV) and the estimated values (EV) of the amount of marine fish landing from the obtained MLR equation was plotted.

RESULTS

The correlation coefficient values (R) for the eight variables, Y, X_1, X_2, X_3, X_4, X_5, X_6 and X_7, were calculated. The results found that R ranged from –0.180 to 0.297 which

was the same previous studies [1][2][3][4] and the highly positive significant correlation was between Y and X_4 (R=0.297, p-value=0.003). Then possible MLR equations were generated by best subset method to select the best fitted equation. It was shown that X_1, X_2, X_3, X_4, X_5 and X_7 were selected to build the MLR equation with the Mallow C-p=6.4, S=77.179 and R^2_{adj}=28.80. After obtaining the equation, checking all assumptions of MLR analysis was determined. However, the test was not satisfied. The Box-Cox method was then used to transform the data [10]. After transforming data, the MLR equation was regenerated and the fitted equation was

$$Y' = -157 + 0.167X_1 + 0.0028X_2 - 0.0857X'_3 - 0.0002X'_4 - 0.000009X'_7$$

where $Y' = 1/\sqrt{Y}$, $X'_3 = 1/X_3^2$, $X'_4 = X_4^2$, $X'_5 = X_5^2$ and $X'_7 = X_7^2$ with S=86.964 and R^2_{adj}=29.20. Checking all assumptions of the analysis was then retested; (I) The test of normality: AD was calculated and the value was 0.614 (p-value=0.107) so the distribution of error term was normal, (II) The test of independence: the results showed that the DW=1.734 was more than critical values (DL=1.547) so the errors were independent, (III) The test of homoscedasticity: BP was 1.788 which less than the critical values (12.593) so the variance of errors was constant, (IV) Test of multicollinearity: all VIF values were less than 3 which less than 5 then there was no relationship among independent variables in MLR equation [11]. The amount of marine fish landing was then estimated by using this equation and the comparison between the RV and the EV was displayed by graph as of Figure 1.

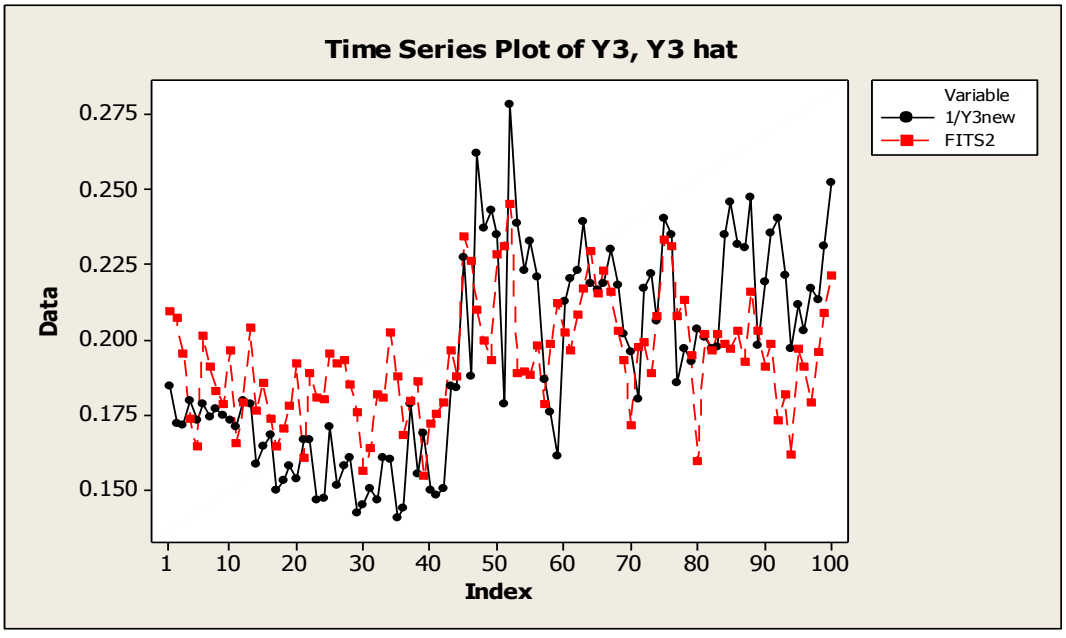

Figure 1: The comparison between the RV and EV of the amount of marine fish landing.

DISCUSSION

The independent variables used to estimate the amount of marine fish landing (Y) in Sattahip District, Chonburi province, Thailand, were average sea level pressure (X_1), rainfall (X_2), the average relative humidity (X_3), average air temperature (X_4) and average wave direction (outward: X_7) with the standard error of the estimation (S) 86.964 and adjusted coefficient of determination (R^2_{adj}) 29.20. The accuracy of estimation was shown by comparing the graph between the real and estimated values from the MLR equation.

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