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THE EFFECT OF FERTILIZER AND TEMPERATURE ON THE YIELD OF RICE USING MULTIPLE REGRESSIONS

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Abstract

Analysis was conducted on the effect of fertilizer and temperature on the yield of Rice using multiple regression analysis. Based on the result of the analysis, tone/hec (Y) has negative (weak) correlation with fertilizer (X_1) and the Temperature(X_2). Only 19.7% of variation in the

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Regression, Fertilizer, Effect, Temperature, Multiple.

INTRODUCTION

This is an extension of simple regression analysis. It helps in measuring the joint effect of any number of independent variables upon the dependent variable. It is based on the assumption that the relationship between the variables can be represented by a linear regression model with explanatory variables in the form:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + - - - + \beta_n X_n + e_{ij}$

The principle objective associated with multiple regression analysis is to estimate the value of dependent variable and to determine the extent of statistical error with the estimate. The least square normal

dependent variable tone/hec (Y) is explained by the model. This shows that the model is not a good model for prediction. The analysis of variance (anova) shows that the result is not significance.

equations for estimated the parameters of the above model could be obtained from the estimated relationship. In the case of two explanatory variables we have.

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + e$

The estimate of the parameters could be obtained by minimizing the sum of square of the residuals (Σe_{ij}^2) and the necessary condition for these will now be the partial derivative and set equal to zero i.e

$d \Sigma eij^2/d_{\beta 0} = 0$, $d \Sigma eij^2/d_{\beta 1} = 0$, $d \Sigma eij^2/d_{\beta 2} = 0$

from the above three equations the least squares normal equations are obtained viz:

$\Sigma Y = n \beta_0 + \beta_1 \Sigma X_1 + \beta_2 \Sigma X_2$ …….. (1)

$\Sigma X_1 Y = \beta_0 \Sigma X_1 + \beta_1 \Sigma X_1^2 + \beta_2 \Sigma X_1 X_2$……..(2)

$\Sigma X_2 Y = \beta_0 \Sigma X_2 + \beta_1 \Sigma X_1 X_2 + \beta_2 \Sigma X_2^2$……..(3)

These equations can be solved simultaneously so that β_0, β_1 β_2 can be expressed as:

$$B_o = \frac{\Sigma Y}{n} - \beta_1 \frac{\Sigma x1}{n} \beta_2 \frac{\Sigma x2}{n}$$

$$B1 = \frac{(\Sigma x_1 Y)(\Sigma x_2^2) - (\Sigma x_2 Y)(\Sigma x_1 x_2)}{(\Sigma x_1^2)(\Sigma x_2^2) - (\Sigma x_1 x_2)^2}$$

$$\beta_2 = \frac{(\Sigma x_2 Y)(\Sigma x_1^2) - (\Sigma x_1 Y)(\Sigma x_1 x_2)}{(\Sigma x_1^2)(\Sigma x_2^2) - (\Sigma x_1 x_2)^2}$$

The estimator β_1 measure the change in Y for a change in X_1 while holding X_2 constant.

These estimated parameters are called the partial regression co-efficients and are Blue (best linear unbiased estimators)

Aims and Objectives

i. To investigate the relationship between fertilizer/ temperature and the yield of rice.
ii. To fit multiple regression model to the data.
iii. To test for the adequacy of the model.
iv. To make recommendations based on the result of the analysis

Scope and Limitation of the study

The work is aimed at analyzing the effect of fertilizer and temperature on the yield of rice for the period of twenty years from 1993 to 2012. The data was collected from Yobe State Ministry Agricultural Development program me of Nigeria.

Partial Correlation

This help to measure the degree of association between Y and one of the variables $X_1, X_2, \ldots, X_k$ with the effects of all other variables removed.
Examples consider three variable models. The partial correlation analysis measures the strength of relationship that exists between a dependent Y and one explanatory X in such a way that the other explanatory variables are not taken into account.
If $r_{12.3}$ denotes the co-efficient of partial correlation of X1 and X_2 keeping X_3 constant. It is found that

$$r12.3 = \frac{r12-r13.r23}{\sqrt{1 - r^2_{13}} \cdot \sqrt{1 - r^2_{23}}}$$

Similarly

$$R13.2 = \frac{r13 - r12.r23}{\sqrt{1 - r^2_{12}} \cdot \sqrt{1 - r^2_{23}}}$$

And

$$r23.1 = \frac{r13 - r12.r23}{\sqrt{1 - r^2_{21}} \cdot \sqrt{1 - r^2_{31}}}$$

Data Analysis

Presentation of Data

Below is the data used for this research work.

Year	Crop yield in tone	Area in hectare	Crop yield in ton/her.	fertilizer in (0000) bag	Temperature In Celsius
1993	3722	6598	0.5641	70.000	**36.2**
1994	2554	5959	0.4286	50.000	**37.7**
1995	2552	5569	0.4583	79.450	**39.8**
1996	3087	5324	0.5795	55.000	**35.2**
1997	3104	5624	0.4515	81.384	**35.6**
1998	2504	5543	0.4517	87.658	**34.9**
1999	3988	6125	0.6511	63.290	**34.8**
2000	3916	5970	0.6559	32.766	**35.0**
2001	2303	6984	0.3296	80.000	**34.9**
2002	2750	5454	0.5042	81.000	**39.0**
2003	2812	5232	0.5449	62.000	**36.0**
2004	3012	5902	0.5103	65.135	**35.0**
2005	2662	5771	0.4612	80.102	**36.3**
2006	2576	5862	0.4394	70.090	**34.9**
2007	2905	5523	0.5260	63.370	**34.9**
2008	3507	6235	0.5609	64.000	**39.2**
2009	3227	6278	0.5137	64.000	**34.5**
2010	3412	6709	0.5086	67.000	**34.7**
2011	3982	5829	0.5118	59.000	**35.2**

2012	3019	6624	0.4558	67.720	36.7

TABLE A: DESCRIPTIVE STATISTICS

	MEAN	STANDARD DEVIATION	N
TONE/HECTARE (Y)	0.510270	0.0761634	20
BAG OF FERTILIZER (X1)	6.68232	9.23837	20
TEMPERATURE (CELSIUS)	36.0800	1.63372	20

TABLE B: CORRELATION

		Tone/hectare	Bag of fertilizer	Temperature(Celsius)
Pearson correlation	Y	1.000	-0.422	-0.036
	X_1	-0.422	1.000	0.392
	X_2	-0.036	0.392	1.000
Sig (1-tailed)	Y		0.032	0.438
	X_1	0.032		0.044
	X_2	0.438	0.044	
N	Y	20	20	20
	X_1	20	20	20
	X_2	20	20	20

.TABLE C: MODEL SUMMARY

Model	R	R square	Adjusted R	Standard deviation of the estimate	Durbin Watson
1	0.444	0.197	0.103	0.0721481	2.442

TABLE D: (ANOVA)

Model	SS	D.f	MS	F Ratio	Sig
Regression	0.022	2	0.011	2.087	**0.155**
Residual	0.088	17	0.005		
Total	**0.110**	**19**			

Table E: COEFFICIENT OF β (UNSTANDARDIZED)

	B	Std Error	Beta	T	Sig
Model	0.521	0.367		1.420	**0.0174**
Bag of fertilizer	-0.004	0.002		-0.481	**2.036**
Temperature	**0.007**	**0.011**		**0.151**	**0.639**

The fitted model is

$\hat{Y} = 0.521 - 0.004X_1 + 0.007X_2$

COEFFICIENTS INTERVAL

	Minimum	Maximum	Mean	Std Deviation	N
Predicted value	0.449331	0.558247	0.510270	0.0338150	**20**
Residual	-1.217854	0.1358641	0.0000	0.0682454	**20**
std predicted value	**-1.802**	**1.419**	**0.000**	**1.000**	**20**

Summary

Correlation and regression coefficients were computed to determine whether there is association between the dependent variable (yield) in tone per hectare and the independent variables (fertilizer and temperature).

Conclusion

The result shows that yield (Y) has a negative (weak) correlation with Temperature and fertilizer.

Also a multiple linear regression model was fitted to the data and the result shows that the model is not adequate for the data.

Recommendation

From the result of the analysis and the information obtained I wish to make the following recommendation.

i. The quantity of fertilizer does not significantly affect the yield so farmers can use any quantities.
ii. Temperature has no effect on the yield of crop under study so the crop can be produced under a wide range of temperature.
iii. Further research shall carried out to determine the effect of other factors like variety, type of fertilizer, spacing etc. on yield.
iv. An agricultural supervisor who has a perfect knowledge and a good background should be employed so as advising them in an appropriate ways.
v. Conservation of soil fertility should encouraged.
vi. Government should help in supplying modern equipment of farming to the farmers.
vii. Government should encourage the use of farm mechanization.

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