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Analysis on the Influencing Factors of Farmers' Family Operating Income in Heilongjiang Province ---Based on Multiple Linear Regression

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Abstract. Farmers' income in Heilongjiang mainly comes from family operating income, so it is necessary to study the influencing factors of family operating income. The paper, using the research data and constructing the multiple linear regression models, studies the key influencing factors of farmers' family operating income from the micro perspective. The paper arrives at the conclusion that the capital investment, land operation scale, the cultural quality of labor force, the agricultural power and the scientific farming play a major role in promoting family operating income.

Introduction

There are many factors that influence the family operating income, such as the amount of capital investment, the land scale, the land quality, the characteristics of labor force, the level of technology, the application of science and technology and the degree of organization [1]. Using the survey data, the paper analyzes the impact of individual differences on family operating income and finds out the key factors to promote income growth.

Model Selection

In this part, the main objective is to find the main influencing factors of family operating income and it involves more types of factors, so it is suitable for multiple linear regression model to analyze. The specific model is as follows:

$$Y = C + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n + \varepsilon \tag{1}$$

Y is the increment of the farmer's income, C is the constant term, βn is the regression coefficient of the corresponding variable, Xn is the corresponding variable, ε is the random disturbance term, n is in the range of 1 to 10.

Indicator Impact Assumptions

The indicators have the impact on farmers' family operating income in Heilongjiang. Assumptions are as follows:

Table 1 Assuming direction of model variables

Variable	Assuming direction
X_1（capital investment）	positive
X_2（land management scale）	positive
X_3（low - yield land scale）	negative
X_4（age of labor force）	uncertain
X_5（cultural quality of labor force）	positive
X_6（number of labor force）	positive
X_7（the agricultural power）	positive
X_8（mechanization rate）	uncertain
X_9（whether it is scientific farming）	positive
X_{10}（whether to join a cooperative）	positive

Data Selection and Feature Analysis

The data of this part are mainly collected from the survey data. The survey involves 431 questionnaires. The specific data are shown in the following table:

Table 2 The analysis of data

Item	N	Minimum	Maximum	Mean	Std. Deviation
X_1	431	1250.00	222650.00	25617.8619	28609.89336
X_2	431	.50	30.00	3.5278	3.15266
X_3	431	.00	60.00	10.1531	6.33042
X_4	431	28.00	70.00	40.8360	6.36396
X_5	431	1.00	4.30	3.0320	.67962
X_6	431	1.00	5.00	2.5824	.74213
X_7	431	.00	80.00	13.5777	15.16323
X_8	431	.00	100.00	66.0209	31.71827
X_9	431	.00	1.00	.3202	.46709
X_{10}	431	.00	1.00	.2251	.41811
Y	431	4160.00	206150.00	23999.2401	25498.40228
Valid N (listwise)	431				

Preliminary Results of the Model Analysis

In the process of analysis using SPSS software, the paper estimates all the selected indicators through the multiple linear regression. The specific model analysis results are as follows:

From the fit point of view, R value is 0.866, R2 is 0.750, after adjusted R2 is 0.743. The three values are greater than 0.7, indicating that the model is a good degree of fitting, a better explanation of influencing effects from family operating income. In addition, from the F test point of view, F value is 96.45, the sig. Value is 0.000, indicating that the model passed the F test, refused to zero hypothesis. It is assumed that the relationship between the independent variable and the dependent variable in the model is linear.

Table 3 Model Summary

Model	R	R Square	Adjusted R Square
1	0.866(a)	0.750	0.743

Table 4 ANOVA (b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	209798472862.511	10	16138344066.347	96.45	.000(a)
	Residual	69773990173.885	420	167323717.443		
	Total	279572463036.396	430			

Table 5 Coefficients (a)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-42319.37	9566.800		-4.424	.000
X_1	0.167	.075	0.187	2.217	.027
X_2	4095.059	686.243	0.506	5.967	.000
X_3	-633.712	104.385	-0.157	-6.071	.000
X_4	460.383	201.532	0.115	2.284	.023
X_5	2814.370	1137.779	0.075	2.474	.014
X_6	1370.412	1338.731	0.040	1.024	.307
X_7	184.111	51.624	0.109	3.566	.000
X_8	-0.323	23.088	0.000	-0.014	.989
X_9	4152.004	1447.220	0.076	2.869	.004
X_{10}	1500.040	1787.551	0.025	0.839	.402

According to the model result, we can see that X1, X2, X4, X5, X6, X7, X9 and X10 has a positive impact on family operating income. The influence coefficients are 0.167, 4095.059, 460.383, 2814.370, 1370.412, 184.111, 4152.004, 1500.040 respectively. Compared with the hypothesis, influencing direction of the above factors are basically the same as the direction of the assumptions. The assumptions are further verified. Among the positive factors, X1, X2, X4, X5, X7, X9, the corresponding sig. is 0.027, 0.000, 0.023, 0.014, 0.000 and 0.004,all less than 0.05, X6 and X10, the corresponding sig. is 0.037 and 0.402 which are not tested by t test.

In addition, X3 and X8 has a negative impact on family operating income. The influence coefficients are -633.712 and -0.323. Compared with the hypothesis, influences from X3 and X8 are basically the same as the direction of the assumptions. X3 and X8, the corresponding sig. is 0.000 and 0.989. X3 is tested by t test and X8 isn't tested by t test.

Model Optimization Analysis

In order to further optimize the model, we can get rid of the index which is not passed, then carry out multiple linear regression and get the following conclusion:

From the fit point of view, R value is 0.848, R2 is 0.718, after adjusted R2 is 0.715. The value of the three is greater than 0.7, indicating that the optimization of the model after a good degree of fitting, a better explanation of influencing effects from family operating income. In addition, from the F test point of view, F value is 139.730, its sig. value of 0.000, indicating that the model passed

the F test, refused to zero hypothesis. It is assumed that the relationship between the independent variable and the dependent variable in the optimization model is linear [2-4].

Table 6 Model Summary

Model	R	R Square	Adjusted R Square
1	0.848	0.718	0.715

Table 7 ANOVA (b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	209453335539.393	7	23272592837.710	139.730	.000(a)
	Residual	70119127497.002	423	166553747.024		
	Total	279572463036.396	430			

According to the model result, we can see that X1, X2, X4, X5, X7and X9 has a positive impact on family operating income. The influence coefficients are 0.177, 4068.880, 308.126, 2950.703, 16692.810, 188.643 and 4382.735. Compared with the hypothesis, influencing direction from X1, X2, X4, X5, X7 and X9 are basically the same as the direction of the assumptions. The corresponding sig. is 0.018, 0.000, 0.031, 0.007, 0.000 and 0.002, all less than 0.05, indicating that they all pass the t test.

In addition, X3 has a negative impact on family operating income [5]. The influence coefficient is -643.823. Compared with the hypothesis, influences from X3 is basically the same as the direction of the assumptions and its corresponding sig. is 0.000, indicating that X3 passes the t test at a confidence level of 5%. Finally, through the model simulation, we can draw the following equation:

$$Y = -39394.89 + 0.177X_1 + 4068.880X_2 - 643.823X_3 + 308.126X_4 + 2950.703X_5 + 188.643X_7 + 4382.735X_9$$

Table 8 Coefficients (a)

	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
	B	Std. Error			
(Constant)	-39394.89	8762.741		-4.496	.000
X_1	0.177	0.075	0.199	2.374	.018
X_2	4068.880	673.756	0.503	6.039	.000
X_3	-643.823	103.634	-0.160	-6.212	.000
X_4	308.126	142.689	0.077	2.159	.031
X_5	2950.703	1082.104	0.079	2.727	.007
X_7	188.643	49.371	0.112	3.821	.000
X_9	4382.735	1417.116	0.080	3.093	.002

Conclusion

From the final simulation equation, it can be seen that X2 (land management scale), X5 (cultural quality of labor force), and X9 (whether it is scientific farming) has a larger positive impact on family operating income, which is the main contributor to farmers' income growth [6-8]. When X2

(land management scale) increases 1 hectare, the family operating income will grow 4068.88 yuan. When X5 (cultural quality of labor force) improves a level, it will grow 2950.703 yuan. When X9 (whether it is scientific farming) chooses the scientific farming behaviors, it will grow 4382.735 yuan. X1 (capital investment), X4 (age of labor force) and X7 (agricultural power) also play a certain role in promoting family operating income, but the influence is smaller [9]. When X1 (capital investment) increases by 1 yuan, the family operating income will grow 0.177 yuan. When X4 (age of labor force) increases by 1 year, it will increase by 308.126 yuan. When X7 (agricultural power) increases by 1 horsepower, it will grow 188.643 yuan.

In addition, X3 (low-yield land scale) has a restrictive effect on family operating income [10]. When X3 (low-yield land scale) increases by 1 unit, it will be reduced by 643.823 yuan.

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