

MEASURING QUALITATIVE RESPONSE OF THE MOST IMPORTANT FACTORS AFFECTING THE ECONOMIC EFFICIENCY OF RICE FARMS IN NAJAF GOVERNORATE SEASON 2017

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ABSTRACT

This study aimed to estimate rice farms efficiency using qualitative response models. The survived field included three districts in Najaf (Al Mishkhab, Al Hirah, Al Manadhira) during agricultural season 2017, including a random sample of 80 farms, representing 7.5% of the total farms. To achieve the goals, analysis was divided into two stages, the first stage was measuring the economic efficiency according to entry guidance of rice farms, while the second stage involved the analysis of factors affecting the economic efficiency of rice farms using the binomial logistic regression model to obtain a mathematical relationship between the dependent variable (response variable), which represents the economic efficiency of rice farms and the independent variables represented by age, experience and education of the owners, geographical area and type of possession for the farms. DEAP software was used to estimate economic efficiency and SPSS software to analyze the logistic regression of the factors affecting economic efficiency. The results showed that the average economic efficiency according to the Economic efficiency was 66.7%, which means that rice farmers can obtain the same production using 66.7% of the total costs i.e. there is a 33% waste in economic resources in the research sample. The logistic regression results indicated that each of experience (more than 35 years), education (university degree) and farm area (greater than 15 dunums) had a significant effect on the efficiency of the rice crop farms.

Keywords: binomial logistic regression, data envelopment analysis, rice crop

الواسطي وآخرون

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قياس الاستجابة النوعية لاهم العوامل المؤثرة على الكفاءة الاقتصادية لمزارع الرز في محافظة النجف للموسم الزراعي 2017

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المستخلص

هدف البحث الى استخدام نماذج الاستجابة النوعية لقياس كفاءة مزارع الرز وشمل المسح الميداني ثلاث أفضية في محافظة النجف (المشخاب، الحيرة، المناذرة) للموسم الزراعي 2017 ولعينة عشوائية بلغت 80 مزرعة (7.5 % من مجموع المزارع الكلية في المحافظة). تحقيقا لاهداف البحث قسمت مرحلة التحليل الى مرحلتين الاولى هي قياس الكفاءة الاقتصادية وفق التوجيه الداخلي لمزارع الرز اما في المرحلة الثانية فقد اعتمد البحث على تحليل تأثير العوامل المؤثرة على الكفاءة الاقتصادية لمزارعي محصول الرز باستخدام نموذج الانحدار اللوجستي الثنائي وذلك للحصول على علاقة رياضية تربط بين المتغير المعتمد (متغير الاستجابة) الذي يمثل الكفاءة الاقتصادية لمزارع الرز اما المتغيرات المستقلة فقد تركزت على الخصائص الاجتماعية لعينة البحث والتي تمثلت بالعمر، الخبرة، التعليم، المنطقة الجغرافية، ونوع الحيازة. استخدم برنامج DEAP لتقدير الكفاءة الاقتصادية، وبرنامج SPSS لتحليل الانحدار اللوجستي للعوامل المؤثرة على الكفاءة الاقتصادية. وبينت النتائج ان متوسط الكفاءة الاقتصادية على وفق دالة التكاليف كانت 66.7% وهذا يعني بإمكان مزارعي الرز الحصول على الانتاج نفسه باستخدام 66.7% من اجمالي التكاليف المستخدمة، اي ان هناك هدر في الموارد الاقتصادية بنسبة 33% في عينة البحث. اشارت نتائج الانحدار اللوجستي ان لكل من الخبرة (اكثر من 35 سنة) والتعليم (شهادة جامعية) و مساحة المزرعة (اكبر من 15 دونم) تأثيرا معنويا على كفاءة مزارع محصول الرز.

الكلمات المفتاحية: الانحدار اللوجستي الثنائي، مغلف البيانات، محصول الرز.

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INTRODUCTION

Several developing countries, including Iraq, suffer from predominance of family farm pattern with a misuse of available resources. This leads to low economic efficiency of farms, which is an important issue in the development of agriculture, especially in developing countries. When farmers are inefficient in their practice, there will be a decrease in agricultural production with increased costs (7). The problem lies in the rate of growth of resources discovered or eligible for use as one of the productive factors, because it is much lower than the growth of population and their needs. Furthermore, Najaf farmers usually lack the optimal use of the economic resources. Therefore, the productive firms seek to reallocate resources for the purpose of achieving economic efficiency by mixing the elements of production and obtaining the largest amount of output. The importance of efficiency lies in the principle of making use of resources at the lowest cost, especially for the rice crop, as it is one of the main crops in the world and ranks second after the wheat crop in terms of cultivated areas. Rice is grown at Iraq mainly in the areas of the Euphrates basin, especially the Najaf governorate, which is one of the most famous provinces in Iraq to grow rice, due to the climate, the quality of the soil for cultivation and the availability of irrigation water (22). The importance of the rice crop comes from being a major food crop that many Asian people depend on as a staple food, so it is an essential food for more than half of the world's population, and an important source of energy, given that it contains relatively high amounts of carbohydrates, protein, fibre, minerals and vitamins. Studies show that 100 g of the rice crop contains (11.67) protein g, (3.33) g fat, (66.67) g carbohydrates, (8.3) g fiber, (0.99) g iron, and finally (0.83) g of saturated fatty acids (5). In addition, rice residues are rich in vitamins and proteins and can be used for animal feed. Rice farms suffer from productive, technical and administrative problems that result in a decrease in their efficiency. This may be at least partly attributed to weak management and their failure to carry out the duties assigned to them

and not taking modern management concepts that enable them to achieve their goals efficiently and effectively. The results will be a waste in the use of some resources and an increase in costs and a decrease in profits making some farms operate with a low production scale. The importance of research lies by identifying a group of factors that play an important role in deviating efficiency, especially when the variables are qualitative. The local, Arab and international studies have focused on studying the qualitative response (1,2, 4,13, 15,17 ,19 ,18 , 23, 24, 25) and the economic efficiency thereof (16, 26). Therefore, the current study aimed to estimate the measurement of the economic efficiency of rice farms in Najaf for season 2017 using the Data Envelopment Analysis (DEA) model, and to study the impact of the most important factors affecting the efficiency of rice farms using qualitative response models. The research is based on the hypothesis that there are factors that affect the efficiency of farms and cannot be quantified, especially with regard to farm management factors. As such, the use of qualitative response models results in the estimation of accurate and logical parameters.

MATERIALS AND METHODS

Data collection:

The study depended on the primary data obtained from its sources. The data were collected through a personal interview with farmers in Najaf Governorate. The field survey included three districts in Najaf Governorate (Al-Mishkhab, Al-Hirah, Al-Manadhira) using a questionnaire for 80 rice farmers (representing 7.5% of the total farms) in study region .

Data analysis

To achieve the research goals, the analysis was divided into two stages. The first stage was to measure the economic efficiency of rice farms in Najaf using the Data Envelopment Analysis (DEA) model, which is one of the non-parametric programming methods to create an envelope or field containing data. As for the second stage, the research relied on an analysis of the factors affecting the economic efficiency of rice farmers, using a binomial logistic regression model. This model was used to obtain a mathematical relationship

between the dependent variable (response variable), which represents the economic efficiency of rice farms and independent variable (The social characteristics of farmers) which includes age, experience, area, education, geographical area, and type of possession. The DEAP software was used to estimate economic efficiency while the SPSS software (version 25) was used analyse the logistic regression of factors affecting economic efficiency.

Economic efficiency (EE): Farrell (1956) stated that the Efficiency of a firm consists of technical efficiency and allocated efficiency. The technical efficiency reflects the firm’s ability to obtain the maximum amount of production using the available quantities of inputs, while the AL locative efficiency indicates the firm's ability to use the optimal mixture of inputs taking into account the prices of inputs and the available production techniques. According to Farrell, there are two methods for calculating efficiency indicators: the first is called efficiency indicator from the input side, and the second is from the output side. The first indicator is also called the input oriented measures, while the second is called the output oriented measures (12). Figure 1 represents the production map from the point of use for a firm that produces output Y using the inputs X_2 and X_1 under technical conditions characterized by the stability of economies of scale. Where SS represents the output of one unit of y with maximum efficiency using inputs X_2 , X_1 and AA' is the cost curve equal to unit production.

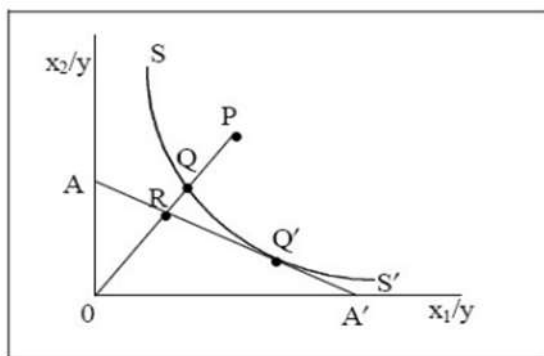


Figure 1. Input data envelope analysis model

The SS curve represents the using points of perfect efficient for producing a unit of y product. Thus, the point P is less efficient than Q for producing one unit of Y and the distance

PQ expresses the extent of the decrease in technical efficiency. It indicates the quantity by which all inputs can be reduced proportionally without reducing production. The technical efficiency index of the firm producing at point P on the OP ray is calculated as follows:

$$TC = \frac{OQ}{OP} \dots \dots \dots (1)$$

The index takes the values 0-1, where the value 1 indicates the full technical efficiency of the firm. The slope of the straight line represents the relative price of the inputs. By knowing this slope, the index of the firm's allocative efficiency on the OP ray can be calculated as follows:

$$AE = \frac{OR}{OQ} \dots \dots \dots (2)$$

The distance QR is the amount at which the unit cost of production of y unit can be reduced by allocating the inputs according point Q' instead of point Q. The economic efficiency of the firm is defined according to the following law:

$$EE_i = \frac{OR}{OP} = \frac{OQ}{OP} \times \frac{OR}{OQ} = TE_i \times AE_i \dots \dots \dots (3)$$

A firm that is characterized by cost efficiency uses prices that reduce costs, or uses productive techniques and technology that make costs at a minimum, and economic efficiency can be expressed by the following

$$formula: EE_i = \frac{\sum_{i=1}^m P_{io} X_i^o}{\sum_{i=1}^m P_{io} X_{io}} \dots \dots \dots (4)$$

Where P_{io} indicates the input prices, X_i^o indicates the minimum input (the optimal level of input), and X_{io} indicates the actual level of input(18).

Logistic regression model

The logistic regression model is one of the regression models in which the relationship between the dependent variable (y) and the independent explanatory variables (X) is nonlinear, and the response function often takes the form S shape (9). Mathematically it is defined as:=

$$P_i = \frac{E(Y_i/X_i)}{1 + e^{(B_0 + B_1 X_1 + \dots + B_K X_K)}} \dots \dots \dots (5)$$

The logistic model is also distinguished by being more flexible than the traditional regression models, as it is possible to assume a specific relationship between the dependent

variable and other explanatory variables. Through this mode, the probability of an event can be directly estimated. Furthermore, the model can be easily transformed in to linear form which is known as Logic as follows (10):=

$$L = Ln\left(\frac{P_i}{1 - P_i}\right) = B_o + B_1X_1 + \dots + B_kX_k \dots (6)$$

Whereas:

$\frac{P}{1-P_i}$: represents the so-called odds ratio, which is the ratio of the probability of the occurrence and non-occurrence of an event. L: is the natural logarithm of the odds ratio.

RESULTS AND DISCUSSION

Estimation the economical efficiency of rice farms The economic efficiency of the research sample was measured, as resource prices were entered as well as the amount of resources. The results showed that the average economic efficiency of rice farms in Najaf for the production season 2017 for the research

sample ranged between 37.3% and 100%, while the average economic efficiency was about (66.6%). This indicates that farmers in the research sample can increase their production by 33.3% without increasing the amount of economic resources used in production. Thus, farmers bear additional costs of about 33.3%, as economic efficiency implies that farmers can produce the same level of production in light of reducing production costs or reducing the amount of resources used. From the table also it was found that there is a variation in the level of economic efficiency between the sample farms and this is due to the difference in experience and management skills. In this regard, the results suggest that the farms achieving 100% economic efficiency are those farms in which the cost line is in contact with the equal output curve. In the present study, these were 4 farms and formed (5%) of the total number of research sample, while the rest farms whose production deviates from the optimal production potential curve in different proportion (table 1 and figure 2).

Table 1. Economic efficiency based on cost function

Efficiency level (EE)	Number of farms	Relative importance%
Less than 50	30	37.5
51-70	4.0	5.0
71-90	35	43.75
91-99	7	23.3
100	4	5.0
Total	80	100%

Source: Collected and calculated from research questionnaires.

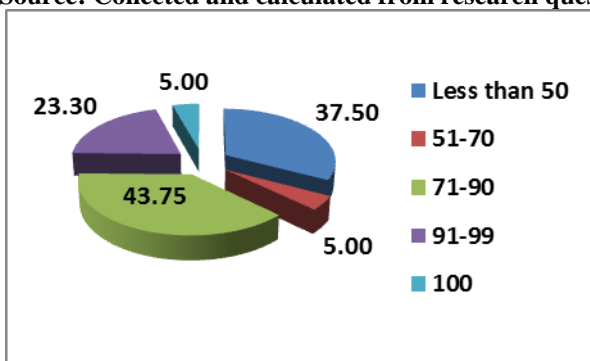


Figure 2. Economic efficiency based on the cost function

Estimation qualitative response to the most important factors that affect the economic efficiency of rice farms

Table 2 shows the sample size distributed according to the basic research variables. The percentage of efficient farms in the research sample was 47 while the inefficient farms ratio was 33. Regarding farmer experience, 55.32%

of efficient farms had long experience (greater than 35 years) farmers compared to only 17.02% of inefficient farms which had such experience farmers. As for the rice-growing areas, Al Mashkhab accounted for about 50% of the efficient and inefficient farms, followed by Al-Manathera by 31.19% in efficient farms compared to 24.24% in the inefficient farms. Ownership farms represented about three quarters of the efficient ones, while there were two farms 4.26% with contract and 19.15% are rented. the percentage of farms with private property in efficient farms than inefficient farms (76.6% versus 60.6%). Farmers with higher education accounted for 14.94% of the total farmers in the efficient farms compared to 6.06% in the inefficient farms. In contrast, the primary education rate was 69.69% in the inefficient farms which indicates the

importance of education in raising economic efficiency through the optimal use of resources. As for the size of the farm, large

farms (greater than 15 dunums) represented 44.68% of the efficient farmers, compared to 24.24% of the inefficient farmers.

Table 2 .Frequency of explanatory variables in efficient and inefficient form

Variable	Efficient farms	Inefficient farms
Experience		
≤35	21(44.68%)	25(53.19%)
>35	26(55.32%)	8 (17.02%)
Location		
Al-mashkhab	23(48.94%)	16(48.48%)
Al-hayra	9 (19.15%)	9(27.27%)
Al-munadhira	15(31.91%)	8(24.24%)
Possession		
Private property	36(76.60%)	20(60.60%)
Rent	9 (19.15%)	9(27.27%)
Contract	2 (4.26%)	4(12.12%)
Education		
primary	17(36.17%)	23(69.69%)
secondary	23(48.94%)	8(24.24%)
high	7(14.94%)	2(6.06%)
Area		
≤15	25(55.32%)	25(75.76%)
>15	22(44.68%)	8(24.24%)

Source: Source: Calculated using SPSS.25

To study the relationship between the basic variables and the economic efficiency of farms, Chi square test was used, and the value of this test and the statistical significance (P-value) were compared and compared with the

standard value (0.05). It is clear from the table (3) that there are statistically significant differences for the experience and education variables. The area was statistically significant at (0.10).

Table 3 . Chi-Square Test Results

Variable	Chi-Square	P-value
Experience	7.662	0.006
Location	0.966	0.617
Property	2.876	0.237
Education	16.809	0.00
Area	3.505	0.061

Source: Collected and calculated from research questionnaires

Parameters of the logistic regression model were estimated by the maximum likelihood as an efficient method that required iterative methods to calculate (Enter) which were settled upon attempt 5 (21) . All explanatory variables entered into the model except for the age variable which was removed from the model due to its correlation with the

experience variable. This step was taken to manipulate the problem of multiple linear correlation. Table 4 summarizes the parameters of the model, which includes the standard error, Wald statistics, degrees of freedom, and the significance of the Exp (B) parameters that we will explain after the model passes the diagnostic tests.

Table 4. Showing model parameters

Variable	B	S.E	Wald	df	Sig	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Experience(X ₁)	1.237	0.599	4.267	1	0.039	3.446	1.065	11.145
Location(X₂)								
Al-mashkhab(X ₂₁)			0.106	2	0.949			
Al-hayra(X ₂₂)	-1.185	0.677	0.075	1	0.784	0.831	0.221	3.130
Al-munadhira(X ₂₃)	-0.235	0.800	0.086	1	0.769	0.791	0.165	3.794
Property(X₃)								
Private Property(X ₃₁)			2.033	2	0.362			
Rent(X ₃₂)	0.728	0.643	1.282	1	0.258	2.071	0.587	7.303
Contract(X ₃₃)	1.141	1.097	1.081	1	0.298	3.129	0.365	26.857
Education(X₄)								
primary(X ₄₁)								
secondary(X ₄₂)	-0.679	0.705	10.766	2	0.005	0.507	0.127	2.020
high(X ₄₃)	1.513	0.660	0.927	1	0.336	4.541	1.245	16.556
			5.255	1	0.022			
Area(X₅)								
≤15(X ₅₁)								
>15(X ₅₂)	1.204	0.633	3.623	1	0.05	3.334	1.01	11.518
Constant	2.338	0.867	7.277	1	0.007	0.96		

Source: Calculated using Spss.25

Diagnostic tests

To fully test the adequacy and quality of the model (Goodness of fit), the Log likelihood ratio, which follows the Chi-Square

distribution (6), was used according to the following relationship:=

$$\chi^2 = -2[\log_e L_0 - \log_e L_1] \dots \dots (7)$$

Table 5. Statistical significance test for the model

Omnibus test of model coefficients			
Chi-Square		df	p-value
Step3a	Model	27.141	0.001
		8	

Source: Calculated using Spss.25

From table 5, that the value of (χ^2) was 27.141 at 8 degree of freedom, and the level of significance p-value = 0.001. That means the model is statistically significant and reconciles the data well, i. e. the variables included in the model have an effect, significance and contribution in farm efficiency for the sample included in the study. To measure the goodness of fit of the logistic regression model, Hosmer and Lemeshow (H) test was

used (14) , which is calculated according to the following relationship:

$$H = \sum_{s=1}^2 \sum_{j=1}^m (hsj - hsj)^2 / h^s j \dots \dots (8)$$

The statistic (H) is distributed according to the distribution (χ^2) in m-2 degrees of freedom, and we note from the table (6) that the value of H-Statistic was 5.861, and p-Value for Chi-Square within the level of significance, which impose the acceptance of the null hypothesis (11). This implies goodness of fit of the model, i.e. the model is appropriate and fits well with the data.

Table 6 . Hosmer and Lemeshow test

Step	Chi-Square	df	p-value
1	5.861	8	0.663

Source: Calculated using Spss.25

To assess the fit quality of the logistic regression model, two $R^2_{Nagelkerke}$, $R^2_{Cox-Snell}$ statistics with the same statistical goal (R^2) were used as(20):=

$$R^2 = 1 - \left[\frac{L_0}{L_1} \right]^{\frac{2}{n}} \dots \dots (9)$$

$$R^{-2} = \frac{R^2}{R_Z^2} \dots \dots (10)$$

$$R_Z^2 = 1 - (L_0)^{\frac{n}{2}} \dots \dots (11)$$

L_0 : maximum likelihood model contains only the constant.

L_1 : maximum likelihood model contains all independent variables.

Table 7. Shows the value of the fifth iteration of the odds function and the R² test

Step	-2 Log likelihood	Cox Snell R Square	Nagelkerke R Square
1	81.300 ^a	0.288	0.388

a- Estimation terminated at iteration number 5 because parameter estimates changed by less than 0.001.

Table 7 shows the fifth value of the derivative of the maximum likelihood function, which is roughly equal (-2log = 81.300) as well as the value of the first measure ($R^2_{Cox-Snell}$) The average was equal to 0.288, meaning that 28.8% of the variance in the response variable was explained. AS for the second measure ($R^2_{Nagelkerke}$) whose value was 0.388, it explains approximately 38% of the explained variance in the logistic regression model.

Economic of analysis

From the estimated results in the table (4) the logistic regression function for the most important factor affecting the economic efficiency of the rice crop takes the following form:

$$Log \left(\frac{\rho}{1 - \rho} \right) = 1.237 - 1.237X_1 - 1.185 X_{22} - 0.235 X_{23} + 0.728X_{32} + 1.141X_{33} - 0.679X_{42} + 1.513X_{43} + 1.204X_{52} \dots \dots (12)$$

The equation was expressed as 'B'. of note, the results were explained as exp^B (27). which represents the odds ratio (OR). This ratio indicates the magnitude of change in the efficiency according to the change in the independent variable associated with B. Table 4 shows that the estimated value of the experience variable is positive (1.237), and the Wald statistic (4.267) points out the level of significance (0.039) of the estimated parameter. This indicates the importance of the experience factor on the efficiency of rice farms, while odds ratio (Exp (β)) for the parameter (3.445 > 1) implies farmers having more than 35 years of experience increase the probability of a farm's efficiency by 3.446-time compared to farms managed by farmers with less than 35 years of experience. The accumulated experience enables farmers to use good types of production requirements, and the farmer is familiar with the agricultural processes necessary for growing and harvesting the crop. Furthermore(8), the experience gives the farmer the required skill for managing the farm as well as a future view of the input prices and the selling prices of the

crop. Therefore, the experience has a positive impact on increasing probability of economic efficiency. Concerning the areas where rice is grown, the Wald statistics for Al-Herra and Al-Manathera (0.075 and 0.086, respectively) which were not significant. Thus, area of cultivation has no significant effect on the economic efficiency of the study sample farms. Likewise, the Wald statistics for rented and contracted farms (1.282 and 1.081, respectively) were not significant. It is worth noting that private ownership may have a positive impact on the farm by providing a surplus of capital through which the farmer can purchase seeds and fertilizers of good quality as well as financing part of the production requirements without resorting to borrowing and incurring financial benefits (3). As such the private property renders farmer with no much fixed costs. On the other hand, the education parameter was significant, as the value of Wald (5.255) reached a significant level (0.022), which indicates the importance of education in raising the economic efficiency of the farm. The odds ratio (4.541) indicates that farm management holds having a higher degree associates with an increase in the economic efficiency of rice farms by 4.54-time compared to the farms administrated by a manager with primary level education. This indicates that farmers with higher education will be more able to apply modern science and technology, marketing and management experiences which increase the possibility of economic efficiency of the farm. As for the area, the value of Wald was (3.623) with a significant level (0.05), and the odds ratio was (3.33), which means that when the farm area is greater than 15 dunums, this may increase the probability of a farm's efficiency by 3.33-time compared to farms with an area smaller or equal than 15 dunums. It was well-established that farms with large areas have a greater ability to invest and use modern technology with a reduction in production costs. Thus, an increase in the potential for efficient farms will be more probable. We can conclude from the current study that there is no optimal exploitation of the available resources as

farmers can increase their production by 33.3% without an increase in economic resources, and that each of long experience, higher education of farm administrative and large areas contribute significantly to increasing the efficiency of the farm. Therefore, the study recommends for optimum utilization of productive resources, especially in large areas of the rice cultivation. Also, to achieve economic efficiency, the study recommends using experienced administration with high education level through which automated work is used, such as the mechanical transplant method and the use of high-yielding varieties, beside increasing cultivated areas. Further studies for expanding the use of qualitative response models are needed as this model is an effective method to have an idea about the impact of the independent variables on the dependent variable.

REFERENCES

1. Abbas A. K. 2012 .Using logistic regression model to predict the functions with economic categorical dependent variables. Kirkuk Uni. J. Administ. Econ. Sci., 2(2):234-2563
2. Al-Farhoud S. H. 2014. The use of logistic regression in studying the factors influencing the performance of stocks. J. Al Azhar Uni. Gaza (Natural Sciences) 16 : 47-68
3. Al-Hiyali, A. D. and R. T. Al-Wasity. 2015. An economic analysis of factors affecting agricultural land ratio in Iraq for period 1980-2013 and forecasting it for period 2014-2024. Iraqi J. Agri. Sci., 46(1): 64-73
4. Ali, E. H. and J. M. H. El-Eezi. 2015..Estimating farm technical efficiency by using stochastic frontier approach. . Iraq J. Agri. Sci., 46 (2):262-268
5. Ali, K. A. and Z. H. Mahmood. 2018. Estimating profit , cost function and technical efficiencies of rice production in Nejaf for season 2016. Iraq J. Agri. Sci., 50 (5): 1237-1246
6. Andrews, D. W. 1988. Chi-Square diagnostic tests for econometric models. J. Econ., 37:135-56
7. Belase. K. and R. Grabowski. 1985. Technical efficiency in Nepalese Agriculture. J. Developing Areas, 19(4):515-526
8. Daowd. H. J. and S. J. Abd. 2013. Productivity determinants and their effect in the planting yield for the crops of main vegetables in Telkeef district. Mesopotamia J. Agric., 14(4):21-30
9. Dutta, A. and G. Bandopadhyay. 2012. Performance in the Indian stock market using logistic regression. Int. J. Buss. Info., 7(1):105-136
10. Fagoyinbo, I.S.; I. A. Ajibode, and Y. O. Olaniran. 2014. The application of logistic regression analysis to the cumulative grade point average of graduating students: a case study of students of Applied Science, Federal Polytechnic, Ilaro. Developing Country Studies, 4(23): 26-30
11. Faisal N. F. 2016. Logistic regression dual response technique to determine the variables affecting the monthly income adequacy for the Iraqi family. J. Baghdad Coll. Uni. Eco., 47:131-148
12. Farrell, M . J , 1957. The measurement of productive efficiency . J. Royal Statist . Society Series A (General).
13. Ghanem A. and K. A. Farid. 2011. Use of the two-response logistic regression technique in studying the most important economic and social determinants sufficient family income. Damascus Uni. J. Eco. Legal Sci., 27(20):113-132
14. Hosmer, D. W. and S. A. Lemeshow. 1980. Goodness-of-fit test for the multiple logistic regression model. Commun. Statistics, 10:1043—1069
15. Hosmer, D.W. and S. Lemeshow. 1989. Applied Logistic Regression. John Wiley & Sons, Inc., New York. Pp:111-119
16. Hussain, E. A .2015. Estimating the economic efficiency of egg plant farms: Diyala province as case study. Iraq J. Agri. Sci., 46 (4): 602-610
17. Hussain, E. A. 2016. Measuring cow farms efficiency by using the quality response. Iraq J. Agric. Sci., 47(2): 600-611.
18. Hussain, E. A.; H . J. Mohammed and N. J. Mohammed. 2016. Use probability regression. models to study the factors affecting efficiency of the production of tomato. Euphrates J. Agric. Sci., 47(2): 111-117
19. Jawad, A. N. 2010. A comparison between methods of estimating economic functions with qualitative dependent variables. Tikrit J. Administ. Eco. Sci., 27(1):102-118
20. King, J.E 2003. Running a best-subsets logistic regression: an alternative to stepwise methods. Educational Psychological Measurement, 63(3):392-403

21. Levinas, A. S. 2003. Guide to SPSS for Analysis of Variance, 2nd ed., New Jersey Lea Publishers, pp:218-222
22. Mhmood, Z. H. 2017. Analysis of paddy growers decisions in light of limited irrigation water in the Euphrates basin region for the period 1980-2015. Iraqi J. Agri. Sci., 48(6): 1530-1540
23. Mohsin, O. M. ; H. H. Kathem and Z. I. Karee. 2019. Using logistic regression to study the most important determinants of the adequacy of family income. Sci. J. Jihan Univ. 3(2):282-292
24. Najm, A. K. and M. A. Saleh. 2011. The use of logistic regression in studying the causes of death in preterm babies in Babylon. J. Uni. Karbala Sci., 16(2):52-64
25. Sarah, B. A. and M. O. Farhan. 2015. Measuring the economic efficiency of potatoes Baghdad province as a case study. Iraq. J. Agri. Sci., 46 (3):410-145
26. Sulaiman, A. A.; A. S. Abdel-Moneim and A. S. Saad. 2016. Comparison of the binary logistic model and the discriminatory function of classification by applying the most important factors affecting the adequacy of family income. J. Eco. Sci., 17(2):112-127
27. Wiley, N. Y. and J. E. King. 2002. Logistic Regression: Going Beyond Point-and-Click. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.