THE EVALUATION OF THE LAYING HENS PERFORMANCES FED WITH COMBINED FODDERS SUPLIMENTED WITH SYNTHETIC AMINO ACIDS - MATHEMATICAL MODELING-

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Summary

As a result of an experiment carried out within the poultry department from the Didactic Station of the Banat's University of Agricultural Sciences and Veterinary Medicine Timişoara on laying eggs, the "Shaver 579" hybrid, for which fodder recipes with different protein levels and synthetic amino acids content were used, it was observed the egg-weight evolution. Staring with the experimental data observed on a group to which it was administered a recipe with 17.03% RP, 0.85% Lysine and 0.38% Methionine, it was observed the fodder consumption and egg production. Using mathematical modelling there have been analysed and determined the connections that exist between the dependent variable (egg production weigh) and the amino acids consumption in order to explain and foresee the dependent variables variance. In research the multiple regression analysis was used and it was analysed the statistical significance of the parameters.

The multilinear regression model introduces the variables' control and estimates the contribution of each independent variable to the explanation of the dependent variable variance if the other independent variables take constant values. It is necessary to specify that regression does not prove the causality between variables but the study of nature and the association degree between them. The studied independent variables are: raw protein, Lysine and Methionine consumption existent in the fodder, and the dependent variable is egg production.

Material and methods

The mathematic model establishment

Egg production does not represent the only productive feature; production quality is represented by a total of features. The supplementation with amino acids of the combined fodders for hens has a practical importance due to the reduced cost required by the partial substitution of the protein fodder. The supplementation in fodder of some very small quantities of essential limitative amino acids may conveniently increase its nutritive and biological value, by using some completely well-balanced and advantageous recipes. It is important to explain and foresee the egg production variance also through the influence of the combined fodders supplementation with amino acids.

In order to present the mentioned factors' amount we referred to the construction of a multilinear regression model as follows:

$$y=k_0+k_1x_1+k_2x_2+k_3x_3$$

As a result of the observed data processing, the obtained regression equation is:

$$y=-2.923-948.1x_1-12.27x_2+7.04x_3$$

Where:
y= egg production weigh
x_1*=g RP*
x_2*=mg Lysine*
x_3*=mg Methionine*

The regression equation parameters (constant and the partial coefficients of regression) were estimated according to the smallest square principle using the Data Fit 8.1.9 Oakdale Engineering Program. The determination of these parameters is made in order to minimize the total error and in the same time to maximize the correlation between the observed values of the dependent variables and the ones calculated using the regression model.

Results and discussions

The analysis of the obtained results through the modelling process

I. The testing of the regression model statistical significance

The Statistical significance testing of the regression model is carried out by checking the null hypothesis which considers that there is no connection between the variable considered dependent and any other independent variable. This testing means on one hand the evaluation of the global significance of the regression model and on the other hand the evaluation of the partial regression coefficient (in other words, the evaluation of each independent variable importance). In both situations the testing is carried out by means of the F test (appropriately adapted).

As a result of data processing from the samples taken into study the following values were obtained for the regression equation coefficients presented in table 1:

Table 1

Regression variables

Variable	Value	Standard error	t-test	Prob(t)
K_0	-2.923	5.85	-0.50	0.636
K_1	-948.1	238.9	-3.97	0.007
K_2	-12.27	23.8	-0.51	0.626
K_3	70.04	56.8	1.23	0.264

k_0, k_1, k_2 and k_3 represent the coefficients of the variables and can be interpreted as gradients of the regression line $y=f(x_1)$ considering that all values of x_1 (with j<>i) remain constant.

The following hypotheses were tested:

I. **H0:** the x_j variable is not necessary, because the x_i variables (i<>j) are included in the model (the alternative hypothesis is: x_i is necessary in the model used for the prediction of *y* values).

In this case it was used a partial t test (student), calculated on the basis of the variation explained by x_i, beside this it is explained by the rest of the variables.

Conclusion:

The achieved **Prob(t)** probabilities, presented in table 1, show that for the k_1 coefficient p is <5%, for this coefficient the hypothesis is rejected, this analysis at first leads to the conclusion that the variable with this coefficient cannot be taken off from the model, but for the other coefficients is higher than 5%, the variables having these coefficients can be removed from the model.

Variance Analysis					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob(F)
Regression	3	198.812	66.270	29.762	0.00053
Error	6	13.359	2.226		
Total	9	212.172			

II. **HO:** $k_0 = k_1 = k_2 = k_3$, or in other words the dependent variable *y* does not depend on any of the independent variables x_i (the alternative hypothesis is: there is at least one coefficient different from zero).

Conclusion:

In this case it was used the F test (named the global F test) (Variance Analysis), for which the achieved probability is zero (the F test=29.76 and Prob(F)=0.001), therefore the probability that the HO hypothesis being true is null, the alternative hypothesis being the true one, y (egg production weigh) depends on the factors taken into study.

II. The interpretation of partial correlation coefficients

The partial correlation coefficients matrix describes the intensity of the connections between two variables, excluding the effect of the other involved variables.

The calculus of the partial correlation coefficients correspondent to the independent variables from the entire model led to the following results:

Table 2

Correlation matrix				
	X_1	**X_2**	**X_3**	**Y**
X_1	1	0.999999101	0.999999206	0.876953339
X_2	0.999999101	1	0.999999968	0.877475444
X_3	0.999999206	0.999999968	1	0.877464779
Y	0.876953339	0.877475444	0.877464779	1

Examining the achieved results, synthesized in table 2, the values from the last line in the table show the influence of each variable within the adopted model. The values are significantly equal and show a very good correlation between the dependent variable and the independent variables. A hierarchy of these factors that concur to the egg production weigh cannot be established.

III. The interpretation of multiple correlation coefficient

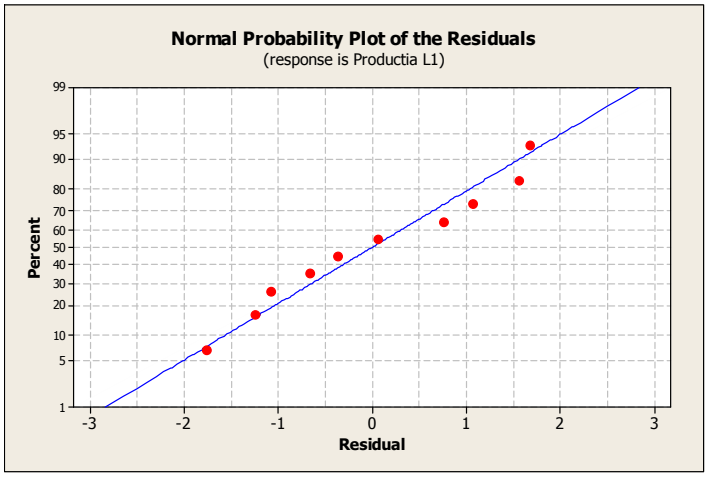
It was calculated the multiple determination coefficient (R^2), it expresses the percentage that influence the parameters taken into study (x_1, x_2, x_3), the dependent variable *y* (egg production).

R^2 = 0.9370327449

The percentage of the explained variance = 93.70%

IV. The checking of the regression model accuracy

The checking of the regression model efficiency was carried out through the analysis of the residual values (calculated as a difference between the observed values and those of the calculated dependent variables). The examination of these residual values has been made in the graphic in figure 1.



Conclusion

- The explanation intensity of the multilinear regression model is indicated by the R^2 value which show what percentage of the dependent variable variance is explained by the independent variables variance; the parameters taken into study explain 93.70% of the independent variable variance *y* (egg production), the rest of 7.3% can be explained through the influence of other parameters that were not taken into study. The composition of the ratio and the foddering technique represent a management problem of the farm, eventually the increase of the fodders ingestion capacity of the laying hens represents a genetic amelioration problem.
- The value obtained for the multiple determination coefficients is close to 1, it reflects the efficiency of the model, which represents a good choice of the factors included in the model.
- In the suggested model the k_1, coefficient correspondent to the variable that expresses the raw protein feature from the fodder composition, is the only that it cannot be given up.
- The dependent variable (egg production) depends on all the variables expressed in the model.

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